Health and the Quality of WATER

Jaroslav Boublik explores the physical, chemical and energetic properties of various types of water, and argues that good water is not just about extracting impurities, but also about maintaining an energetic structure of the water molecules matching that found in the water from a spring-fed mountain stream. With this quality, the water we drink can perform its work in the body in the optimum way.

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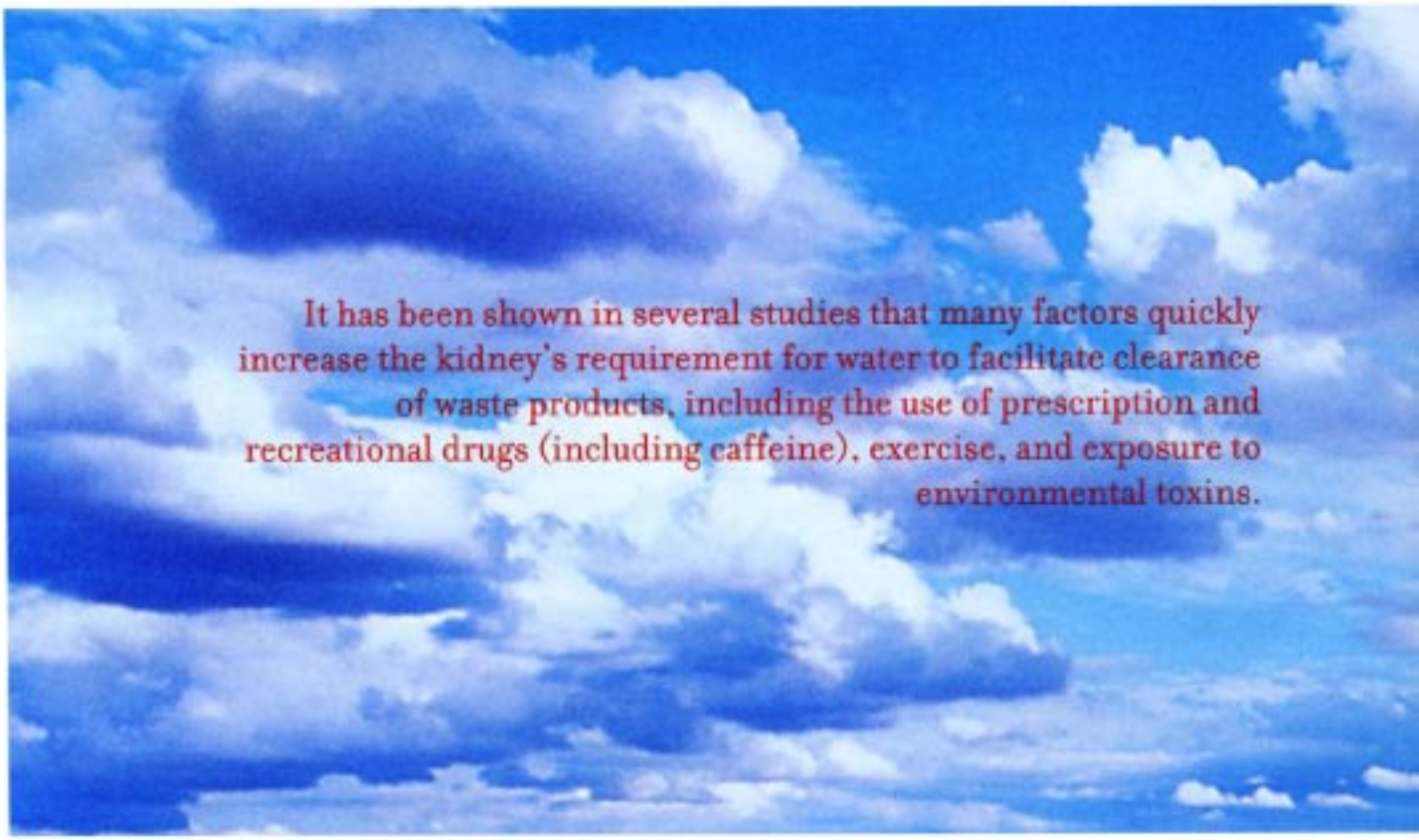
by JAROSLAV BOUBLIK

It is an essential component of all living things. It is a force that shapes the earth. It is a rarity in the universe yet abundant on this blue planet Earth. It is water – the key to life.

