Unlearning the Relationship between Water and Salt Through Making “Miso and Miso Soup”. Implications for Cancer and Radiation Therapy

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Article

Unlearning the Relationship Between Water and Salt Through Making "Miso and Miso Soup" Implications for Cancer and Radiation Therapy

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Abstract: This paper explores a novel, bio-inspired concept for addressing global health and water scarcity challenges by "unlearning" conventional perspectives on water and salt, focusing on the potential of using steamed soybeans for seawater desalination and subsequent production of health-promoting foods like miso. Drawing inspiration from traditional food practices and established health benefits, such as a large Japanese epidemiological study correlating daily miso soup intake with a significantly lower stomach cancer mortality rate (Hirayama, 1982), the work investigates a method to mitigate the "salt problem" historically associated with miso. We highlight recent findings indicating miso's broader health effects, including the prevention of various cancers, potential improvement in cancer patient survival, and notably, radioprotective effects suggesting relevance for mitigating radiation injury. Here, we demonstrated that steamed soybeans effectively adsorb salt from simulated seawater (3% concentration), reducing it to 0.89% after four 1-hour exchanges of soybeans, and further to 0.77% with additional treatment, suggesting potential for achieving potable water standards. An intriguing observation also indicated that exposure to a low-frequency sound of 116 Hz appeared to enhance this salt reduction, a frequency previously linked to reductions in chloride ion concentration in water and hypothesized to influence biological functions relevant to cell proliferation and response to cancer. This process yields salt-enriched soybeans that could be used for making miso, potentially creating a sustainable cycle of seawater desalination and production of a highly nutritious fermented food. The robustness and nutritional value of miso, even in challenging environments, are underscored by its recent successful production on the International Space Station (Coblenlz et al., 2025). While preliminary, these findings suggest a promising interdisciplinary avenue for empirical verification of the health effects of miso made from seawater-treated soybeans and dedicated investigation into the biological relevance of specific physical stimuli like the 116 Hz frequency, proposing a potential shift in value perception towards integrated benefit, goodness, and beauty for global health and supportive strategies in fields like oncology and radiation therapy.

Keywords: miso; seawater desalination; soybeans; cancer prevention; radiation therapy; 116 Hz; sustainable food

Introduction

The increasing global population and the pervasive challenges of water scarcity and diet-related diseases necessitate innovative approaches to secure both potable water and nutritious food sources. Our conventional understanding of the relationship between water and salt, particularly the emphasis on salt reduction in modern diets and the energy-intensive processes of desalination, may require "unlearning" from a perspective that incorporates "Narrative History", the accumulated wisdom and practices of human civilization. Traditional food cultures, often deeply intertwined with local environments, may hold keys to sustainable solutions that offer integrated benefits.

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In Japan, Miso, a traditional fermented soybean paste, stands out as a food with a long history and recognized health benefits. Despite a historical public health focus on salt reduction, large-scale research has revealed compelling evidence of miso's potent health-promoting properties, extending beyond simple nutritional value. A notable epidemiological survey conducted by Dr. T. Hirayama between 1966 and 1978 (Hirayama, 1982) involving over 265,000 individuals across six prefectures revealed a compelling inverse correlation between the frequency of miso soup intake and the standardized mortality rate for stomach cancer, showing a 50% lower rate among daily consumers (Figure 1).

