Health and Healing Wisdom Journal Article

www.ppnf.org

Acid-Alkaline Balance And Your Health

By Virginia Worthington, ScD
Winter 1997: Volume 21 #4

[Dr. Worthington has a Master of Science degree in nutritional sciences from the University of Maryland and a doctorate in International Health with a specialty in nutrition from Johns Hopkins University, School of Public Health. In addition, she has studied herbal and nutritional medicine with several herbalists and traditional healers.

Dr. Worthington has 13 years of experience in various aspects of nutrition including research, community nutrition, nutrition education, and clinical work with individual patients using nutritional and herbal therapies. She is currently in private practice in Washington, DC and writes on health related subjects.]

Many healers are concerned with the level of acidity or alkalinity of the body, from orthodox medical doctors to alternative practitioners like cancer doctor Emanuel Revici, controversial test developer Dr. Carey Reams, or the sleeping prophet Edgar Cayce. When these different healers speak about acid-alkaline balance in the body, what do they mean? Why is this important? And how do nutrition and lifestyle affect acid/alkaline balance? Our purpose here is to explore this topic and to answer some of these questions, particularly as it relates to the research of Dr. Weston A. Price.

First, let us define the terms acidity and alkalinity and get familiar with some basic chemistry. In terms of chemistry, when one talks about acidity or alkalinity, one is talking about hydrogen. An acid is a substance that releases hydrogen into a solution and an alkali or base is one that removes hydrogen from a solution. The amount of free hydrogen is measured on a scale ranging from 1 to 14, called pH, that denotes the exact level of acidity or alkalinity. A pH value below 7 is considered acid and above 7 alkaline.

Inside the human body, the acid-alkaline balance is important since many functions in the body occur only at a certain level of acidity or alkalinity. Many enzymes and chemical reactions in the body work best at a particular pH. A small change in pH can have a profound effect on body function. For example, muscle contractibility declines and hormones like adrenaline and aldosterone increase as the body becomes slightly more acid. In addition, different parts of the body have different levels of acidity and alkalinity. Some of these are shown in Table 1. It should be noted that while there can be a wide range of pH values for the saliva and urine, the value for the blood is maintained within narrow bounds.

TABLE 1. pH of Various Body Tissues [1,12]

TISSUE	pH
skeletal muscle	6.9 to 7.2
heart	7.0 to 74
liver	7.2
brain	7.1
blood	7.35 to 7.45
saliva	6.0 to 7.4
urine	4.5 to 8.0

REGULATION OF ACID-ALKALINE BALANCE

Because of the importance of the acid-alkaline balance in the blood and tissues, the body has a number of mechanisms for regulating this balance[1,2]. These mechanisms are shown in Table 2.

TABLE 2. Factors Regulating Acid-Alkaline Balance in the Body [1]

In the blood	bicarbonate
	amino acids
	albumin
	globulin
	hemoglobin
Inside cells	chemical reactions generating or consuming hydrogen
	entry or exit of hydrogen from the cell via pumps or diffusion

Many body functions are involved in the regulation of acid-alkaline balance including respiration, excretion, digestion and cellular metabolism. In the bloodstream, there are substances known as buffers that act chemically to resist changes in pH. The most important of these compounds in the blood are bicarbonate, albumin, globulin and hemoglobin. Other regulation of blood pH is done chiefly by the lungs and kidneys.

The lungs aid in acid-alkaline regulation by removing carbon dioxide from the blood. Carbon dioxide combines with water in the body to form carbonic acid, so that removing carbon dioxide is equivalent to removing acid. Respiratory rates can vary depending on the acidity of the body, speeding up under acid conditions to remove carbon dioxide and reduce acidity and slowing down under alkaline conditions to retain acids and reduce alkalinity.

The kidney also responds to the pH of the blood. If the blood is too acid, the kidney excretes extra hydrogens into the urine and retains extra sodium. Phosphorus in the form of phosphate is required for this exchange. The body obtains this phosphorus from bone if it is otherwise unavailable. When the bloodstream is extremely acid, the kidney uses a different method and excretes ammonium ions, which contain four hydrogens, into the urine. When the body is too alkaline, the process is reversed, and hydrogen is retained.