Unfortunately the importance of water for our day-to-day wellness is so often overlooked. Maybe it's because it is so ubiquitous and we take it for granted. Maybe it's because so many of us rarely drink plain water. Maybe because in this high tech world the sheer simplicity of just drinking more and better water is anathema to most people. In this article I want to consider some of the important questions that are so often asked about water. From the answers to these questions I hope to convince you that there is more to water than our everyday experience would have us believe.

HOW MUCH SHOULD WE DRINK?

Much has been said about the need to drink some set number of "glasses of water" a day. Articles have been published where that number is 12 and in a recent article from the United States, a medical professional said the number is zero as we get all the water we need from the food we eat![1] The usual standard is 8 but let's consider where this figure comes from. The average (adult but not elderly) 55 kg female is composed of about 32 kg of water. For a 70 kg male that figure is 42 kg. A component of that water is



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exchanged each day and if that woman or man is well but sedentary that component is about 2-2.5 litres and 3-3.5 litres respectively. That means this amount of water is excreted each day; 60% in urine, 5% in faeces, 5% in basal sweating and 30% in exhaled air. That water must be replaced and that will come as follows: 10% from the burning of carbohydrate fuel, 30% from ingested food and 60% from ingested fluids.[3]

On these figures it would appear that the baseline requirement is more like 5 glasses but this is baseline only. The figures will all vary according to factors including the amount of exercise (exercise increases respiration, metabolism and sweating), the ambient temperature (the hotter it gets the more you sweat), humidity (the more humid it is the less water you expire) and so on. In addition it has been shown in several studies that many factors quickly increase the kidney's requirement for water to facilitate clearance of waste products, including the use of prescription and recreational drugs (including caffeine), exercise, and exposure to environmental toxins. Taking all of this into consideration leads towards supporting 8 glasses a day as a good rule of thumb.

What is even better, however, is to let the body itself set the correct intake on a moment to moment basis by maintaining an accurate and effective thirst reflex. The thirst reflex has been discussed in detail in a previous article I wrote for *Diversity*[3] but put simply it is the mechanism by which our body regulates its water intake. The accuracy of the reflex is easily damaged but attention to appropriate intake of water over the long term will tend to maintain the integrity of the reflex and ensure that it's an effective regulator of water intake.

THE QUEST FOR PURE WATER

But how important is the purity of the water we should drink?

While water is on face value a simple molecule, composed of one oxygen atom bound with two hydrogen atoms (hence "H_2O"), it is in fact one of the most complex and remarkable compounds in nature. Water possesses many properties that, given its simple structure, are unexpected. Science knows much about water and volumes have been written about its importance in chemistry, physics, biology, geology, botany and economics and yet there are mysteries about water that are only now being unravelled.

My own interest in water began when, as a graduate student, I first entered a real laboratory. It was at Monash University Department of Chemistry and my honours degree project required me to make solutions in water of various copper salts and combine them with organic molecules to form copper complexes in a variety of beautiful blues and greens.[4] Of course the appreciation of the colours was scientifically defined using an ultraviolet-visible spectrometer so that precise measurements of the wavelength of maximum absorbance could be made. This gave a numerical value for the "exact colour" of each complex. Try as I may I could not match the literature values for one series of compounds and after

several weeks of work determined that the problem lay in the water I was using. Impurities of metal salts of chromium and iron in the water I was using were complexing with the organics and "contaminating" the pure solutions giving different results than expected. The problem was traced to a defective distillation apparatus and once rectified the correct results quickly followed. The success of the experiment all came down to the purity of the water.

Several years after my first experience with the importance of pure water in a laboratory setting a new technique I was using upped the ante. I was completing my PhD studies at Prince Henry's Hospital Medical Research Centre (now Prince Henry's Institute for Medical Research) and using a new technique for isolating biomolecules – high performance liquid chromatography.[5] Again the measurement instrument was an ultraviolet-visible spectrometer but this time much more sensitive and working at much lower wavelengths. After many months of poor results it became apparent that the quality of the water I was using for both sample preparation and to do the chromatographic separation was the culprit.

