Macrobiotics and the Environment

Simon Brown 30.10.2019

ASSUMPTIONS

Macrobiotics is based on the idea that humans are connected to and dependant on the environment they inhabit. Sapiens are nature and part of nature. The well-being of people relies on the health and quality of water, land, air, food, sunlight, micro organisms and ambient temperature as the very basics for survival.

According to the founder of modern macrobiotics, George Ohsawa, The healthy, happy man has understood that to live a joyful life, no matter where on this earth, he must first of all make himself one with his environment. He must eat, drink, and behave in a manner that does not alienate him from the orderly, simple truth of nature. He must discover natural food—that which grows in his immediate area—uncontaminated by the imposed, artificial protection that science misguidedly offers through insecticides, pesticides, artificial fertilizers, preservatives, and additives[1].

Humans are approximately 70% a flow of water and further made up of a flow of oxygen, and nutrients from the earth. Therefore sapiens are essentially a flow of nature.

In terms of personal health, individuals are reliant on nature and therefore this needs to be a primary consideration in any hierarchy of healing, health or wellbeing lifestyles. It is ultimately self-defeating to follow a regime that maybe beneficial for individual health, supports a personal philosophy of life or satisfies ideological principles, if it does not prioritise on the wellbeing of nature.

Ohsawa writes, Our human body is part of the whole. It owes its very existence to it. The whole is nature and whole nature is our spirit. To know God, to recall nature, to acknowledge wholeness is the highest wisdom to which a human being can aspire. The highest form of discipline with which to achieve such wisdom is the macrobiotic way of living[2].

It is likely that humans will increasingly be confronted by the choice of whether to make individual sacrifices to help nature as a whole or to put the individual first and risk provoking further compromising changes to the natural world.

It is contended that all human made environmental harm, including climate change, extinction, waste, pollution, degradation of soil quality, depletion of the ozone layer, is the result of a human first approach to living. Human selfishness, greed and arrogance are key characteristics that lead to behaviours that increase changes to nature that risk creating an environment that is unsustainable for human life. If these innate characteristics are the cause of a disconnect from nature and ultimately harming nature, then finding ways to moderate more selfish behaviours needs to be part of the solution.

---

[1] George Ohsawa. Essential Ohsawa. George Ohsawa Macrobiotic Foundation. 1994 revised 2013. Page 30.

[2] George Ohsawa. Essential Ohsawa. George Ohsawa Macrobiotic Foundation. 1994 revised 2013. Page 32.

The human population has increased from an estimated 190 million when AD years began, 990 million in 1800, 3 billion in 1960 (when Zen Macrobiotics was published in English) to 7.7 billion in 2019[3]. Projections suggest that the population will rise to 10.9 billion in 2100[4]. If macrobiotics is based on principles that can be enjoyed by everyone, we need to find a way of living that is sustainable for at least 7.7 billion inhabitants.

There is no surety that a lifestyle that used to be sustainable for less than 1 billion people is sustainable for 8 billion people. Given that as the human population has experienced an approximately 8 times increase in the last 220 years, and this is coupled with an increase in individual consumption with the resulting waste, pollution and stress on nature and her resources, we need to find new ways of living that will work for a human population potentially rising to 11 billion people. Therefore, going back to the more natural lifestyle of previous generations is unlikely be sufficient due to population increase.

Macrobiotics always has been an environmentally conscious lifestyle, however, the population size and way people live has changed so much since 1960, that what was a pioneering environmental approach to living needs to be constantly updated.

This paper proposes changes that will update and improve macrobiotics in terms of food choices, preparation and cooking.

FOOD CHOICES

Plant based foods

Macrobiotics recommends a variety of primarily whole locally grown seasonal food that has not been processed; including vegetables, whole grains, beans, fruits, nuts, seeds, wild edible plants, herbs and teas.

