# "CLINICAL TRIALS OF *PHYLLANTHUS AMARUS* AS HEPATOPROTECTIVE AND THEIR MARKET FORMULATIONS"

**By**

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**Saurashtra University, Rajkot, India**

**in partial fulfillment**

**of the requirements for the degree of**

**Doctor of Philosophy**

**in**

**Pharmaceutical Science**

**Under the guidance of**

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**Saurashtra University**

**Rajkot – 360 005**

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*I hereby declare that this thesis entitled*

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*is a bonafide and genuine research work carried out by*

**Mrs. Hemangi J. Patel [M. Pharm.]**

*Under the guidance of*

**Dr. K. N. Patel [M. Pharm., Ph. D]**

**Date:**

**Place:** **Mrs. Hemangi J. Patel [M. Pharm]**

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Dadicated

to

my Parents

and

my Family

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# Introduction

# INTRODUCTION

NATURE always stands as a golden mark to exemplify the outstanding phenomenon of symbiosis. The plants are indispensable to man for his life. Nature has provided a complete storehouse of remedies to cure all ailments of mankind.

In the past, almost all the medicines used were from the plants, the plant being man's only chemist for ages. Today, vast store of knowledge concerning therapeutic properties of different plants has accumulated.

The history of herbal medicines is as that old as human civilization. The documents, many of which are of great antiquity, revealed that plants were used medicinally in China, India, Egypt and Greece long before the beginning of Christian era. One of most famous surviving remnant is Papyrus ebers, a scroll some 60 feet long and a foot wide, dating back to the sixtieth century before Christ. The drugs such as acacia, castor oil and fennel are mentioned along with apparent references to such compounds as iron oxide, sodium chloride, sodium carbonate and sulphur. In China many medicinal plants had been in use since 5000 B.C. Indians do, worked meticulously to examine and classify the herbs, which they came across into groups called Gunas. **Charka** made fifty groups of ten herbs, each which according to him, would suffice an ordinary physician's need. A large portion of the Indian population even the present time depends on the Indian System of Medicine – Ayurveda – Ancient science of life. The well-known treatises in Ayurveda are the **Charak Samhita** and the **Sushruta Samhita.**

### 1.1.1 Ayurveda - Indian System of Medicine:

Ayurveda is believed to be prevalent since last 5000 years in India. It is one of the most noted systems of medicine in the world. Ayurveda is based on the hypothesis that everything in the universe is composed of five basic elements viz. space, air, energy, liquid and solid. They exist in the human body in combined forms like *Vata* (space and air), *Pitta* (energy and liquid) and *Kapha* (liquid and solid). *Vata, Pitta* and *Kapha* together called Tridosha (three pillars of life). It is believed that they are harmony with each other but in every human being one of them is dominating which is in turn is called as the prakruti of that person. Tridosha exist in human body in seven forms called *Saptadhatu* viz. *Rasa* (lymph), *Rakata* (blood), *Meda* (adipose tissues), *Mamsa* (flesh), *Majja* (nervine tissue), *Shukra* (reproductive tissue) and *Asthi* (bones). These tissues are subjected to wear and tear so that Mala (excretory material) is formed from them. When *Tridosha, Saptadhatu* and *Mala* are in balance with each other, it is called as healthy condition while imbalance causes a pathological condition. It is hypothesised that the five characters of the medicinal herbs viz. *Rasa, Guna, Virya, Vipak* and *Prabhava* can be applied to treat various pathological conditions. Ayurvedic pharmacy (Bhaisajya – Vigyan) proposes five basic dosage forms like *Swaras, Kalka, Kwath*, Heem and Plant. A number of dosage forms like *Churna*, *Avaleha, Ghrita, Sandhana kalpa, Bhasma* are prepared from them. Some important herbs from Ayurveda are *Rauwolfia, sepentina*, *Sesamum indicum, Withania somnifera* etc. (Kokate *et al*., 1998)

### 1.1.2 Recent Trends and Choice of Therapy:

Considerable scope of ethanobotanical studies is found in different parts of India; who mainly use natural plant product directly as drugs to get rid from various diseases. Much work in the field of medicinal plants has accumulated in India during 20$^{th}$ century. Therapeutic use of plants for treatment of human illness dates back our many millennia. Evidence of their effectiveness in the diagnosis, cure and prevention disease state exist in every culture throughout the world. (Kapur, 1994)

Plants constitute one of the major raw materials for drugs for treating various ailments of human being, although there has been significant development in the field of synthetic drug chemistry and antibiotics. In all over the world now considerable changes have taken place during last two decades. Due to the awareness of toxicity associated with the long use of synthetic drugs and antibiotic, the western society prefers the drug from natural sources than the synthetics. Moreover modern medicine does not have a suitable answer for many conditions such as liver disorder and for chronic conditions such as asthma, arthritis, etc. and this leads to increase interest in herbal drugs. (Naik, 1986)

Therapeutic use of plants for the treatment of human illnesses dates back our many millennia. Evidence of their effectiveness in the diagnosis, cure and prevention of disease state exists in every culture throughout the world. Today, "traditional medicine", characterized by the use of herbs and other natural products, still remains regular component of health care in countries such as China, Japan, India, South America and Egypt. Even today more than 40 % of drugs in Allopathic have their origin from plants. Keeping

this significant contribution, there is a need that we should understand the original system of medicine and stop calling them as "Alternative Systems". (Narayan, 1998)

### 1.1.3. Introduction to medicinal plants

Man's existence on this earth has been made possible only because of the vital role played by plant kingdom. Nature always stands as golden mark to amplify the outstanding phenomenon of symbiosis. (Kokate, *et al*., 1996) Medicinal plants were existing even before human being made their appearance on the earth (Siddhiqui, 1985). Practically every country develops its own medical system, which includes the ancient civilization of China, Egypt and India. Thus, the Indian Medical System – Ayurveda, came into existence. The raw materials for Ayurvedic medicines were mostly obtained from plant sources in the form of crude drugs such as dried herbal powders or their extracts or mixture of products. Also, Siddha, Unani and Tibb are traditional health care systems have been flourishing for many centuries. Apart from these systems there has been a rich heritage of ethanobotanical usage of herbs by various colorful tribal communities in the country (Handa, 1991).

If we do well for a moment on our hoary past, Rigveda, one of our oldest repositories of human knowledge written between 4500 – 1500 B.C. mentions the use of 67 plants for the therapeutic purposes and Yajurveda enlists 81 plants whereas Atharvaveda written somewhere 1200 B.C. describes 290 plants.

India unquestionably occupies the top position in the use of herbal drugs. It is one of the foremost countries exporting plant drugs or their derivatives, and excels in home consumption too. According to Indian

mythology, when the illness and diseases got rampant on the earth, the sages learnt the science of healing from Lord Indra and recorded them in scriptures (Handa, 1991).

It has been estimated that from 25000 to 75000 species of higher plants exist on the earth. A reasonable estimate of about 10% has been used in traditional medicine. However, perhaps only about 1% of these are acknowledged through scientific studies to have therapeutic value when used in extract form by human. (Norman *et al*., 1985)

Natural products have been derived from higher plants, microbes or animals and those can be of either terrestrial or marine or aquatic origin. The medicinal preparations based on these raw materials were in the form of crude drug. With the advent of scientific methods, many of these reputed medicinal plants came under chemical investigation leading to the isolations of active principles. Beginning with 1800 AD there was continuous activity in this area and many of the well known medicinal plants were chemically analyzed and their active principles characterized. Soon after their isolation and characterization these compounds, either in pure state or in the form of extracts, became part of pharmacopoeias of several countries. This is where herbal medicine and modern medicine have a common link (Handa, 1991). According to the Eccleriates *"The lord created medicines out of the earth and a wise man will not adore them"* (Siddhiqui, 1985).

**1.1.3.1. Brief History of Medicinal Plants:**

- Western medicine originates with the Greeks.
    - Hippocrates (460-377 BC) – founder of medicine.
    - Aristotle – was a great natural historian.

- Theophrastus (372-287 BC) – founder of botany, described many plants.
- Pliny (43-70 AD) – Major compendium of natural history.
- Dioscorides (40-90 AD) – De materia medica encyclopedia of medicinal plants that was major gospel of plant medicines from hundreds of years.

- Gerard's Herbal
- Herbal medicine eventually gave way to more scientific studies. From the Greek notion that pure reason could answer any question, empirical studies developed.
- Herbal medicines in other cultures. Herbs are very important components of medicine in other cultures (i.e. Chinese medicine, Indian Ayurvedic medicine).

### 1.1.4 Herbal medicine

World Health Organization (WHO) currently encourages, recommends and promotes traditional /herbal remedies in national health care systems because such drugs are easily available at low cost, are comparatively safe and the people have faith in such remedies (Handa, 1995). WHO defined total health, is not just the absence of disease, but a state of physical, mental, social and spiritual well-being. Today we are more concerned with life style diseases like depression, cancer and heart troubles caused by faulty nutrition and stress. Because these diseases have a mental or emotional component, there is a growing conviction that allopathy is largely unable to cure them, all of it offers is temporary relief from symptoms. There is a need of alternative

therapy, to cover a good health for all. Herbal therapy will be one of the best practices to overcome the illness (Gupta *et al*., 2000).

Natural products are an integral part of human health care system now a day because there is now popular concern over toxicity and side effects of modern drugs. There is also a realization that natural drugs are safer and allopathic drugs are often ineffective. Due to these facts over the past ten years a considerable revival of interest in the use of herbal medicine in the world has come up. WHO has also appreciated the fact that most of the world population depends on traditional medicine and therefore WHO has evolved guidelines to support the member states in their efforts to formulate remedies on traditional medicine and to study their potential usefulness, safety and efficacy. In the last few decades there has been an exponential growth in the filed of herbal medicine. It is getting popularized in developing and developed countries owing to its natural origin and lesser side effects (Mukherjee *et al*., 1981).

The Indian contribution in international herbal market has emphasized on novel research for capturing as well as to remain in the market. ‘Phytochemical standardization of herbal drugs and highly processed materials in herbal formulation are required. The importance and challenges of conducting clinical research in herbal drugs, simple bioassays for biological standardization, pharmacological and toxicological evaluation, toxic herbal drugs in use, various animal models for toxicity and safety evaluation, were dealt with in detail by various experts in the field (Padh, *et al*., 2000).

For pharmaceutical proposes, the quality of medicinal plant material must be as high as that of their medicinal preparations. However, it is

impossible to assay for a specific chemical entity when the bioactive ingredient is not known. In practice, assay procedures are not carried out even for those medicinal plant materials where there are known active ingredients.

Problems in standardization arise from the complex composition of drugs which are used in the form of whole plant, parts of the plant(s) and of plant extracts. Standardization of the presumed active compounds of drug in general does not reflect reality. Only in a few cases does drug activity depend upon single component. Generally, it is the result of concerted activity of several active compounds as well as of inert accompanying substances. Though these inert accompanying components do not directly affect pathological mechanism, it is reasonable to use the complex mixtures of components provided by a medicinal plant because these inert components might influence bioavailability and excretions of the active component. Further, by inert plant components the stability of the active component might be increased and the rate of side effects be minimized. If there are different active compounds present in a plant drug, they might have additive or potentiating effects.

The purpose of standardization of traditional remedies is obviously to ensure therapeutic efficacy. The quality assurance of traditional remedies rely upon good manufacturing practices with adequate batch analysis and standardized methods of preparation. Various processes used in manufacture of herbal drugs lack standardized methods.

**Problems with Modern (Allopathic) Drugs: (**Rao, 2000)

1) High cost and long time taken in development of new drug.

2) Toxicity – A new branch of medicine is termed iatrogenic diseases.
3) Non-renewable source of basic raw materials. Most synthetic drug utilizes fossil resources like petrochemicals.
4) Environmental pollution by the chemical industry.
5) Inadequate, specially in management of certain chronic diseases.

**Advantages of Plant-based Drugs: (**Rao, 2000)

1) Long history of use and better patient tolerance as well as public acceptance.
2) Renewable source.
3) Cultivation and processing is environmental friendly.
4) Local availability, specially in developing countries.
5) Plants constitute to be a major source of new lead generation.

**1.1.4.1. Steps Necessary for Promoting Herbal Drugs:**

Phytochemistry or natural product chemistry research is the backbone of herbal industry. For promoting use of herbals in modern medicine, Phytochemistry should be envisaged for:

- Isolation, purification and characterization of new phytoconstituents.
- Use of newly isolated phytoconstituents as “lead” compound for the synthetic design of analogues with either improved therapeutic activity or reduced toxicity.
- Conservation of lead phytoconstituents into medicinally important drugs. (Graham *et al*.,1990)

**1.1.4.2 Ethno-Pharmacological Approach to Herbal Drugs**:

The term ethno-pharmacology refers the interdisciplinary scientific observation, description, and experimental investigation of indigenous drugs

and biological activities. Recent interest in the use of ethno- pharmacological information of plant drugs has greatly increased for several reasons.

Scientists showed that of 119 important plant derived drugs used in one or more countries, 88 were regarded as having been discovered as a result of being derived from a plant used in traditional medicine. (De Smet *et al*., 1989)

**1.1.4.3. Practical Aspects of Herbal Drug Discovery:**

The following scheme represents a summary of the stages involved in the development of pure drug from a plant source.

- Collection and identification of the plant and deposition of voucher sample in local and major herbaria.
- Literature survey on the plant species selected for studies.
- Extraction with solvent and preparation of non-polar and polar extracts for initial biological testing.
- Evaluation of plant extract against a panel of biological test methods, as exemplified by receptor biding, enzyme inhibition, and or cytotoxicity assays.
- Activity guided fractionation on the extract showing activity, by monitoring each chromatographic fraction with bioassay chosen from the panel available to the investigation.
- Structure elucidation of pure active isolate(s) using spectroscopic techniques and chemical methods, if necessary.
- Test each active compound (whether of novel or known chemical structure) in all *in vitro* and *in vivo* biological test methods available, in order to determine potency and selectivity of the drug.

- Perform molecular modeling studies and prepare derivatives of the active compound of interest.
- When total synthesis is not practical, carry out large scale reisolation of interesting active compounds for toxicological, pharmacological and for mutation studies.
- Clinical trials (phase I – III).

**1.1.4.4 Current Status of Herbal Drugs:**

Recent years newer and newer diseases are posing threat to humanity. In fact diseases are not new but are detected newly. Despite this, WHO had taken the vouch of providing 'Health for all' by 2000 A. D.

In spite of stupendous advances made by modern medicine, the present century has many more health problems than earlier centuries. Drugs for viral diseases like 'AIDs', certain type of cancers, arthritis, parkinsonism are yet to come. The newer concept about herbal drugs have immunomodulators and adaptogens gaining importance and are recognized for prophylactic and preventive therapy.

Surprisingly, a recent survey revealed that more than 50% of all prescription drugs issued by rational physicians are either directly derived from the natural sources or synthesized from the natural models as the sole ingredient or as one of the several ingredients. It seems certain that the continued scientific study of medicinal plants afford a plethora of novel, structurally diverse and bioactive compounds. Multidisciplinary research on plants has lead to many new drugs, as well as prototype active molecules and biological tools.

### 1.1.4.5. Future Prospects in Herbal Medicines:

At the moment, scientific research on medicinal plants is continuing most intensely in research institutes, universities and pharmaceutical laboratories as well as in the clinics of many developed countries. This research is oriented mainly in two directions. Firstly the active ingredients of plants that have long been known for their healing properties are being investigated. The second sphere of basic research has led to the discovery of new kinds of medicinal plants and new drugs from the more remote regions of the world where new species with unknown substances still remain to be looked into. Each and every traditional medicine, drugs of Ayurveda, Unani and Siddha need to be tested and validated scientifically. CSIR, New Delhi, which is already involved in this field and validated about 350 formulations for different activities. This is a welcome trend since it attempt to marry traditional practice with modern knowledge for the betterment of health (Gupta and Chitme, 2000). WHO has emphasized the need to ensure the quality control of herbs and herbal formulations by using modern techniques. Several countries have herbal pharmacopoeias and lay down monographs to maintain their quality. Ayurvedic Pharmacopoeia of India, which recommends basic quality parameters for 400 common herbal drugs. (Dobriyal *et al*., 1998)

## 1.2. Liver

### 1.2.1 Anatomy of Liver

Liver is heaviest gland of the body lies deep into peritoneum and weighs about 3 pounds in an adult. The liver lies to the right of the stomach and overlies the gallbladder. The liver is held in place by ligamentous attachments to the diaphragm, peritoneum, great vessels, and upper gastrointestinal organs. It receives a dual blood supply; approximately 20% of the blood flow is oxygen-rich blood from the hepatic artery, and 80% is nutrient-rich blood from the portal vein arising from the stomach, intestines, pancreas, and spleen (Dennis *et al*., 2005).

Liver is divided into two lobes, large right lobe and smaller left lobe are made up of lobules which consist of epithelial cells called hepatocyte, arranged in irregular, branching, inter connected plate around a central vein. Between each row of hepatocyte are small cavities called sinusoids. Each sinusoid is lined with kupffer cells, phagocytic cells.

### 1.2.2 Structure of Liver

The liver is composed of four lobes: the right, left, caudate, and quadrate lobes. The right and left lobes are the largest lobes of the liver. A conspicuous external duct system emerges from the inferior side of the liver. A right and left hepatic duct departs from the right and left lobes respectively. The two ducts then fuse forming a common hepatic duct. The common hepatic duct joins the cystic duct from the gallbladder and beyond this junction the duct is termed the common bile duct. The common bile duct then connects with the duodenum. At the base of the bile duct is a sphincter, which controls the flow of bile from the liver and gallbladder into the small intestine.

The sphincter, called the sphincter ampulla, can therefore remain constricted and store bile until it is needed within the digestive tract.

Structurally and histologically, the liver can be divided into four tissue systems: (1) intrahepatic vascular system, (2) stroma, (3) sinusoidal cells, and (4) hepatocyte. (Erwin and Hans-Dieter Kuntz, 2005).

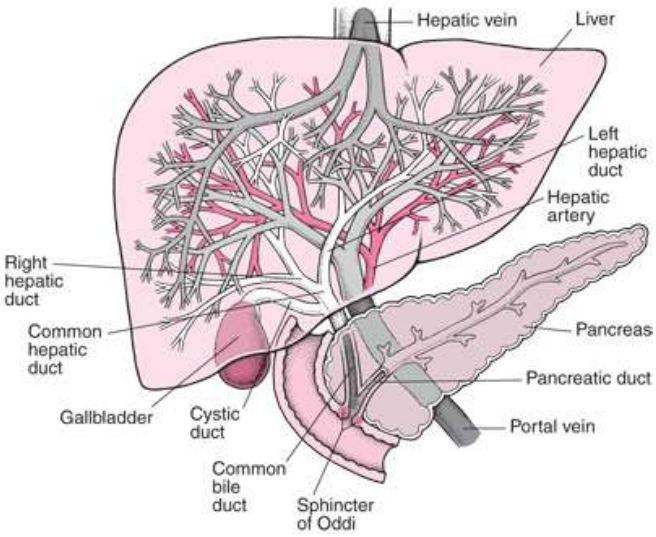



**Fig. 1.1 Liver**

### 1.2.3 Functions of Liver

- Bile production and excretion
- Excretion of billirubin, cholesterol, hormones, and drugs
- Metabolism of fats, proteins, and carbohydrates
- Enzyme activation
- Storage of glycogen, vitamins, and minerals
- Synthesis of plasma proteins, such as albumin and globulin, and clotting factors
- Blood detoxification and purification

The liver synthesizes and transports bile pigments and bile salts that are needed for fat digestion. Bile is a combination of water, bile acids, bile

pigments, cholesterol, billirubin, phospholipids, potassium, sodium, and chloride. Primary bile acids are produced from cholesterol. When bile acids are converted or "conjugated" in the liver, they become bile salts.

Billirubin is the main bile pigment that is formed from the breakdown of haem in red blood cells. The broken-down haem travels to the liver, where it is secreted into the bile by the liver. Billirubin production and excretion follow a specific pathway. When the reticuloendothelial system breaks down old red blood cells, billirubin is one of the waste products. This "free billirubin" is a lipid soluble form that must be made water-soluble to be excreted. The conjugation process in the liver converts the billirubin from a fat-soluble to a water-soluble form. The liver also plays a major role in excreting cholesterol, hormones, and drugs from the body.

The liver plays an important role in metabolizing nutrients such as carbohydrates, proteins, and fats. The liver helps to metabolize carbohydrates in three ways:

- Through the process of glycogenesis, glucose, fructose, and galactose are converted to glycogen and stored in the liver.
- Through the process of glycogenolysis, the liver breaks down stored glycogen to maintain blood glucose levels when there is a decrease in carbohydrate intake.
- Through the process of gluconeogenesis, the liver synthesizes glucose from proteins or fats to maintain blood glucose levels.

The liver synthesizes about 50 grams of protein each day, primarily in the form of albumin. Liver cells also chemically convert amino acids to produce ketoacids and ammonia, from which urea is formed and excreted in

the urine. Digested fat is converted in the intestine to triglycerides, cholesterol, phospholipids, and lipoproteins. These substances are converted in the liver into glycerol and fatty acids, through a process known as ketogenesis.

Prothrombin and fibrinogen, substances needed to help blood coagulate, are both produced by the liver. The liver also produces the anticoagulant heparin and releases vasopressor substances after hemorrhage.

Liver cells protect the body from toxic injury by detoxifying potentially harmful substances. By making toxic substances more water soluble, they can be excreted from the body in the urine. The liver also has an important role in vitamin storage. High concentrations of riboflavin or Vitamin B1 are found in the liver. 95% of the body's vitamin A stores are concentrated in the liver. The liver also contains small amounts of Vitamin C, most of the body's Vitamin D stores, and Vitamins E and K.

### 1.2.4 Disease of Liver

Although liver disease is stereotypically linked to alcohol or drugs, the truth is that there are over 100 known forms of liver disease caused by a variety of factors and affecting everyone from infants to older adults. They generally present clinically in a few distinct patterns, usually classified as hepatocellular, cholestatic (obstructive), or mixed. In hepatocellular diseases (such as viral hepatitis or alcoholic liver disease), features of liver injury, inflammation, and necrosis predominate. In cholestatic diseases (such as gall stone or malignant obstruction, primary biliary cirrhosis, some drug-induced liver diseases), features of inhibition of bile flow predominate. In a mixed pattern, features of both hepatocellular and cholestatic injury are present

(such as in cholestatic forms of viral hepatitis and many drug-induced liver diseases) (Dennis *et al*., 2005).

Cirrhosis is often considered to be a form of liver disease. Cirrhosis is a condition that results from permanent damage or scarring of the liver. It is the end stage of many different forms of liver disease and is known to cause a number of other health problems, including variceal bleeding, ascites and hepatic encephalopathy.

Some diseases cause bad things to build up in the liver. Hemochromatosis causes extra iron to build up in the liver. Wilson's disease causes extra copper to build up in the liver. Both of these diseases hurt the cells and can cause very bad liver disease that kills people. Many types of liver disease still have unknown causes but the most frequent liver diseases are generally caused by one of the following factors:

- **Viral hepatitis**

  Caused by viruses that attack the liver, viral hepatitis comes in many forms. The most common forms world-wide are hepatitis **A**, **B** and **C**. Although hepatitis A and B can be prevented by vaccine, there is no vaccine for hepatitis C. In Canada, hepatitis C is the leading cause of liver transplants.

- **Obesity**

  The leading cause of liver disease in Canada is **fatty liver disease** linked to obesity.

- **Alcohol**

  Factors such as gender, age, nationality, weight and health can affect how a person’s liver metabolizes alcohol. When the liver has too much alcohol

to handle, normal liver function may be interrupted leading to a chemical imbalance. If the liver is required to detoxify alcohol continuously, liver cells may be destroyed or altered resulting in fat deposits (fatty liver) and more seriously, either inflammation (alcoholic hepatitis) and/or permanent scarring (cirrhosis). **Liver cancer** can also result from alcohol induced liver disease.

- **Genetics**

  Several forms of liver disease are caused or thought to be caused, by defective genes. These forms of liver disease may be diagnosed in infancy or may not show up until later in life. Examples include **hemochromatosis**, **Wilson disease**, **tyrosinemia**, **alpha 1 antitrypsin deficiency** and **Glycogen Storage disease**.

- **Autoimmune disorders**

  Sometimes a body's immune system may begin to attack the liver or bile ducts causing inflammation and scarring which leads to a progressive form of liver disease. Examples of liver diseases believed to be caused by the immune system are **primary biliary cirrhosis** (PBC), **primary sclerosing cholangitis** (PSC) and **autoimmune hepatitis**.

- **Drugs and toxins**

  The liver is responsible for processing most of the chemicals and medications that enter your body – this leaves it vulnerable to acute or chronic liver disease caused by chemicals. In some cases, this is a predictable consequence of overexposure or over-consumption of certain chemicals such as acetaminophen or industrial toxins like polyvinyl

chloride or carbon tetrachloride. In other cases, chemicals can cause an unpredictable reaction.

- **Cancer**

  Although primary **liver cancer** is relatively uncommon, many other forms of cancer often metastasize in the liver. Because the liver filters a high volume of blood which may be carrying cancer cells, it is susceptible to developing a form of secondary cancer. If cancer originates in the liver, it is often caused by hepatitis B, hepatitis C or it can develop in cases of advanced liver disease when cirrhosis is present.

### 1.2.5 Hepatotoxicity

**Hepatotoxicity** (from *hepatic toxicity*) implies chemical-driven liver damage. The liver plays a central role in transforming and clearing chemicals and is susceptible to the toxicity from these agents. Certain medicinal agents when taken in overdoses and sometime even when introduced within therapeutic ranges may injure the organ. Other chemical agents such as those used in laboratories and industries, natural chemicals (e.g. microcystins) and herbal remedies can also induce hepatotoxicity. Chemicals that cause liver injury are called hepatotoxins.

The blood draining the stomach and small intestine is delivered directly to the liver via the hepatic portal vein, thus exposing the liver to relatively large concentrations of ingested drugs or toxicants. Hepatic exposure to agents that undergo bioactivation to toxic species can be significant (Charles and Robert, 2002).

### 1.2.5.1 Pathogenesis of Drug induced liver damage

The pathogenesis of drug-induced liver damage is an individual, albeit multifactorial process. The main **mechanisms** known to include:

**Lipid peroxidation:** Free radicals induce peroxidation of the unsaturated fatty acids of the ER. As a result, there is fatty degeneration of the liver, whereby the mitochondria and biomembranes are damaged (possibly leading even to cell death).

**Oxidative stress:** This process causes a depletion of glutathione in the hepatocytes with subsequent damage to (and even death of) liver cells.

**Inhibition of β-oxidation:** The enhanced formation of mitochondrial oxygen radicals in the presence of fatty degeneration of the liver causes lipid peroxidation, which can lead to steatohepatitis and fibrosis or cirrhosis.

**Inhibition of protein synthesis:** Some substances can inhibit RNA polymerase II and III. This in turn impairs the synthesis of enzymes, structural proteins and apolipoproteins. The result is fatty degeneration of the liver and cell necrosis.

**Disorder of haem synthesis:** Inhibition of hepatic coproporphyrinogen-oxidase and uroporphyrinogen-decarboxylase can give rise to secondary copro- and uroporphyrinuria or porphyria cutanea tarda.

**Inhibition of bile acid transport:** More than 100 medicaments can cause intrahepatic cholestasis. In this case, the canalicular transport mechanisms are impaired. The retained bile acids damage the cells.

**Immunoallergenic reactions:** Chemically generated neoantigens trigger a cytotoxic immune response to those hepatocytes that have such neoantigens on their surface.

**Carcinogenesis:** Highly active or metabolically activated foreign substances may form DNA adducts, which culminate in mutations, above all in the p 53 gene. Drug metabolism in the liver is subject to numerous endogenic and exogenic influences. They interfere with various biotransformation reactions, alter the sensitivity of the liver to drug products and determine the pattern of damage (Erwin and Hans-Dieter Kuntz, 2005).

A. Non-variable factors are genetics, gender and age.

B. Variable factors are coexisting diseases (diabetes, liver or renal disease, endocrinopathies), overweight, malnutrition (e. g. lack of protein), alcohol, additional medication, tobacco smoke particles, heavy metals and pregnancy as well as drug-related overdose, long term intake or application form, etc. Foreign substances, including medicinal products, are classified as obligate (directly effective) or as facultative (indirectly effective) hepatotoxins, depending on their degree of hepatic toxicity. Hepatotoxins are therefore grouped as either directly toxic or indirectly toxic according to the pathogenetic mechanisms of liver damage. Indirect hepatotoxins may, however, also cause an idiosyncratic type of liver impairment through immunological or metabolic mechanisms.

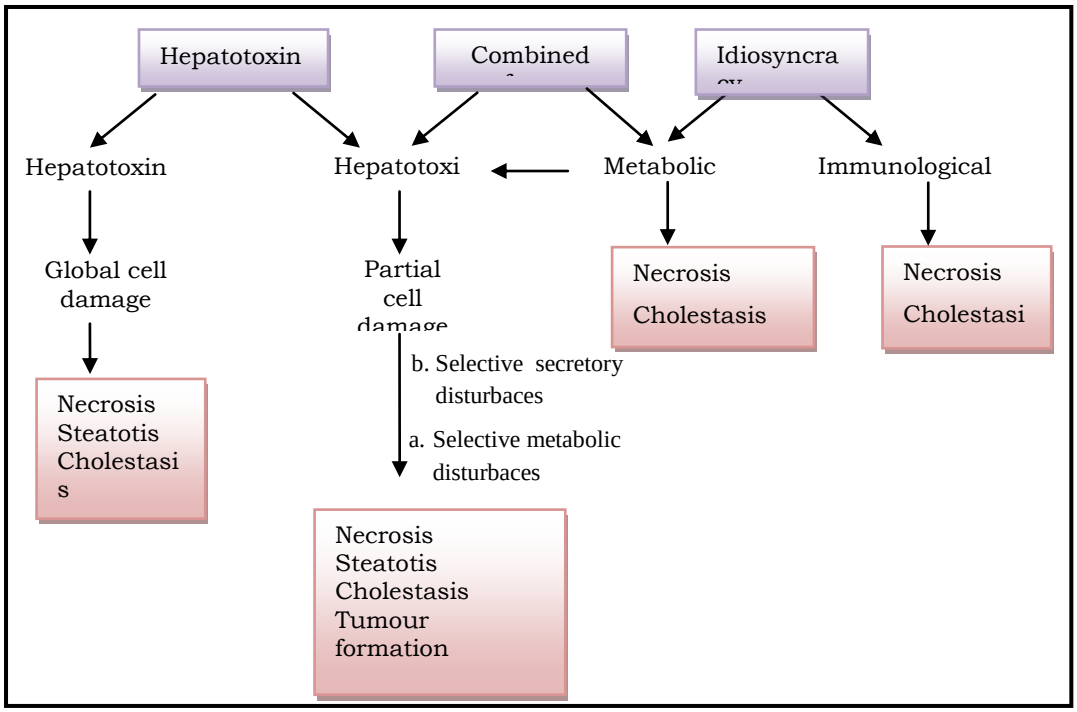



**Fig. 1.2 Pathogenetic mechanism of drug induced liver injury**

**Table 1.1: List of Drug having Hepatotoxicity**

| Sr. No. | Name of drugs | Category of drug |
|---|---|---|
| 1 | Paracetamol | Antipyretic, Analgesic |
| 2 | Isoniazide | Antituberculosic |
| 3 | Rifampicin | Antituberculosic |
| 4 | Chlorpromazine | Antipsychotic |
| 5 | Halothane | Anesthetic |
| 6 | Chloroform | Anesthetic |
| 7 | Statines | Hypolipidemic |
| 8 | Sodium Valproate | Antiepileptic |
| 9 | Pyrazinamide | Antituberculosic |
| 10 | Tetracycline | Antibiotic |

| | | |
|---|---|---|
| 11 | Amiodarone | Antianginal |
| 12 | Valproic acid | Anticonvulsive |
| 13 | Estrogen | Female sex hormone |

Many therapeutic drugs cause liver damage, manifested clinically as hepatitis or (in less severe cases) only as laboratory abnormalities (e.g. increased activity of plasma aspartate transaminase, an enzyme released from damaged liver cells). Paracetamol, isoniazid , iproniazid and halothane cause hepatotoxicity by the mechanisms of cell damage. Genetic differences in drug metabolism have been implicated in some instances (e.g. isoniazid , phenytoin ). Mild drug-induced abnormalities of liver function are not uncommon, but the mechanism of liver injury is often uncertain (e.g. statins). It is not always necessary to discontinue a drug when such mild laboratory abnormalities occur, but the occurrence of irreversible liver disease (cirrhosis) as a result of long-term low-dose methotrexate treatment for arthritis or psoriasis argues for caution. Hepatotoxicity of a different kind, namely reversible obstructive jaundice, occurs with chlorpromazine and androgens. (Rang and Dale, 2003)

### 1.2.5.2. Types of drug induced liver damage

- Hepatocellular Necrosis
  - A. Zonal Necrosis ($CCl_4$ type)

    $CCl_4$

    Helogenated benzenes

    Acetamenophen
  - B. Viral Hepatitis like (cincophen type)

    Isoniazid

Iproniazide

Halothane

- Uncomplicated cholestasis (Steroid type)

Anabolic Steroid

Estrogen

- Nonspecific Hepatitis with Cholestasis (Chlorpromazine type)

Phenothiazines

Isoniazide

Erythromycin estolate

- Drug Induced Steatosis

Tetracycline

**1.2.5.3 Hepatotoxins**

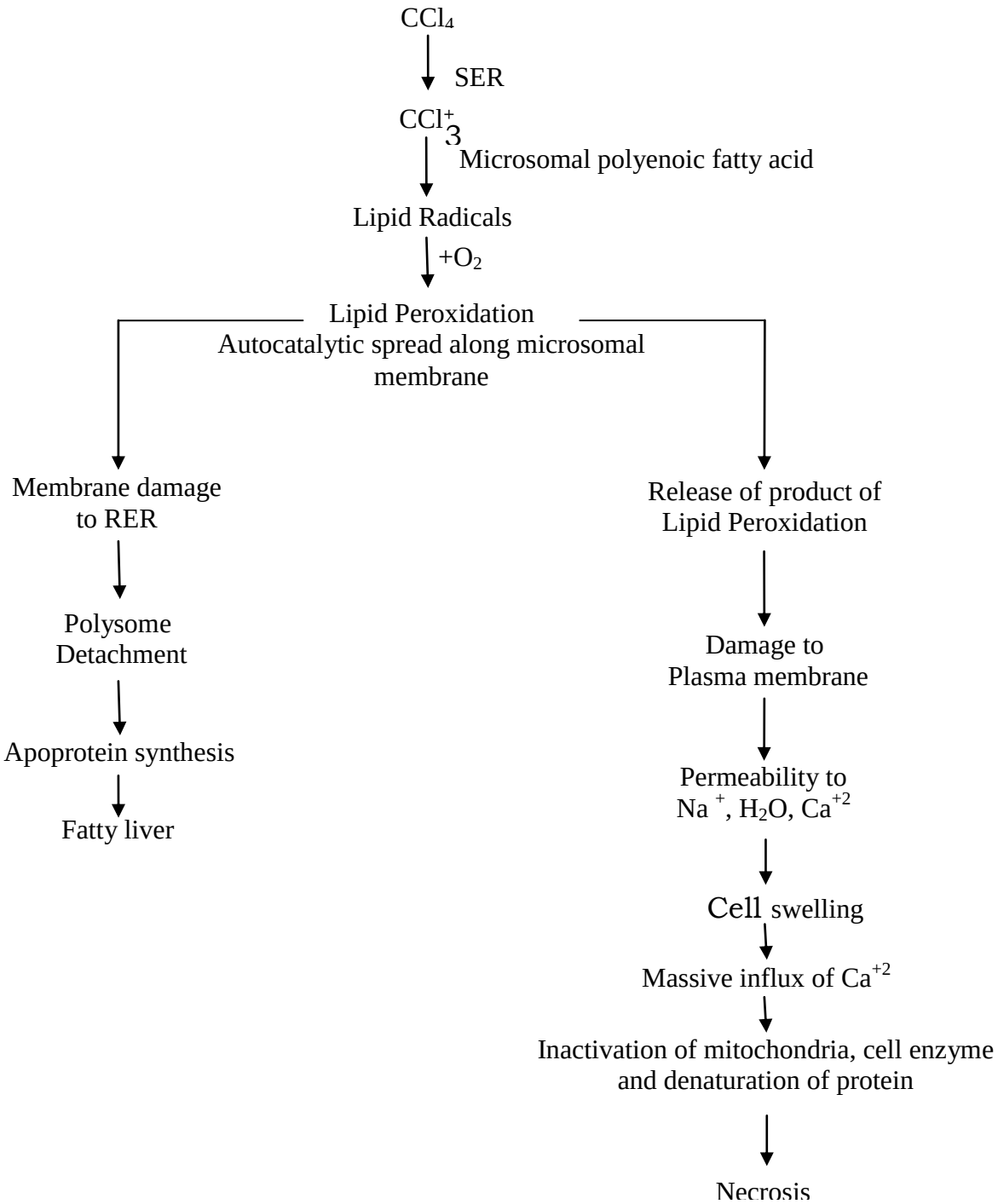
For every liver disease that cannot be clarified with certainty, each differential diagnosis should always include toxic substances in food, at work, in the house or garden and in those places where people pursue leisure activities. It is extremely difficult to identify the causal noxa. In the individual case, however, identification can be of considerable importance for general assessment purposes.

**1.2.5.3.1 Industrial toxin**

Example: Arsenic, Carbon tetrachloride, Vinyl Chloride, Thiocetamide, Alcohol

**Carbon Tetrachloride**

Carbon tetrachloride ($CCl_4$), a potent hepatotoxic agent is biotransformed to a trichloromethyl radical by the cytochrome P450 system in liver microsomes, and consequently causes lipid peroxidation of membranes that leads to liver injury (Recknagel, 1983; Slater, 1984; McCay *et al*., 1984)




**Thioacetamide**

Toxicity experienced by the liver during thioacetamide poisoning results from the production of a metabolite, thioacetamide *s*-oxide, which is a direct hepatotoxin (Neal and Halpert, 1982) responsible for change in cell

permeability and it inhibits mitochondrial activity followed by cell death (Ambrose *et al*., 1950). It has also been reported that chronic thioacetamide exposure produced cirrhosis in rats (Chieli and Malvadi, 1985).

**Alcohol**

In the United States, about half of the adult population actively consumes alcoholic beverages and about 15 to 20 million people suffer from alcoholism (Stinson *et al*., 1997) and it is the fourth leading cause of death in urban American males (Libber, 1991). Alcohol consumption can lead to a variety of abnormalities in the liver including steatosis, alcoholic hepatitis, and hepatic fibrosis, which typically precede the development of alcoholic cirrhosis, an end-stage liver disease most often requiring liver transplantation. Alcoholic cirrhosis is also a major risk factor for hepatocellular carcinoma that accounts for nearly 6% of all human cancers. Alcoholic liver disease affects more than 2 million people in the United States. According to a US surveillance report, liver cirrhosis was the $10^{th}$ leading cause of mortality in 1997 accounting for approximately 25,000 deaths in that year (Saadatmand *et al*., 2000).

CYP2E1-dependent ethanol metabolism produces oxidative stress through generation of reactive oxygen species (ROS), a possible mechanism by which ethanol is hepatotoxic (Bondy, 1992; Dianzani, 1985).

Induction of cytochrome P4502E1 by ethanol is a central pathway by which ethanol generates oxidative stress and in the intragastric model of ethanol feeding a prominent induction of CYP2E1 occurs along with significant alcohol liver injury (Morimoto *et al*., 1994; Nanji *et al*., 1994). Lipid peroxidation also occurs, and ethanol-induced liver pathology correlates with

CYP2E1 levels and elevated lipid peroxidation, which is blocked by inhibitors of CYP2E1.

**1.2.5.3.2 Mycotoxins**

Example: Aflatoxins (Erwin and Hans-Dieter Kuntz, 2005)

**1.2.5.3.3 Phytotoxins**

Example: *Amanita phalloides*, Pyrrolizidine alkaloids, Helvella esculenta (Erwin and Hans-Dieter Kuntz, 2005)

**1.2.5.3.4 Endotoxin**

Endotoxins are fragments of long-chain lipopolysaccharides. They pass from the cell membrane mainly from gram-negative bacteria in the intestine into the circulation and, as potential hepatotoxins, subsequently lead to liver damage (Erwin and Hans-Dieter Kuntz, 2005).

**1.2.5.3.5 Drugs**

Example: Paracetamol, Isoniazide, NSAIDS, Glucorticoids

**Acetamenophen**

Acetaminophen (paracetamol) is usually well tolerated in prescribed dose but overdose is the most common cause of drug induced liver disease and acute liver failure worldwide (Keeffe *et al*., 2004).Damage to the liver is not due to the drug itself but to a toxic metabolite (*N*-acetyl-*p*-benzoquinone imine NAPQI, or NABQI) which is produced by cytochrome P4502E1 enzymes in the liver (Wallace, 2004). In normal circumstances this metabolite is detoxified by conjugating with glutathione in phase 2 reaction. In overdose large amount of NAPQI that can induce a dose dependent depletion of intracellular glutathione and perturbations of calcium homeostasis and lead to damage to liver cells (Lee *et al*., 1996; Chup *et al*., 1999; Holownia and

Braszko, 2004) Administration of Acetylcysteine, a precursor of glutathione, can limit the severity of the liver damage by capturing the toxic NAPQI.

Nitric oxide also plays role in inducing toxicity (James *et al*., 2003). Peroxynitrite, a highly reactive nitrating and oxidizing species formed by the rapid reaction of nitric oxide (NO) and superoxide, produces nitrated tyrosine (Beckman, 1996; Pryor and Squadrito, 1995). Since acetaminophen-protein adducts correlate with development of necrosis (Hart *et al*., 1995; Roberts *et al*., 1991), it follows that nitration of tyrosine correlates with necrosis.

**Nonsteroidal anti-inflammatory drugs**

Although individual analgesics rarely induce liver damage, due to their widespread use NSAIDs have emerged as a major group of drugs exhibiting hepatotoxicity. Both dose dependent and idiosyncratic reactions have been documented (Manov *et al*., 2006). Aspirin and phenylbutazone are associated with intrinsic hepatotoxicity; idiosyncratic reaction has been associated with ibuprofen, sulindac, phenylbutazone, piroxicam, diclofenac and indomethacin.

**Glucocorticoids**

Glucocorticoids are so named due to their effect on carbohydrate mechanism. They promote glycogen storage in liver. Enlarged liver is a rare side effect of long term steroid use in children (Iancu *et al*., 1986). The classical effect of prolonged use both in adult and paediatric population is steatosis (Alpers, 1982).

**Isoniazid**

Isoniazide (INH) is one of the most commonly used drugs for tuberculosis. It is associated with mild elevation of liver enzymes up to 20% of patients and severe hepatotoxicity in 1-2% of patients (Sarich *et al*., 1999).

Isoniazide (INH) the first line drug used for tuberculosis chemotherapy is associated with hepatotoxicity (Tasduq *et al*., 2005**).** For decades, it has been well documented that INH can cause adverse effects on the liver, ranging from mild transient elevations in aminotransferases (transaminases), which occur in approximately 10 to 20% of patients, to overt hepatitis, occurring much more rarely (Randolph & Joseph, 1953; Cohen *et al*., 1961; Black *et al*., 1975; Kopanoff *et al*., 1978). The rate of hepatotoxicity with INH has been reported to be much higher in developing countries like India (8%-30%) compared to that in advanced countries (2%-3%) with a similar dose schedule (Sharma, 2004).

Isoniazide is acetylated and then hydrolyzed, resulting in isonicotinic acid and monoacetylhydrazine; the latter compound can be activated to a toxic species by cytochrome P-450 (Thomas, 1981). *In vitro* studies indicate that metabolic oxidation of acetylhydrazine leads to a reactive acylating species that binds covalently to microsomal protein. It is postulated that acetylhydrazine and hydrazine act as acetylating agents by binding covalently with liver cell macromolecules, causing hepatocyte injury (Noda, 1983) Isoniazid-induced hepatitis is associated with ballooning degeneration, focal hepatocyte necrosis, with minimal cholestasis (Mitchell, 1976). Study reported diffuse microvesicular fatty infiltration with mild portal triaditis (Sodhi, 1997).

**Halothane**

Halothane is a widely used inhalation anesthetics cause allergic liver damage. Trifluoracetychloride, a reactive metabolite of halothane, couple to a macromolecule to form an immunogen. Most patient with halothane induced liver damage have antibodies that react with halothane-carrier conjugates.

Halothane-protein antigen can be expressed on the surface of hepatocytes. Destruction of cell occurs by type II hypersensitivity reaction involving killer T cell. If antigen-antibody complexes are released by damaged cells, type III reaction can occur.

### 1.2.6. Herbal Remedies for Hepatotoxicity

Herbal medicines have been used in the treatment of liver diseases for a long time. A number of herbal preparations are available in the market (Dhiman & Chawla, 2005). Medicinal herbs and extracts are widely used in the treatment of liver diseases like hepatitis, cirrhosis, and loss of appetite (Cupp, 1999). *Silybum marianum*, *Picrrorhiza kurroa*, *Andrographis paniculata*, *Strychnos potatorum, Aquilegia vulgaris, Phyllanthus niruri*, and *Eclipta alba* are some of the well known plants those have shown genuine utility in liver disorders (Bisset, 1994; Sanmugapriya and Venkataraman, 2006; Liebert *et al*., 2005).

## 1.3 Clinical Trials

### 1.3.1. What is a clinical trial? (http://www.biotechmedia.com/definitions-c.html)

A clinical trial is a research study in which a treatment or therapy is tested in people to see whether it is safe and effective. The information learned from clinical trials helps to improve health care and to keep people healthier. Researchers also conduct clinical trials to find out which treatments are more effective than others. The results from trials can also contribute to our understanding of diseases and conditions—for example, how a disease progresses or how it affects different systems in the body. Clinical trials are also called medical research, research studies, or clinical studies. Each trial follows a protocol—a written, detailed plan that explains why there is a need for the study, what it is intended to do, and how it will be conducted. The protocol is written by the trial's principal investigator (the person who is in charge of the trial).

### 1.3.2. What are the major types of clinical trials? (http://www.biotechmedia.com/definitions-c.html)

Clinical trials are used to study many aspects of medical care:

- Treatment trials tests for a specific disease or condition.
- Supportive care trials, also called quality-of-life trials, study ways of making sick people more comfortable and giving them a better quality of life.
- Prevention trials study ways, to reduce the chance of the disease to people who are healthy, but may be at the risk for a disease, will develop the disease.

- Early detection or screening trials, study new ways of finding diseases or conditions in people who are at risk, before they have any signs or symptoms.
- Diagnostic trials, test new ways to identify, more accurately and earlier, whether people have diseases and conditions.

Clinical trials have sometimes been thought of as a last resort for those who have a disease and have tried all other treatment options. This is not true. There are trials for healthy people (for example, to study disease prevention) and trials for all different types and stages of diseases.

### 1.3.3. What are the different phases of Clinical trials?

**(**http://www.biotechmedia.com/definitions-c.html**)**

Because the therapy will be tested in people, before a clinical trial can start, there needs to be some evidence that it is likely to work. This evidence can come either from previous research studies in animals or from reported information on its use by people. Clinical trials take place in phases. In each phase, different research questions are answered.