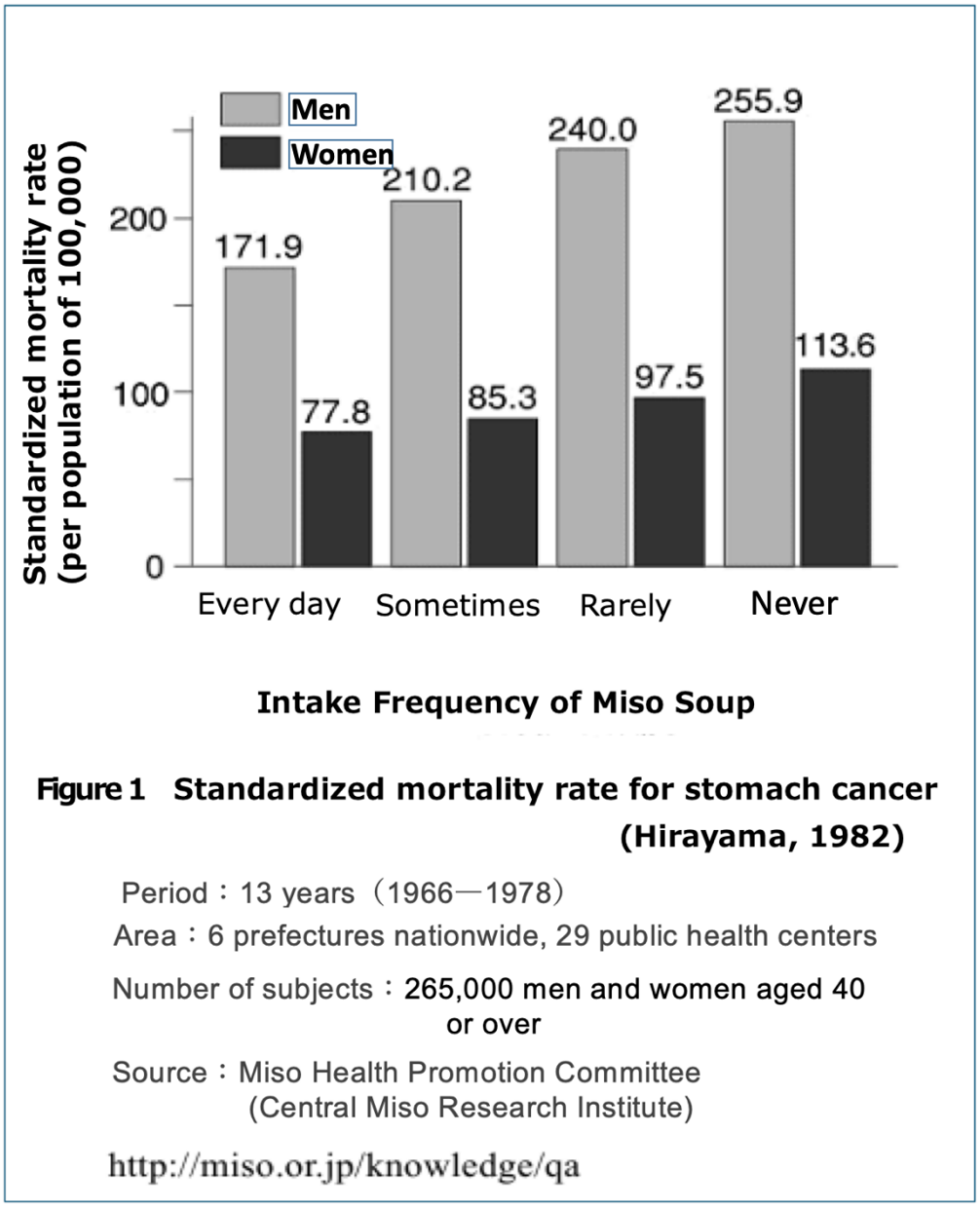

Figure 1. Standardized mortality rate for stomach cancer (Hirayama, 1982). Source: https://www.saltscience.or.jp/images/2023/07/1-gmyou.pdf

More recent research further supports and expands upon these findings, suggesting benefits not only in preventing disease but potentially also in improving prognosis. A comprehensive review examining both epidemiological and experimental evidence highlights miso's potential in preventing radiation injury, various cancers, and even mitigating hypertension (Watanabe, 2013). Specifically, this review notes that miso, particularly with a longer fermentation time (around 180 days),

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significantly increased crypt survival in mice exposed to radiation injury. This finding holds significant implications, suggesting that dietary intake of miso, particularly longer-fermented varieties, could potentially offer protection against radiation-induced damage, which is a critical concern for individuals undergoing radiotherapy for cancer treatment. Beyond radiation protection and the previously noted link to stomach cancer prevention, experimental studies cited in the review demonstrate that 180-day fermented miso inhibits the development of aberrant crypt foci (ACF) and colon cancers in rats and has shown effectiveness in suppressing lung tumors, breast tumors in rats, and liver tumors in mice. Furthermore, studies on rats indicate that the sodium in miso might behave differently than isolated NaCl, as miso consumption did not increase blood pressure even at sodium levels comparable to those from high NaCl intake. These diverse biological effects appear to be strongly linked to longer fermentation periods.