CLUSTERS OF MOLECULES

I began to realise that water is a difficult substance to obtain in its pure form, and that this arises from one of water's important characteristics – the tendency to form chains, clusters and higher order structures. In liquid water, the individual H_2O molecules associate to form clusters in sizes ranging from six to hundreds of molecules.[6] This is because the hydrogen atoms attach to the oxygen atoms in a precise arrangement with the two hydrogens at 107° to each other – looking rather like a set of Mickey Mouse ears.

This arrangement means that, while each water molecule is electrically neutral (with the singly positive hydrogens neutralising the doubly negative oxygen) there is an uneven charge distribution on the water molecule. This gives a slight negative charge in the region of the oxygen and a slight positive charge on the side nearest the two hydrogens. This uneven charge distribution allows one of the wonders of nature – the hydrogen bond – to occur.[7]

Hydrogen bonds arise from the slight positive charge on one water molecule attracting the slight negative charge on another and allow chains, networks and even three-dimensional lattices to form. The hydrogen bonds hold water together in structures giving rise to characteristics such as surface tension and the ability of water to wrap around other molecules in "hydration sheaths".

Water can be thought of as a "liquid crystal" and just as solid crystals can trap other atoms so water can lock impurities into cages from which they are difficult to break free. These structures can also hold electrical charge in the form of isolated ions, and are also responsible for many of the important but unexpected characteristics of water such as its ability to reduce its density upon solidification resulting in solid ice floating on liquid water.[8]

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METHODS OF PURIFICATION

The challenge of purifying water is to break down the structure to allow impurities to be removed. In distillation this is done by boiling the water which breaks apart the structures to individual H_2O molecules. These rise and are condensed elsewhere, usually on some cooled surface, where they reassociate into larger order structures, to be collected as "pure" water leaving the impurities behind in a concentrated "soup". Other purification methods have the same aim. Reverse osmosis uses membranes that only allow small clusters, too small to carry impurities, to pass through. Ion exchange and activated carbon cartridge filters depend on the attraction between the filter matrix and the clusters containing impurities, which have different properties to the pure clusters without trapped impurities. Water purifiers that depend on "ionisation" methods use a strong electric field to electrically break down the structure of the water to facilitate the removal of impurities. "Depth" filters (such a sand filters used in swimming pools) and sizing membranes (such as those used to generate sterile water for medical use) simply sieve out the larger clusters that wrap around large impurities such as particulates and bacteria.[9]

In the lab at Prince Henry's I discovered that the contaminants were plasticisers from the large polyvinyl vessel in which the water was being collected from the distillation apparatus. The solution was a second level of purification using an activated carbon filter followed by a silica cartridge to remove the two kinds of contaminated clusters. Last I subjected the water to high vacuum and pumped out all of the dissolved gases. Very soon my experiments began to work and as long as I used freshly prepared "ultrapure" water all was well. I quickly understood that very pure water was "hungry" to absorb new contaminants from the air or from the glass containers and could not be stored for long.

One day I thought it would be interesting to taste this "ultrapure" water and to my surprise it tasted very poor – flat and rank like water from an overboiled kettle. Of course that is exactly what should be expected of water with no dissolved gas, particularly oxygen, but I didn't understand the real nature of the flat taste until several years later.

THE BODY'S NEEDS FOR WATER

In 1994 I left academic research to start a company – AquaConneXions Pty. Ltd. and to pursue what had by then become a passion for research into hydration, that is, the body's ability to manage water (the story of hydration is also covered in my earlier *Diversity* article).

During this time I was drawn to look more deeply into the question of what water really does in the body, how much we need to drink and which water is best to drink. Water has several roles in the human body.[10] It gives structure and form to cells and tissues. It provides the medium for movement of heat from the core of the body to the surface. It is the matrix within which occurs all of the biochemical reactions that

together make up cellular metabolism. Last, it is the transport mechanism for all internal movements of all nutrients and biomolecules, exchange of nutrients between the environment and cells and clearance of waste products. Therefore supplying the body with sufficient high quality water to satisfy all of these requirements should be the goal. But what kind of water and how much?