**Phase 1**: (http://www.nccam.nih.gov)

Initial safety trials on a new medicine in which investigators attempt to establish the dose range tolerated by about 20-30 healthy volunteers for single or multiple doses. Although usually conducted with healthy volunteers, Phase 1 trials are sometimes conducted with severely ill patients, for example those with cancer or AIDS. When pharmacokinetic issues are being addressed (for example, metabolism of a new antiepileptic medicine on stable epileptic patients whose microsomal liver enzymes have been induced by other antiepileptic medicines), trials may be conducted in less ill patients.

Pharmacokinetic trials are usually considered Phase 1 trials regardless of when they are conducted during a medicine's development.

**Phase 2a:** (http://www.nccam.nih.gov)

Pilot clinical trials to evaluate efficacy and safety in selected populations of about 100 to 300 patients who have the disease or condition to be treated, diagnosed or prevented. Often involve hospitalized patients who can be closely monitored. Objectives may focus on dose-response, type of patient, frequency of dosing, or any of a number of other issues involved in safety and efficacy.

**Phase 2b**: (http://www.nccam.nih.gov)

Well controlled trials to evaluate safety and efficacy in patients who have the disease or condition to be treated, diagnosed or prevented. These trials usually represent the most rigorous demonstration of the efficacy medicine. Synonym: pivotal trials.

**Phase 3a:** (http://www.nccam.nih.gov)

Multicenter studies in populations of 1000 to 3000 patients (or more) for whom the medicine is eventually intended. Phase 3 trials generate additional safety and efficacy data from relatively large numbers of patients in both controlled and uncontrolled designs and are used to support a PLA (Product License Application). Trials are also conducted in special groups of patients or under special conditions dictated by the nature of the particular medicine and/or disease. Phase 3 trials are often providing much of the information needed for package insert and labeling of the medicine.

**Phase 3b:** (http://www.nccam.nih.gov):

Trials are conducted after submission of a new drug application (NDA), but before the product's approval for market launch. Phase 3b trials may supplement or complete earlier trials, or they may seek different kinds of information (for example, quality of life or marketing). Phase 3b is the period between submission for approval and receipt of marketing authorization.

**Phase 4:** (http://www.nccam.nih.gov)

After a medicine is marketed, Phase 4 trials provide additional details about the product's safety and efficacy. They may be used to evaluate formulations, dosages, and duration of treatment, medicine interactions, and other factors. Patients from various demographic groups may be studied. An important part of many Phase 4 studies is detecting and defining previously unknown or inadequately quantified adverse reactions and related risk factors. Phase 4 studies that are primarily observational or non experimental are frequently called post marketing surveillance.

### 1.3.4. What are some common elements of Clinical trials?

**(**http://www.biotechmedia.com/definitions-c.html**)**

Trials can be randomized. Each participant in a randomized trial is assigned by chance (through a computer or a table of random numbers) to one of two groups:

- The investigational group, made up of people who will receive the therapy, also called the active treatment
- The control group, made up of people who will receive either the standard treatment (if there is one) for their disease or condition, or a placebo

Each participant has an equal chance of being assigned to either group. In some complex trials, there are more than two groups. Randomization is used in all phase III studies and in some phase II studies. It gives the best chance of knowing that the study results are caused by the treatment and not some other factor, such as people's choices or beliefs. Trials can be double-blind. This means that neither the researchers nor the participants know who has been assigned to which group. Blinding is another way to help minimize the chance of bias influencing the trial results. The information is kept on file at a central office, so if there is an urgent need for the research team to find out who was assigned the active treatment, they can.

Researchers design clinical trials to have one or more endpoints. An endpoint is a measure that determines whether the treatment under study has an effect. An example of an endpoint is whether a person's tumor shrinks after receiving chemotherapy.

**1.3.5. What is a placebo? (**http://www.biotechmedia.com/definitions-c.html**)**

A placebo is designed to resemble as much as possible the treatment being studied in a clinical trial, except that the placebo is inactive. An example of a placebo is a pill containing sugar instead of the drug being studied. By giving one group of participants a placebo and the other group the active treatment, the researchers can compare how the two groups respond and get a true picture of the effect of active treatment.

Another type of placebo is called a "sham" procedure. When the treatment under study is a procedure (not a drug or other substance), a sham procedure may be designed that resembles the active treatment but does not have any active treatment qualities. For example, in a clinical trial of acupuncture, the

sham procedure might consist of placing acupuncture needles in areas of the body that are not expected (from previous knowledge) to have any therapeutic response.

In recent years, the definition of placebo has been expanded to include other things that could have an effect on the results of health care. Examples include how a patient and a health care provider interact, how a patient feels about receiving the care, and what he or she expects to happen from the care. Therefore, when a treatment is compared to a placebo in clinical trials, the patients should differ only in whether they receive treatment, and not in other aspects. Not all clinical trials compare an active treatment to a placebo. No patient is denied treatment in a clinical trial if there is a standard therapy available that could improve the comfort and survival of the patient.

### 1.3.6 Who can participate in a clinical trial?

**(**http://www.biotechmedia.com/definitions-c.html**)**

Clinical trials include people of various ages and ethnic groups and both genders as much as possible, so that the results can apply to the general population. Each clinical trial, however, is unique in its eligibility criteria (rules for who can and cannot participate). Examples of criteria include sex, age, type of disease, severity of disease, and history of prior treatment. If a disease is being studied in a trial, participants must have a similar degree of illness, so that there is a good chance they will respond in similar ways to the treatment being studied.

### 1.3.7. Are there protections for people who participate in clinical trials?

**(**http://www.biotechmedia.com/definitions-c.html**)**

Yes, the Federal Government requires many protections for people who participate in federally funded clinical trials. Before a clinical trial can start, the written protocol must be approved and monitored by an Institutional Review Board (IRB). An IRB is an independent group of health care providers, other experts, and lay people from the community who make sure that the study is set up and run safely and fairly. IRBs review protocols and the consent documents that people must sign in order to participate in a clinical trial.

Participants are also protected by a process called informed consent. If you are considering taking part in a clinical trial, during this process you will meet with a member of the research team. He or she will provide you with key facts about the study, such as:

- Who is sponsoring and conducting the research.
- Who has reviewed and approved the study.
- What the researchers want to learn.
- How the research team will monitor your health and safety.
- What participants will be required to do during the trial, and for how long.
- Possible benefits and risks of participating.
- Other treatments that are available for your disease or condition.
- How the privacy of your medical records will be protected.

You have a right to have all your questions answered. If you do not understand an answer you receive, ask again. It can be helpful to make a list of questions and concerns before you talk to the study team.

The staff will also give you a consent form, an agreement that you will sign if you decide to join the trial. Consent forms can be long, and they contain a lot

of information. It is a good idea to take the consent form home, so that you can think about it and review it with family members or friends. If you have an interest in joining a study, it is also very helpful to discuss it with your health care practitioner and others whose advice you trust.

Participating in a clinical trial is completely voluntary. You can leave the trial at any time, for any reason even after you have signed the consent form.

**1.3.8. What happens once a clinical trial starts?**

**(**http://www.biotechmedia.com/definitions-c.html**)**

The research team will check the participant's health at the beginning of the trial, give specific instructions for participating, and monitor their health carefully during the trial. Participants may be required to do some things between appointments, such as take medication according to a schedule or make a phone call to report their experiences.

Clinical trials take place in a variety of settings, depending on the type of trial and what is being studied. For example, participants in a trial of an herb might follow the protocol at home, while a trial that involves specialized equipment (such as acupuncture) might be carried out in a clinic or other health care setting. Still other trials may require participants to be in a hospital, clinic, or research center while the therapy is given.

**1.3.9. What happens after a clinical trial ends?**

**(**http://www.biotechmedia.com/definitions-c.html**)**

The researchers carefully analyze the data from the trial. Then they conclude about their findings and decide whether further testing is required or not. If the trial is completed, the results have medical importance, they usually report the results first in a peer-reviewed medical journal ("peer reviewed" means that

each report is reviewed before publication by a group of experts in the same field). A new treatment which is found safe and effective in a carefully conducted clinical trial become new standard practice. The results of clinical trials are given to the participants after its completion.

**1.3.10. What are the possible benefits of being in a clinical trial?**

**(**http://www.biotechmedia.com/definitions-c.html**)**

- You will receive expert medical care.
- Your health will be closely watched throughout the study.
- Clinical trials can be one treatment or prevention option for a disease or condition.
- In some types of trials, you may be among the first to get benefit from a new treatment or get new knowledge about a current treatment.
- You can motivate others to take part in the clinical trial or to be treated in the clinical trial.

**1.3.11. What are the possible risks in a clinical trial?**

**(**http://www.biotechmedia.com/definitions-c.html**)**

There are some risks for being in a clinical trial, as they are treatment with any other illness in a clinical trial:

- The treatment under study does not always turn out to be better than, or even as good as, standard treatment.
- The treatment may have side effects which are not known to the researchers.
- If you are in a randomized trial, you may be assigned to the control group, where you may not receive the drug but you may receive placebo treatment.

- Participation may require more tests and more visits or treatments than regular care.

# Objective

# OBJECTIVE

## 2.1 Aim of the present work:

- To study different effects of *Phyllanthus amarus* in the patients of jaundice. The plant is described in Ayurveda and is proven pharmacologically for the hepatoprotective activity.
- To study different effects of treatment of the marketed polyherbal formulation containing *Phyllanthus amarus* in patients with jaundice.
- Compare the effects of *Phyllanthus amarus* and its market formulation in the patients of jaundice.

## 2.2 Plan of the work:

- Collect the plant *Phyllanthus amarus.* Confirmation of its identity by the government authority and comparing its morphological and microscopical characters with the published literature.
- Drying, powdering and storage of the collected drug.
- Determination of quality of the powder drug by determining its water soluble extractive value, alcohol soluble extractive value, ash value, acid insoluble ash value and water soluble ash value.
- TLC study of the powdered drug and comparison with the published literature to determine the quality.
- To form ethical committee to surprise protocol and condition of patients etc. To explain importance of this medicine, regarding different tests and importance of this study to the patients.
- Confirming the hepatoprotective activity (Ayurvedic claim) of the powder of *Phyllanthus amarus* by giving it to the patients with jaundice and determining their biochemical markers like SGPT, bilirubin at

different time interval. Also to study effect of this herb on other biochemical parameters like Haemoglobin, Urine sugar, Creatinine, etc.

- To study effects of different marketed polyherbal formulations containing *Phyllanthus amarus* on the patients having jaundice by determining different biochemical markers like SGPT, bilirubin, haemoglobin etc.
- Comparison of the activity of *Phyllanthus amarus* and its marketed formulations.

# Review of Literature

**REVIEW OF LITERATURE**

### 3. 1 *Phyllanthus amarus.*

A genus of herbs or undershrub chiefly distributed in tropical and subtropical regions of the world. About 24 species occur wild in India (Wealth of India, 1969) but very few have been used in medicine.

**Synonyms:** *Phyllanthus niruri* Avet non L.

***Phyllanthus amarus*** Schum & Thonn (Kirtikar and Basu, 1933; Thakur *et al*., 1989; Wealth of India**,** 1969).


Fig. 3.1 Plant of *Phyllanthus amarus*

### 3. 1. 1 Introduction

**Common Name** (Kirtikar and Basu, 1933; Thakur *et al*., 1989; Wealth of India**,** 1969**)**

Bengali : Bhuiamla, Sadahazurmani

Gujarati : Bhony aanmali

Hindi : Jaramla, Jangli amli

Malayalam : Kizhanelli, Kilarnelli

Marathi : Bhuiavali

Oriya : Bhuin amla, Badianla

Sanskrit : Bhumyamalaki , Bahupatra, Bahuphala, Bahupushpi

Tamil : Kilaneli, Kilakkainelli

Telugu : Nela usirika

**Biological Source**: Drug consists of dried whole plants of *Phyllanthus amarus* (Fam. Asteraceae).

**Scientific Classification (**Bagchi *et al*., 1992)

Kingdom : Plantae

Division : Angiospermae

Class : Dicotyledoneae

Order :Tubiflorae

Family : Euphorbiaceae

Genus : *Phyllanthus*

Part Used : Leaves, Flowers, Whole plants

**Geographical Source**: **(**Kirtikar and Basu, 1933; Thakur *et al*., 1989; Ross, 1999) Probably native to America but found throughout India and almost all tropical countries.

**3.2. MACROSCOPIC**: (Ayurvedic Pharmacopoeia, 2001; Patel, 2000)

A herb that grows upto 10-60 cms tall, erect, Stem terete, younger parts rough, cataphylls 1.5-1.9 mm long, deltoid acuminate. Leaf: 3.0-11.0 x 1.5-6.0 mm, elliptic oblong to obvate, obtuseor minutely apiculate at apex, obtuse or slightly in equilateral at base.

**Flowers** axillary, proximal 2-3 axils with unisexual 1-3 male flowers and all succeeding axils with bisexual cymules. Male flowers-pedicel 1mm long, calyx 5, sub equal 0.7 x 0.3 mm, oblong, elliptic, apex acute, hyaline with unbranched mid rib; disc segments 5, rounded, stamens 3, filaments connate. Female flowers-pedicel 0.8-1.0 mm long, calyx lobes 5, 0.6 x 0.25 mm, ovate-oblong, acute at apex; disc flat deeply 5 lobed, lobes often toothed at apex, styles 3, free, shallowly bifid at apex. Capsule 1.8 mm in diameter, oblate and rounded.

**Seeds** about 0.9 mm long, triangular with 6-7 longitudinal ribs and many transverse striations on the back

**Medicinal uses** (Kirtikar and Basu, 1933; Wealth of India, 1969; Sivarajan *et al*., 1994):

Whole plant is bitter, stomachic and medicinal. The drug is highly reputed as a single drug remedy in the treatment of jaundice in traditional medicine (Joshi *et al*., 1996; Indian Herbal Pharmacopoeia. 1999; Prakas *et al* 1995: Asha *et al* 1998). It is carminative, styptic, astringent, cooling and used in cough and indigestion. It is also used in diabetes. It is also much used as a diuretic in dropsial affections, gonorrhoea and other troubles of the genito-urinary tract. An infusion of the young shoot is given in dysentery. The powdered leaves and roots are made into poultice with rice-water and used to lessen the oedematous swelling and ulcers.

The fruit is bitter, useful for tubercular ulcers, wounds, sores, bruises, scabies, ringworm etc. (antifungal, antibacterial activity) and the fresh root is said to be an excellent remedy for jaundice. In the Konkan, the root rubbed down with rice water is given as a remedy for menorrhagia.

Leaves are stomachic; juice is a good application to offensive sores. A poultice of the leaves with salt cures scabby affections (antifungal action) and without salt may be applied to bruises (antibacterial action) etc. The leaves are boiled and the liquor is drunk to stop acute pains in the stomach. The chief use of the plant is to allay griping in cases of dysentery.

Kirtikar and Basu has also proved the efficacy of the plant in the case of paroxysm, where tincture was made up from whole plant and two drachms was given in the morning. Sometimes the dose was repeated, which acted upon the bowels as a slight purgative and was very useful in inveterate intermittents with infarcts of the spleen and liver. (Kirtikar and Basu, 1933)

The infusion of the root and leaves is a good tonic, and a diuretic when taken cold in repeated doses.

### 3.3. Microscopic

#### 3.3.1. Lamina in surface view (Lower surface) (Patel, 2000)

The cells of both the epidermis are polygonal and wavy in outline, the lower being more wavy than the upper one. Three types of stomata are present; paracytic, anomocytic and anisocytic, the later being more frequent. It shows clusters and prisms of Ca-oxalate in the mesophyll cells, palisade cells and vein. Trichomes are absent on both the surface Average stomatal index of lower epidermis is 25, palisade ratio is 12 and vein islet number is 22.

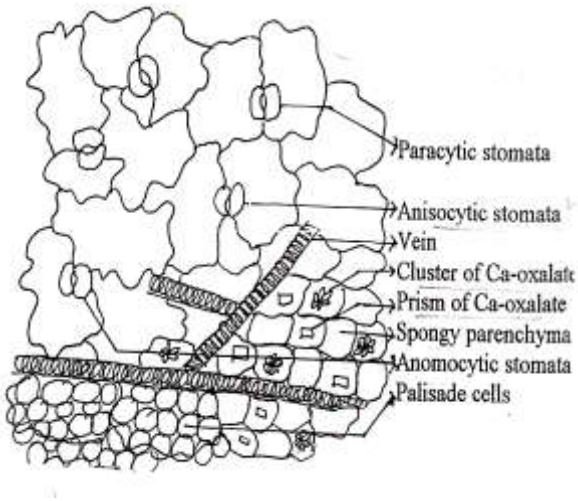



Fig: 3.2 Lamina of *P. amarus* in surface view (Lower surface)

**3.3.2. Transverse section of the leaf passing through midrib (Patel, 2000)**

The leaf is a dorsiventral, a layer of palisade cells being present below the upper epidermis. It is discontinuous over the midrib. The cells of both the epidermis are tabular a shape, devoid of trichomes and are covered with thin cuticle. A small collateral vascular bundle consisting of few spirally thickened xylem vessels and parenchymatous phloem lies in the center of the midrib. Occasionally few parenchymatous cells lying below the upper epidermis in the midrib region become thick walled and lignified. The spongy parenchyma of lamina and midrib contain clusters of Ca-oxalate, while the palisade cells contain prisms of Ca-oxalate.

Lots of controversial reports are found to be existing regarding the types of Ca-oxalate crystals in the leaf and the types of stomata. (De *et al*., 1990) have mentioned the presence of rosettes and few prisms in the leaf while Indian Herbal Pharmacopoeia vol560 –II (HP-II) has mentioned the presence of clusters in the leaf and (Bagchi *et al*., 1992) have not mentioned this content at all. In fact both clusters and prisms of Calcium oxalate crystals are found in the leaf.

The presence of paracytic and sometimes anomocytic types of stomata have been reported by (De *et al*., 1990) while anisocytic type by (Bagchi *et al*., 1992) and anisocytic and paracytic type by (IHP, 1999). In fact the leaf contains many anisocytic stomata and few paracytic and anomocytic.

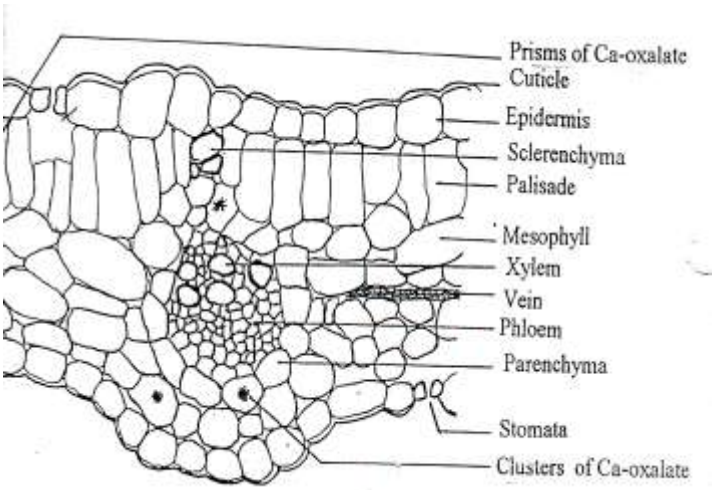



Fig: 3.3 T.S. of *P. amarus* leaf through midrib.

**3.3.3. Transverse section of the stem (Patel, 2000)**

The transverse section of the stem is circular in outline, and show wide central pith encircled by the ring of xylem, phloem and groups of discontinuous pericyclic fibres, cortex is very narrow.

The cells of the epidermis are tabular in shape and are covered with thin cuticle. Cortex is made up of 5 to 10 layers of parenchyma, the outermost 2 to 3 layers are collenchymatous. The cells of cortex contain cluster and prisms of Ca-oxalate crystals, chloroplasts, tannin and starch grains. The cells of endodermis are quite big in size and contain starch grains. Pericyclic region is characterized by groups of 10 to 20 thick-walled lignified fibers forming a discontinuous ring. Phloem is made up of sieve tube companion cells and parenchyma containing Ca-oxalate cluster and prisms and tannin. Xylem is made up of xylem vessels, isolated or in groups, annular thickened, arranged

in radial rows; trachieds, fibres, parenchyma and medullary rays. The parenchymatous cells of the pith contain clusters and prisms of Ca-oxalate and simple starch grains.

The controversial aspect regarding the presence of Ca-oxalate crystals is noticed in stem also. (De *et al*., 1990) have mentioned the presence of rosettes and prisms of Ca-oxalate crystals while (Bagchi *et al*., 1992) the cluster and (IHP, 1999) has not mentioned anything regarding Ca-oxalate crystals. Contrary to these earlier finding, infact the parenchymatous cells of the stem contain clusters and prisms of Ca-oxalate. Beside this (De *et al*., 1990) and (IHP, 1999) do not mention anything about the tannins content also, which are found to be abundant in the parenchymatous cells of the stem. Regarding the thickening of xylem vessels, (De *et al*., 1990) have mentioned bordered pitted thickening and (IHP, 1999) has mentioned pitted thickening, which is infect not found, instead it shows annular thickening.

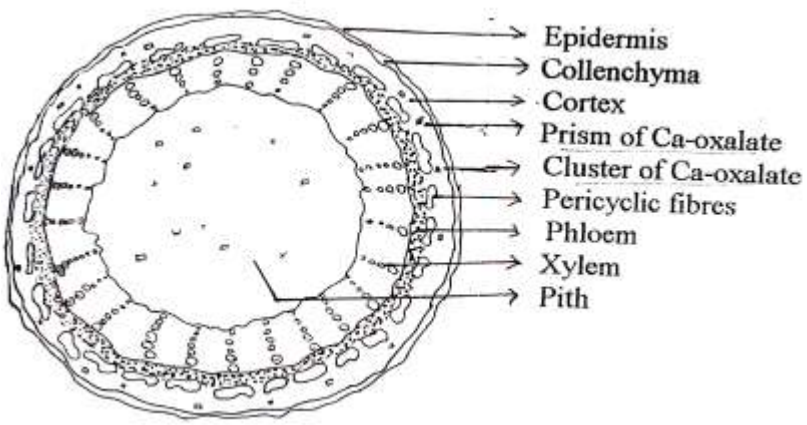



Fig: 3.4 Diagrammatic T.S. of stem of *P. amarus.*

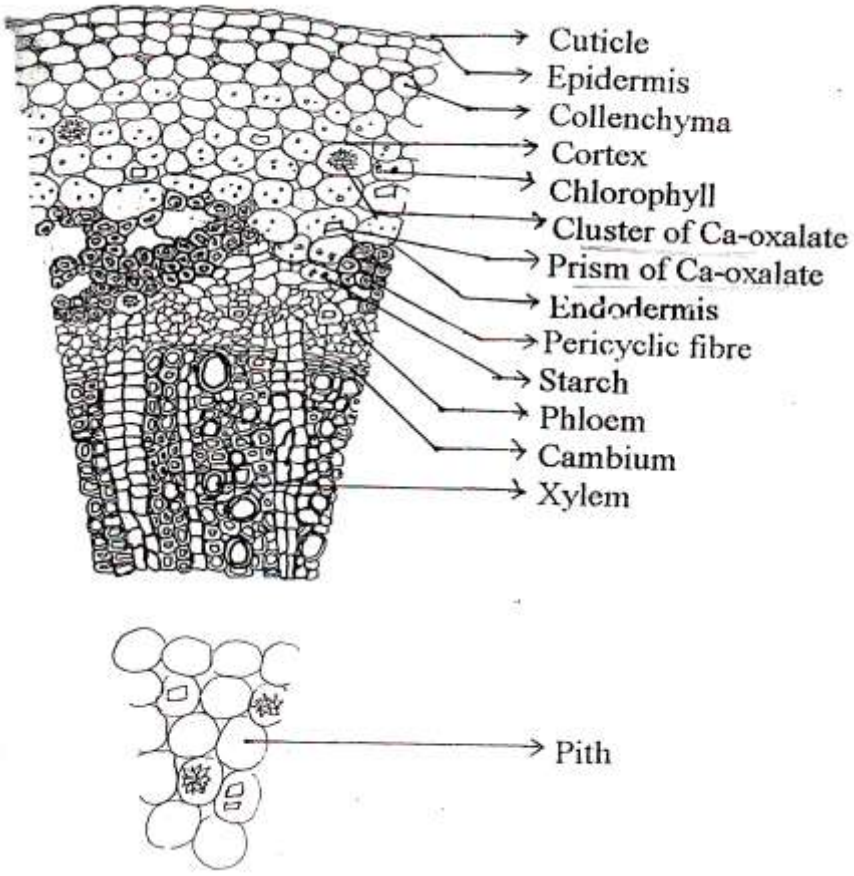



Fig: 3.5 Detail T.S. of stem of *P. amarus.*

**3.3.4. Transverse section of the root (Patel, 2000)**

Transverse section of the root is circular in outline with central lignified wood occupying more than 2/3 area of the root. Cortex and phloem are narrow.

In the young root, outermost region is occupied by a layer of epidermis but in older roots 2-3 layers of cork cells containing tannins are seen. Cortex is parenchymatous contains simple starch grains and tannin. Inner cortex is characterized by the presence of lignified sclerides isolated or in groups of 2-5. In L.S. their walls appear irregularly projected. The phloem is parenchymatous. Xylem is composed of radially arranged xylem vessels with bordered pitted thickening. Xylem fibres are thick-walled; parenchyma and medullary rays which are usually biserriate contain starch grains.

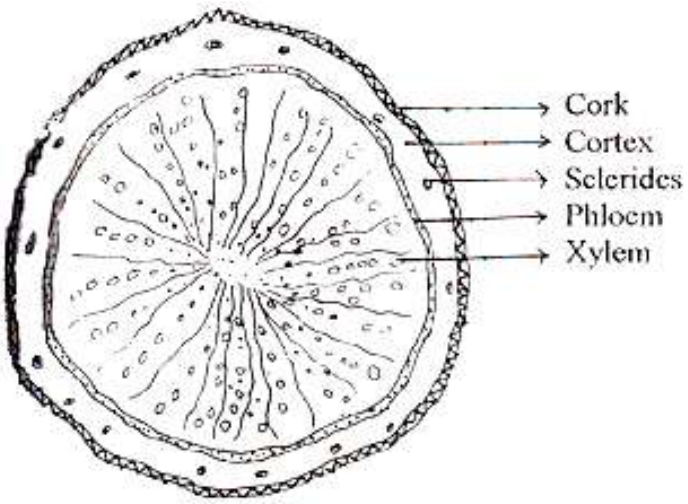



Fig: 3.6 Diagrammatic T.S. of root of *P. amarus.*

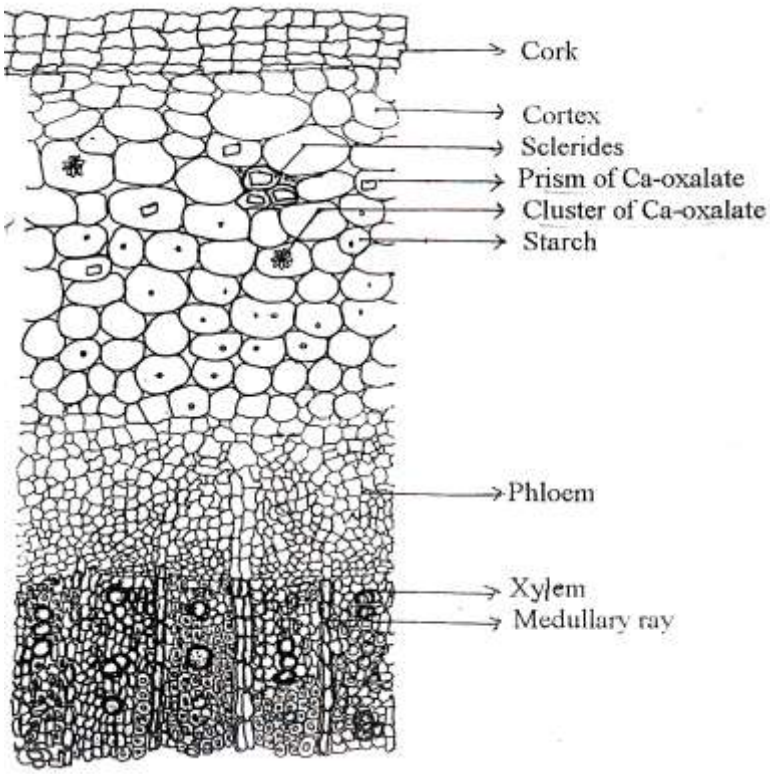



Fig: 3.7 Detail T.S. of root of *P. amarus.*

### 3.3.5. Powder study of the *P. amarus* herb: (Patel, 2000)

It shows the surface characters of leaf, stem, root and seed. The diagnostic important characters of the powder are:

**Leaf :** As described in 3.3.1 and shown in fig 3.2, it shows the surface characters of lamina like annular thickened xylem vessels, clusters and prisms of Ca-oxalate crystals; anisocytic, paracytic and anomocytic stomata.

**Stem** (fig 3.8a to 3.8d): It shows prisms and clusters of Ca-oxalate and tannin containing cells of cortex (3.8a) and phloem (3.8b); groups of pericyclic fibres (3.8c) and annular thickened xylem vessels (3.8d).

**Root** (fig3.8e to 3.8g): It shows polygonal brownish cells of cork (3.8e), sclerides of cortex (3.8f), and bordered pitted xylem vessels along with thick-walled xylem fibres (3.8g).

**Seed** (fig 3.8h): It shows thick-walled rectangular lignified cells of testa.

Commercially the powder of *P. amarus* is available and hence it's microscopically evaluation becomes the important criteria for its correct identification but the microscopically character reported earlier appears to be very scanty e.g. no body has mentioned the testa of the seed which is frequently found in the powder. The mesophyll cells of leaf containing Ca-oxalate crystals have also not been reported. The other characters which are missing are the cortex and phloem cells of the stem filled with tannin.

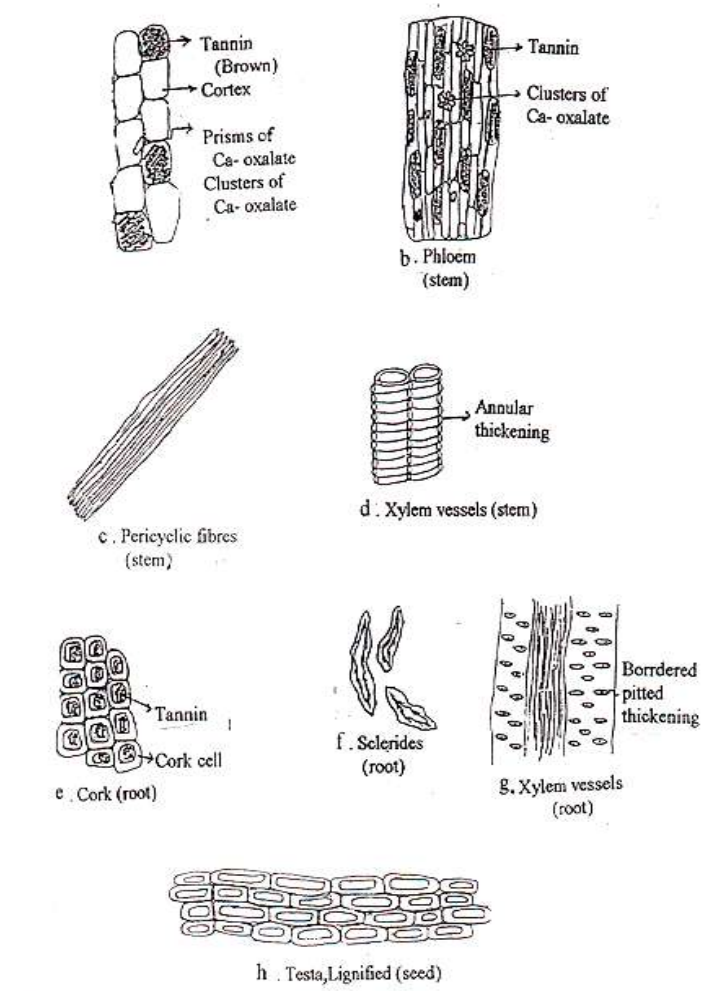



Fig: 3.8 Powder of *P. amarus* herb.

**3.4. Ethnomedical uses.**

Different parts of the plant are used by the traditional people in different countries for various ailments. In India, it is mainly used in jaundice, pyrexia, veneral diseases, eye disease, skin disease, diabetes etc. The plant has more or less similar uses in the other parts of the world which are mentioned below; name of place and parts of plants are mentioned in the bracket.

**3.4.1. Antiasthamatic**: Decoction (Hb-India) is used orally. (Sircar, 1984)

**3.4.2. Anti diabetic:** Decoction (Sd and Ft- Brazil; Hirschmann *et al*., 1990) or Hb- India (Jain *et al*., 1967), East Indies (Dragandorff, 1898), and West Indies (Aspray *et al*., 1955) or Lf-India (Hukeri *et al*., 1988) are taken orally.

**3.4.3. Antidiarrhoeal and antidysenteric**: Powder of young shoot (Orrisa India; Reddy *et al*., 1989) or decoction of the fresh shoot are used to orally in the treatment of dysentery (India; Hukeri *et al*., 1988): Decoction (Ar- India; Gupta *et al*., 1993) or Lf- Papau New Guinea; Holdsworth *et al*., 1992) are used orally in the treatment of diarrhea. Infusion of dried leaves is administration orally for treatment of diarrhea and dysentery (Fiji; Singh, 1986).

**3.4.5. Antiinflammatory**: Decoction (Hb- Thailand) is administered orally as an anti inflammatory. (Wasuwat, 1967)

**3.4.6. Antimalarial:** Decoction (Hb- Thailand; Kitisin, 1952) and Hb-West Indies (Aspray *et al*., 1955) are used orally.

**3.4.7. Antipyretic:** Decoction (Hb- Thailand; Kitisin, 1952: Mokkhamit *et al*., 1971), Haiti (Weninger *et al*., 1982), Bohmianisland (Halbertstein *et al*., 1978) and Fiji (Singh, 1986), Ar- Puerto Rico (Loustalot *et al*., 1949) and Lf- Dominican Republic (Ricardo, 1944) are used orally, the leaf decoction is taken orally and is also used for bathing as an antipyretic (Haiti, French Guiana; Weniger *et al*.,1986). Decoction (Lf- India) is administered orally in fever (Krishnamurthi *et al*., 1946).

**3.4.8. Antiseptic**: Fresh juice of leaf is applied externally on cuts and wounds (Fiji; Singh, 1986). Decoction of dried entire plant is used to bath newborns. It removes disease causing elements from the skin (Philippines; Velazco, 1980).

**3.4.9. Cholagogue**: Decoction (Lf- French Guiana; Luu, 1975) is administered orally.

**3.4.10. Cough treatment**: Decoction (Hb- Philippines; Velazco, 1980) is used orally for cough in infants.

**3.4.11. Diuretics**: Decoction (Ar- India; Ogata *et al*., 1992) and Hb- E. Africa (Stanilas *et al*., 1967), Thailand (Kitisin, 1952), Peru (Remirez *et al*., 1988) and West Indies (Halbertstein *et al*., 1978) are used orally.

**3.4.12. Emetic**: Decoction (Lf- Mexico; Schulters, 1969) is taken as a strong tea.

**3.4.13. Eye disease**: People (Kondh tribe, Orrisa; Girach *et al*., 1994) use drop of plant juice to treat conjunctivitis. Plant juice mixed with castor oil is applied to the eyes (Fiji; Singh, 1986).

**3.4.14. Gall stone:** Decoction (Hb- Peru; Kitisin, 1952) is administered orally.

**3.4.15. Genitourinary disorders**: Fresh plant juice is taken orally for genito-urinary troubles (India; Sahu, 1984).

**3.4.16. Jaundice:**

- People (Kani tribe, Keala; John, 1984) taken paste of the plant with cow's milk for 3 days to cure jaundice.
- Traditional healers (Chittoor district, A. P; Reddy, 1988: Reddy, 1989) prepare a paste of leaves with few pieces of *Allium sativum, Piper nigrum* fruits and buttermilk. The paste is given orally for seven days for the treatment for jaundice.
- Traditional people used decoction (Rt- Brazil; Sircar, 1984) or fresh Ar- India (Hukeri *et al*., 1988) orally for the treatment of jaundice. Dried entire plant is churned with buttermilk and is used orally (Fiji; Singh, 1986) for the purpose.

**3.4.17. Viral hepatitis**: Herbalists (Anantapur district, A.P; Reddy *et al*.,1989) make small pills (size of *Ziziphus mauritiana* seeds) from powder

of *P. amarus*, cardamom and pepper with the help of tamarind juice. One pill per day is given orally to treat viral hepatitis.

**3.4.18. Laxative**: Traditional people use orally decoction (Hb- Bahamian Island; Halberstein *et al*., 1978).

**3.4.19. Menstrual regulation**:

- People use decoction (Hb –Argentina; Moreno, 1975), Phillipines (Holdsworth *et al*., 1982) as an emmenogogue.
- Decoction (Hb- East Indies; Dragandorff, 1898) is administered orally for menstrual troubles.
- Decoction of the leaves is given orally after a miscarriage; it is also used as emmenogogue (Burkhill, 1966).

**3.4.20. Ring worm:** Fruits are used externally (India; Chauhan, 1977).

**3.4.21. Scabies**: Fruits are used externally (India; Chauhan, 1977).

**3.4.22. Sores**: The herbalists (Anantapur district, A.P; Reddy *et al*., 1989) Apply juice of the plant externally for offensive sores.

**3.4.23. Spasmolytic**: Hot water extract of the entire plant is administered orally (Haiti, French Guiana; Weniger *et al*., 1986).

**3.4.24. Stomachic**:

- Decoction of leaves (India; Chauhan, 1977) and herb (Virgin island; Oakes *et al*., 1958) are used orally.
- Decoction of roots of *P. niruri* and Citrus aurantifolia are mixed and taken orally to increases the appettite (West Indies; Aspray *et al*., 1955).

**3.4.25. Tonic**: Decoction (Hb- East Indies; Dragandorff, 1898) and Fiji (Singh, 1986) is taken orally.

**3.4.26. Urinary calculi**:

- Infusion of dried leaves and stem is taken orally to treat kidney and bladder calculi (Brazil 1990).
- Decoction (Hb- Peru; Kitisin, 1952) is administered orally for renal calculi.

**3.4.27. Veneral diseases**:

- People (New Ireland of Papua New Guiena) used orally the juice squeezed from the leaves or decoction of whole plant daily as per requirement to treat veneral diseases. They also chew the roots for the same purpose (Holdsworth *et al*., 1989). In Manns Island decoction of the bark and leaf is used to combat gonorrhoea (Holdsworth *et al*., 1989). People of Admiralty Island also use hot water extract of dried bark and leaves twice a day orally (500 ml) up to six months to treat acute condition of veneral diseases.
- Decoction (Hb- India) is administered orally for leucorrhoea (Jain, 1989) gonorrhoea and urogenital tract infections (Hukeri, *et al*., 1988).
- Decoction (Hb- Tanzania) is used orally for gonorrhoea.

**3. 5. Pharmacognostical Review**

- Saha and Krishnamurthy (1959) have studied the Pharmacognosy of P*. niruri* (Saha *et al*., 1959).
- Webster (1957) has reported revision of the taxonomy of the genus *Phyllanthus.* He has shown that *P. niruri* is an entirely American species, found in West Indies. The other three closely related species are reported from India viz. *P. amarus, P. debilis and P. fraternus.*

- Mitra and Jain (1985) have described the concept of *P. niruri*. Their studies have also revealed that *P. niruri* in 'Flora of British India' in a mixture of three distinct species viz. *P. amarus* Schum and Thonn*, P. fraternus* Webster and *P. debilis* Klein ex. Willd. They have given a key to identify these species and also given their detail description in Table no 3.1 (Mitra *et al*., 1985).

**Table 3.1**: Comparative macroscopic characters of three *Phyllanthus* species

| Sr. no | *Phyllanthus amarus* | *Phyllanthus fraternus* | *Phyllanthus maderaspatensis* |
|---|---|---|---|
| 1 | Plant 10–60 cm tall | Plant 7–50 cm tall | Plant 30–90 cm long |
| 2 | Stem terete, younger part rough | Stem terete, mostly naked below and tetragonous above | Stem glabrous |
| 3 | Branchlet 2–6 cm long with 10–20 leaves | Branchlet 2–11 cm long with 10–30 leaves | Branchlet absent |
| 4 | Leaf elliptic, oblong to ovate, obtuse or minutely apiculate at apex | Leaves elliptic, oblong, rounded at the apex | Leaves, rounded truncate or somewhat obcordate at the apex, mucronate, much tapering into a very short petiole |

| | | | |
|---|---|---|---|
| 5 | Flowers axillary, proximal two to three axils with unisexual one to three male flowers and all succeeding axils with bisexual cymules | Flowers in axillary, unisexual cymules proximal three to four male flowers, succeeding solitary female flowers | Flowers axillary, male flowers minute in small clusters, subsessile female flower solitary and larger with shortly stalked |
| 6 | Sepals five | Sepals six | Sepals six |

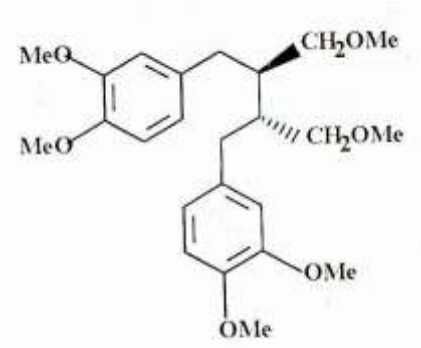
- Joshi (1996) has mentioned the characters to distinguish *P. fraternus* from *P. amarus;* they have 6 and 5 sepal's respectively.
- Bagchi *et al*. (1992) have reported morphological and microscopical characters of four species of *Phyllanthus viz. P. amarus, P. fraternus, P. urinaria* and *P. virgatus*. They have compared microscopical characters of leaf, branch, stem and root. A key also given to identify these four species.
- Blumeberg *et al*. (1991, 1993) have reported that these plants can be cultivated without loss in the activity.
- Choudhary *et al*. (1998) have reported that seeds shown in April, Plantlets transplanted in May and herb harvested in September gives maximum yield of leaves as compared to harvesting in October, November and December. Sowing the seeds in May or June, transplanting the plantlets in June and July and harvesting from Sep to Dec. also give low yield of leaves. However, yield of leaves in

September is maximum. Leaves are rich in the active constituent (Phyllanthin and Hypophyllanthin), so they should be more when the herb is harvested.

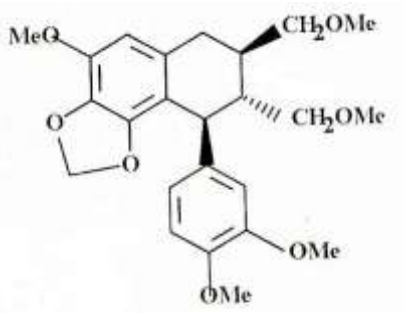
- Indian Herbal Pharmacopoeia, Vol. II (1999) has described morphology of the herb; microscopical character of powdered leaf, stem and fruit; extractive and ash value of the aerial parts.

**3.6. Chemical Constituents:**

Various types of chemical constituents have been isolated from *P. amarus,* either under the name of *P. niruri or P. amarus* in India and outside India. Lignans, phyllanthin and hypophyllanthin and triterpene, triacontnal are reported to be hepatoprotective constituent of the plant (Syamasundar *et al*., 1985). Besides Lignans, it is also reported to contain various flavenoids, alkaloids, tannis, sterols, triterpenoids, aliphatic diterpene and triterpene derivatives etc.




Phyllanthin




Hypophyllanthin

Phyllanthin (a bitter principle) and hypophyllanthin (a non bitter principle) where isolated by Krishnamurthy and Seshadri (1946), their structures were not assigned (Krishnamurthy *et al*., 1946). Row *et al*. (1964, 1966, and 1967) have established the structures of phyllanthin and hypophyllanthin. (Row, *et al*., 1964: Row, *et al*., 1966: Row, *et al*., 1967). Structure of hypophyllanthin was proposed and revised several times (Row, *et al*., 1964: Row *et al*., 1966: Subha Rao, *et al*., 1971: Bhadbhade *et al*., 1980: Sureshpure *et al*., 1981) and was established finally by Somanbandhu *et al*. (1993). Following constituents have been reported from the plant.

Lignans: Phyllanthin (Krishnamurthy *et al*., 1946: Row *et al*., 1964: Row *et al*., 1966: Row *et al*., 1967: Somanabandhu *et al*., 1993: Huang *et al*., 1992: Nara *et al*., 1977: Sharma *et al*., 1993), hypophyllanthin (Krishnamurthy *et al*., 1946: Row *et al*., 1964: Row *et al*., 1966: Row *et al*., 1967: Subha Rao *et al*., 1971: Bhadbhade *et al*., 1980: Sureshpure *et al*.,1981: Somanabandhu *et al*., 1993: Rao *et al*., 1970: Huang *et al*., 1992: Nara *et al*., 1977: Sharma *et al*., 1993), nirtetralin (Sureshpure *et al*., 1981: Stevenson *et al*., 1977: Singh *et al*., 1986), lintetralin (Stevenson *et al*., 1977: Huang *et al*., 1992: Singh *et al*., 1986), phylltetralin (Sureshpure *et al*.,1981: Stevenson *et al*., 1977: Singh *et al*., 1986), niranthin (Huang *et al*., 1992: Singh *et al*., 1986), seco-4-hydroxy

lintetralin, seco-isolariciresinol trimethyl ether; hydroxy niranthin, dibenzyl butyrolactone.(Satyanarayan *et al*., 1988), nirphyllin, phyllnirurin (Singh *et al*., 1989, isolintetralin (Huang *et al*., 1992), niruriside (Cutrone *et al*., 1996) etc.;

Flavonoids: Quercetin, quercetrin, isoquercetrin, astragalin (Nara *et al*., 1977), rutin (Nara *et al*., 1977: Foo *et al*., 1993: Agrawal *et al*., 1991), quercetin-3-O-glucopyranoside ( Foo *et al*., 1993), kaempferol-4-rhamnopyranoside, eriodictyol-7-rhamnopyranoside (Chauhan J. S. *et al*.,1977), nirurin (Gupta D. R. *et al*., 1984) (a prenylated flavonoid), fisetin-4-glucoside.(Gupta *et al*., 1984) and 3, 5, 7, 4,-tetrahydroxy flavone (Agrawal *et al*.,1991).

Alkaloids: Ent-nor securinine (Rouffiac *et al*., 1969: Joshi *et al*., 1986), 4-methoxy securinine(phyllanthin), 4-methoxy nor securinine, 4-methoxy dihydrosecurinine, 4-methoxy tetrahydrosecurinine, 4-methoxy securinine,securinol A, securinine B, securinine, dihydrosecurinine, tetrahydro securinine, allosecurinine, nor securinne (Hassarajani *et al*., 1990), isobubbialine and epibubbialine (Houghton *et al*., 1996)

Tannins: Geraniin (Foo, 1993: Veno *et al*., 1988), gallic acid( Veno *et al*., 1988), ellagic acid (Veno *et al*., 1988, phyllanthusiin-D.(Foo *et al*., 1992), amariin, corilagin, 1, 6-digalloyl glucopyranoside (Foo , 1993) and amiriinic acid.(Foo *et al*., 1995) Triterpenes: Lupeol, lupeol-3-acetate (Chauhan *et al*., 1979), 7-lupeol, α-amyrin (Agrawal *et al*., 1991).

