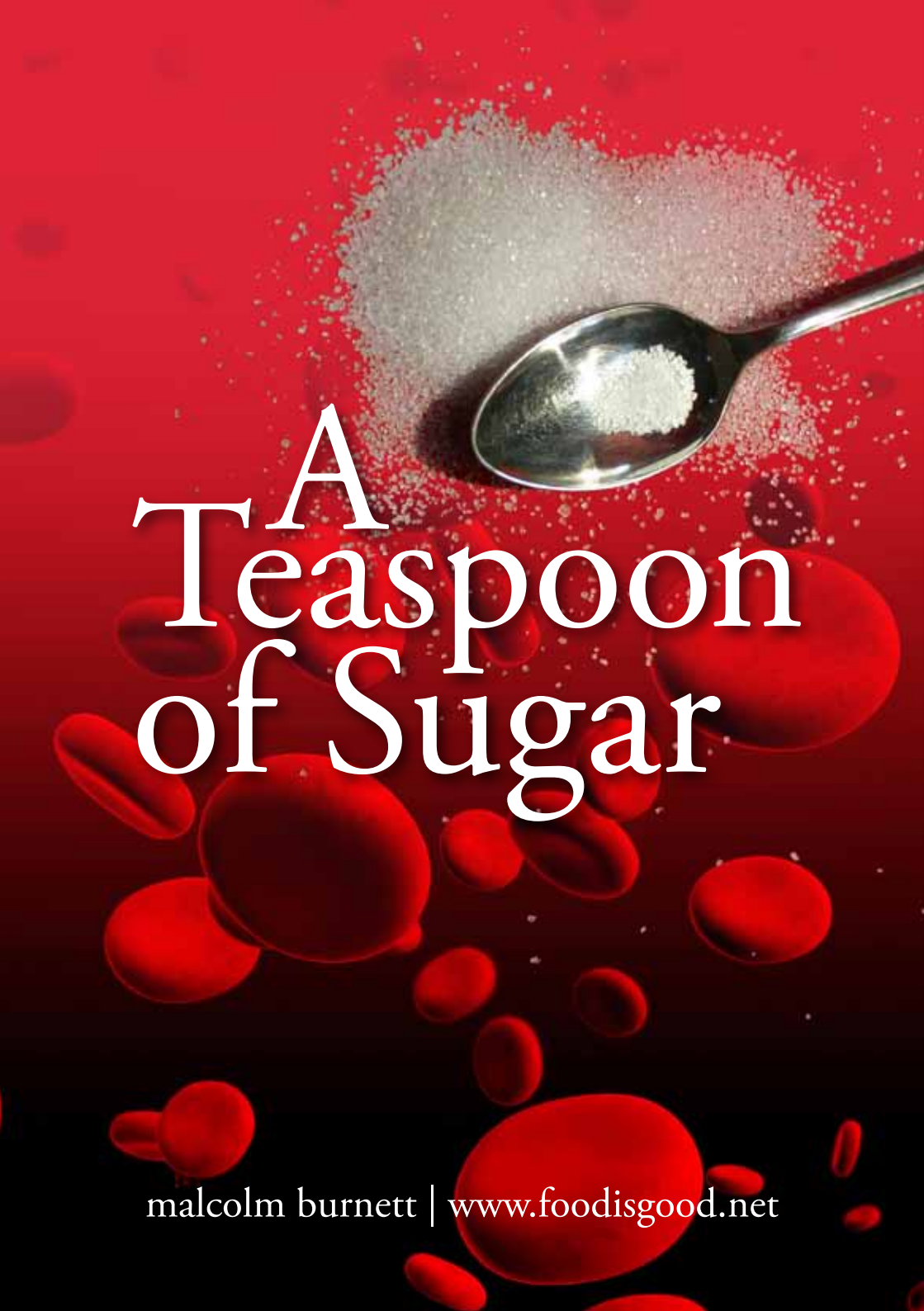
A Teaspoon of Sugar
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Inhale

From the moment I picked up your book until I laid it down
I was convulsed with laughter. Someday I intend reading it.

Groucho Marx, 1880–1977

Many people view any connections between food choices and our health and well being similarly. Eventually we find ourselves at the brink of the eternal abyss and wonder whether a few nutritional insights along the way may have enhanced our quality of life and extended our sojourn before eternity beckons. Our food has profound effects on how we feel and function and *A Teaspoon of Sugar* will help you understand how to get more pleasurable benefits from the foods you enjoy.

