A chronic state of acidity (acidosis) within the fluids, cells and tissues of the body is linked by many naturopaths to poor health and the development of a wide variety of diseases including osteoporosis, kidney stones, arthritis and even cancer. This leads us to suggest that pH (or acid-alkaline state) of the body is one of the critical factors that determine our state of health and well-being.

It’s well known that the body has several very sensitive homeostatic mechanisms, including the kidney, that maintain a crucial balance in cell and tissue acid-alkaline levels. However, many factors in our lives, including diet and environment, challenge these systems on a daily basis leading to an established alternative view of a subtle state of sub-clinical cellular and tissue metabolic acidosis, which if left unchecked could contribute to chronic disease pathways.

A wide range of studies suggests that our diets can affect the body’s acid-alkaline balance. Traditional discussion is often centered on the acid or alkaline forming nature of food ash. A contemporary (and more accurate) understanding about the effects of different foods and drinks on the acid-alkaline balance in the body tissues assigns scores based on potential renal acid load (PRAL). This provides a simple way to determine the acid load of individual foods and entire meals. As eating is something we do on a regular basis it seems obvious that we can therefore use the diet to become your own pH master! Read on for more information about understanding body pH and its link to health and disease, as well as a comprehensive practical guide about the power of an alkalising diet.

**WHAT IS pH?**

We measure how acidic or alkaline something is using a pH scale, which records the amount of hydrogen or hydroxide ions that are present. Lower pH numbers (0-7) indicate higher levels of acidity (i.e. higher levels of hydrogen ions) whereas higher pH numbers (7-14) indicate an alkaline (or basic) pH due to greater levels of hydroxide ions reducing levels of hydrogen ions. pH is measured on a logarithmic scale where each one-unit change in the pH scale (0-14) corresponds to a ten-fold change in hydrogen ion concentration. The pH level of vinegar is about 2, which means that it is very acidic: in fact, 10 times more acidic (so 10 times the quantity of hydrogen ions) than orange juice, which has a pH of around 3, and 100 times more acidic than tomato juice, which has a pH of around 4. Anything with a pH of 7 is classed as neutral, and above that is alkaline. Seawater has a mildly alkaline pH of about 8, baking soda (bicarbonate) is 10 times more alkaline with a pH of 9, soapy water has a highly alkaline pH of around 12, and bleach is very strongly alkaline with a pH of about 13.

**WHAT SHOULD OUR BODY pH BE?**

Precise pH levels vary from person to person (but remain tightly regulated), and also from moment to moment throughout the day and night, depending on our experiences and how well the body is regulating our acid-alkaline response. There are also some variations within the body depending on what is most useful for the local function. The stomach, for example, needs a very strong acidic environment to kill off harmful bacteria, help to break down foods and activate gastric proteases (protein-digesting enzymes). Mucous membranes, such as found in the digestive tract, uterus, lungs and sinuses, are usually slightly acidic. The pH of skin is around 5.5, which is very different from many of the soaps and detergents we expose it to.

Most bodily tissues and fluids prefer to be just slightly on the alkaline side of neutral, however. Blood, for example, has a slightly alkaline pH of between 7.34 - 7.43; the body will prioritise keeping the blood to this pH as it is involved in so much vital activity. Healthy lymph fluid, which is part of the interstitial fluids that bath the cells and makes up on average around 12-15% of our body mass, is also slightly alkaline with a pH of around 7.4. Unfortunately, due to poor diets lacking in many essential nutrients and modern lifestyles some research suggests that the average pH of body fluids has become more acidic, for example some naturopaths suggest that the lymph pH of some adults is on average more acidic around pH6.2, changed from the more natural alkaline state of >pH7. This may have health consequences when you consider that “Lymph” in Greek means a pure, clear stream; a view held by many naturopaths who understand that healthy, flowing lymph is necessary to remove metabolic waste away from the cells and tissues whilst supplying them with oxygen and vital nutrients for optimal function, as well as having a role in immune system function.
HOW DOES OUR BODY MAINTAIN A HEALTHY pH?

The body has very intelligent ways of maintaining healthy pH levels. Firstly, we have bicarbonate, phosphate, and protein buffer systems that neutralise acids, for example by combining acids with alkaline minerals like magnesium, potassium, calcium and sodium. This prevents strong acids from building up and causing damage in the blood; lymph and tissue cells. The kidneys, in particular, take centre stage in neutralising acids by combining them with bicarbonate and other alkalis before eliminating them via the urine.

Breathing also helps us to alkalise, as we inhale oxygen and exhale acidic carbon dioxide. Finally, our skin eliminates acids through the action of sweating. All of these systems, especially the kidneys, keep a tight rein on controlling body pH, especially the blood.7

EXPLORING THE CONSEQUENCES OF CHANGES IN BODY pH

We can all agree that the body must, at all costs, operate at a stable pH, so any increase in internal acid load, for whatever reason, has to be neutralised by one of a number of homeostatic base-producing mechanisms.

It is also well documented that when acidosis (increased acidity in the blood and other tissues) is triggered, the body responses elicited to correct the pH creates a measurable increase in renal net acid secretion. In conjunction with this homeostatic response is a concomitant decrease in plasma bicarbonate concentrations.4 This state results in naturesis (increased sodium excretion in the urine), which in turn reduces blood volume (and increases viscosity), as osmotic forces drag water out of the blood circulation to dilute the urine.9 Once again, the body has a number of homeostatic systems in place, including the hormone aldosterone, to help balance fluid volume such as resulting from acidosis, but chronic perturbation of cell function and energy balance from persistent stressors such as pH imbalances will ultimately affect health.10 Could this state be linked to the traditional naturopathic understanding of ‘fluid stagnation’ whereby increasing body acidity and dehydration affects fluid movement and ultimately long-term health if left unchecked?