Adding to the growing body of evidence, recent investigations have explored the link between pretreatment dietary factors and survival in patients diagnosed with digestive tract cancers (Minami et al., 2020). A study involving patients with histologically confirmed stomach, colon, and rectal cancers diagnosed between 1997 and 2013 at a single institution in Japan assessed pretreatment dietary intake using a food frequency questionnaire. The findings indicated that among patients with stomach cancer, frequent intake of both soy food and miso soup was inversely associated with the risk of all-cause and stomach cancer death. While the study also found inverse associations between seaweed intake and death risk in colon and rectal cancer patients, the results pertaining to soy food and miso soup provide further support for the protective and potentially therapeutic effects of these soybean-based products specifically in the context of gastric health and prognosis. These findings underscore the potential for dietary interventions involving traditional Japanese foods like miso to play a favorable role in the survival of patients with certain digestive tract cancers.

Addressing the dual challenges of salt intake and water scarcity requires re-evaluating potential synergies between traditional food practices and environmental engineering principles, especially in light of miso's multifaceted health benefits, including potential radioprotective effects and links to improved cancer patient survival. This paper explores a novel concept inspired by the traditional method of miso production: utilizing the natural adsorptive properties of steamed soybeans to reduce salt concentration in seawater. The aim is to investigate the feasibility of using this method not only to produce water suitable for drinking but also to create a valuable byproduct – salt-enriched soybeans – that could serve as the basis for making health-benefiting miso, thereby potentially transforming a saline resource into both potable water and a nutritious food source with documented advantages for disease prevention, treatment support, and prognosis.

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Materials and Methods

Materials

Non-genetically modified (GMO-free) soybeans, sourced from Hokkaido, Japan (250g quantity purchased), were used for all experiments. Steamed soybeans are generally recognized as having a high content of potassium (typically 810 mg/100g), phosphorus (typically 290 mg/100g), and protein (typically 16.6 g/100g) (Rosso et al., 2024). Simulated seawater with an initial salt concentration of 3% was prepared for the salt adsorption experiments. Salinity measurements were performed using a Pocket Salt Meter (PAL-SIO, Cat. No. 4100; ATAGO Co., Ltd.).

Preparation of Steamed Soybeans

Steamed soybeans were prepared prior to the adsorption experiments. First, raw soybeans were washed briefly and then soaked in water overnight for approximately 8 to 12 hours. Following soaking, the hydrated soybeans were transferred to steaming equipment and steamed for approximately one hour at a boiling state using medium-low heat, ensuring the soybeans were cooked thoroughly. After steaming, the soybeans were allowed to cool slightly at room temperature before being used in experiments or stored under refrigerated conditions for later use.

Seawater Salt Adsorption Experiment

A static experiment was conducted to evaluate the salt adsorption capacity of the steamed soybeans using prepared simulated seawater. The experimental conditions were maintained at room temperature (25℃) with a relative humidity of 56%. Initially, 100g of steamed soybeans were immersed in 100 mL of simulated seawater with a starting salt concentration of 3%.

Based on preliminary observations indicating that the salt adsorption capacity of the steamed soybeans gradually weakened after approximately one hour of contact, the experiment involved sequential exchanges of the soybeans. After each one-hour interval, the 100g of used steamed soybeans were removed and replaced with a fresh 100g batch of newly prepared steamed soybeans. This exchange process was repeated four times over a total static duration of four hours, utilizing a cumulative total of 400g of steamed soybeans (100g per hour × 4 exchanges). The objective of this sequential exchange method was to progressively reduce the salt concentration in the simulated seawater, targeting a final concentration of less than 0.9%. Salt concentration measurements were performed on the simulated seawater at the end of each one-hour interval immediately prior to the soybean exchange (as implied by the results presented in the Results section).

