

Alkaline Water

A common view on health, especially in Asian cultures, is that the [root cause](#) of maladies and diseases is an “acidic” body, and that the key to good health and longevity is to achieve an “alkaline” body. One can purportedly become “alkaline” through diet and consuming “alkaline water”. There are entire industries based on this concept (such as [Kangen](#)), along with countless internet memes and articles. This month, we take a look at the evidence to see if the claims hold water.

What Is the Evidence?

The evidence most often cited is a finding by a Japanese doctor who supposedly tested 100 cancer patients, and found their blood to be acidic. From this he concludes that acidic blood is the root cause of cancer.

The skeptic’s rule is to always go to the primary source, which in this case would be the actual study. I could not find the doctor, the study, where it was published, whether it was reviewed or replicated - in fact, any trace of it.

For argument’s sake, let’s assume that the doctor existed, did the study, and the findings were real, essentially [conceding everything](#). Despite all this, the conclusion is still invalid. Even if every single patient had acidic blood, one cannot conclude that acidic blood *caused* the cancer. Correlation does not imply causation, and this type of study (retrospective observational study) can, by definition, only determine correlation.

Why is that? For example, maybe the acidic blood is a side effect from existing therapy. Maybe the acidic blood was *caused by the cancer*, and not the other way around. Correlation merely suggests a possible connection, yet the brain, hard-wired for pattern seeking and causality, often jumps the gun. Highly correlated events may have nothing to do with another, and events that are clearly causal may have no correlation. My favorite example: even in the days without birth control, the frequency of sex and number of pregnancies [have zero statistical correlation](#). Yet, to mildly understate, sex is the leading cause of pregnancy.

What Benefits Are Claimed?

With slogans like “Change your water, change your life”, what better way is there to make your body alkaline than by drinking alkaline water? The people marketing these machines make claims that sound vaguely scientific, but are either made up or meaningless. For example:

- “Micro-clusters” of water that the body can absorb more readily. This has never been substantiated and has [no basis in reality](#).
- “Oxidation reduction potential”. Although reducing oxidative stress sounds like a great thing, oxidation is a [complex system](#) that mocks our simplistic attempts at manipulation. Not that it matters anyway, as there is no evidence that electrolyzed water has any anti-oxidizing potential.

- Detoxifying/hydrating. This, I concede is true. Water hydrates, and your liver and kidney need water to remove waste. In fact, alkaline water works exactly like the tap variety, only more expensive.

In Search of the Truth (...And Shocking Human Experiments)

Is it even possible to have acidic or alkaline blood? The truth is that we all have alkaline blood, with a pH between 7.38-7.42. Below 7.35, acidosis occurs, above 7.45, alkalosis occurs. To have “acidic” blood (pH < 7.0) would mean that your whole body acid-base buffer, i.e., homeostasis, is broken. When that happens for an extended period of time, an unpleasant event will happen. It’s called “death”.

Since bad things can happen if blood pH wanders outside of this very tight range, I wondered, wouldn’t it be easier to kill someone by injecting acid instead of, say, cyanide? After all, anybody that has taken chemistry knows that it doesn’t take much to alter pH levels. I did [some research](#), and to my horror, someone actually tried that. In 1917, Van Slyke and Cullen, sadistically injected a large amount of sulfuric acid *directly into the bloodstream* of a poor dog. The dog not only lived, but surprisingly, its blood pH level did not change by much. Presumably emboldened by this experiment, many others have proceeded to test the body’s acid-base buffer with a variety of acids and alkali, not only in dogs and cats, but in humans as well. Thankfully we have [IRB](#) ethics reviews on human experiments now.

Why did the blood pH not change? It turns out that our lungs (and kidney) are very, very good at regulating pH. If the blood is too acidic, the body will

respond by increasing breathing; if the blood is too alkaline, the opposite occurs. It turns out, the easiest way to make your blood pH level higher, at least temporarily, is by hyperventilating. Not that you would want to do it; the reason people [hyperventilate into a brown paper bag](#), is to *prevent* your blood from becoming too alkaline.

Let's look at the claims that [certain foods](#) or water can affect blood pH. This is a patently absurd claim with no prior plausibility. All food passes through the stomach, which has plenty of hydrochloric acid – an acid strong enough to break down the stomach wall if we did not constantly produce protective mucus. It takes a very large dose of antacid to even temporarily neutralize the acidity, and normal food in normal quantity doesn't even come close. When food reaches the stomach, it becomes acidic; when it enters the intestines, it becomes alkaline.

What We Learned

Our bodies have a robust system (homeostasis) to regulate our pH, making it difficult to alter blood pH levels. It is both difficult and unwise to break homeostasis.

An “acidic” or “alkaline” body is an imaginary problem with no scientific basis. And how do you properly address an imaginary problem? Why, with an expensive pseudoscientific machine of course! (pardon the sarcasm) In short, skip the alkaline water machine and save your hard earned yuans.

We live in a complicated world, and instinctively yearn for simple solutions. Good scams exploit this inclination, [mixing common sense lifestyle advice](#) with a nonsensical, magical worldview. The best defense against scams, is always a healthy dose of skepticism.