Animal foods

Many current macrobiotic teachers recommend a plant based diet that avoids meat and dairy foods. Intensively farmed animal foods are highly inefficient at delivering nutrients in terms of use of natural resources[5]. Animal farming that requires additional food in the form of agricultural crops, beyond all year round low density natural pasture grazing, has negative influence on forests, land use, crop growth, water consumption, waste, monocultures, extinction and methane production[6]. Advocating complete avoidance of

---

[3] Max Roser, Hannah Ritchie and Esteban Ortiz-Ospina. World Population Growth. Our World in Data. 2013 revised 2019 https://ourworldindata.org/world-population-growth 16/09/19

[4] *Ibid*

[5] Damian Carrington. Avoiding meat and dairy is 'single biggest way' to reduce your impact on Earth. The Guardian 31.05.18 https://www.theguardian.com/environment/2018/may/31/avoiding-meat-and-dairy-is-single-biggest-way-to-reduce-your-impact-on-earth 10.10.19

[6] Almut Arneth (Germany), Humberto Barbosa (Brazil), Tim Benton (United Kingdom), Katherine Calvin (The United States of America) et all. Climate Change and Land. IPCC. 07.08.19. https://www.ipcc.ch/site/assets/uploads/2019/08/Fullreport-1.pdf 10.10.19

meat and dairy food is a clear, simple and effective message that leads to a clear target for each individual.

In addition the consumption of fish, seafood and eggs needs to be reduced to sustainable levels or eliminated completely. Commercialised egg production and farmed fish require large quantities of mono culture crops. There is also the argument that being vegan helps compensate for those people who have not yet changed to more sustainable eating choices.

Whilst becoming plant based or vegan makes a great difference to the environment, care is required to make new sustainable choices. As consumers move from animal food to vegan foods there is a move to monetise this trend with high added value processed and exotic imported foods claiming to be healthy and natural. Examples are avocado, vegan milks, soya products, coconut and palm oil. These create new harm to the environment.

A good example of a country that has a history of low consumption of meat and yet considered to have a low cost, colourful, tasty and potentially healthy diet, based on local ingredients is India with an average meat consumption of 3.4kg (7.5lb) per person in 2017 compared to the USA with an average meat consumption of 98.4kg (217lb) per person in the same year[7].

Mono cultures, diversity and insect life

Mono cultures are those where the consumption of specific crops is so large they create large tracts of land that only grow those crops. The result is that nature becomes unbalanced in terms of demands on the soil, food for insects and all life above in the food chain. Mono culture farming is considered a major influence on extinction. For example soya, rice, wheat and corn take up almost 50% of the worlds agricultural lands[8].

There are estimated to be 200,000 different kinds of edible plants on the planet and yet humans tend to focus on about 200 plants[9]. Even within one species there are many varieties. For example millet includes finger, fonio, foxtail, Japanese, kodo, pearl and proso.

A macrobiotic approach to food selection recommends using a wide variety of vegetables, fruits, grains, beans, nuts, seeds, sea vegetables, herbs, spices and teas, to increase biodiversity and reduce consumption of mono-culture crops. This is achieved by consciously sourcing a wide variety of different ingredients and also by eating foods in season. Particular focus initially is needed on buying grains and beans or bean products.

---

[7] FAO Agricultural Outlook 2019-2028. OECD 20.10.19. https://stats.oecd.org/viewhtml.aspx?datasetcode=HIGH_AGLINK_2019&lang=en

[8] Don Campbell - University of Toronto. A very small number of crops are dominating globally. ScienceDaily, 6 February 2019. www.sciencedaily.com/releases/2019/02/190206161446.htm 11.10.19.

[9] John Warren. Why do we consume only a tiny fraction of the world's edible plants? World Economic Forum. 15.01.2016. https://www.weforum.org/agenda/2016/01/why-do-we-consume-only-a-tiny-fraction-of-the-world-s-edible-plants 21.10.19.