In the digestive process, acid-alkaline balance is affected by the secretions of the stomach and the pancreas. These secretions are absorbed into the bloodstream and affect the rest of the body. When food

is eaten, the stomach secretes hydrochloric acid. In response to this acid, the pancreas secretes bicarbonate, which neutralizes the stomach acid so that pancreatic enzymes can work properly. Normally, after eating, there are transient changes in blood pH, known as the acid and alkaline tides, that correspond to the stomach and pancreatic secretions. Usually the pH of the blood quickly returns to normal. However, if digestive secretions are out of balance, then the whole body can be affected. Some physicians, like Dr. William Philpott, feel that insufficient secretion of pancreatic bicarbonate is a major cause of over-acidity in the body. Other digestive problems that affect the body's pH are diarrhea, which results in a loss of bicarbonate, and vomiting, which results in a loss of acid.

Just as the pH of the bloodstream is kept under tight control, the acid-alkaline environment inside the cells is also regulated so that it remains within narrow bounds. One way that this regulation occurs is by pumps in the cell membrane that cause hydrogen to enter or exit from the cell. Many of these pumps require phosphorus and magnesium to function so that micronutrient nutrition is a factor affecting acid-alkaline balance. Another way that cells regulate the pH inside the cell is by changing the chemical reactions that occur so that more or less hydrogen is produced[1].

SYMPTOMS OF OVER ACIDITY OR ALKALINITY

When the blood is too acid, symptoms include drowsiness, progressing to stupor and coma. Acute acidosis can result from kidney or lung problems, dehydration, ingestion of certain drugs, diabetes or diarrhea, and is treated by giving an alkaline solution such as bicarbonate of soda. A particular form of acidosis is ketosis that occurs in diets high in fat and lacking in carbohydrates, as well as in conditions of diabetes or starvation, when the body burns fats rather than carbohydrates. However, when normal quantities of fat are consumed in a diet containing carbohydrate, the fats cause no problems in acid-alkaline balance for the majority of people.

When the blood is too alkaline, symptoms include cramps, muscle spasms, irritability and hyperexcitability. Acute alkalosis may be caused by impaired kidney function, hyperventilation, use of diuretic or steroid drugs, vomiting or gastric drainage. Acute alkalosis is treated by giving an acid solution such as ammonium chloride or by breathing expired carbon dioxide from a paper bag[3].

HOW BODY pH IS MEASURED

Most of what is known and used clinically relates to the acidity and alkalinity of the bloodstream, since it is possible to measure the pH of blood and difficult and sometimes impossible to measure the pH of other tissues. Medical doctors typically try to determine the acidity or alkalinity of the body and its cells by analyzing the blood. Some of the elements in blood that are measured are sodium, potassium, chloride, carbon dioxide, and bicarbonate. A number known as the anion gap can be calculated using the sodium, chloride, and bicarbonate measurement. The anion gap, along with the other values, is used to assess the acidity or alkalinity of the body tissues [1].

Alternative practitioners may use systems developed by Carey Reams, Harold Hawkins, or Emanuel Revici. All three measure urine pH plus other factors to assess metabolism. Drs. Reams and Hawkins also measured saliva pH. None of these systems claims that internal pH can be determined by saliva or urine pH alone. As we saw earlier, the kidney has several methods for disposing of excess acid, and each has a different effect on the urine pH. Similarly, the saliva pH is affected by bacteria and other microbes in the mouth so that saliva pH is not a reliable indicator of the internal environment. Nonetheless, Dr. Reams felt that saliva pH reflected the strength of digestive fluids[4,5,6].

NUTRITION AND ACID-ALKALINE BALANCE

Before World War II, there was considerable interest in how the food we eat affects the acid-alkaline balance of the body. While today the subject is not receiving much attention in orthodox circles, many alternative practitioners place considerable stress on the acid-base balance characteristics of various diets. In spite of a certain amount of ongoing debate, it is generally acknowledged that the food that is eaten is a major source of acid and alkali for the body[7].

Some confusion in terminology has resulted because of the way that the discussion evolved. In investigating how different foods might affect the acid-alkaline balance, various foods were burned to ash in the laboratory, and the pH of the resulting ash was measured. These foods were then classified as acid, alkaline, or neutral ash foods as shown in Table 3[8].

