

International Journal of Statistics and Applied Mathematics

ISSN: 2456-1452
Maths 2023; SP-8(5): 910-914
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<https://www.mathsjournal.com>
Received: 02-07-2023
Accepted: 03-09-2023

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Potential health benefits of Vegan dairy products by using Indian millets: A review and critique

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Abstract

Unwanted impacts on human health and the environment are partially caused by excessive consumption of foods that need a lot of resources, including animal-based goods. Reduced dairy consumption by the use of plant-based dairy products, vegan milk drinks, or nuts based milk is a significant alternative to furthering animal husbandry and resource exploitation. Multigrain proteins must be converted into plant-based dairy substitutes in order to satisfy consumer demand and strengthen the food supply chain to conserve the biodiversity. Various millets support a healthy immune system, lower blood pressure, and fewer cardiac illnesses in humans. Antioxidants included in millet protect against cancer, heart disease, diabetes, and tumour growth. Variety of millets like Kodo millet, Barnyard millet, Proso millet, and Foxtail millet rich in protein and fibre content increased in malted drinks. The dairy substitute comes to the rescue and offers the same level of creaminess and froth as dairy milk without any of the fat, cholesterol, or hormones from cows. On the other hand, plant based foods has no cholesterol, 90% less saturated fat, fewer calories, and all the essential vitamins. Additionally, plant-based milk has various health advantages. Since it produces a product with more protein and less fat, the malting process is advantageous. The malting process proves beneficial since it results in a product with increased protein and decreased fat levels. Along with the all health benefits of vegan milk preparation through the millet, it proved super food and healthier option for each age group.

Keywords: Multigrain, biodiversity, malted drinks, vegan milk, plant based milk

Introduction

Vegan millet-based milk or plant-based milk in general, offers several advantages over animal milk, making it necessary for various reasons. Vegan millet-based milk is free from animal cruelty and exploitation. For those who follow a vegan lifestyle, avoiding animal products is essential to promote ethical treatment of animals and reduce the demand for animal agriculture. The production of vegan millet-based milk generally has a lower environmental impact than animal milk. Raising livestock for dairy production requires significant amounts of land, water, and feed, contributing to deforestation, greenhouse gas emissions, and other environmental issues. In contrast, millet-based milk production can be more sustainable and have a smaller ecological footprint. Plant-based milks, including those made from millets, can be a healthier alternative for some people. They are naturally cholesterol-free, lower in saturated fats, and often fortified with essential nutrients like calcium, vitamin D, and vitamin B12, which are commonly found in animal milk.

Additionally, some people may be lactose intolerant or have dairy allergies, making millet-based milk a suitable option for them. Millets, the grains used to make plant-based milk, are rich in nutrients like fiber, protein, vitamins (B-complex vitamins), and minerals (iron, magnesium, phosphorus). Including millet-based milk in the diet can offer a diverse range of nutrients. Millet-based milk is free from common allergens like dairy, soy, and nuts, making it a safe option for people with allergies or intolerances to these substances. Incorporating millet-based milk into the diet encourages dietary diversity and reduces the reliance on a single food source (e.g., cow's milk). Consuming a variety of plant-based foods can lead to a more balanced and nutritious diet. Growing millets requires fewer resources like water and fertilizer compared to some animal feed crops.

Cultivating millets can support sustainable agricultural practices and potentially benefit local communities. Vegan millet-based milk offers many benefits; the choice of milk depends on individual dietary preferences, health considerations, and ethical beliefs. Millet-based milk is not as common as other plant-based milks like almond, soy, or oat milk.

Pearl Millet

"Pearl millet," also known as "bajra." It is often used in India to make a traditional millet-based beverage known as "bajra milk" or "BAJRAKHEER". Pearl millet is also a good source of essential minerals such as iron, magnesium, phosphorus, potassium, and zinc, as well as B-vitamins like niacin, thiamin, and folate. The nutritional value of bajra milk would largely depend on the proportion of pearl millet used in the preparation and any other ingredients added, such as sweeteners, flavorings, or other additives.

Approximate nutritional composition per 100 grams

Calories	378 kcal
Carbohydrates	73 grams
Protein	11 grams
Fat	4.08 grams
Dietary Fiber	8.5 grams

Sudha *et al.*, 2015, study to development of fermented millet sprout milk beverage based on physicochemical properties

Protein	Ragi is a good source of plant-based protein, making it an excellent choice for vegetarians and vegans.
Dietary Fiber	Ragi is high in dietary fiber, which aids in digestion and helps maintain a feeling of fullness.
Calcium	Ragi contains a significant amount of calcium, essential for bone health.
Iron	It is a good source of iron, which is crucial for maintaining healthy blood and preventing anemia.
Vitamins	Ragi is rich in various vitamins, including B-complex vitamins like thiamin, riboflavin, niacin, and vitamin B6.
Minerals	In addition to calcium and iron, ragi also contains other essential minerals such as magnesium, phosphorus, and potassium.