Euphane Triterpenoids: Phyllanthenol, phyllanthenone and phyllantheol (Singh *et al*., 1989)

Sterols: B-sitosterol and isopropyl cholesterol (Singh *et al*., 1986).

Steroidal hormone: Estradiol (Mannan *et al*., 1978)

Acyclic diterpene: Trans-phytol (Singh *et al*., 1991)

Acyclic triterpenes: Triacontanal, triacontanol (Syamsunder *et al*., 1985), 32-methyl-1-triacontanol. (Agrawal *et al*., 1991), dotriacontanoic acid (Singh *et al*., 1986), Phthalic acid bis-ester: Phyllester (Singh *et al*., 1986).

Miscellaneous: Vitamin C (Sinha *et al*., 1984), ricinoleic acid, linoleic acid and linolenic acid (Ahmed *et al*.1981).

**3.7. Pharmacological review:**

*Phyllanthus amarus* is reported to have varieties of activities from various types of extracts prepared from its different parts using different solvents. It is reported to have hepatoprotective, antihepatitis B, anticancer, antihypertensive, antinociceptive, antifungal, contraceptive, diuretic, hypoglycaemic, hypotensive etc. activities. The literature survey of all these activities are separately mentioned below:

**3.7.1. Anticancer activities**:

- Dhar *et al*. (1968) have reported that ethanol: water (1:1) extract was active when administered (i.p) to mice on LEUK (Friend Virus solid). However the extract was inactive on CA-9KB at ED50 > 20.0 mcg/ml.
- Macrae *et al*. (1988) have reported the activity of the ethyl acetate and aqueous fraction of methanolic extract of aerial part (Amazon). The EC50 value is 0.05 and 1.31 µg/ml against Agrobacterium induced tumour.
- Srinivasulu (1992) has reported that phyllanthin and hypophyllanthin, lignans constituents of P.niruri when tested on various cancer cell lines, did not show significant cytotoxic effect on any cell line. Phyllanthin showed modest inhibition on small cell lung line and hypophyllanthin on CNS cancer line640. However dibenzyl-butyrolactone which is also

present in *P.niruri* is reported to exhibit antitumor activites. (McDoniel *et al*., 1972).

- Somanabandhu *et al*. (1993) have reported that neither phyllanthin nor hypophyllanthin demonstrated significant cytotoxic activity when cultured with battery of cultured mammalian cells, but both were found to enhance the cytotoxic response mediated by vinblastine with membrane vesicles derived from these cell line, suggesting the interaction with the P- glycoprotein..

**3.7.2. Anticlastogenic activity**:

- Dhir *et al*. (1990) have found that oral administration of aqueous extract of *P. niruri* leaves to mice for a week; significantly reduce the cytotoxic action of lead nitrate and aluminium sulphate. The frequency of chromosomal breakage, gaps and rearrangement induced by three concentrations of these salts was decreased when compared to control animals which had received the salts alone. The extract was given at the dose of 685 mg of leaf per kg body weight. It was effective in modifying the clastogenic effects of both the salts. Same group of workers have also reported similar results for the protection afforded by the aqueous extract of *P. niruri* at the same dose level against toxicity produced by three different dose of nickel chloride on mice. (Agrawal *et al*., 1992).

**3.7.3. Antihepatotoxic activity**.

- Syamsunder *et al*. (1985) have shown the significant antihepatotoxic activity of the hexane extract of the plant in rat hepatocytes intoxicated with $CCl_4$. The individual isolates of the extract, phyllanthin,

hypophyllanthin, triacontanal, and triacontanol were also tested separately in rat hepatocytes intoxicated with $CCl_4$ and galactosamine. The former two compounds showed significant antihepatotoxic activity in these two models while triacontanal showed activity against later intoxicant only and triacontanol did not show significant activity in any..

- Naduveettil (1985) has also reported the activity of phyllanthin and hypophyllanthin, isolated from *P. niruri* and its extract (alcohol: water) through oral route on mice intoxicated with $CCl_4$. Phyllanthin (100 mg/ml) normalized the sleeping time of hexobarbitone, hypophyllanthin (20 mg/ml) was inactive and the extract (600 mg/kg) did not show significant activity.
- Rao (1985) has shown that pretreatment with water extract of *P. niruri* orally 2ml/kg one month protected the liver of albino rats against $CCl_4$ toxicity.
- Urmani *et al*. (1985) administered the powder of *P. niruri* orally for 45 days (200 mg/kg) to ethanol induced fatty liver rats and studied its effect on the increased deposition of triglycerides, cholesterol and phospholipids of liver, heart and kidney. All of them were brought down to the normal value.
- Murthy *et al*. (1993) have studied the effect of alcoholic extract of *P. niruri* on rats intoxicated with $CCl_4$. It reduces the SGPT, SGOT, serum billirubin etc indicating its significant antihepatotoxic activity.
- Prakash *et al*. (1995) have reported the effect of alcohol extracts of three spices of Phyllanthus against $CCl_4$ induced hepatic damage on rats. The extracts of *P. niruri, P. urinaria* and *P. simplex* were

administered orally at three different dose level 100 and 400 mg/kg to the rats. Statistically significant reversal of the elevated serum levels were observed in the animals in *P. niruri* and *P. urinaria* extracts. Hepatoprotective activity of *P. urinaria* was about 60% in comparison with *P. niruri*, it may be consider as a substitute of *P. niruri* but *P. simplex* lacked in significant activity.

- Sane *et al*. (1995) have compared the hepatoprotective activity of *P. amarus* and *P. debilis* on the rats intoxicated with $CCl_4$. Slurry prepared from each of the whole plant powder was fed 0.66 mg/kg for 3 days, $CCl_4$ was given on the first day. Study of serum enzyme levels and hepatocellular damage revealed that both the plants are effective in protecting the liver damage. *P. debilis* has more activity than *P. amarus*. (Macrae *et al*.,1988)
- Subramanian (1995) has criticized the hepatoprotective studies of Sane *et al*. and pointed out some of the mistake in his calculations. He has suggested the following formula for finding out the hepatoprotective of the drug.

$$\% \text{ of protection} = 100 - \left[ \frac{100}{\text{Difference in the values between CCl4 control and normal control}} * \text{Differnce in the values between CCl4 control and (CCl4 + drug group)} \right]$$

### 3.7.4. **Antihepatotoxic polyherbal formulations**:

- The pharmacological activity of antihepatotoxic polyherbal formulations have not been found to be much investigated. Reports of some of the formulations mentioned below are available.

- Sharma *et al*. (1991) have reported hepatoprotective activity of M-Liv against CCL4 induced toxicity in rats. (Subramanian *et al*., 1999).
- Bhaumik and Sharma (1993) have studied the antihepatotoxic activities of a formulation consisting of mixture of equal proportion of *P. niruri*, *Andrographis paniculata* and *Solanum nigrum*. Sheep were intoxicated with paracetamol and subsequently administered 1.0 g/kg drug by gastric intubation daily for 10 days. The drug protected the animals from jaundice and increased AST, ALT etc.
- Kapur *et al*. (1994) have reported hepatoprotective activity of Jigrine, a polyherbal formulation containing 14 medical plants, some amongst them being *Phyllanthus niruri, Solanum nigrum, Cichorium intybus* and *Foeniculum vulgare.* The effects of oral pretreatment with Jigrine (0.5 ml and 1.0 ml/kg for 7 days) were studied on hepatic damaged induced by alcohol-carbon tetrachloride (40% alcohol 2.0 ml/100 g, p.o for 21 days and $CCl_4$ 1:1 in groundnut oil,(o.1 ml/kg, S.C. on $20^{th}$ day ) and paracetamol (750 mg/kg i.p.) In rats. The study of biochemical parameters and histopathology confirmed its hepatoprotective activity.

**3.7.5. Antihepatitis B. Surface Antigen activity**:

- Mehrotra *et al*. (1990); (Thyagarajan *et al*., 1982) have reported *in vitro* inactivation of HBsAg by *P. niruri* extract. Four extracts were prepared separately from aerial parts and roots of the plants, by macerating at room temperature as well as by Soxhlet extraction 0.2 ml solution of all the four extracts (2% solution of dried extracts) incubated with 0.2 ml of HBsAg positive sera (1:64 CEP titre), brought about *in vitro* inactivation

of HBsAg within 24 hours at 37$^{o}$C and also at room temperature. All these extracts contain a red pigment, which is active.

- Venkateswaran *et al*. (1987) have reported *in vitro* and *in vivo* studies of an aqueous extract of *P. niruri* on hepatitis B and Woodchuck hepatitis B virus. The extract inhibits endogenous DNA polymerase of Hepatitis B virus and binds to the surface antigen of hepatitis B virus *in vitro*. The extract also inhibits Woodchuck hepatitis virus (WHV) DNA polymerase and binds to the surface antigen of WHV *in vitro*. In trials using six long term WHV-carrier Woodchuck, five treated animals showed a faster decrease in Woodchuck hepatitis virus surface antigen titre compared to untreated control. In animals recently infected with WHV, the extract was effective when administered i.p. in three out of four animals eliminating both the surface antigen titre and DNA polymerase activity in serum. The treatment was discontinued after 10 weeks, and the treated animals have remained free detectable markers of WHV for more than 45 weeks. In contrast, three untreated controls remained positive for both markers for WHV for more than 45 weeks. One of the controls died after 8 weeks. In a third trial with long term carries, test animals treated subcutaneously with the extract for 12 weeks did not respond; but on switching the mode of administration to i.p., two out of the five animals showed a significant decrease in Woodchuck hepatitis virus surface antigen titre compared to controls.
- Venkateswaran *et al*. (1987) have also reported that both water and methanol extracts of the dried entire plant were active against woodchuck hepatitis virus at variable concentrations. They inhibited

DNA polymerase of woodchuck hepatitis virus; water extract afforded 25% inhibition at 50 mg/ml concentration.

- Jayram *et al*. (1989) have reported *in vitro* inactivation of the hepatitis B surface antigen by the crude extract of *P. niruri* in 48-72 hours. A red pigment was found to be active.
- Mehrotra *et al*. (1990) have reported that alcoholic extract of *P. niruri* has *in vitro* anti HBsAg activity (68%) at a concentration ranging from 1.6 to 2.6 mg/ml against 0.039 µg/ml HBsAg at 37$^{o}$C after 24 hours incubation. HBsAg were collected from different type of patients, like patients with acute HBV infection, chronic carrier of HBV or having liver cirrhosis along with HBV.
- Mehrotra *et al*. (1990) have also further studied *in vitro* effects of *P. amarus* on hepatitis B virus. Ethanolic extract of whole plant and subsequent fractions prepared from it, viz. hexane, chloroform, butanol and finally water were tested for *in vitro* effects on HBsAg, HBeAg and HBV- DNA in serum samples positive for HBV antigen. The extracts were effective against HBV antigens, the n-butanol extract being the most potent; its further fractionation showed enhance activity. The active fractions inhibited the interaction between HBsAg, HBsAg, and their corresponding antibodies suggesting anti-HBs, anti-HBe like activity and also an effect on HBV-DNA.
- Unander *et al*. (1991) have studied *in vitro* activity of different species of Phyllanthus against DNA polymerase of hepatitis viruses, effects of growing environment and inter and intra specific differences.

1) Aqueous extracts of several herbaceous species of Phyllanthus inhibited the endogenous DNA of hepadnavirues *in vitro*. This inhibitory activity varied among the pieces viz. *P. urinaria, P. debilis, P. fraternus, P. mimics, P. odontadenius, P. caroliniensis, P. niruri* etc.
2) Within *P. urinaria*, there were highly significant differences among plants grown from seeds of diverse origin. Within *P. amarus*, plant from seeds of diverse origin did not differ significantly.
3) One seed lot which was tested for intra-accession variability showed highly significant plant to plant differences in viral DNA polymerase inhibition, but these differences were not highly heritable.
4) Differences in general fertility, soil moisture, PH or calcium generally did not significantly affected the *in vitro* inhibition of DNAp.
5) Plant grown at low temperature (winter) showed decreased DNAp activity as compared to high temperature (summer) grown plants.
6) Plants of *P. amarus* were successfully grown as a raw crop with fertilizers and irrigation without loss of activity relative to samples from the wild.
7) Roots of *P. amarus* were more active than the herb.

- Pousset *et al*. (1993) have reported *in vitro* inactivation of HBsAg by water and methanol extract of the dried leaves; IC50 for water extract was 3.3 mcg/ml and for later extract 1.2 mcg/ml.

**3.7.6. Anti HIV activity:**

- Ogeta *et al*. (1992) have shown that water extract of dried entire plant is active on HIV I virus; ID50 is 50.0 mcg/l.

- Hussain *et al*. (1995) studied that phyllanthin, hypophyllanthin and nirtetralin inhibit labeled ET1 binding receptor expressed in Chinese hamster ovary cells(CHO-ETA) but were inactive against the recombinant ETB receptors.
- Cutrone *et al*. (1996) have isolated niruriside from the methanol extract of the plant. It inhibited HIV REV/RRE binding, the $IC_{50}$ value was 3.3μm.

**3.7.7. Antihypercholesterolemic activity (antihyperlipemic activity):**

- Urmani *et al*. have reported that dried entire plant was active in the rats in which fatty liver was induced with alcohol. The drug powder was given orally, 200 mg/kg for 45 days. It reduces the increases deposition of triglycerides, cholesterol and phospholipids in the liver, heart and kidney that resulted from alcohol treatment.

**3.7.8. Molliscidal activity**:

- Ahmed *et al*. (1984) have reported molluscidal activity of certain Sudanese plants. Successive petroleum ether extract and successive alcohol extract of *P. niruri* have molluscidal activity at concentration of 25 ppm and 250 ppm respectively. These extracts produced 100% mortality in *Bulinus trunctatus* and *Biomphakria pfeifferi*.

**3.7.9**. **Nematocidal activity**:

- Kiuchi *et al*. (1989) have shown that decoction of commercial sample of bark, at a concentration of 1.0 mg/ml was active on *Toxacare canis*.

**3.7.10. Antinociceptive activity**:

- Antinociceptive activity of *P. niruri* has been compared with number of other species of Phyllanthus found in China and America. These activities are mentioned below:
- Analgesic effects of hydro alcoholic extract (HEs, 50% alcohol water) of *P. urinaria, P. tenellus, P. niruri and P. sellowiarius* have been investigated. The extract of four species of Phyllanthus (1-90 mg/kg, i.p.) caused a dose related inhibition of acetic acid induced abdominal constriction in mice with $ID_{50}$ values of 5.4, 8.4, 18.2 and 53 mg/kg and maximum inhibition (%) of 80, 67, 63 and 50 for *P. urinaria, P. niruri, P. tenellus* and *P. sellowiarius*.
- In the formalin tests, the HEs of all Phyllanthus species (0.3-60 mg/kg, i.p.) caused graded inhibition of both the phases of formalin induced pain, but they were, however, more potent in relation to the second phase of the pain. The $ID_{50}$ values (mg/kg) for the first phase were 20, 23, > 60 and > 60 for *P. urinaria, P. tenellus P. niruri and P. sellowiarius* respectively. The $ID_{50}$ value respectively and percentage of maximum inhibition were 63, 70, 41 and 33 with maximum inhibition percentage of 91, 97, 97 and 92 respectively. Given orally, the extract caused significant antinociceptive profile, but they were about one tenth to one twentieth as potent when given intraparitonially. However the HEs of Phyllanthus failed to affect formalin induced rat paw edema and did not completely reversed the analgesic effect of HEs of Phyllanthus. Further more; the HEs of Phyllanthus in contrast to

morphine had no analgesic effect in either tail-flick or hot plate tests (Santos *et al*., 1994).

**3.7.11**. **The antinociceptive activities are in following order**:

*P. urinaria* > *P. corcovadensis* > *P. tenellus* > *P. niruri* > *P. sellowiarius* (Santos *et al*., 1994).

- The methanolic extract of callus culture (grown on media containing 2, 4 –D: IAA and IBA) of P*. tenellus, P. corcovadensis* and *P. niruri* have antinociceptive activity (3-90 mg/kg, i.p.). The extract caused graded inhibition of abdominal constrictions induced by acetic acid (0.6). $ID_{50}$ values are 30, 19 and > 30 mg/kg for *P. corcovadensis, P. niruri* and *P. tenellus* respectively (Santos *et al*., 1994).

**3.7.12**. **Anti pyretic activity**.

- Mokkhamit *et al*. (1972) have reported that ethanol: water (1:1) extract of commercial sample of entire plant, when administered at variable dosage levels by gastric intubation of rabbits was inactive against yeast induced pyrexia

**3.7.13. Antispasmodic activity.**

- Patel *et al*. (1965) has reported that phyllanthin, alcohol extract and aqueous extract has antispasmodic activity on rat's duodenum against Ba-induced contraction. Activity of phyllanthin was more than alcohol and water extract
- Dhar *et al*. (1968) have reported that ethanol: water (1:1) extract of entire plant was active on guinea pig ileum against acetyl chloride and histamine induced spasms.

- Santos *et al*. (1994) have reported that methanol extract of dried callus tissue at a concentration of 320.0 mcg/ml was inactive on guinea pig ileum against acetyl chloride induced contractions.

**3.7.14. Contraceptive effects:**

- Feeding an alcoholic extract of *P. amarus* to male mice at a dose of 500 mg/kg for 45days, induced gradual inhibition of fertility potential. There was 72% reduction in the fertility, it reduced sperm count, sperm motility, sperm viability, weight of testis etc. it has no adverse effect on blood biochemical profile and cell count. Upon withdrawal of feeding the extract, the anti fertility effects were reversed gradually (Rao *et al*., 1997).

**3.7.15. Diuretic activity**:

- Woers (1941) have reported diuretic activity of the plant
- Patel *et al*. (1965) have also reported that aqueous extract of *P. niruri* is having significant diuretic activity on rats at the dose of 0.05 ml/kg (1 ml extract = 1 g drug) through oral route. Alcohol extract has less activity and phyllanthin has feeble activity.

**3.7.16. Hypoglycaemic activity**

- Jain and Sharma *et al*. (1967) have reported that alcohol extract of entire plant is inactive in reducing blood sugar level at 10 mg/kg dose level through oral route in normal rabbits.
- RamKrishnan *et al*.(1982) have reported that an aqueous extract of the leaves of *P. niruri* at a dose of 5 ml (representing 5 g leaf) per kg body weight, through oral route, lowered blood sugar level in normal and alloxan diabetic rabbits and the effects is more than that of tolbutamide

(250 mg/ kg p.o.). The extract also lowers blood sugar level even after the administration of glucose.

- Hukeri *et al*. (1988) have reported that water extract of dried entire plant when administered by gastric intubation to rats, was active against alloxan induced hyperglycemia.
- Moshi *et al*.(1997) have reported that aqueous extract of aerial parts of *P. amarus* (in Tanzania), 0.1 and 1 g/kg body weight, significantly enhanced clearance of glucose from the blood as compared to control during an oral glucose tolerance test, using normal fasted albino rabbits. Both dose had no effect on blood glucose in the unfed rabbits. Chlorpropamide, 0.1 g/kg body weight, has shown a greater effect than both dose, on glucose clearance in the fed state and on blood glucose on fasted rabbits. A methanol extract of the aerial parts, 1 g/kg body weight, worsened glucose tolerance causing a significant increase in glucose in blood, use of an aqueous extract tolerance causing a significant increase in glucose in the blood, use of an aqueous extracts as suggested by traditional healers appears to be the correct remedy.

**3.7.17**. **Hypoglycaemic activity – clinical trials**:

- Sivprakash *et al*. (1995) have carried out clinical studies of *P. amarus* on 25 diabetic patients in the age of group of 35-55 years with moderate to severe diabetic blood sugar level (250 – 400 mg/ 100ml). The drug brought down statistically significant lowering of blood sugar level at a dose of 1 g thrice a day for the period of 3 months.

**3.7.18 Hypotensive, chronotropic and cardiotoxic activity:**

- Patel (1965) has reported that aqueous extract, alcohol extract and phyllanthin have hypotensive activity on dog. Phyllanthin is having maximum activity followed by alcohol and water extract.
- Mokhamit *et al*. (1971) have reported that ethanol: water (1:1) extract of commercial sample of the entire plant was devoid of hypotensive, chronotropic or cardiotoxic activity at variable concentration through i.v. route.

**3.7.19. Diuretic, Hypoglycaemic and Hypotensive activity- Clinical trials**:

- Srividya and Periwal (1995) have carried out a clinical trial on nine mild hypertensive patients (four of them also suffering from diabetes mellitus). They were treated with 5 gm pellets (prepared from whole plant powder and honey) per day (orally) in three divided doses for 10 days. After the treatment there was a significant increase in 24 hour urine volume, urine and serum sodium levels. There was also a significant reduction in systolic blood pressure in non- diabetic hypertensive and female subjects. There was also reduction in blood glucose levels (5 to 50 mg/10 ml) in both diabetic and non-diabetic subjects.

**3.7.20**. **Antibacterial activity**:

- Collier and Van (1949) have reported that saline extract of leaves was active on *Pasteurella pestis* and *Staphylococcus aureus* and inactive on *Escherichia coli* at a 10 % concentration using agar plate method.

- Khan *et al*. (1978) have reported that water extract of fresh entire plant of *P. niruri* was inactive on *Neisseria gonorrhoea* at 1.0% concentration on agar plate.
- Khan *et al*. (1980) have reported antibacterial activity of alcoholic extract of *P. niruri* against *Staphylococcus aureus* and *E. coli* using filter paper disc assay method with 1 % solution of the extract for the assay.
- Farouk *et al*. (1983) have reported that chloroform extract at a concentration of 1.0 gm/ml on agar plate was inactive on *Bacillus subtilis, E. coli, Pseudomonas aeruginosa* and *Staphylococcus aureus*. Methanol extract was active on *Staphylococcus aureus* but inactive on *B. subtilis, E. coli* and *P. aeruginosa*.
- Macrae *et al*. (1988) have reported the activity of ethyl acetate and water fractions of methanol extract of aerial part (Amazon). The ethyl acetate fraction is inactive against *E. coli* and *S. aureus* while aqueous fraction is active against *S. aureus* but inactive against *E. coli*.
- Macrae *et al*. (1988) have reported the activity of ethyl acetate and water fraction of the methanol extract of the aerial part (Amazon). Ethyl acetate fraction and aqueous fraction are active against *Microsporum canis, M. gypseum* and *Trichophyton gallinae*. Aqueous fraction is also against *M. fulvum*.

**3.7.21**. **Antifungal activity**:

- Bhatnagar *et al*. (1961) have shown that petroleum ether extract of whole plant has antifungal activity against *Helminthosporium sativa*.

**3.7.22. Antiviral activity:**

- Khan *et al*. (1991) have reported that ethanol extract of fresh entire plant when tested on *Tobacco Mosaic virus* in cell culture was equivocal. The viral inhibitory activity was 7%.
- Saigopal *et al*. (1986) have reported that the fresh leaf and fresh root extract (in 0.05 M Phosphate buffer, pH 7.5) of the plant have antiviral activity on *Peanut Mosaic Virus, Tobacco Mosaic Virus* and *Tobacco Ring Spot Virus* at 4% concentration.
- Macrae *et al*. (198) have reported the activity of ethyl acetate and aqueous fractions of the methanol extract of the aerial parts (Amazon) against *Sindbis virus* and *Murine cytomegalovirus*. Ethyl acetate fraction is active (1 to 100 µg/ml) against pre-infection by both the viruses treatment (100 % activity) but inactive against post-infection treatment (1 to 100 µg/ml concentration level); while ethyl acetate fraction is active against both the viruses by pretreatment at 10 to 100 µg/ml concentration (100 % activity). Aqueous fraction is having moderate activity when used for post-infection treatment against Sindbis virus and pre-infection treatment against Murine cytomegalovirus.

**3.7.23. Anti-yeast activity**:

- Macrae *et al*. (1988) have reported the activity of ethyl acetate and aqueous fractions of the methanolic extract of aerial parts (Amazon). Both the extracts are inactive against *Saccharomyces cerevisiae* and *Candida albicans*.

**3.7.24. Brine Shrimp mortality**:

- Macrae *et al*. (1988) have reported the activity of ethyl acetate and aqueous fractions of methanolic extract of the aerial part (Amazon). Ethyl acetate fraction has $LD_{50}$ value 114 µg/ml, aqueous fraction has no activity.

**3.7.25. Biochemical effects**

- John and Krishnamurthy (1993) have studied some biochemical effects of *P. niruri* after oral administration to rats. *In vitro* tissue respiration and hepatic K+, Mg ++ and inorganic phosphorous content were not significantly altered by the drug for a period of two weeks, however the concentration of Na+ in the liver was elevated by 4 dosed of the drug. Aspartate and alanine transaminases and alkaline phosphatase of serum and liver as well as liver microsomal glucose-6-beta phosphatase, ali-esterase and glucopyronyl transferase were unaffected by feeding the aqueous extract of the drug. Erythrocytes from rats receiving the drug were more resistant to chronic haemolysis. The drug however, showed antidiuretic and antioxidant activity.

**3.8 Clinical trials- *P. amarus.***

**3.8.1. Hepatoprotection - Clinical trials**:

- Dixit and Achar (1983) have studied the result of clinical trials by administrating the powder of *P. niruri* to 160 children (1 to 12 years old) suffering from jaundice. Majority of them (90%) were admitted after 5 days of jaundice attack while the remaining were still more severe cases (6 to 10 to 15 or more days attack). They were given 50 mg *P. niruri* powder per kg body weight in three divided doses for the period

of 6 weeks. They were examined twice a week for 6 weeks clinically and by laboratory reports and followed up for 3 months after the recovery. There was restoration of appetite within one week (77% cases) to two weeks (20% cases); disappearance of jaundice, liver tenderness and bile pigment salts from urine within 1 to 3 weeks in about 95% cases. There was complete recovery within six weeks in 101 patients out of 160 patients who continued the treatment. There was a drop out of 59 patients within 1 or 2 weeks. The follow up study for 3 months indicated there was no reappearance of jaundice. These studies indicated the remedial cure of jaundice by *P. niruri*.

### 3.8.2. Antihepatitis B virus activity – Clinical trials

- Thyagarajan *et al*. (1988) have reported the effect of *P. amarus* on chronic carriers of hepatitis B virus. 200mg of dried and sterilized powder prepared from whole plant was given in a capsule form; 3 capsules/day for 30 days to the chronic carriers of hepatitis B virus. 22 of 37 (59%) treated patients lost hepatitis B surface antigen (HBsAg) when tested 15-20 days after the end of the treatment; compared with placebo treated control, 1 of 23 (4%) lost HBsAg. Some subject followed for 9 months, in no case the surface antigen has returned. Clinical observation revealed no toxic effects.
- Thumlikitul *et al*. (1991) have studied they efficacy of *P. amarus* for eradication of hepatitis B virus in chronic carriers in Thailand. The aerial parts of *P. amarus* grown in central part of Thailand, at a dose of 200 mg TDS for 60 days or 400 mg TDS for 30 days through oral route has a minimal effect on eradication of HBsAg from Thai adult

asymptomatic chronic carriers. These results are contradictory to that reported by Thyagarajan *et al*. (1988) from India probably because of the different environment condition or the age of the plant or the subjects in India were younger than those in the present study.

- Doshi *et al*. (1994) have studied the role of *P. amarus* in eradication of hepatitis B virus in carriers. They have showed that *P. amarus* is not effective in clearing HBsAg in asymptomatic carriers at the doses of 250 mg and 500 mg TDS for 4 to 8 weeks in 30 subjects.

**3.9. Toxicity assessment:**

- Dhar *et al*. (1968) have reported that ethanol: water (1:1) extract of the entire plant administered orally to mice, tolerated a maximum dose of 1 gm/kg.
- Naduveettil (1985) has reported LD 50 for phyllanthin 800 mg/kg and hypophyllanthin 20 mg/kg in mice.
- Venkateswaran *et al*. (1987) have reported that water extract of dried entire plant at a dose of 0.1 mcg/animal was inactive. No weight loss was found seven days after the treatment.
- Jayram *et al*. (1987) have reported the safety study of *P. niruri in vitro* and *in vivo* while using it for anti HBV properties, using mice as the model and Vero cell line as the tissue culture system. Acute and chronic toxicity was carried out. There was no mortality, weight loss, behavioral change, and change in histopathological pictures of liver, spleen and kidney or biochemical profile after 90 days treatment. Vero cell- line also indicated no cytotoxicity.

- After summarizing the review of the literature it was noticed that eventhough much of the Pharmacognostical, Pharmacological and chemical evaluation of *P. amarus* is reported the polyherbal formulations were not clinically evaluated so far for their quality. So the activity of *P. amarus* and two of the marketed formulations Livercare Churna and Hepatogard forte Tablet is planned to evaluate in the patients having liver toxicity.

# Methodology

# METHODOLOGY

## 4.1. Material and Method:

### 4.1.1 Plant material

The plant of *Phyllanthus amarus* was collected in the month of August 2006 from the fields of a village Dugarwada in Modasa Taluka in Sabarkatha (S.K.) District (Gujarat) where it is growing wild. The herb was authenticated by Dr. H.B. Singh, Scientist F & Head, Raw Materials Herbarium & Museum, Council of Scientific and Industrial Research (CSIR), NISCAIR, New Delhi. (Date: 04-08-08, Ref. 1031/62). After authentication, the herbs were subjected to study of physicochemical parameters. Livercare Churna manufactured by Rajsha pharmaceuticals, Ahmadabad and Hepatogard Forte Tablet manufactured by Surajmani Enterprises, Daman were purchased from local market.

### 4.1.2 Study protocol

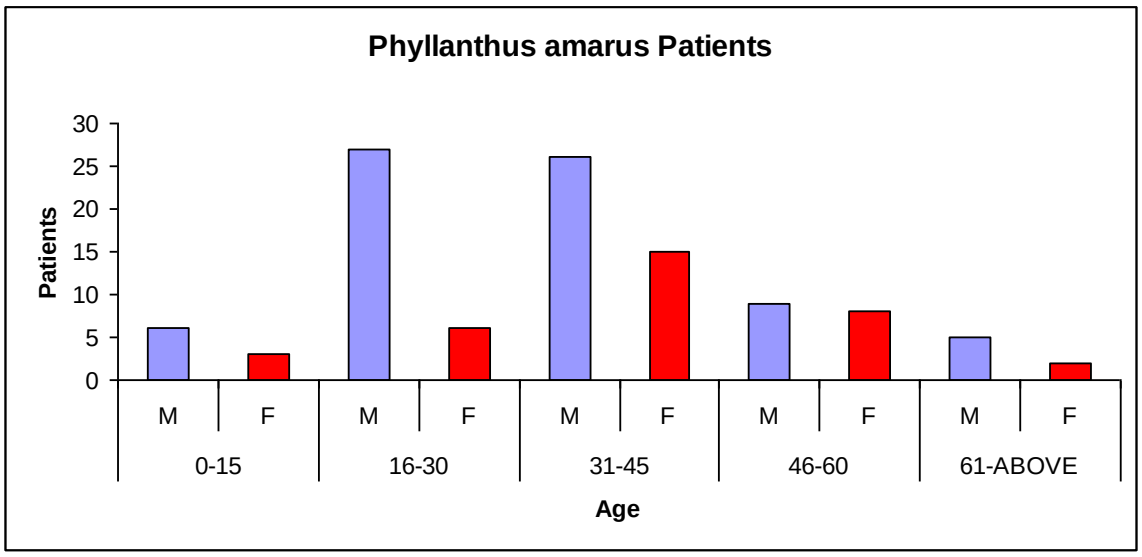
The ability of whole dried drug powder of *Phyllanthus amarus* was tested at Sapan Hospital, Bayad, Dist-S.K., Gujarat, for hepatoprotective activity on patients who were suffering from liver disease. Before starting this study on the patients an ethical committee was formed (consisting of an ayurvedic physician, modern physician MD, social worker, advocate, scientist etc. Annexure II). The strategy of work was planned and before starting the work with patients. Their written consent was taken, after explaining the details regarding the effect of the drug and the analysis of blood sample at different time interval. The powder of *Phyllanthus amarus* was given thrice a day (morning, noon and night, 3 gm each time) orally with glucose to the first group of liver damage 107 patients of different age groups and sex for one,

two, three, four and six weeks as per severity of the patient and treatment was continued until the recovery. The marketed formulation Livercare Churna was given thrice a day (morning, noon and night, 3 gm each time) orally with honey to the second group of liver damage 93 patients of different age groups and sex for one, two, three, four and six weeks as per severity of the patients and treatment was continued until the recovery. Tablet Hepatogard Forte was given thrice a day (morning, noon and night, 1 tablet each time) orally to the third group of liver damage 95 patients of different age groups and sex for one, two, three, four and six weeks as per severity of the patients and treatment was continued until the recovery. Biological parameter like SGPT, Bilirubin, Haemoglobin, Creatinine, HBsAg, urine sugar, blood pressure, etc were measured and monitored during the treatment.

The reagents used in clinical investigations were collected from Span Diagnostic Ltd, Shivam Surgical, Ahmadabad, for estimation of SGPT, Bilirubin and Haemoglobin.

**Table 4.1: Different age of patients who were treated with *Phyllanthus amarus* as hepatoprotective drug.**

| ***PHYLLANTHUS AMARUS*** | | | |
|---|---|---|---|
| **Age** | **Male** | **Female** | **Total Patients** |
| 0-15 | 6 | 3 | 9 |
| 16-30 | 27 | 6 | 33 |
| 31-45 | 26 | 15 | 41 |
| 46-60 | 9 | 8 | 17 |
| 61-ABOVE | 5 | 2 | 7 |
| Total | 73 | 34 | 107 |

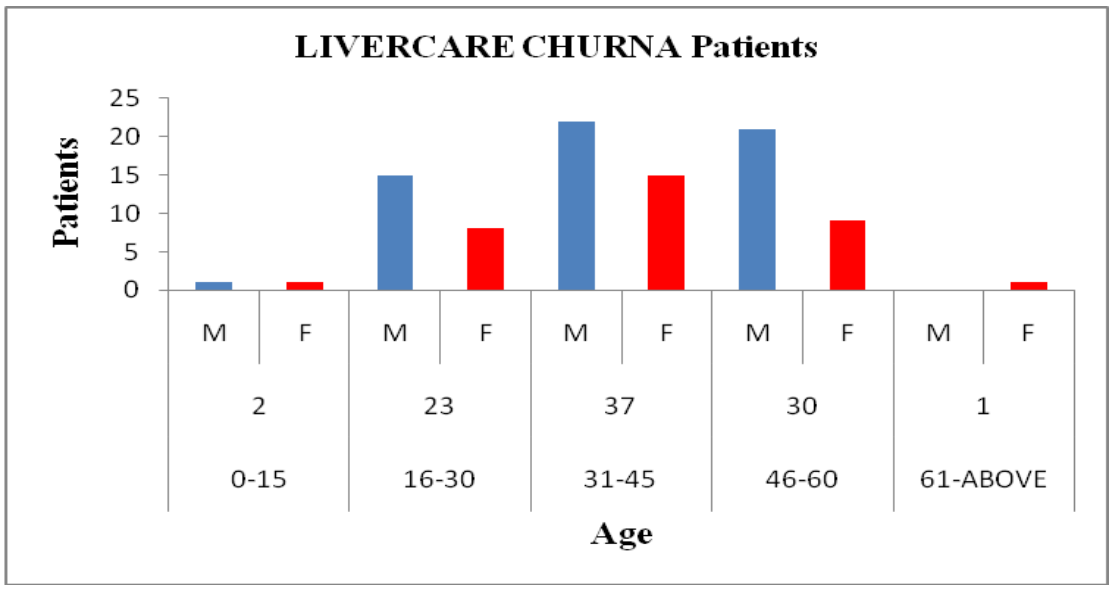



M = Male, F = Female

**Figure 4.1: Patients v/s Age. Column graph showing patients of *Phyllanthus amarus* with different age.**

**Table 4.2: Different age of patients who were treated with Livercare Churna as hepatoprotective drug.**

| LIVERCARE CHURNA | | | |
|---|---|---|---|
| **Age** | **Male** | **Female** | **Total Patients** |
| 0-15 | 1 | 1 | 2 |
| 16-30 | 15 | 8 | 23 |
| 31-45 | 22 | 15 | 37 |
| 46-60 | 21 | 9 | 30 |
| 61-ABOVE | 0 | 1 | 1 |
| Total | 59 | 34 | 93 |

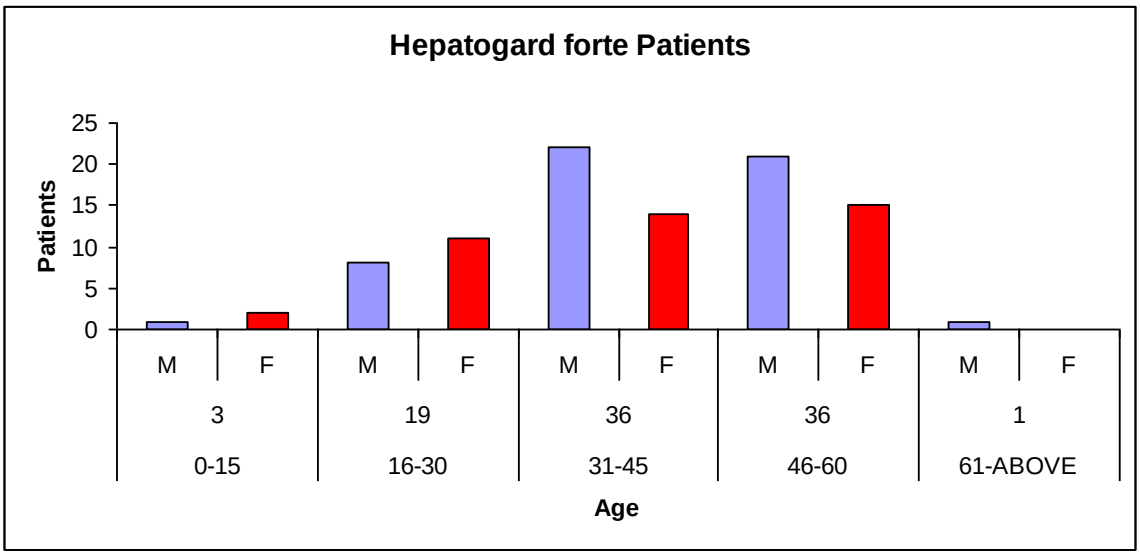



M = Male, F = Female

**Figure 4.2: Patients v/s Age. Column graph showing Patients of Livercare Churna with different age**.

**Table 4.3: Different age of patients who were treated with Hepatogard Forte Tablet as hepatoprotective drug.**

| HEPATOGARD FORTETABLET | | | |
|---|---|---|---|
| **Age** | **Male** | **Female** | **Total Patients** |
| 0-15 | 1 | 2 | 3 |
| 16-30 | 8 | 11 | 19 |
| 31-45 | 22 | 14 | 36 |
| 46-60 | 21 | 15 | 36 |
| 61-ABOVE | 1 | 0 | 1 |
| Total | 53 | 42 | 95 |



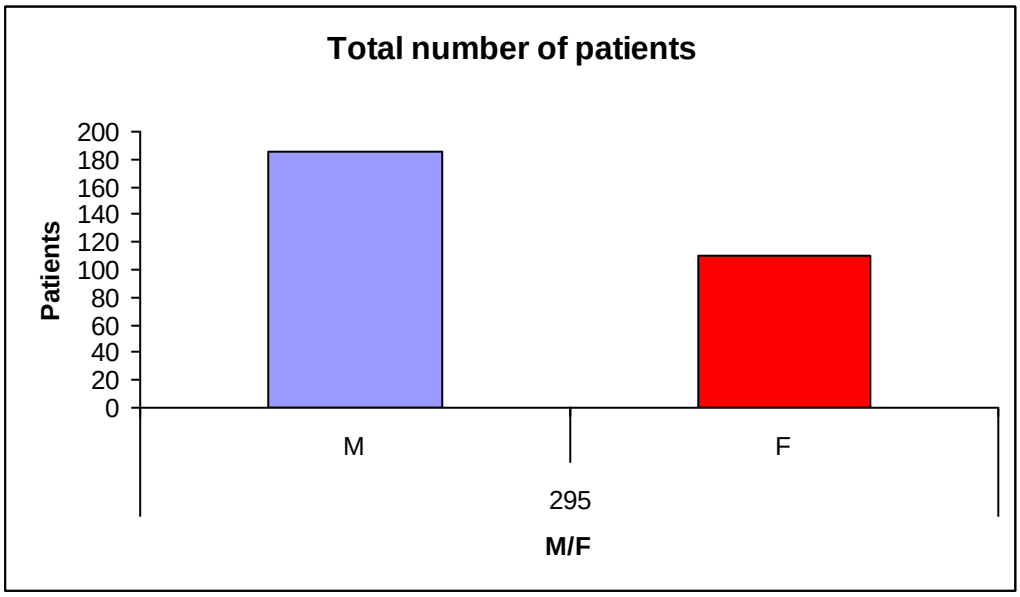

M = Male, F = Female

**Figure 4.3: Patients v/s Age. Column graph showing patients of tablet Hepatogard Forte with different age**

**Table 4.4: Total number of patients for *Phyllanthus amarus*, Livercare Churna, and Hepatogard Forte Tablet .**

| M/F | *Phyllanthus amarus* | Livercare Churna | Tablet Hepatogard Forte | Total |
|---|---|---|---|---|
| M | 73 | 59 | 53 | 185 |
| F | 34 | 34 | 42 | 110 |
| Total | 107 | 93 | 95 | 295 |

M = Male, F = Female




M = Male, F = Female

**Figure 4.4: Patients V/S Total number of patients M/F. Column graph showing total number of Patients for *Phyllanthus amarus*, Livercare Churna, and Hepatogard Forte Tablet.**

**4.2. TLC studies of the herbs (Patel, 2000)**

TLC studies of the extracts of fresh herb as well as their market formulations were carried out to know their TLC finger prints and to compare them and also to identify the presence of the active hepatoprotective compound present in them.

***Phyllanthus amarus***

Extraction: 50 mg of dry herb *Phyllanthus amarus* (PP) and marketed formulations containing 50 mg equivalent amount of *Phyllanthus amarus* of Livercare Churna (PL) and 50 mg equivalent amount of *Phyllanthus amarus* of Hepatogaurd Forte Tablet (PH) were extracted with 10 ml of petroleum ether (60 – 80 C) by heating on water bath for 10 minutes and filtered. The marc was extracted similarly twice taking 5 ml of petroleum ether each time. The combined filtrate was concentrated to 0.5 ml and used for TLC studies.

**TLC:**

Extract of each of the above dry fresh herb (PP), and marketed formulation Livercare Churna (PL) and tablet Hepatogaurd Forte (PH) were spotted on TLC plate separately. It was developed in Toluene: Ethyl acetate (4: 2) dried and observed in day light, UV light and after spraying 10 % methanolic sulphuric acid followed by heating at 110 C for 10 minutes.

**Detection:**

1. 10 % methanolic sulphuric acid (day light)
2. UV light (254)

**Extracts:** Petroleum ether extracts of dry fresh herb of *Phyllanthus amarus* (PP), and marketed formulations containing Livercare Churna (PL) and tablet Hepatogaurd Forte (PH).

## 4.3. PHYSICOCHEMICAL PARAMETER

**4.3.1. Ash values**. (Harbone, 1998; WHO/QCMMPM guidelines, 1992)

Ash content of the crude drug is generally taken to be the residue remaining after incineration. It represents the inorganic salts naturally occurring in the drug and adhering to it, but it may also include inorganic matter added for the purpose of adulteration.

Total ash is the residue remaining after incineration. Acid insoluble ash is the part of the total ash, which is insoluble in dilute hydrochloric acid. Water-soluble ash is the part of total ash, which is soluble in hot water.

**4.3.1.1. Determination of Total Ash.**

About 2g of the powdered drug was accurately weighed (W) in a tarred silica crucible. The powdered drug was spread as a fine layer at the bottom of the crucible. The crucible was incinerated at a temperature not exceeding 450°C until free from carbon. The crucible was cooled and weighed.

The procedure was repeated till a constant weight was observed. The percentage of the total ash was calculated with reference to the air-dried drug.

**4.3.1.2. Determination of Acid Insoluble Ash**

The ash obtained as described in the determination of total ash was boiled with 25 ml of hydrochloric acid for 5 min. The insoluble ash was collected on an ashless filter paper and washed with hot water. The insoluble ash was transferred into a tarred silica crucible along with filter paper, ignited, cooled and weighed. The procedure was repeated till a constant weight was observed. The percentage of acid insoluble ash was calculated with reference to the air-dried drug.

**4.3.1.3. Determination of Alcohol-Soluble Extractive:**

Macerate 5 gm of the air dried coarsely powdered drug with 100 ml of alcohol in a 250 ml volumetric flask for 24 hours, shake frequently during six hours and allow to stand for 18 hours. Filter rapidly taking precaution against loss of alcohol, evaporate 25% of the filtrate to dryness in a tarred shallow dish dried at $105^0$c and weighed. Calculate the percentage of alcohol soluble extractive with reference to the air dried drug.

**4.3.1.4. Determination of Water-Soluble Extractive:**

Macerate 5 gm of the air dried coarsely powdered drug with 100 ml of chloroform water in a 250 ml volumetric flask for 24 hours, shake frequently during six hours and allow to stand for 18 hours. Filter rapidly, evaporate 25% of the filtrate to dryness in a tarred shallow dish dried at 105 $^0$C and weighed. Calculated the percentage of water soluble extractive with reference to the air dried drug.

**4.4. Estimation of SGPT** (Reitman *et al*., 1957: Nobert, 1970, Godkar *et al*, 2006)

**4.4.1. Intended Use:**

This reagent kit is intended for *in-vitro* quantitative determination of SGPT (ALT) activity in serum/plasma.

**4.4.2. Principle:**

Glutamate pyruvate transaminase (GPT) or Alanine aminotransferase (ALT) catalyses alphaketoglutarate and L-Alanine. Pyruvate formed by this catalysis reacts with 2, 4 dinitrophenylhydrazine (2, 4 DNPH) to give a brown-red colored hydrazone complex in an alkaline medium. The concentration of brown red colored complex is directly proportional to the activity of SGPT

present in sample and it is measured colorimetrically at 505nm or with green filter.

**4.4.3. Reaction:**

i. Alpha-ketoglutarate + L-Alanine $\xleftrightarrow{GPT}$ L-Glutamate + Pyruvate.

ii. Pyruvate + 2, 4 DNPH $\xleftrightarrow{Alk\ medium}$ Brown-Red Hydrazone Complex

**4.4.4. Clinical Significance:**

Even though glutamate pyruvate transaminase is widely distributed in various tissues of the body; it is a useful parameter in evaluating liver function. The elevated serum levels are found in case of hepatitis, obstructive jaundice, metastatic carcinoma, hepatic congestion and myocardial infarction or in kidney diseases.

**4.4.5. Reagent Preparation:**

Reagent 1: Buffered alanine $\alpha$-KG substrate.

Reagent 2: DNPH color reagent.

Reagent 3: sodium hydroxide, 4N.

Reagent 4: Working pyruvate standard, 2mM.

Solution 1: One ml of Reagent No.3 was diluted to 10 ml with distilled water. Reagent 1, 2 & 4 are ready for use as such.