Traditional naturopaths suggest that as a result of modern dietary and lifestyle choices (e.g. smoking, alcohol, city pollution), low-grade chronic metabolic acidosis is now a common problem in many industrialised societies. Medical research agrees that there are a number of disease states that induce severe metabolic acidosis (e.g. renal disease) but some naturopaths recognise a more subtle sub-clinical rise in acidity within the body. This mild but chronic state is believed to indicate higher than optimal levels of acidity in the body tissues and that, in turn, may negatively impact on cellular function and health through disruption of biochemical pathways. This problem remains undiagnosed and even unrecognised by many in the medical profession but traditional naturopaths believe that these changes to tissue and cellular pH may induce or aggravate biochemical and physiological changes from chronic tissue stress.

HERE ARE SOME EXAMPLES TRADITIONAL NATUROPATHS SUGGEST MIGHT OCCUR IF LOW-GRADE, CHRONIC METABOLIC ACIDOSIS PREVAILS:

Osteoporosis

Raised acid levels in the body tissues may lead to hypercalciuria (high concentrations of calcium in the urine). Since calcium is a strong alkaline mineral and bone contains the body’s largest calcium store, metabolic acidosis has been suggested to cause a release in calcium from bones, as well as reduce renal tubular calcium resorption.11 Some studies have also shown that in humans, metabolic acidosis can increase 1,25-(OH)2 Vitamin D and decrease parathyroid hormone (PTH) levels, proposed to be part of the early homeostatic mechanisms employed in response to calcium imbalances.12 This suggests that metabolic acidosis may alter calcium levels and bone response in the body.

As a result of systemic calcium imbalance, osteoclastic (bone degrading) activity is thought to increase and osteoblastic (bone building) activity decrease. Some studies have shown that the net result of these changes is a reduction in bone density in order to neutralise the acidic environment of the body. The calcium stored in the bone is then excreted in the urine along with the acid it was mobilised to neutralise. These studies have shown this effect creates a negative calcium balance (i.e. more calcium is lost from the body than is replaced) and bone structure may be weakened as a result.13,14,15,16,17 One particular study showed a direct correlation between animal protein consumption, especially consuming more than 5 portions of red meat a week and bone fractures in women, in part due to the higher content of acid forming sulfur-containing amino acids found in animal proteins.18

Arthritis & Joint Problems

According to traditional naturopaths, another type of calcium misplacement in the body can occur when acidic toxins (suggestions include those derived from cellular metabolic waste, gut bacterial endotoxins or environmental toxins) accumulate in the joints such as fingers and toes, i.e. extremities in the body far away from the vital soft tissue organs including the heart. Some naturopaths believe that the body uses calcium to buffer the increasing acidity within the joints (i.e. calcium displacement) leading to stiffness and arthritic changes normally starting with the fingers and toes, leading onto wrists, ankles, elbows, knees then shoulders and hips19 with the order of body parts affected attributed to classic naturopathic empirical observations.20
Sarcopenia

Studies have shown that high acid levels in the body contribute to negative nitrogen balance (i.e. high concentrations of nitrogen in urine) and skeletal muscle protein breakdown as the body ages (i.e. sarcopenia). Glutamine is responsible for binding hydrogen ions to form ammonium. Since hydrogen ions are acidic, some believe that glutamine acts much like calcium to neutralise the body’s accumulating acidosis. Since skeletal muscle contains the body’s largest glutamine store, low-grade metabolic acidosis may contribute to muscle breakdown to liberate glutamine from the muscle. The amino acids from this muscle breakdown are then excreted, causing a net loss of muscle protein.

Endocrine Imbalances

In humans, serum insulin growth factor-1 (IGF-1) concentrations are decreased in response to metabolic acidosis, as well as a reduction in thyroid hormone secretion as characterised by slight decreases recorded in free T3 and free T4 and an increase in thyroid stimulating hormone (TSH) with the underlying potential to induce primary hypothyroidism.

Chronic metabolic acidosis has also been demonstrated to significantly increase glucocorticoid activity (e.g. increasing cortisol levels as characterised by hypercortisolemia) in humans, which may contribute to protein (muscle) breakdown and increase renal acid load, given the enhancing effects of glucocorticoids on renal acidification and renal tubular acid-base transport mechanisms.

Kidney Stones & Renal Disease

Clinical evidence demonstrates that many forms of kidney stones are calciferous, so in naturopathic terms this is another example of calcium misplacement (like the classical naturopathic interpretation of arthritis) potentially arising from chronic tissue pH imbalances. Organic citrates, used as carriers in some high quality food supplements to bind alkaline minerals like magnesium, may reduce the formation of kidney stones. Recent clinical studies have shown how manipulating the acid content of the diet and reducing potassium concentrations helps successfully manage cases of chronic kidney disease.

Cancer

A cancerous cell is known to produce more acid (e.g. lactic acid) from glycolysis energy producing pathways rather than aerobic respiration, which uses oxygen and nutrients to produce a plentiful supply of cellular energy. Cancer is a complex disease with many variations. Many naturopaths conceptualise this process to describe the final stage of chronic cellular changes, resulting from many different internal and external factors and complications including functional changes in cellular pH.

Ageing

It’s been postulated that low-grade metabolic acidosis may worsen with age (potentially contributing to development of one of the isolated conditions previously described). We could speculate that this is due to an age-related decline in kidney function and therefore ability to excrete acids. Some traditional naturopaths may also consider the increasing levels of acidic toxins (e.g. cellular metabolic waste and related dietary metabolites) that accumulate with advancing age, coupled with reduced detoxification (biotransformation of naturally created toxins and ingested toxicants) capacity and increased dehydration, which may contribute to age-related body acid load.