Food is enchanting nourishment for our palate and body, yet with access to so much variety our food choices are being dominated by the sweet and the bland. We are being overwhelmed by more sugar than we are physically using as each of us tries to maintain a dynamic balance of around a teaspoon of sugar in our blood stream.

How our bodies respond to different sugars varies:

- Sugar is a clean, efficient fuel for our brain and muscles.
- Sugar can increase our appetite.
- Sugar can increase our blood pressure.
- Sugar can increase our resistance to the hormone insulin.
- Sugar can increase our cholesterol levels.
- Sugar complexes in some common foods can cause bloating and diarrhoea
- Sugar can accelerate the ageing effects of oxygen.

From the moment we inflate our lungs with their first sample of air we have an insatiable need to breathe. Our mother no longer breathes for us and life forever becomes as tenuous as our next breath. Food provides the raw energy for us to burn the oxygen we inhale as it permeates our body with each breath. When we breathe out, the tide of air carries some of the carbon remnants of our digested food, like ash from a fire. Instead of ash the carbon is returned to the air around us in our breath as carbon dioxide.

Oxygen provides up to two thirds of our body weight[1] and the vitality it floods our being with comes at a price. It eventually overwhelms us and by the time we are 80 years of age oxygen will have modified 80% of our body proteins[1]. Many of these effects come from the actions of oxygen and excessive sugar in our blood stream. Fortunately the world of colourful foods offers many pathways that help to slow the ravages of oxygen.

We all have a lifelong relationship with food and whatever our preferences, good food is one of life's sustaining pleasures.

A Teaspoon of Sugar

The universe would be nothing were it not for life and all that lives must be fed

Brillat Savarin: The Physiology of Taste

Our blood is a busy fluid and maintaining around a teaspoon of sugar in our blood stream is a dynamic balance in sharing the limited space available. Around half of our blood is water carrying all the joyriding molecules and specialized structures to all the vital reaches of our body.

Sugar is relatively easy for our body to digest and use or store for use another time. The easy delivery of sugar in our blood enables us to think with clarity and move quickly. Sugars are very versatile and our body uses them in a variety of useful ways.

Much of their versatility is because sugars are rich in oxygen and readily form attachments with a range of other molecules throughout our body. Sugars aid communication between cells and help our immune system by attaching to microbes that we inhale, swallow or encounter in our blood stream through cuts and abrasions. Sugars form complexes with water and proteins to keep our mucous membranes like our eyes, lungs and mouth moist and slippery.

It is when we view sugar as a source of fuel for the oxygen we inhale that our predilections for this versatile molecule can become unbalanced. It is the disparities between what we need and the quantities we consume that affect our internal environment.

The amount of sugar in our blood stream may drop to around three grams when we are hungry and increase to around eight grams while digesting a meal. That total variation is only a teaspoon of sugar in itself, which is phenomenally efficient when we consider the demands of providing fuel for our physical activities.

Our blood stream does not store sugar and there are limits to how much sugar our brain and muscles can use before we store any excess as fat.

Where does the sugar come from?

A small variety of grasses that feed most of the 7 billion people on Earth store the energy of sunlight in their grains as tightly packed strings of sugars called **carbohydrate**. These sugars physically occupy around two thirds of each grain which is similar to the level of sugar in jam. Having so much energy in the form of sugar bound up in such small packages is what makes grains so useful.

Sugar makes up most of the raw material food processing companies use, because it is cheap, plentiful and versatile. Sugar adds to the palatability of our food and drinks and increases product sales.

For many of us the colours, aromas, textures and flavours of real foods have been replaced by chemicals added to the processed foods we consume. The more we accept and relate to these 'brand standardized' aromas and flavours, the more comfortable we are choosing them as 'food'.

The branding and marketing of sugared products is targeted to our susceptibilities, behaviours and preferences regardless of their nutritional value.