**4.4.6. Test Procedure:**

Reagent 1(Buffered alanine $\alpha$-KG substrate) 0.5 ml is taken in a test tube. It is incubated at 37$^{o}$C for 5 min, fasted serum 0.1 ml is added to the test tube. It is mixed well and incubate at 37$^{o}$C for 30 min. Reagent 2, (DNPH color reagent) 0.5 ml is added to the above test tube. It is allowed to stand at room temperature for 20 min. Solution 1; 5 ml is added to the solution of the test

tube. It is mixed well and allow to stand for 10 min. The absorbance of the solution is measured 505 nm using water as blank.

**4.4.7. Test Results:**

The calibration graph is used to obtain test results in U/ml.

**4.4.8. Linearity:**

This method is linear up to 150 U/ml of SGPT in serum. Samples having higher values are diluted with 0.9% saline and assay results were multiplied with dilution factor.

**4.5. Estimation of Bilirubin (**Malloy *et al*., 1937, Godkar and Godkar, 2006**)**

**4.5.1. Intended Use:**

This diagnostic reagent kit is intended for *in-vitro* quantitative estimation of direct and indirect bilirubin from serum/plasma.

**4.5.2. Principle:**

The direct or conjugated bilirubin reacts with diazotized sulphanilic acid to form purple colored complex, whereas indirect or unconjugated Bilirubin reacts only in presence of DMSO reagent to give purple colored complex. The intensity of the purple color developed is proportional to the amount of either total or direct bilirubin present in sample and it is measured colorimetrically at 540 nm or with yellow-green filter.

**4.5.3. Reaction:**

Direct/ conjugated Bilirubin + Diazotized Sulphanilic acid → Purple colored azo bilirubin complex

Indirect / unconjugated bilirubin + Diazotized sulphanilic acid $\xrightarrow{\text{DMSO}}$ Purple colored azo bilirubin complex.

### 4.5.4. Clinical Significance:

Bilirubin is produced from Haemoglobin in reticulo endothelial system and circulates in normal concentration in blood. It is conjugated with glucuronic acid in liver and excreted through bile. The estimation of total and direct bilirubin is of importance for diagnosis, differentiation and follows up of jaundice. The serum levels of unconjugated Bilirubin rises in the cases of hemolytic jaundice. Whereas conjugated serum bilirubin levels rises in the cases of obstructive jaundice. Hepatic jaundice is characterized by simultaneous rise in both, conjugated and unconjugated serum bilirubin levels.

### 4.5.5. Reagent Preparation:

Reagent A: Total bilirubin reagent.

Reagent B: Direct bilirubin reagent.

Reagent C: Sodium nitrite reagent.

Reagent D: standard bilirubin = 10mg% bilirubin.

All reagents in the kit are ready to use as such.

### 4.5.6. Procedure for Colorimetric estimation of Bilirubin:

For total bilirubin estimation 3 ml of reagent A and 0.1 ml of reagent C are mixed by inversion of test tube No T and waited for 30 seconds. For total bilirubin blank 3 ml of reagent A is taken in test tube No TB. Fasted serum 0.15 ml is added in each test tube No T and TB. The content of both the test tubes are mixed well and incubated at $37^{o}$C for 5 min and absorbance is read at 540 nm using water as blank.

For direct bilirubin estimation 3 ml of reagent B and 0.1 ml of reagent C are mixed by inversion of test tube No D and waited for 30 seconds. For direct

bilirubin blank 3 ml of reagent B is taken in test tube No DB. Fasted serum 0.15 ml is added in each test tube No D and DB. The content of both the test tubes are mixed well and incubated for 37$^{o}$C for 5 min and absorbance is read at 540 nm using water as blank.

The absorbance of the reagent D (standard bilirubin) is read directly against distilled water. The standard once used is discarded. Serum Bilirubin in mg% calculated as below.

**4.5.7. Test Results:**

$$\text{Total bilirubin mg\% (A)} = \frac{\text{Absorbance of T - Absorbance of TB}}{\text{Absorbance of standard bilirubin}} * 10$$

$$\text{Direct bilirubin mg\% (B)} = \frac{\text{Absorbance of D - Absorbance of DB}}{\text{Absorbance of standard bilirubin}} * 10$$

Where T= Total bilirubin, TB= Total bilirubin blank, D= Direct bilirubin, DB= Direct bilirubin blank.

**4.5.8. Linearity:**

This method is linear up to bilirubin concentration of 15 mg%, for sample having higher values of bilirubin are diluted with 0.9% normal saline and multiplied with dilution factor.

**4.6. Estimation of Creatinine (**Tora and Ackermann, 1975; Bonses and Taussky, 1945, Godkar and Godkar, 2006**)**

**4.6.1. Method**: Alkaline Picrate Method

**4.6.2. Principle:** Creatinine in a protein free solution reacts, with Alkaline Picrates and produces a red colored complex, which is measured colorimetrically.

**4.6.3. Advantages**:

- Very popular method
- Simple, convenient and highly reproducible.
- One minute deprotenization step with a single deprotenization reagent.
- Result within half an hour.
- Economic.

Sample: 24hrs urine is preferred. Dilute 1ml of urine to 250 ml with purified water.

**4.6.4. Reagent:**

Reagent 1: Picric acid

Reagent 2: Sodium Hydroxide, 0.75N

Reagent 3: Stock Creatinine Standard, 150 mg%

Preparation of working solution: Dilute 0.1 ml of reagent 3 to 10 ml with purified water and mix well. All other reagents are ready for use.

Storage and stability: All reagents are stable at room temperature till the expiry date mentioned on the individual label. Once opened Reagent 3 is stable at 2-8 $^{0}$C. Working standard has to be prepared fresh everyday.

**4.6.5. Precautions**:

1) Use clean and dry glassware.
2) Bring all solution to room temperature before use.
3) Prepare one blank and one standard for each series of estimations.
4) Mark the test tube properly as blank (B), standard (S), and test (T) before proceeding for the estimation, because markings may come off when the tubes are placed in the boiling water bath during deprotenization (step A).

5) Do not fail to dilute the urine during creatinine estimation from urine.

**4.6.6. Procedure**

A. For colorimetry

Step A. Deprotenization of test sample:

| | |
|---|---|
| Dilute urine | 0.5 ml |
| Purified water | 0.5 ml |
| Reagent 1: Picric acid | 3.0 ml |

Mix well; keep in a boiling water bath exactly for one minute. Cool immediately under running tap water and centrifuge or filter

| Step B. Color Development: | Blank | Standard | Test |
|---|---|---|---|
| Filtrate/Supernant (From Step A.) | - | - | 2.0 ml |
| Working Standard | - | 0.5 ml | - |
| Purified water | 0.5 ml | - | - |
| Reagent 1: Picric acid | 1.5 ml | 1.5 ml | - |
| Reagent 2: NaOH, 0.75N | 0.5 ml | 0.5 ml | 0.5 ml |

Mix well and allow to stand at room temperature exactly for 20 minutes and measure immediately the optical density of Blank (B), Standard(S) and Test (T) against Purified water on a colorimeter with a green filter.

B. For Spectrophotometer: All the volumes mentioned under colorimetric procedure can be adjusted proportionately depending on flow cell/cuvette capacity. Rest of the procedure remains unchanged. Measure the O.D. at 520nm.

**4.6.7. Calculation**:

$$\text{Urine Creatinine in mg/ 100ml} = \frac{\text{O.D. test} - \text{O.D. blank}}{\text{O.D. std} - \text{O.D. blank}}$$

Normal values of Urine Creatinine: Men: 1.1- 2.8 g/ 24hrs

Women: 0.9- 1.6 g/24 hrs

**4.6.8. Note**:

1) If the O.D. of test exceeds 0.8 repeat the test after diluting the urine 1 → 50 or more if necessary and multiply the final result so obtained with 2.0 or an appropriate factor.
2) Optical density should be measured exactly after 20 minutes after the addition of sodium hydroxide.
3) The filtrate/ supplement obtained during deprotenization should be crystal clear.

**4.6.9. Clinical significance**

In renal disease, Creatinine determinations have one advantage over urea determinations that they are not affected by a high protein diet as is the case for urea determinations. In addition to renal disease, elevated levels of Serum Creatinine and Creatinuria may be observed in extensive muscle destruction.

**4.7. Estimation OF HBsAg test (**Godkar and Godkar, 2006**)**

**4.7.1. Intended use**:

The Advanced quality one step HBsAg test is a rapid, one step, immunochromatographic assay for the detection of Hepatitis B surface antigen (HBsAg) in human serum or plasma. The presence of 5ng/ml HBsAg can be detected within 10 minutes and 1ng/ml HBsAg in 30 minutes. The test provides a visual, qualitative result, and is intended for professional use.

**4.7.2. Principle of the assay**

Solid phase “Sandwich” immunoassay for the detection of HBsAg was described by Wisdom (Wisdom, 1976, Wolters *et al.,* Wei *et al*., 1977). The

production, characterization and application of monoclonal antibodies for the detection of HBsAg have previously been reported (David, 1981: Goodall, *et al*., 1981: Kennedy. e*t al*., 1983: Shih, *et al*., 1980: Wands *et al*., 1981).

The advanced quality one step HBsAg test is a colloidal gold enhanced immunoassay that detects Hepatitis B surface antigen in human serum or plasma. The sample initially reacts with the monoclonal antibody-colloidal conjugate on the sample pad. This mixture migrates across the membrane by capillary action and reacts with the anti-HBsAg in the test region. If the sample contains HBsAg a line will form on the membrane at this point. If the antigen is not present in the sample no line is formed, indicating a negative result. The mixture continues to flow to the control area of the membrane, where it forms a line indicating the test result valid.

### 4.7.3. Storage conditions

The kit must be stored at 2-30C.

### 4.7.4. Precautions

It is recommended that all specimens be handled in accordance with biosafety level 2 practices as described in the CDC NIH publication, Biosafety on microbiological and biomedical laboratories (USDHHS, 1988) or other equivalent guidelines (WHO, 1983: NCCLS, 1989)

1. For *in vitro* diagnostic use only.
2. Wear gloves to perform this procedure and treat all specimens and used devices as potentially infectious.
3. Clean and disinfect all spills of specimens and reagents using a suitable disinfectant, such as 1% sodium hydrochlorite12.
4. Sterilize all devices used in this assay prior to disposal.

5. Do not use test beyond the expiration date

### 4.7.5. Specimen collection

1. **S**erum or plasma may be used in this test .Anticoagulants typically used for blood collection do not interfere with this test.
2. Remove the serum or plasma from the clot or red cells as soon as possible to avoid hemolysis.
3. Haemolyzed extremely thickened or fatty specimens are not suitable for this assay. Specimens containing particulate matter may give inconsistent results and should be clarified prior to testing.
4. Serum or plasma specimens should be refrigerated at 2 to 8 $^{o}$C up to 3 days and frozen at -20 $^{o}$C for longer periods.
5. Shipped specimens should be packed in compliance with federal and international regulations covering the transportation of etiologic agents.
6. Avoid frequent (more than 3 times) thaw- and freeze of specimens.
7. 0.1% sodium azide can be added to the specimen as a preservative without affecting results of the assay.

### 4.7.6. Materials provided

- 10 or 40 test cards individually foil pouched with a desiccant.
- Instruction for use.
- Sample dispensing plastic dropper with each test pouch.

### 4.7.7. Assay procedure

Do not open pouch until you are ready to the sample.

1. Bring all reagents and specimens to room temperature.
2. Remove the test card from the foil pouch and place on a clean dry surface.

3. Identify the test card for each specimen or control.
4. Dispense 2-3 drops of the specimen or control into the sample well on the card by provided plastic sample dropper. Caution: Use only provided sample dropper for every sample to avoid cross-contamination.
5. Read the result between 5 to 10 minutes for 5ng/ml, and 30 minutes for 1ng/ml. A positive result may be interpreted early, however read any negative at 30 minutes to ensure sample is negative and not a low concentration of the HBsAg, requiring more time to develop. Do not interpret the result after 30 minutes.

It is recommended to run a known positive and negative control in each performance to ensure the assay procedure.

### 4.7.8. Interpretation of Results

**Negative:** Only one purplish red colored band appears in the control region.

**Positive:** In addition to the purplish red control band, a distinct purplish red colored band also appears in the test region.

**Invalid:** Neither test band nor control band appears. The specimen should be tested again using a new test card.

### 4.7.9. Limitations:

Although the association between the presence of HBsAg and infection is strong, available methods for HBsAg detection are not sensitive enough to detect all potentially infectious units of blood or possible hepatitis infections.

**4.7.10. Performance characteristics**

Serum or plasma concentration as low as 1ng/ml is detected by this assay. The advanced quality one step HBsAg test has been compared to an equivalent EIA system. A result of 99.5% correction to EIA test was demonstrated by a clinical study of 1208 patient's specimens.

**4.8. Estimation of Urine Sugar** (Godkar and Godkar, 2006, Goyal *et al*., 2006)

**4.8.1. Principle**:

Benedict's quantitative reagent consists of copper sulphate, potassium thiocyanate and other chemicals in alkaline media. Copper sulphate is reduced to cuprous oxide by glucose. Potassium thiocyanate reacts with cuprous oxide and form white precipitates of cuprous thiocyanate instead of usual precipitates of cuprous oxide. Disappearance of blue tint from solution, indicate complete reaction of copper sulphate.

**4.8.2. Reaction**

$$2\ Cu(OH)_2 \ \text{(reduction)} \rightarrow Cu_2O + 2\ H_2O$$

**4.8.3. Reagents**:

1) Benedict's quantitative reagent:

(A) Dissolve with the aid of heat, 100 gm of anhydrous sodium carbonate, 200 gm of sodium or potassium citrate and 125 gm of dry potassium thiocyanate in 800 ml water and filter if necessary.

(B) Dissolve 18gm of copper sulphate in 100ml of water. Cool the solution. Add 'B' to 'A' with constant stirring. Add 5 ml of 5% potassium ferricyanide solution. Add water to make 1000 ml. 25ml of the reagent

is reduced by 50 mg of glucose. Check the strength by titrating with standard solution of glucose; 1ml of reagent = 2mg of glucose.

2) Anhydrous sodium carbonate:

Dilution: The urine is diluted in such a way that the burrate reading is between 5 to 15 ml for 10 ml of the reagent. For this, take 5 ml of Benedict‘s qualitative reagent. Add 8 drops of urine, boil and cool.

Green ppts: Dilute urine 1 in 2 or 3

Yellow ppts: Dilute urine 1in 5 or 8

Brick red ppts: Dilute urine 1 in 10 or more

End point: Complete disappearance of the blue color.

**4.8.4. Procedure:**

(A) Pipette out 10 ml of Benedict‘s qualitative reagent solution in a 100 ml conical flask. Add 20 ml of water, 5gm of anhydrous sodium carbonate and few pieces of porcelain to prevent bumping. Heat the flask on a flame to boiling. Keeping the mixture just boiling, add this urine in a flask rapidly, until white precipitates begin to form. After this add urine, drop by drop at the interval of 10 seconds until the blue color just disappear. The solution must be kept vigorously boiling and be stirred continuously throughout the entire titration.

(B) Add 5ml of the Benedict‘s qualitative reagent and mix with 0.5 ml of urine, Boil for 2 minute and cool

| | |
|---|---|
| Green precipitates | Glucose up to 1% |
| Yellow precipitates | Glucose up to 2% |
| Red precipitates | Greater than 2% |

**4.8.5. Calculation:**

If n ml of urine, dilution 1 in D (if not diluted D=1) required, then the glucose contents of urine are,

$$\frac{0.02 \times 100}{N} \times D = \frac{2D}{n} \text{ gm\%}$$

**Note:** In Benedict's qualitative reagent, small amount of potassium ferricyanide assists in maintaining the cuprous oxide in solution. The use of sodium carbonate as alkali instead of sodium hydroxide, prevent the destruction of the small amount of sugar.

**4.8.6. Interpretation**; Normal value of glucose excretion is 2 to 10 mg glucose/100 ml or 78.5 mg/day, which is not detected by common qualitative test. Determination of sugar concentration in urine is important for the management of diabetics. Presence of sugar in urine is known as glucosuria and the persistent presence indicate diabetes mellitus.

**4.9. Determination of Heamoglobin. (**Godkar and Godkar, 2006, Goyal *et al*., 2006**)**

**4.9.1. Reagent and Glassware**:

Sahil haemoglobinometer or hemometer which consists of two sealed comparison tubes fixed in rack, a specially graduated diluting tube, a thin glass rod and micropipette of 20 cubic millimeter capacity, pricking needle, N/10 HCl, distilled water, 70% alcohol and absorbent cotton.

**4.9.2. Principle**:

When blood is mixed with N/10 HCl, RBCs are haemolyzed and Hb is librated. This Hb is converted into acid hematin which is reddish brown in color. The solution is diluted with distilled water till it matches with the standard glass (Comparison) tubes. The Hb% can directly be read from the graduated tube.

**4.9.3. Procedure**:

The graduated diluting tube and the micropipette are cleaned thoroughly and dried. The graduated diluting tube is filled with N/10 HCl up to the mark 2 gm or till the micropipette touches the level of acid in the tube. The finger is cleaned with 70% alcohol and it is pricked to obtain a drop of blood. First drop is wiped out. Second drop is sucked in the micropipette upto the mark 20cmm. The blood is immediately deposited at the bottom of the graduated tube. The pipette is rinsed two to three times in HCl. The blood is mixed with the help of stirrer and then solution is allowed to stand for 10-15 minutes so that all Hb is converted into acid haematin. Then mixture is diluted with distilled water. Distilled water is added drop by drop and every time it is stirred till the exact match with standard glass tubes is obtain and the scale is read on the side of tube.

**4.9.4. Observation and Calculation**

Observed Hb gm % = --------- gm %

Observed Hb % = ---------- %

International value of Hb is 14.5 gm% = 100 %

Calculation Hb% = $\frac{\text{gm \%}}{14.5} \times 100$

**4.9.5. Normal value**

Normally 14.5 gm of Hb in 100 cc of blood is considered to be 100 % Hb according to British Standards. The value may vary according to sex, age and altitude. In female adults it may vary from 12 to 15 gm (average 13.7 gm %) and in adult males it ranges from 13 gm to 16 gm (average 14.8 gm %). New born child has an average of 23 gm% by the end of third month it falls below the normal. After this it gradually recovers within a

year to 12.5 gm. People at higher altitude have higher value, because oxygen of air is less at that level.

**4.9.6. Precautions**;

- While filling the micropipette, entry of air bubbles should be avoided. It is advisable to fill up the micropipette more than 20 cmm marks. The excess of blood in the micropipette may be removed by touching the tip of the pipette on palm.
- While depositing blood into graduated tube, one should not blow it forcibly so that blood sticks to the side of pipette. Rinsing should also be done slowly.
- Never take less quantity of N/10 HCl.
- While observing for color match, stirrer should be kept out of solution, and the calibrated side should not come in view. The observation must be done while facing it against uniform intensity of light.

**4.10. Estimation of Blood Pressure (**Godkar and Godkar, 2006, Goyal *et al*., 2006**)**

Blood pressure (B.P.) is defined as the lateral pressure exerted on the walls of the vessels by the contained blood. This is due to muscularity and elasticity of the walls of blood vessels. The B.P. also depends on the force with which heart pumps the blood. The maximum pressure during systole is defined as systolic B.P whereas the minimum pressure during diastole is defined as the diastolic B.P. The difference between systolic and diastolic B.P is described as the pulse pressure.

**4.10.1. Principle:**

The blood flow through a large sized artery is obstructed by means of air pressure exerted through a rubber bag wrapped around the limb. The pressure is slowly released and the entry of blood through the obstruction is studied by

- Feeling of the pulse(Palpatory method)
- Observation of oscillation of the mercury level ( oscillatory method)
- Hearing with the stethoscope the sounds produced in the segment of the artery distal to obstruction (Auscultatory method)

The blood flow stops when the pressure transmitted to the artery through the rubber bag is equal to or more than the blood pressure. The first entry of blood through an obstruction indicates the blood pressure. Usually the arm or thigh is used because there is only one big vessel which runs superficially in each of these parts of the extremities.

**4.10.2. Procedure**:

1. The cuff is tied around the arm. It should be neither too tight to cause any discomfort to the subject, nor too loose to allow its movement round the arm.
2. The artery is felt and its course is marked in the cubital fossa. Also the radial pulse is felt and marked at the place where it is felt well.
3. The manometer is placed by the side of the subject, between his arm and the body. The screw of the rubber pump is tightened and the pump is pressed to inflate the bag. It is inflated to raise the mercury to 200 mm level or 20-25 mm hg higher after the disappearance of pulse.

4. Keeping the eyes fixed at mercury level and the finger at the pulse, pressure is slowly released by unscrewing the valve of the rubber pump. The reading of the level of mercury when the pulse reappears gives systolic pressure. This is Palpatory method. This method does not give idea of diastolic pressure. The systolic pressure recorded by this method is about 5-10 mm lower than the actual systolic pressure.

When the pulse appears, it is also noted that mercury starts oscillation. The first oscillation starts increasing in magnitude and then slowly diminishes. The level at which the oscillation are maximum is taken as the diastolic pressure. This is oscillatory method. In this method the deflation has to be carried out slowly the systolic pressure should be read within fifteen seconds and the diastolic pressure within thirty second.

In the Auscultatory method after as usual the chest piece of stethoscope is placed over the brachial artery in the cubital fossa and deflation is started by slowly releasing the pressure. The level at which a sudden tap is heared is the systolic blood pressure. The sound suddenly gets muffled and disappears. The level at which the sinus muffles is the diastolic pressure, the sounds heared are korokorr's sounds. These are due to interrupted flow of blood.

In many instances when the systolic blood pressure is very high, the first sound is a faint tap and is then missed. As the pressure in the bag is reduced the sound produced become louder and audible at a much lower level. This reading is then erroneously taken as the systolic blood pressure

reading. The difference between this reading and the true systolic reading is described as the 'Auscultatory gap'.

**4.11 Statistical analysis**

Results of biochemical estimation were reported as Mean, S.D, SEM and Median for determination of significant inter group difference each parameter was analyzed separately and one way analysis of variance P value was carried out Graph Pad statistics software.

Results of biochemical estimation were reported as Mean, S.D, and SEM for determination Student T Test of significant inter group difference each parameter was analyzed separately and one way analysis of variance t value and P value was carried out by SPSS 12.0 statistics software.

# Results & Discussion

## RESULT AND DISCUSSION

### Result and Discussion

The herb of *Phyllanthus amarus* collected from the field of village Dugarwada in Modasa was identified as *Phyllanthus amarus* by scientist of NISCAIR, New Delhi (4/8/08; Ref: 1031/62).

The physicochemical parameters of the powder of the herb were determined which are shown in Table no. 5.1

**Table 5.1: Physicochemical parameter for *Phyllanthus amarus***

| Sr. no | Name of parameter | Experimental Value | Indian Herbal Pharmacopoeia | Ayurvedic Pharmacopoeia of India |
|---|---|---|---|---|
| 1 | Water soluble extract value | 18% | NLT 15 % | NLT 13 % |
| 2 | Alcoholic soluble extractive value | 14% | Not mentioned | NLT 3 % |
| 3 | Total ash | 7% | NMT 8 % | NMT 16 % |
| 4 | Acid insoluble ash value | 4% | NMT 5 % | NMT 7 % |

Water soluble extractive value, Alcoholic soluble extractive value, Total ash and Acid insoluble ash value of the *Phyllanthus amarus* herb collected for the use comply with the Ayurvedic Pharmacopoeia of India as well as Indian Herbal Pharmacopoeia.

## 5.2 TLC of *Phyllanthus amarus* and its market formulations

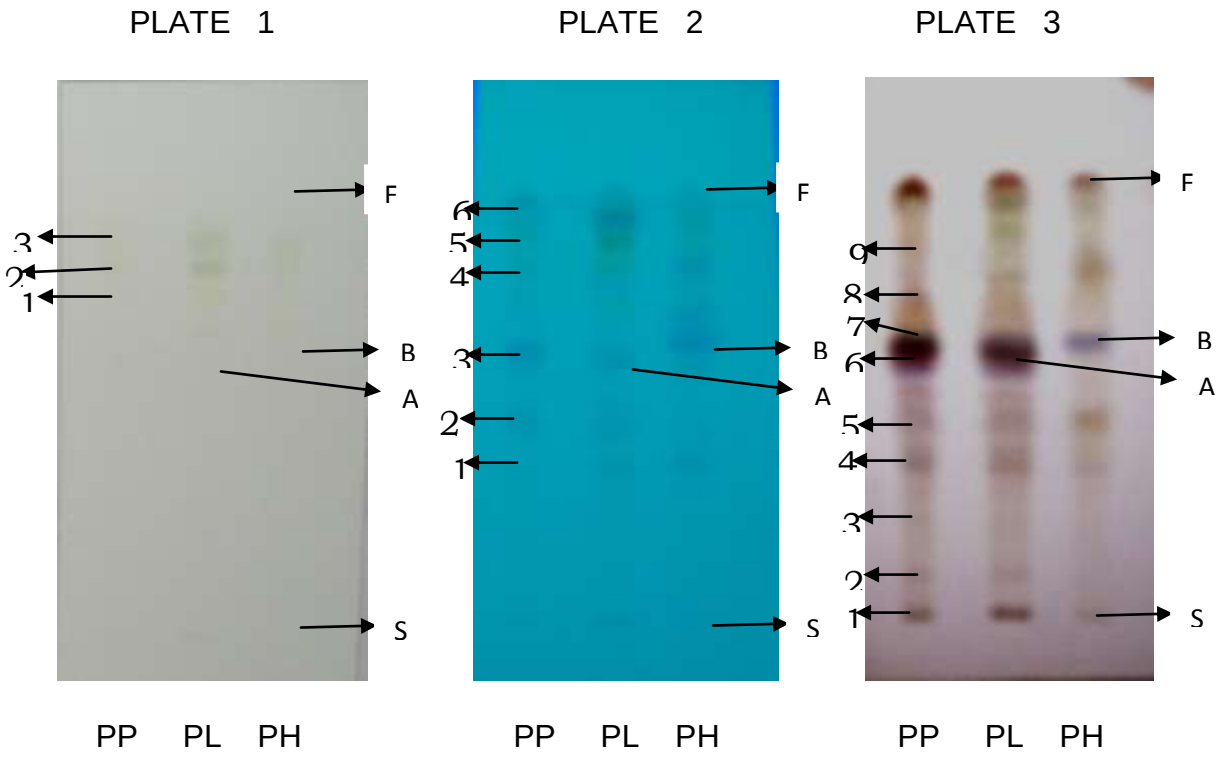



**Figure 3**: TLC study of *Phyllanthus amarus* and their formulations.

Where **A=** Spot of hypophyllanthin (Rf =0.54, identified through literature as hypophyllanthin), **B =**Spot of phyllanthin (Rf = 0.58, identified through literature as phyllanthus), **S =** Place of spotting, **F =** Solvent front. (through Rf value and literature study)

**Stationary phase**: Silica gel G

**Mobile phase**: Toluene: Ethyl acetate (4: 2)

**Detection:** **Plate 1**: as seen in day light,

**Plate 2**: as seen in UV 254 light,

**Plate 3**: 10 % methanolic sulphuric acid followed by heating in a oven at 100$^{o}$C for 10 min

**PH**; Petroleum ether extract of Hepatogard forte

**PL**; Petroleum ether extract of Liver care

**PP**; Petroleum ether extract of *Phyllanthus amarus*

TLC was observed in day light, UV light (254nm) and after spraying with 10% methanolic sulphuric acid solution as seen in day light.

In day light, UV and after spraying with 10% methanolic sulphuric acid reagent spot at Rf = 0.54 and 0.58 are prominent. It turns red and blue spots after spraying with 10% methanolic sulphuric acid reagent. As per the literature description red spot at Rf= 0.54 is hypophyllanthin and blue spot at Rf = 0.58 is phyllanthin, which are present in the collected herb sample, Livercare Churna and Hepatogard forte Tablet. However the intensity of the spot (Rf = 0.54 and 0.58) and diameter was bigger in the sample of in collected herb and Livercare Churna than Hepatogard forte Tablet.

Total 3 spots were seen in *Phyllanthus amarus* herb and Livercare Churna in day light, but there was less in number in Hepatogard forte Tablet.

About 10 spots were seen in *Phyllanthus amarus* herb chromatogram after spraying with 10% methanolic sulphuric acid reagent. All the spots were red, blue to dark blue in colour. The number of spots were less in Hepatogard forte Tablet after spraying with 10% methanolic sulphuric acid reagent.

**Clinical Data**

**Table 5.2: SGPT values of the patients after treatment with *Phyllanthus amarus***

| Sr. no of patients | Age | SGPT values after different weeks treatment | | | | | |
|---|---|---|---|---|---|---|---|
| | | Initial (zero week) | First | Second | Third | Forth | Six |
| 1 | 28 | 109 | 52 | - | - | - | - |
| 2 | 51 | 45 | 40 | - | - | - | - |
| 3 | 20 | 110 | 45 | - | - | - | - |
| 4 | 16 | 460 | 210 | 110 | 50 | 45 | - |
| 5 | 42 | 980 | 430 | 210 | 80 | 65 | - |
| 6 | 17 | 105 | 65 | 35 | - | - | - |
| 7 | 65 | 34 | 30 | - | - | - | - |
| 8 | 65 | 60 | 45 | - | - | - | - |
| 9 | 36 | 399 | 240 | 65 | 35 | - | - |
| 10 | 42 | 104 | 50 | - | - | - | - |
| 11 | 35 | 885 | 590 | 315 | 45 | - | - |
| 12 | 21 | 784 | 620 | 310 | 40 | - | - |
| 13 | 32 | 436 | 210 | 70 | - | - | - |
| 14 | 32 | 144 | 64 | 58 | - | - | - |
| 15 | 28 | 1560 | 1210 | 880 | 410 | 60 | - |
| 16 | 45 | 325 | 40 | 35 | - | - | - |
| 17 | 17 | 65 | 40 | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 18 | 32 | 72 | 40 | - | - | - | - |
| 19 | 20 | 594 | 470 | 240 | 85 | 55 | - |
| 20 | 38 | 2400 | 1890 | 930 | 310 | 160 | 65 |
| 21 | 19 | 1900 | 1180 | 430 | 120 | - | - |
| 22 | 38 | 360 | 90 | - | - | - | - |
| 23 | 16 | 3100 | 2200 | 1650 | 740 | 390 | 85 |
| 24 | 19 | 1600 | 680 | 290 | 65 | - | - |
| 25 | 22 | 1500 | 740 | 330 | 90 | - | - |
| 26 | 65 | 700 | 320 | 160 | 50 | - | - |
| 27 | 35 | 260 | 65 | 45 | - | - | - |
| 28 | 32 | 345 | 200 | 55 | - | - | - |
| 29 | 42 | 290 | 65 | - | - | - | - |
| 30 | 43 | 1045 | 740 | 370 | 210 | 140 | 80 |
| 31 | 28 | 1120 | 740 | 550 | 320 | 65 | - |
| 32 | 50 | 800 | 480 | 300 | 140 | 35 | - |
| 33 | 55 | 600 | 210 | 85 | 35 | - | - |
| 34 | 45 | 460 | 290 | 100 | 65 | - | - |
| 35 | 55 | 490 | 140 | 45 | - | - | - |
| 36 | 40 | 270 | 120 | 60 | - | - | - |
| 37 | 20 | 800 | 340 | 110 | 35 | - | - |
| 38 | 50 | 500 | 190 | 45 | - | - | - |
| 39 | 45 | 520 | 210 | 65 | - | - | - |
| 40 | 50 | 1950 | 870 | 430 | 210 | 45 | - |
| 41 | 50 | 2100 | 1090 | 420 | 95 | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 42 | 45 | 980 | 320 | 85 | - | - | - |
| 43 | 32 | 1700 | 840 | 430 | 270 | 40 | - |
| 44 | 55 | 130 | 60 | 45 | - | - | - |
| 45 | 21 | 3200 | 1745 | 795 | 380 | 95 | - |
| 46 | 50 | 3890 | 1640 | 890 | 490 | 120 | - |
| 47 | 19 | 185 | 60 | - | - | - | - |
| 48 | 42 | 1300 | 673 | 290 | 45 | - | - |
| 49 | 71 | 235 | 95 | - | - | - | - |
| 50 | 38 | 1340 | 690 | 305 | 130 | 95 | - |
| 51 | 30 | 226 | 170 | 110 | 45 | - | - |
| 52 | 30 | 200 | 90 | - | - | - | - |
| 53 | 54 | 107 | 55 | - | - | - | - |
| 54 | 42 | 296 | 165 | 65 | - | - | - |
| 55 | 22 | 560 | 190 | 45 | - | - | - |
| 56 | 42 | 580 | 320 | 190 | 55 | - | - |
| 57 | 46 | 780 | 620 | 370 | 240 | 90 | - |
| 58 | 11 | 152 | 60 | - | - | - | - |
| 59 | 38 | 700 | 390 | 170 | 80 | - | - |
| 60 | 70 | 230 | 95 | - | - | - | - |
| 61 | 20 | 700 | 430 | 240 | 95 | - | - |
| 62 | 23 | 640 | 210 | 45 | - | - | - |
| 63 | 35 | 680 | 290 | 75 | 45 | - | - |
| 64 | 36 | 790 | 390 | 120 | - | - | - |
| 65 | 24 | 165 | 110 | 45 | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 66 | 40 | 160 | 55 | - | - | - | - |
| 67 | 28 | 150 | 110 | 45 | 35 | - | - |
| 68 | 13 | 160 | 75 | - | - | - | - |
| 69 | 45 | 970 | 430 | 280 | 95 | - | - |
| 70 | 15 | 160 | 65 | | - | - | - |
| 71 | 32 | 1590 | 570 | 170 | 55 | - | - |
| 72 | 55 | 2900 | 1890 | 590 | 230 | 75 | - |
| 73 | 11 | 972 | 310 | 95 | - | - | - |
| 74 | 30 | 1110 | 540 | 270 | 80 | - | - |
| 75 | 12 | 300 | 110 | 45 | - | - | - |
| 76 | 13 | 170 | 75 | - | - | - | - |
| 77 | 65 | 238 | 170 | 85 | 60 | 30 | - |
| 78 | 30 | 238 | 65 | - | - | - | - |
| 79 | 50 | 320 | 140 | 65 | - | - | - |
| 80 | 49 | 2100 | 990 | 520 | 270 | 95 | - |
| 81 | 45 | 590 | 240 | 60 | - | - | - |
| 82 | 36 | 2840 | 1920 | 1140 | 455 | 110 | - |
| 83 | 40 | 590 | 190 | 55 | - | - | - |
| 84 | 11 | 2390 | 1520 | 910 | 330 | 65 | - |
| 85 | 50 | 681 | 209 | 95 | - | - | - |
| 86 | 35 | 700 | 310 | 95 | - | - | - |
| 87 | 30 | 1010 | 510 | 190 | 95 | - | - |
| 88 | 25 | 210 | 95 | 45 | - | - | - |
| 89 | 65 | 248 | 140 | 60 | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 90 | 30 | 180 | 75 | - | - | - | - |
| 91 | 35 | 100 | 65 | - | - | - | - |
| 92 | 50 | 620 | 470 | 270 | 95 | - | - |
| 93 | 37 | 175 | 65 | - | - | - | - |
| 94 | 53 | 930 | 520 | 340 | 95 | - | - |
| 95 | 42 | 500 | 290 | 130 | 45 | - | - |
| 96 | 12 | 1000 | 430 | 210 | 65 | - | - |
| 97 | 40 | 460 | 270 | 190 | 110 | 90 | 35 |
| 98 | 45 | 157 | 55 | - | - | - | - |
| 99 | 27 | 550 | 310 | 170 | 85 | - | - |
| 100 | 25 | 103 | 45 | - | - | - | - |
| 101 | 21 | 716 | 230 | 65 | - | - | - |
| 102 | 30 | 1520 | 980 | 630 | 210 | 65 | - |
| 103 | 20 | 105 | 95 | 55 | - | - | - |
| 104 | 51 | 175 | 62 | - | - | - | - |
| 105 | 5 | 940 | 730 | 430 | 210 | 95 | - |
| 106 | 42 | 185 | 90 | - | - | - | - |
| 107 | 32 | 670 | 450 | 290 | 70 | - | - |
| **Average** | | **747.943** | **402** | **262.126** | **152.843** | **92.391** | **66.25** |

**Table 5.3.a** : **P value of SGPT after treatment with *Phyllanthus amarus***

| Group | Mean | Standard Deviation | Standard Error of Mean | Median |
|---|---|---|---|---|
| Initial | 747.94 | 771.02 | 74.192 | 535.00 |
| First | 402.00 | 469.50 | 45.178 | 210.00 |
| Second | 262.13 | 291.23 | 32.561 | 170.00 |
| Third | 152.84 | 144.42 | 20.027 | 95.00 |
| Fourth | 92.391 | 71.229 | 14.540 | 82.00 |
| Sixth | 66.250 | 19.486 | 8.714 | 66.25 |

**Table 5.3.b: Paired Samples Test of SGPT for *Phyllanthus amarus.***

| Pair | Paired Differences | | | | | t test | df | P value Significant (2 tailed) |
|---|---|---|---|---|---|---|---|---|
| | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | Lower | Upper | | | |
| A | 345.943 | 351.729 | 34.003 | 278.529 | 413.358 | 10.174 | 106 | 0.000* |
| B | 696.215 | 569.257 | 64.046 | 568.708 | 823.721 | 10.870 | 78 | 0.000* |
| C | 1088.74 | 749.371 | 104.933 | 877.980 | 1299.50 | 10.376 | 50 | 0.000* |
| D | 1573.13 | 991.899 | 206.825 | 1144.20 | 2002.05 | 7.606 | 22 | 0.000* |
| E | 1685.00 | 1196.85 | 598.428 | 219.466 | 3589.46 | 2.816 | 3 | 0.067 |

A=Initial-First week, B=Initial- Second week, C= Initial- Third week, D=Initial-Fourth week, E= Initial-Sixth week

Where * = The P value is < 0.001, considered significant.

**Table 5.4: SGPT values of the patients after treatment with Livercare Churna**

| Sr. no of patients | Age | SGPT values after different weeks treatment | | | | | |
|---|---|---|---|---|---|---|---|
| | | Initial (zero week) | First | Second | Third | Fourth | Sixth |
| 1 | 17 | 210 | 130 | 70 | - | - | - |
| 2 | 47 | 1050 | 630 | 290 | 80 | - | - |
| 3 | 49 | 490 | 270 | 85 | - | - | - |
| 4 | 51 | 2450 | 1760 | 1030 | 540 | 230 | 40 |
| 5 | 31 | 610 | 310 | 110 | - | - | - |
| 6 | 53 | 890 | 470 | 190 | 45 | - | - |
| 7 | 47 | 298 | 170 | 110 | 45 | - | - |
| 8 | 40 | 3200 | 2350 | 1430 | 770 | 310 | 35 |
| 9 | 47 | 2250 | 1770 | 1090 | 440 | 130 | - |
| 10 | 50 | 1450 | 730 | 470 | 180 | 90 | - |
| 11 | 44 | 790 | 410 | 100 | - | - | - |
| 12 | 46 | 3480 | 2570 | 1720 | 1070 | 645 | 95 |
| 13 | 35 | 780 | 590 | 310 | 80 | - | - |
| 14 | 55 | 450 | 195 | 60 | - | - | - |
| 15 | 50 | 1270 | 1040 | 770 | 490 | 110 | |
| 16 | 60 | 3610 | 2140 | 1950 | 1170 | 640 | 80 |
| 17 | 43 | 270 | 110 | - | - | - | - |
| 18 | 45 | 320 | 185 | 65 | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 19 | 40 | 3200 | 1530 | 890 | 540 | 360 | 40 |
| 20 | 29 | 492 | 240 | 80 | | - | - |
| 21 | 44 | 2015 | 1310 | 430 | 190 | 28 | - |
| 22 | 25 | 2540 | 1070 | 610 | 310 | 35 | - |
| 23 | 17 | 2215 | 1130 | 680 | 210 | 42 | - |
| 24 | 40 | 195 | 45 | - | - | - | - |
| 25 | 35 | 2250 | 1240 | 700 | 240 | 60 | - |
| 26 | 25 | 2600 | 1330 | 790 | 320 | 75 | - |
| 27 | 21 | 1810 | 1020 | 570 | 270 | 40 | - |
| 28 | 52 | 285 | 70 | 25 | - | - | - |
| 29 | 45 | 1420 | 830 | 440 | 180 | 65 | - |
| 30 | 62 | 2470 | 1820 | 1180 | 830 | 540 | 90 |
| 31 | 50 | 430 | 110 | 55 | - | - | - |
| 32 | 45 | 1350 | 760 | 320 | 85 | - | - |
| 33 | 50 | 1845 | 1130 | 680 | 210 | 80 | - |
| 34 | 30 | 1530 | 890 | 570 | 390 | 100 | - |
| 35 | 19 | 1745 | 1090 | 630 | 210 | 55 | - |
| 36 | 45 | 515 | 270 | 65 | - | - | - |
| 37 | 25 | 1420 | 690 | 120 | 60 | - | - |
| 38 | 25 | 1240 | 640 | 210 | 90 | - | - |
| 39 | 27 | 1420 | 890 | 480 | 110 | 75 | - |
| 40 | 17 | 945 | 540 | 320 | 90 | - | - |
| 41 | 57 | 1200 | 580 | 270 | 85 | - | - |
| 42 | 45 | 260 | 190 | 65 | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 43 | 60 | 380 | 210 | 100 | - | - | - |
| 44 | 49 | 360 | 170 | 65 | - | - | - |
| 45 | 36 | 200 | 120 | 65 | - | - | - |
| 46 | 49 | 2200 | 1870 | 1170 | 775 | 390 | 50 |
| 47 | 50 | 1240 | 730 | 370 | 85 | - | - |
| 48 | 40 | 3290 | 2500 | 1390 | 820 | 380 | 75 |
| 49 | 40 | 2100 | 1870 | 1070 | 390 | 90 | - |
| 50 | 39 | 245 | 95 | - | - | - | - |
| 51 | 41 | 2700 | 2250 | 1785 | 1190 | 540 | 95 |
| 52 | 45 | 480 | 170 | 80 | - | - | - |
| 53 | 29 | 1210 | 650 | 320 | 65 | - | - |
| 54 | 52 | 560 | 270 | 62 | - | - | - |
| 55 | 50 | 1265 | 775 | 390 | 100 | - | - |
| 56 | 49 | 1750 | 1080 | 680 | 310 | 45 | - |
| 57 | 39 | 340 | 110 | - | - | - | - |
| 58 | 11 | 680 | 240 | 60 | - | - | - |
| 59 | 19 | 715 | 210 | 45 | - | - | - |
| 60 | 52 | 550 | 430 | 240 | 90 | - | - |
| 61 | 21 | 1320 | 940 | 690 | 360 | 120 | - |
| 62 | 29 | 750 | 580 | 310 | 180 | 55 | - |
| 63 | 40 | 140 | 80 | 45 | - | - | - |
| 64 | 55 | 180 | 40 | - | - | - | - |
| 65 | 50 | 750 | 480 | 370 | 210 | 70 | - |
| 66 | 39 | 310 | 110 | 54 | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 67 | 38 | 380 | 160 | 45 | - | - | - |
| 68 | 19 | 1075 | 490 | 210 | 85 | - | - |
| 69 | 35 | 2650 | 1280 | 630 | 290 | 80 | - |
| 70 | 45 | 340 | 190 | 75 | - | - | - |
| 71 | 31 | 1625 | 745 | 320 | 65 | - | - |
| 72 | 49 | 190 | 60 | - | - | - | - |
| 73 | 45 | 130 | 65 | - | - | - | - |
| 74 | 53 | 470 | 190 | 75 | - | - | - |
| 75 | 48 | 230 | 40 | - | - | - | - |
| 76 | 20 | 160 | 45 | - | - | - | - |
| 77 | 17 | 750 | 370 | 60 | - | - | - |
| 78 | 27 | 3010 | 1830 | 1110 | 830 | 460 | 80 |
| 79 | 31 | 800 | 380 | 45 | - | - | - |
| 80 | 50 | 180 | 50 | - | - | - | - |
| 81 | 35 | 2190 | 1745 | 1070 | 470 | 90 | |
| 82 | 39 | 130 | 50 | - | - | - | - |
| 83 | 29 | 380 | 85 | - | - | - | - |
| 84 | 41 | 118 | 45 | - | - | - | - |
| 85 | 22 | 120 | 85 | - | - | - | - |
| 86 | 31 | 1060 | 470 | 270 | 95 | - | - |
| 87 | 47 | 260 | 75 | - | - | - | - |
| 88 | 28 | 425 | 190 | 40 | - | - | - |
| 89 | 12 | 390 | 90 | - | - | - | - |
| 90 | 41 | 140 | 50 | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 91 | 36 | 410 | 85 | - | - | - | - |
| 92 | 44 | 460 | 180 | 65 | - | - | - |
| 93 | 39 | 540 | 280 | 65 | - | - | - |
| **Average** | | **1092.344** | **651.075** | **446.28** | **334.893** | **194.516** | **68** |

**Table 5.5.a: P value of SGPT after treatment with Livercare Churna**

| **Group (week)** | **Mean** | **Standard Deviation** | **Standard Error of Mean** | **Median** |
|---|---|---|---|---|
| Initial | 1092.3 | 933.22 | 96.254 | 750.00 |
| First | 651.08 | 658.63 | 67.932 | 420.00 |
| Second | 446.28 | 463.63 | 53.182 | 310.00 |
| Third | 334.89 | 309.64 | 44.692 | 210.00 |
| Fourth | 194.52 | 192.65 | 34.056 | 90.00 |
| Sixth | 68.000 | 22.935 | 6.915 | 75.00 |

**Table 5.5.b: Paired samples test of SGPT after treatment with Livercare Churna**

| Pair | Paired Differences | | | | | t test | df | P value Significant (2 tailed) |
|---|---|---|---|---|---|---|---|---|
| | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference Lower | Upper | | | |
| A | 397.374 | 354.245 | 34.407 | 329.151 | 465.597 | 11.549 | 105 | 0.000* |
| B | 779.914 | 558.323 | 60.918 | 658.750 | 901.077 | 12.803 | 83 | 0.000* |
| C | 1342.05 | 698.744 | 96.898 | 1147.52 | 1536.58 | 13.850 | 51 | 0.000* |
| D | 1862.10 | 777.905 | 135.41 | 1586.26 | 2137.93 | 13.751 | 32 | 0.000* |
| E | 2893.00 | 474.881 | 150.17 | 2553.29 | 3232.70 | 19.265 | 9 | 0.000* |

A=Initial-First week, B=Initial- Second week, C= Initial- Third week, D=Initial-Fourth week, E= Initial-Sixth week

Where * = The P value is < 0.001, considered significant.