Many of these studies we’ve just discussed investigated cases of chronic acidosis or clinically induced acidosis. However, we can postulate that the body is most likely to move through preliminary stages of acidosis (i.e. low-grade metabolic acidosis) before entering a deeper level of acidity and pH imbalance – after all “we don’t catch chronic diseases, we create them by breaking down the natural defences according to the way we eat, drink, think and live” (Dr. Bernard Jensen, Natural Health Doctor 1908-2001). For the classical naturopathic approach this means regularly employing a few simple acid-base strategies to help support the optimal cellular function and consequently helping to maintain the health of tissues and organs such as bone, muscle, kidneys and beyond.

MEASURING BODY pH

There are varying opinions on what constitutes a healthy pH for different bodily fluids. Saliva is generally suggested to have an optimum pH of 6.4, but recently consumed foods and drinks, or even toothpaste may create a false pH reading. The ideal pH for urine is not so clear. Some argue the more alkaline the better; others caution that urine with a slightly acidic pH of 5.5-6.5 is a sign that the kidneys are effectively ridding the body of metabolic acids, and so an alkaline reading might suggest problems.

Gastric acid can be detected using a simple bicarbonate test or the Heidelberg stomach acid test using a capsule swallowed into the stomach to more accurately measure gastric acid levels. Traditionally, the pH of other bodily fluids, including the urine and saliva, is measured using pH paper and a measurable change in urine pH can be recorded when eating and drinking different foods and beverages. However, measuring the pH of the urine or saliva does not give a recording of the overall pH of the body tissues, cellular pH or acidity (or otherwise) of the blood. Naturopaths would say that urine, blood and sweat are all excretions and are therefore not an accurate indication of cellular pH; it’s essentially offloaded waste matter and, as such, is not a direct indicator of cellular pH.

So how can we measure cellular/tissue pH? In reality it’s incredibly difficult to accurately measure the pH (acidity) of specific body tissues. Current diagnostic methods reveal only that acid wastes are present in the body fluids (e.g. blood, lymph, urine, mucus, and saliva), but not in what quantity, because fluids are constantly circulating through the tissues removing excess acid wastes. This is where we can make use of taking and interpreting a case history to piece together information about lifestyle, symptoms and environment to help create a picture of how the person has arrived at their current health condition.
IS THERE A LINK BETWEEN DIET AND BODY pH?

Many traditional naturopaths consider the diet plays a role in influencing the pH levels in the body. What we consume (or not) on a daily basis, alongside lifestyle and environment, is believed to contribute to fluctuations in the acid-alkaline status; manipulating different foods - based on their digestibility, micronutrient composition, protein content, and a number of other factors - is a classical approach to helping positively influence the body’s acid-alkaline balance.33

When burned, foods are known to leave behind acid or alkaline ash, with the pH determined by the relative content of acid-forming components such as phosphate, sulphur, and alkaloids such as calcium, magnesium and potassium.34 In general, animal products and grains are acid forming, while fruit and vegetables are alkaline forming. Pure fats, sugars and starches are neutral because they don’t contain protein, sulphur or minerals. We will explore the acid-alkaline nature of foods in the “Measuring Acidity in the Diet” section.

However, as with any area of health and disease there are also scientific views that suggest body pH doesn’t change in response to external factors like food.35 For example, one meta-analysis study reviewed osteoporosis and dietary association studies and concluded that the change in urine calcium cannot be used to accurately represent calcium balance. Therefore promotion of an alkaline diet to prevent calcium loss from bone health is not justified.36 The same scientific group also carried out another meta-analysis on studies investigating phosphates (i.e. acids) and calcium balance in the body and concluded that phosphate intake does not contribute to the demineralisation of bone or increase bone-derived calcium excretion in the urine.37

Meta-analysis studies are a powerful but controversial tool, as even small violations of certain rules can lead to misleading conclusions; for example designing and performing a meta-analysis requires personal judgment, thus creating personal biases or expectations that may influence the result.38 Another common criticism of meta-analysis is that the analysis focuses on the summary effect, and ignores the fact that the treatment effect or study characteristics may vary from study to study.39 They are also inherently complicated to analyse in their own right potentially leading to error when interpreting results. Around a third of meta-analysis results differ to the mixed results.

There are also observational studies that do not show a correlation between dietary acid load, protein and bone mineral density (BMD) or fracture risk40, though these studies did demonstrate that magnesium, potassium, fruit and vegetable intakes were significantly associated with BMD.41 Some studies also contradict the effect of acid-forming diet on muscle health.42 One such study that has been used in the argument to denigrate the hypothesis about the effects of acidity on muscle tissues (and health in general) observed, “dietary protein does not always result in increased renal net acid excretion (NAE)” (i.e. kidney acid excretion). That is, the study could not provide conclusive data to show that protein intake did not affect muscle tissues, rather that in some individuals protein intake increased NAE and in others it didn’t. When you delve into the study content there is a lack of information about what constituted dietary protein and besides, NAE measures total dietary acid load not acid load of individual foods so this study was not able to delineate between the effects of different proteins, potentially contributing to the mixed results. Also, these types of differences are just what anyone who studies the holistic medicine would expect; everyone is individual (including their gut microbiomes, that facilitate digestion and excretion) in how they respond to dietary composition and the nuances of protein effects on NAE are going to vary between individuals.43 Also this particular study clearly states and agrees that “nutrition has long been known to strongly influence acid-base balance” with NAE corresponding to the composition of the subjects diet therefore supporting the hypothesis that acid-alkaline nature of food does indeed affect the tissues of the body.