Also, avoiding meat and dairy can reduce mono culture crops by up to 60%[10]. Another concern is that once a single crop is farmed on a massive scale, its own environmental issue become significant, so for example nitrous oxide and methane become concerns when rice is cultivated on a large scale[11]. Further mono culture crops like rice, wheat and corn require much larger quantities of water that create further issues with local hydration[12].

Processed Foods

The processing of foods tends to be highly wasteful and requires large quantities of natural ingredients for a smaller quantity of finished product. At the same time research suggests that prioritising the original whole natural ingredient such as nuts, seeds, beans and grains is more healthy for humans due to increased fibre, phyto-nutrients and nutrient diversity.

Examples of processed foods include oils, juices, plant based milks, soya products and similar processed foods. Typically only 10% to 30% of an olive is converted to oil[13]. A sudden rise in the popularity of a food like almond milk can have huge environmental impacts, draining lands of water. It takes 4.16 litres of water to grow one almond[14] and 92 almonds are typically required for 1 litre of milk, so 383 litres of water for 1 litre of almond milk (920 gallons of water for 1 gallon almond milk).

In macrobiotic thinking primary choices are whole, natural, unprocessed ingredients include vegetables, fruits, grains, beans, nuts, seeds, herbs, spices and teas.

Drying, fermenting and pickling are considered natural forms of processing that do not waste any of the original food and in the case of fermenting enhance the health benefits of the food in terms of exposure to healthy bacteria.

---

[10] Appetite for Destruction. WWF.03.10.19 https://www.wwf.org.uk/sites/default/files/2017-10/WWF_AppetiteForDestruction_Summary_Report_SignOff.pdf 16.10.19

[11] Kritee Kritee et all. High nitrous oxide fluxes from rice indicate the need to manage water for both long- and short-term climate impacts. PNAS 25. 09. 2018. https://www.pnas.org/content/115/39/9720?fbclid=IwAR35e-GQmKUrMRLnae8u2tDzDiUDRl1oFXTIK54HpsyiY-ZX2iGdlW_SE30 20.10.19

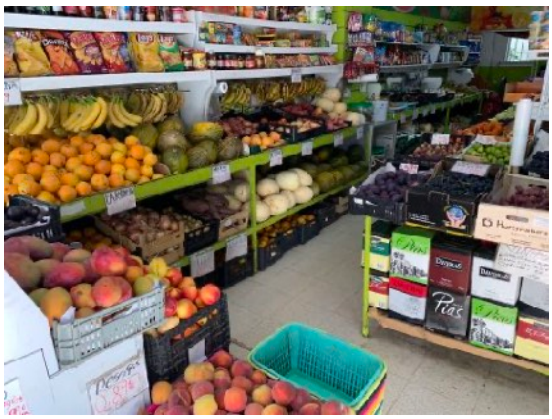
[12] Rahaman, Shourov. Production of rice versus groundwater depletion in Bangladesh during 1988-2014. 2016 https://www.researchgate.net/publication/311468386_Production_of_rice_versus_groundwater_depletion_in_Bangladesh_during_1988-2014 13.11.19

[13] Paul Vossen. Olive Oil Yield. First Press. 2006 http://cesonoma.ucanr.edu/files/27239.pdf 13.10.19.

[14] Tom Philpott. Your Almond Habit Is Sucking California Dry. MotherJones 2014. https://www.motherjones.com/food/2014/07/your-almond-habit-sucking-califoirnia-dry/ 11.09.19.

Refrigeration at home and buying refrigerated foods

Refrigeration is a major source of energy consumption and still contributes to the thinning of the ozone layer and global warming[15]. Foods that are refrigerated in retail stores are likely to have passed through refrigerated warehouses and been transported using refrigerated vehicles. Consumers often assume these foods require refrigeration at home. More traditional shops keep fruit and vegetables, including berries, at room temperature, without refrigeration, even with ambient temperatures above 30 degrees C (86 degrees F).



The above pictures are of shops in Lisbon during the summer. Refrigerating can dehydrate foods and keeps foods at a temperature below which healthy fermentation can take place. Typically, spores from the air land on the surface of fruits and vegetables and precipitate fermentation at room temperatures, leading to the presence of healthy bacterias[16].