碱性水

百病之源为“酸性体质”，长寿健康之钥为“碱性体质”是亚洲文化中关于健康的一个[常见观点](#)。根据这个观点我们据说可以经由特定食物及碱性水来改变成为“碱性体质”。围绕着这个概念有一整个产业（如 [Kangen](#)），以及无数的网络谣言及文章。这个月我们看看这个概念的证据能否禁得起考验。

有什么样的证据？

最常被引述的证据是一位日本医生，据说在测量了 100 位癌症患者的血液之后，发现他们的血液都是酸性的。自此他推论出酸性血液是癌症的罪魁祸首。

存疑者的定律是要追踪到最原始的资料来源，亦即这个原始的研究论文。我找了非常久，但没有找到这位医生，这篇论文，在哪里出版的，有没有经过同行评议或实验复制确认 - 没有任何踪迹。

即使我们[默认所有的前提](#)，也就是说有这么位医生，做了这么个研究，并确实有这个发现；他的结论仍然不成立。就算每一位患者都有酸性血液，这并不表示酸性血液 导致癌症的发生。相关性并不等于因果关系，而这类型的研究（回顾观察性研究）根据实验法则，只能确定相关性。

为什么呢？举个比例，也许，酸性血液是现有疗程的副作用。也许，酸性血液是癌症导致的现象(因果倒置)。相关性仅仅暗示一个可能的关联，但我们的大脑用既有的模式识别与因果推论回路，经常妄下定论。有高相关性的事件经常没有任何因果关系，而有因果关系的事件有时却显现不出任何相关性。我最喜欢的例子是：即使在没有任何避孕机制的年代，性行为的频率与妊娠的次数[没有任何的相关性](#)。但是，说得保守一点，性行为是造成妊娠的最大原因。

有什么宣称的益处？

打着“改变饮水，改变人生”这种口号，还有什么能比喝碱性水更能让人变成碱性体质的呢？行销这些机器的人提出一些听起来像科学性的声称，但实际上是杜撰或无意义的。比如说：

- 人体更容易吸收的“聚合水分子”。这个声明从未被证实，而且[没有任何科学依据](#)。
- “抗氧化势能”。抗氧化似乎是件好事，但实际上氧化机制是一个非常[复杂的系统](#)，简单化的操控未曾奏效。其实不打紧，因为没有任何证据显示离子化的水有任何的抗氧化功能。
- 排毒/补水。没错，这点我承认。喝水可以补充水分，而且肝脏与肾脏需要水分才能排除废物。事实上，碱性水和一般水龙头的水一样有效，唯一的差别是碱性水比较贵。

寻求真相 (... 和耸人听闻的人体实验)

血液究竟有没有可能是酸性或碱性的呢？真相是，我们的血液都是弱碱性的，pH 值介于 7.38-7.45 之间。低于 7.35，酸毒症便会产生；高于 7.45，碱毒症便会产生。真正的“酸

性血液”（ $\text{pH}<7.0$ ）表示你的自身酸碱动态平衡机制已经不正常。长时间下来，一个不良的后果会发生。那便是死亡。

既然血液酸碱值如果偏离这个非常窄的范围会有不良反应，我在想，那么要杀人的话，注射强酸不是比注射氢化物更容易吗？学过化学的人都知道，要改变 pH 值不是那么困难。我研究了一下，惊悚地发现有人居然[真的试过](#)。在 1917 年，Van Slyke 和 Cullen 残酷地将大量的硫酸直接注射到一条可怜的小狗的血管中。神奇的是，小狗不只没有死，牠的血液 pH 值并没有太大的改变。经过这番鼓励，许多人继续尝试使用各种的酸碱来破坏身体的动态平衡功能。不只是用猫狗，甚至用人体做实验。还好，我们现在有 [IRB](#) 来评估人体实验的道德性。

为什么血液的酸碱值没有变化呢？因为我们的肺（和肾脏）对于保持血液平衡非常，非常地有效率。假如血液太酸，身体会相应的加快呼吸；如果血液太碱则反之。要让自身的血液变碱的最佳方式，即便是暂时性的，是加快呼吸频率。但这并不是好事；当人紧张过度开始过度呼吸时，会用[纸袋盖住口鼻](#)循环呼吸的用意，是防止血液过碱。

我们再来检视[吃某些特定事物](#)或水可以影响血液酸碱的宣称。这个完全没有理论根据，甚至没有可能性。所有的食物都要经过胃，而胃里有大量的盐酸 – 如果不是常态性补充胃壁黏膜的话，胃酸的强度足以消化胃壁。要暂时性地中和胃酸需要足量的胃酸锭，远远超出一般分量食物的能耐。当食物到达胃就变成酸性，到达肠道就变成碱性。

我们学到了什么

我们的身体有一个有力的平衡系统来管制酸碱度，让血液酸碱度难以轻易动摇。要改变这个平衡不只困难，而且不是一件聪明的事。

一个“酸性”或“碱性”体质是没有科学根据，凭空想象出来的问题。那么要如何正确地解决一个想象出来的问题呢？那当然是要用一个昂贵的伪科学机器啦！（请原谅我的讽刺）简而言之，别把辛苦挣来的人民币浪费在碱性水机器上。

我们活在一个复杂的世界，直觉地寻求一些简单的答案。一个好的骗局会利用这个心态，鱼目混珠地将一些[合理的健康指南](#)混在无根据的、魔术性的世界观里。对抗这些骗局的不二法门，便是经常保持一个科学的怀疑态度。