Ragi milk is considered a nutritious and wholesome beverage, particularly for infants, children, pregnant women, and lactating mothers. It is also an excellent option for those who are lactose intolerant or allergic to dairy products, as it provides essential nutrients without the use of animal-derived milk. Gull *et al.*, 2014 [3], conducted a study to Significance of Finger Millet in Nutrition, Health and Value added Products. Finger millet orragi or mandua is one of the important millet grown extensively in various regions of India and Africa. Fat (1-2%) and protein (6-8%) It is comparable to rice and outperforms wheat and rice in terms of mineral and micronutrient content. High concentration of calcium (344 mg/100g), dietary fibre (15-20%), and phenolic compounds (0.3-3%) from a nutritional view. Other starchy foods lack the essential amino acids isoleucine, leucine, methionine, and phenylalanine which small millet possesses. Numerous health advantages, including anti-diabetic, anti-tumorogenic, anti-atherosclerogenic, and antioxidant activities, are mostly due to the polyphenol and dietary fibre levels present in food. Minor millet is used to make a variety of dishes, both in its natural and malted forms. Millet's grains are processed into flours that are used to make porridge, puddings, pancakes, biscuits, roti, bread, and noodles. Also used as a nourishing diet for infants and is regarded as a healthy food for diabetic patients.

Proso millet

Proso millet (*Panicummili aceum*) is a type of millet that is primarily used as a grain for human consumption, animal feed, or birdseed. While it is a nutritious grain, proso millet is

and consumer acceptability. Millets play a important role in the food of nutritional security, Use of millet for production of fermented millet based milk beverage. Beverages was prepared using skimmed milk along with 3 different millets (finger millets, pearl millet and sorghum). Techniques used for processing millets are soaking, sprouting and extraction of milk from millets. Acceptability was optimized sample was 7.1 which is very close to the predicted value. Nutritional analysis was done for sample prepared using optimize combination of millet milk.

Finger millet

Ragi milk, also known as finger millet milk or ragi porridge, is a nutritious beverage made from ragi (finger millet) flour. Ragi is a nutritious whole grain widely cultivated in India and some other Asian and African countries. It is known for its health benefits and is commonly used in various dishes, including porridges, pancakes, and bread. To prepare ragi milk, and the ragi flour is first mixed with water to create a smooth paste. This paste is then cooked with additional water or milk until it thickens into a porridge-like consistency. Sometimes, sweeteners like jaggery or sugar are added to enhance the taste. Ragi milk can be served warm or cold and is often consumed as a wholesome breakfast or snack. The nutritional value of ragi milk can vary depending on the specific recipe and ingredients used, but in general, ragi is known to be rich in.

not as widely utilized for making milk alternatives as some other grains like rice, oats, or millets like pearl millet (*bajra*). The approximate nutritional value of cooked proso millet per 100 grams.

Calories	378 kcal
Carbohydrates	72.85 grams
Protein	11 grams
Fat	3.85 grams
Dietary Fiber	3.5 grams

Proso millet is gluten-free and rich in essential minerals and vitamins, including.

Calcium	8 mg
Iron	2.08 mg
Magnesium	114 mg
Phosphorus	285 mg
Potassium	195 mg
Zinc	1.23 mg

Proso millet also contains several B-complex vitamins, including.

Thiamin (B1)	0.15 mg
Riboflavin (B2)	0.20 mg
Niacin (B3)	4.72 mg
Vitamin (B6)	0.38 mg
Folate (B9)	82 mcg

Das *et al.* 2019 [2], study on proso millet for human health and environment, consumed as food by people, proso millet offers multiple benefits. Minerals, dietary fibre, polyphenols,

vitamins, and proteins are all high in proso millet. It is gluten-free which makes it excellent for those who cannot tolerate gluten. High levels of lecithin in proso millet help the neurological health system. It is high in essential amino acids (methionine and cysteine), minerals (P, Ca, Zn, Fe), and vitamins (niacin, B-complex vitamins, folic acid). It lowers the risk of type 2 diabetes and has a low glycemic index. proso millet has an impeccable environmental benefit. Proso millet is a useful rotational crop for dryland farming systems based on winter wheat since it has multiple unique properties. When applied in a two-year wheat/summer fallow cropping system, proso millet offers the most cost-effective production method. It helps in reducing disease and pest pressure, controlling winter annual grass weeds, and conserving deep soil moisture for wheat. Because of its resistance for atrazine, the main herbicide used in the cultivation of maize and sorghum, proso millet can also be used in rotation with maize or sorghum. Proso millet is definitely a climate-smart, gluten-free, small-grain cereal that is good for both people and the environment.

