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## Chapter

# Tasty Spices as Nutraceuticals

*Vijaya Rabade, Ashwini Ingole, Purushottam Gangane,  
Vidya Sabale, Ujwala Mahajan and Yash Kale*

## Abstract

Spices, food additives, which are the main sources of taste, colour, and perfume in foods and beverages, are becoming more and more important due to their wide range of applications. Spices are consumed as food additives to improve the sensory quality of foods. Traditional systems of medicine have employed spices for centuries since they have been known to have physiological effects that are good for human health. In the past few decades, pioneering experimental research involving both animal studies and human trials has been carried out which proved that spices have therapeutic effects. The benefits of spices' like nutritional, antioxidant, anti-microbial, and therapeutic characteristics are many. These potentials activities of spices also adds up with their far reaching nutraceutical values. The primary health challenges facing humanity today are diabetes, cardio-vascular illnesses, arthritis, and cancer. Thus the anti-diabetic, anti-hypercholesterolemic, anti-carcinogenic, digestive stimulant action, antilithogenic property, anti-inflammatory property, antimutagenic, and anticarcinogenic and anti-inflammatory actions of spices are of utmost importance in the current situation. The present chapter deals with review of the nutraceutical and health benefits of various spices used in daily diet.

**Keywords:** nutritional, medicine, antioxidants, health benefits

## 1. Introduction

Due to the extensive usage of numerous chemicals, heavy metals, electromagnetic waves, and other potentially hazardous man-made things, industrialisation has led to significant soil, water, and food pollution. Due to these issues, the prevalence of diabetes, obesity, different malignancies, vascular illnesses, physiological issues, and other degenerative diseases has increased. The expense of medical treatment has significantly increased due to the rising demand for healthcare. Research into new dietary products with healing properties has created a resurgence in health and nutrition research. Nutraceuticals opens a new era of quality of life research. May reduce the risk of disease by maintaining normal health and boosting immunity [1].

Plants are one of the most important resources in human nutrition and medicine. Increased knowledge of nutrition, medicine and plant biotechnology has drastically changed and revolutionised the concepts of nutrition, health and agriculture [2, 3].

“Food” is a term introduced by Stephen De Felice in 1979 which is defined as “a food or part of a food that has a medical or health benefit, including the prevention and treatment of disease”. The motto of nutritional therapy is based on

complementary therapy with nutraceuticals, because food is not only a source of energy and nutrition, but also has a healing effect. Food detoxifies our body, restores our digestive system and eating habits [4]. Nutrients are sold in concentrated forms such as pills, capsules, powders, and tinctures, either as a single substance or as a combination. Nutrients can be foods rich in natural nutrients such as spirulina, garlic, soybeans, or certain foodstuffs such as omega-3 salmon oil. They are also known as medicinal foods, nutritional supplements, and nutritional supplements. The global demand for herbal and non-herbal extracts is growing all the time. For e.g. green tea is used for weight loss and cancer treatment, while *Ginkgo biloba* L. is widely used as a nutrient to improve cognitive function. The nutrition market has grown in recent years due to the increased attention of researchers and advanced techniques for determining qualitative and quantitative parameters. Consumers are disillusioned with expensive high-tech approaches to disease treatment in modern medicine and looking for useful additions or alternatives to food products [5].

## **2. Why nutraceuticals?**

For many of us, a regular diet does not provide us with enough nutrition. Second, the pollution and pesticides in our surroundings are so poisonous that they prevent our bodies from controlling them. Our culture is being plagued by a variety of new illnesses. High-quality nutritional supplements may be absorbed and utilised by the body, unlike medications, which typically have side effects because they are not natural for the body. They can actually strengthen our bodies and bring energy [6, 7].

### **2.1 DEFINATION**

**Nutrient:** As coined by Association of American Feed Control Officials (AAFCO) (1996), “a feed constituent in a form and at a level that will help support the life of an animal.” Proteins, lipids, carbohydrates, minerals and vitamins are the main categories of feed nutrients.

