

CLINICAL IMPORTANCE OF NUTRACEUTICALS PROPERTIES OF MILLETS: AREVIEW

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ABSTRACT

In spite of the presence of high nutritional and nutraceuticals components of Millets, their consumption remains well below in developed countries where diet-related chronic diseases are alarming. Millets are considered as rich source of phytochemicals such as phenolic acids, flavonoids, catechins, phytic acid, and phytosterols. These phytochemicals are reported to have antioxidant and antimicrobial properties. This study will help to know its clinical importance. Most of the health benefits associated with the millets are generally due to the presence of phytochemicals. Some epidemiological studies have shown that regular consumption of millet grains and their products is associated with reduced risk of developing chronic diseases such as diabetes, CVD and cancers. Phytosterol esters have the potential to reduce serum LDL. Arabinoxylan-

oligosaccharides and xylooligosaccharides have a prebiotic effect in the colon and are beneficial for intestinal microbiota. Many healthful effects are attributed to millets and some of these effects have more scientific support. But the strongest evidence for health effects of millets comes from animal studies and evidence from human studies is still limited. Also, there is a lack in the processing techniques, machinery, and standardization of products. Because of health benefits of Millets, these grains do need a great promotion to reach heights of the major cereals in terms of their utilization.

KEYWORDS: Nutraceuticals, Millets, Antioxidants.

INTRODUCTION

In recent years, mankind has started moving towards being fit and healthy. Among various measures adopted for this purpose, dietary changes play a vital role. These altered dietary

practices have incorporated the use of millet into our diet by highlighting its nutritional richness and health benefits. Ayurveda, giving immense importance to the diet of both healthy and diseased, has explained these millets in detail under Dhanya Varga (category of cereals).^[1] The Lancet commission report emphasizes that among more than 14,000 edible plant species that exist on the planet, 150 to 200 are consumed by humans. However, rice, wheat, and maize account for 60% of total caloric intake.^[2] With significantly higher investments in these major crops over the decades, millet species and varieties and their value chain advancements were comparatively stagnant while their consumption significantly decreased over the decades. However, there is a recent resurgence in attention to the need for increasing biodiversity on farms and in diets, including revamped interest in millets, as supported by scientific promotion of millets being smart food that is “good for you, the planet, and the farmer”.^[3] Their nutritional and health benefits are widely recognized, and several pieces of evidence were recently produced to validate those claims. Millets help in managing type 2 diabetes, moderating blood lipid profile, raising hemoglobin levels, and thereby reducing anemia.^[4–6] The term nutraceuticals (like pharmaceuticals) are used for such bioactive compounds from food sources which are having a protective effect against degenerative diseases in its isolated form. Most of the health benefits associated with the millets are generally due to the presence of phytochemicals.

AIM AND OBJECTIVES

To study nutraceuticals aspects of millets (Shridhanyam) and its clinical importance for preventing life style disorder.

MATERIAL AND METHODS

To study nutraceuticals aspects of millets (Shridhanyam) and its clinical importance for preventing life style disorder, the literature search was performed using the following electronic database: Google, Google Scholar, PubMed, Science Direct, Different Research Journals using keywords like Millets, Nutraceuticals. Articles containing research done on nutraceuticals aspects of millets were reviewed, screened and used for deriving conclusion in this article.

RESULT

The following findings are observed after review of different Research articles and electronic database.

Common properties of Millets according to Ayurveda

These are Sheeta (cold in potency), Swadu (sweet in taste), and Swadu Vipaka (Sweet after digestion). They are said to be Vatavardhak, Alpa varchasa, Brimhana, Shukrala.^[7]

The general Guna and Karma (qualities and effects) of millets are,^{[8],[9]}

Rasa- Kashaya-Madhura Veerya-Sheeta

Vipaka-Katu

Guna-Laghu Ruksha

Karma- Lekhana, Vrishya, Kledashoshana, Baddhamalakara

Effect on Tridosha and Dhātu- Kapha-Pittahara, Vata, Rakta Shaamaka.

Nutraceuticals in Millets

1. Phenolic Compounds

Phenolic compounds are generally categorized as phenolic acids, flavonoids, and lignans. They are important source of antioxidants and work in multiple ways to prevent disease associated with oxidative stress, such as cancer and CVD and are well-known antioxidants compounds.