Foxtail millet

Foxtail millet (*Setaria Italica*) is a nutritious grain primarily used as a staple food in some parts of Asia. There is limited information about foxtail millet milk being used as a milk substitute. Making foxtail millet milk, you can experiment by blending soaked foxtail millet grains with water and then straining the mixture to achieve a milk-like consistency. Keep in mind that the taste, texture, and nutritional profile of homemade foxtail millet milk may differ from commercially available plant-based milks. oxtail millet is gluten-free and has a low glycemic index, making it a suitable grain for those with gluten sensitivity or diabetes.

The approximate nutritional value of cooked foxtail millet (per 100 grams)

Calories	351 kcal
Carbohydrates	72.85 grams
Protein	11.02 grams
Fat	4.07 grams
Dietary Fiber	6.3 grams

Foxtail millet is a good source of various essential minerals and vitamins, including.

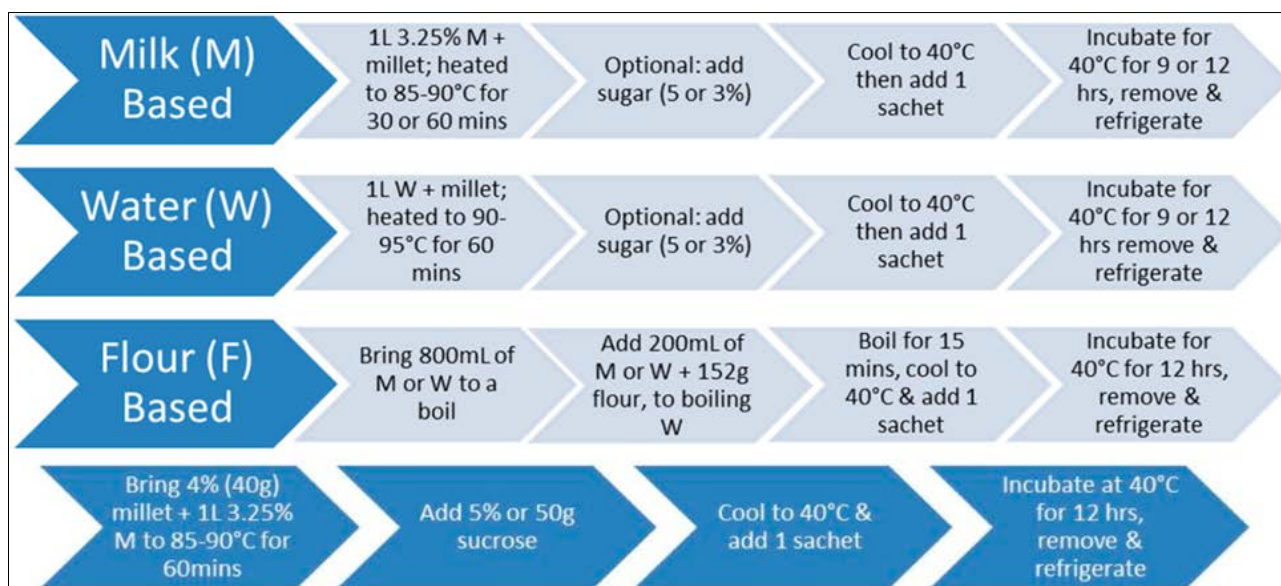
Calcium	31 mg
Iron	2.80 mg
Magnesium	27 mg
Phosphorus	285 mg
Potassium	119 mg
Zinc	1.25 mg

Foxtail millet also contains several B-complex vitamins, including.