**Feed:** As coined by Association of American Feed Control Officials (AAFCO) (1996), “edible materials which are consumed by animals and contribute energy and/or nutrients to the animal’s diet.”

**Food:** As coined by the Food, Drug and Cosmetic Act (1968), “an article that provides taste, aroma or nutritive value. Food and Drug Administration (FDA) considers food as ‘generally recognized as safe’ (GRAS).”

**Drug:** As coined by Association of American Feed Control Officials (AAFCO) (1996), “a substance intended for use in the diagnosis, cure, mitigation, treatment or prevention of disease in man or other animals. A substance other than food intended to affect the structure or any function of the body of man or other animals.”

**Dietary Supplement:** As coined by the Dietary Supplement Health and Education Act (DSHEA, 1994), “a product that contains one or more of the following dietary ingredients: vitamin, mineral, herb, or other botanical, and amino acid (protein). Includes any possible component of the diet as well as concentrates, constituents, extracts or metabolites of these compounds.”

**Nutraceutical:** As commonly coined by the dietary supplement industry, “any nontoxic food component that has scientifically proven health benefits, including disease treatment and prevention.”

Veterinary Nutraceutical: As coined by the newly created North American Veterinarian Nutraceutical Council, Inc. (NAVNC), “a substance which is produced in a purified or extracted form and administered orally to patients to provide agents required for normal body structure and function and administered with the intent of improving the health and well-being of animals” [8].

## 2.2 Classification

### a. Traditional

- Chemical constituents in the form of nutrients and herbals
- Probiotic supplements.
- Enzyme supplements.

### b. Non Traditional

- Fortified nutraceuticals.
- Recombinant Nutraceutical.

### c. Substance with established nutritional functions

- Vitamins
- Minerals
- Amino acids
- Fatty acids

### d. Herbs (or) Botanical products

### e. Reagents derived from other sources

- Pyruvate
- Chondroitin sulphate
- Steroid hormone precursors

### f. Functional foods

### g. Probiotics and prebiotics

### h. Polyunsaturated fatty acids

### i. Antioxidant vitamin

j. Polyphenols

k. Spices

### **2.3 Advantages**

- Nutraceuticals have the ability to aid in good eating as well as the diagnosis, treatment, and prevention of diseases.
- There is unquestionably a very large and expanding market, thus many pharmaceutical corporations are now attempting to enter the nutraceutical space.
- Consumers' perception that these foodstuff-like chemicals are less harmful or hazardous than traditional medications [9].

### **2.4 Dis-advantages**

- Companies making unregulated items to generate large profit margins.
- Harder and more expensive than ever to identify new molecules.
- Reduced bioavailability of nutrients [9].

### **2.5 Traditional nutraceuticals**

Foods that do not go through manual modifications fall under this category. The ingredients are all-natural and may actively contribute to health advantages, such as Tomatoes, pink grapes, guava, papaya, and melon water contain lycopene, an antioxidant with anti-cancer properties, notably for the prostate, bladder, cervix, and leukaemia [10].

### **2.6 Non-traditional nutraceuticals**

Nontraditional nutraceuticals are synthetic foods made by adding bioactive ingredients for human health. It can be further broken down into recombinant and fortified nutraceuticals. Nutraceuticals with agricultural breeding or additional nutrients are known as fortified foods. Some examples of fortified nutraceuticals include orange juice with calcium, cereals with extra vitamins or minerals, flour with added folic acid, and milk with cholecalciferol [1].

### **2.7 Fortified nutraceuticals**

Fortification of food components is a technique of enhancing food with micronutrients (vitamins, minerals, and essential elements) increases the food's nutritional worth and effectiveness. Cholecalciferol-enriched breast milk used to treat vitamin D insufficiency is one example [5, 11].

### **2.8 Recombinant nutraceuticals**

In order to produce food like yoghurt and cheese or bioactive extraction components using enzymatic or fermented technology, biotechnology and genetic

engineering are applied in this way. Gold Ascorbic acid, carotene, lutein, and zeaxanthin levels in kiwifruit have been increased through genetic modification. For example: Lutein is obtained from corn, avocado, egg yolks, spinach and have potential benefits as an anti-cancer activity [5, 11].