What we’re really discussing here is the well-known fact that no science is perfect! Scientific studies and clinical trials investigating diet and its effects on health are notoriously difficult to control. There are many variables from the food composition to an individual’s digestive capacity and metabolism and their underlying health (i.e. cellular environment) at the start of a study. Whatever your philosophical approach and beliefs are towards health and body pH, several things remain clear; switching to a more plant based diet reduces acid-ash foods, as well as gluten and dairy, whilst increasing levels of alkaline forming vegetables and fruit rich in beneficial phytonutrients, vitamins and minerals and water. All of this is undeniably a positive improvement for health.44
In the past, scientists have looked for various techniques to try to quantify whether a food is acid producing or alkaline producing in the body. One method that was commonly used was ash analysis. Using this technique, a food would be combusted (thought to simulate what happens during digestion) and the ash would be analysed to determine how much of the food was alkaline and how much was acid.

When examining the micronutrients present in many foods Hermann Aihara in his seminal book “Acid and Alkaline”44 found that:

- Acidic foods included chloride, phosphorous, sulfates, and other organic acids
- Alkaline foods included minerals sodium, potassium, calcium, and magnesium

From this type of analysis, animal proteins (e.g. meat and dairy) are considered the most acidic; grains (such as wheat and rye) are more on the acidic side, unless sprouted in which case they become more alkalising; and vegetables, especially raw vegetables, and seaweeds are largely alkalising. Most fruits, including citrus fruits like lemon and lemon juice, produce an alkalising ash, but the excess of sugar fruits contain is suggested to potentially produce acidic conditions in the body, especially when consumed in large amounts.

However, this is where some confusion may lie. Traditional naturopathic understanding is that the food ash pH may have a direct effect on body tissue pH, i.e. have the ability to alkalise acid tissues. What’s important to remember is it’s not the pH of foods or drinks that has a direct impact on reducing metabolic acids and building alkalinity in the body.45 It’s the content of alkalising minerals (electrolytes) and buffering components such as bicarbonates or hydroxides (i.e. alkalinity) that neutralises acid.46 Remember, lemons, apple cider vinegar and carbonated water all have acid pH but some research suggest these liquids may have an alkalising effect on body tissues.

One of the best ways to alkalise the body is achieved by drinking ½ litre of fresh green juice with greens powder alongside fresh greens like spinach, kale, cucumber, celery, parsley etc. This will deliver about 2000mg of alkalinity in the form of a variety of alkalising mineral compounds. But here is the surprise; the pH of ALL fresh green juices, which deliver the most beneficial alkalinity, is acid (pH 5.8 to 6.8). So what neutralises acid is alkalinity and not pH; that is an acid beverage with the right minerals can be very alkalising!48

The ash analysis technique also has other limitations since simple food/ash analysis doesn’t take into account bioavailability of the nutrients in a given food. This means the acid-alkaline balance of the body after consuming specific foods may not accurately match the acid or base-producing estimate generated from the ash analysis. In other words, the ash analysis is a useful tool to identify acid or alkaline foods but we need additional information in order to understand how this food may interact with the body pH and to produce a naturopathic alkalisising diet programme. This was actually recognised by Aihara at the time of his research in the 1980s, who stated in his book that factors other than ash pH needed to be taken into consideration, such as looking at the bigger picture of what effect each food has on the body.

Remer and Manz developed a food-rating value system that they refer to as PRAL (potential renal acid load) and the NAE (net acid excretion) to give us a contemporary (and more accurate) take on understanding the effects of different foods and drinks on acid-alkaline balance in the body tissues.47 The NAE can be determined directly by measuring the acid and the ammonium appearing in the urine and then subtracting out the measured urinary bicarbonate. This method yields a NAE score based on direct measurements of the urine. This score, however, reflects total acid and alkaline load of a mixed diet and not the acid or alkaline load of the individual foods in the diet (see the point in an earlier section of this newsletter about a study investigating the variability of NAE only on muscle tissue health).

Assessing the PRAL provides a more detailed way to identify acid or alkaline load of individual foods and drinks; a bit like the difference between describing the effects of foods on blood sugar levels using the glycaemic index (GI; which measures the blood sugar raising ability of a particular food versus sugar) versus glycaemic load (GL; which measures the amount of carbohydrate in a portion of food together with how quickly it raises blood sugar versus sugar itself). PRAL assesses an estimate of the production of endogenous acid that exceeds the level of alkali produced for given amounts of individual foods ingested daily.49 The concept of PRAL calculation is physiologically based and experimentally validated in healthy adults. It also takes into account different intestinal absorption rates of individual minerals and of sulphur-containing protein (i.e. bioavailability), as well as the amount of sulphate produced from metabolised sulphur in proteins, food composition and the obligatory diet-independent organic acid losses. This method of calculation shows that under controlled conditions, acid loads and renal NAE can be reliably estimated from diet composition.51 In layman’s terms, this now means that researchers can analyse a food and, based on its components, determine what the true acid or base load on the body will be. Simply speaking, a positive PRAL score means a food contributes to the acid load whereas a negative PRAL score means a food has an alkaline affect in the body (Table 1).

Of course, the influence of diet and its effects on cellular pH and health will probably be debated for years to come. However, one approach that fits with centuries of classical naturopathic wisdom and expertise is to encourage an alkaline based diet alongside implementing and employing contemporary understanding of manipulating PRAL foods to affect cellular biochemical changes in order to support long term health and well-being.
Studies have compared the pre-agricultural diet of our ancestors to the modern North American diet. After evaluating the two diets for what they call NEAP (net endogenous acid production) - essentially the same measure as the PRAL - a -88mEq/day acid load was identified in the pre-agricultural diet whilst the modern diet was characterised by a +48mEq/day acid load. The conclusions we can draw according to this research is that many of our ancestors evolved eating a diet that was highly alkaline and low acid, i.e. more plant based than animal and grain produce as one would expect in hunter-gatherers as plants are easier to catch!