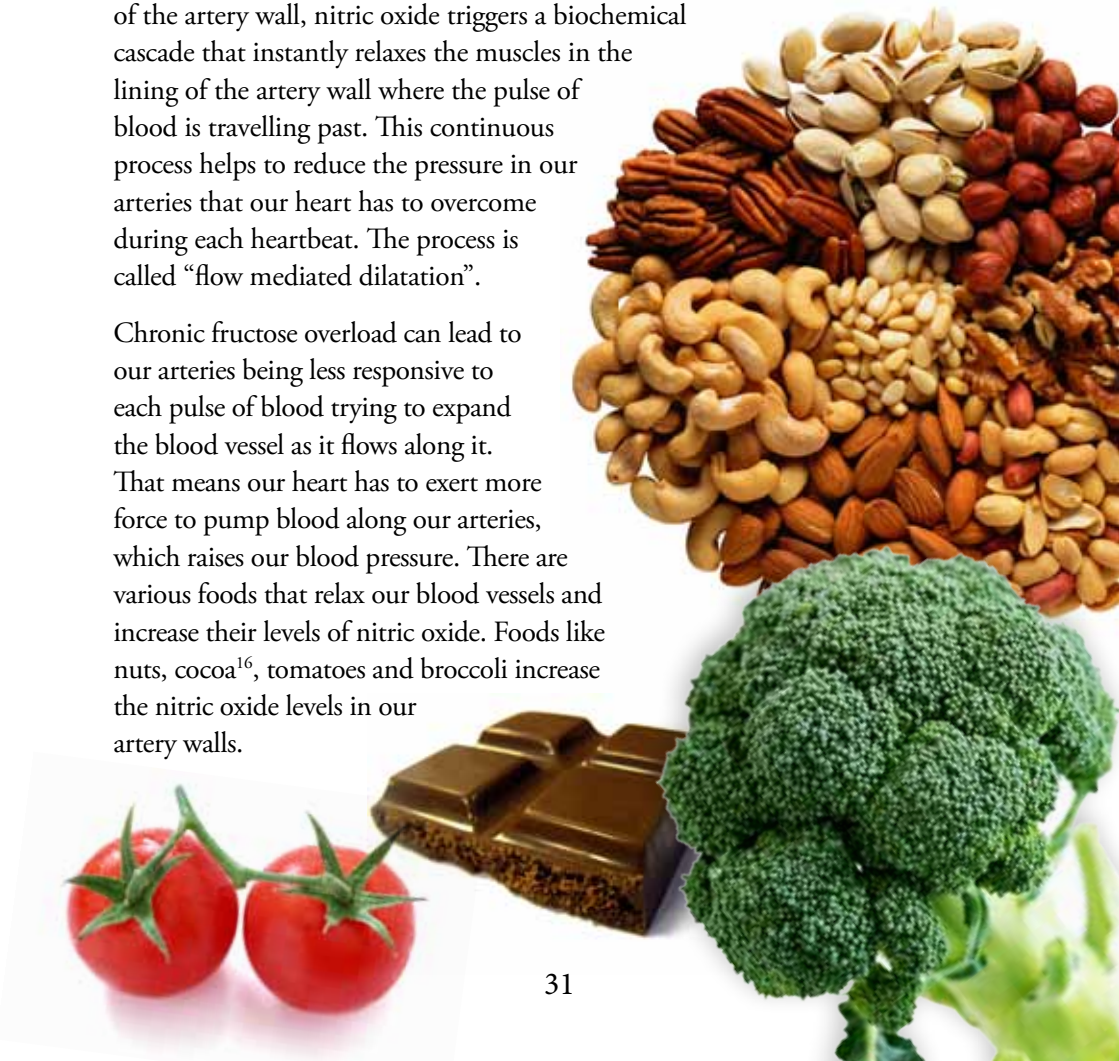
The younger the 'targeted audience' the larger the potential market is. The sooner children get a taste for sugar combined with caffeine in drinks and salt in biscuits and snack confectionery, the more products gets sold.

Fructose and Blood Pressure

One of the molecules that can build up during the biochemical processing of excessive amounts of fructose is called uric acid.[14] Anybody that has had gout knows how painful it can feel when uric acid crystallizes in their joints. Normally uric acid is in solution and is filtered from our blood by our kidneys into our bladder.

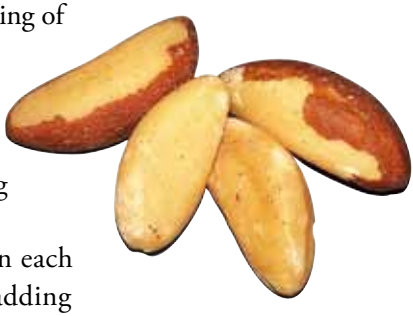
Excess uric acid can also inhibit the production of a small gas molecule called nitric oxide (NO) that is in the muscle lined wall of our arteries.[8,9,14,15] Each pulse of blood from our heart continually stretches the artery wall as it travels along the blood vessel. In response to this continuous shear stress of the artery wall, nitric oxide triggers a biochemical cascade that instantly relaxes the muscles in the lining of the artery wall where the pulse of blood is travelling past. This continuous process helps to reduce the pressure in our arteries that our heart has to overcome during each heartbeat. The process is called "flow mediated dilatation".