### **3. Substance with established nutritional functions**

#### **3.1 Vitamin**

The importance of numerous vitamins in preserving a healthy metabolism and state of wellness cannot be overstated. All vitamin deficiencies can result in distinct clinical signs. As a result, the majority of nutritional supplements or nutraceutical therapy products contain vitamins, often common vitamins like vitamin A, vitamin C, vitamin D, and vitamin E. Humans mostly obtain their vitamins from plant-based meals and plant biotechnology. As a result, it has been utilised to boost the vitamin content of plants [12].

#### **3.2 Herbal (or) botanical products**

Extracts and concentrates are the two ways to get herbal or botanical goods. Herbs have been used to treat acute and chronic illnesses for as long as human civilization has existed. The “Ayurveda” natural remedy, which includes numerous efficient means of ensuring health care, has its earliest written heritage in India. The essential elements of herbal medicine contain numerous nutraceuticals.

### **4. Reagents come from other sources**

#### **4.1 Glucosamine and chondroitin**

The building and repair of cartilage involve the usage of chemicals known as glycosaminoglycans, of which glucosamine is a precursor. Bovine or calf cartilage as the source, in certain European nations, glucosamine sulphate is the first line of defence against arthritis. In joint fluid, glucosamine sulphate encourages the formation of hyaluronic acid. Hyaluronic acid improves injured cartilage while reducing discomfort. Proteoglycan dosages were found to rise after glucosamine administration in in vitro tests. It is typically marketed as salt hydrochloride or salt sulphate. Both substances have anti-inflammatory properties. There is a glucosamine and chondroitin supplement available. The most prevalent glycosaminoglycan in cartilage, chondroitin, is what gives cartilage its resilience.

#### **4.2 Flavonoids**

Flavonoids are the primary biologically active component of plants. Regarding phenolic compounds, they have anti-inflammatory, hepatoprotective, anti-microbial, antibacterial, antiviral, anti-ulcer, vasorelaxant, anti-atherosclerotic, antithrombotic, antithrombogenic, cardio added, and anti-Neoplastic properties for profound impacts on the central nervous system [13].

### **4.3 Food supplements and food fibres**

Food supplements are goods that have extra food elements added as medicines for deficiencies or illnesses. Dietary supplements are becoming more and more popular as a way to boost performance, prevent ageing, maintain fitness, and build up the body. One of the growing food and nutritional assessments is of groceries. On the market, there are numerous materials or products with a single ingredient that contain vitamins and minerals as dietary supplements [14]. Other than vitamins and minerals, dietary supplements may also include botanicals, amino acids, pure extracts, concentrates, a combination of glandular extracts, and organ tissue. It wasn't intended to be a staple in the diet or used as a component of traditional or conventional food [15]. Fibre foods and high fibre products are very attractive because of the health benefits signifikan. E.g: rice, bananas, cereals etc.

### **4.4 Phytochemicals**

In today's communication, phytochemicals are also referred to as nutraceuticals and offer medicinal and health benefits. An intriguing reevaluation of conventional diabetes treatment has been made, and one of the key characteristics of phytochemicals is their ability to regulate glucose and insulin. Actually, fewer than a thousand manufacturers have received scientific research despite claims that they offer more unique benefits in the treatment of diabetes. Additionally, the importance of traditional medicines like anticancer, antiviral, and hypolyphical effects have been highlighted, as well as the nature of nutrition, tonic, and mushroom medicine. Lentinan enhances the host's resistance to parasites, viruses, AIDS-causing bacteria and fungus, and other types of infections.