ENERGETIC NATURE OF WATER

Until I began to really study water my understanding of water was that of a typical biochemist. I understood the basic physico-chemical properties of water and, as I have described, had several occasions to question the purity of the water I was using in the lab. I understood a little of the higher order structure of water but didn't really understand the full implications of what that structure might mean. My reading now took me into a new area – the energetic nature of water. I soon realised that this was really important to hydration.

The structure of water does more than give it surface tension and act as a net to hold impurities. The same structure allows water to carry all kinds of molecular "signatures" and energetic "information", and it has been theorised that this feature forms one of the bases of how homoeopathy works.[11] (Recent studies suggest that there are some anomalies in homoeopathic preparations where specifically shaped clusters created by the "succussion" process may in fact concentrate the dissolved signature molecules).[12] The structure of water also allows water to carry a quality that has been termed "life force" or "vital energy".[13] This may equate to the "chi" of Chinese medicine or even the "kundalini" of Indian medicine. Many techniques have been used to energise water and these are discussed below. All of them work to some extent to "restructure" the water into molecular arrays more akin to the structure found in water in nature – the spring-fed mountain stream being widely characterised as the "ideal".

Why is it that these energetic characteristics are so important to hydration? There are several reasons. First, energetic water displays low surface tension as a direct consequence of its small cluster size. Low surface tension allows water to have greater "wetting" capacity and so it does a better job of dissolving other substances and making them available for transport as solutions. This is important in moving nutrients and waste products around the body – one of water's essential roles in maintaining optimal hydration. Low-surface-tension/small-cluster-size water also penetrates membranes more easily. Water moves around the body by passing through membranes. The movement of a cluster of water molecules from the gut to its final point of activity sees the cluster pass through up to a dozen membranes. In some cases these processes are actively pumped – where there is a specific mechanism to move the water from one side of the membrane to the other – and in others the mechanism is passive driven, by osmotic gradients or passive diffusion. The variety of mechanisms and the factors that switch between them are beyond the scope of this article but are well reviewed elsewhere.[14]

The importance to the hydration process of several of water's other characteristics are more difficult to pin down.

ACID OR ALKALINE?

One characteristic, pH – the relative concentration of hydrogen ions versus hydroxyl ions – has been touted as an essential characteristic of the ideal water. The problem is that there is not general agreement as to what the ideal pH is of the water you should ideally drink. "Pure" water is neutral and has a balance of free H^+ and OH^- ions. This equates to a pH of 7.0. Most of the biological fluids in the human body, e.g. blood serum, are pH 7.4 – slightly alkaline – and it is known that in people where this value changes significantly, such as with systemic acidosis where the pH may drop by several units, and remains altered

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long term, there are many negative consequences.[45]

For this reason many natural therapists promote diets and activities that promote "alkalinisation" or a move to higher pH. Consumption of alkaline water (sometimes at very high pH) is promoted as a method of alkalinisation but to my knowledge no studies demonstrate this conclusively. There is no doubt that mildly alkaline water may have some useful properties but the large volume of acid present in a healthy stomach would quickly buffer and neutralise all but the most extremely alkaline water. On the other hand acidic water has been shown to be useful when applied on the skin surface to manage skin diseases and counteract the effect of alkalising detergent and soap products. Again, consumption of acidic water would be quickly buffered by the acid in the stomach and neutralised by digestive secretions during its passage through the gut. The consumption of extremely acidic or alkaline waters may be associated with gastric disturbance.

CONTAMINANTS

Another measure often used to indicate the fitness of water for consumption is its electrical conductivity or resistivity. This is simply a measure of the amount of ions present in the water that will allow the water to conduct (or resist) the passage of electric current. What is probably more important than the actual measure is the nature of the ions which are

contributing to the conductivity and whether they represent beneficial or dangerous "contaminants".