Low-Frequency Sound Treatment Experiment

An additional experiment was conducted to investigate the potential effect of low-frequency sound on the salt adsorption process. This experiment involved exposing samples to a 116 Hz sound generated by a vibration speaker. The speaker had a frequency range of 30 Hz to 18 KHz and a power output of 26W RMS. The experimental temperature was 25°C. Samples were subjected to the 116 Hz sound treatment for one hour.

Results and Discussion

The concept explored in this work centers on the potential of steamed soybeans to act as a natural agent for salt reduction in seawater, inspired by the role of soybeans in traditional miso production. To investigate this, static experiments were conducted using steamed soybeans and simulated seawater with an initial concentration of 3%, representative of typical ocean salinity.

The experimental setup involved immersing 100g of steamed soybeans in 100mL of simulated seawater for a static period of 1 hour at room temperature (25℃, 56% humidity). A preliminary observation indicated that the salt adsorption capacity of the soybeans gradually weakened after approximately one hour. Based on this, the experiment involved sequential exchanges of steamed

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soybeans. After the first hour, the salt concentration in the simulated seawater decreased from 3.0% to 2.3%. The used soybeans were then replaced with a fresh 100g batch, and the process was repeated. After the second hour (with the second batch of soybeans), the concentration further reduced from 2.3% to 1.5%. A third exchange in the third hour brought the concentration down from 1.5% to 1.17%. Finally, a fourth exchange in the fourth hour resulted in a reduction from 1.17% to 0.89% (Figure 2). This demonstrates a progressive and significant reduction in salt concentration through repeated exposure to fresh steamed soybeans.

