SHORT FEATURE

Base-rich Diet Best for Humans

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MANY different diets have been proposed by food diet Gurus (advocates) over the years that promise to benefit the human body in one way or the other. While some promise weight loss, others pledge to be high in anti-oxidants to boost immunity.

A different kind of health benefit is assured by the alkaline diet, a great favorite of many celebrities such as Victoria Beckham, Jennifer Aniston and Gwyneth Paltrow. We set out to explore if there is any scientific basis for health benefits attributed to the alkaline diet.

pH Balance in Human Body

A scale known as the pH scale describes the strength of an acid or a base more accurately. 'pH' literally means hydrogen ion potential and the pH scale extends between 0 to 14. A solution whose pH is below 7 is acidic while above 7 is said to be alkaline. A solution is neutral when its pH is 7.

Living organisms need to have appropriate pH in and around their cells. Maintenance of pH is critical for the proper functioning of every part of the body, which is always striving to maintain an acid-base balance. This is also known as acid-base homeostasis.

Fluids help in digestion, lubrication, protection, nutrition and oxygen transportation. Optimal pH is required to perform each of these functions. However, optimal pH is different for individual parts of the body. The pH of the blood is usually maintained in the range of 7.35 to 7.45. If the blood pH falls below 6.9 it causes diabetic coma whereas above 7.9 may lead to tetanus or lock jaw. The stomach on the other hand is extremely acidic with a pH of 0.7 to 1.9. This low pH is required for digestion of the food. The pH of the saliva is usually acidic but varies within a range of 5 to 8 depending on the food we eat. Thus, the perfect pH for one body part is different from that of the other.

pH Regulators in Human Body

Lungs and kidneys jointly maintain the Acid-Base balance in the body. In a typical diet, the majority of calories are consumed as carbohydrates and fats. The complete metabolism of carbohydrates and fats requires oxygen and yields CO_2 and H_2O. With normal lung function, the CO_2 produced (20 mol/day) is excreted and there is no impact on the systemic acid-base balance.

Alterations in ventilation may cause changes in the PCO_2 (Partial pressure of carbon dioxide) of the blood thus changing blood pH. For example, an increase in PCO_2 produces acidosis and a decrease in PCO_2 produces alkalosis.

The metabolism of the amino acid in proteins may produce either acids or alkali depending on the specific amino acid. However, the metabolism of dietary protein produces net acids (e.g. HCl or H_2SO_4). These acids are often referred to as non-volatile acids.

It is well established that diet and certain food components have a clear impact on acid-base balance. Some foods are alkaline in nature while others are acidic. A disturbance of the acid-base balance occurs when acid-base changes surpass the body's ability to regulate it, or when normal regulatory mechanisms become ineffective.

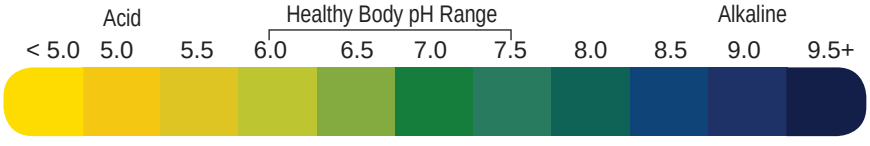
Food is an important factor that contributes a net acid or base effect due to the balance between the base forming constituents. For example, bicarbonate, produced from the metabolism of the K salts of organic anions in plant foods and the acid-forming constituents, such as sulfuric acid produced by the catabolism of methionine and cysteine in dietary proteins, need to be balanced.

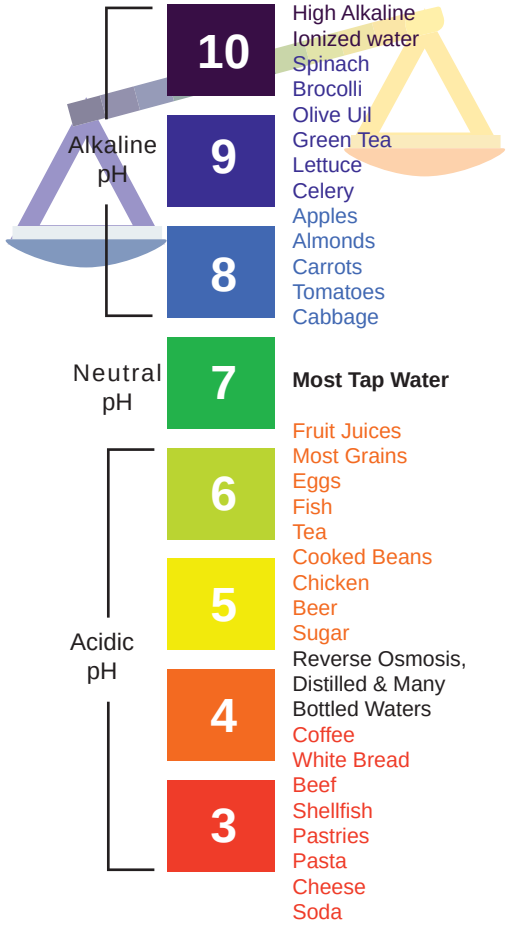
Important differences in acid–base chemistry have been noticed in contemporary diets as compared to the diets of human ancestors. Although it is difficult to know what exactly our hominid ancestors ate, hunter-gatherer studies suggest that compared to modern-day human diets there was relatively a much higher intake of plant foods or base-rich food.