TABLE 3. Acid, Alkaline and Neutral Ash Foods[8]

Acid Ash Foods	**Alkaline Ash Foods**	**Neutral Ash Foods**
bread (grains)	cheese	arrowroot
cake	cream	butter
cereal	most fruit	candy
mayonnaise	jam	coffee
cranberries	milk	cornstarch
plums	almonds	lard
prunes	chestnuts	margarine
meat	coconut	vegetable oil
Brazil nuts	molasses	postum
walnuts	most vegetables	white sugar
peanuts		syrup
legumes		tapioca
corn		tea

In addition, various alternative practitioners such as Edgar Cayce and Bernard Jensen have referred to acid and alkaline-*forming* foods, based on the reaction of foods in the body. These categories are shown in Table 4[9].

TABLE 4. Acid and Alkaline Forming Foods[9]

Acid-Forming Foods	all meat, poultry, eggs, and seafood
	all foods made from cereal grains, including breads, breakfast cereals, crackers, pasta, and rice
	fat, including salad oil, butter, margarine, lard, etc.
	legumes, including beans, peas, lentils, and peanuts
	fruits containing benzoic or oxalic acid, including prunes, plums, cranberries, rhubarb, and sour cherries
	chocolate
	coffee, tea, and most soft drinks
	sugar, syrup
	all true nuts
Alkaline-Forming Foods	all fruits except those noted above
	all vegetables except beans, peas, and lentils
	dairy products, including milk, buttermilk, cheeses, and yoghurt

The terms acid or alkaline *ash* and acid and alkaline *forming* are often used interchangeably, but as can be seen from these tables, the terms are not always synonymous.

Using the more scientific definitions, alkaline ash foods are those that contain large quantities of magnesium, calcium, potassium and/or sodium, minerals that form alkaline compounds. Most fruits and vegetables are considered alkaline. Acid ash foods are those that contain chloride, phosphorus, or sulphur, minerals that form acid compounds. These acid ash foods include meat, fish, poultry, legumes and grains, which all contain high levels of phosphorus, and mustard and eggs, which contain sulphur. In addition, the fruits, plums, prunes, cranberries, rhubarb and sour cherries are also acid-forming since they contain either oxalic or benzoic acid, organic acids which are not completely broken down in the body[5,7,8].

Individual digestion and metabolism also plays a role in determining whether a food leaves an acid or alkaline residue. For example, certain foods containing organic acids, such as citrus fruits and tomatoes, which normally leave no acid residues, may be incompletely metabolized in some people and are acid-forming for these individuals. This is quite frequently the case where stomach acid is low or thyroid activity is subnormal[5].

There are other metabolic and life style factors which affect the acidity of the body and the reactions of foods. Infection, smoking, and alcohol consumption tend to make the body more acid[5,10]. Conversely, exercise will tend to make the body more alkaline, but if continued beyond a comfortable level it can become acid-forming, as lactic acid levels build up[1,5]. Furthermore, the dietary content of trace elements also affects acid-alkaline balance. Adequate magnesium and phosphorus are necessary for cellular pumps. Zinc is necessary both for secretion of acid in the stomach and for excretion or retention of acid

by the kidney. In addition, many other nutrients, the B vitamins as an example, are necessary to completely oxidize carbohydrates and fats.

It has been recommended by Edgar Cayce and others that the diet be comprised of 80% alkaline-forming foods and 20% acid-forming ones. In more practical terms, the recommendation was four vegetables and two fruits to one starchy food and one protein food[9]. It is not clear whether these proportions apply for all people. By contrast, Dr. Weston A. Price found that the traditional diets of the healthy primitives he studied were higher in acid ash foods than in alkaline ash foods. (see *From the Archives,* page 10.) The traditional diets were higher in minerals than the more processed modern diets[11]. Dr. Price's research confirms the importance of nutrient-dense, unrefined, properly prepared foods.

Moreover, genetic differences may play a role in what constitutes an appropriate balance in the diet. For example, it is known that Eskimos handle fats far more efficiently than other populations and do not suffer from ketosis from very high fat consumption as other groups do[12]. The fact that Cayce's recommendations seem at odds with those of Dr. Price can be explained by the fact they were aimed at a different population group, living in a different climate with a different level of activity.