On the question of contaminants present in water I don't have the space here to address this important environmental and wellness issue. If a full review of this subject is required I would recommend John Archer's book *The Water You Drink*.[16] Suffice to say that our water supplies are contaminated by a large range of substances ranging from metal ions through organic compounds to bacteria. Some are beneficial in certain circumstances but many are to be avoided and so I believe the water you drink should be subjected to some kind of purification prior to consumption.

SO WHAT WATER SHOULD WE DRINK?

The presence of contaminants means that tap water falls short of our requirements for purity and energetic integrity. The purity issue must also be considered when using water collected in tanks, from outdoor sources and rainwater. The potential for contamination is very high despite the fact that these waters may be energetically better than tap water. There have been some questions asked about the purity of bottled water but for the most part they far surpass tap water. Unfortunately with very few exceptions they are energetically "dead" and therefore contain water with large clusters, which displays high surface tension. The exceptions are some specifically structure-modified waters where, via a range of techniques, the large clusters are reduced to smaller rings (6 or even 5 water molecules maximum).[17] Long term stability of these small clusters is at question as is the inherent stability of five-molecule rings. One particular bottled water I have examined, a spring water from New Zealand, displays many of the desired characteristics of a pure energetic water and this is in keeping with features of its production and packaging which the manufacturers claim maintain the integrity of the water structure.[18]

The last choice is water purified in situ via the use of a water filter. The variety of water filters on the market is bewildering and it seems that each week another player enters the market. However, because it is such a complex issue and raises so many important questions in the quest for the ideal water, there is not enough space in this article to do justice to the issue, so this will be subject of a separate article in a forthcoming issue of *Diversity*.

Energetic water displays low surface tension, so it does a better job of dissolving other substances and making them available for transport as solutions. This is important in moving nutrients and waste products around the body.

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References

1. Carey, B., "Eight glasses a day? Rubbish", *The Age*, 30 April 2001. Today section, p. 4.
2. Greenleaf, J.E. & Morimoto, T., "Mechanisms Controlling Fluid Ingestion - Thirst & Drinking", in Buskirk, E. R. & Puhl, S.M. (eds). *Body Fluid Balance*, CRC Press, Boca Raton, 1996.
3. Boublik, J., "Hydration Equation", *Diversity - Natural and Complementary Health*, Vol. 3, No. 3, pp. 20-24.
4. Boublik, J., Monash University Department of Chemistry Honours Thesis 1980, pp. 31-40.
5. Lim, A.T., Lolait, S.J., Barlow, J., Autelitano, D.J., Toh, B., Abraham, J. Johnston, C.I., Boublik, J.H. & Funder, J.W. "Immunoreactive arginine vasopressin in the Brattleboro rat ovary", *Nature*, Vol. 310, 1984, pp. 61-64.
6. Coates, C., *Living Energies*, Gateway Books, Bath, 1996, pp. 108-111.
7. Lehninger, A.L., *Biochemistry*, Worth, New York, pp. 39-43.
8. ibid. pp. 44-51.
9. Archer, J., *The Water You Drink*, Pure Water Press, Pearl Beach, 1996, pp. 83-98.
10. Taylor, P.N., Wolinsky, I. & Klimis, D.J., "Water in Exercise and Sport", in Driskell, J.A. and Wolinsky, I. (eds), *Macroelements, Water and Electrolytes in Sports Nutrition*, CRC Press, Boca Raton, 1999, pp. 93-108.
11. Gerber, R., *Vibrational Medicine*, 2nd edition, Bear & Co, Santa Fe, 1996, pp. 77-89.
12. Shashadhar Samal & Geckeler, K., "Unexpected solute aggregation in water on dilution", *Chemical Communications*, 2001, p. 2224.
13. Cater, J.H., *The Awesome Life Force*, Cadake Industries, Winter Haven, 1984.
14. Zeuthen, T., *Molecular Mechanisms of Water Transport*, Springer, Heidelberg, 1996.
15. Senay, L.C., "Potassium in Exercise and Sport", in Driskell, J.A. and Wolinsky, I. (eds), op. cit. (Ref 10), pp. 155-156.
16. Archer, J., op. cit. (Ref 9).
17. Pentahydrate website: http://www.pentahydrate.co.uk/faqs.html#1
18. Eternal Springs website: http://www.eternal.co.n