Thiamin (B1)	0.46 mg
Riboflavin(B2)	0.10 mg
Niacin (B3)	4.30 mg
Vitamin (B6)	0.35 mg
Folate (B9)	44 mcg

Vegan food and desserts are slowly gaining a popular base amongst foodies across our country. With many celebrities hailing the vegan diet for its various health benefits, the plant based diet has become the latest food trend of 2022. While vegan meats and vegan milk are some of the common vegan diet options popularly available in grocery stores, vegan desserts were an area that needed huge focus. Taking the much needed step towards repleting the dearth of vegan desserts, India’s first 100% vegan millet milk based ice-cream parlour has opened up in South India. In the region of Trichy, in Tamil Nadu, this ice-cream parlour makes ice creams from millet milk that is a 100% vegan. The vegans do not drink milk obtained from any animal including a cow or a buffalo;

many times they have to struggle to find a good dessert parlour that sells vegan ice-creams. However, the parlour that we are talking about has put an end to this problem for the residents who live near the Trichy region of Tamil Nadu. Sachdev *et al.*, 2020 ^[9], study on foxtail millet a potential crop to meet future demand scenario for alternative sustainable protein, 60% of the total protein in mature foxtail seeds is made up of proline-rich, alcohol-soluble proteins (prolamins) called setarins, with less covalent cross-linked protein concentration than in other cereal and millets. For treatment of human chronic disorders, foxtail protein or soluble hydrolysate has demonstrated a number of bioactive properties that demand further investigation. Foxtail millet can be seen as a good choice for replacing foods that contain animal protein due to its low cost and great functional qualities of flour and protein concentrate. Great opportunity for successfully developing low-cost, protein-rich functional food items to help in the management and prevention of chronic diseases linked to lifestyle.

Methods of formulating millets milk**Fig 1:** Methods of formulating millets milk**Milk-Based Millet**

To prepare milk-based fermented millet (shown in the above figure), the same procedure was followed except that one liter of 3.25% homogenized milk, or 50% water and 50% milk, was added to the experimental concentrations of 3%, 4%, 6%, 7%, 9%, and 10% hulled millet. The mixture was brought to 85-90 °C and maintained for 30 or 60 min. After the pre-treatment, the mixture was cooled to 40 °C, before adding the bacterial cultures.

Water-Based Millet

To prepare water-based fermented millet (shown in the above figure), one liter of water was added to the experimental concentrations of 4%, 6%, 7%, 8%, and 10% hulled millet. To degrade the starch in the millet, the mixture was brought to 90-95 °C for 60 min. optionally, 5% sugar (sucrose or honey) was added in the last five minutes of the pre-treatment. After the pre-treatment, the mixture was cooled to 40 °C before adding the bacterial cultures.

Flour-Based Millet

To prepare flour based millet (shown in the above figure), one liter of either milk, water, or 50% water and 50% milk was used. In a bowl, 200 mL of 3.25% homogenized milk was added to 152 g (one cup) of millet flour-obtained by using a blender to grind the whole grain into a flour-and then mixed. Subsequently, 800 mL of milk was added and brought to a boil. Once boiling point was reached, the wet flour mixture was added and stirred constantly at a boil for 15 min. After the pre-treatment, the mixture was cooled to 40 °C, before adding the bacterial cultures. Likewise, the same procedure was applied for the water-based mixture, and 50% water to 50% milk.

Dried Millet

To prepare dried millet (shown in the above figure), one liter of water was added to 400 g of hulled pearl millet in a 2:1 ratio of water: millet. The mixture was then brought to a boil and reduced to low heat, covered and left to simmer until the water was absorbed. After the pre-treatment, the mixture was cooled to 40 °C, before adding the bacterial cultures.

Health benefits of millets**Millets-Obesity**

Now days it is seen that Obesity has become an emerging problem which is associated with several other diseases like Diabetes, Blood pressure and Cardiac problems. Studies suggested that consuming high fibre food helps in improving the bowel function and reduce the prevalence of Obesity by improving the digestion and absorption in the body thereby reducing the risk of chronic diseases. Millets helps in satiating hunger satisfaction and helps in weight management reducing obesity.

Millets-Diabetes

National Institute of Nutrition (ICMR) in 2010 assessed Glycemic Index (GI) of sorghum based foods in collaboration with the Indian Institute of Millets Research, Hyderabad under National Agricultural Innovation Project (NAIP). The results showed that sorghum based foods are having low GI and reduces the postprandial blood glucose level. Finger millet diets showed low glycemic response due to high fiber content. They also help in dermal wound healing process. Diabetes is a disease is found in millions of people throughout the world. Millets help in prevention of Type II Diabetes due to their significant levels of magnesium. Magnesium is an important mineral which helps in increasing the efficiency of Insulin and glucose receptors by producing many carbohydrate digesting enzymes, which manages insulin action.