### **4.5 Functional food**

Functional food is a supply of nutrients that is actually required and offers more than what is required for maintenance, growth, and development. Numerous additional subclasses, including cereal, nuts, and fermented foods, are included in the functional food classes [16]. Functional foods, such as cereals like rice, corn, wheat, millet, sorghum, and buckwheat, have been proven to have the ability to lower blood pressure, reduce the incidence of tumours, and remove the risk of coronary heart disease [17]. It has been discovered that kidney beans, almonds, beans, lentils, and soybeans contain potent antioxidants and have preventive effects against diabetes and cardiovascular disease [18]. Additionally, chocolate is a subtype of functional food that is the richest source of protein and a good supply of calcium, iron, magnesium, and riboflavin [19, 20]. Other functional food groups include citrus fruits, which have the potential to boost the immune system and have been shown to have therapeutic benefits as anticancer, antiviral, and antioxidant agents [21]. Other examples of functional foods that have positive effects on digestion are fermented milk and related items. For instance, yoghurt is a very nutrient-dense fermented food with anticancer potential; it has also been linked to the prevention of atherosclerosis and gastrointestinal illnesses. Patients who are lactose intolerant are advised to use it [22].

### **4.6 Prebiotics and probiotics**

Direct microbial foods that are good for your health are under the probiotic group. They adhere to certain parts of the digestive tract and expel infections as a result of

their activity [23]. Prebiotics are ingredients that have been specifically or fermented to encourage changes in gastrointestinal bacteria and whose actions have a positive impact on domestic health. They serve as probiotic bacteria's fertilisers in the big intestine. Gastric pH and digestive acid have little effect on this. Examples include insulin, which when subjected to further hydrolysis yields oligo fructose and oligosaccharide from galactose [24, 25].

#### **4.7 Polyunsaturated fatty acids**

Omega-3 (N-3) and Omega-6 (N-6) polyunsaturated fatty acids (PUFA), which differ in the location of the first double bond, are two kinds of polyunsaturated fatty acids (PUFA). Because they cannot be produced by the human body and are crucial for maintaining physiological integrity, two PUFAs are known as essential fatty acids. As a result, they need to be consumed with food.

#### **4.8 Anti-oxidant**

Free radical-induced cell damage is thought to be a major factor in both the ageing process and the onset of illness. Antioxidants are crucial for preserving our best health and wellbeing because they are our body's first defence against free radical damage. Being a highly reactive element, oxygen can be found in potentially harmful molecules known as free radicals. Healthy bodily cells may be attacked by free radicals, losing their structures and functions. Free radicals can be stabilised or rendered inactive by antioxidants before they damage cells.

#### **4.9 Polyphenols**

Natural phytochemicals called polyphenols are found in plant-based foods such as fruits, vegetables, grains, cereals, nuts, tea, coffee, wine, and cocoa; All plant meals include more than 8000 polyphenol components, including flavonoids and phenolic acid. These substances are plant secondary metabolites that serve as a line of defence against infections, oxidants, and UV radiation. Based on the amount of phenol rings and the structural components that connect these rings to one another, polyphenols can be divided into a number of types. Berry fruits, kiwis, cherries, apples, pears, chicory, and coffee are foods with high content of this phenolic acid. Phenolic acids constitute around a third of polyphenol compounds in a diet and include two primary types of acid, ferulic acid, and synapaphic acid.

#### **4.10 Spices**

Herbs and spices are seasonings made from plants that are used in cooking. Although the phrases "herbs" and "spices" are sometimes used synonymously, they have distinct meanings in botany. Spices preserve their flavour in their seeds, bark, and roots, whereas herbs store it in their leaves [26]. The word "spice" is derived from the Latin word "species," which denotes a specific kind [27]. Plant parts like clove buds, cinnamon bark, ginger roots, cumin fragrant seeds, and saffron flower stigmas can all be considered spices. Culinary spices have long been used as food preservatives and for their health-improving qualities in addition to improving the taste of food. Additionally, spices pique people's appetites and improve the appearance of food for people all over the world [26]. Spices form the foundation of flavour in food



