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Health and immunity enhancing properties of barnyard millet and its use in the food industry: A study

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Abstract
Consumers' appetite for nutritious and natural foods made from whole grains is rising. They are riche in dietary fibre, low glycemic load and have micronutrients like vitamin such as magnesium, iron and vitamin B. One of the fastest growing small millets is the Barnyard millet (*Echinochloa frumentacea* Link). In the review paper, major varietal variations were observed in physico-chemical characteristics and nutrient composition.

Keywords: Barnyard millet, health gain, nutritional value, functional food.

Introduction
Millets are seasonal cereals, susceptible to drought, cultivated in arid and moderately regions. They are highly nutritious to wheat and rice in respect of proteins, vitamins, minerals and dietary fibre content. There are seven categories of millets usable, in market terms. Pearl, Finger, Foxtail, Proso, Kodo, Barnyard millet (*Echinochloa frumentacea*) and Little millet (Jaybhaye, Pardeshi, Vengaiah, & Srivastav, 2014) [1].
One of the fastest growing crops is Barnyard (*Echinochloa frumentacea* Link), maturing in 90 to 100 days. Many labels, like Japanese barnyard millet, Ooda, Oodalu, Sawan and Sanwank, refer to it. It is a grain suitable for low to moderate precipitation varying between 500 and 700 mm in a temperate zone.
In Japan, China, India and other countries in South East Asia, millet is essential. In India, its cultivation is limited to Tamil Nadu, Andhra Pradesh, Karnataka and the north eastern areas of Jharkhand and Uttar Pradesh on the south eastern portion, which are hilly and semi-arid areas.
The smallest and largest developing millet, *Echinochloa frumentacea* (Barnyard millet), is (Veena *et al*. 2005) [4, 8]. In terms of diet, barnyard millet is also an important crop. This is a fair, highly nutritious source of protein and an outstanding intake of food fiber with additional value of soluble and insoluble fractions (Veena *et al*. 2005) [4, 8].
Barnyard millet (*Echinochloa frumentacea*e), sometimes known as sawa millet, is among the millets frequently grown in India, Nigeria, Niger, China, Burkina Faso, Mali, Sudan, Uganda, Chad and Ethiopia. It is an outstanding source of dietary fiber (13 g/100 g) with high soluble (4.66 g/100 g) and insoluble (8.18 g/100 g) nominal grades and an excellent reference of highly nutritious (81.13 g/100 g) protein (8.18 g/100 g)

Nutritional Value of flaxseed
Millets are rich in nutrients including carbohydrates, proteins, fiber, minerals, and vitamins that are important. The protein content is somewhat close to that of other cereals, but lower levels of carbohydrates are present. The fat content of barnyard millet is very high, which is one of the reasons for reducing the stability of storage. Millets display a greater quantity of inorganic matter and are rich in ash content.
Barnyard millet contains carbohydrates (65%), proteins (11%), fat(3.9%) and crude fiber (13.6 percent). It is also an outstanding source of minerals such as iron (Fe) and zinc (Zn) and oxidative compounds for ants (Hadimani. 1993 and Watanabe, 1999) [3, 5, 6].
The essential minor millets with equal quantities of highly digestible protein (12 percent) (81.13 percent) coupled with low carbohydrate content (58.56 percent) of slow digestibility (25.88 percent) and fat with higher polyunsaturated fatty acids are the barnyard (*Echinochloa frumentacea*), Kodo (*Paspalum scrobiculatum*) and foxtail (Setaria italicl).

Approximately 13 percent of dietary fibre is a major phytochemical portion of small millets comprising approximately 35.66 percent, soluble and 64.34 percent, insoluble Veena fractions (2003) [7].

