

pH of blood and the role of diet

The pH of human blood is 7.35 to 7.45 and it is maintained in this region. No, what you eat has no impact on the pH of blood, before it is buffered by phosphate and bicarbonate-CO₂.

We have measured the intracellular pH of human peripheral blood lymphocytes by means of high-resolution ¹⁹F NMR spectroscopy using D,L-2-amino-3,3-difluoro-2-methylpropanoic acid (F₂MeAla) as a probe. Lymphocytes readily took up the methyl ester of F₂MeAla, and endogenous esterase hydrolyzed the ester to the free amino acid inside the cell. This alpha-methyl amino acid is not metabolized by the cell, and its ¹⁹F NMR spectrum exhibits large pH-dependent shifts as the alpha-amino group is protonated. The size of the ¹⁹F shifts, the high sensitivity of ¹⁹F NMR, and the favorable pK_a of the alpha-amino group of F₂MeAla (pK_a = 7.3) allowed us to measure intracellular pH of lymphocytes at 25-30 degrees C with approximately 5-min acquisition times.

Measurements at various external pH values demonstrated that human peripheral blood lymphocytes regulate their internal pH, a process requiring expenditure of metabolic energy. In the pH range between 6.8 and 7.4, lymphocytes maintain a constant internal pH of 7.17 +/- 0.06 pH unit. Outside this range, intracellular pH changes with extra-cellular pH. The accuracy of this ¹⁹F pH probe has been confirmed by independent measurements of intracellular pH using equilibrium distributions of 5,5-dimethyloxazolidine-2,4-dione.

Is it true that each food that you eat can cause your blood to become more alkaline or acidic?

The answer is: not really. The pH of your blood is tightly regulated by a complex system of buffers that are continuously at work to maintain a range of 7.35 to 7.45, which is slightly more alkaline than pure water.

If the pH of your blood falls below 7.35, the result is a condition called acidosis, a state that leads to central nervous system depression. Severe

acidosis - where blood pH falls below 7.00 - can lead to a coma and even death.

If the pH of your blood rises above 7.45, the result is alkalosis. Severe alkalosis can also lead to death, but through a different mechanism - alkalosis causes all of the nerves in your body to become hypersensitive and over-excitabile, often resulting in muscle spasms, nervousness, and convulsions; it is usually the convulsions that cause death in severe cases.

The bottom line is that if you are out and about, your body is doing an adequate job of keeping your blood pH somewhere between 7.35 to 7.45 and the foods that you are eating are not causing any wild deviations of your blood pH.

So what is up with all the hype about the need to alkalize your body? And what is to be made of the claim that being too acidic can cause osteoporosis, kidney stones, and a number of other undesirable health challenges?

As usual, the answers to such questions about human health can be found by understanding basic principles of human physiology. So let us take a look at the fundamentals of pH and how your body regulates the acid-alkaline balance of its fluids on a moment-to-moment basis.

pH is a measure of how acidic or alkaline a liquid is. With respect to your health, the liquids involved are your body fluids, which can be categorized into the following two main groups:

1. *Intracellular fluid*, which is the fluid found in all of your cells. Intracellular fluid is often called cytosol, and makes up about two-thirds of the total amount of fluid in your body.
2. *Extra-cellular fluid*, which is the fluid found outside of your cells. Extra-cellular fluids are further classified as one of two types:
 - *Plasma*, which is fluid that makes up your blood.
 - *Interstitial fluid*, which occupies all of the spaces that surround your tissues. Interstitial fluid includes the fluids found in your

eyes, lymphatic system, joints, nervous system, and between the protective membranes that surround your cardiovascular, respiratory, and abdominal cavities.

Your blood (plasma) needs to maintain a pH of 7.35 to 7.45 for your cells to function properly. Why your cells require your blood to maintain a pH in this range to stay healthy is beyond the scope of this article, but the most important reason is that all of the proteins that work in your body have to maintain a specific geometric shape to function, and the three-dimensional shapes of the proteins in your body are affected by the tiniest changes in the pH of your body fluids.

The pH scale ranges from 0 to 14. A liquid that has a pH of 7 is considered to be neutral (pure water is generally considered to have a neutral pH). Fluids that have a pH below 7 - like lemon juice and coffee - are considered to be acidic. And fluids that have a pH above 7 - like human blood and milk of magnesia - are considered to be alkaline.

It is important to note that on the pH scale, each number represents a tenfold difference from adjacent numbers; in other words, a liquid that has a pH of 6 is ten times more acidic than a liquid that has a pH of 7, and a liquid with a pH of 5 is one hundred times more acidic than pure water. Most carbonated soft drinks have a pH of about 2-3, making them about ten thousand times more acidic than pure water. Please remember this the next time you think about drinking a can of coke.

When you ingest foods and liquids, the end products of digestion and assimilation of nutrients often results in an acid or alkaline-forming effect - the end products are sometimes called acid ash or alkaline ash.