Conversely, there is an evolutionary study that suggests that 40-60% of the worldwide sample of historically studied hunter-gather populations may have actually had net acid producing diets but no record of the corresponding acidosis health problems. Opponents of the alkaline diet and health hypothesis use this study to suggest that the evolutionary argument for the importance of diet, body pH, health and disease does not stack up. However, the authors of this study did concede that their study parameters did not take into account the geography of the ancestral populations (which plays an important role in net acid production of the diet) and that Sebestien et al (2002) present a valid conclusion that “ancestral pre-agricultural hunter-gatherers consumed plant:animal subsistence ratios that yielded net-base (alkaline) producing diets habitually or at least for considerable periods of time during any given year.” In short, we can assume from evolutionary data that ancient hunter-gather populations had diets predominantly formed from alkaline forming foods.

Consider the evolution of our diets from the Paleolithic Age: modern living means that people are more likely to be eating processed foods, meat and dairy on a more regular basis, i.e. a diet that is high in acid, and therefore very different from what we evolved to eat. As a result, we suggest here that our modern diet is greatly responsible for what we believe is chronic low-grade, and pathogenically significant systemic acidosis.

How have these pH changes evolved? Well, the shift from net alkaline producing foods to net acid producing foods comes mostly as a result of displacing the high bicarbonate-yielding plants and fruits in the diet with high acid forming grains. Diets rich in diverse plant matter deliver important key nutrients, phytochemicals, fibres and alkalisising minerals like potassium and magnesium, as well as important elements like enzymes, whilst also having the favourable effect of alkalisising our body. Vegetables and fruit, along with other plant food sources like beans and pulses, are key to long-term good health.

In addition, most of our modern energy dense food selections are acid forming (PRAL positive scores) not to mention deficient in many vital vitamins, alkalisising minerals (e.g. magnesium and potassium), fibre and other health-promoting nutrients, as well as containing high levels of potentially harmful anti-nutrients like chemically altered fats and sugars.

Many of us have been brought up consuming high levels of meat, dairy, bread and pasta, with alkalisising vegetables struggling to find space on our plates. Sweets, pastries and caffeine add more to the acid load, with regular intake of tea and cake or daily puddings pushing us even more in the acid direction. So how can we halt this lifestyle induction of advancing cellular acidity?

You’ll be relieved to hear, the answer is not to stop eating everything acidic. The key word is balance. This may be a relief for those who are confused by the different acid/alkaline information out there. We need to address our diet and lifestyles to consistently bring things back into balance. The aim is not to totally banish acidic foods; rather we need to increase intake of more alkalisising/PRAL negative foods, make wiser choices about which acid-forming foods are most useful to us, and manage our increasingly hectic lifestyles to ensure our body has all the resources it needs to maintain a healthy body pH.

**UNDERSTANDING ACID/ALKALINE FOODS**

Data is taken from the USDA nutrient database – a full list of PRAL values can be accessed from the online database. A negative value means the food has an alkaline (base forming) load, a positive value means the food has an acid load. All values are per 100g (about 3.5 oz) of food. If you eat, for example, 200g of amaranth flakes, the PRAL value for the amaranth for your meal is 23.2 (11.6*2).

**ACHIEVING DIETARY ACID-ALKALINE BALANCE**

**CALCULATING YOUR DIETARY ACID LOAD**

You can use PRAL food scores to calculate the net acid or alkaline content of your diet so you can either make long-term changes or identify the times when you need balance, such as if you’re going to be eating a big meal that’s going to be a net acid producer.

Use the PRAL scores for individual foods in Table 1 to calculate a PRAL score for each meal. To do this, you simply record the amount (in grammes) of each food you eat in a meal. Then, divide your food amount by 100 (as PRAL scores are listed per 100g of food) and multiply by the PRAL score listed for that food.

For example, if you’ve eaten 250g of lean meat, your PRAL score for the meat will be 7.8 (score for 100g) multiplied by 2.5 (250g serving/100g PRAL lean meat score), or 19.5.

If you’ve also eaten 250g of potato, your PRAL score for the potato is -4 (score for 100g) multiplied by 2.5 (for the 250g serving) or -10.

In addition, if you’ve eaten 100g of spinach, the PRAL score for the spinach is -1.4 etc.

Tally up the total score of this meal, the net PRAL is 19.5 (meat), -10 (potato), -1.4 (spinach), giving an overall PRAL meal score of -4.5. This means a meal containing 250g lean meat, 250g potato, and 100g of spinach produces a PRAL of -4.5. In other words, the meal produces a net alkalinity.

After calculating the alkaline or acid potential of the meal, add more vegetables regardless of the final tally. Everyone can always benefit from more vegetables in the diet! You can also supplement your daily vegetable intake with concentrated greens powders to add an alkalisising daily boost to your smoothie or fresh juice.
TABLE 1: PRAL VALUES TO IDENTIFY ACID AND ALKALINE FORMING FOODS