Sr.no	Name of spice	Biological source	Uses	Health benefits	Contraindications
1.	Turmeric (Haldi)	<i>Curcuma longa</i> L.	In addition to cosmetics, it is utilised in food. There are several medical applications for it.	It aids in the treatment of skin issues. Turmeric powder can be used to treat cuts and wounds. It also makes diabetes management simpler.	It is contraindicated in gallstones or a bile duct obstruction.
2.	Star anise (Chakra Phool)	<i>Illicium verum</i> Hook.f.	It is useful in both cooking and medicine.	For rheumatism, star anise oil is helpful. Digestive health and breath freshening are benefits.	Pregnant and lactating women, liver disease, alcoholism, hormonal sensitivity, intestinal diseases.
3.	Pepper (Kaali Mirch)	<i>Piper nigrum</i> L.	It is frequently used in cooking, particularly as a garnish. It also has a variety of medicinal uses.	It makes it easier to handle illnesses like the common cold, cough, and infections. Both digestion issues and muscle discomfort can be treated with it.	Increase the risk of bleeding in people with bleeding disorders.
4.	Nutmeg (Jaiphal)	<i>Myristica fragrans</i> Houtt.	For garnishing and making masala, it is used in powdered form. It is used in soaps, perfumes and shampoos. It can also be used for medicinal purpose.	It helps with the treatment of heart disease, asthma, and foul breath.	It is contraindicated in pregnant women.
5.	Ginger (Adrak)	<i>Zingiber officinale</i> Roscoe.	It is used for giving a specific flavour to food and has many medicinal uses.	Helps prevent stomach issues. It helps people deal with coughs and colds.	Contraindicated with aspirin, anticoagulant, antiplatelet, NSAIDS drugs
6.	Garlic (Lassan)	<i>Allium sativum</i> L.	In addition to being used medicinally, it is also utilised in cooking.	It helps individuals cope with coughs and colds. Additionally, it possesses antibacterial activities.	Bleeding disorders, surgery within 1–2 weeks.
7.	Coriander (Dhaniya)	<i>Coriandrum sativum</i> L.	Both the seeds and the leaves of coriander are used in cooking. It also has a few medical applications.	It can be applied externally to treat rheumatism and achy joints. Additionally, it helps in hay fever, a sore throat, allergies, digestion issues, etc.	—

Sr.no	Name of spice	Biological source	Uses	Health benefits	Contraindications
8.	Cumin (Zeera)	<i>Cuminum cyminum</i> L.	It has therapeutic qualities in addition to being used in cooking.	It supports a healthy immune system and is a rich source of iron. Dysentery can be treated with water that has been boiled with cumin seeds.	Heavy menstrual bleeding, diabetic patients.
9.	Cinnamon (Dalchini)	<i>Cinnamomum zeylanicum</i> Nees	It is widely utilised when making masalas and seasoning food. It also serves medical purposes.	It decreases blood cholesterol and increases insulin production naturally.	Pregnant womens.
10.	Fenugreek (Methi)	<i>Trigonella foenum graecum</i> L.	It is typically consumed as a green leafy vegetable, and the seeds are used to make masalas. It can be used medicinally as well.	Tea made from fenugreek seeds or sweet fudge can increase the production of breast milk. It also lowers cholesterol and aids in the treatment of diabetes.	Diabetes and low blood sugar.
11.	Bishop's weed (Ajwain)	<i>Trachyspermum ammi</i> L.	It serves a medical benefit in addition to being used as a seasoning and flavouring.	A medication that is applied to treat GI issues like cholera, dyspepsia, flatulence, and diarrhoea. In Ayurvedic medicine, it is utilised as an antiseptic, preservative, and treatment for respiratory and GI problems. As a boost to the body's defence mechanisms, unani medicine.	Contraindicated in diverticulitis, liver diseases and ulcerative colitis.

**Table 1.**

List of important Indian spices with their uses, health benefits and contraindications [30].

applications. People use spices all around the world to enhance the flavour, texture, and appearance of food as well as to boost hunger. Spices are also prized for their healing abilities as antimicrobials and antioxidants [27].