Diet of Humans versus Carnivores

Anatomically we are herbivores although many of us choose to eat both plant and animal food. The comparative anatomy of humans and carnivores reveals that the humans have small fingernails and canine teeth but carnivores have large canine teeth and sharp claws that are capable of tearing flesh.

All humans and other plant-eating creatures maintain alkaline saliva but saliva of the carnivores or meat-eating animals is acidic. Carnivores do not chew but swallow their food in large pieces, relying on their extremely acidic





Impact of diet on acid-base homeostasis in the body

stomach juice to break down flesh and kill the harmful bacteria in the meat that would otherwise sicken or kill the meat-eater. Carnivores have no digestive enzymes in the saliva whereas humans and herbivores have carbohydrate digestive enzyme (amylase).

The pH level of stomach juices in humans ranges from 3 to 4 – human-preferred foods are all alkaline-forming. The stomach pH of carnivores is very low or highly acidic meaning they thrive on a diet of acid-forming foods. The stomach of carnivores or meat eaters is therefore more capable of digesting meat than humans.

In a recent study, 159 hypothetical pre-agricultural diets were estimated for net endogenous acid production (NEAP) out of which 87% were found to be base producing, with an estimated mean NEAP of negative 88mEq/d. In comparison, calculations from the US Third National Health and Nutrition Examination Survey (NHANES III) found the average American diet to be acid producing, with an NEAP of positive 48mEq/d. This represents a switch from the net base producing diet we ate for the majority of our evolutionary history.

In general, western diets are considered acidogenic due to high amount of protein and insufficiency of fruits and vegetable intake. Bad diet and stress lead to inflammation, which further leads to acid-base disorders or imbalance of blood pH. Inflammation is linked to diseases such as cancer, heart diseases, and stroke.

Current research highlights the changes that occur in the acid-base homeostasis and the potential long-term physiological consequences of a chronic, low-grade metabolic acidosis among all those people having the typical acidic diet, lacking in fruits and vegetables. These effects of diet can be reduced or eliminated by altering the diet or giving base supplements.

Acid-base homeostasis is influenced not only by intake of protein, alkalizing food constituents, or metabolically noncombustible dietary organic acid but also by drinking water, which must be taken into consideration. Not only the usual drinking water but also the choice of mineral water influences acid-base balance.

So, it is important to preferably consume only a moderate quantity of acid-forming foods and considerable amount of alkali-forming foods. Examples are vegetables, fruits, grains, milk, butter and cheese.

There are many health problems associated with increased acidity in the body:

- Decreased growth factors
- Mild hypothyroidism
- Higher levels of blood cortisol
- Decreased uptake and release of oxygen
- Loss of muscle mass
- Altered regulation of metabolites and minerals
- Enzymatic changes in cells
- Growth hormone resistance

Chronic imbalance of acid and base in the diet leads to acid-base disorders in the body such as acidosis and alkalosis.

When the blood has low alkalinity or too much of acid, it results in the decrease of the blood pH, called acidosis. This is caused by the loss of bicarbonate in the blood, increased consumption or generation of organic acids, or buildup of carbon dioxide in the blood, and renal and/or gastrointestinal loss of biocarbonates. Acidosis leads to poor lung function or slow breathing, renal disease, kidney failure, obesity, dehydration, diabetes, diarrhoea, dehydration and pancreatic drainage.

When the blood has low acid and too much base it increases blood pH and is known as alkalosis. Low level of carbon dioxide in the blood, or loss of acid from the blood causes alkalosis. It is also caused by over abundance of bicarbonate in the blood. Alkalosis leads to irritability, muscle twitching and cramps, tingling of the fingers and toes and around the lips.

The acidic food does not directly damage our internal system but regular consumption of acid-forming foods lead to tremendous pressure on the body, causing acidosis-acidaemia. Dietary interventions such as lowering animal protein and increasing vegetable and fruit consumption and nutritional supplementation with salts such as K^+ and Mg^+ normalise acidosis.

So, we should eat plenty of vegetables and fruits, as well as other plant foods, such as whole grains and beans for acid-base balance in our body.

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