<table>
<thead>
<tr>
<th>FOOD</th>
<th>PRAL values</th>
<th>FOOD</th>
<th>PRAL values</th>
<th>FOOD</th>
<th>PRAL values</th>
<th>FOOD</th>
<th>PRAL values</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GRAINS</strong></td>
<td></td>
<td><strong>FISH</strong></td>
<td></td>
<td><strong>NUTS &amp; SEEDS</strong></td>
<td></td>
<td><strong>OIL</strong></td>
<td></td>
</tr>
<tr>
<td>Amaranth flakes</td>
<td>11.6</td>
<td>Cod, white fish, cooked</td>
<td>6.8</td>
<td>Flaxseeds</td>
<td>2.1</td>
<td>Coconut</td>
<td>0.0</td>
</tr>
<tr>
<td>Barley</td>
<td>0.4</td>
<td>Salmon, oily fish, cooked</td>
<td>12.8</td>
<td>Pumpkin seeds</td>
<td>24.0</td>
<td>Flaxseed</td>
<td>0.0</td>
</tr>
<tr>
<td>Buckwheat</td>
<td>1.0</td>
<td>Mussel</td>
<td>4.7</td>
<td>Sesame seeds</td>
<td>17.7</td>
<td>Olive</td>
<td>0.0</td>
</tr>
<tr>
<td>Buckwheat whole-groat</td>
<td>-0.5</td>
<td>Tuna, deep water fish, fresh, cooked</td>
<td>8.8</td>
<td>Sunflower seeds</td>
<td>12.1</td>
<td>Pumpkin seed</td>
<td>0.0</td>
</tr>
<tr>
<td>Bulgur, dry</td>
<td>0.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Millet, raw</td>
<td>8.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oat bran, raw</td>
<td>16.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quinoa</td>
<td>-0.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice, brown, long-grain</td>
<td>2.1</td>
<td>Cheese, aged (e.g. parmesan)</td>
<td>24.7</td>
<td>Chestnut</td>
<td>-8.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice, white basmati</td>
<td>1.7</td>
<td>Cheese, soft</td>
<td>11.0</td>
<td>Hazelnuts</td>
<td>-1.9</td>
<td>Coconut milk</td>
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<td><strong>FRUIT</strong></td>
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<td><strong>EGGS</strong></td>
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<td><strong>VEGETABLES</strong></td>
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<td><strong>SUGAR</strong></td>
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<td>2.1</td>
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<td>Whole egg</td>
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<td>Tomatoes, red, ripe, raw</td>
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<td>10.2</td>
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<td>Lamb</td>
<td>11.5</td>
<td>Mung beans, mature seeds, sprouted, raw</td>
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<td>Bread, white</td>
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<td>Pork</td>
<td>13.6</td>
<td>Beets, raw</td>
<td>-5.4</td>
<td>Bread, wholewheat</td>
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<td>Turkey</td>
<td>9.9</td>
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<td>Lemons, raw, without peel</td>
<td>-2.3</td>
<td>Beer</td>
<td>0.9</td>
<td>Cabbage, chinese (pak-choi), raw</td>
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<td>Ice cream</td>
<td>-0.7</td>
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<td>Carbonated water</td>
<td>0.0</td>
<td>Carrots, raw</td>
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<td>Pasta</td>
<td>1.6</td>
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<td>Coconut water (bottled or canned)</td>
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<td>-4.4</td>
<td>Salami</td>
<td>11.6</td>
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<td>-3.6</td>
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<td>-0.9</td>
<td>Chard, swiss, raw</td>
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<td>-2.2</td>
<td>Filtered water</td>
<td>-1.8</td>
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<td>0.4</td>
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<td>Soybeans</td>
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<td>Dandelion greens, raw</td>
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<td>Kale, raw</td>
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<td>Tea, herbal</td>
<td>-0.2</td>
<td>Leeks, raw</td>
<td>-3.2</td>
<td>Chickpeas, cooked</td>
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<td>Strawberries, raw</td>
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<td>Vegetable juice, average</td>
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<td>Lettuce, green leaf, raw</td>
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<td>-2.0</td>
<td>Wine, red</td>
<td>-2.4</td>
<td>Onions, raw</td>
<td>-2.1</td>
<td>Lima beans, raw</td>
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<td>Dates, medjool</td>
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<td>Wine, white</td>
<td>-1.2</td>
<td>Peppers, sweet, red, raw</td>
<td>-3.4</td>
<td>Mung beans, mature seeds, raw</td>
<td>2.3</td>
</tr>
<tr>
<td><strong>MEAT</strong></td>
<td></td>
<td><strong>BEVERAGE</strong></td>
<td></td>
<td><strong>LEGUMES</strong></td>
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<td><strong>FREE FROM FOODS</strong></td>
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</table>

You may notice that the acid or alkaline nature of the majority of foods correlate between using PRAL scores or acid/ash forming hypothesis from Aihara’s work, though there are some discrepancies, which we will discuss in the next section.
WHICH FOODS ARE GOOD TO REDUCE OR AVOID?

Traditional naturopaths view most dairy products, caffeine and sugars as acid forming, including artificial sweeteners and fizzy drinks, though raw honey, molasses and maple syrup in moderation are classically considered less acid forming choices due to their mineral content. However, the PRAL values of sugars and cow’s milk (Table 1) indicate that they have a more neutral than acid-forming effect on the body and that ice-cream may even have an alkaline effect! However, we need to heed caution and remember the words of Aihara that factors other than ash pH needed to be taken into consideration, such as looking at the bigger picture of what effect each food has on the body. This is wise to follow when considering the highly deleterious effects excess sugar or processed dairy, in any form, can have in the body when consumed in large amounts. Processing of dairy products by homogenisation and pasteurisation and the levels of certain sugars and proteins such as lactose and casein in milk is believed by some naturopaths to present a digestive challenge for some people. Ice-cream contains a combination cow’s milk, eggs and sugar plus many other stabilisers and chemicals found in commercial products. Caffeine can also affect blood sugar and mineral balance for some people.

For this reason, refined sugar, processed foods, sugary drinks, alcohol, caffeine and processed dairy, especially cheese and including cow’s milk, are best avoided or at least kept to a minimum on a naturopathic nutrition programme.