In people of European descent in the U.S., manipulation of the acid or alkaline nature of the diet has been used along with other measures to treat disease conditions, particularly dental caries. Dr. Harold Hawkins, a professor of dentistry at the University of Southern California in the 1940s, studied the effects of foods on the pH and mineral content of the saliva, urine and bloodstream. Dr. Hawkins found that the pH and mineral composition of the saliva and urine were affected by diet, but that the pH of the bloodstream was more influenced by digestion and other metabolic and lifestyle factors.

As a result of his studies over many years, Dr. Hawkins was able to construct a diet that was adequate for most people and to treat those with dental problems and other disease conditions using primarily diets adjusted to balance saliva and urine chemistry. Like Dr. Price, Dr. Hawkins stressed the importance of animal protein and whole grains along with adequate fat and vegetable intake[5].

CONCLUSION

The acid-alkaline balance is an important factor in the health and functioning of the body. Diet is one factor that influences acid-alkaline balance both through the acid or alkaline forming nature of the foods that are eaten and through the nutrient content which affects metabolism. Nutrient-rich traditional diets provide the essential factors necessary for excellent metabolism, good acid-alkaline regulation, and optimal health.

[Editor's Note: A number of alternative practitioners today advocate a diet based primarily on fruits and vegetables, one that minimizes "acid-forming" foods such as meat, fish and grains. While the inclusion of fruits and vegetables in the diet is important for many reasons, including the fact that these foods provide alkalinizing minerals, for most people it is not necessary to minimize acid ash foods such as meat and whole grains in order to maintain acid-base balance. In fact, a diet in which these acid ash foods are absent can lead to deficiencies which undermine the body's ability to maintain the proper blood pH. Meat and other animal foods provide protein, red meats provide zinc, and meat and properly prepared whole grains provide phosphorus, all of which are needed for the regulation of acid-base balance. Fat-soluble vitamins found in organ meats, shellfish, and good quality butter help maintain the health of the lungs and kidneys, the two prime organs involved in acid-base regulation. Dr. Weston A.

Price's research indicates a nutrient-dense diet that supplies both alkaline-ash and acid-ash minerals in liberal amounts is key to the health of the entire organism, including the complex systems that regulate acid-base balance.]

References:

1. BedaniA, DuBose TD(1995). Cellular and whole-body acid-base regulation. IN: Fluid, Electrolyte and Acid Base Disorders (Arieff, AI and DeFronzo, RA, eds.). Churchill Livingstone. New York. p. 69-103.
2. Narins RC, Kupi W, Faber MD, Goodkin DA, Dunfee TD (1995). Pathophysiology, class and Uierapy of acid-base disorders. IN: Fluid, Electrolyte and Acid Base Disorders (Arieff, AI and DeFronzo, RA, eds.). Churchill Livingstone. New York. p. 104-198.
3. Berkow R, ed. (1982). Merck Manual (14th edition). Merck, Sharp & Dohme Research Labs, Rahwy, N.J. p. 945-52.
4. Beddoe AF (1984). Biological Ionization as Applied to Human Nutrition, Principles and Techniques. Agro-Bio Systems, Fort Bragg, Ca.
5. Hawkins HF (1947). Applied Nutrition. International College of Applied Nutrition. La Habra, California.
6. Shenker GR (1997). The Nutri-Spec Letter 8(7):l-6.
7. Rector FC (1973). Acidification of the urine. Handbook of Physiology Section 8: Renal Physiology (Orloff J, Berliner RW and Fieger S, eds.) American Physiological Society. Washington D.C. p. 431-54.
8. Ensminger AH, Ensminger ME, Konlande JE, Robsin JRK (1994). Foods and Nutrition Encyclopedia (2nd edition). CRC Press. Boca Raton, Florida, p. 6-7, 41.
9. Read A, Ilstrup C (1967). A Diet/Recipe Guide Based on the Edgar Cayce Readings. A.R.E. Press. Virginia Beach, Va.
10. Beisel WR (1990). Nutrition and infection. IN: Nutritional Biochemistry and Metabolism (Linder M, ed.). Elsevier. New York. p. 50742.
11. Price WA (1935). Acid-base balance of diets which produce immunity to dental caries among the south sea islanders and other primitive races. Dental Cosmos 1935:842-46.
12. Guyton AC (1980). Textbook of Medical Physiology (2nd edition). W.B. Saunders Co. Philadelphia, p. 457, 803, 853.