Studies had reported that bound polyphenols were highest in kodo millet, followed by foxtail, little millet, pearl millet, finger millet, and proso millet.^[10] Bound phenolic content in rice samples was less than that of millet samples, thus indicating it as a better source of nutraceutical concentrate. Bound phenolic compounds have antioxidant, antiobesity, antidiabetic, antimutagenic, anticarcinogenic, antimicrobial, and antiviral properties with a potential to inhibit the growth of variety of organisms as well as influenza virus. The potential of phenolic compounds to work as antioxidants arises from their inherent ability to donate hydrogen atoms to electron-deficient free radicals. Pietta reported that polyphenolic compounds such as flavonoids, phenolic acids, and proanthocyanidins are of great interest for the radical scavenging activity and are expected to be effective in the prevention of many diseases and morbid states.^[11] Phenolic compounds in the diet may provide health benefits associated with reduced risk of chronic diseases.^[12] The synergy between phenolics may play a role in mediating amylase inhibition, and therefore, have the potential to contribute the management of type 2 diabetes mellitus.^[13] Being the inhibitors of amylase and glucosidase (similar to acarbose, miglitol, and voglibose), polyphenols result in the decrease in postprandial hyperglycemia.^[14]

2. Phenolic Acids

Phenolic acids are aromatic compounds with one benzene ring and a carboxylic acid function. The common phenolic acids found in finger millet grains include ferulic acid, vanillic acid, caffeic acid, syringic acid, and p-coumaric acid.^[15] Ferulic acid exists in bounded form is major phenolic acid in millets. Ferulic acid is supposed to have a number of health benefits from decrease in total cholesterol level, increase in Vitamin-E bioavailability, and increase in the vitality of sperms and to act as protective agent against UV radiation-induced skin damage. Ferulic acid exhibited very strong antioxidant, free radical scavenging, and anti-inflammatory activity and shows effects against cancer and tumor.

3. Flavonoids

Flavonoids are a class of plant secondary metabolites. Flavonoids such as catechin, anthocyanin, tannin, etc., are important for human health because of their pharmacological activities as radical scavengers.^[16] Studies conducted by Miller et al., 2000 show that whole grains have almost equivalent antioxidant activity (AA) to fruits and vegetables.^[17] Finger millet is the sole millet reported to have condensed tannins.

4. Phytic Acid

Phytic acid is chemically known as myo-inositol. Reddy et al., 1982 found that it is present in bran region of the cereal grains or in cotyledon of oil seeds or legumes inside the protein bodies.^[18]

5. Carotenoid and Tocopherols

Carotenoids protect against various diseases because they act as antioxidants. Recent report by Asharani et al. have shown that values for total carotenoids content in edible millet flour varied from 78 to 366 µg/100 g with an average of 199, 78, 173, and 366 µg/100 g in finger, little, foxtail, and proso millets, respectively.^[19] Vitamin E analyzed by HPLC indicated a higher proportion of γ - and α -tocopherols and lower levels of tocotrienols in the millets. Total tocopherol content in finger (3.6–4.0 mg/100 g) and proso (3.6–4.0 mg/100 g) millet varieties were higher than foxtail and little millet varieties (~1.3 mg/100 g). Vitamin E acts as antioxidant, anti-inflammatory, decrease superoxide production in mitochondria, and anti-atherosclerotic compound.

6. Phytosterols

These are essential structural and functional components of plant cells. As their structure is

very much similar to cholesterol, they show significant lowering in the serum cholesterol levels by altering the rate of uptake of both dietary and endogenously produced cholesterol. Phytosterol esters have the potential to reduce blood serum LDL cholesterol levels up to 14% but no effect on HDL levels.^[20] Daily consumption of phytosterols reduces the risk of heart diseases up to 40% that depends on age and some other factors. Phytosterol content of sorghum and corn was reported to be 0.5 mg/g and 0.9 mg/g.^[21]