It is recommended to buy non refrigerated foods, keep foods outside the fridge as much as possible and keep your fridge at the lowest setting / highest temperature practical. In cooler climates it may be possible not to have a fridge at home and use a larder or cool room.

Organic / bio agriculture

To assist with a healthy insect life and reduce harmful pollution to farmlands and water, it is recommended to buy organic / bio foods whenever possible. If these are not available, it is suggested to request organic / bio foods to put pressure on retailers to stock these foods. This preference needs to be balanced with buying local foods and a more diverse range of foods.

---

[15] Australian Government Department of the Environment and Energy. https://www.environment.gov.au/protection/ozone/rac/consumers 18.09.19

[16] Gregory Robinson. 100m bacteria a day keep the doctor away, apple research suggests. The Guardian. 2019 https://www.theguardian.com/society/2019/jul/24/100m-bacteria-a-day-keep-the-doctor-away-apple-research-suggests 16.10.19

Local foods in season

Macrobiotic principles recommend preferencing local foods in season. This can be by region, country or in some cases continent. It is important to consider transport methods from the area of origin. For example train will be more environmentally conscious than plane.

Japanese ingredients

Although the macrobiotic style of eating originated in Japan, the diet is not reliant on Japanese ingredients and can be adapted to the local foods in any part of the world. There is no need to use Japanese ingredients and it is recommended not to use these if there is a significant environmental impact in using them. Many foods that used to be only produced in Japan, like tofu, miso and sea vegetables, are now produced in many locations and preference is given to the most local sources.

Importing dried food and the effect on local water supplies

Consider the amount of water taken to grow an ingredient. For example 130 litres of water is required to grow the beans for one cup of coffee[17]. Try to buy dried foods from local farms to reduce the risk of creating unsustainably dry areas in other locations.

WASTE

Packaging

Many foods are packaged in plastic. The greater the weight and mass of the packaging the greater the pollution. So a hard plastic container for berries contains more plastic than a thin plastic bag for carrots, for example.

Choose ingredients that are not packaged and take shopping bags to avoid the unnecessary use of plastic bags. Complain to shops where you see excessive packaging. Many small family shop in Lisbon use no packaging for fruit and vegetables.

Organic and bio vegetables and fruits have to be wrapped to provide labelling to ensure these foods really are organic/bio. There will be ways to label with less plastic or use alternatives and we can petition the regulatory bodies to find better solutions.

Waste and using the whole food

One third of food is wasted or lost[18]. This waste creates further waste and excess in terms of agro chemicals, human time, energy, transport, storage, packaging, refrigeration and other consumables used to farm and deliver foods to a store. Part of the problem is that consumers select what is considered the best fruits and vegetables in terms of

[17] https://waterfootprint.org/en/resources/interactive-tools/product-gallery/

[18] Food Loss and Food Waste. Food and Agriculture Organization of the United Nations. http://www.fao.org/food-loss-and-food-waste/en/ 08.10.19

shape, colour and texture. This encourages stores to only buy the ‘perfect’ vegetables from farmers as they know consumers will not buy less than perfect looking produce. This trend is encouraged by advertising and posting photographs in social media of food that subscribes to the trend of food having to look perfect.

Selecting foods that have less popular shapes, different colouring or even small blemishes will help reduce waste from shops and farms. Showing the range of real foods in photographs will encourage other people to embrace a more natural range of foods whilst shopping.

In macrobiotic thinking wild foods that have grown around stones will be stronger in terms of the energy required for their growth and therefore vegetables that have grown in harsher environments, resulting in unusual shapes, are preferable in terms of the life force of the plant. In contrast, commercial root vegetables that are grown in artificially loosened soil for easier and greater growth have less life force.