Also, as your cells produce energy on a continual basis, a number of different acids are formed and released into your body fluids. These acids - generated by your everyday metabolic activities - are unavoidable; as long as your body has to generate energy to survive, it will produce a continuous supply of acids.

So there are two main forces at work on a daily basis that can disrupt the pH of your body fluids - these forces are the acid or alkaline-forming effects of foods and liquids that you ingest, and the acids that you generate through regular metabolic activities.

Fortunately, your body has three major mechanisms at work at all times to prevent these forces from shifting the pH of your blood outside of the 7.35 to 7.45 range.

These mechanisms are:

1. Buffer Systems

- Carbonic Acid-Bicarbonate Buffer System
- Protein Buffer System
- Phosphate Buffer System

2. Exhalation of Carbon Dioxide

3. Elimination of Hydrogen Ions via Kidneys

It is not in the scope of this article to discuss the mechanisms listed above in detail. For this article, we only want to point out that these systems are in place to prevent dietary, metabolic, and other factors from pushing the pH of your blood outside of the 7.35 to 7.45 range.

When people encourage you to ‘alkalize your blood,’ most of them mean that you should eat plenty of foods that have an alkaline-forming effect on your system. The reason for making this suggestion is that the vast majority of highly processed foods - like white flour products and white sugar - have an acid-forming effect on your system, and if you spend years eating a poor diet that is mainly acid-forming, you will overwork some of the buffering systems mentioned above to a point where you could create undesirable changes in your health.

For example, your phosphate buffer system uses different phosphate ions in your body to neutralize strong acids and bases. About 85% of the phosphate ions that are used in your phosphate buffer system come from calcium phosphate salts, which are structural components of your bones and teeth. If your body fluids are regularly exposed to large quantities of

acid-forming foods and liquids, your body will draw upon its calcium phosphate reserves to supply your phosphate buffer system to neutralize the acid-forming effects of your diet. Over time, this may lead to structural weakness in your bones and teeth.

Drawing on your calcium phosphate reserves at a high rate can also increase the amount of calcium that is eliminated via your genito -urinary system, which is why a predominantly acid-forming diet can increase your risk of developing calcium-rich kidney stones.

This is just one example of how your buffering systems can be overtaxed to a point where you experience negative health consequences. Since your buffering systems have to work all the time anyway to neutralize the acids that are formed from everyday metabolic activities, it is in your best interest to follow a diet that does not create unnecessary work for your buffering systems.

Acid and Alkaline-Forming Effects of Common Foods

- Generally speaking, most vegetables and fruits have an alkaline-forming effect on your body fluids.
- Most grains, animal foods, and highly processed foods have an acid-forming effect on your body fluids.

Your health is best served by a good mix of nutrient-dense, alkaline **and** acid-forming foods; ideally, you want to eat more alkaline-forming foods than acid-forming foods to have the net acid and alkaline-forming effects of your diet match the slightly alkaline pH of your blood.

The following lists indicate which common foods have an alkaline-forming effect on your body fluids, and which ones result in acid ash formation when they are digested and assimilated into your system.

Foods that have a Moderate to Strong Alkaline-Forming Effect

Watermelon
Lemons

Cantaloupe
Celery
Limes
Mango
Honeydew
Papaya
Parsley
Seaweed
Sweet, seedless grapes
Watercress
Asparagus
Kiwi
Pears
Pineapple
Raisins
Vegetable juices
Apples
Apricots
Alfalfa sprouts
Avocados
Bananas
Garlic
Ginger
Peaches
Nectarines
Grapefruit
Oranges
Most herbs
Peas
Lettuce
Broccoli
Cauliflower

Foods that have a Moderate to Strong Acid-Forming Effect

Alcohol
Carbonated Soft drinks
Tobacco
Coffee
White sugar
Refined Salt
Artificial sweeteners
Antibiotics (and most drugs)
White flour products (including maida based products)
Seafood
White vinegar
Barley
Most boxed cereals
Cheese
Most beans
Flesh meats
Most types of bread

Please note that these lists of acid and alkaline-forming foods are not comprehensive, nor are they meant to be.

If you are eating mainly grains, flour products, animal foods, and washing these foods down with coffee, soda, and milk, you will almost certainly improve your health by replacing some of your food and beverage choices with fresh vegetables and fruits.

The primary purpose of this article is to offer information that explains why we believe that you do not need to take one or more nutritional supplements for the sole purpose of alkalizing your body. Your body is already designed to keep the pH of your body fluids in a tight, slightly alkaline range.

The ideal scenario is to make fresh vegetables and fruits the centerpieces of your diet, and to eat small amounts of any other nutrient-dense foods

that your appetite calls for and that experience shows your body can tolerate.

What is the normal Ph of Blood, Urine, And Saliva?

The normal pH of blood running through arteries (large elastic-walled blood vessels that carry blood from the heart to other parts of the body) is 7.4; the pH of blood in the veins (vessels that transports blood to the heart) is about 7.35. Normal urine pH averages about 6.0- 6.5. Saliva has a pH between 6.0 and 7.4.