Other animal protein sources, including meat, fish and eggs, also have positive PRAL values indicating high acid foods. Historically, naturopaths view pork as the most challenging animal protein for digestion due to its high fat content, followed by beef, lamb, chicken, and then fish. The PRAL scores indicate this to a degree but places chicken as a higher acid food than pork or beef.

What this information does reveal is that animal protein foods have some of the highest PRAL scores of any foods in our diet, so their inclusion often needs to be modified within a naturopathic nutrition programme. This may mean increasing alkaline foods (i.e. negative PRAL scores like vegetables) to counteract the high acid load found in animal protein foods or replacing animal protein with vegetable protein sources like nuts, seeds, pulses and legumes, depending on the intensity of the programme required and confidence and compliance of the patient in making dietary changes.
WHICH FOODS ARE GOOD TO INCREASE?

FRESH VEGETABLES AND FRUIT

Organic fruit and vegetables yield a wide range of plant nutrients and fibre, as well as alkaline minerals like magnesium and potassium, and water. At least 5 portions (but ideally as many as 8) of vegetable daily are recommended by current government guidelines with 3 portions being green vegetables; the chlorophyll content means these vegetables are particularly rich in magnesium, which is an important alkaline mineral for many areas of cellular function.

Even though most of us know about the government’s suggested Five A Day campaign, the National Diet and Nutrition Survey shows that 70% UK adults eat fewer than 5 portions of fruit and vegetables (or minimum 400g per day in five lots of 80g portions), let alone the recommended 7-9 daily portions that is now suggested to support health. Some foods are also labelled as being part of the 5 a day when in reality they are processed fruit juices high in sugar or beans covered in salty and sugary sauces negating the benefits that come from consuming the unprocessed, fresh plant or fruit and its associated fibre. In fact 29% of 10,000 adults recently surveyed said they did not eat fruit as way of contributing to their vitamin C intake but 22% of those drank fruit squash in the belief they were increasing levels of this essential vitamin, despite this being a sub-optimal source. This worrying set of statistics suggests that alkalising super-greens powders may play a positive part in the daily diets of those struggling to attain 5 portions of fresh plant matter every day.

GRAINS

We can see in Table 1 that buckwheat and quinoa are essentially neutral grains so can be included in an alkalising diet without substantially affecting the body’s acid-alkaline balance. However, many grains are traditionally viewed as mildly acid-forming foods, backed up by a range of positive PRAL values (Table 1). That said, certain grains may still play an important role in alkalising naturopathic programmes. For example, oats, which have the highest grain PRAL value of 13.3 or 16.9 for raw oat bran, is still an important grain for many people being rich in different types of fibre, vitamins, minerals and phytonutrients like beta-glucans.

Some naturopaths view a hierarchy of challenge in grains with the greatest challenge exerted by wheat > spelt > rye > oats > barley > rice > millet due to the different levels of anti-nutrients such as gluten, lectins and phytic acid, and not just based on acid-forming ability (Table 1). Wheat can be the most challenging grain in the diet for some people, despite having a lower PRAL value than oats; reduction or avoidance is therefore often suggested in naturopathic programmes. Some people fair better on gluten free grains or balancing intake of grains. Gluten free grains like brown rice also play a valuable role in many naturopathic diet by increasing dietary soluble fibre and water levels, as well as containing important vitamins and minerals.

In conclusion, grains (especially gluten free) can play an important part of a naturopathic alkalising and hydrating diet; for example, eating porridge oats for breakfast requires offsetting the acid-forming potential with more alkaline foods like fruit. Sprouting grains by leaving them to soak for a few hours in filtered water is also an ideal way to improve the nutrient quality and improve digestibility.

LEGUMES

Like grains, beans and pulses often play an important role in many naturopathic diets despite some of this food group exerting a potential increase in body acid load (Table 1). These foods are rich in vitamins, minerals and fibre, as well as being an important source of vegetarian protein. However, beans and lentils also contain other nutrients such as certain sugars that encourage the growth of fermenting (gas-producing) species of gut bacteria, which if translocated from the large to the small intestine may develop a condition identified as Small Intestinal Bowel Overgrowth (SIBO). For some people this can create great intestinal discomfort and contribute to symptoms of Irritable Bowel Syndrome (IBS). So whilst legumes can play a role in naturopathic diets – balanced with more alkaline-contributing foods (i.e. foods with negative PRAL values) - some people need to temporarily eliminate this food group (along with other foods containing FODMAPs) to improve digestive health and regulate colon health (therefore hydration) and eliminations.

NUTS & SEEDS

Nuts and seeds are important sources of amino acids, as well as vitamins, minerals and also essential fatty acids, though many nuts and seeds are heavy in omega 6 essential fatty acid, whilst not always delivering suitable levels of omega 3 essential fatty acids. They also tend towards high PRAL values, so are associated with an acid load in the body, and anti-nutrients like phytic acid, which can decrease the bioavailability of nutrients. That said nuts and seeds are still important in many naturopathic diets! Again, like grains and legumes, we just need to remember the balance in the diet. Enjoying a range of nuts and seeds and sprouting or soaking by leaving them in filtered water for a few hours is an ideal way to improve the nutrient quality, reducing levels of anti-nutrients, and improve digestibility.
As we’ve discussed, green vegetables are rich in alkalising nutrients that can neutralise acidity within the body (despite having a slightly acid pH).65 These nutrients include the alkaline minerals magnesium and potassium, important for many areas of our health as well as pH balance. Vegetables also contain many important groups of phytonutrients. One of broccoli’s claims to fame is sulforaphane, an organic sulphur compound also found in other cruciferous vegetables including Brussel sprouts, cabbage, cauliflower and rocket.