Similarly, in theory, fruits and vegetables that have been attacked by insects may have more active immune systems and therefore a greater concentration of phytonutrients. Small blemishes can easily be cut out of the fruit or vegetable and what is lost in quantity may be made up for in quality. This particularly applies to organic/bio foods where it is more likely that foods will have blemishes. The blemishes come from sharing food with insects and encouraging a better environment for insect diversity.

Macrobiotic principles encourage cooks to use the whole food as much as possible so that the minimum is wasted. The edible skins of vegetables, grains, beans, fruit, seeds nuts and sea vegetables are consumed to provide the maximum nutrition. Even pumpkin, squash, potato, fish and other skins are readily edible and often provide greater concentrations of nutrients than the internal flesh.

In addition, macrobiotic cooking principles recommend using the inedible parts of vegetables as stock for soups and stews so that the maximum nutrition is taken from the food.

Further, a greater use of local foods in season will potentially reduce waste compared to foods that need to travel large distances to consumers.

There will be a balance between using packaging and refrigeration to extend the life of foods and reduce waste, with the environmental impact of the packaging and refrigeration. The ideal would be to reduce waste through a focus on local foods eaten fresh in season without relying on packaging or refrigeration to extend their shelf life.

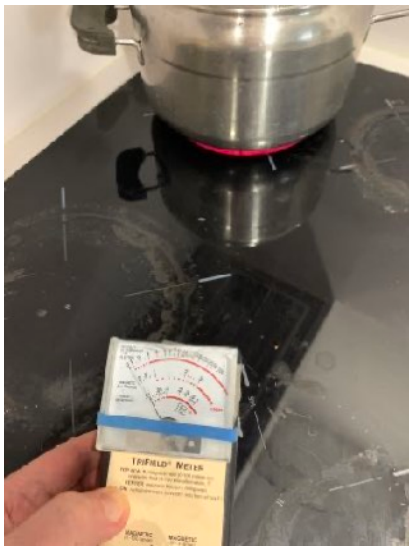
COOKING

Cooking and Fossil Fuel

The current options for cooking are generally electricity or gas, although new cleaner fuels may emerge. Apart from oxygen absorption and carbon dioxide production, natural gas extraction can be a significant contributor to green house emissions and water contamination in the form of methane. This primarily occurs through leaks during extraction and transport. Fracking is a particularly polluting form of gas extraction.

As countries move towards electrical generation from clean renewable sources, electricity for cooking becomes a cleaner alternative to cooking on gas. For example in 2016, 55.5% of Portugal's electricity was generated using renewables. The aim is for nearly all electrical generation in Portugal to be by renewables by 2030[19]. Increasingly electricity is becoming the environmental choice for cooking and heating. Further many energy companies offer an option for electricity from 100% renewable sources.

At the same time, US states such as California, Washington, and Massachusetts are looking to reduce residential gas consumption to improve the environment[20]. Buildings account for approximately 12% greenhouse gas emissions, according to the US Environmental Protection Agency[21]. The current aims are to ban gas hook ups to new buildings, however, to meet environmental targets there will need to be a reduction in current use of gas for cooking and heating[22].


There is concern that electric cooking increases local EMF (Electro Magnetic Fields) that may alter the quality of the food and influence the cook if close to the stove. My own measurements show that the EMF reduces to less than 1 milligauss when more than 20cm (7.9 inches) away from an electric ring, at its highest setting of 9, making it unlikely to influence someone cooking at the hob. However, 2cm (.8 inches) from the heat source, the EMF rises to 25 milligauss when the heat is on the highest setting of 9 and reduces to 2 or 3 milligauss when on a heat setting of 2 for simmering. It is possible that food may be subtly influenced by this level of EMF. To reduce exposure, the water can be heated before the food is added and then the electricity turned off. To put these readings into context in some urban environments the baseline ambient EMF can be between 0 and 3 milligauss inside and around a home.