Millets-cardiovascular disease (CVD)

Millets are also a good source of magnesium which is known for the reducing of heart attack. Millets which are known to be rich in phyto-chemicals which contains phytic acid helping in lowering cholesterol and preventing cardiovascular disease by reducing plasma triglycerides. Millet is a rich source of magnesium, which is an important mineral for reducing blood pressure and the risk of heart attacks of strokes, particularly in the case of atherosclerosis. Millets are also a great source of potassium, which further keeps blood pressure low by acting as a vasodilator. Reducing your blood pressure and optimizing your circulatory system is one of the best ways to protect your cardiovascular health.

Millets-Cancer

Millets showed results that they are rich phenolic acids, phytates and tannins which are the ant nutrients which help in reducing the risk for colon and breast cancer. Millet has linoleic acid which contain anti-tumor activity. Many of the antioxidants found in millets, in addition to their beneficial impact on neutralizing free radicals, which can cause cancer, they can also clean up other toxins from your body, such as those in your kidney and liver. Quercetin, curcumin, ellagic acid, and various other beneficial catechins can help to rid your system of any foreign agents and toxins by promoting proper excretion and neutralizing enzymatic activity

Mishra *et al.*, 2022 ^[5] conducted a study to assess the knowledge of nutritional values and potential health benefits of millets. Millets can act as a multifaceted solution to the above global challenges because of their rich vitamins, minerals, phytochemicals and anti-oxidant content. In addition to vitamins, Millets are the rich source of flavanoids. The presence of essential amino acids enriches the nutritive potential of Millets. The rich anti-oxidant content in Millets reduces oxidative stress in human and animal models by significantly minimizing Reactive Oxygen Species (ROS) generation. Millets are known to decrease cardiovascular risk, diabetes, ageing and even cancer. Millets are effects in reducing anti-nutritional factors enhancing nutrient bioavailability along with the potential health benefits of millets. Consumption of various traditional and modern millet based food.

Prathyusha *et al.*, 2021 ^[6] conducted a study to consumer awareness and health benefits about millets. In the traditional meals, millet has a crucial function to play. The great nutritional benefits of millet can be simply grown. Due to millet's high photochemical content, numerous health-promoting characteristics, such as its ability to prevent diabetes, heart disease, and obesity, are enhanced by millet-based diets. The information that is currently available from published literature, both offline and online, about consumer awareness of millet's health benefits and its beneficial functions, and offers to provide the gathered data in a format that is simple to document. Because millets have a good nutritional profile, nutritionists and dieticians must work to promote millet intake among people of all ages.

Rotela *et al.*, 2021 ^[10] study to assess the importance of millets as a functional food and their health advantages Millets have been examined as useful applicants for the growing trend of functional foods. Because of their antioxidant, anti-aging, anti-microbial, and anti-carcinogenic characteristics as well as several key vitamins like beta carotene (found in yellow pearl millets), niacin, riboflavin, thiamine, and minerals (Ca, Zn, Mg, Fe, and Cu), millets are said to be a significant source of nutrition. Millets are useful for gluten-sensitivity, diabetes, heart disease, vascular disease, gastrointestinal issue, malnutrition, and many other conditions. For millions of the poorest individuals in Africa and Asia, millets remain a staple diet. The beneficial properties of millet as a component in multigrain and gluten-free grain products is highlighted by the fact that it is not currently among the top foods in North America and Europe.

Kaur *et al.*, 2023 ^[4], study to assess millets nutritional make-up, starch modification/extraction, product design, and health benefits, Including macronutrients like protein (7-13%), carbs (60-70%), fat (1.5-5%), and fibre (2-7%) as well as micronutrients like iron, calcium, phosphorus, and magnesium, they provide good nutritional value. These entire positive characteristics, together with the presence of

bioactive components (polyphenols and antioxidants), show that they have therapeutic effects and boost user immunity. Minor millets contain between 50% and 70% starch. A quality that could be covered in attractive food fragments. If natural starches somehow have a poor track record of application in the food and non-food sectors, modification is the only way to address deficiencies. The molecular structure of millet starch can be significantly modified by enzymatic, chemical, and physical means.

Conclusion

Millet-based vegan milk, which is made from various plant sources like Soy, bajara, finger millet, oat, rice, hemp, or cashew, can have various impacts on human health. It is important to note that the health effects can vary depending on the specific type of vegan milk and individual dietary needs. Millet-based vegan milk can be a suitable and healthy alternative to dairy milk for many individuals, especially those with lactose intolerance, dairy allergies, or ethical/environmental concerns. However, it is essential to choose fortified options and ensure a balanced diet that meets all nutritional needs.

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