Sulforaphane has been shown to have antimicrobial properties, and research also shows it kills cancer stem cells, which slows tumor growth by increasing enzymes in the liver that help destroy cancer-causing chemicals. In fact this compound has even been called one of the most powerful anti-carcinogens found in food. This sulfur compound also normalises DNA methylation, which plays a role in a number of diseases, including hypertension, kidney function, gut health, and cancer.66

Sulforaphane also plays an important anti-inflammatory role and has been shown to protect the gastrointestinal mucosa from toxic insults by enhancing host defense systems against oxidative stress and by inhibiting mucosal invasion of anaerobic bacteria.67,68

Sulforaphane is produced when the enzyme myrosinase transforms glucoraphanin into sulforaphane. Glucoraphanin has been shown to have useful health benefits in its own right by reduce cholesterol.69 Chopping vegetables rich in glucoraphanin or chewing activates myrosinase raising the levels of available health-promoting sulforaphane: a good reason to carefully chew each mouthful of green veg! Raw or lightly steaming green vegetables also helps to increase the amount of bioavailable sulforaphane.70

Another important phytonutrient is diindolylmethane (DIM), obtained by digestion of indole-3 carbinol found in high levels in cruciferous vegetables like broccoli. Like sulforaphane, DIM has been shown to have multiple health benefits including boosting immune system function, reducing harmful oestrogen levels through stimulating liver detoxification pathways and anti-carcinogenic effects from enhanced liver detoxification as well as stimulating cancer cell death and halting growth of new blood vessels needed by cancerous tumours (angiogenesis).71

**BOOST YOUR JUICE!**

So how can you increase alkalising green nutrients in your diet? Firstly, increase your intake of vegetables by including daily dark green vegetables like broccoli, cabbage and rocket. Natural greens powders are also a popular way to increase the alkalising nutrient intake and boost a fresh juice. These powders derived from green vegetables like broccoli, as well as spirulina and chlorella contain concentrated levels of natural alkalising nutrients including sulforaphane.72 They are easy to use and provide a simple way of enhancing your daily alkalising programme.73

Juicing is believed to offer many health benefits including a faster, more efficient way to absorb beneficial alkalising nutrients naturally found in fruits and vegetables. Many commercial juices are processed and pasteurised so lack the complete spectrum of bioactive nutrients. It’s for this reason that freshly prepared juices are recommended during a naturopathic programme and beyond. Vegetables often contain less natural sugar than fruits so should provide the bulk of juicing produce. Green juices, including dark green leaves, cucumber and celery, are rich in magnesium and potassium. Beetroot with apple, and carrot with ginger are two other tasty combinations. There are different types of juicers – masticating juicers grind the fruit and vegetables producing a much drier pulp compared to centrifugal juicers so may offer greater nutritional benefits.

Smoothies are also a popular way to increase vegetable and fruit intake and can include beneficial fats such as those found in avocado. Fibre remains in the smoothie so there may be a different level of nutrient utilisation between these two types of drink. Many naturopaths would favour juices over smoothies but it’s often down to equipment availability. The important factor is to encourage increased daily intake of alkalising nutrients.
A NATUROPATHIC PERSPECTIVE ON BODY pH

We have described in great detail how many naturopaths believe the importance of the body’s acid-alkaline status is to health and disease. However, this can all too readily be overlooked, especially at the beginning of naturopathic programmes, when standard protocols and tests are often employed. We should always remember to address the basic question “what is the state of the cells and tissues that we are dealing with” in order to effect true changes to long-term health and vitality.

We should always respect the unique ways in which the body reacts when returning to a more positive and dynamic health status by drawing on the elegantly simple paradigms of elder naturopaths and not just rely on changing just one cellular factors like pH in isolation. We believe the following foundation phases should always be addressed to create optimal cellular health and empower the person back to long-term good health:

- Promote a well-hydrated, alkalised cellular environment by addressing fluid and pH balance as outlined in this newsletter.
- Reduce external and internal toxin exposure such as environmental pollutants, cigarettes and endotoxins derived from gut bacterial imbalances (dysbiosis).7
- Optimise pathways of elimination, in particular supporting liver and gut function, and reduce ‘cellular toxicity’ through established naturopathic detoxification support.6
- Address specific areas of disturbed homeostasis through a holistic approach including utilising an appropriate food supplement regime applied at the right time to work in harmony with the natural body rhythms.7

DESIGN YOUR OWN ALKALISING DIET

![PRAL Score Table]

<table>
<thead>
<tr>
<th></th>
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<th>Snacks</th>
<th>Drinks</th>
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</tbody>
</table>

Acidic Neutral Alkaline

![pH Scale]

1 2 3 4 5 6 7 8 9 10 11 12 13 14
Should you need a more detailed approach, or should you have any questions or concerns that are not addressed in this article, you are always welcome to contact our nutritional advice team on 0845 603 5675 (9.00am – 5.00pm Monday – Friday).

Alternatively if you would like a more personalised approach, addressing dietary recommendations, lifestyle changes etc., we would suggest you consider consulting a qualified nutrition adviser or therapist, which you can do by either asking us for details of your local practitioners, or contacting the Federation of Nutritional Therapy Practitioners on 0870 312 0042 or by emailing them at admin@fntp.org.uk.

For more information visit the website at: www.fntp.org.uk

This newsletter was co-written with and for Nutrigold by Dr Elisabeth Philipps PhD, a highly qualified and practicing Natural Nutritional Therapist and a member of the Federation of Nutritional Therapists. To find out more please visit www.hartwellnutrition.co.uk.

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47. Aihara (1989) Acid and Alkaline. George Ohsawa Macrobiotic Foundation