---

[19] Renewable energy in Portugal. Wikipedia. https://en.wikipedia.org/wiki/Renewable_energy_in_Portugal 03.10.19

[20] Valerie Volcovici, Nichola Groom. The next target in the climate-change debate: your gas stove. Sustainable Business. 09.09.2019

[21] *Ibid*

[22] *Ibid*

It is helpful to realise that natural gas also has health issues. Burning gas absorbs oxygen and creates carbon dioxide. Gas cooking also produces a complex mixture of volatile organic compounds, sulfur dioxide, particulates, carbon monoxide, carbon dioxide, nitric oxide, and nitrogen dioxide[23]. A study published in Epidemiology in 2012, found that homes with gas cooking had a subtle negative influence on infant neurodevelopment[24]. Because gas cooking is a pollutant, ideally homes need to be well ventilated and this has the effect of reducing the internal air temperature in the winter when the external air temperature is lower than the internal temperature, requiring more heating and energy consumption to restore the internal temperature, further increasing green house emissions. Cooking with electricity without ventilation will act as a form of heating during the winter, reducing the need for other forms of heating.

Many cooks find cooking with gas easier as the adjustments to temperature are quick whereas with electricity there is a time lag, making precise adjustments more difficult. Ultimately, the choice between the two will become between personal preference and environmental consciousness.

A more environmental cooking solution in sunny climates is to use a solar oven, where the food is placed in a reflective container, often with a glass lid and mirrors are used to focus sunlight onto the foods. In time more environmentally healthy forms of gas cooking may emerge through biomass based gas collection.

Raw Foods

Raw foods provide a way of eating with minimum energy consumption for preparation. From a macrobiotic perspective, raw foods are best when the weather is hotter. So during the summer, macrobiotic meals tend to have more raw foods. On very hot days when the air temperature is above the blood temperature, totally raw meals are cooling. The rest of the year a mix of cooked and raw foods can be used to get a balance that provides adequate warmth and energy, with freshness. This balance can also take into account the desire to reduce green house emissions through less cooking.

---

[23] Vrijheid, Martine; Martinez, David; Aguilera, Inma; Bustamante, Mariona; Ballester, Ferran; Estarlich, Marisa; Fernandez-Somoano, Ana; Guxens, Mònica; Lertxundi, Nerea; Martinez, M. Dolores; Tardon, Adonina; Sunyer, Jordi. Indoor Air Pollution From Gas Cooking and Infant Neurodevelopment. Epidemiology: January 2012 - Volume 23 - Issue 1 - p 23–32. https://journals.lww.com/epidem/FullText/2012/01000/Indoor_Air_Pollution_From_Gas_Cooking_and_Infant.5.aspx

[24] *Ibid*

Cooking Time and Soaking

The cooking time of beans and grains can be significantly reduced by soaking. Brown rice that has been soaked for 5 hours can be cooked in 20 minutes, compared to the 45 typically recommended in macrobiotic recipes. As soaking only requires water and acts to cleanse grains and beans as well as reduce phytic acids, arsenic and water soluble agro chemicals from modern farming, soaking is a healthy, energy efficient process. Excessive soaking may leach out nutrients[25] and will eventually lead to sprouting.

Energy Saving Cooking Method

Cooking occurs once the temperature exceeds 40c (104°F). Water cannot not exceed 100c (212°F) at atmospheric pressure near sea level. Boiling water, wastes energy as energy is unnecessarily used to change water into steam. So any energy required to cook above a simmer is wasted. For this reason is would be more efficient to cook at a maximum of 95c (203°F). Cooking for 2 minutes above 70c (158°F) is considered to be sufficient to kill harmful bacteria[26].

Further, cooking times can be reduced by bringing water to a simmer and turning off the heat and putting a lid on. For example:

The first image shows the starting water temperature, the second heated to 95c (203F) at 10:31h, the third at 74c at 10:55h and the forth the cooked grains.

With an ambient temperature of 23c (73°F) and cooking on gas, a mix of water, millet, buckwheat and jumbo oat flakes was raised to a temperature of 95c (203°F). The gas was turned off and a lid covered the foods (with a small air gap to allow for a thermometer). 24 minutes later the temperature reduced to 74c (165F).