Essential oils are liquids that are produced when plant parts are steam or water distilled (leaves, stems, bark, seeds, fruits, roots and plant exudates). Citrus oil can only be extracted from fruit peels using expression since heat readily damages the chemical makeup of the oil. Citrus oil production is a substantial byproduct of the juice industry nowadays. Up to several hundred chemical compounds can be found

in an essential oil, and it is this complex combination of components that gives the oil its distinctive aroma and flavour. An essential oil can include up to several hundred chemical compounds, and it is this intricate assemblage of ingredients that gives the oil its unique flavour and perfume. In addition to the volatile essential oil, these oleo-resins and extracts, which are widely used in the food and pharmaceutical industries, also contain concentrated non-volatile flavour components. The solvent extraction processes are more complex and difficult than steam distillation, and most small-scale producers will not be able to afford them. Selling the raw materials to these extraction facilities, however, might be a good market strategy [28].

The majority of the significant spices that are currently traded internationally are produced in tropical areas. The most notable exceptions to this rule are the capsicums (chilli peppers, paprika, and coriander), which may be cultivated in a far wider variety of tropical and nontropical conditions. In these humid and damp settings, growing spices and essential oils presents unique crop and product management challenges. The crop must be dried in order to produce a stable stored product, which necessitates the use of effective drying techniques in wet, rainy climates [28].

## **5. Health and medicinal use of spices and herbs of India**

Indians employ herbs and spices in their traditional medical practises, much like people from many other cultures do. “Ayurvedic medicine” refers to an Indian medical system that employs herbs and spices. In Indian culture, this all-encompassing method of healing is referred to as the “science of life.” In addition to adding flavour to dull dishes, research demonstrates that herbs and spices “have a huge impact on human health because they affect many of the body’s metabolic processes.” Indian Festival (Rani) Herbs have long been utilised in both Eastern and Western medicine to treat a number of diseases (**Table 1**) [29].

## **6. Conclusion**

Spices are not essential but still have become most important part of our daily routine. The spices makes food attractive and palatable with flavour, colour, taste and aroma. By using healthy and tasty spices, the use of less healthy ingredients can be minimised. Many health problems are prevailing in human being, now a days. The spices are tasty and attractive. In addition, they also possess bioactives which acts as nutraceuticals, and are found to be effective against variety of health problems. The spices like turmeric, nutmeg, pepper, star anise, ginger, garlic, coriander, cumin, cinnamon, fenugreek and Bishop’s weed are being using as spices since long. Their medical benefits have been proven. These spices will not only make our food tasty and attractive but their proper use in routine life will keep us healthy.

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### **Author details**

Vijaya Rabade<sup>1\*</sup>, Ashwini Ingole<sup>1</sup>, Purushottam Gangane<sup>1</sup>, Vidya Sabale<sup>1</sup>,  
Ujwala Mahajan<sup>1</sup> and Yash Kale<sup>2</sup>