**Table 5.6: SGPT values of the patients after treatment with Hepatogard forte Tablet**

| Sr. no of patients | Age | SGPT values after different weeks treatment | | | | | |
|---|---|---|---|---|---|---|---|
| | | Initial (zero week) | First | Second | Third | Fourth | Sixth |
| 1 | 32 | 370 | 190 | 45 | - | - | - |
| 2 | 34 | 700 | 390 | 210 | 85 | - | - |
| 3 | 50 | 2250 | 1890 | 1200 | 970 | 535 | 110 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4 | 39 | 3690 | 2980 | 2110 | 1340 | 650 | 210 |
| 5 | 39 | 2700 | 2260 | 1390 | 810 | 390 | 110 |
| 6 | 60 | 3250 | 2790 | 1770 | 1090 | 435 | 110 |
| 7 | 32 | 1250 | 810 | 645 | 290 | 85 | - |
| 8 | 49 | 780 | 610 | 370 | 230 | 65 | - |
| 9 | 55 | 260 | 170 | 90 | - | - | - |
| 10 | 60 | 380 | 210 | 85 | - | - | - |
| 11 | 35 | 520 | 310 | 140 | 65 | - | - |
| 12 | 36 | 290 | 130 | 90 | - | - | - |
| 13 | 58 | 680 | 490 | 330 | 290 | 170 | 65 |
| 14 | 40 | 300 | 130 | 60 | - | - | - |
| 15 | 50 | 340 | 170 | 65 | - | - | - |
| 16 | 29 | 235 | 165 | 90 | - | - | - |
| 17 | 38 | 180 | 112 | 65 | - | - | - |
| 18 | 42 | 210 | 150 | 75 | - | - | - |
| 19 | 59 | 205 | 130 | 65 | - | - | - |
| 20 | 11 | 340 | 190 | 70 | - | - | - |
| 21 | 32 | 1150 | 740 | 390 | 190 | 45 | - |
| 22 | 60 | 1800 | 845 | 340 | 190 | 65 | - |
| 23 | 35 | 470 | 190 | 75 | - | - | - |
| 24 | 59 | 1100 | 590 | 240 | 85 | - | - |
| 25 | 49 | 680 | 390 | 110 | 55 | - | - |
| 26 | 21 | 1260 | 740 | 320 | 110 | - | - |
| 27 | 60 | 260 | 180 | 80 | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 28 | 45 | 220 | 170 | 110 | 45 | - | - |
| 29 | 50 | 1490 | 970 | 530 | 320 | 110 | - |
| 30 | 55 | 250 | 120 | 85 | 45 | - | - |
| 31 | 51 | 940 | 430 | 190 | 110 | - | - |
| 32 | 23 | 1110 | 820 | 520 | 310 | 90 | - |
| 33 | 20 | 210 | 120 | 50 | - | - | - |
| 34 | 22 | 115 | 50 | - | - | - | - |
| 35 | 48 | 220 | 130 | 60 | - | - | - |
| 36 | 47 | 1500 | 980 | 590 | 310 | 95 | - |
| 37 | 41 | 940 | 470 | 230 | 110 | - | - |
| 38 | 32 | 1040 | 725 | 410 | 210 | 110 | - |
| 39 | 21 | 740 | 360 | 95 | - | - | - |
| 40 | 21 | 810 | 430 | 220 | 65 | - | - |
| 41 | 22 | 140 | 60 | - | - | - | - |
| 42 | 50 | 180 | 70 | - | - | - | - |
| 43 | 42 | 120 | 55 | - | - | - | - |
| 44 | 30 | 375 | 110 | 55 | - | - | - |
| 45 | 18 | 425 | 340 | 210 | 63 | - | - |
| 46 | 30 | 150 | 45 | - | - | - | - |
| 47 | 40 | 410 | 180 | 120 | 58 | - | - |
| 48 | 35 | 180 | 50 | - | - | - | - |
| 49 | 28 | 430 | 370 | 290 | 180 | 70 | - |
| 50 | 37 | 895 | 710 | 410 | 310 | 170 | 60 |
| 51 | 49 | 130 | 100 | 45 | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 52 | 30 | 125 | 110 | 65 | - | - | - |
| 53 | 29 | 190 | 70 | - | - | - | - |
| 54 | 41 | 470 | 310 | 190 | 85 | - | - |
| 55 | 42 | 450 | 300 | 95 | - | - | - |
| 56 | 37 | 130 | 55 | - | - | - | - |
| 57 | 18 | 650 | 430 | 280 | 160 | 60 | - |
| 58 | 13 | 145 | 65 | - | - | - | - |
| 59 | 23 | 485 | 240 | 180 | 150 | 100 | 45 |
| 60 | 28 | 110 | 53 | - | - | - | - |
| 61 | 45 | 635 | 540 | 320 | 120 | 80 | - |
| 62 | 15 | 670 | 480 | 370 | 80 | - | - |
| 63 | 50 | 1310 | 840 | 530 | 210 | 80 | - |
| 64 | 32 | 380 | 90 | - | - | - | - |
| 65 | 43 | 2100 | 1400 | 790 | 460 | 320 | 80 |
| 66 | 36 | 2020 | 970 | 470 | 310 | 70 | - |
| 67 | 38 | 390 | 90 | - | - | - | - |
| 68 | 35 | 648 | 320 | 110 | - | - | - |
| 69 | 51 | 290 | 180 | 80 | - | - | - |
| 70 | 55 | 550 | 430 | 220 | 110 | 50 | - |
| 71 | 43 | 270 | 120 | 60 | - | - | - |
| 72 | 46 | 390 | 190 | 70 | - | - | - |
| 73 | 59 | 270 | 90 | - | - | - | - |
| 74 | 39 | 320 | 280 | 170 | 110 | 70 | - |
| 75 | 55 | 1060 | 630 | 480 | 210 | 90 | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 76 | 35 | 1100 | 620 | 310 | 80 | - | - |
| 77 | 51 | 155 | 60 | - | - | - | - |
| 78 | 45 | 980 | 610 | 290 | 85 | - | - |
| 79 | 40 | 600 | 310 | 90 | - | - | - |
| 80 | 17 | 1920 | 1010 | 640 | 380 | 200 | 49 |
| 81 | 50 | 825 | 580 | 320 | 75 | - | - |
| 82 | 50 | 280 | 95 | - | - | - | - |
| 83 | 20 | 700 | 350 | 85 | - | - | - |
| 84 | 51 | 430 | 220 | 75 | - | - | - |
| 85 | 55 | 320 | 120 | 60 | - | - | - |
| 86 | 50 | 1250 | 570 | 310 | 45 | - | - |
| 87 | 39 | 250 | 150 | 55 | - | - | - |
| 88 | 47 | 2190 | 1540 | 630 | 310 | 45 | - |
| 89 | 37 | 538 | 230 | 110 | - | - | - |
| 90 | 40 | 280 | 130 | 45 | - | - | - |
| 91 | 51 | 1750 | 880 | 320 | 75 | - | - |
| 92 | 47 | 2380 | 1790 | 1430 | 910 | 425 | 90 |
| 93 | 49 | 1390 | 870 | 530 | 290 | 95 | - |
| 94 | 39 | 300 | 140 | 55 | - | - | - |
| 95 | 35 | 550 | 290 | 130 | 45 | - | - |
| **Average** | | **746.484** | **470.157** | **308.812** | **254.916** | **170.357** | **92.9** |

**Table 5.7.a: P value of SGPT after treatment with Hepatogard forte Tablet**

| Group (week) | Mean | Standard Deviation | Standard Error of Mean | Median |
|---|---|---|---|---|
| Initial | 746.48 | 690.95 | 66.486 | 430.00 |
| First | 470.15 | 533.54 | 52.318 | 285.00 |
| Second | 308.81 | 370.96 | 39.771 | 180.00 |
| Third | 254.91 | 280.11 | 38.477 | 120.00 |
| Fourth | 170.35 | 159.93 | 28.725 | 90.000 |
| Sixth | 92.900 | 45.658 | 13.767 | 90.000 |

**Table 5.7.b: Paired samples test of SGPT after treatment with Hepatogard forte Tablet**

| Pair | Paired Differences | | | | | t test | df | P value Significant (2 tailed) |
|---|---|---|---|---|---|---|---|---|
| | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | Lower | Upper | | | |
| A | 271.822 | 218.012 | 21.076 | 230.037 | 313.607 | 12.89 | 106 | 0.000* |
| B | 536.329 | 395.935 | 42.206 | 452.438 | 620.220 | 12.70 | 87 | 0.000* |
| C | 907.944 | 528.325 | 71.895 | 763.739 | 1052.14 | 12.62 | 53 | 0.000* |
| D | 1255.645 | 728.786 | 130.893 | 988.324 | 1522.96 | 9.593 | 30 | 0.000* |
| E | 1804.181 | 1082.89 | 326.506 | 1076.67 | 2531.68 | 5.526 | 10 | 0.000* |

A=Initial-First week, B=Initial- Second week, C= Initial- Third week, D=Initial-Fourth week, E= Initial-Sixth week

Where * = The P value is < 0.001, considered significant.

**Table 5.8: Comparative average SGPT values for different week treatment using *Phyllanthus amarus*, Livercare Churna and Hepatogard forte Tablet.**

| Week | *Phyllanthus amarus* | Livercare Churna | Hepatogard forte Tablet |
|---|---|---|---|
| Initial | 747.944 | 1092.344 | 746.484 |
| First | 402.000 | 651.075 | 470.157 |
| Second | 262.126 | 446.280 | 308.812 |
| Third | 152.843 | 334.893 | 254.916 |
| Fourth | 92.391 | 194.516 | 170.357 |
| Sixth | 66.250 | 68.000 | 92.900 |

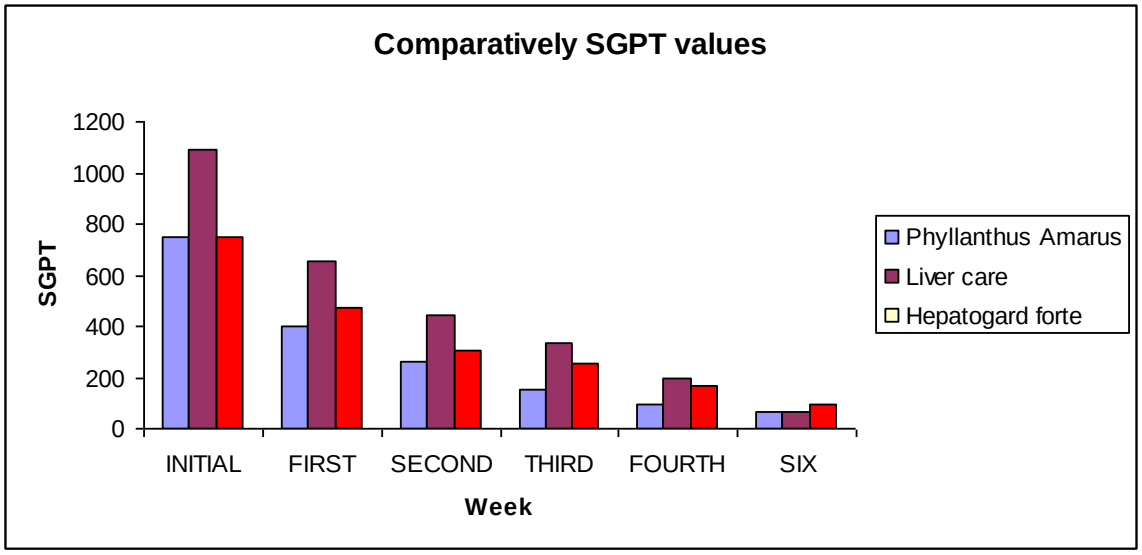



**Figure 5.2: SGPT v/s Week of treatment. Column graph showing comparative value of SGPT for different week treatment using *Phyllanthus amarus*, Livercare Churna and Hepatogard forte Tablet as hepatoprotective drugs.**

For *Phyllanthus amarus* the mean SGPT value of the group on zero day is considered as 100%. In comparison with zero week, SGPT level are recovered on first week 46.18% on second week 64.92% on third week 79.65%, on fourth week87.63% and sixth weeks 91.13% respectively. The P value is < 0.0001.

For Livercare Churna the mean SGPT value of the group on zero day is considered as 100%. In comparison with zero week, SGPT level are recovered on first week 40.38%, on second week 59.15%, on third week 69.41%, on fourth week 82.23% and sixth weeks 93.77% respectively. The P value is < 0.0001.

For Hepatogard forte Tablet the mean SGPT value of the group on zero day is considered as 100%. In comparison with zero week, SGPT level are recovered on first week 36.99%, on second week 58.71%, on third week 65.95%, on fourth week 77.21% and sixth weeks 87.66% respectively. The P value is < 0.0001.

**Table 5. 9: Percentage recovery of SGPT with different formulations**

| **Treatment** | **%Recovery** | | | | |
|---|---|---|---|---|---|
| Formulation | First week | Second week | Third week | Fourth week | Sixth week |
| *Phyllanthus amarus* | 46.18 | 64.92 | 79.65 | 87.63 | 91.13 |
| Livercare Churna | 40.38 | 59.15 | 69.41 | 82.23 | 93.77 |
| Hepatogard forte Tablet | 36.99 | 58.71 | 65.95 | 77.21 | 87.66 |

**Table 5.10: Bilirubin values of the patients after treatment with *Phyllanthus amarus.***

| Sr. no of patients | Age | Bilirubin value mg % after different week treatment | | | | | |
|---|---|---|---|---|---|---|---|
| | | Initial (zero week) | First | Second | Third | Forth | Six |
| 1 | 28 | 1.6 | 1.1 | - | - | - | - |
| 2 | 51 | 3.2 | 1.4 | - | - | - | - |
| 3 | 20 | 3 | 1.1 | - | - | - | - |
| 4 | 16 | 9.6 | 6.2 | 4.6 | 2.9 | 1.1 | - |
| 5 | 42 | 12.2 | 8.2 | 5.2 | 2.8 | 1 | - |
| 6 | 17 | 4.2 | 1.9 | 0.9 | - | - | - |
| 7 | 65 | 2.6 | 1 | - | - | - | - |
| 8 | 65 | 1.3 | 0.9 | - | - | - | - |
| 9 | 36 | 12 | 7.3 | 4.3 | 1.1 | - | - |
| 10 | 42 | 2.7 | 1.2 | - | - | - | - |
| 11 | 35 | 11.2 | 7.4 | 4.3 | 1.1 | - | - |
| 12 | 21 | 6.1 | 5.8 | 4.3 | 1 | - | - |
| 13 | 32 | 4.7 | 3.1 | 1.2 | - | - | - |
| 14 | 32 | 13 | 5.4 | 1.2 | - | - | - |
| 15 | 28 | 12.4 | 10.2 | 8.2 | 6.3 | 1.2 | - |
| 16 | 45 | 1.5 | 1.2 | 1 | - | - | - |
| 17 | 17 | 3.2 | 1.2 | - | - | - | - |
| 18 | 32 | 3.5 | 1.1 | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 19 | 20 | 12.5 | 11.1 | 7.8 | 3.8 | 0.9 | - |
| 20 | 38 | 10.6 | 9.8 | 6.5 | 3.6 | 1.3 | 0.9 |
| 21 | 19 | 1.8 | 1.6 | 1.2 | 0.9 | - | - |
| 22 | 38 | 1.8 | 1.1 | - | - | - | - |
| 23 | 16 | 4.8 | 4.1 | 3.9 | 2.9 | 2.1 | 1.1 |
| 24 | 19 | 3.9 | 2.8 | 2 | 1 | - | - |
| 25 | 22 | 4.8 | 3.9 | 2.4 | 1.1 | - | - |
| 26 | 65 | 12.1 | 6.2 | 3.1 | 1.3 | - | - |
| 27 | 35 | 5.4 | 2.6 | 1.1 | - | - | - |
| 28 | 32 | 4.8 | 2.1 | 0.9 | - | - | - |
| 29 | 42 | 2.2 | 1 | - | - | - | - |
| 30 | 43 | 18 | 13.4 | 8.3 | 5.3 | 3 | 1.2 |
| 31 | 28 | 12.3 | 8.1 | 4.4 | 2.1 | 1.2 | - |
| 32 | 50 | 13.3 | 9.2 | 6.1 | 3.2 | 1.3 | - |
| 33 | 55 | 7.4 | 3.1 | 0.9 | 0.9 | - | - |
| 34 | 45 | 9.4 | 5.2 | 2.1 | 0.9 | - | - |
| 35 | 55 | 7.3 | 3.9 | 1 | - | - | - |
| 36 | 40 | 3.2 | 1.6 | 1 | - | - | - |
| 37 | 20 | 4.2 | 2.1 | 1 | 0.9 | - | - |
| 38 | 50 | 4.3 | 2.1 | 0.9 | - | - | - |
| 39 | 45 | 4.3 | 1.9 | 1 | - | - | - |
| 40 | 50 | 5.5 | 3.2 | 2 | 1.2 | 0.9 | - |
| 41 | 50 | 7.3 | 4.2 | 2.1 | 0.9 | - | - |
| 42 | 45 | 4.9 | 1.7 | 1.2 | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 43 | 32 | 6.4 | 2.2 | 1.6 | 1.2 | 0.9 | - |
| 44 | 55 | 3.9 | 1.7 | 1 | - | - | - |
| 45 | 21 | 10.2 | 6.4 | 3.2 | 2.1 | 0.9 | - |
| 46 | 50 | 9.8 | 4.8 | 3.4 | 2.2 | 1 | - |
| 47 | 19 | 3.4 | 1.2 | - | - | - | - |
| 48 | 42 | 8.5 | 4.3 | 1.7 | 0.9 | - | - |
| 49 | 71 | 2.5 | 1.2 | - | - | - | - |
| 50 | 38 | 14 | 9.2 | 6.2 | 3.6 | 1.3 | - |
| 51 | 30 | 11.5 | 7.3 | 3.4 | 1.1 | - | - |
| 52 | 30 | 1.9 | 0.9 | - | - | - | - |
| 53 | 54 | 2.9 | 1 | - | - | - | - |
| 54 | 42 | 1.7 | 1 | 0.9 | - | - | - |
| 55 | 22 | 2.9 | 1.4 | 0.9 | - | - | - |
| 56 | 42 | 7.4 | 4.8 | 2.3 | 1 | - | - |
| 57 | 46 | 10.1 | 8.2 | 6.3 | 3.4 | 1 | - |
| 58 | 11 | 2.9 | 0.9 | - | - | - | - |
| 59 | 38 | 6.5 | 3.4 | 1.9 | 0.9 | - | - |
| 60 | 70 | 2.7 | 1 | - | - | - | - |
| 61 | 20 | 11.2 | 8.2 | 4.2 | 1.2 | - | - |
| 62 | 23 | 4.5 | 1.2 | 0.9 | - | - | - |
| 63 | 35 | 8.5 | 5.1 | 2.4 | 1 | - | - |
| 64 | 36 | 3.4 | 2 | 1 | - | - | - |
| 65 | 24 | 6.1 | 2.8 | 1.1 | - | - | - |
| 66 | 40 | 2.9 | 0.9 | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 67 | 28 | 9.3 | 4.2 | 2 | 1 | - | - |
| 68 | 13 | 2.9 | 1 | - | - | - | - |
| 69 | 45 | 3.2 | 2.1 | 1.1 | 0.9 | - | - |
| 70 | 15 | 3.2 | 1 | - | - | - | - |
| 71 | 32 | 4.8 | 2.1 | 1.3 | 0.9 | - | - |
| 72 | 55 | 5.1 | 3.2 | 2.7 | 1.4 | 0.9 | - |
| 73 | 11 | 3.4 | 2.1 | 1 | - | - | - |
| 74 | 30 | 5.9 | 3.1 | 1.9 | 1 | - | - |
| 75 | 12 | 4 | 2.1 | 1 | - | - | - |
| 76 | 13 | 3.2 | 1.2 | - | - | - | - |
| 77 | 65 | 12 | 8.4 | 5.4 | 3.1 | 1.1 | - |
| 78 | 30 | 3.4 | 1.3 | - | - | - | - |
| 79 | 50 | 6 | 2.9 | 1 | - | - | - |
| 80 | 49 | 4.9 | 3.2 | 2.2 | 1.7 | 1 | - |
| 81 | 45 | 3.9 | 1.8 | 1 | - | - | - |
| 82 | 36 | 4.3 | 3.3 | 2.3 | 1.7 | 0.9 | - |
| 83 | 40 | 6.1 | 2.9 | 1.2 | - | - | - |
| 84 | 11 | 3.9 | 3 | 2.4 | 1.3 | 0.8 | - |
| 85 | 50 | 4.5 | 2.4 | 1.1 | - | - | - |
| 86 | 35 | 4.2 | 2.1 | 0.9 | - | - | - |
| 87 | 30 | 6.5 | 3.2 | 1.8 | 0.9 | - | - |
| 88 | 25 | 4.5 | 2.3 | 1 | - | - | - |
| 89 | 65 | 3 | 1.7 | 0.9 | - | - | - |
| 90 | 30 | 1.5 | 1 | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 91 | 35 | 2.8 | 1 | - | - | - | - |
| 92 | 50 | 7.8 | 5.1 | 3.2 | 0.9 | - | - |
| 93 | 37 | 1.7 | 1 | - | - | - | - |
| 94 | 53 | 5 | 3.2 | 2.1 | 1 | - | - |
| 95 | 42 | 7 | 4.5 | 2.9 | 1.1 | - | - |
| 96 | 12 | 3.9 | 2.9 | 1.4 | 0.9 | - | - |
| 97 | 40 | 17 | 11.2 | 8.3 | 6 | 3.2 | 1 |
| 98 | 45 | 3 | 1 | - | - | - | - |
| 99 | 27 | 9.1 | 6.2 | 3.8 | 1 | - | - |
| 100 | 25 | 2.4 | 1 | - | - | - | - |
| 101 | 21 | 2.5 | 1.8 | 11.7 | - | - | - |
| 102 | 30 | 4 | 3.2 | 2.1 | 1.7 | 0.9 | - |
| 103 | 20 | 7.8 | 4.2 | 1.3 | - | - | - |
| 104 | 51 | 3.2 | 1.2 | - | - | - | - |
| 105 | 5 | 14 | 8.4 | 5.3 | 2.9 | 1 | - |
| 106 | 42 | 3.3 | 1.1 | - | - | - | - |
| 107 | 32 | 7.5 | 4.7 | 2.1 | 1 | - | - |
| **Average** | | **5.9401** | **3.5149** | **2.7202** | **1.8470** | **1.2565** | **1.05** |

**Table5.11.a**: **P value of Billirubin after treatment with *Phyllanthus amarus***

| Group | Mean | Standard Deviation | Standard Error of Mean | Median |
|---|---|---|---|---|
| Initial | 5.940 | 3.744 | 0.3602 | 4.600 |
| First | 3.515 | 2.804 | 0.2698 | 2.700 |
| Second | 2.720 | 2.226 | 0.2489 | 2.000 |
| Third | 1.847 | 1.339 | 0.1856 | 1.150 |
| Fourth | 1.257 | 0.6261 | 0.1278 | 1.000 |
| Sixth | 1.050 | 0.1118 | 0.0500 | 1.050 |

**Table 5.11.b: Paired samples test of bilirubin after treatment with *Phyllanthus amarus***

| | Paired Differences | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | 95% Confidence Interval of the Difference | | | | |
| Pair | Mean | Std. Deviation | Std. Error Mean | Lower | Upper | t test | df | P value Significant (2 tailed) |
| A | 2.4252 | 1.399 | 0.135 | 2.1569 | 2.693 | 17.922 | 106 | 0.000* |
| B | 4.3772 | 2.803 | 0.315 | 3.7491 | 5.005 | 13.876 | 78 | 0.000* |
| C | 6.5980 | 2.970 | 0.415 | 5.7625 | 7.433 | 15.862 | 50 | 0.000* |
| D | 8.6087 | 3.933 | 0.820 | 6.9075 | 10.309 | 10.495 | 22 | 0.000* |
| E | 11.550 | 6.121 | 3.064 | 1.8096 | 21.290 | 3.774 | 3 | 0.033 |

A=Initial-First week, B=Initial- Second week, C= Initial- Third week , D=Initial-Fourth week, E= Initial-Sixth week

Where * = The P value is < 0.001, considered significant.

**Table 5.12: Bilirubin values of the patients after treatment with Livercare Churna.**

| Sr. no of patients | Age | Bilirubin value mg % after different week treatment | | | | | |
|---|---|---|---|---|---|---|---|
| | | Initial (zero week) | First | Second | Third | Fourth | Sixth |
| 1 | 17 | 4.1 | 2.2 | 1 | - | - | - |
| 2 | 47 | 3.9 | 2.9 | 1.8 | 1 | - | - |
| 3 | 49 | 5.7 | 2.1 | 1.2 | - | - | - |
| 4 | 51 | 6.9 | 4.6 | 3.1 | 2.3 | 1.7 | 0.8 |
| 5 | 31 | 4.9 | 2.6 | 1 | - | - | - |
| 6 | 53 | 8 | 4.4 | 2.1 | 0.9 | - | - |
| 7 | 47 | 8.9 | 5.4 | 3.1 | 1 | - | - |
| 8 | 40 | 7.9 | 6.3 | 5.3 | 3.1 | 2.7 | 0.9 |
| 9 | 47 | 9.7 | 4.3 | 3.1 | 2 | 1 | - |
| 10 | 50 | 6.8 | 4.2 | 3.4 | 2.1 | 1 | - |
| 11 | 44 | 3.2 | 1.7 | 0.9 | - | - | - |
| 12 | 46 | 9.9 | 7.8 | 5.4 | 4.3 | 2.1 | 0.9 |
| 13 | 35 | 5.5 | 3.3 | 2 | 0.9 | - | - |
| 14 | 55 | 3.7 | 2.1 | 0.9 | - | - | - |
| 15 | 50 | 11.5 | 8.9 | 6.5 | 3.1 | 1 | - |
| 16 | 60 | 7.7 | 4.3 | 3.2 | 2.1 | 1.3 | 0.9 |
| 17 | 43 | 3.9 | 1.1 | - | - | - | - |
| 18 | 45 | 4.5 | 2.9 | 0.9 | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 19 | 40 | 7.6 | 6.2 | 4.9 | 2.4 | 1.4 | 1 |
| 20 | 29 | 2.4 | 1.7 | 0.9 | - | - | - |
| 21 | 44 | 9.5 | 6.3 | 4.3 | 2.1 | 1 | - |
| 22 | 25 | 4.1 | 3.2 | 2.5 | 1.8 | 0.9 | - |
| 23 | 17 | 6.7 | 4.3 | 3.2 | 1.8 | 1.1 | - |
| 24 | 40 | 2.9 | 1.2 | - | - | - | - |
| 25 | 35 | 8 | 6.1 | 4.3 | 3.1 | 1 | - |
| 26 | 25 | 5.3 | 5.2 | 4.6 | 2.8 | 1.2 | - |
| 27 | 21 | 6.5 | 4.3 | 3.2 | 1.8 | 1 | - |
| 28 | 52 | 4 | 1.8 | 1 | - | - | - |
| 29 | 45 | 4.8 | 3.2 | 2 | 1.3 | 0.9 | - |
| 30 | 62 | 30 | 21.2 | 12.6 | 7.3 | 4.9 | 1.2 |
| 31 | 50 | 2 | 1.4 | 1 | - | - | - |
| 32 | 45 | 5.7 | 4.5 | 2.2 | 1 | - | - |
| 33 | 50 | 7.3 | 4.3 | 3.2 | 1.8 | 1 | - |
| 34 | 30 | 6 | 4.9 | 4 | 2.1 | 1.1 | - |
| 35 | 19 | 6.2 | 4.8 | 3.2 | 2.2 | 0.9 | - |
| 36 | 45 | 4 | 2.3 | 1 | - | - | - |
| 37 | 25 | 3.2 | 1.9 | 1.4 | 0.9 | - | - |
| 38 | 25 | 4 | 2.4 | 1.6 | 1 | - | - |
| 39 | 27 | 6.6 | 5.1 | 3.8 | 2.1 | 1.1 | - |
| 40 | 17 | 2.4 | 2 | 1.5 | 1 | - | - |
| 41 | 57 | 5.3 | 2.9 | 1.6 | 1 | - | - |
| 42 | 45 | 4.7 | 2.1 | 1.1 | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 43 | 60 | 5.1 | 2.6 | 1.2 | - | - | - |
| 44 | 49 | 5.5 | 2.6 | 1.1 | - | - | - |
| 45 | 36 | 4.7 | 1.9 | 0.9 | - | - | - |
| 46 | 49 | 6.9 | 6.2 | 4.4 | 3.2 | 2.1 | 0.9 |
| 47 | 50 | 4.3 | 3.2 | 2.1 | 1 | - | - |
| 48 | 40 | 7.4 | 5.9 | 3.6 | 2.2 | 1.7 | 0.9 |
| 49 | 40 | 6.7 | 5.8 | 3.2 | 1.8 | 0.9 | - |
| 50 | 39 | 3.9 | 1.2 | - | - | - | - |
| 51 | 41 | 13.2 | 11.2 | 8.9 | 6.4 | 2.8 | 1 |
| 52 | 45 | 5.6 | 2.8 | 0.9 | - | - | - |
| 53 | 29 | 5.3 | 2.4 | 1.8 | 0.9 | - | - |
| 54 | 52 | 3.5 | 1.3 | 0.9 | - | - | - |
| 55 | 50 | 7.8 | 4.7 | 3.8 | 1.1 | - | - |
| 56 | 49 | 6.8 | 5.3 | 4.3 | 2.1 | 1 | - |
| 57 | 39 | 3.8 | 1 | - | - | - | - |
| 58 | 11 | 7 | 3.2 | 1.1 | - | - | - |
| 59 | 19 | 5.5 | 2.2 | 1.1 | - | - | - |
| 60 | 52 | 4.5 | 3.9 | 2.3 | 1 | - | - |
| 61 | 21 | 12.2 | 8.4 | 5.9 | 3.4 | 1 | - |
| 62 | 29 | 10.3 | 8 | 4.7 | 2.1 | 0.9 | - |
| 63 | 40 | 6.9 | 3.1 | 1.2 | - | - | - |
| 64 | 55 | 1.9 | 1.1 | - | - | - | - |
| 65 | 50 | 14.9 | 8.4 | 5.3 | 2.9 | 1.1 | - |
| 66 | 39 | 4.3 | 1.8 | 0.9 | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 67 | 38 | 4 | 2.1 | 1 | - | - | - |
| 68 | 19 | 3.2 | 2.3 | 1.2 | 0.9 | - | - |
| 69 | 35 | 6.2 | 5.4 | 3.8 | 2.4 | 1.1 | - |
| 70 | 45 | 5.5 | 3.2 | 1.2 | - | - | - |
| 71 | 31 | 5.6 | 3.1 | 2.4 | 1.1 | - | - |
| 72 | 49 | 2.6 | 0.9 | - | - | - | - |
| 73 | 45 | 2.4 | 1 | - | - | - | - |
| 74 | 53 | 3.4 | 1.8 | 0.9 | - | - | - |
| 75 | 48 | 1.9 | 0.9 | - | - | - | - |
| 76 | 20 | 2.1 | 1 | - | - | - | - |
| 77 | 17 | 3.6 | 1.9 | 1 | - | - | - |
| 78 | 27 | 16 | 10.3 | 7.6 | 5 | 3.1 | 0.9 |
| 79 | 31 | 3.9 | 1.8 | 0.9 | - | - | - |
| 80 | 50 | 1.3 | 1 | - | - | - | - |
| 81 | 35 | 12 | 9.7 | 6.4 | 3 | 1 | - |
| 82 | 39 | 3.9 | 1 | - | - | - | - |
| 83 | 29 | 3.4 | 1 | - | - | - | - |
| 84 | 41 | 2.1 | 1 | - | - | - | - |
| 85 | 22 | 2.9 | 1 | - | - | - | - |
| 86 | 31 | 6.7 | 4.1 | 2.3 | 1 | - | - |
| 87 | 47 | 3.4 | 1 | - | - | - | - |
| 88 | 28 | 5.1 | 2.3 | 1 | - | - | - |
| 89 | 12 | 4.4 | 1 | - | - | - | - |
| 90 | 41 | 1.4 | 1 | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 91 | 36 | 3.2 | 1 | - | - | - | - |
| 92 | 44 | 5.2 | 3.1 | 0.9 | - | - | - |
| 93 | 39 | 4.9 | 2.8 | 1.1 | - | - | - |
| **Average** | | **5.8516** | **3.6483** | **2.7373** | **2.1659** | **1.4516** | **0.94** |

**Table 5.13.a: P value of bilirubin after Livercare Churna treatment**

| **Group (week)** | **Mean** | **Standard Deviation** | **Standard Error of Mean** | **Median** |
|---|---|---|---|---|
| Initial | 5.851 | 3.758 | 0.3614 | 4.85 |
| First | 3.648 | 2.996 | 0.2938 | 2.9 |
| Second | 2.737 | 2.105 | 0.2297 | 2.0 |
| Third | 2.165 | 1.347 | 0.1869 | 2.05 |
| Fourth | 1..451 | 0.8450 | 0.1449 | 1.075 |
| Sixth | 0.940 | 0.1020 | 0.03075 | 0.9 |

**Table 5.13.b: Paired samples test of bilirubin after treatment with Livercare Churna**

| Pair | Paired Differences | | | | | t test | df | P value Significant (2 tailed) |
|---|---|---|---|---|---|---|---|---|
| | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference Lower | Upper | | | |
| A | 2.1561 | 1.3007 | 0.1314 | 1.8953 | 2.4169 | 16.409 | 97 | 0.000* |
| B | 3.7794 | 2.1930 | 0.2483 | 3.2850 | 4.2739 | 15.221 | 77 | 0.000* |
| C | 5.5416 | 3.4018 | 0.4910 | 4.5538 | 6.5294 | 11.286 | 47 | 0.000* |
| D | 7.6322 | 4.2186 | 0.7576 | 6.0848 | 9.1796 | 10.073 | 30 | 0.000* |
| E | 10.410 | 7.1326 | 2.2555 | 5.3076 | 15.5123 | 4.615 | 9 | 0.001* |

A=Initial-First week, B=Initial- Second week, C= Initial- Third week, D=Initial-Fourth week, E= Initial-Sixth week

Where * = The P value is < 0.001, considered significant.

**Table 5.14: Bilirubin values of the patients after treatment with Hepatogard forte Tablet.**

| Sr. no of patients | Age | Bilirubin value mg % after different week treatment | | | | | |
|---|---|---|---|---|---|---|---|
| | | Initial(zero week) | First | Second | Third | Fourth | Sixth |
| 1 | 32 | 4.2 | 2.1 | 1 | - | - | - |
| 2 | 34 | 6.9 | 4.2 | 2.2 | 1.1 | - | - |
| 3 | 50 | 13.4 | 8.9 | 6.3 | 4.8 | 3.1 | 1 |
| 4 | 39 | 6.9 | 5.4 | 4.9 | 4 | 3.1 | 1.7 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5 | 39 | 22.1 | 18.3 | 12.2 | 9.4 | 6.3 | 2.1 |
| 6 | 60 | 14 | 12.1 | 8.3 | 6.9 | 3.4 | 1.2 |
| 7 | 32 | 7.4 | 4.3 | 3.1 | 2.7 | 1 | - |
| 8 | 49 | 11 | 8.4 | 5.9 | 3.7 | 1.2 | - |
| 9 | 55 | 6.2 | 3.9 | 1.3 | - | - | - |
| 10 | 60 | 4.3 | 2.4 | 0.9 | - | - | - |
| 11 | 35 | 6.9 | 3.6 | 1.7 | 0.9 | - | - |
| 12 | 36 | 4.9 | 2.4 | 1 | - | - | - |
| 13 | 58 | 13.7 | 8.9 | 6.2 | 3.4 | 2.1 | 0.9 |
| 14 | 40 | 7.4 | 3.2 | 1.2 | - | - | - |
| 15 | 50 | 2.9 | 1.4 | 0.9 | - | - | - |
| 16 | 29 | 3.7 | 2.1 | 1 | - | - | - |
| 17 | 38 | 4 | 1.9 | 1 | - | - | - |
| 18 | 42 | 5.1 | 2.9 | 1 | - | - | - |
| 19 | 59 | 3.4 | 2.1 | 0.9 | - | - | - |
| 20 | 11 | 4.3 | 2.1 | 1 | - | - | - |
| 21 | 32 | 6.4 | 3.2 | 2.4 | 1.3 | 0.9 | - |
| 22 | 60 | 7 | 4.3 | 2.1 | 1.7 | 0.9 | - |
| 23 | 35 | 3.9 | 1.6 | 1 | - | - | - |
| 24 | 59 | 7 | 3.2 | 2.1 | 1 | - | - |
| 25 | 49 | 4.4 | 2.1 | 1.7 | 0.9 | - | - |
| 26 | 21 | 3.9 | 2.1 | 1.4 | 1 | - | - |
| 27 | 60 | 2.9 | 1.4 | 0.9 | - | - | - |
| 28 | 45 | 6.4 | 3.9 | 2.1 | 1 | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 29 | 50 | 8.2 | 6.8 | 4.6 | 2.8 | 1.2 | - |
| 30 | 55 | 6.3 | 4.2 | 2.4 | 1.1 | - | - |
| 31 | 51 | 6.4 | 4.2 | 1.9 | 1 | - | - |
| 32 | 23 | 4.2 | 2.2 | 1.2 | 1 | 0.9 | - |
| 33 | 20 | 5.7 | 2.6 | 1.2 | - | - | - |
| 34 | 22 | 3.2 | 1.2 | - | - | - | - |
| 35 | 48 | 5.3 | 2.9 | 1.1 | - | - | - |
| 36 | 47 | 4.3 | 3.2 | 2.8 | 1.9 | 1 | - |
| 37 | 41 | 5.9 | 4 | 2.2 | 1 | - | - |
| 38 | 32 | 7.4 | 5.4 | 3.2 | 2.8 | 1.1 | - |
| 39 | 21 | 4.4 | 2.2 | 0.9 | - | - | - |
| 40 | 21 | 4.3 | 2.3 | 1.4 | 0.9 | - | - |
| 41 | 22 | 1.3 | 0.9 | - | - | - | - |
| 42 | 50 | 3.3 | 1.1 | - | - | - | - |
| 43 | 42 | 1.4 | 1 | - | - | - | - |
| 44 | 30 | 5.6 | 3.2 | 1 | - | - | - |
| 45 | 18 | 10 | 8.3 | 5.8 | 1.2 | - | - |
| 46 | 30 | 1.3 | 1 | - | - | - | - |
| 47 | 40 | 7.1 | 4.3 | 2.3 | 1 | - | - |
| 48 | 35 | 2.7 | 1 | - | - | - | - |
| 49 | 28 | 8.3 | 6.3 | 3.9 | 2 | 1 | - |
| 50 | 37 | 12.1 | 9.1 | 8.4 | 6.1 | 2.3 | 1 |
| 51 | 49 | 3 | 1.8 | 0.9 | - | - | - |
| 52 | 30 | 5.9 | 3 | 1.2 | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 53 | 29 | 3.8 | 1.4 | - | - | - | - |
| 54 | 41 | 6.1 | 4.8 | 1.9 | 1 | - | - |
| 55 | 42 | 5.9 | 3.2 | 1.1 | - | - | - |
| 56 | 37 | 1.6 | 0.9 | - | - | - | - |
| 57 | 18 | 11.2 | 9.3 | 6.1 | 4.1 | 1.2 | - |
| 58 | 13 | 3.2 | 1.1 | - | - | - | - |
| 59 | 23 | 19 | 12.7 | 9.5 | 6.1 | 3.1 | 1 |
| 60 | 28 | 2.9 | 1.1 | - | - | - | - |
| 61 | 45 | 13.25 | 10.8 | 9.7 | 3.2 | 1.2 | - |
| 62 | 15 | 5.7 | 5 | 3.8 | 1.2 | | - |
| 63 | 50 | 7.4 | 6.2 | 4.1 | 1.8 | 0.9 | - |
| 64 | 32 | 2.1 | 1 | - | - | - | - |
| 65 | 43 | 8.3 | 6.8 | 4.9 | 3.2 | 1.8 | 0.9 |
| 66 | 36 | 10.1 | 8 | 5.8 | 3.2 | 1.1 | - |
| 67 | 38 | 1.2 | 0.9 | - | - | - | - |
| 68 | 35 | 3.2 | 2.2 | 1.1 | - | - | - |
| 69 | 51 | 3.1 | 2.1 | 1.1 | - | - | - |
| 70 | 55 | 6.2 | 4.8 | 2.9 | 1.8 | 0.9 | - |
| 71 | 43 | 3.1 | 1.4 | 0.9 | - | - | - |
| 72 | 46 | 4.1 | 2 | 1 | - | - | - |
| 73 | 59 | 1.6 | 1 | - | - | - | - |
| 74 | 39 | 7.6 | 6.4 | 4.3 | 2.6 | 1.1 | - |
| 75 | 55 | 6.3 | 4.2 | 2.9 | 1.8 | 0.9 | - |
| 76 | 35 | 3.2 | 1.8 | 1 | 0.9 | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 77 | 51 | 1.9 | 1 | - | - | - | - |
| 78 | 45 | 4.8 | 3.2 | 1.7 | 0.9 | - | - |
| 79 | 40 | 4.8 | 2.1 | 1 | | - | - |
| 80 | 17 | 16 | 12.2 | 9.3 | 6.2 | 4.1 | 1.1 |
| 81 | 50 | 4.9 | 4.1 | 2.1 | 0.9 | - | - |
| 82 | 50 | 3.7 | 1 | - | - | - | - |
| 83 | 20 | 3.1 | 2.7 | 1 | - | - | - |
| 84 | 51 | 5.1 | 2.3 | 1 | - | - | - |
| 85 | 55 | 4.1 | 2.7 | 1 | - | - | - |
| 86 | 50 | 6.6 | 4 | 1.9 | 0.9 | - | - |
| 87 | 39 | 4 | 2.1 | 1 | - | - | - |
| 88 | 47 | 6.9 | 4 | 2.7 | 1.3 | 0.9 | - |
| 89 | 37 | 5.7 | 2.9 | 1 | - | - | - |
| 90 | 40 | 3.7 | 1.9 | 0.8 | - | - | - |
| 91 | 51 | 6.7 | 3.2 | 2 | 0.9 | - | - |
| 92 | 47 | 8.4 | 6.2 | 5 | 3.9 | 2.1 | 0.9 |
| 93 | 49 | 10.7 | 7.4 | 4.9 | 2.1 | 0.9 | - |
| 94 | 39 | 3.2 | 1.9 | 1 | - | - | - |
| 95 | 35 | 4.9 | 2.3 | 1.7 | 0.9 | - | - |
| **Average** | | **6.0163** | **3.9042** | **2.7912** | **2.4062** | **1.775** | **1.18** |

**Table 5.15.a: P value of bilirubin after treatment with Hepatogard forte Tablet.**

| Group (week) | Mean | Standard Deviation | Standard Error of Mean | Median |
|---|---|---|---|---|
| Initial | 6.016 | 3.702 | 0.3630 | 5.1 |
| First | 3.904 | 3.076 | 0.3045 | 2.9 |
| Second | 2.791 | 2.457 | 0.2665 | 1.7 |
| Third | 2.406 | 1.897 | 0.2656 | 1.7 |
| Fourth | 1.775 | 1.266 | 0.2351 | 1.2 |
| Sixth | 1.180 | 0.3816 | 0.1150 | 1.0 |

**Table 5.15.b: Paired samples test of bilirubin after treatment with Hepatogard forte Tablet**

| Pair | Paired Differences | | | | | t test | df | P value Significant (2 tailed) |
|---|---|---|---|---|---|---|---|---|
| | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | Lower | Upper | | | |
| A | 2.163 | 1.112 | 0.107 | 1.949 | 2.376 | 20.111 | 106 | 0.000* |
| B | 3.896 | 2.202 | 0.234 | 3.429 | 4.362 | 16.597 | 87 | 0.000* |
| C | 5.975 | 2.554 | 0.347 | 5.277 | 6.672 | 17.185 | 53 | 0.000* |
| D | 8.320 | 3.560 | 0.639 | 7.014 | 9.627 | 13.011 | 30 | 0.000* |
| E | 12.55 | 4.592 | 1.384 | 9.469 | 15.639 | 9.066 | 10 | 0.000* |

A=Initial-First week, B=Initial- Second week, C= Initial- Third week , D=Initial-Fourth week, E= Initial-Sixth week

Where * = The P value is < 0.001, considered significant.

**Table 5.16: Comparative average bilirubin values for different week treatment using *Phyllanthus amarus*, Livercare Churna and Hepatogard forte Tablet.**

| Week | *Phyllanthus amarus* | Livercare Churna | Hepatogard forte Tablet |
|---|---|---|---|
| Initial | 5.9401 | 5.8516 | 6.0163 |
| First | 3.5149 | 3.6483 | 3.9042 |
| Second | 2.7202 | 2.7373 | 2.7912 |
| Third | 1.8470 | 2.1659 | 2.4062 |
| Fourth | 1.2565 | 1.4516 | 1.7750 |
| Sixth | 1.0560 | 0.9400 | 1.1800 |

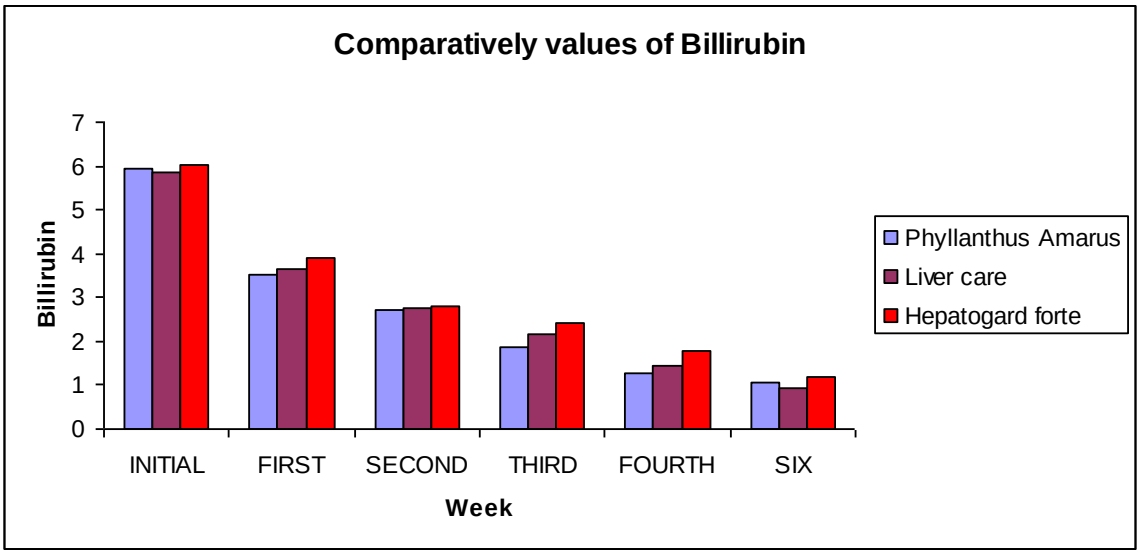



**Figure 5.3: Bilirubin v/s Week. Column graph showing comparative values of bilirubin for different week treatment using *Phyllanthus amarus*, Livercare Churna and Hepatogard forte Tablet as hepatoprotective drugs.**

For *Phyllanthus amarus* the mean bilirubin value of the group on zero day is considered as 100%. In comparison with zero week, bilirubin level are recovered on first week 46.18%, on second week 64.92%, on third week 79.65%, on fourth week 87.63% and sixth weeks 91.13% respectively. The P value is < 0.0001.

For Livercare Churna the mean bilirubin value of the group on zero day is considered as 100%. In comparison with zero week, bilirubin level are recovered on first week 37.7%, on second week 53.33%, on third week 63.07%, on fourth week 75.21% and sixth weeks 83.93% respectively. The P value is < 0.0001.

For Hepatogard forte Tablet the mean bilirubin value of the group on zero day is considered as 100%. In comparison with zero week, bilirubin level are recovered on first week 35.10%, on second week 55.07%, on third week 60.06%, on fourth week 70.46% and sixth weeks 80.36% respectively. The P value is < 0.0001.