---

[25] Julie Garden-Robinson. All About Beans Nutrition, Health Benefits, Preparation and Use in Menus. NDSU Feb 2019. https://www.ag.ndsu.edu/publications/food-nutrition/all-about-beans-nutrition-health-benefits-preparation-and-use-in-menus 08.10.19

[26] Cooking your food - How to cook your food to prevent food poisoning. Food Standards Agency. https://www.food.gov.uk/safety-hygiene/cooking-your-food 08.10.19




The first image shows the starting water temperature, the second heated to 92c (198F) at 11:43h, the third at 70c at 12:33h and the forth the cooked grains.

Similarly, with an ambient temperature of 28c heating the same mix of ingredients to 92c (198F) on an electric hob and turning off the electricity along with placing a lid over the pot (again with a small air gap for a thermometer) it took 29 minutes to reduce to 80c (176F) and 50 minutes to reduce to 70c (158F).

In both experiments the porridge was fully cooked and creamy. It is likely that the temperature drop would be reduced with a tight fitting lid in both cases, however, a cooler winter ambient temperature may speed up the rate the temperature decreases. The pot used was a stainless steel pot.

Similar results were experience for cooking soups and soaked grains including brown rice. As water retains heat, this method is better suited to cooking styles where greater quantities of water are used, however, it also works for nishime. Best results are from using a pressure cooker, where soaked brown rice and beans can be fully cooked by turning off the heat source as soon as the pot is up to pressure. In all experiments the pot was left on the hob and benefited from residual heat radiated from the surfaces of the hob. This process can be enhanced by using a process where the pot is wrapped in a blanket or duvet to retain the heat for longer.

If keeping ingredients in a fridge, taking them out earlier and letting them rise to room temperature will reduce the energy required to raise their temperature during cooking.

In addition most teas, including sencha, kukicha, genmaicha, hojicha, oolong, puer and white can be brewed at temperatures between 60c (140°F) and 80c (176°F). There is no need to heat the water above these temperatures. If the water starts at a temperature of 20c (68°F) at least 25% of energy will be saved heating to 80c (176°F) and 50% saved heating to 60c (140°F), instead of 100c (212°F). Usually the last section of heating requires more energy as the thermal losses are greater the higher the temperature, so more than these percentages will be saved. Over heating the teas can lead to a more bitter taste and harms the more fragile nutrients in the leaves.

Heat Conservation Through Consecutive and Simultaneous Cooking

The same heat source and energy can be used several times. Most of the energy will be used in raising the temperature of water, so once a temperature of, for example 95c (203°F), has been reached, maintaining the temperature requires a smaller quantity of energy. This hot water can be used to initially blanch vegetables and then cook a soup. Whilst cooking the soup, other vegetables can be steamed above. Each time the vegetables are added further energy will be required to raise their temperature, however, this is less than when the water has to be heated from cold each time.

Conclusion

Macrobiotics provides an excellent approach to eating that minimises the impact of human food consumption on climate change, extinction, pollution and waste. At the same time macrobiotics provides the principles for healthy eating that is being increasingly confirmed by nutritional and medical research.

As the environmental issues around food are changing, with new discoveries and challenges, the macrobiotic approach to the environment will need to be regularly reviewed and updated to remain current.

Author

Simon Brown is the author of Modern Day Macrobiotics and Macrobiotics For Life, director of the Community Health Foundation 1986-1993 and past chair of the Macrobiotic Association. Simon lectures at the Instituto Macrobiótico de Portugal and Instituto Macrobiótica de España.

simon@chienergy.co.uk

Date

Presented at the International Macrobiotic Conference in Valencia 30 October 2019.

Acknowledgements

Alexander Brown, Carl Ferre, Filipa Silva, Gerdy de Pypere and Bill Tara.

Much appreciation for reviewing text and making recommendations during the writing of this paper.

Images

All images are sourced from Simon Brown.