Chronic fructose overload can lead to our arteries being less responsive to each pulse of blood trying to expand the blood vessel as it flows along it. That means our heart has to exert more force to pump blood along our arteries, which raises our blood pressure. There are various foods that relax our blood vessels and increase their levels of nitric oxide. Foods like nuts, cocoa[16], tomatoes and broccoli increase the nitric oxide levels in our artery walls.



Selenium

Selenium is necessary as part of the molecular structure of the antioxidant glutathione. Glutathione is a major antioxidant inside our cells where it sequesters oxygen radicals and helps to down regulate inflammatory pathways. Selenium is also important for the normal functioning of our brain and thyroid gland.



Its main sources are seafood, Brazil nuts and eggs. Like iodine it is leached from mountainous soils. The recommended daily intake is 60–75µg (micrograms), with an upper limit of 400µg.[7] Brazil nuts provide around 100µg of selenium in each 100g (3½oz). Grinding them to a powder and adding that to yogurt or with fruit helps if you have dentures or diverticular disease.

Vitamin B12 Absorption

Vitamin B12 (cyanocobalamin) is necessary for healthy nerve function and the growth of healthy red blood cells. Plants do not make B12, but can be sources if fermented or contaminated by particular bacteria or algae. Effective absorption of B12 requires the healthy function of different parts of our digestive tract that may be less productive as we age or affected by long term medication use.

The cobalamin (B12) is released from its food source in our stomach by acid and pepsin (antacid medications can hinder this). This allows the B12 to attach to 'R binders' in our stomach.[8] These then release the B12 in the alkaline environment of our small intestine (duodenum) where Intrinsic Factor then binds to it. This prevents the B12 from being digested as it travels along our small intestine.[8] At the far end (ileum) of our small intestine, receptors in the ileum wall bind to the intrinsic factor and absorb the B12 with it into our blood stream.[8] So we need to have good stomach acid production and keep producing enough intrinsic factor as we age, assuming our food contains the 2–3µg of B12 daily.[9] The richest sources are liver, cheese, meats, seafood, eggs.

As our appetite gets smaller, our choices may become more restricted (tea and biscuits, toast and jam *etc*.). Snacks of fruit and cheese, nuts, yogurt, provide a variety of valuable nutrients with less sugar disturbing the teaspoonful already pulsing along in our blood stream.

As we age we need to balance a smaller appetite and shrinking muscle tone with enough food to prevent constipation while getting enough nutrients.

Sardines are small, rich sources of the long fish oils EPA and DHA. They also provide the fat soluble vitamins A, D, E and K, valuable protein and the B group vitamins including B12. They are also good sources of minerals including zinc, copper, selenium, iron and the element iodine.

Salmon, trout, herrings and mackerel are oily fish as well with similar nutrients. May need to be sure of the environment they grew in for contaminants.

Eggs are an ideal all round nutritious food. Their protein consists of a complete mix of the amino acids our bodies need. They also provide the fat soluble vitamins A, D, E and K. They also contain the B group vitamins including B12 and folic acid and a range of essential minerals.

The orange – yellow colour of the yolk is due to the presence of two carotenes called lutein and zeaxanthine. These carotenes are also concentrated in the fovea, which is the part of the macula at the back of our eyes where light is focused. The lutein and zeaxanthine act as antioxidants filtering the blue and ultraviolet light from damaging the rods and cones that are concentrated in the fovea for clear vision.

They are also in the lenses of our eyes, so they may help protect our eyes against and delay the onset of age related macula degeneration and cataracts. Each egg yolk contains around 290µg of lutein and 210µg of zeaxanthine.[10]

Cocoa

Cocoa (*Theobroma cacao*) is consumed in some form or other by most of us. Cocoa is one of the richest sources of a group of antioxidants called flavonoids. Cocoa contains plenty of a sub-group of flavonoids called flavonols, in particular catechin, epicatechin and polymers of these called procyanidins.[5]

Cocoa reduces the oxidation of the unsaturated oils that make up all our cell membranes. This includes the oils encapsulating the globules of cholesterol in LDL particles, so there is less oxidized LDL to stick to our artery walls. Cocoa also helps to reduce the amount of LDL and increase the amount of HDL which clears unused cholesterol to our liver to be secreted into our intestine as bile.[5]

Cocoa increases nitric oxide levels in our artery walls which helps relax the artery as blood pulses along with each heartbeat. It also reduces the levels of a compound called ACE that then also helps to lower blood pressure. Cocoa improves the normal function of our blood vessels and reduces various inflammatory pathways. Cocoa helps prevent blood clots by inhibiting how the platelets (that form blood clots) clump together. It also increases the rate they are dissolved.[5]

Cocoa also affects how we feel and may help to protect our brain from oxidative damage. When made into chocolate, some of the flavonols are removed as they taste bitter. So the higher the cocoa content of chocolate the greater the health benefits. A snack of dark chocolate (10–15g or ½oz) with a couple of walnuts, Brazil nuts, almonds or hazel nuts has many benefits for our heart and blood vessels as well as how we feel.