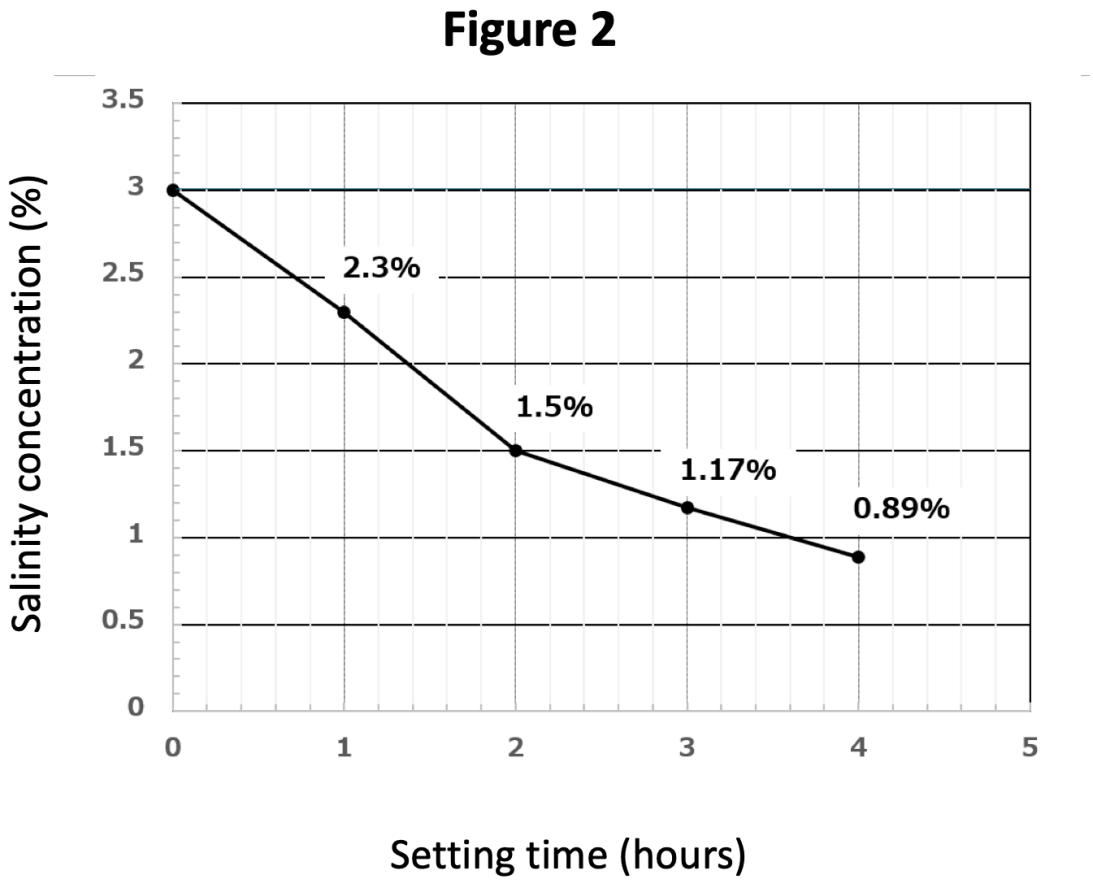

Figure 2. Reduction in salt concentration through repeated exposure to fresh steamed soybeans.

A subsequent experiment was conducted with a lower initial salt concentration (0.89%) using 40g of steamed soybeans in 40mL of simulated seawater for 1 hour. This resulted in a further reduction to 0.77%. These results suggest that by repeatedly changing the steamed soybeans, it is theoretically possible to reduce the salt concentration in simulated seawater to levels approaching zero percent, potentially rendering the water suitable for drinking according to established standards (typically below 0.5-1% for palatability and health). The observed effectiveness of steamed soybeans in salt adsorption appears promising, and a preliminary observation suggests they may be more effective than other foodstuffs like okra in this regard.

An intriguing observation during these experiments was that applying a frequency of 116 Hz appeared to further enhance the salt reduction, decreasing the concentration from 3.0% to 2.2% in one hour compared to 2.3% without this low-frequency sound treatment.

The frequency of 116 Hz is of particular interest due to its appearance as a prominent peak frequency in studies related to human chanting practices. Specifically, 116 Hz has been studied in the

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context of chanting Nam-Myoho-Renge-Kyo and has been referred to as the "fundamental sound of life" (Hiratsuka and Wakae, 2019). More directly relevant to the observed salt reduction, previous research has indicated that exposure of seawater to a sound at 116 Hz for 30 minutes significantly reduced chloride ion concentration (Hiratsuka and Imamura, 2020). Given that chloride ion is the dominant physiological anion and plays a crucial role in balancing key cations like sodium, potassium, and calcium both in seawater and biological fluids, the observed reduction in salinity in the116 Hz experiment might be linked to this specific effect on chloride ions.

The biological significance of chloride ions, particularly within the central nervous system, where chloride channels are integral to maintaining electrical potentials, regulating cell volume, and influencing cell proliferation and programmed cell death, suggests potential broader implications. It can be hypothesized that if external stimuli, such as specific frequencies like 116 Hz, can modulate chloride ion behavior in aqueous systems (like seawater or even potentially biological fluids), this could hypothetically influence various biological functions, including brain activity, the function of other physiological systems, or even cellular responses relevant to conditions like cancer (for rev., see Ruggiero, 2024). Specifically within the context of oncology and radiation therapy, modulating ion homeostasis via non-thermal means like specific sound frequencies could theoretically impact cancer cell viability, proliferation, or sensitivity/resistance to radiation. For example, altered chloride channel function is implicated in cancer progression and treatment response, making interventions that influence chloride dynamics potentially relevant. Therefore, the preliminary observation of enhanced salt reduction at 116 Hz not only suggests a potential method to improve the desalination process but also opens speculative avenues linking physical phenomena (sound frequencies), ion dynamics, and potential biological effects with potential relevance for cancer research and radiation oncology, drawing parallels with traditional practices associated with this frequency.

The process of using steamed soybeans to adsorb salt from seawater yields a valuable byproduct: soybeans enriched with minerals from the seawater. The potential exists to utilize these salt-containing soybeans as a primary ingredient for making miso. Traditional miso production involves fermenting soybeans with salt and koji (fermented rice or barley). By using soybeans that have already adsorbed salt from seawater, the need to add external salt during miso production could be reduced or potentially eliminated, thereby addressing the historical "salt problem" associated with miso consumption while retaining its established health benefits.