**Table 5. 17: Percentage recovery of bilirubin with different formulations**

| **Treatment** | **%Recovery** | | | | |
|---|---|---|---|---|---|
| Formulation | First week | Second week | Third week | Fourth week | Sixth week |
| *Phyllanthus amarus* | 46.18 | 64.92 | 79.65 | 87.63 | 91.13 |
| Livercare Churna | 37.70 | 53.33 | 63.07 | 75.21 | 83.93 |
| Hepatogard forte Tablet | 35.10 | 55.07 | 66.06 | 70.46 | 80.36 |

**Table 5.18: Haemoglobin values of the patients after treatment with *Phyllanthus amarus.***

| Sr. no of patients | Age | Hb values after different weeks treatment | | | | | |
|---|---|---|---|---|---|---|---|
| | | Initial (zero week) | First | Second | Third | Forth | Six |
| 1 | 28 | 8.4 | 9.2 | - | - | - | - |
| 2 | 51 | 12.1 | 12.2 | - | - | - | - |
| 3 | 20 | 12.2 | 12.4 | - | - | - | - |
| 4 | 16 | 10.2 | 10.3 | 10.4 | 10.5 | 10.5 | - |
| 5 | 42 | 12.6 | 12.7 | 12.7 | 12.8 | 12.8 | - |
| 6 | 17 | 10.7 | 10.8 | 10.9 | - | - | - |
| 7 | 65 | 12.2 | 12.4 | - | - | - | - |
| 8 | 65 | 9.8 | 9.9 | - | - | - | - |
| 9 | 36 | 10.3 | 10.4 | 10.4 | 10.5 | - | - |
| 10 | 42 | 11.2 | 11.3 | - | - | - | - |
| 11 | 35 | 11.2 | 11.3 | 11.4 | 11.6 | - | - |
| 12 | 21 | 10.6 | 10.8 | 10.9 | 11.1 | - | - |
| 13 | 32 | 10.4 | 10.5 | 11.1 | - | - | - |
| 14 | 32 | 9.8 | 10.1 | 10.2 | - | - | - |
| 15 | 28 | 10.2 | 10.3 | 10.4 | 12.1 | 12.1 | |
| 16 | 45 | 10.2 | 10.5 | 10.7 | - | - | - |
| 17 | 17 | 11.4 | 11.8 | - | - | - | - |
| 18 | 32 | 10.7 | 10.9 | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 19 | 20 | 11.3 | 11.5 | 12.3 | 12.5 | 12.6 | - |
| 20 | 38 | 11.3 | 11.3 | 11.4 | 11.6 | 11.7 | 11.8 |
| 21 | 19 | 11.7 | 11.9 | 12.1 | 12.3 | - | - |
| 22 | 38 | 10.8 | 10.9 | - | - | - | - |
| 23 | 16 | 9 | 9.1 | 9.3 | 9.6 | 9.8 | 10 |
| 24 | 19 | 13 | 13.1 | 13.4 | 13.5 | - | - |
| 25 | 22 | 12 | 12.1 | 12.4 | 12.5 | - | - |
| 26 | 65 | 12.2 | 12.4 | 12.6 | 12.7 | - | - |
| 27 | 35 | 11.9 | 12.1 | 12.5 | - | - | - |
| 28 | 32 | 10.4 | 10.6 | 10.6 | - | - | - |
| 29 | 42 | 13.2 | 13.3 | - | - | - | - |
| 30 | 43 | 12.1 | 12.2 | 12.3 | 12.5 | 12.7 | 12.8 |
| 31 | 28 | 12.7 | 12.8 | 12.8 | 12.9 | 12.9 | - |
| 32 | 50 | 12.2 | 12.4 | 12.7 | 12.9 | 13 | - |
| 33 | 55 | 9.2 | 9.3 | 9.5 | 9.7 | - | - |
| 34 | 45 | 10.9 | 10.9 | 11 | 11.1 | - | - |
| 35 | 55 | 9.1 | 9.5 | 9.5 | - | - | - |
| 36 | 40 | 10.2 | 10.4 | 10.5 | - | - | - |
| 37 | 20 | 9.1 | 9.3 | 9.5 | 9.6 | - | - |
| 38 | 50 | 12.2 | 12.4 | 12.4 | - | - | - |
| 39 | 45 | 11.4 | 11.6 | 11.6 | - | - | - |
| 40 | 50 | 9.5 | 9.7 | 9.9 | 9.9 | 10.1 | - |
| 41 | 50 | 10.2 | 10.7 | 10.7 | 10.9 | - | - |
| 42 | 45 | 11.4 | 11.9 | 11.9 | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 43 | 32 | 12.2 | 12.6 | 12.6 | 12.7 | 12.8 | - |
| 44 | 55 | 12.2 | 12.4 | 12.6 | - | - | - |
| 45 | 21 | 9.2 | 9.4 | 9.7 | 9.9 | 10.1 | - |
| 46 | 50 | 9.4 | 9.6 | 9.9 | 10 | 10.3 | - |
| 47 | 19 | 11.4 | 11.5 | - | - | - | - |
| 48 | 42 | 11.2 | 11.4 | 11.5 | 11.6 | - | - |
| 49 | 71 | 11.2 | 11.4 | - | - | - | - |
| 50 | 38 | 10.2 | 10.4 | 10.5 | 10.5 | 10.5 | - |
| 51 | 30 | 9.2 | 9.4 | 9.5 | 9.6 | - | - |
| 52 | 30 | 10.2 | 10.4 | - | - | - | - |
| 53 | 54 | 9.7 | 9.9 | - | - | - | - |
| 54 | 42 | 10.7 | 10.9 | 11 | - | - | - |
| 55 | 22 | 10.1 | 10.3 | 10.3 | - | - | - |
| 56 | 42 | 11.1 | 11.3 | 11.4 | 11.4 | - | - |
| 57 | 46 | 12.1 | 12.1 | 12.2 | 12.4 | 12.4 | - |
| 58 | 11 | 10.6 | 10.8 | - | - | - | - |
| 59 | 38 | 9.4 | 9.6 | 9.6 | 9.6 | - | - |
| 60 | 70 | 10.4 | 10.6 | - | - | - | - |
| 61 | 20 | 11.9 | 12 | 12.1 | 12.2 | - | - |
| 62 | 23 | 10.4 | 10.6 | 10.7 | - | - | - |
| 63 | 35 | 12.2 | 12.4 | 12.5 | 12.6 | - | - |
| 64 | 36 | 12.7 | 12.8 | 12.9 | - | - | - |
| 65 | 24 | 11.8 | 12.4 | 12.5 | - | - | - |
| 66 | 40 | 13.6 | 13.8 | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 67 | 28 | 12.4 | 12.5 | 12.6 | 12.7 | - | - |
| 68 | 13 | 11.3 | 11.5 | - | - | - | - |
| 69 | 45 | 12.7 | 12.9 | 13 | 13.1 | - | - |
| 70 | 15 | 10.4 | 10.6 | - | - | - | - |
| 71 | 32 | 10.3 | 10.5 | 10.5 | 10.6 | - | - |
| 72 | 55 | 8.3 | 8.5 | 8.6 | 8.7 | 8.8 | - |
| 73 | 11 | 11.3 | 11.5 | 11.5 | - | - | - |
| 74 | 30 | 12 | 12.6 | 12.6 | 12.6 | - | - |
| 75 | 12 | 11.2 | 12.4 | 12.5 | - | - | - |
| 76 | 13 | 11.7 | 11.9 | - | - | - | - |
| 77 | 65 | 11.9 | 12 | 12.1 | 12.3 | 12.5 | - |
| 78 | 30 | 12.9 | 13.2 | - | - | - | - |
| 79 | 50 | 13.4 | 13.6 | 13.7 | - | - | - |
| 80 | 49 | 11.7 | 11.9 | 12 | 12.1 | 12.1 | - |
| 81 | 45 | 13.2 | 13.3 | 13.4 | - | - | - |
| 82 | 36 | 11 | 11.1 | 11.2 | 11.4 | 11.5 | - |
| 83 | 40 | 10.6 | 10.7 | 10.7 | - | - | - |
| 84 | 11 | 9.9 | 10 | 10.1 | 10.1 | 10.2 | - |
| 85 | 50 | 8.6 | 8.8 | 8.9 | - | - | - |
| 86 | 35 | 8.6 | 8.8 | 8.9 | - | - | - |
| 87 | 30 | 9.9 | 10 | 10 | 10.1 | - | - |
| 88 | 25 | 13.2 | 13.2 | 13.2 | - | - | - |
| 89 | 65 | 12.4 | 12.4 | 12.5 | - | - | - |
| 90 | 30 | 12.4 | 12.4 | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 91 | 35 | 10.6 | 10.7 | - | - | - | - |
| 92 | 50 | 11.3 | 11.4 | 11.5 | 11.5 | - | - |
| 93 | 37 | 8.7 | 8.8 | - | - | - | - |
| 94 | 53 | 7.1 | 7.2 | 7.3 | 7.5 | - | - |
| 95 | 42 | 8.7 | 8.8 | 8.9 | 9 | - | - |
| 96 | 12 | 10.1 | 10.3 | 10.4 | 10.4 | - | - |
| 97 | 40 | 10.9 | 11 | 11.1 | 11.2 | 11.3 | 11.4 |
| 98 | 45 | 8.4 | 8.6 | - | - | - | - |
| 99 | 27 | 8.7 | 8.8 | 8.9 | 8.9 | - | - |
| 100 | 25 | 10.1 | 10.3 | - | - | - | - |
| 101 | 21 | 11.4 | 11.6 | 11.6 | - | - | - |
| 102 | 30 | 10.2 | 10.3 | 10.3 | 10.4 | 10.5 | - |
| 103 | 20 | 12.6 | 12.7 | 12.8 | - | - | - |
| 104 | 51 | 10.6 | 10.8 | - | - | - | - |
| 105 | 5 | 10.2 | 10.3 | 10.4 | 10.5 | 10.5 | - |
| 106 | 42 | 11.6 | 11.7 | - | - | - | - |
| 107 | 32 | 9.1 | 9.3 | 9.4 | 9.5 | - | - |
| **Average** | | **10.8962** | **11.0850** | **11.1658** | **11.1352** | **11.3782** | **11.5** |

**Table 5.19.a: P value of Hb after treatment with *Phyllanthus amarus***

| Group | Mean | Standard Deviation | Standard Error of Mean | Median |
|---|---|---|---|---|
| Initial | 10.896 | 1.336 | 0.1286 | 10.9 |
| First | 11.085 | 1.332 | 0.1282 | 11.043 |
| Second | 11.166 | 1.358 | 0.1518 | 11.133 |
| Third | 11.135 | 1.374 | 0.1906 | 11.168 |
| Fourth | 11.387 | 1.211 | 0.2472 | 11.439 |
| Sixth | 11.5 | 1.005 | 0.4494 | 11.5 |

**Table 5.19.b: Paired samples test of Hb after treatment with *Phyllanthus amarus***

| Pair | Paired Differences | | | | | t test | df | P value Significant (2 tailed) |
|---|---|---|---|---|---|---|---|---|
| | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | Lower | Upper | | | |
| A | -.188 | .157 | .015 | -.218 | -.158 | -12.40 | 106 | 0.000* |
| B | -.303 | .199 | .022 | -.348 | -.259 | -13.56 | 78 | 0.000* |
| C | -.429 | .278 | .038 | -.507 | -.351 | -11.02 | 50 | 0.000* |
| D | -.582 | .395 | .082 | -.753 | -.411 | -7.073 | 22 | 0.000* |
| E | -.675 | .236 | .118 | -1.051 | -.299 | -5.713 | 3 | 0.011 |

A=Initial-First week, B=Initial- Second week, C= Initial- Third week , D=Initial-Fourth week, E= Initial-Sixth week

Where * = The P value is < 0.001, considered significant.

**Table 5.20: Haemoglobin values of the patients after treatment with Livercare Churna.**

| Sr. no of patients | Hb value after different weeks treatment | | | | | | |
|---|---|---|---|---|---|---|---|
| | Age | Initial | First | Second | Third | Fourth | Sixth |
| 1 | 17 | 11.5 | 11.6 | 11.7 | - | - | - |
| 2 | 47 | 10.5 | 10.6 | 10.7 | 10.7 | - | - |
| 3 | 49 | 11.2 | 11.4 | 11.5 | - | - | - |
| 4 | 51 | 9.6 | 9.8 | 9.9 | 10 | 10 | 10.1 |
| 5 | 31 | 11.6 | 11.7 | 11.9 | - | - | - |
| 6 | 53 | 12.1 | 12.3 | 12.4 | 12.5 | - | - |
| 7 | 47 | 9.1 | 9.4 | 9.5 | 9.5 | - | - |
| 8 | 40 | 12.2 | 12.4 | 12.6 | 12.7 | 12.8 | 12.8 |
| 9 | 47 | 8.6 | 8.7 | 8.8 | 8.9 | 9 | - |
| 10 | 50 | 11.4 | 11.6 | 11.7 | 11.8 | 11.9 | - |
| 11 | 44 | 11.4 | 11.6 | 11.7 | - | - | - |
| 12 | 46 | 10.7 | 10.9 | 11 | 11 | 11.5 | 11.6 |
| 13 | 35 | 9.6 | 9.7 | 9.8 | 9.8 | - | - |
| 14 | 55 | 10.9 | 11 | 11.1 | - | - | - |
| 15 | 50 | 12.2 | 12.4 | 12.5 | 12.5 | 12.5 | - |
| 16 | 60 | 10.1 | 10.4 | 10.7 | 10.8 | 10.8 | 10.8 |
| 17 | 43 | 10.3 | 10.6 | - | - | - | - |
| 18 | 45 | 10.2 | 10.4 | 10.5 | - | - | - |
| 19 | 40 | 9.4 | 9.6 | 9.7 | 9.7 | 9.8 | 9.9 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 20 | 29 | 10.7 | 10.9 | 11 | - | - | - |
| 21 | 44 | 8.9 | 9 | 9.1 | 9.3 | 9.4 | - |
| 22 | 25 | 12.1 | 12.3 | 12.4 | 12.4 | 12.5 | - |
| 23 | 17 | 10.3 | 10.4 | 10.5 | 10.6 | 10.6 | - |
| 24 | 40 | 10.2 | 10.7 | - | - | - | - |
| 25 | 35 | 11.2 | 11.4 | 11.4 | 11.5 | 11.6 | - |
| 26 | 25 | 11.2 | 11.3 | 11.4 | 11.6 | 11.6 | - |
| 27 | 21 | 10.1 | 10.4 | 10.6 | 10.7 | 10.9 | - |
| 28 | 52 | 10.1 | 10.4 | 10.8 | - | - | - |
| 29 | 45 | 8.7 | 8.8 | 8.9 | 9.1 | 9.2 | - |
| 30 | 62 | 8.2 | 8.6 | 9 | 9.2 | 9.3 | 9.5 |
| 31 | 50 | 9.2 | 9.4 | 9.6 | - | - | - |
| 32 | 45 | 11.2 | 11.3 | 11.4 | 11.5 | - | - |
| 33 | 50 | 10.7 | 10.8 | 10.8 | 10.9 | 10.9 | - |
| 34 | 30 | 9.3 | 9.5 | 9.8 | 10 | 10.1 | - |
| 35 | 19 | 11.2 | 11.2 | 11.3 | 11.4 | 11.5 | - |
| 36 | 45 | 9.3 | 9.4 | 9.6 | - | - | - |
| 37 | 25 | 9.3 | 9.6 | 9.8 | 9.9 | - | - |
| 38 | 25 | 11.4 | 11.6 | 11.7 | 11.8 | - | - |
| 39 | 27 | 9.3 | 9.6 | 9.8 | 10 | 10.1 | - |
| 40 | 17 | 11.3 | 11.6 | 11.7 | 11.8 | - | - |
| 41 | 57 | 13 | 13.2 | 13.3 | 13.4 | - | - |
| 42 | 45 | 13.2 | 13.3 | 13.4 | - | - | - |
| 43 | 60 | 12.6 | 12.8 | 12.9 | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 44 | 49 | 12.1 | 12.2 | 12.4 | - | - | - |
| 45 | 36 | 12.7 | 12.7 | 12.8 | - | - | - |
| 46 | 49 | 8.7 | 8.8 | 9 | 9.2 | 9.3 | 9.5 |
| 47 | 50 | 9.3 | 9.4 | 9.6 | 9.9 | - | - |
| 48 | 40 | 8.2 | 8.4 | 8.6 | 8.7 | 8.8. | 8.9 |
| 49 | 40 | 7.9 | 8.1 | 8.2 | 8.3 | 8.4 | - |
| 50 | 39 | 12.4 | 12.6 | - | - | - | - |
| 51 | 41 | 9.4 | 9.5 | 9.7 | 9.8 | 9.8 | 9.9 |
| 52 | 45 | 12.1 | 12.3 | 12.4 | - | - | - |
| 53 | 29 | 8.5 | 8.6 | 8.8 | 8.9 | - | - |
| 54 | 52 | 11.7 | 11.9 | 12 | - | - | - |
| 55 | 50 | 11.3 | 11.5 | 11.5 | 11.6 | - | - |
| 56 | 49 | 10.2 | 10.4 | 10.5 | 10.6 | 10.7 | - |
| 57 | 39 | 12.2 | 12.5 | - | - | - | - |
| 58 | 11 | 10.2 | 10.4 | 10.6 | - | - | - |
| 59 | 19 | 11.2 | 11.2 | 11.3 | - | - | - |
| 60 | 52 | 6 | 6.4 | 6.7 | 7.2 | - | - |
| 61 | 21 | 12.5 | 12.6 | 12.8 | 12.8 | 12.9 | - |
| 62 | 29 | 9.8 | 9.9 | 10 | 10.1 | 10.2 | - |
| 63 | 40 | 13.7 | 13.8 | 13.9 | - | - | - |
| 64 | 55 | 12.6 | 12.7 | - | - | - | - |
| 65 | 50 | 13 | 13.2 | 13.3 | 13.3 | 13.4 | - |
| 66 | 39 | 10.1 | 10.3 | 10.4 | - | - | - |
| 67 | 38 | 11.4 | 11.6 | 11.7 | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 68 | 19 | 9.2 | 9.4 | 9.5 | 9.6 | - | - |
| 69 | 35 | 8.1 | 8.4 | 8.5 | 8.6 | 8.8 | - |
| 70 | 45 | 8.2 | 8.8 | 9 | - | - | - |
| 71 | 31 | 10.7 | 10.9 | 11 | 11.1 | - | - |
| 72 | 49 | 10.3 | 10.3 | - | - | - | - |
| 73 | 45 | 11.6 | 11.7 | - | - | - | - |
| 74 | 53 | 9.7 | 9.9 | 10 | - | - | - |
| 75 | 48 | 10.3 | 10.5 | - | - | - | - |
| 76 | 20 | 10.9 | 11 | - | - | - | - |
| 77 | 17 | 11 | 11.2 | 11.4 | - | - | - |
| 78 | 27 | 9.2 | 9.4 | 9.5 | 9.5 | 9.6 | 9.6 |
| 79 | 31 | 11.2 | 11.4 | 11.5 | - | - | - |
| 80 | 50 | 10.9 | 10.9 | - | - | - | - |
| 81 | 35 | 9.4 | 9.6 | 9.7 | 9.8 | 9.8 | - |
| 82 | 39 | 10.7 | 10.9 | - | - | - | - |
| 83 | 29 | 10.4 | 10.9 | - | - | - | - |
| 84 | 41 | 11.1 | 11.6 | - | - | - | - |
| 85 | 22 | 10.1 | 10.7 | - | - | - | - |
| 86 | 31 | 8.9 | 9.2 | 9.4 | 9.5 | - | - |
| 87 | 47 | 11.4 | 11.6 | - | - | - | - |
| 88 | 28 | 9.6 | 9.9 | 10 | - | - | - |
| 89 | 12 | 9.4 | 9.8 | - | - | - | - |
| 90 | 41 | 10.3 | 10.5 | - | - | - | - |
| 91 | 36 | 10.8 | 11.3 | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 92 | 44 | 10.9 | 11 | 11.2 | - | - | - |
| 93 | 39 | 10.3 | 10.5 | 10.6 | - | - | - |
| **Average** | | **10.50645** | **10.7086** | **10.73867** | **10.5** | **10.63** | **10.26** |

**Table 5.21. a: P value of Hb after treatment with Livercare Churna**

| **Group (week)** | **Mean** | **Standard Deviation** | **Standard Error of Mean** | **Median** |
|---|---|---|---|---|
| Initial | 10.506 | 1.395 | 0.1402 | 10.4 |
| First | 10.708 | 1.368 | 0.1389 | 10.709 |
| Second | 10.738 | 1.413 | 0.1599 | 10.719 |
| Third | 10.50 | 1.381 | 0.1972 | 10.5 |
| Fourth | 10.63 | 1.299 | 0.2296 | 10.615 |
| Sixth | 10.260 | 1.107 | 0.3339 | 9.9 |

**Table 5.21.b: Paired samples test of Hb after treatment with Livercare Churna**

| Pair | Paired Differences | | | | | t test | df | P value Significant (2 tailed) |
|---|---|---|---|---|---|---|---|---|
| | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference Lower | Upper | | | |
| A | .0234 | .856 | .082 | -.140 | .18749 | .282 | 106 | 0.778 |
| B | -.076 | 1.811 | .197 | -.469 | .31701 | -.385 | 83 | 0.701 |
| C | .142 | 2.195 | .304 | -.468 | .75361 | .467 | 51 | 0.642 |
| D | .025 | 2.459 | .434 | -.861 | .91178 | .057 | 31 | 0.955 |
| E | -.690 | .264 | .083 | -.879 | -.5008 | -8.25 | 9 | 0.000* |

A=Initial-First week, B=Initial- Second week, C= Initial- Third week, D=Initial-Fourth week, E= Initial-Sixth week

Where * = The P value is < 0.001, considered significant.

**Table 5.22: Haemoglobin values of the patients after treatment with Hepatogard forte Tablet.**

| Sr. no of patients | Age | Hb values after different week treatments | | | | | |
|---|---|---|---|---|---|---|---|
| | | Initial (zero week) | First | Second | Third | Fourth | Sixth |
| 1 | 32 | 12.3 | 12.4 | 12.4 | - | - | - |
| 2 | 34 | 13.6 | 13.7 | 13.7 | 13.7 | - | - |
| 3 | 50 | 11 | 11.1 | 11.2 | 11.2 | 11.2 | 11.3 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4 | 39 | 11.2 | 11.2 | 11.3 | 11.4 | 11.4 | 11.4 |
| 5 | 39 | 10.1 | 10.1 | 10.2 | 10.3 | 10.3 | 10.4 |
| 6 | 60 | 11.2 | 11.2 | 11.3 | 11.3 | 11.3 | 11.4 |
| 7 | 32 | 9.3 | 9.3 | 9.4 | 9.4 | 9.5 | - |
| 8 | 49 | 11.8 | 12 | 12.1 | 12.1 | 12.1 | - |
| 9 | 55 | 10.6 | 10.6 | 10.7 | - | - | - |
| 10 | 60 | 11.4 | 11.5 | 11.5 | - | - | - |
| 11 | 35 | 10.3 | 10.4 | 10.4 | 10.5 | - | - |
| 12 | 36 | 13.4 | 13.4 | 13.5 | - | - | - |
| 13 | 58 | 12.1 | 12.2 | 12.2 | 12.2 | 12.3 | 12.3 |
| 14 | 40 | 11.2 | 11.3 | 11.4 | - | - | - |
| 15 | 50 | 12.1 | 12.2 | 12.3 | - | - | - |
| 16 | 29 | 12.7 | 12.8 | 12.8 | - | - | - |
| 17 | 38 | 12.7 | 12.7 | 12.8 | - | - | - |
| 18 | 42 | 12.8 | 12.8 | 12.9 | - | - | - |
| 19 | 59 | 11.9 | 12 | 12 | - | - | - |
| 20 | 11 | 12.1 | 12.2 | 12.2 | - | - | - |
| 21 | 32 | 10.4 | 10.5 | 10.5 | 10.6 | 10.6 | - |
| 22 | 60 | 11.4 | 11.5 | 11.6 | 11.6 | 11.6 | - |
| 23 | 35 | 12.3 | 12.4 | 12.4 | - | - | - |
| 24 | 59 | 9.6 | 9.7 | 9.7 | 9.7 | - | - |
| 25 | 49 | 11.2 | 11.3 | 11.3 | 11.4 | - | - |
| 26 | 21 | 11.4 | 11.4 | 11.5 | 11.5 | - | - |
| 27 | 60 | 9.8 | 9.9 | 9.9 | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 28 | 45 | 12.9 | 13 | 13 | 13 | - | - |
| 29 | 50 | 11.4 | 11.5 | 11.6 | 11.6 | 11.7 | - |
| 30 | 55 | 10.2 | 10.3 | 10.3 | 10.4 | - | - |
| 31 | 51 | 11.2 | 11.4 | 11.4 | 11.5 | - | - |
| 32 | 23 | 10.2 | 10.4 | 10.5 | 10.5 | 10.6 | - |
| 33 | 20 | 13.7 | 13.7 | 13.7 | - | - | - |
| 34 | 22 | 8.1 | 8.2 | - | - | - | - |
| 35 | 48 | 5.4 | 2.8 | 1.1 | - | - | - |
| 36 | 47 | 10.1 | 10.3 | 10.3 | 10.4 | 10.5 | - |
| 37 | 41 | 11.7 | 11.8 | 11.9 | 12 | - | - |
| 38 | 32 | 11.3 | 11.4 | 11.5 | 11.5 | 11.5 | - |
| 39 | 21 | 10.7 | 10.9 | 11 | - | - | - |
| 40 | 21 | 14.5 | 14.5 | 14.5 | 14.6 | - | - |
| 41 | 22 | 9.8 | 10 | - | - | - | - |
| 42 | 50 | 11 | 11.1 | - | - | - | - |
| 43 | 42 | 13.1 | 13.2 | - | - | - | - |
| 44 | 30 | 12.4 | 12.4 | 12.4 | - | - | - |
| 45 | 18 | 10.8 | 10.9 | 10.9 | 11 | - | - |
| 46 | 30 | 13.2 | 13.3 | - | - | - | - |
| 47 | 40 | 12.1 | 12.2 | 12.2 | 12.3 | - | - |
| 48 | 35 | 11.2 | 11.3 | - | - | - | - |
| 49 | 28 | 11.7 | 11.7 | 11.8 | 11.8 | 11.9 | - |
| 50 | 37 | 12.2 | 12.2 | 12.3 | 12.4 | 12.4 | 12.5 |
| 51 | 49 | 9.9 | 10 | 10.3 | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 52 | 30 | 10.8 | 10.9 | 11 | - | - | - |
| 53 | 29 | 11.2 | 11.4 | - | - | - | - |
| 54 | 41 | 8.9 | 9 | 9.1 | 9.2 | - | - |
| 55 | 42 | 8.4 | 8.7 | 8.9 | - | - | - |
| 56 | 37 | 12.3 | 12.4 | - | - | - | - |
| 57 | 18 | 10.8 | 10.9 | 11 | 11 | 11.1 | - |
| 58 | 13 | 10.3 | 10.5 | - | - | - | - |
| 59 | 23 | 11.6 | 11.8 | 11.9 | 11.9 | 12 | 12.1 |
| 60 | 28 | 13.2 | 13.4 | - | - | - | - |
| 61 | 45 | 12 | 12.2 | 12.5 | 12.5 | 12.6 | - |
| 62 | 15 | 11.6 | 11.8 | 11.9 | 12 | | - |
| 63 | 50 | 9.6 | 9.8 | 9.9 | 10 | 10.1 | - |
| 64 | 32 | 9.3 | 9.4 | - | - | - | - |
| 65 | 43 | 8.3 | 8.5 | 8.6 | 8.7 | 8.8 | 8.8 |
| 66 | 36 | 9.1 | 9.2 | 9.4 | 9.5 | 9.6 | - |
| 67 | 38 | 10.2 | 10.3 | - | - | - | - |
| 68 | 35 | 10.1 | 10.2 | 10.3 | - | - | - |
| 69 | 51 | 6.8 | 6.9 | 7 | - | - | - |
| 70 | 55 | 11.1 | 11.2 | 11.3 | 11.3 | 11.4 | - |
| 71 | 43 | 12.3 | 12.5 | 12.5 | - | - | - |
| 72 | 46 | 12.1 | 12.3 | 12.3 | - | - | - |
| 73 | 59 | 13.2 | 13.4 | - | - | - | - |
| 74 | 39 | 8.3 | 8.4 | 8.6 | 8.7 | 8.8 | - |
| 75 | 55 | 10.9 | 11 | 11.1 | 11.2 | 11.2 | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 76 | 35 | 8.2 | 8.4 | 8.5 | 8.5 | - | - |
| 77 | 51 | 12.1 | 12.2 | - | - | - | - |
| 78 | 45 | 12.2 | 12.3 | 12.4 | 12.4 | - | - |
| 79 | 40 | 8.9 | 8.9 | 9 | | - | - |
| 80 | 17 | 7.3 | 7.5 | 7.6 | 7.7 | 7.8 | 7.8 |
| 81 | 50 | 11.7 | 11.8 | 11.9 | 11.9 | - | - |
| 82 | 50 | 12.7 | 12.7 | - | - | - | - |
| 83 | 20 | 13.6 | 13.9 | 14 | - | - | - |
| 84 | 51 | 11.4 | 11.6 | 11.7 | - | - | - |
| 85 | 55 | 12.5 | 12.6 | 12.7 | - | - | - |
| 86 | 50 | 10.9 | 11.1 | 11.1 | 11.3 | - | - |
| 87 | 39 | 13.7 | 13.9 | 14 | - | - | - |
| 88 | 47 | 11.4 | 11.6 | 11.6 | 11.7 | 11.7 | - |
| 89 | 37 | 12.4 | 12.5 | 12.6 | - | - | - |
| 90 | 40 | 13.7 | 13.9 | 14 | - | - | - |
| 91 | 51 | 12.6 | 12.8 | 12.8 | 12.9 | - | - |
| 92 | 47 | 10.7 | 10.9 | 11 | 11.1 | 11.1 | 11.1 |
| 93 | 49 | 8 | 8.3 | 8.3 | 8.3 | 8.4 | - |
| 94 | 39 | 9 | 9.3 | 9.3 | - | - | - |
| 95 | 35 | 9.2 | 9.3 | 9.4 | 9.4 | - | - |
| **Average** | | **11.0873** | **11.1778** | **11.1637** | **11.0645** | **10.8392** | **10.91** |

**Table 5.23.a: P value of Hb after treatment with Hepatogard forte Tablet**

| Group (week) | Mean | Standard Deviation | Standard Error of Mean | Median |
|---|---|---|---|---|
| Initial | 11.087 | 1.682 | 0.1699 | 11.2 |
| First | 11.177 | 1.774 | 0.1801 | 11.4 |
| Second | 11.163 | 1.900 | 0.2099 | 11.4 |
| Third | 11.064 | 1.394 | 0.1972 | 11.3 |
| Fourth | 10.839 | 1.245 | 0.2311 | 11.2 |
| Sixth | 10.910 | 1.447 | 0.4362 | 11.3 |

**Table 5.23.b: Paired samples test of Hb after treatment with Hepatogard forte Tablet**

| | Paired Differences | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | 95% Confidence Interval of the Difference | | | | |
| Pair | Mean | Std. Deviation | Std. Error Mean | Lower | Upper | t test | df | P value Significant (2 tailed) |
| A | -.0972 | .273 | .0264 | -.1496 | -.0447 | -3.676 | 106 | 0.000* |
| B | -.1409 | .489 | .0521 | -.2445 | -.0372 | -2.703 | 87 | 0.008 |
| C | -.250 | .102 | .0139 | -.2779 | -.2220 | -17.95 | 53 | 0.000* |
| D | -.322 | .125 | .0225 | -.3687 | -.2764 | -14.28 | 30 | 0.000* |
| E | -.354 | .129 | .0390 | -.4414 | -.2676 | -9.092 | 10 | 0.000* |

A=Initial-First week, B=Initial- Second week, C= Initial- Third week , D=Initial-Fourth week, E= Initial-Sixth week

Where * = The P value is < 0.001, considered significant.

**Table 5.24: Comparative average haemoglobin values for different week treatment using *Phyllanthus amarus*, Livercare Churna and Hepatogard forte Tablet.**

| Week | *Phyllanthus amarus* | Livercare Churna | Hepatogard forte Tablet |
|---|---|---|---|
| Initial | 10.8962 | 10.5064 | 11.0873 |
| First | 11.0850 | 10.7086 | 11.1778 |
| Second | 11.1658 | 10.7386 | 11.1637 |
| Third | 11.1352 | 10.5000 | 11.0645 |
| Fourth | 11.3782 | 10.6300 | 10.8392 |
| Sixth | 11.5000 | 10.2600 | 10.9100 |

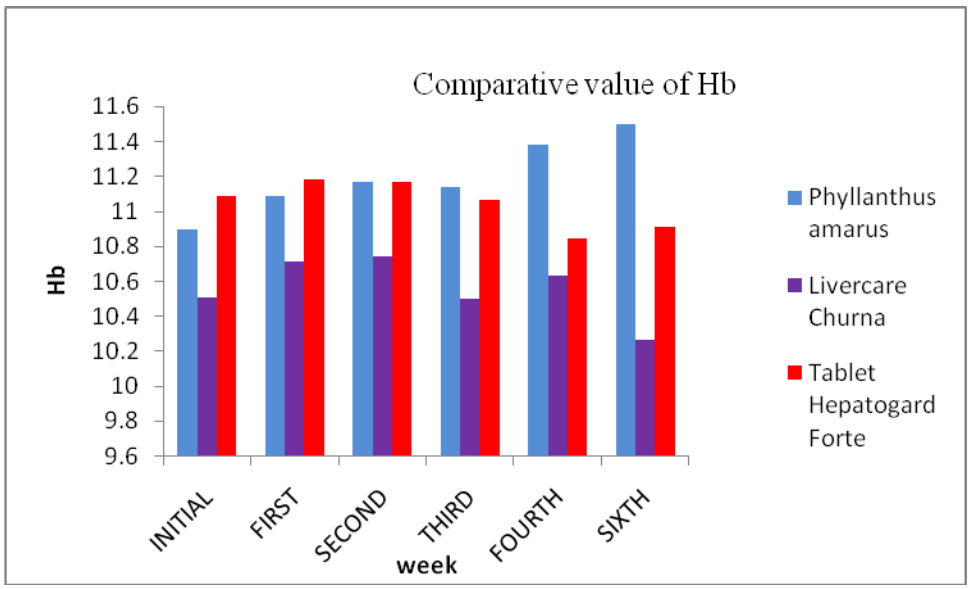



**Figure 5.4: Haemoglobin v/s Week. Column graph showing comparative values of haemoglobin for different week treatment using *Phyllanthus amarus*, Livercare Churna and Hepatogard forte Tablet as hepatoprotective drugs.**

For *Phyllanthus amarus* the mean haemoglobin values of group on zero day is consider 100% (10.89). In comparison with zero week, haemoglobin level increase on first, second and third week, on fourth and sixth week haemoglobin level decreases slightly but in comparison with zero week it is increased. The P value is insignificant for haemoglobin.

For Livercare Churna the mean haemoglobin values of group on zero day is 10.50 gm%. In comparison with zero week, haemoglobin level increase on first, and second, on third and fourth week haemoglobin level decreases slightly but in comparison with zero week it is increased. On sixth week haemoglobin level decreased compared to zero week. The P value is insignificant for haemoglobin.

For Hepatogard forte Tablet the mean haemoglobin values of group on zero day is 11.087 gm%. In comparison with zero week, haemoglobin level increase on first and second week, on third, fourth and sixth week haemoglobin level decreases slightly but in comparison with zero week it is decreased. The P value is insignificant for haemoglobin

Actually there is an increasing heamoglobin values in each patients in each group of treatment. However there is decrease in average heamoglobine values in third fourth and sixth week of treatment because number of patients being treated for longer duration are having severe liver damage and less heamoglobin. Number of patients are also less in these long (4 to 6 week) treatments, so mean heamoglobin decreases in these later weeks

**Table 5.25: Blood pressure values of the patients after treatment with *Phyllanthus amarus.***

| Sr. no of patients | Age | Blood pressure after different weeks treatment | | | | | |
|---|---|---|---|---|---|---|---|
| | | Initial (zero week) | First | Second | Third | Forth | Six |
| 1 | 28 | 80-120 | 80-120 | - | - | - | - |
| 2 | 51 | 80-120 | 80-120 | - | - | - | - |
| 3 | 20 | 80-120 | 80-120 | - | - | - | - |
| 4 | 16 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 5 | 42 | 90-130 | 90-130 | 80-120 | 80-120 | 80-120 | - |
| 6 | 17 | 80-120 | 80-120 | 80-120 | - | - | - |
| 7 | 65 | 80-120 | 80-120 | - | - | - | - |
| 8 | 65 | 80-120 | 80-120 | - | - | - | - |
| 9 | 36 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 10 | 42 | 80-120 | 80-120 | - | - | - | - |
| 11 | 35 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 12 | 21 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 13 | 32 | 80-120 | 80-120 | 80-120 | - | - | - |
| 14 | 32 | 80-120 | 80-120 | 80-120 | - | - | - |
| 15 | 28 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 16 | 45 | 90-130 | 90-130 | 80-120 | - | - | - |
| 17 | 17 | 80-120 | 80-120 | - | - | - | - |
| 18 | 32 | 80-120 | 80-120 | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 19 | 20 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 20 | 38 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 |
| 21 | 19 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 22 | 38 | 80-120 | 80-120 | - | - | - | - |
| 23 | 16 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 |
| 24 | 19 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 25 | 22 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 26 | 65 | 100-140 | 100-140 | 90-130 | 90-130 | - | - |
| 27 | 35 | 80-120 | 80-120 | 80-120 | - | - | - |
| 28 | 32 | 80-120 | 80-120 | 80-120 | - | - | - |
| 29 | 42 | 80-120 | 80-120 | - | - | - | - |
| 30 | 43 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 |
| 31 | 28 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 32 | 50 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 33 | 55 | 100-120 | 80-120 | 80-120 | 80-120 | - | - |
| 34 | 45 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 35 | 55 | 80-120 | 80-120 | 80-120 | - | - | - |
| 36 | 40 | 80-120 | 80-120 | 80-120 | - | - | - |
| 37 | 20 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 38 | 50 | 80-120 | 80-120 | 80-120 | - | - | - |
| 39 | 45 | 80-120 | 80-120 | 80-120 | - | - | - |
| 40 | 50 | 100-120 | 90-130 | 80-120 | 80-120 | 80-120 | - |
| 41 | 50 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 42 | 45 | 80-120 | 80-120 | 80-120 | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 43 | 32 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 44 | 55 | 80-120 | 80-120 | 80-120 | - | - | - |
| 45 | 21 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 46 | 50 | 90-130 | 90-130 | 90-130 | 90-13- | 90-130 | - |
| 47 | 19 | 80-120 | 80-120 | - | - | - | - |
| 48 | 42 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 49 | 71 | 80-120 | 80-120 | - | - | - | - |
| 50 | 38 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 51 | 30 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 52 | 30 | 80-120 | 80-120 | - | - | - | - |
| 53 | 54 | 80-120 | 80-120 | - | - | - | - |
| 54 | 42 | 80-120 | 80-120 | 80-120 | - | - | - |
| 55 | 22 | 80-120 | 80-120 | 80-120 | - | - | - |
| 56 | 42 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 57 | 46 | 100-140 | 90-130 | 90-130 | 90-130 | 90-130 | - |
| 58 | 11 | 80-120 | 80-120 | - | - | - | - |
| 59 | 38 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 60 | 70 | 90-130 | 80-120 | - | - | - | - |
| 61 | 20 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 62 | 23 | 80-120 | 80-120 | 80-120 | - | - | - |
| 63 | 35 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 64 | 36 | 80-120 | 80-120 | 80-120 | - | - | - |
| 65 | 24 | 80-120 | 80-120 | 80-120 | - | - | - |
| 66 | 40 | 80-120 | 80-120 | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 67 | 28 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 68 | 13 | 80-120 | 80-120 | - | - | - | - |
| 69 | 45 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 70 | 15 | 80-120 | 80-120 | - | - | - | - |
| 71 | 32 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 72 | 55 | 100-140 | 90-130 | 90-130 | 90-130 | 90-130 | - |
| 73 | 11 | 80-120 | 80-120 | 80-120 | - | - | - |
| 74 | 30 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 75 | 12 | 80-120 | 80-120 | 80-120 | - | - | - |
| 76 | 13 | 80-120 | 80-120 | - | - | - | - |
| 77 | 65 | 90-130 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 78 | 30 | 80-120 | 80-120 | - | - | - | - |
| 79 | 50 | 100-140 | 90-120 | 90-130 | - | - | - |
| 80 | 49 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 81 | 45 | 100-140 | 100-140 | 90-130 | - | - | - |
| 82 | 36 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 83 | 40 | 90-130 | 90-130 | 90-130 | - | - | - |
| 84 | 11 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 85 | 50 | 90-130 | 90-130 | 90-130 | - | - | - |
| 86 | 35 | 80-120 | 80-120 | 80-120 | - | - | - |
| 87 | 30 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 88 | 25 | 80-120 | 80-120 | 80-120 | - | - | - |
| 89 | 65 | 90-130 | 90-130 | 90-130 | - | - | - |
| 90 | 30 | 80-120 | 80-120 | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 91 | 35 | 80-120 | 80-120 | - | - | - | - |
| 92 | 50 | 90-130 | 90-130 | 90-130 | 90-130 | - | - |
| 93 | 37 | 80-120 | 80-120 | - | - | - | - |
| 94 | 53 | 90-130 | 90-130 | 90-130 | 90-130 | - | - |
| 95 | 42 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 96 | 12 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 97 | 40 | 90-130 | 90-130 | 90-130 | 90-130 | 90-130 | 90-130 |
| 98 | 45 | 80-120 | 80-120 | - | - | - | - |
| 99 | 27 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 100 | 25 | 80-120 | 80-120 | - | - | - | - |
| 101 | 21 | 80-120 | 80-120 | 80-120 | - | - | - |
| 102 | 30 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 103 | 20 | 80-120 | 80-120 | 80-120 | - | - | - |
| 104 | 51 | 80-120 | 80-120 | - | - | - | - |
| 105 | 5 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 106 | 42 | 80-120 | 80-120 | - | - | - | - |
| 107 | 32 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |

**Table 5.26: Blood pressure values of the patients after treatment with Livercare Churna.**

| Sr. no of patients | Age | Blood pressure after different weeks treatment | | | | | |
|---|---|---|---|---|---|---|---|
| | | Initial (zero week) | First | Second | Third | Fourth | Sixth |
| 1 | 17 | 80-120 | 80-120 | 80-120 | - | - | - |
| 2 | 47 | 90-130 | 80-120 | 80-120 | 80-120 | - | - |
| 3 | 49 | 100-140 | 100-140 | 90-130 | - | - | - |
| 4 | 51 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 |
| 5 | 31 | 80-120 | 80-120 | 80-120 | - | - | - |
| 6 | 53 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 7 | 47 | 90-130 | 90-130 | 80-120 | 80-120 | - | - |
| 8 | 40 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 |
| 9 | 47 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 10 | 50 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 11 | 44 | 80-120 | 80-120 | 80-120 | - | - | - |
| 12 | 46 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 |
| 13 | 35 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 14 | 55 | 90-130 | 80-120 | 80-120 | - | - | - |
| 15 | 50 | 100-140 | 90-130 | 90-130 | 90-130 | 80-120 | - |
| 16 | 60 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 |
| 17 | 43 | 80-120 | 80-120 | - | - | - | - |
| 18 | 45 | 80-120 | 80-120 | 80-120 | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 19 | 40 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 |
| 20 | 29 | 80-120 | 80-120 | 80-120 | - | - | - |
| 21 | 44 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 22 | 25 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 23 | 17 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 24 | 40 | 80-120 | 80-120 | - | - | - | - |
| 25 | 35 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 26 | 25 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 27 | 21 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 28 | 52 | 80-120 | 80-120 | 80-120 | - | - | - |
| 29 | 45 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 30 | 62 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 |
| 31 | 50 | 80-120 | 80-120 | 80-120 | - | - | - |
| 32 | 45 | 90-130 | 90-130 | 80-120 | 80-120 | - | - |
| 33 | 50 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 34 | 30 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 35 | 19 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 36 | 45 | 80-120 | 80-120 | 80-120 | - | - | - |
| 37 | 25 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 38 | 25 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 39 | 27 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 40 | 17 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 41 | 57 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 42 | 45 | 80-120 | 80-120 | 80-120 | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 43 | 60 | 80-120 | 80-120 | 80-120 | - | - | - |
| 44 | 49 | 80-120 | 80-120 | 80-120 | - | - | - |
| 45 | 36 | 80-120 | 80-120 | 80-120 | - | - | - |
| 46 | 49 | 90-130 | 90-130 | 90-130 | 90-130 | 90-130 | 90-130 |
| 47 | 50 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 48 | 40 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 |
| 49 | 40 | 90-130 | 90-130 | 90-130 | 90-130 | 90-130 | - |
| 50 | 39 | 80-120 | 80-120 | - | - | - | - |
| 51 | 41 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 |
| 52 | 45 | 80-120 | 80-120 | 80-120 | - | - | - |
| 53 | 29 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 54 | 52 | 80-120 | 80-120 | 80-120 | - | - | - |
| 55 | 50 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 56 | 49 | 100-140 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 57 | 39 | 80-120 | 80-120 | - | - | - | - |
| 58 | 11 | 80-120 | 80-120 | 80-120 | - | - | - |
| 59 | 19 | 80-120 | 80-120 | 80-120 | - | - | - |
| 60 | 52 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 61 | 21 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 62 | 29 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 63 | 40 | 80-120 | 80-120 | 80-120 | - | - | - |
| 64 | 55 | 80-120 | 80-120 | - | - | - | - |
| 65 | 50 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 66 | 39 | 80-120 | 80-120 | 80-120 | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 67 | 38 | 80-120 | 80-120 | 80-120 | - | - | - |
| 68 | 19 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 69 | 35 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 70 | 45 | 80-120 | 80-120 | 80-120 | - | - | - |
| 71 | 31 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 72 | 49 | 80-120 | 80-120 | - | - | - | - |
| 73 | 45 | 80-120 | 80-120 | - | - | - | - |
| 74 | 53 | 90-130 | 90-130 | 80-120 | - | - | - |
| 75 | 48 | 80-120 | 80-120 | - | - | - | - |
| 76 | 20 | 80-120 | 80-120 | - | - | - | - |
| 77 | 17 | 80-120 | 80-120 | 80-120 | - | - | - |
| 78 | 27 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 |
| 79 | 31 | 80-120 | 80-120 | 80-120 | - | - | - |
| 80 | 50 | 90-130 | 80-120 | - | - | - | - |
| 81 | 35 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 82 | 39 | 80-120 | 80-120 | - | - | - | - |
| 83 | 29 | 80-120 | 80-120 | - | - | - | - |
| 84 | 41 | 80-120 | 80-120 | - | - | - | - |
| 85 | 22 | 80-120 | 80-120 | - | - | - | - |
| 86 | 31 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 87 | 47 | 80-120 | 80-120 | - | - | - | - |
| 88 | 28 | 80-120 | 80-120 | 80-120 | - | - | - |
| 89 | 12 | 80-120 | 80-120 | - | - | - | - |
| 90 | 41 | 80-120 | 80-120 | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 91 | 36 | 80-120 | 80-120 | - | - | - | - |
| 92 | 44 | 80-120 | 80-120 | 80-120 | - | - | - |
| 93 | 39 | 80-120 | 80-120 | 80-120 | - | - | - |