1 Dadasaheb Balpande College of Pharmacy, Nagpur, India

2 Kamla Nehru College of Pharmacy, Nagpur, India

\*Address all correspondence to: vijayarabade24@gmail.com

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## References

- [1] Rajasekaran A. Nutraceuticals, Comprehensive Medical Chemistry III. Elsevier Science. 2017;1-8:107-134
- [2] Berger MM, Shenkin A. Vitamins and trace elements: Practical aspects of supplementation. *Nutrition*. 2006;22(9):952-955
- [3] Bagchi D. Nutraceuticals and functional foods regulations in the United States and around the world. *Toxicology*. 2006;221(1):1-3
- [4] Chauhan B, Kumar G, Kalam N, Ansari SH. Current concepts and prospects of herbal nutraceutical: A review. *Journal of Advanced Pharmaceutical Technology & Research*. 2013;4(1):4-8
- [5] Singh J, Sinha S. Classification, regulatory acts and applications of nutraceuticals for health. *International Journal of Pharmacy and Biological Sciences*. 2012;2(1):177-187
- [6] Whitman M. Understanding the perceived need for complementary and alternative nutraceuticals: Lifestyle. *Clinical Journal of Oncology Nursing*. 2001;5:190-194
- [7] EANN C, Teratogen N, Service I. Over-the-counter products: nonprescription medications, nutraceuticals, and herbal agents. *Clinical Obstetrics and Gynecology*. 2002;45(1):89-98
- [8] Baici A, Hörler D, Moser B, Hofer HO, Fehr K, Wagenhäuser FJ. Analysis of glycosaminoglycans in human serum after oral administration of chondroitin sulfate. *Rheumatology International*. 1992;12(3):81-88
- [9] Khogali SEO, Harper AA, Lyall JA, Rennie MJ. Effects of L-glutamine on post-ischaemic cardiac function: Protection and rescue. *Journal of Molecular and Cellular Cardiology*. 1998;30(4):819-827
- [10] Lokhande SS. Role of nutraceuticals in various diseases: A comprehensive review. *Asian Journal of Pharmaceutical Research*. 2018;8(4):236
- [11] Casey CF, Slawson DCNL. Vitamin D supplementation in infants, children, and adolescents. *American Family Physician*. 2010;81(6):745-748
- [12] Dureja H, Kaushik D, Kumar V. Developments in nutraceuticals. *Indian Journal of Pharmacology*. 2003;35(6):363-372
- [13] Lin JK, Weng MS. Flavonoids as nutraceuticals. *Science of Flavonoids*. 2006;7(September):213-238
- [14] Pandey M, Vijayakumar. Nutraceutical supplementation for diabetes: A review. *Int. Journal of Pharmacy & Pharmaceutical Sciences*. 2011;3(SUPPL. 4):33-40
- [15] Spano M. Functional foods, beverages, and ingredients in athletics. *Strength & Conditioning Journal*. 2010;32(1):79-86
- [16] Gaidhani KA, Harwalkar M, Nirgude PS. Seed extracts. *World Journal of Pharmaceutical Research*. 2014;3(3):5041-5048
- [17] Madar Z, Stark AH. New legume sources as therapeutic agents. *The British Journal of Nutrition*. 2002;88(S3):287-292

- [18] Preuss HG. Bean amylase inhibitor and other carbohydrate absorption blockers: Effects on diabetes and general health. *Journal of the American College of Nutrition*. 2009;**28**(3):266-276
- [19] Pucciarelli DL, Grivetti LE. The medicinal use of chocolate in early North America. *Molecular Nutrition & Food Research*. 2008;**52**(10):1215-1227
- [20] Cooper KA, Donovan JL, Waterhouse AI, Williamson G. Cocoa and health: A decade of research. *The British Journal of Nutrition*. 2008;**99**(1):1-11
- [21] Okwu DE. Citrus fruits: A rich source of phytochemicals and their roles in human health. *International Journal of Chemical Sciences*. 2008;**6**(2):451-471
- [22] Shiby VK, Mishra HN. Fermented milks and Milk products as functional foods-a review. *Critical Reviews in Food Science and Nutrition*. 2013;**53**(5):482-496
- [23] Gibson GR. Fibre and effects on probiotics (the prebiotic concept). *Clinical Nutrition Supplements*. 2004;**1**(2):25-31
- [24] Ramaa C, Shirode A, Mundada A, Kadam V. Nutraceuticals - an emerging era in the treatment and prevention of cardiovascular diseases. *Current Pharmaceutical Biotechnology*. 2006;**7**(1):15-23
- [25] Venter CS. Prebiotics: An update. *Journal of Family Ecology and Consumer Sciences*. 2007;**35**:17-25
- [26] Ogbunugafor HA, Ugochukwu CG, Kyrian-Ogbonna AE. The role of spices in nutrition and health: A review of three popular spices used in southern Nigeria. *Food Quality and Safety*. 2017;**1**(3):171-185
- [27] Okonkwo C, Ogu A. Nutritional evaluation of some selected spices commonly used in the south-eastern part of Nigeria. *Journal of Biology, Agriculture and Healthcare*. 2014;**4**(15):97-103
- [28] Darriet A. Section II. Flavors. Food processing, product developments, and recent advances: Herbs, spices, and essential oils. In: *Handbook of Food Products Manufacturing*. Vol. 1. John Wiley & Sons; 2006. pp. 205-220
- [29] FCH14-04–Leader’s Guide December, 2013
- [30] Dubey S. Indian spices and their medicinal value. *Indian Journal of Pharmaceutical Education and Research*. 2017;**51**(3):S330-S332