Our blood volume varies from around 80ml for every kilogram of our body weight at birth to around 70ml per kilogram as adults.[1] It is easy to overlook how small a child's digestive capacity is. A one year old child weighs around 10kg (22lb) and they only have about one litre (2 pints) of blood pulsing through their blood vessels. The total level of sugar in their blood stream is only one gram, which is the same amount of sugar that is in two teaspoons of juice or soda.

Drinking juices, sodas or cordials may not be in the nutritional interests of a young child. They simply do not have the muscle mass to use the volume of sugar these drinks can provide especially in the volumes some young children drink them. Drinking clean water for hydration and eating pieces of fruit for refreshment suit children's needs very well.

Alcohol

Our body does not need the alcohol called ethanol that is in beers, wines, ciders and spirits. Ethanol releases around 80% more energy than the same quantity of protein or sugar when it is broken down, mainly in our liver. We cannot store alcohol and it is evenly distributed throughout our body fluids. Its metabolism and effects on various signalling pathways is a feature of its consumption.

Alcohol is a depressant and in volumes up to around one gram in each litre of our blood it affects parts of our brain in ways that lessen the influence of inhibitory control pathways.[4] This tends to make people more socially interactive. In excess, a drinker's perception of their motor coordination skills is usually at odds with reality.

Alcohol is metabolised in our liver by an enzyme called alcohol dehydrogenase (ADH). This is the same enzyme needed to convert the food form of vitamin A, retinol to its active form retinal. Retinal is necessary for the recycling of rhodopsin[3] (visual purple) in the cells called rods in the retinas of our eyes to enable us to see in low levels of light.

Frequent daily alcohol intake that exceeds the rate our body metabolizes it can saturate our supply of the enzyme alcohol dehydrogenase. This can prevent the conversion of retinol to retinal, which can significantly reduce our visual acuity in low light levels, like at dawn and dusk. Retinal is also necessary for sperm production[4] so as the frequency and volume of alcohol consumption increases, sperm production tends to drop off.

Ethanol is metabolised at an average rate of 1 gram for each 10 kilograms of body weight each hour.[4] So people weighing 100 kilograms (220lbs) metabolize one standard drink (10 grams or 12½ ml) of alcohol in one hour.

Alcohol

The density of ethanol is only around 80% that of water, so 10 grams expands to a volume of 12½ ml (100/80 = 1.25). That is the amount of alcohol in a fluid ounce of spirits with a concentration of 40% alcohol.

The alcohol that is in 100 millilitres of wine provides a similar amount of energy as a slice of bread (7 slices to the bottle). People who drink alcohol regularly may notice their girth is larger than they may prefer, unless they are more physically active.

In small amounts alcohol stimulates our appetite, yet in large frequent amounts it suppresses our appetite.

cell membranes. These oils also assist our cells and tissues carry toxins to the surface of cells lining our lungs, kidneys, skin and digestive tract to be discarded.[2]

Free Radicals

Oxygen is highly reactive and can form small molecules called "free radicals" in our cells that can damage the cell membranes. We have lifelong skirmishes in our cells with these radicals like hydrogen peroxide H_2O_2 (great for bleaching hair etc.). Our cells use these and other oxygen radicals to kill viruses and harmful bacteria before neutralising the radicals to water and oxygen.[2]

The free radical molecules that do get to cause damage to our cells drive inflammation cascades that can have immediate and long term effects on our wellbeing. To combat this relentless onslaught, there is the ever present antioxidant glutathione inside each of our cells.

Glutathione incorporates selenium from Brazil nuts and seafood, Vitamin C from fruits and vegetables and Vitamin E from fats and oils. We are so alive with oxygen atoms the task of containing them is relentless. The production of glutathione in our cells decreases as we age.[7]

Our need for colourful antioxidant rich spices, fruits and vegetables to engage in the lifelong skirmishes with oxygen rich free radicals only ceases with our final breath.

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