The significant findings from the large-scale epidemiological survey by Hirayama (1982), showing a 50% lower standardized mortality rate for stomach cancer among daily miso soup consumers, underscore the potent health-promoting properties of miso. These effects are attributed to the complex interplay of components in fermented soybeans, including peptides, amino acids, melanoidins, and beneficial microbes, which have demonstrated antioxidant, anti-inflammatory, and potentially anti-cancer activities. Furthermore, recent investigations show that pretreatment intake of soy food and miso soup is inversely associated with the risk of all-cause and stomach cancer death in stomach cancer patients, suggesting potential benefits for patient survival (Minami et al., 2020). It is also particularly relevant that established research highlights miso's potential in preventing various cancers and, significantly, in offering protection against radiation injury (Watanabe, 2013). Studies have shown that miso, especially with longer fermentation times, can increase crypt survival against radiation injury in mice, suggesting a potential radioprotective effect relevant to mitigating side effects of radiation therapy. Producing miso from seawater-treated soybeans could potentially leverage these benefits while offering a more mineral-rich profile, given the similarity in mineral composition between seawater and human body fluids, presenting a novel approach to delivering these potential health benefits.

This approach offers a compelling vision: transforming a readily available resource (seawater) into both potable water and a highly nutritious fermented food (miso) through a simple, potentially low-energy process inspired by traditional food preparation. The inherent robustness and adaptability of miso as a food source, even in extremely challenging environments, is highlighted by recent advancements in space exploration. A notable experiment successfully demonstrated the

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feasibility of food fermentation in space by producing traditional Japanese miso on the International Space Station (ISS) over a 30-day period (Coblenlz et al., 2025). This space-fermented miso was compared to earthbound controls using a comprehensive suite of analytical methods, including environmental metadata, shotgun metagenomics, whole-genome sequencing, untargeted metabolomics, colorimetry, and sensory analysis. The results confirmed that the space miso was recognizable as a fermented miso product, definitively showing that fermentation is possible in microgravity. While key microbiological and sensory differences were observed, suggesting distinctive features imparted by the space environment, the overall success underscores miso's resilience and potential utility. This successful production of miso in space further supports the idea of its potential global, and even extraterrestrial, relevance for nutrition and well-being, making the concept of producing it from locally available (seawater) resources on Earth particularly compelling.

The concept of using seawater-treated soybeans for miso production and drinking water represents a potential convergence of environmental sustainability, nutritional science, and traditional food culture that could instigate a significant shift in our societal values (Hiratsuka et al., 2023). This shift could move from a focus solely on "Truth, Goodness, and Beauty" in abstract terms towards a more integrated understanding of "Benefit, Goodness, and Beauty," where scientific understanding (Truth) is applied to create tangible advantages for human health and the environment (Benefit), aligning with aesthetic and ethical considerations (Goodness and Beauty).

While the experiments presented here are preliminary and require further scientific validation with controlled conditions, larger volumes, and detailed chemical analysis of both the desalinated water and the resulting soybeans, they offer a compelling proof-of-concept. Further research is needed to optimize the salt adsorption process, characterize the mineral content of the treated soybeans, and conduct studies on the fermentation process and the nutritional and health properties of miso produced using this method. The intriguing observation regarding the 116 Hz frequency also warrants dedicated investigation to confirm the effect and explore potential mechanisms.

In conclusion, this work proposes a novel, bio-inspired approach to seawater desalination and food production using steamed soybeans. The preliminary experimental results on salt adsorption are promising and, combined with the established health benefits of miso and the intriguing preliminary observation regarding the 116 Hz frequency, suggest a potential pathway to address critical global challenges related to water scarcity and nutrition. Furthermore, this research explores novel avenues that, with further investigation, could potentially contribute to our understanding of dietary factors and non-thermal physical stimuli relevant to cancer prevention, supportive care in oncology, and modulating cellular responses relevant to radiation therapy. This concept warrants further comprehensive scientific investigation to unlock its full potential for human health and environmental sustainability.

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Ethics: This article is original and contains material that has not been submitted or published in any scientific journal.

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