7. Arabinoxylans

Arabinoxylans is a class of hemicelluloses which are found as components of plant cell wall. These components as non-digestible are regarded as dietary fibers. Dietary fiber provides bulk to the diet and has a positive effect on cholesterol regulation. Xylo- oligosaccharide content in finger millet bran was estimated at level of 15.60%, wheat bran at 40%, and corn bran 9.33%.^[22] These arabinoxylans undergo enzymatic hydrolysis to yield arabinoxylan-oligosaccharides (AXOS), which consists of arabinoxyloligosaccharides and xylooligosaccharides (XOS). These compounds (AXOS and XOS) shown to have a prebiotic effect in the colon of humans and animals through selective stimulation of beneficial intestinal microbiota.^[23] Studies have shown positive effect of dietary fibers on chronic diseases such as type II diabetes,^[24] CVD,^[25] and gastrointestinal cancer.^[26]

MILLETS AND HEALTH EFFECTS

1. Epidemiological studies have shown a lower incidence of diabetes in millet consuming populations.^[27] Kumari and Sumathi (2002) studied the effect of consuming finger millet on hyperglycemia in non-insulin-dependent diabetes mellitus (NIDDM).^[28] It was found that glycemic index of finger millet was lower than that of rice and wheat. The reason of lower glycemic response may be due to the presence of polyphenols in whole finger millet flour. These are known to reduce the starch digestibility and absorption. The starch digestive enzymes were inhibited by many nutraceuticals which are present in millets.^[29]
2. Diabetes is one of the major and quite a significant risk factor in retinopathy and cataract. In diabetes induced cataract, there occurs an accumulation of sorbitol. This accumulation is mediated by the action of enzyme aldose reductase (AR). Chethan et al. evaluated FMP (Finger Millet Porridges) for AR inhibiting activity to show their antidiabetic and antioxidant potential. Phenolic constituent in Millets such as gallic, protocatechuic, p-hydroxybenzoic, p-coumaric, vanillic, syringic, ferulic, trans-cinnamic acids, and the quercetin inhibited cataract eye lens effectively.^[30] Structural and functional analysis of

phenolics revealed that the presence of -hydroxyl group at the 4th position was important for the aldose reductase inhibitory property.

3. Rajasekaran et al. reported the role of finger millet feeding on skin antioxidant status, NGF production, and woundhealing parameters in healing impaired early diabetic rats.^[31] This study shows, finger millet feeding to the diabetic animals, for 4 weeks, controlled not only the glucose levels but also improved the antioxidant status, which hastened the dermal wound healing process.
4. As being rich in antioxidants, fiber and complex carbohydrates millets have beneficial effects against cancer, cardiovascular disease, and aging. These diseases are caused due to the generation of harmful oxygen species such as free radicals and peroxides which damage the cells. Millets are reported to protect us from oxidative stress.
5. Millets are non-glutinous so they are being used by the people suffering from celiac disease and gluten allergy. It can be replaced in place of wheat in diet. When consumed, they do not form acid in the digestive tract and hence easy to digest. They are also non allergenic.
6. Liver studies have shown that proso millet can be considered as preventive food in liver injury like hepatic encephalopathy upon chronic liver failure and liver injury.

CONCLUSION

Some epidemiological studies have shown that regular consumption of millet grains and their products is associated with reduced risk of developing chronic diseases such as diabetes, CVD and cancers. Therefore, dietary modification by increasing the consumption of a wide variety of fruits, vegetables, and millet grains daily is a practical strategy for consumers to optimize their health and reduce the risk of chronic diseases. Most of the health benefits associated with the millets are generally due to the presence of phytochemicals such as tocopherols, polyphenols, phytosterols, and dietary fiber and also due to the abundant presence of some of the minerals, vitamins, and trace elements. Many healthful effects of millets are supported by scientific studies. The strongest evidence for health effects of millets comes from animal studies and evidence from human studies (epidemiology and experimental) is still limited. Although millet foods are considered among the healthiest food choices that are available, their consumption remains well below in developed countries where diet-related chronic diseases are alarming. There is a lack in the processing techniques, machinery, and standardization of products. Many processed products need to be optimized to give proper benefits to the consumer. Millets have potential to protect against age-onset degenerative

diseases. This area needs to be explored as these diseases are engulfing Indian population. India is the largest producer of millets so we should try to capture the world market by supplying appropriate validated functional foods.

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