**Table 5.27: Blood pressure values of the patients after treatment with Hepatogard forte Tablet**

| Sr. no of the patients | Age | Blood pressure after different weeks treatment | | | | | |
|---|---|---|---|---|---|---|---|
| | | Initial (zero week) | First | Second | Third | Fourth | Sixth |
| 1 | 32 | 80-120 | 80-120 | 80-120 | - | - | - |
| 2 | 34 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 3 | 50 | 100-140 | 100-140 | 100-140 | 90-130 | 90-130 | 90-130 |
| 4 | 39 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 |
| 5 | 39 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 |
| 6 | 60 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 |
| 7 | 32 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 8 | 49 | 100-140 | 100-140 | 100-140 | 90-130 | 90-130 | - |
| 9 | 55 | 80-120 | 80-120 | 80-120 | - | - | - |
| 10 | 60 | 90-130 | 90-130 | 80-120 | - | - | - |
| 11 | 35 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 12 | 36 | 80-120 | 80-120 | 80-120 | - | - | - |
| 13 | 58 | 90-130 | 90-130 | 90-130 | 90-130 | 90-130 | 90-130 |
| 14 | 40 | 90-130 | 90-130 | 80-120 | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 15 | 50 | 90-130 | 90-130 | 80-120 | - | - | - |
| 16 | 29 | 80-120 | 80-120 | 80-120 | - | - | - |
| 17 | 38 | 80-120 | 80-120 | 80-120 | - | - | - |
| 18 | 42 | 80-120 | 80-120 | 80-120 | - | - | - |
| 19 | 59 | 90-130 | 90-130 | 90-130 | - | - | - |
| 20 | 11 | 80-120 | 80-120 | 80-120 | - | - | - |
| 21 | 32 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 22 | 60 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 23 | 35 | 80-120 | 80-120 | 80-120 | - | - | - |
| 24 | 59 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 25 | 49 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 26 | 21 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 27 | 60 | 80-120 | 80-120 | 80-120 | - | - | - |
| 28 | 45 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 29 | 50 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 30 | 55 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 31 | 51 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 32 | 23 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 33 | 20 | 80-120 | 80-120 | 80-120 | - | - | - |
| 34 | 22 | 80-120 | 80-120 | - | - | - | - |
| 35 | 48 | 80-120 | 80-120 | 80-120 | - | - | - |
| 36 | 47 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 37 | 41 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 38 | 32 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 39 | 21 | 80-120 | 80-120 | 80-120 | - | - | - |
| 40 | 21 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 41 | 22 | 80-120 | 80-120 | - | - | - | - |
| 42 | 50 | 80-120 | 80-120 | - | - | - | - |
| 43 | 42 | 80-120 | 80-120 | - | - | - | - |
| 44 | 30 | 80-120 | 80-120 | 80-120 | - | - | - |
| 45 | 18 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 46 | 30 | 80-120 | 80-120 | - | - | - | - |
| 47 | 40 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 48 | 35 | 80-120 | 80-120 | - | - | - | - |
| 49 | 28 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 50 | 37 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 |
| 51 | 49 | 80-120 | 80-120 | 80-120 | - | - | - |
| 52 | 30 | 80-120 | 80-120 | 80-120 | - | - | - |
| 53 | 29 | 80-120 | 80-120 | - | - | - | - |
| 54 | 41 | 90-130 | 90-130 | 80-120 | 80-120 | - | - |
| 55 | 42 | 80-120 | 80-120 | 80-120 | - | - | - |
| 56 | 37 | 80-120 | 80-120 | - | - | - | - |
| 57 | 18 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 58 | 13 | 80-120 | 80-120 | - | - | - | - |
| 59 | 23 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 |
| 60 | 28 | 80-120 | 80-120 | - | - | - | - |
| 61 | 45 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 62 | 15 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 63 | 50 | 90-130 | 90-130 | 80-120 | 80-120 | 80-120 | - |
| 64 | 32 | 80-120 | 80-120 | - | - | - | - |
| 65 | 43 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 |
| 66 | 36 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 67 | 38 | 80-120 | 80-120 | - | - | - | - |
| 68 | 35 | 80-120 | 80-120 | 80-120 | - | - | - |
| 69 | 51 | 80-120 | 80-120 | 80-120 | - | - | - |
| 70 | 55 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 71 | 43 | 80-120 | 80-120 | 80-120 | - | - | - |
| 72 | 46 | 80-120 | 80-120 | 80-120 | - | - | - |
| 73 | 59 | 80-120 | 80-120 | - | - | - | - |
| 74 | 39 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 75 | 55 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 76 | 35 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 77 | 51 | 80-120 | 80-120 | - | - | - | - |
| 78 | 45 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |
| 79 | 40 | 80-120 | 80-120 | 80-120 | - | - | - |
| 80 | 17 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 |
| 81 | 50 | 100-140 | 100-140 | 90-130 | 90-130 | - | - |
| 82 | 50 | 100-140 | 100-140 | - | - | - | - |
| 83 | 20 | 80-120 | 80-120 | 80-120 | - | - | - |
| 84 | 51 | 80-120 | 80-120 | 80-120 | - | - | - |
| 85 | 55 | 100-140 | 100-140 | 100-140 | - | - | - |
| 86 | 50 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 87 | 39 | 80-120 | 80-120 | 80-120 | - | - | - |
| 88 | 47 | 100-120 | 100-120 | 90-120 | 90-130 | 80-120 | - |
| 89 | 37 | 80-120 | 80-120 | 80-120 | - | - | - |
| 90 | 40 | 80-120 | 80-120 | 80-120 | - | - | - |
| 91 | 51 | 100-140 | 90-120 | 90-120 | 90-130 | - | - |
| 92 | 47 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 |
| 93 | 49 | 80-120 | 80-120 | 80-120 | 80-120 | 80-120 | - |
| 94 | 39 | 80-120 | 80-120 | 80-120 | - | - | - |
| 95 | 35 | 80-120 | 80-120 | 80-120 | 80-120 | - | - |

**Table 5.28: Comparative blood pressure values for different week treatment using *Phyllanthus amarus*, Livercare Churna and Hepatogard forte Tablet.**

| Sr. no | Drug | Total num of patients | No of patients having BP | Normalized | Reduced | Remain unchanged |
|---|---|---|---|---|---|---|
| 1 | *Phyllanthus amarus* | 107 | 18 | 6 | 5 | 7 |
| 2 | Livercare Churna | 93 | 10 | 8 | 2 | - |
| 3 | Hepatogard forte Tablet | 95 | 14 | 6 | 4 | 4 |

During clinical study selected 107 patients of *Phyllanthus amarus* group were found infected with jaundice among them 18 patients have hypertension. After treatment with *Phyllanthus amarus* 6 patients were normalized, 5 patients slightly reduced hypertension and 7 patients remained unchanged. 93 patients of Livercare Churna group were found infected with jaundice among them 10 patients have hypertension. After treatment with Livercare Churna 8 patients were normalized, 2 patients slightly reduced hypertension. 95 patients of Hepatogard forte Tablet were found infected with jaundice among them 14 patients have hypertension. After treatment with Hepatogard forte Tablet 6 patients were normalized, 4 patients slightly reduced hypertension and 4 patients remained unchanged.

**Table 5.29: Urine sugar values of the patients after treatment with *Phyllanthus amarus***

| Sr. no of patients | Age | Urine sugar after different weeks treatment | | | | | |
|---|---|---|---|---|---|---|---|
| | | Initial (zero week) | First | Second | Third | Forth | Six |
| 1 | 28 | Normal | Normal | - | - | - | - |
| 2 | 51 | Normal | Normal | - | - | - | - |
| 3 | 20 | Normal | Normal | - | - | - | - |
| 4 | 16 | Normal | Normal | Normal | Normal | Normal | - |
| 5 | 42 | Normal | Normal | Normal | Normal | Normal | - |
| 6 | 17 | Normal | Normal | Normal | - | - | - |
| 7 | 65 | Normal | Normal | - | - | - | - |
| 8 | 65 | Normal | Normal | - | - | - | - |
| 9 | 36 | Normal | Normal | Normal | Normal | - | - |
| 10 | 42 | Normal | Normal | - | - | - | - |
| 11 | 35 | Normal | Normal | Normal | Normal | - | - |
| 12 | 21 | Normal | Normal | Normal | Normal | - | - |
| 13 | 32 | Normal | Normal | Normal | - | - | - |
| 14 | 32 | Normal | Normal | Normal | - | - | - |
| 15 | 28 | Normal | Normal | Normal | Normal | Normal | - |
| 16 | 45 | XX | X | Normal | - | - | - |
| 17 | 17 | Normal | Normal | - | - | - | - |
| 18 | 32 | Normal | Normal | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 19 | 20 | Normal | Normal | Normal | Normal | Normal | - |
| 20 | 38 | Normal | Normal | Normal | Normal | Normal | Normal |
| 21 | 19 | Normal | Normal | Normal | Normal | - | - |
| 22 | 38 | Normal | Normal | - | - | - | - |
| 23 | 16 | Normal | Normal | Normal | Normal | Normal | Normal |
| 24 | 19 | Normal | Normal | Normal | Normal | - | - |
| 25 | 22 | Normal | Normal | Normal | Normal | - | - |
| 26 | 65 | Normal | Normal | Normal | Normal | - | - |
| 27 | 35 | Normal | Normal | Normal | - | - | - |
| 28 | 32 | Normal | Normal | Normal | - | - | - |
| 29 | 42 | Normal | Normal | - | - | - | - |
| 30 | 43 | Normal | Normal | Normal | Normal | Normal | Normal |
| 31 | 28 | Normal | Normal | Normal | Normal | Normal | - |
| 32 | 50 | X | X | Normal | Normal | Normal | - |
| 33 | 55 | XX | X | X | Normal | - | - |
| 34 | 45 | Normal | Normal | Normal | Normal | - | - |
| 35 | 55 | Normal | Normal | Normal | - | - | - |
| 36 | 40 | Normal | Normal | Normal | - | - | - |
| 37 | 20 | Normal | Normal | Normal | Normal | - | - |
| 38 | 50 | XX | X | Normal | - | - | - |
| 39 | 45 | Normal | Normal | Normal | - | - | - |
| 40 | 50 | XX | XX | X | Normal | Normal | - |
| 41 | 50 | Normal | Normal | Normal | Normal | - | - |
| 42 | 45 | Normal | Normal | Normal | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 43 | 32 | Normal | Normal | Normal | Normal | Normal | - |
| 44 | 55 | XX | X | X | - | - | - |
| 45 | 21 | Normal | Normal | Normal | Normal | Normal | - |
| 46 | 50 | XX | X | X | Normal | Normal | - |
| 47 | 19 | Normal | Normal | - | - | - | - |
| 48 | 42 | Normal | Normal | Normal | Normal | - | - |
| 49 | 71 | Normal | Normal | - | - | - | - |
| 50 | 38 | Normal | Normal | Normal | Normal | Normal | - |
| 51 | 30 | Normal | Normal | Normal | Normal | - | - |
| 52 | 30 | Normal | Normal | - | - | - | - |
| 53 | 54 | Normal | Normal | - | - | - | - |
| 54 | 42 | Normal | Normal | Normal | - | - | - |
| 55 | 22 | Normal | Normal | Normal | - | - | - |
| 56 | 42 | Normal | Normal | Normal | Normal | - | - |
| 57 | 46 | XX | X | X | X | Normal | - |
| 58 | 11 | Normal | Normal | - | - | - | - |
| 59 | 38 | Normal | Normal | Normal | Normal | - | - |
| 60 | 70 | XX | X | - | - | - | - |
| 61 | 20 | Normal | Normal | Normal | Normal | - | - |
| 62 | 23 | Normal | Normal | Normal | - | - | - |
| 63 | 35 | Normal | Normal | Normal | Normal | - | - |
| 64 | 36 | Normal | Normal | Normal | - | - | - |
| 65 | 24 | Normal | Normal | Normal | - | - | - |
| 66 | 40 | Normal | Normal | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 67 | 28 | Normal | Normal | Normal | Normal | - | - |
| 68 | 13 | Normal | Normal | - | - | - | - |
| 69 | 45 | Normal | Normal | Normal | Normal | - | - |
| 70 | 15 | Normal | Normal | - | - | - | - |
| 71 | 32 | Normal | Normal | Normal | Normal | - | - |
| 72 | 55 | XX | XX | X | X | Normal | - |
| 73 | 11 | Normal | Normal | Normal | - | - | - |
| 74 | 30 | Normal | Normal | Normal | Normal | - | - |
| 75 | 12 | Normal | Normal | Normal | - | - | - |
| 76 | 13 | Normal | Normal | - | - | - | - |
| 77 | 65 | XX | Normal | Normal | Normal | Normal | - |
| 78 | 30 | Normal | Normal | - | - | - | - |
| 79 | 50 | XX | X | X | - | - | - |
| 80 | 49 | Normal | Normal | Normal | Normal | Normal | - |
| 81 | 45 | X | X | Normal | - | - | - |
| 82 | 36 | Normal | Normal | Normal | Normal | Normal | - |
| 83 | 40 | X | X | Normal | - | - | - |
| 84 | 11 | Normal | Normal | Normal | Normal | Normal | - |
| 85 | 50 | XX | X | Normal | - | - | - |
| 86 | 35 | Normal | Normal | Normal | - | - | - |
| 87 | 30 | Normal | Normal | Normal | Normal | - | - |
| 88 | 25 | Normal | Normal | Normal | - | - | - |
| 89 | 65 | XX | X | X | - | - | - |
| 90 | 30 | Normal | Normal | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 91 | 35 | X | X | - | - | - | - |
| 92 | 50 | XX | X | X | X | - | - |
| 93 | 37 | Normal | Normal | - | - | - | - |
| 94 | 53 | X | X | Normal | Normal | - | - |
| 95 | 42 | Normal | Normal | Normal | Normal | - | - |
| 96 | 12 | Normal | Normal | Normal | Normal | - | - |
| 97 | 40 | X | X | Normal | Normal | Normal | Normal |
| 98 | 45 | Normal | Normal | - | - | - | - |
| 99 | 27 | Normal | Normal | Normal | Normal | - | - |
| 100 | 25 | Normal | Normal | - | - | - | - |
| 101 | 21 | Normal | Normal | Normal | - | - | - |
| 102 | 30 | Normal | Normal | Normal | Normal | Normal | - |
| 103 | 20 | Normal | Normal | Normal | - | - | - |
| 104 | 51 | Normal | Normal | - | - | - | - |
| 105 | 5 | Normal | Normal | Normal | Normal | Normal | - |
| 106 | 42 | X | Normal | - | - | - | - |
| 107 | 32 | Normal | Normal | Normal | Normal | - | - |

**Table 5.30: Urine Sugar values of the patients after treatment with Livercare Churna.**

| Sr. no of patients | Age | Urine sugar after different weeks treatment | | | | | |
|---|---|---|---|---|---|---|---|
| | | Initial (zero week) | First | Second | Third | Fourth | Sixth |
| 1 | 17 | Normal | Normal | Normal | - | - | - |
| 2 | 47 | Normal | Normal | Normal | Normal | - | - |
| 3 | 49 | Normal | Normal | Normal | - | - | - |
| 4 | 51 | X | X | X | Normal | Normal | Normal |
| 5 | 31 | Normal | Normal | Normal | - | - | - |
| 6 | 53 | Normal | Normal | Normal | Normal | - | - |
| 7 | 47 | Normal | Normal | Normal | Normal | - | - |
| 8 | 40 | Normal | Normal | Normal | Normal | Normal | Normal |
| 9 | 47 | Normal | Normal | Normal | Normal | Normal | - |
| 10 | 50 | X | X | X | Normal | Normal | - |
| 11 | 44 | Normal | Normal | Normal | - | - | - |
| 12 | 46 | Normal | Normal | Normal | Normal | Normal | Normal |
| 13 | 35 | Normal | Normal | Normal | Normal | - | - |
| 14 | 55 | X | Normal | Normal | - | - | - |
| 15 | 50 | XX | XX | X | X | X | - |
| 16 | 60 | Normal | Normal | Normal | Normal | Normal | Normal |
| 17 | 43 | Normal | Normal | - | - | - | - |
| 18 | 45 | Normal | Normal | Normal | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 19 | 40 | Normal | Normal | Normal | Normal | Normal | Normal |
| 20 | 29 | Normal | Normal | Normal | - | - | - |
| 21 | 44 | Normal | Normal | Normal | Normal | Normal | - |
| 22 | 25 | Normal | Normal | Normal | Normal | Normal | - |
| 23 | 17 | Normal | Normal | Normal | Normal | Normal | - |
| 24 | 40 | Normal | Normal | - | - | - | - |
| 25 | 35 | Normal | Normal | Normal | Normal | Normal | - |
| 26 | 25 | Normal | Normal | Normal | Normal | Normal | - |
| 27 | 21 | Normal | Normal | Normal | Normal | Normal | - |
| 28 | 52 | X | X | Normal | | | - |
| 29 | 45 | Normal | Normal | Normal | Normal | Normal | - |
| 30 | 62 | Normal | Normal | Normal | Normal | Normal | Normal |
| 31 | 50 | Normal | Normal | Normal | - | - | - |
| 32 | 45 | Normal | Normal | Normal | Normal | - | - |
| 33 | 50 | Normal | Normal | Normal | Normal | Normal | - |
| 34 | 30 | Normal | Normal | Normal | Normal | Normal | - |
| 35 | 19 | Normal | Normal | Normal | Normal | Normal | - |
| 36 | 45 | X | X | Normal | - | - | - |
| 37 | 25 | Normal | Normal | Normal | Normal | - | - |
| 38 | 25 | Normal | Normal | Normal | Normal | - | - |
| 39 | 27 | Normal | Normal | Normal | Normal | Normal | - |
| 40 | 17 | Normal | Normal | Normal | Normal | - | - |
| 41 | 57 | X | X | Normal | Normal | - | - |
| 42 | 45 | Normal | Normal | Normal | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 43 | 60 | Normal | Normal | Normal | - | - | - |
| 44 | 49 | X | X | Normal | - | - | - |
| 45 | 36 | Normal | Normal | Normal | - | - | - |
| 46 | 49 | X | X | Normal | Normal | Normal | Normal |
| 47 | 50 | Normal | Normal | Normal | Normal | - | - |
| 48 | 40 | Normal | Normal | Normal | Normal | Normal | Normal |
| 49 | 40 | X | X | X | Normal | Normal | - |
| 50 | 39 | Normal | Normal | - | - | - | - |
| 51 | 41 | Normal | Normal | Normal | Normal | Normal | Normal |
| 52 | 45 | Normal | Normal | Normal | - | - | - |
| 53 | 29 | Normal | Normal | Normal | Normal | - | - |
| 54 | 52 | X | X | Normal | - | - | - |
| 55 | 50 | Normal | Normal | Normal | Normal | - | - |
| 56 | 49 | XX | XX | X | X | X | - |
| 57 | 39 | Normal | Normal | - | - | - | - |
| 58 | 11 | Normal | Normal | Normal | - | - | - |
| 59 | 19 | Normal | Normal | Normal | - | - | - |
| 60 | 52 | Normal | Normal | Normal | Normal | - | - |
| 61 | 21 | Normal | Normal | Normal | Normal | Normal | - |
| 62 | 29 | Normal | Normal | Normal | Normal | Normal | - |
| 63 | 40 | Normal | Normal | Normal | - | - | - |
| 64 | 55 | Normal | Normal | - | - | - | - |
| 65 | 50 | Normal | Normal | Normal | Normal | Normal | - |
| 66 | 39 | Normal | Normal | Normal | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 67 | 38 | Normal | Normal | Normal | - | - | - |
| 68 | 19 | Normal | Normal | Normal | Normal | - | - |
| 69 | 35 | Normal | Normal | Normal | Normal | Normal | - |
| 70 | 45 | Normal | Normal | Normal | - | - | - |
| 71 | 31 | Normal | Normal | Normal | Normal | - | - |
| 72 | 49 | Normal | Normal | - | - | - | - |
| 73 | 45 | Normal | Normal | - | - | - | - |
| 74 | 53 | Normal | Normal | Normal | - | - | - |
| 75 | 48 | Normal | Normal | - | - | - | - |
| 76 | 20 | Normal | Normal | - | - | - | - |
| 77 | 17 | Normal | Normal | Normal | - | - | - |
| 78 | 27 | Normal | Normal | Normal | Normal | Normal | Normal |
| 79 | 31 | Normal | Normal | Normal | - | - | - |
| 80 | 50 | Normal | Normal | - | - | - | - |
| 81 | 35 | Normal | Normal | Normal | Normal | Normal | - |
| 82 | 39 | Normal | Normal | - | - | - | - |
| 83 | 29 | Normal | Normal | - | - | - | - |
| 84 | 41 | Normal | Normal | - | - | - | - |
| 85 | 22 | Normal | Normal | - | - | - | - |
| 86 | 31 | Normal | Normal | Normal | Normal | - | - |
| 87 | 47 | Normal | Normal | - | - | - | - |
| 88 | 28 | Normal | Normal | Normal | - | - | - |
| 89 | 12 | Normal | Normal | - | - | - | - |
| 90 | 41 | Normal | Normal | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 91 | 36 | Normal | Normal | - | - | - | - |
| 92 | 44 | Normal | Normal | Normal | - | - | - |
| 93 | 39 | Normal | Normal | Normal | - | - | - |

**Table 5.31: Urine Sugar values of the patients after treatment with Hepatogard forte Tablet**

| Sr. no of patients | Age | Urine sugar after different weeks treatment | | | | | |
|---|---|---|---|---|---|---|---|
| | | Initial (zero week) | First | Second | Third | Fourth | Sixth |
| 1 | 32 | Normal | Normal | Normal | - | - | - |
| 2 | 34 | Normal | Normal | Normal | Normal | - | - |
| 3 | 50 | X | X | X | X | X | X |
| 4 | 39 | Normal | Normal | Normal | Normal | Normal | Normal |
| 5 | 39 | Normal | Normal | Normal | Normal | Normal | Normal |
| 6 | 60 | Normal | Normal | Normal | Normal | Normal | Normal |
| 7 | 32 | Normal | Normal | Normal | Normal | Normal | - |
| 8 | 49 | Normal | Normal | Normal | Normal | Normal | - |
| 9 | 55 | XX | XX | XX | - | - | - |
| 10 | 60 | X | X | X | - | - | - |
| 11 | 35 | Normal | Normal | Normal | Normal | - | - |
| 12 | 36 | Normal | Normal | Normal | - | - | - |
| 13 | 58 | XX | XX | XX | XX | X | X |
| 14 | 40 | Normal | Normal | Normal | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 15 | 50 | Normal | Normal | Normal | - | - | - |
| 16 | 29 | Normal | Normal | Normal | - | - | - |
| 17 | 38 | Normal | Normal | Normal | - | - | - |
| 18 | 42 | Normal | Normal | Normal | - | - | - |
| 19 | 59 | XX | XX | XX | - | - | - |
| 20 | 11 | Normal | Normal | Normal | - | - | - |
| 21 | 32 | Normal | Normal | Normal | Normal | Normal | - |
| 22 | 60 | X | X | X | X | X | - |
| 23 | 35 | Normal | Normal | Normal | - | - | - |
| 24 | 59 | Normal | Normal | Normal | Normal | - | - |
| 25 | 49 | Normal | Normal | Normal | Normal | - | - |
| 26 | 21 | Normal | Normal | Normal | Normal | - | - |
| 27 | 60 | X | X | X | - | - | - |
| 28 | 45 | Normal | Normal | Normal | Normal | - | - |
| 29 | 50 | Normal | Normal | Normal | Normal | Normal | - |
| 30 | 55 | Normal | Normal | Normal | Normal | - | - |
| 31 | 51 | X | Normal | Normal | Normal | - | - |
| 32 | 23 | Normal | Normal | Normal | Normal | Normal | - |
| 33 | 20 | Normal | Normal | Normal | - | - | - |
| 34 | 22 | Normal | Normal | - | - | - | - |
| 35 | 48 | Normal | Normal | Normal | - | - | - |
| 36 | 47 | Normal | Normal | Normal | Normal | Normal | - |
| 37 | 41 | Normal | Normal | Normal | Normal | - | - |
| 38 | 32 | Normal | Normal | Normal | Normal | Normal | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 39 | 21 | Normal | Normal | Normal | - | - | - |
| 40 | 21 | Normal | Normal | Normal | Normal | - | - |
| 41 | 22 | Normal | Normal | - | - | - | - |
| 42 | 50 | Normal | Normal | - | - | - | - |
| 43 | 42 | Normal | Normal | - | - | - | - |
| 44 | 30 | Normal | Normal | Normal | - | - | - |
| 45 | 18 | Normal | Normal | Normal | Normal | - | - |
| 46 | 30 | Normal | Normal | - | - | - | - |
| 47 | 40 | Normal | Normal | Normal | Normal | - | - |
| 48 | 35 | Normal | Normal | - | - | - | - |
| 49 | 28 | Normal | Normal | Normal | Normal | Normal | |
| 50 | 37 | Normal | Normal | Normal | Normal | Normal | Normal |
| 51 | 49 | Normal | Normal | Normal | - | - | - |
| 52 | 30 | Normal | Normal | Normal | - | - | - |
| 53 | 29 | Normal | Normal | - | - | - | - |
| 54 | 41 | X | X | X | X | - | - |
| 55 | 42 | Normal | Normal | Normal | - | - | - |
| 56 | 37 | Normal | Normal | - | - | - | - |
| 57 | 18 | Normal | Normal | Normal | Normal | Normal | - |
| 58 | 13 | Normal | Normal | - | - | - | - |
| 59 | 23 | Normal | Normal | Normal | Normal | Normal | Normal |
| 60 | 28 | Normal | Normal | - | - | - | - |
| 61 | 45 | X | X | X | X | X | - |
| 62 | 15 | Normal | Normal | Normal | Normal | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 63 | 50 | Xx | X | X | X | X | - |
| 64 | 32 | Normal | Normal | - | - | - | - |
| 65 | 43 | Normal | Normal | Normal | Normal | Normal | Normal |
| 66 | 36 | Normal | Normal | Normal | Normal | Normal | - |
| 67 | 38 | Normal | Normal | - | - | - | - |
| 68 | 35 | Normal | Normal | Normal | - | - | - |
| 69 | 51 | X | X | Normal | - | - | - |
| 70 | 55 | Normal | Normal | Normal | Normal | Normal | - |
| 71 | 43 | Normal | Normal | Normal | - | - | - |
| 72 | 46 | Normal | Normal | Normal | - | - | - |
| 73 | 59 | Normal | Normal | - | - | - | - |
| 74 | 39 | Normal | Normal | Normal | Normal | Normal | - |
| 75 | 55 | X | X | X | X | X | - |
| 76 | 35 | Normal | Normal | Normal | Normal | - | - |
| 77 | 51 | Normal | Normal | - | | - | - |
| 78 | 45 | Normal | Normal | Normal | Normal | - | - |
| 79 | 40 | Normal | Normal | Normal | - | - | - |
| 80 | 17 | Normal | Normal | Normal | Normal | Normal | Normal |
| 81 | 50 | XX | XX | XX | X | - | - |
| 82 | 50 | XX | XX | - | - | - | - |
| 83 | 20 | Normal | Normal | Normal | - | - | - |
| 84 | 51 | Normal | Normal | Normal | - | - | - |
| 85 | 55 | Normal | Normal | Normal | - | - | - |
| 86 | 50 | X | X | X | X | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 87 | 39 | Normal | Normal | Normal | - | - | - |
| 88 | 47 | XX | XX | XX | XX | X | - |
| 89 | 37 | Normal | Normal | Normal | - | - | - |
| 90 | 40 | Normal | Normal | Normal | - | - | - |
| 91 | 51 | XX | XX | XX | XX | - | - |
| 92 | 47 | Normal | Normal | Normal | Normal | Normal | Normal |
| 93 | 49 | Normal | Normal | Normal | Normal | Normal | - |
| 94 | 39 | Normal | Normal | Normal | - | - | - |
| 95 | 35 | Normal | Normal | Normal | Normal | - | - |

**Table 5.32: Comparative urine sugar values of *Phyllanthus amarus*, Livercare Churna and Hepatogard forte Tablet as hepatoprotective drug**

| Sr. no | Drug | Total number of patient | No of patients having urine sugar | Normalized | Reduced | Remain unchanged |
|---|---|---|---|---|---|---|
| 1 | *Phyllanthus amarus* | 107 | 21 | 14 | 7 | - |
| 2 | Livercare Churna | 93 | 12 | 10 | 2 | - |
| 3 | Hepatogard forte Tablet | 95 | 18 | 2 | 4 | 12 |

During clinical study selected 107 patients of *Phyllanthus amarus* group were found infected with jaundice among them 21 patients have higher urine sugar level. After treatment with *Phyllanthus amarus* 14 patients was normalized, 7 patients reduced the sugar level and no patient remained unchanged. 93 patients of Livercare Churna group were found infected with jaundice among them 12 patients have higher urine sugar level. After treatment with Livercare Churna 10 patients were normalized, 2 patients reduced urine sugar and no patients with unchanged urine sugar. 95 patients of Hepatogard forte Tablet were found infected with jaundice among them 18 patients have higher urine sugar level. After treatment with Hepatogard forte Tablet 2 patients were normalized, 4 patients reduced the sugar level and 12 patients remained unchanged.

**Table 5.33: Urine Creatinine levels of the patients after treatment with *Phyllanthus amarus.***

| Sr. No of patients | Age | Urine Creatinine after different weeks treatment | | | | | |
|---|---|---|---|---|---|---|---|
| | | Initial (zero week) | First | Second | Third | Forth | Six |
| 1 | 28 | Positive | Normal | - | - | - | - |
| 2 | 51 | Positive | Normal | - | - | - | - |
| 3 | 20 | Positive | Normal | - | - | - | - |
| 4 | 16 | Positive | Positive | Positive | Positive | Normal | - |
| 5 | 42 | Positive | Positive | Positive | Positive | Normal | - |
| 6 | 17 | Positive | Positive | Normal | - | - | - |
| 7 | 65 | Normal | Normal | - | - | - | - |
| 8 | 65 | Positive | Normal | - | - | - | - |
| 9 | 36 | Positive | Positive | Positive | Normal | - | - |
| 10 | 42 | Positive | Normal | - | - | - | - |
| 11 | 35 | Positive | Positive | Positive | Normal | - | - |
| 12 | 21 | Positive | Positive | Positive | Normal | - | - |
| 13 | 32 | Positive | Positive | Normal | - | - | - |
| 14 | 32 | Positive | Positive | Normal | - | - | - |
| 15 | 28 | Positive | Positive | Normal | Positive | Normal | - |
| 16 | 45 | Positive | Normal | Normal | - | - | - |
| 17 | 17 | Positive | Normal | - | - | - | - |
| 18 | 32 | Positive | Normal | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 19 | 20 | Positive | Positive | Positive | Positive | Normal | - |
| 20 | 38 | Positive | Positive | Positive | Positive | Positive | Normal |
| 21 | 19 | Positive | Positive | Positive | Normal | - | - |
| 22 | 38 | Positive | Positive | - | - | - | - |
| 23 | 16 | Positive | Positive | Positive | Positive | Positive | Normal |
| 24 | 19 | Positive | Positive | Positive | Normal | - | - |
| 25 | 22 | Positive | Positive | Positive | Normal | - | - |
| 26 | 65 | Positive | Positive | Positive | Normal | - | - |
| 27 | 35 | Positive | Positive | Normal | - | - | - |
| 28 | 32 | Positive | Positive | Normal | - | - | - |
| 29 | 42 | Positive | Normal | - | - | - | - |
| 30 | 43 | Positive | Positive | Positive | Positive | Positive | Normal |
| 31 | 28 | Positive | Positive | Positive | Positive | Normal | - |
| 32 | 50 | Positive | Positive | Positive | Positive | Normal | - |
| 33 | 55 | Positive | Positive | Normal | Normal | - | - |
| 34 | 45 | Positive | Positive | Positive | Normal | - | - |
| 35 | 55 | Positive | Positive | Normal | - | - | - |
| 36 | 40 | Positive | Positive | Normal | - | - | - |
| 37 | 20 | Positive | Positive | Positive | Normal | - | - |
| 38 | 50 | Positive | Positive | Positive | - | - | - |
| 39 | 45 | Positive | Positive | Normal | - | - | - |
| 40 | 50 | Positive | Positive | Positive | Positive | Normal | - |
| 41 | 50 | Positive | Positive | Positive | Normal | - | - |
| 42 | 45 | Positive | Positive | Normal | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 43 | 32 | Positive | Positive | Positive | Positive | Normal | - |
| 44 | 55 | Positive | Positive | Normal | - | - | - |
| 45 | 21 | Positive | Positive | Normal | Positive | Normal | - |
| 46 | 50 | Positive | Positive | Positive | Positive | Normal | - |
| 47 | 19 | Positive | Normal | - | - | - | - |
| 48 | 42 | Positive | Positive | Positive | Normal | - | - |
| 49 | 71 | Positive | Normal | - | - | - | - |
| 50 | 38 | Positive | Normal | Positive | Normal | Normal | - |
| 51 | 30 | Positive | Positive | Positive | Normal | - | - |
| 52 | 30 | Positive | Normal | - | - | - | - |
| 53 | 54 | Positive | Normal | - | - | - | - |
| 54 | 42 | Positive | Positive | Normal | - | - | - |
| 55 | 22 | Positive | Positive | Normal | - | - | - |
| 56 | 42 | Positive | Positive | Positive | Normal | - | - |
| 57 | 46 | Positive | Positive | Positive | Positive | Normal | - |
| 58 | 11 | Positive | Positive | - | - | - | - |
| 59 | 38 | Positive | Positive | Positive | Normal | - | - |
| 60 | 70 | Positive | Normal | - | - | - | - |
| 61 | 20 | Positive | Positive | Positive | Normal | - | - |
| 62 | 23 | Positive | Positive | Normal | - | - | - |
| 63 | 35 | Positive | Positive | Positive | Normal | - | - |
| 64 | 36 | Positive | Positive | Positive | - | - | - |
| 65 | 24 | Positive | Positive | Normal | - | - | - |
| 66 | 40 | Positive | Normal | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 67 | 28 | Positive | Positive | Positive | Normal | - | - |
| 68 | 13 | Positive | Normal | - | - | - | - |
| 69 | 45 | Positive | Positive | Positive | Normal | - | - |
| 70 | 15 | Positive | Normal | - | - | - | - |
| 71 | 32 | Positive | Positive | Positive | Normal | - | - |
| 72 | 55 | Positive | Positive | Positive | Positive | Normal | - |
| 73 | 11 | Positive | Positive | Normal | - | - | - |
| 74 | 30 | Positive | Positive | Positive | Normal | - | - |
| 75 | 12 | Positive | Positive | Normal | - | - | - |
| 76 | 13 | Positive | Normal | - | - | - | - |
| 77 | 65 | Positive | Positive | Positive | Positive | Normal | - |
| 78 | 30 | Positive | Normal | - | - | - | - |
| 79 | 50 | Positive | Positive | Normal | - | - | - |
| 80 | 49 | Positive | Positive | Positive | Positive | Normal | - |
| 81 | 45 | Positive | Positive | Positive | - | - | - |
| 82 | 36 | Positive | Positive | Positive | Positive | Normal | - |
| 83 | 40 | Positive | Positive | Normal | - | - | - |
| 84 | 11 | Positive | Positive | Positive | Positive | Normal | - |
| 85 | 50 | Positive | Positive | Normal | - | - | - |
| 86 | 35 | Positive | Positive | Normal | - | - | - |
| 87 | 30 | Positive | Positive | Positive | Positive | - | - |
| 88 | 25 | Positive | Positive | Normal | - | - | - |
| 89 | 65 | Positive | Positive | Normal | - | - | - |
| 90 | 30 | Positive | Normal | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 91 | 35 | Positive | Normal | - | - | - | - |
| 92 | 50 | Positive | Positive | Positive | Normal | - | - |
| 93 | 37 | Positive | Positive | - | - | - | - |
| 94 | 53 | Positive | Positive | Positive | Positive | - | - |
| 95 | 42 | Positive | Positive | Positive | Normal | - | - |
| 96 | 12 | Positive | Positive | Positive | Normal | - | - |
| 97 | 40 | Positive | Positive | Positive | Positive | Positive | Normal |
| 98 | 45 | Positive | Positive | - | - | - | - |
| 99 | 27 | Positive | Positive | Positive | Positive | - | - |
| 100 | 25 | Positive | Normal | - | - | - | - |
| 101 | 21 | Positive | Positive | Normal | - | - | - |
| 102 | 30 | Positive | Positive | Positive | Positive | Normal | - |
| 103 | 20 | Positive | Positive | Normal | - | - | - |
| 104 | 51 | Positive | Normal | - | - | - | - |
| 105 | 5 | Positive | Positive | Positive | Positive | Positive | - |
| 106 | 42 | Positive | Normal | - | - | - | - |
| 107 | 32 | Positive | Positive | Positive | Normal | - | - |

**Table 5.34: Urine Creatinine levels of the patients after treatment with Livercare Churna.**

| Sr. no of patients | Age | Urine Creatinine after different weeks treatment | | | | | |
|---|---|---|---|---|---|---|---|
| | | Initial (zero week) | First | Second | Third | Fourth | Sixth |
| 1 | 17 | Positive | Positive | Normal | - | - | - |
| 2 | 47 | Positive | Positive | Positive | Normal | - | - |
| 3 | 49 | Positive | Positive | Normal | - | - | - |
| 4 | 51 | Positive | Positive | Positive | Positive | Positive | Normal |
| 5 | 31 | Positive | Positive | Normal | - | - | - |
| 6 | 53 | Positive | Positive | Positive | Normal | - | - |
| 7 | 47 | Positive | Positive | Positive | Normal | - | - |
| 8 | 40 | Positive | Positive | Positive | Positive | Positive | Normal |
| 9 | 47 | Positive | Positive | Positive | Positive | Positive | - |
| 10 | 50 | Positive | Positive | Positive | Positive | Normal | - |
| 11 | 44 | Positive | Positive | Positive | - | - | - |
| 12 | 46 | Positive | Positive | Positive | Positive | Positive | Normal |
| 13 | 35 | Positive | Positive | Positive | Normal | - | - |
| 14 | 55 | Positive | Positive | Normal | - | - | - |
| 15 | 50 | Positive | Positive | Positive | Positive | Normal | - |
| 16 | 60 | Positive | Positive | Positive | Positive | Positive | Normal |
| 17 | 43 | Positive | Normal | - | - | - | - |
| 18 | 45 | Positive | Positive | Normal | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 19 | 40 | Positive | Positive | Positive | Positive | Positive | Normal |
| 20 | 29 | Positive | Positive | Normal | - | - | - |
| 21 | 44 | Positive | Positive | Positive | Positive | Positive | - |
| 22 | 25 | Positive | Positive | Positive | Positive | Normal | - |
| 23 | 17 | Positive | Positive | Positive | Positive | Normal | - |
| 24 | 40 | Positive | Normal | - | - | - | - |
| 25 | 35 | Positive | Positive | Positive | Positive | Normal | - |
| 26 | 25 | Positive | Positive | Positive | Positive | Normal | - |
| 27 | 21 | Positive | Positive | Positive | Positive | Normal | - |
| 28 | 52 | Positive | Positive | Normal | - | - | - |
| 29 | 45 | Positive | Positive | Positive | Positive | Normal | - |
| 30 | 62 | Positive | Positive | Positive | Positive | Positive | Normal |
| 31 | 50 | Positive | Positive | Normal | - | - | - |
| 32 | 45 | Positive | Positive | Positive | Positive | - | - |
| 33 | 50 | Positive | Positive | Positive | Positive | Normal | - |
| 34 | 30 | Positive | Positive | Positive | Positive | Positive | - |
| 35 | 19 | Positive | Positive | Positive | Positive | Normal | - |
| 36 | 45 | Positive | Positive | Positive | - | - | - |
| 37 | 25 | Positive | Positive | Positive | Normal | - | - |
| 38 | 25 | Positive | Positive | Positive | Normal | - | - |
| 39 | 27 | Positive | Positive | Positive | Positive | Normal | - |
| 40 | 17 | Positive | Positive | Positive | Normal | - | - |
| 41 | 57 | Positive | Positive | Positive | Normal | - | - |
| 42 | 45 | Positive | Positive | Normal | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 43 | 60 | Positive | Positive | Normal | - | - | - |
| 44 | 49 | Positive | Positive | Normal | - | - | - |
| 45 | 36 | Positive | Positive | Normal | - | - | - |
| 46 | 49 | Positive | Positive | Positive | Positive | Positive | Normal |
| 47 | 50 | Positive | Positive | Positive | Normal | - | - |
| 48 | 40 | Positive | Positive | Positive | Positive | Positive | Normal |
| 49 | 40 | Positive | Positive | Positive | Positive | Normal | - |
| 50 | 39 | Positive | Normal | - | - | - | - |
| 51 | 41 | Positive | Positive | Positive | Positive | Positive | Normal |
| 52 | 45 | Positive | Positive | Normal | - | - | - |
| 53 | 29 | Positive | Positive | Positive | Normal | - | - |
| 54 | 52 | Positive | Positive | Normal | - | - | - |
| 55 | 50 | Positive | Positive | Positive | Normal | - | - |
| 56 | 49 | Positive | Positive | Positive | Positive | Normal | - |
| 57 | 39 | Positive | Normal | - | - | - | - |
| 58 | 11 | Positive | Positive | Normal | - | - | - |
| 59 | 19 | Positive | Positive | Normal | - | - | - |
| 60 | 52 | Positive | Positive | Positive | Normal | - | - |
| 61 | 21 | Positive | Positive | Positive | Positive | Normal | - |
| 62 | 29 | Positive | Positive | Positive | Positive | Normal | - |
| 63 | 40 | Positive | Normal | Normal | - | - | - |
| 64 | 55 | Positive | Normal | - | - | - | - |
| 65 | 50 | Positive | Positive | Positive | Positive | Normal | - |
| 66 | 39 | Positive | Positive | Normal | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 67 | 38 | Positive | Positive | Normal | - | - | - |
| 68 | 19 | Positive | Positive | Positive | Normal | - | - |
| 69 | 35 | Positive | Positive | Positive | Positive | Normal | - |
| 70 | 45 | Positive | Positive | Normal | - | - | - |
| 71 | 31 | Positive | Positive | Positive | Normal | - | - |
| 72 | 49 | Positive | Normal | - | - | - | - |
| 73 | 45 | Positive | Normal | - | - | - | - |
| 74 | 53 | Positive | Positive | Normal | - | - | - |
| 75 | 48 | Positive | Normal | - | - | - | - |
| 76 | 20 | Positive | Normal | - | - | - | - |
| 77 | 17 | Positive | Positive | Normal | - | - | - |
| 78 | 27 | Positive | Positive | Positive | Positive | Positive | Normal |
| 79 | 31 | Positive | Positive | Normal | - | - | - |
| 80 | 50 | Positive | Positive | - | - | - | - |
| 81 | 35 | Positive | Positive | Positive | Positive | Normal | - |
| 82 | 39 | Positive | Normal | - | - | - | - |
| 83 | 29 | Positive | Normal | - | - | - | - |
| 84 | 41 | Positive | Normal | - | - | - | - |
| 85 | 22 | Positive | Normal | - | - | - | - |
| 86 | 31 | Positive | Positive | Positive | Normal | - | - |
| 87 | 47 | Positive | Normal | - | - | - | - |
| 88 | 28 | Positive | Positive | Normal | - | - | - |
| 89 | 12 | Positive | Normal | - | - | - | - |
| 90 | 41 | Positive | Normal | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 91 | 36 | Positive | Normal | - | - | - | - |
| 92 | 44 | Positive | Positive | Normal | - | - | - |
| 93 | 39 | Positive | Positive | Normal | - | - | - |

**Table 5.35: Urine Creatinine levels of the patients after treatment with Hepatogard forte Tablet.**

| Sr. no of patients | Age | Urine Creatinine after different weeks treatment | | | | | |
|---|---|---|---|---|---|---|---|
| | | Initial (zero week) | First | Second | Third | Fourth | Sixth |
| 1 | 32 | Positive | Positive | Normal | - | - | - |
| 2 | 34 | Positive | Positive | Positive | Normal | - | - |
| 3 | 50 | Positive | Positive | Positive | Positive | Positive | Normal |
| 4 | 39 | Positive | Positive | Positive | Positive | Positive | Positive |
| 5 | 39 | Positive | Positive | Positive | Positive | Positive | Positive |
| 6 | 60 | Positive | Positive | Positive | Positive | Positive | Normal |
| 7 | 32 | Positive | Positive | Positive | Positive | Normal | - |
| 8 | 49 | Positive | Positive | Positive | Positive | Normal | - |
| 9 | 55 | Positive | Positive | Normal | - | - | - |
| 10 | 60 | Positive | Positive | Normal | - | - | - |
| 11 | 35 | Positive | Positive | Positive | Normal | - | - |
| 12 | 36 | Positive | Positive | Normal | - | - | - |
| 13 | 58 | Positive | Positive | Positive | Positive | Positive | Normal |
| 14 | 40 | Positive | Positive | Normal | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 15 | 50 | Positive | Positive | Normal | - | - | - |
| 16 | 29 | Positive | Positive | Normal | - | - | - |
| 17 | 38 | Positive | Positive | Normal | - | - | - |
| 18 | 42 | Positive | Positive | Normal | - | - | - |
| 19 | 59 | Positive | Positive | Normal | - | - | - |
| 20 | 11 | Positive | Positive | Normal | - | - | - |
| 21 | 32 | Positive | Positive | Positive | Positive | Normal | - |
| 22 | 60 | Positive | Positive | Positive | Positive | Normal | - |
| 23 | 35 | Positive | Positive | Normal | - | - | - |
| 24 | 59 | Positive | Positive | Positive | Normal | - | - |
| 25 | 49 | Positive | Positive | Positive | Normal | - | - |
| 26 | 21 | Positive | Positive | Positive | Normal | - | - |
| 27 | 60 | Positive | Positive | Normal | - | - | - |
| 28 | 45 | Positive | Positive | Positive | Normal | - | - |
| 29 | 50 | Positive | Positive | Positive | Positive | Normal | - |
| 30 | 55 | Positive | Positive | Positive | Normal | - | - |
| 31 | 51 | Positive | Positive | Positive | Normal | - | - |
| 32 | 23 | Positive | Positive | Positive | Positive | Normal | - |
| 33 | 20 | Positive | Positive | Normal | - | - | - |
| 34 | 22 | Positive | Normal | - | - | - | - |
| 35 | 48 | Positive | Positive | Normal | - | - | - |
| 36 | 47 | Positive | Positive | Positive | Positive | Normal | - |
| 37 | 41 | Positive | Positive | Positive | Normal | - | - |
| 38 | 32 | Positive | Positive | Positive | Positive | Normal | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 39 | 21 | Positive | Positive | Normal | - | - | - |
| 40 | 21 | Positive | Positive | Positive | Normal | - | - |
| 41 | 22 | Positive | Normal | - | - | - | - |
| 42 | 50 | Positive | Normal | - | - | - | - |
| 43 | 42 | Positive | Normal | - | - | - | - |
| 44 | 30 | Positive | Positive | Positive | - | - | - |
| 45 | 18 | Positive | Positive | Positive | Normal | - | - |
| 46 | 30 | Positive | Normal | - | - | - | - |
| 47 | 40 | Positive | Positive | Positive | Normal | - | - |
| 48 | 35 | Positive | Normal | - | - | - | - |
| 49 | 28 | Positive | Positive | Positive | Normal | Normal | - |
| 50 | 37 | Positive | Positive | Positive | Positive | Positive | Normal |
| 51 | 49 | Positive | Positive | Normal | - | - | - |
| 52 | 30 | Positive | Positive | Normal | - | - | - |
| 53 | 29 | Positive | Normal | - | - | - | - |
| 54 | 41 | Positive | Positive | Positive | Normal | - | - |
| 55 | 42 | Positive | Positive | Normal | - | - | - |
| 56 | 37 | Positive | Normal | - | - | - | - |
| 57 | 18 | Positive | Positive | Positive | Positive | Normal | - |
| 58 | 13 | Positive | Normal | - | - | - | - |
| 59 | 23 | Positive | Positive | Positive | Positive | Positive | Normal |
| 60 | 28 | Positive | Normal | - | - | - | - |
| 61 | 45 | Positive | Positive | Positive | Positive | Normal | - |
| 62 | 15 | Positive | Positive | Positive | Normal | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 63 | 50 | Positive | Positive | Positive | Positive | Normal | - |
| 64 | 32 | Positive | Normal | - | - | - | - |
| 65 | 43 | Positive | Positive | Positive | Positive | Positive | Normal |
| 66 | 36 | Positive | Positive | Positive | Positive | Normal | - |
| 67 | 38 | Positive | Normal | - | - | - | - |
| 68 | 35 | Positive | Positive | Normal | - | - | - |
| 69 | 51 | Positive | Positive | Normal | - | - | - |
| 70 | 55 | Positive | Positive | Positive | Positive | Normal | - |
| 71 | 43 | Positive | Positive | Normal | - | - | - |
| 72 | 46 | Positive | Positive | Normal | - | - | - |
| 73 | 59 | Positive | Normal | - | - | - | - |
| 74 | 39 | Positive | Positive | Positive | Positive | Normal | - |
| 75 | 55 | Positive | Positive | Positive | Positive | Normal | - |
| 76 | 35 | Positive | Positive | Positive | Normal | - | - |
| 77 | 51 | Positive | Normal | - | - | - | - |
| 78 | 45 | Positive | Positive | Positive | Normal | - | - |
| 79 | 40 | Positive | Positive | Normal | - | - | - |
| 80 | 17 | Positive | Positive | Positive | Positive | Positive | Normal |
| 81 | 50 | Positive | Positive | Positive | Normal | - | - |
| 82 | 50 | Positive | Normal | - | - | - | - |
| 83 | 20 | Positive | Positive | Normal | - | - | - |
| 84 | 51 | Positive | Positive | Normal | - | - | - |
| 85 | 55 | Positive | Positive | Normal | - | - | - |
| 86 | 50 | Positive | Positive | Positive | Normal | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 87 | 39 | Positive | Positive | Normal | - | - | - |
| 88 | 47 | Positive | Positive | Positive | Positive | Normal | - |
| 89 | 37 | Positive | Positive | Normal | - | - | - |
| 90 | 40 | Positive | Positive | Normal | - | - | - |
| 91 | 51 | Positive | Positive | Positive | Normal | - | - |
| 92 | 47 | Positive | Positive | Positive | Positive | Positive | Normal |
| 93 | 49 | Positive | Positive | Positive | Positive | Normal | - |
| 94 | 39 | Positive | Positive | Normal | - | - | - |
| 95 | 35 | Positive | Positive | Positive | Normal | - | - |

**Table 5.36: Comparative urine Creatinine levels for different week treatment with *Phyllanthus amarus*, Livercare Churna and Hepatogard forte Tablet**

| Sr. no | Drug | Total number of patients | No of patients having positive Creatinine | Normalized | Reduced | Remain unchanged |
|---|---|---|---|---|---|---|
| 1 | *Phyllanthus amarus* | 107 | 107 | 107 | - | - |
| 2 | Livercare Churna | 93 | 93 | 93 | - | - |
| 3 | Hepatogard forte Tablet | 95 | 95 | 93 | 02 | - |

During clinical study selected 107 patients of *Phyllanthus amarus* group were found infected with jaundice among them 107 patients were urine Creatinine positive. After treatment with *Phyllanthus amarus* all 107 patients were normalized. 93 patients of Livercare Churna group were found infected with jaundice among them 93 patients were urine Creatinine positive. After treatment with Livercare Churna all 93 patients were normalized. 95 patients of Hepatogard forte Tablet group were found infected with jaundice among them 95 patients were urine Creatinine positive. After treatment with Hepatogard forte Tablet all 93 patients were normalized and 2 patients decreases the urine Creatinine level.

**Table 5.37: HBsAg values of the patients after treatment with *Phyllanthus amarus***

| Sr. no of patients | Age | HBsAg after different weeks treatment | | | | | |
|---|---|---|---|---|---|---|---|
| | | Initial (zero week) | First | Second | Third | Fourth | Sixth |
| 1 | 28 | Negative | Negative | - | - | - | - |
| 2 | 51 | Negative | Negative | - | - | - | - |
| 3 | 20 | Negative | Negative | - | - | - | - |
| 4 | 16 | Negative | Negative | Negative | Negative | Negative | - |
| 5 | 42 | Negative | Negative | Negative | Negative | Negative | - |
| 6 | 17 | Negative | Negative | Negative | - | - | - |
| 7 | 65 | Negative | Negative | - | - | - | - |
| 8 | 65 | Negative | Negative | - | - | - | - |
| 9 | 36 | Negative | Negative | Negative | Negative | - | - |
| 10 | 42 | Negative | Negative | - | - | - | - |
| 11 | 35 | Negative | Negative | Negative | Negative | - | - |
| 12 | 21 | Negative | Negative | Negative | Negative | - | - |
| 13 | 32 | Positive | Positive | Negative | - | - | - |
| 14 | 32 | Negative | Positive | Negative | - | - | - |
| 15 | 28 | Negative | Positive | Negative | Negative | Negative | - |
| 16 | 45 | Negative | Negative | Negative | - | - | - |
| 17 | 17 | Negative | Negative | - | - | - | - |
| 18 | 32 | Negative | Negative | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 19 | 20 | Negative | Negative | Negative | Negative | Negative | - |
| 20 | 38 | Positive | Negative | Negative | Negative | Negative | Negative |
| 21 | 19 | Negative | Negative | Negative | Negative | - | - |
| 22 | 38 | Negative | Negative | - | - | - | - |
| 23 | 16 | Positive | Negative | Negative | Negative | Negative | Negative |
| 24 | 19 | Negative | Negative | Negative | Negative | - | - |
| 25 | 22 | Negative | Negative | Negative | Negative | - | - |
| 26 | 65 | Negative | Negative | Negative | Negative | - | - |
| 27 | 35 | Negative | Negative | Negative | - | - | - |
| 28 | 32 | Negative | Negative | Negative | - | - | - |
| 29 | 42 | Negative | Negative | - | - | - | - |
| 30 | 43 | Positive | Negative | Negative | Negative | Negative | Negative |
| 31 | 28 | Negative | Negative | Negative | Negative | Negative | - |
| 32 | 50 | Positive | Negative | Negative | Negative | Negative | - |
| 33 | 55 | Negative | Negative | Negative | Negative | - | - |
| 34 | 45 | Negative | Negative | Negative | Negative | - | - |
| 35 | 55 | Negative | Negative | Negative | - | - | - |
| 36 | 40 | Negative | Negative | Negative | - | - | - |
| 37 | 20 | Negative | Negative | Negative | Negative | - | - |
| 38 | 50 | Negative | Negative | Negative | - | - | - |
| 39 | 45 | Negative | Negative | Negative | - | - | - |
| 40 | 50 | Negative | Negative | Negative | Negative | Negative | - |
| 41 | 50 | Positive | Negative | Negative | Negative | - | - |
| 42 | 45 | Negative | Negative | Negative | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 43 | 32 | Negative | Negative | Negative | Negative | Negative | - |
| 44 | 55 | Negative | Negative | Negative | - | - | - |
| 45 | 21 | Positive | Negative | Negative | Negative | Negative | - |
| 46 | 50 | Positive | Negative | Negative | Negative | Negative | - |
| 47 | 19 | Negative | Negative | - | - | - | - |
| 48 | 42 | Negative | Negative | Negative | Negative | - | - |
| 49 | 71 | Negative | Negative | - | - | - | - |
| 50 | 38 | Positive | Negative | Negative | Negative | Negative | - |
| 51 | 30 | Negative | Negative | Negative | Negative | - | - |
| 52 | 30 | Negative | Negative | - | - | - | - |
| 53 | 54 | Negative | Negative | - | - | - | - |
| 54 | 42 | Negative | Negative | Negative | - | - | - |
| 55 | 22 | Negative | Negative | Negative | - | - | - |
| 56 | 42 | Negative | Negative | Negative | Negative | - | - |
| 57 | 46 | Negative | Negative | Negative | Negative | Negative | - |
| 58 | 11 | Negative | Negative | - | - | - | - |
| 59 | 38 | Negative | Negative | Negative | Negative | - | - |
| 60 | 70 | Negative | Negative | - | - | - | - |
| 61 | 20 | Negative | Negative | Negative | Negative | - | - |
| 62 | 23 | Negative | Negative | Negative | - | - | - |
| 63 | 35 | Positive | Negative | Negative | Negative | - | - |
| 64 | 36 | Positive | Negative | Negative | - | - | - |
| 65 | 24 | Negative | Negative | Negative | - | - | - |
| 66 | 40 | Negative | Negative | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 67 | 28 | Negative | Negative | Negative | Negative | - | - |
| 68 | 13 | Negative | Negative | - | - | - | - |
| 69 | 45 | Negative | Negative | Negative | Negative | - | - |
| 70 | 15 | Negative | Negative | - | - | - | - |
| 71 | 32 | Positive | Negative | Negative | Negative | - | - |
| 72 | 55 | Positive | Negative | Negative | Negative | Negative | - |
| 73 | 11 | Negative | Negative | Negative | - | - | - |
| 74 | 30 | Positive | Negative | Negative | Negative | - | - |
| 75 | 12 | Negative | Negative | Negative | - | - | - |
| 76 | 13 | Negative | Negative | - | - | - | - |
| 77 | 65 | Negative | Negative | Negative | Negative | Negative | - |
| 78 | 30 | Negative | Negative | - | - | - | - |
| 79 | 50 | Positive | Negative | Negative | - | - | - |
| 80 | 49 | Positive | Negative | Negative | Negative | Negative | - |
| 81 | 45 | Negative | Negative | Negative | - | - | - |
| 82 | 36 | Negative | Negative | Negative | Negative | Negative | - |
| 83 | 40 | Positive | Negative | Negative | - | - | - |
| 84 | 11 | Negative | Negative | Negative | Negative | Negative | - |
| 85 | 50 | Negative | Negative | Negative | - | - | - |
| 86 | 35 | Negative | Negative | Negative | - | - | - |
| 87 | 30 | Negative | Negative | Negative | Negative | - | - |
| 88 | 25 | Negative | Negative | Negative | - | - | - |
| 89 | 65 | Negative | Negative | Negative | - | - | - |
| 90 | 30 | Negative | Negative | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 91 | 35 | Negative | Negative | - | - | - | - |
| 92 | 50 | Negative | Negative | Negative | Negative | - | - |
| 93 | 37 | Negative | Negative | - | - | - | - |
| 94 | 53 | Positive | Negative | Negative | Negative | - | - |
| 95 | 42 | Positive | Negative | Negative | Negative | - | - |
| 96 | 12 | Negative | Negative | Negative | Negative | - | - |
| 97 | 40 | Positive | Negative | Negative | Negative | Negative | Negative |
| 98 | 45 | Negative | Negative | - | - | - | - |
| 99 | 27 | Positive | Negative | Negative | Negative | - | - |
| 100 | 25 | Negative | Negative | - | - | - | - |
| 101 | 21 | Negative | Negative | Negative | - | - | - |
| 102 | 30 | Positive | Negative | Negative | Negative | Negative | - |
| 103 | 20 | Negative | Negative | Negative | - | - | - |
| 104 | 51 | Negative | Negative | - | - | - | - |
| 105 | 5 | Negative | Negative | Negative | Negative | Negative | - |
| 106 | 42 | Negative | Negative | - | - | - | - |
| 107 | 32 | Negative | Negative | Negative | Negative | - | - |

**Table 5.38: HBsAg values of the patients after treatment with Livercare Churna**

| Sr. no of patients | Age | HBsAg after different weeks treatment | | | | | |
|---|---|---|---|---|---|---|---|
| | | Initial (zero week) | First | Second | Third | Fourth | Sixth |
| 1 | 17 | Negative | Negative | - | - | - | - |
| 2 | 47 | Negative | Negative | Negative | - | - | - |
| 3 | 49 | Negative | Negative | - | - | - | - |
| 4 | 51 | Positive | Negative | Negative | Negative | Negative | Negative |
| 5 | 31 | Negative | Negative | - | - | - | - |
| 6 | 53 | Negative | Negative | Negative | - | - | - |
| 7 | 47 | Positive | Negative | Negative | - | - | - |
| 8 | 40 | Positive | Negative | Negative | Negative | Negative | Negative |
| 9 | 47 | Positive | Negative | Negative | Negative | - | - |
| 10 | 50 | Negative | Negative | Negative | Negative | - | - |
| 11 | 44 | Negative | Negative | - | - | - | - |
| 12 | 46 | Positive | Negative | Negative | Negative | Negative | Negative |
| 13 | 35 | Negative | Negative | Negative | - | - | - |
| 14 | 55 | Positive | Negative | - | - | - | - |
| 15 | 50 | Positive | Negative | Negative | Negative | - | - |
| 16 | 60 | Positive | Negative | Negative | Negative | Negative | Negative |
| 17 | 43 | Negative | - | - | - | - | - |
| 18 | 45 | Positive | Negative | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 19 | 40 | Positive | Negative | Negative | Negative | Negative | Negative |
| 20 | 29 | Negative | Negative | - | - | - | - |
| 21 | 44 | Negative | Negative | Negative | Negative | - | - |
| 22 | 25 | Positive | Negative | Negative | Negative | - | - |
| 23 | 17 | Negative | Negative | Negative | Negative | - | - |
| 24 | 40 | Negative | - | - | - | - | - |
| 25 | 35 | Positive | Negative | Negative | Negative | - | - |
| 26 | 25 | Positive | Negative | Negative | Negative | - | - |
| 27 | 21 | Negative | Negative | Negative | Negative | - | - |
| 28 | 52 | Negative | Negative | - | - | - | - |
| 29 | 45 | Negative | Negative | Negative | Negative | - | - |
| 30 | 62 | Positive | Negative | Negative | Negative | Negative | Negative |
| 31 | 50 | Negative | Negative | - | - | - | - |
| 32 | 45 | Negative | Negative | Negative | - | - | - |
| 33 | 50 | Positive | Negative | Negative | Negative | - | - |
| 34 | 30 | Negative | Negative | Negative | Negative | - | - |
| 35 | 19 | Positive | Negative | Negative | Negative | - | - |
| 36 | 45 | Negative | Negative | - | - | - | - |
| 37 | 25 | Negative | Negative | Negative | - | - | - |
| 38 | 25 | Positive | Negative | Negative | - | - | - |
| 39 | 27 | Negative | Negative | Negative | Negative | - | - |
| 40 | 17 | Negative | Negative | Negative | - | - | - |
| 41 | 57 | Negative | Negative | Negative | - | - | - |
| 42 | 45 | Negative | Negative | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 43 | 60 | Negative | Negative | - | - | - | - |
| 44 | 49 | Negative | Negative | - | - | - | - |
| 45 | 36 | Negative | Negative | - | - | - | - |
| 46 | 49 | Positive | Negative | Negative | Negative | Negative | Negative |
| 47 | 50 | Negative | Negative | Negative | - | - | - |
| 48 | 40 | Positive | Negative | Negative | Negative | Negative | Negative |
| 49 | 40 | Negative | Negative | Negative | Negative | - | - |
| 50 | 39 | Negative | - | - | - | - | - |
| 51 | 41 | Positive | Negative | Negative | Negative | Negative | Negative |
| 52 | 45 | Negative | Negative | - | - | - | - |
| 53 | 29 | Negative | Negative | Negative | - | - | - |
| 54 | 52 | Negative | Negative | - | - | - | - |
| 55 | 50 | Negative | Negative | Negative | - | - | - |
| 56 | 49 | Positive | Negative | Negative | Negative | - | - |
| 57 | 39 | Negative | - | - | - | - | - |
| 58 | 11 | Negative | Negative | - | - | - | - |
| 59 | 19 | Negative | Negative | - | - | - | - |
| 60 | 52 | Negative | Negative | Negative | - | - | - |
| 61 | 21 | Positive | Negative | Negative | Negative | - | - |
| 62 | 29 | Negative | Negative | Negative | Negative | - | - |
| 63 | 40 | Negative | Negative | - | - | - | - |
| 64 | 55 | Negative | - | - | - | - | - |
| 65 | 50 | Positive | Negative | Negative | Negative | - | - |
| 66 | 39 | Negative | Negative | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 67 | 38 | Negative | Negative | - | - | - | - |
| 68 | 19 | Negative | Negative | Negative | - | - | - |
| 69 | 35 | Positive | Negative | Negative | Negative | - | - |
| 70 | 45 | Negative | Negative | - | - | - | - |
| 71 | 31 | Negative | Negative | Negative | - | - | - |
| 72 | 49 | Negative | - | - | - | - | - |
| 73 | 45 | Negative | - | - | - | - | - |
| 74 | 53 | Negative | Negative | - | - | - | - |
| 75 | 48 | Negative | - | - | - | - | - |
| 76 | 20 | Negative | - | - | - | - | - |
| 77 | 17 | Negative | Negative | - | - | - | - |
| 78 | 27 | Positive | Negative | Negative | Negative | Negative | Negative |
| 79 | 31 | Negative | Negative | - | - | - | - |
| 80 | 50 | Positive | Negative | - | - | - | - |
| 81 | 35 | Positive | Negative | Negative | Negative | - | - |
| 82 | 39 | Negative | - | - | - | - | - |
| 83 | 29 | Negative | - | - | - | - | - |
| 84 | 41 | Negative | - | - | - | - | - |
| 85 | 22 | Positive | - | - | - | - | - |
| 86 | 31 | Positive | Negative | Negative | - | - | - |
| 87 | 47 | Negative | - | - | - | - | - |
| 88 | 28 | Negative | Negative | - | - | - | - |
| 89 | 12 | Negative | - | - | - | - | - |
| 90 | 41 | Negative | - | - | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 91 | 36 | Negative | - | - | - | - | - |
| 92 | 44 | Negative | Negative | - | - | - | - |
| 93 | 39 | Positive | Negative | - | - | - | - |

**Table 5.39: HBsAg values of the patients after treatment with Hepatogard forte Tablet.**

| Sr. no of patients | Age | HBsAg after different weeks treatment | | | | | |
|---|---|---|---|---|---|---|---|
| | | Initial (zero week) | First | Second | Third | Fourth | Sixth |
| 1 | 32 | Negative | Negative | Negative | - | - | - |
| 2 | 34 | Negative | Negative | Negative | Negative | - | - |
| 3 | 50 | Negative | Negative | Negative | Negative | Negative | Negative |
| 4 | 39 | Positive | Negative | Negative | Negative | Negative | Negative |
| 5 | 39 | Positive | Negative | Negative | Negative | Negative | Negative |
| 6 | 60 | Positive | Negative | Negative | Negative | Negative | Negative |
| 7 | 32 | Negative | Negative | Negative | Negative | Negative | - |
| 8 | 49 | Negative | Negative | Negative | Negative | Negative | - |
| 9 | 55 | Negative | Negative | Negative | - | - | - |
| 10 | 60 | Negative | Negative | Negative | - | - | - |
| 11 | 35 | Negative | Negative | Negative | Negative | - | - |
| 12 | 36 | Negative | Negative | Negative | - | - | - |
| 13 | 58 | Positive | Negative | Negative | Negative | Negative | Negative |
| 14 | 40 | Positive | Negative | Negative | - | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 15 | 50 | Negative | Negative | Negative | - | - | - |
| 16 | 29 | Negative | Negative | Negative | - | - | - |
| 17 | 38 | Negative | Negative | Negative | - | - | - |
| 18 | 42 | Positive | Negative | Negative | - | - | - |
| 19 | 59 | Negative | Negative | Negative | - | - | - |
| 20 | 11 | Negative | Negative | Negative | - | - | - |
| 21 | 32 | Negative | Negative | Negative | Negative | Negative | - |
| 22 | 60 | Positive | Negative | Negative | Negative | Negative | - |
| 23 | 35 | Negative | Negative | Negative | - | - | - |
| 24 | 59 | Negative | Negative | Negative | Negative | - | - |
| 25 | 49 | Negative | Negative | Negative | Negative | - | - |
| 26 | 21 | Positive | Negative | Negative | Negative | - | - |
| 27 | 60 | Negative | Negative | Negative | - | - | - |
| 28 | 45 | Negative | Negative | Negative | Negative | - | - |
| 29 | 50 | Negative | Negative | Negative | Negative | Negative | - |
| 30 | 55 | Positive | Negative | Negative | Negative | - | - |
| 31 | 51 | Negative | Negative | Negative | Negative | - | - |
| 32 | 23 | Negative | Negative | Negative | Negative | Negative | - |
| 33 | 20 | Negative | Negative | Negative | - | - | - |
| 34 | 22 | Negative | Negative | - | - | - | - |
| 35 | 48 | Negative | Negative | Negative | - | - | - |
| 36 | 47 | Negative | Negative | Negative | Negative | Negative | - |
| 37 | 41 | Negative | Negative | Negative | Negative | - | - |
| 38 | 32 | Negative | Negative | Negative | Negative | Negative | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 39 | 21 | Negative | Negative | Negative | - | - | - |
| 40 | 21 | Negative | Negative | Negative | Negative | - | - |
| 41 | 22 | Negative | Negative | - | - | - | - |
| 42 | 50 | Negative | Negative | - | - | - | - |
| 43 | 42 | Negative | Negative | - | - | - | - |
| 44 | 30 | Negative | Negative | Negative | - | - | - |
| 45 | 18 | Positive | Negative | Negative | Negative | - | - |
| 46 | 30 | Negative | Negative | - | - | - | - |
| 47 | 40 | Negative | Negative | Negative | Negative | - | - |
| 48 | 35 | Negative | Negative | - | - | - | - |
| 49 | 28 | Positive | Negative | Negative | Negative | Negative | - |
| 50 | 37 | Positive | Negative | Negative | Negative | Negative | Negative |
| 51 | 49 | Negative | Negative | Negative | - | - | - |
| 52 | 30 | Positive | Negative | Negative | - | - | - |
| 53 | 29 | Negative | Negative | - | - | - | - |
| 54 | 41 | Negative | Negative | Negative | Negative | - | - |
| 55 | 42 | Negative | Negative | Negative | - | - | - |
| 56 | 37 | Negative | Negative | - | - | - | - |
| 57 | 18 | Positive | Negative | Negative | Negative | Negative | - |
| 58 | 13 | Negative | Negative | - | - | - | - |
| 59 | 23 | Positive | Negative | Negative | Negative | Negative | Negative |
| 60 | 28 | Negative | Negative | - | - | - | - |
| 61 | 45 | Negative | Negative | Negative | Negative | Negative | - |
| 62 | 15 | Negative | Negative | Negative | Negative | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 63 | 50 | Positive | Negative | Negative | Negative | Negative | - |
| 64 | 32 | Negative | Negative | - | - | - | - |
| 65 | 43 | Negative | Negative | Negative | Negative | Negative | Negative |
| 66 | 36 | Positive | Negative | Negative | Negative | Negative | - |
| 67 | 38 | Negative | Negative | - | - | - | - |
| 68 | 35 | Negative | Negative | Negative | - | - | - |
| 69 | 51 | Negative | Negative | Negative | - | - | - |
| 70 | 55 | Positive | Negative | Negative | Negative | Negative | - |
| 71 | 43 | Negative | Negative | Negative | - | - | - |
| 72 | 46 | Negative | Negative | Negative | - | - | - |
| 73 | 59 | Negative | Negative | - | - | - | - |
| 74 | 39 | Negative | Negative | Negative | Negative | Negative | - |
| 75 | 55 | Positive | Negative | Negative | Negative | Negative | - |
| 76 | 35 | Negative | Negative | Negative | Negative | - | - |
| 77 | 51 | Negative | Negative | - | - | - | - |
| 78 | 45 | Negative | Negative | Negative | Negative | - | - |
| 79 | 40 | Negative | Negative | Negative | - | - | - |
| 80 | 17 | Positive | Negative | Negative | Negative | Negative | Negative |
| 81 | 50 | Positive | Negative | Negative | Negative | - | - |
| 82 | 50 | Negative | Negative | - | - | - | - |
| 83 | 20 | Negative | Negative | Negative | - | - | - |
| 84 | 51 | Negative | Negative | Negative | - | - | - |
| 85 | 55 | Negative | Negative | Negative | - | - | - |
| 86 | 50 | Negative | Negative | Negative | Negative | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 87 | 39 | Positive | Negative | Negative | - | - | - |
| 88 | 47 | Negative | Negative | Negative | Negative | Negative | - |
| 89 | 37 | Positive | Negative | Negative | - | - | - |
| 90 | 40 | Negative | Negative | Negative | - | - | - |
| 91 | 51 | Negative | Negative | Negative | Negative | - | - |
| 92 | 47 | Positive | Negative | Negative | Negative | Negative | Negative |
| 93 | 49 | Positive | Negative | Negative | Negative | Negative | - |
| 94 | 39 | Positive | Negative | Negative | - | - | - |
| 95 | 35 | Positive | Negative | Negative | Negative | - | - |

**Table 5.40: Comparative HBsAg values for different weeks treatment with *Phyllanthus amarus*, Livercare Churna and Hepatogard forte Tablet**

| Sr no | Drug | Total no of patients | No of patients having HepatitisB | Normalized | Reduced | Remain unchanged |
|---|---|---|---|---|---|---|
| 1 | *Phyllanthus amarus* | 107 | 22 | 22 | - | - |
| 2 | Livercare Churna | 93 | 30 | 30 | - | - |
| 3 | Hepatogard forte Tablet | 95 | 27 | 27 | - | - |

During clinical study selected 107 patients of *Phyllanthus amarus* group were found infected with jaundice among them 22 patients were Hepatitis B positive. After treatment with *Phyllanthus amarus* all 22 patients were normalized. 93 patients of Livercare Churna group were found infected with jaundice among them 30 patients were Hepatitis B positive. After treatment with Livercare Churna all 30 patients were normalized. 95 patients of Hepatogard forte Tablet were found infected with jaundice among them 27 patients were Hepatitis B positive. After treatment with Hepatogard forte Tablet all 27 patients were normalized.

**Table 5.41: Comparative asthma values for different weeks treatment with *Phyllanthus amarus*, Livercare Churna and Hepatogard forte Tablet.**

| Sr. no | Drug | Total no. of patients | No of patients having Asthma | No. of patients Normalized from asthma | Reduction in severity of asthma | No of patients remain unchanged |
|---|---|---|---|---|---|---|
| 1 | *Phyllanthus amarus* | 107 | 4 | - | 3 | 1 |
| 2 | Livercare Churna | 93 | 2 | - | 2 | - |
| 3 | Hepatogard forte Tablet | 95 | 2 | - | 1 | 1 |

During clinical study selected 107 patients of *Phyllanthus amarus* group were found to be infected with jaundice among them 4 patients had problem of asthma. After treatment with *Phyllanthus amarus,* there was reduction in asthmatic severity in the three patients and there was no improvement in one patient in asthma. 93 patients of Livercare Churna group were found infected with jaundice among them 2 patients had a problem of asthma. After treatment with Livercare Churna, there was reduction in asthmatic severity in all the two patients. 95 patients of Hepatogard forte Tablet were found infected with jaundice among them 2 patients had a problem of asthma. After treatment with Hepatogard forte Tablet there was improvement in the condition of asthmatic one patient while there was no improvement in another patient in asthma.

**Table 5.42: Comparative hair growth values for different weeks treatment with *Phyllanthus amarus*, Livercare Churna and Hepatogard forte Tablet.**

| Sr. no | Drug | Total no. of patients | Increase in hair growth in number of patients | Remain unchanged in number of patients |
|---|---|---|---|---|
| 1 | *Phyllanthus amarus* | 107 | 10 | 97 |
| 2 | Livercare Churna | 93 | 18 | 75 |
| 3 | Hepatogard forte Tablet | 95 | 13 | 82 |

During clinical study selected 107 patients of *Phyllanthus amarus* group were found infected with jaundice among them patient's hair growth was observed. After treatment with *Phyllanthus amarus* 10 patients have shown about 1-1.5 cm growth of hair. 10 patients remained unchanged. 93 patients of Livercare Churna group were found infected with jaundice among them patient's hair growth was observed. After treatment with Livercare Churna 18 patients have shown about 1-1.5 cm growth of hair and 75 patients remained unchanged. 95 patients of Hepatogard forte Tablet were found infected with jaundice among them patient's hair growth was observed. After treatment with Hepatogard forte Tablet 13 patients have shown about 1 cm growth of hair and 82 patients remained unchanged.

**Table 5.43: Comparative kidney stone study for different weeks treatment with *Phyllanthus amarus*, Livercare Churna and Hepatogard forte Tablet**

| Sr no | Drug | Total no. of patients | No of patients having Kidney stone | Patient number/stone size / place | Stone size after treatment |
|---|---|---|---|---|---|
| 1 | *Phyllanthus amarus* | 107 | 2 | 39/5mm/right kidney<br>27/4mm/left kidney | 4mm<br>4mm |
| 2 | Livercare Churna | 93 | 1 | 66/ 6mm / left kidney | 4mm |
| 3 | Hepatogard forte Tablet | 95 | - | - | - |

During clinical study selected 107 patients of *Phyllanthus amarus* group were found infected with jaundice among them 2 patients have complain of pain of kidney stone. Pain and Sonography report showed presence of stone. After the treatment with *Phyllanthus amarus* there was reduction in the stone size from 5mm to 4mm and in one patient there was no change in the stone size. 93 patients of Livercare Churna group were found infected with jaundice among them 1 patient showed presence of kidney stone in Sonography report. After the treatment with Livercare Churna the size of stone was reduced from 6mm to 4mm.

**Table 5.44: Comparative pimples values for different weeks treatment with *Phyllanthus amarus*, Livercare Churna and Hepatogard forte Tablet**

| Sr. no | Drug | Total no. of patients | No of patients having Pimples | Normalized | Reduced | Remain unchanged |
|---|---|---|---|---|---|---|
| 1 | *Phyllanthus amarus* | 107 | 6 | - | 3 | 3 |
| 2 | Livercare Churna | 93 | 7 | - | 5 | 2 |
| 3 | Hepatogard forte Tablet | 95 | 4 | - | 2 | 2 |

During clinical study selected 107 patients of *Phyllanthus amarus* group were found infected with jaundice among them 6 patients have pimple. After the treatment with *Phyllanthus amarus* there was reduction in size in 3 patients and in 3 patients it remained unchanged. 93 patients of Livercare Churna group were found infected with jaundice among them 7 patients have pimples. After treatment with Livercare Churna no patients was normalized but there was reduction in pimples size in 5 patients and it remained unchanged in 2 patients. 95 patients of Hepatogard forte Tablet were found infected with jaundice among them 4 patients have pimples. After treatment with Hepatogard forte Tablet there was reduction pimple size in 2 patients and no change in remaining 2 patients.

**Table 5.45: Comparative cough values for different weeks treatment *Phyllanthus amarus*, Livercare Churna and Hepatogard forte Tablet**

| Sr. no | Drug | Total no of patients | No of patients having Cough | Normalized | Reduced | Remain unchanged |
|---|---|---|---|---|---|---|
| 1 | *Phyllanthus amarus* | 107 | 4 | - | 4 | - |
| 2 | Livercare Churna | 93 | 2 | - | 1 | 1 |
| 3 | Hepatogard forte Tablet | 95 | 2 | - | 1 | 1 |

During clinical study selected 107 patients of *Phyllanthus amarus* group were found infected with jaundice among them 4 patients have problem of cough. After the treatment with *Phyllanthus amarus* there was relief in cough in all the 4 patients and no patient remained unchanged. 93 patients of Livercare Churna group were found infected with jaundice among them 2 patients have problem of cough. After the treatment with Livercare Churna there was relief in cough of one patient and 1 patient remained unchanged. 95 patients of Hepatogard forte Tablet were found infected with jaundice among them 2 patients have problem of cough. After the treatment with Hepatogard forte Tablet there was relief in cough of 1 patient and 1 patient remained unchanged.

**Table 5.46: Comparative study of arthritis condition for different weeks treatment with *Phyllanthus amarus*, Livercare Churna and Hepatogard forte Tablet**

| Sr. no | Drug | Total no of patients | No of patients having Arthritis | Normalized | Reduced | Remain unchanged |
|---|---|---|---|---|---|---|
| 1 | *Phyllanthus amarus* | 107 | 2 | - | 1 | 1 |
| 2 | Livercare Churna | 93 | 2 | - | 1 | 1 |
| 3 | Hepatogard forte Tablet | 95 | 1 | - | - | 1 |

During clinical study selected 107 patients of *Phyllanthus amarus* group were found infected with jaundice among them 2 patients have a problem of arthritis. After the treatment with *Phyllanthus amarus* there was relief in pain of arthritis in 1 patient and 1 patient remained unchanged. 93 patients of Livercare Churna group were found infected with jaundice among them 2 patients have a problem of arthritis. After the treatment with Livercare Churna there was relief in pain of arthritis in 1 patient and 1 patient remained unchanged. 95 patients of Hepatogard forte Tablet were found infected with jaundice among them 1 patient has a problem of arthritis. After the treatment with Hepatogard forte Tablet there was no improvement in the pain of above arthritic patient.

# Summary

## SUMMARY

Liver is a versatile organ in the body concerned with regulation of internal chemical environment. Therefore, damage to the liver inflicted by hepatotoxic agents is of grave consequence. There is an ever increasing need for an agent which could protect liver damage especially of one which facilitates regeneration by the proliferation of parenchymal cells after damage and arrests growth of fibrous tissue.

In the present study of hepatoprotective activity was observed in the patients having liver damage.

- In the present study, fresh herb of *Phyllanthus amarus* was collected, authentified and shade dried. The dried material was reduced to a powder of required particle size.
- Study of physicochemical parameters of fresh powdered material of *Phyllanthus amarus* was carried out which comply with the parameters given in Ayurvedic Pharmacopoeia of India and Indian herbal Pharmacopoeia.
- Marketed hepatoprotective formulations (Hepatogaurd forte Tablet and Livercare Churna) were collected from the local market. On TLC study the Petrolium ether extract of herb and the market formulations showed presence of Phyllanthin and Hypophyllanthin an active constituent of *Phyllanthus amarus.*
- Evaluation of parameters such as SGPT, Billirubin, Hb, Creatinine, HBsAg, urine sugar were carried out in the patients of jaundice after forming an Ethical committee and taking the written consent of the patients.

- Treatment with *Phyllanthus amarus* powder, Livercare Churna and Hepatogard forte Tablets orally for the period of 1 to 3weeks, to 4 and 6weeks was carried out as per severity of the condition and recovery of the patients.
- Evaluation parameters such as SGPT, Billirubin showed significant P value <0.001 treatment with *Phyllanthus amarus* herb powder, Livercare Churna and Hepatogard forte Tablets.
- Drug *Phyllanthus amarus*, and marketed formulation Livercare Churna showed better hepatoprotective effects than marketed formulation Hepatogaurd forte Tablet.
- There was also improvement in Hb, reduction in blood pressure, urine sugar, removal of HBsAg, reduction in kidney stone size, reduction in asthmatic discomfort, reduction in pimples.
- The multiple claims described for a single herb in Ayurveda or traditional system of medicines seems to be true. *Phyllanthus amarus* and its formulations have hepatoprotective activity and also tonic (increase Hb %), antidiabetis (decreases urine sugar), reduce blood pressure, dissolve kidney stone, useful in asthma, cough, etc.

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# Annexure

# ANNEXURE

## Annexure I

## *Phyllanthus amarus* is utilized as Hepatoprotective drug

1) Patients name:
2) Address:

3) Contact number:
4) Patients age:
5) Patients sex:
6) Patients weight:
7) Patients diagnosis: Hepatitis A/ Hepatitis B/ Hepatitis C

8) Drug is given:
   (a) *Eclipta Prostrata*
   (b) Hepatogard forte Tablet
   (c) Livercare Churna

9) Dose of drug: OD/BD/TD

10) Duration of illness:1) One day 2)2-3 days 3)Week
    4) Fort night 5) Month 6) Chronic

11) Patient habituated like:
    - House wife yes/no
    - Farmer yes/no
    - Business yes/no
    - Smoking yes/no
    - Tobacco consumption yes/no
    - Alcohol consumption yes/no
    - Narcotic consumption yes/no
    - Pregnancy yes/no
    - Feeding yes/no

12) Laboratory tests

| **SR no** | **SGPT Liver problem** | **HB (tonicity)** | **Urine (Creatinine)** | **Billirubin** | **Urine Sugar (Diabetes)** | **HBsAg** |
|---|---|---|---|---|---|---|
| 1st | | | | | | |
| 2nd | | | | | | |
| 3rd | | | | | | |
| 4th | | | | | | |
| 6th | | | | | | |

13) Patient improvement in other disease

| **SR no** | **Blood pressure** | **Kidney stone** | **Hair growth/ dandruff** | **Pimples** | **Arthritis** | **Asthma** | **Cough** |
|---|---|---|---|---|---|---|---|
| 1st | | | | | | | |
| 2nd | | | | | | | |
| 3rd | | | | | | | |
| 4th | | | | | | | |
| 6th | | | | | | | |

# Annexure II

Date: 05/10/2006

## ETHICAL COMMITTEE MEETING

Ethical committee for Clinical trial of *Phyllanthus amarus* and *Eclipta prostrata* as hepatoprotective and their marketed formulations.

For liver disease (jaundice, hepatitis) there is a no modern medicines mostly Ayurvedic formulation are prescribed along with B- complex, sorbitol and rest. Actually herbal drugs / ayurvedic drugs have activity in liver disease. For above drugs we do not have clinical trial data / documentation. If we have enough clinical data we can strongly advice and market these drug.

1) We want to study effect of the marketed formulation in patient with jaundice and hepatitis B.
2) We want to also study effect of single herb in patient with jaundice and hepatitis.
3) Which is prescribed in ayurveda and is reported to have very good hepatoprotective action in pharmacological and clinical studies.
4) We want to see effect of these ayurvedic formulation and the herbs on other parameter on body like hemoglobin, blood sugar, hair, hair color, skin, etc.

For these purpose we form a advisory committee to advise the workers. The committee consists of a social worker, a scientist, a modern physician, modern surgeon and modern advocate.

| Name | Address | sign |
|---|---|---|
| Social worker<br>**Dr. P. G. Shah**<br>M.D. Medicine<br>District Chairman and Past president of Lions Club, Bayad. | Shreeji Heart and Medical Hospital, Sanjivani complex Bayad | |
| Committee member<br>**Dr. M. S. Patel**<br>M.S. | Gayatri Surgical Hospital and Sonography clinic, Sanjivani complex Bayad | |
| Committee member<br>**Dr. S. P. Shah**<br>M.D. D.T.C.D. Physician | Anand hospital, Uday complex. near Bus stand, Bayad | |
| Research scientist<br>**Dr. N. M. Patel**<br>M. Pharm. Ph.D. | B. M. Shah College of Pharmaceutical Edu. and Res, Modasa. | |
| Advocate<br>**Mr. A. M. Chauhan**<br>B.A., L.L.B. | Giriraj society. Bayad. | |
| Project in charge<br>**Dr. M. J. Shah.**<br>M.S. | Sapan hospital and Sonography clinic. Bayad | |
| Project in charge<br>**Dr. B. H. Patel**<br>B.S.A.M.M.R.S.H. | Sapan hospital and Sonography clinic. Bayad | |
| Research guide<br>**Dr. K. N. Patel**<br>M. Pharm. Ph.D. | Arihant school of pharmacy and bio research institute, Adalaj, Ahmedabad | |
| Research student<br>**Mr. Jitendra S. Patel**<br>M. Pharm. | H. N. Shukla College of Pharmaceutical Edu. and Res., Rajkot | J. S. Patel |
| Research student<br>**Mrs. Hemangi J. Patel**<br>M. Pharm. | H. N. Shukla College of Pharmaceutical Edu. and Res., Rajkot | H. J Patel |

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# Annexure III

Date: 07/06/2007

## ETHICAL COMMITTEE MEETING

Ethical committee for Clinical trial of *Phyllanthus amarus* and *Eclipta prostrata* as hepatoprotective and their marketed formulations.

We want to study the effect of these herbs and herbal formulation in the liver patients. We want to systematically study the gradual change / improvement in body profile like SGPT , Billirubin, Urine, Blood sugar, Hb, Cholesterol, etc. We plan to give these drugs to the liver patients at normal cost for the test. We take consent letter and study the effect for three weeks under the guidance of advisory committee / ethical committee.

For these purpose we form a advisory committee to advise the workers. The committee consists of a social worker, a scientist, a modern physician, modern surgeon and modern advocate.

1

| Name | Address | sign |
|---|---|---|
| Social worker<br>**Dr. P. G. Shah**<br>M.D. Medicine<br>District Chairman and Past president of Lions Club, Bayad. | Shreeji Heart and Medical Hospital, Sanjivani complex Bayad | |
| Committee member<br>**Dr. M. S. Patel**<br>M.S. | Gayatri Surgical Hospital and Sonography clinic, Sanjivani complex Bayad | |
| Committee member<br>**Dr. S. P. Shah**<br>M.D. D.T.C.D. Physician | Anand hospital, Uday complex, near Bus stand, Bayad | |
| Research scientist<br>**Dr. N. M. Patel**<br>M. Pharm. Ph.D. | B. M. Shah College of Pharmaceutical Edu. and Res, Modasa. | |
| Advocate<br>**Mr. A. M. Chauhan**<br>B.A., L.L.B. | Giriraj society, Bayad. | |
| Project in charge<br>**Dr. M. J. Shah.**<br>M.S. | Sapan hospital and Sonography clinic, Bayad | |
| Project in charge<br>**Dr. B. H. Patel**<br>B.S.A.M.M.R.S.H. | Sapan hospital and Sonography clinic, Bayad | |
| Research guide<br>**Dr. K. N. Patel**<br>M. Pharm. Ph.D. | Arihant school of pharmacy and bio research institute, Adalaj, Ahmedabad | |
| Research student<br>**Mr. Jitendra S. Patel**<br>M. Pharm. | H. N. Shukla College of Pharmaceutical Edu. and Res., Rajkot | J. S. Patel |
| Research student<br>**Mrs. Hemangi J. Patel**<br>M. Pharm. | H. N. Shukla College of Pharmaceutical Edu. and Res., Rajkot | H. J Patel |

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# Annexure IV


**ગાયત્રી સર્જીકલ હોસ્પિટલ અને સોનોગ્રાફી ક્લિનીક**

સંજીવની કોમ્પલેક્ષ, એસ.ટી.ડેપો પાસે, બાયડ. ફોન : (હો.) ૨૨૨૩૭

**ડૉ. મહેન્દ્ર એસ. પટેલ**
એમ.એસ. સર્જન (ગોલ્ડ મેડાલીસ્ટ)
હોજરી, આંતરડા, મળાશય, પ્રોસ્ટેટ, પથરી, સારણગાંઠ, લેપ્રોસ્કોપી, પ્રસુતિ, સ્ત્રી રોગો તથા વંધત્વના નિષ્ણાત.

**ડૉ. અમીત ડી. ચૌહાણ**
એમ.ડી. ગાયનેક
પ્રસુતિ, સ્ત્રી રોગો તથા વંધ્યત્વના નિષ્ણાત
ફોન :(રહે.) ૨૨૦૧૧૧


તા. - -૨૦૦

**TO WHOM SO EVER IT MAY CONCERN**

**Sub. :** Regarding the ethical committee.

As mention above subject I Dr. Mahendra S. Patel (M.S.) accept the membership of ethical committee formed for the Ph.D. research on clinical trial as hepatoprotactive on the drug *E.alba* and *P.amarus* by Jitendra S. Patel and Hemangi J. Patel at Sapal Hospital, Bayad.

**With regards**

**Dr. M. S. Patel**

# Annexure V

**Dr. SUNIL P. SHAH**
M. D. D.T.C.D. Physician
Uday Complax, Near Purohit Hotal
opp. S.T. stand, BAYAD-383325
Date.

**TO WHOM SOEVER IT MAY CONCERN**

**Sub. :** Regarding the ethical committee.

As mention above subject I Sunil P. Shah (M.D. D.T.C.D. Physician) accept the membership of ethical committee formed for the Ph.D. research on clinical trial as hepatoprotactive on the drug *E.alba* and *P.amarus* by Jitendra S. Patel and Hemangi J. Patel at Sapal Hospital, Bayad.

**With regards**

**Dr. Sunil P. Shah**

# Annexure VI

**Adesinh M. Chauhan**
B. A, LL. B.
Advocate
Res. Giriraj Society
BAYAD Dist. Sabarkantha

અદેસિંહ એમ. ચૌહાણ
બી. એ. એલ એલ. બી.
એડવોકેટ
રે. ગિરિરાજ સોસાયટી,
બાયડ, ડી. સાબરકાંઠા

Ref. No. Date ;

**TO WHOM SOEVER IT MAY CONCERN**

**Sub. :** Regarding the ethical commitee.

As mention above subject I Adesinh M. Chauhan (Advocate) accept the membership of ethical committee formed for the Ph.D. research on clinical trial as hepatoprotactive on the drug *E.alba* and *P.amarus* by Jitendra S. Patel and Hemangi J. Patel at Sapal Hospital, Bayad.

**With regards**

**Adesinh M. Chauhan**

# Annexure VII

ડૉ.પ્રકાશ જી. શાહ
એમ.ડી. (મેડીસીન)
કન્સલ્ટીંગ ફિજીશીયન
હૃદય, લકવો, ફેફસાં, ડાયાબીટીસ, કીડની,
લીવર અને ખેંચના રોગોના નિષ્ણાત
શ્રીજી હાર્ટ એન્ડ
મેડીકલ હોસ્પિટલ
સંજીવની કોમ્પ્લેક્ષ, એસ. ટી. ડેપો પાસે,
બાયડ, જી. સાબરકાંઠા.
ફોન : (૦૨૭૭૯) (H) ૨૨૨૨૩૭ (R) ૨૨૨૩૩૩

TO WHOM SO EVER IT MAY CONCERN

**Sub. :** Regarding the ethical committee.

As mention above subject I Dr. Prakash G. Shah (M.D. Physician) accept the membership of ethical committee formed for the Ph.D. research on clinical trial as hepatoprotactive on the drug *E.alba* and *P.amarus* by Jitendra S. Patel and Hemangi J. Patel at Sapal Hospital, Bayad.

**With regards**

**Dr. P. G. Shah**

ફરીથી બતાવવા આવો ત્યારે આ કાગળ સાથે લાવવો.
ડોકટરને મળવાનો સમય : સવારે ૧૦ થી ૧ + સાંજે ૫ થી ૭ + રવિવારે રજા -
+ મૌખિક સૂચના અને પરેજીનું બરાબર પાલન કરવું +