One of the fastest growing small millets is the Barnyard millet (*Echinochloa frumentacea* Link). In nine varieties of barnyard millet, major varietal variations in physico-chemical characteristics and nutrient composition were observed. In others, strong physical and hydration characteristics have been found. The time for cooking ranged from 8.5 to 12.0 minutes. The varieties showed total minerals (2.7-4.2 percent), calcium (17.1-32.7 mg 100 g-1), iron (1.2-1.5 mg 100 g-1), and starch (51.5-59.5 percent). With soluble and insoluble fractions ranging from 3.5 to 4.6 per cent and 6.1 to 10.5 per cent, the dietary fiber content was fairly large. Protein and starch *in vitro* digestibility ranged from 74.9 to 84.7 percent and from 20.7 to 28.8 percent, respectively, for Veena *et al*. (2005) [4, 8].

Nutritional composition study revealed 11.93 percent of the moisture content of barnyard millet. Barnyard millet's total ash, crude protein, crude fat, crude fiber and carbohydrates were4.27, 6.93, 2.02, 2.98 and 71.87 percent, respectively. The energy value for barnyard millet was 407 Kcal, respectively. 23.16 mg/100 g calcium and 6.91 mg/100 g iron were present in the barnyard millet Suman *et al.,* (2014) [9, 14]. Vivekananda Parvatiya Krishi Anusandhan Sansthan (VPKAS), Almora, procured Barnyard millet (cv. VL Madira 172). The grain was washed, dehulled, polished and pulverized into fine flour (1 min in a rice polisher) (Sieve Mesh No. 65 m). Before further use, this flour was packed in air tight containers. The 11.82 g/100 g moisture, 8.39 g/100 g protein, 2.21 g/100 g crude fat, 1.35 g/100 g minerals, 76.23 g/100 g carbohydrates and 6.5 g/100 g crude fiber were present in the millet. The assessment of the wet gluten content indicated that it has no gluten content (0 g/100 g) Goswami *et al*, (2015) [10].

Barnyard millet for Functional food

Coarse grains are essential and rich in nutrients for small millets. For foods that promote health through the prevention of specific degenerative diseases such as diabetes, cancer, Parkinson's disease, cataract, etc., the term functional foods has been widely used due to the role of health promotion and bioactive phytochemicals in plant foods.

The term nutraceuticals (like pharmaceuticals) is used in isolated form for such bioactive compounds as vitamins, minerals, critical fatty acids that have a protective effect against degenerative diseases.

Due to health-promoting phytochemicals, millets have gained publicity for their potential role as functional foods. For individuals suffering from gluten allergy and celiac disease, millets are healthy. They are non-acid and non-allergenic, which makes them easy to digest (Saleh *et al*., 2013) [22].

Barnyard millet for industrial application

"The millets have different nutritional qualities, and have been correctly referred to as "nutri-cereals. Wheat is historically used in breads, and by replacing wheat with millet to the appropriate degree, millet consumption can be increased. The goal of this study was to optimize composite flours based on millet for bread preparation. By combining 61.8 g/100 g barnyard-millet, 31.4 g/100 g wheat and 6.8 g/100 g gluten, the barnyard-millet and wheat composite flour (BWCF) was formulated and prepared. Using 9.1 g/100 g barnyard, 10.1 g/100 g finger-millet, 10.2 g/100 g proso-millet and 69.6 g/100 g wheat Singh *et al*., another barnyard-millet, finger-millet, proso-millet and wheat composite flour (BFPWCF) formulation was developed Singh *et al.,* (2012) [13].

The goods formulated *viz*. For their sensory qualities, laddu, halwa and biryani from foxtail millet, barnyard millet and rice (control) were analyzed. No substantial difference in color, taste, texture, appearance and overall acceptability of foxtail and barnyard millet laddu and halwa compared to control was noted among the products prepared. Foxtail millet biryani was most acceptable compared to barnyard millet and control biryani Suman *et al.,* (2014) [9, 14].

The dough characteristics and parameters of flat bread quality were studied to substitute a portion of wheat flour with a 3:1 ratio of various minor millets (finger, foxtail, barnyard, kodo, thin, proso). Although damaged starch decreased after substituting wheat flour for millet flour, dietary fiber and phytic acid increased. The millet flours decreased water absorption and dough stability, but Bharati and Hardeep increased protein weakening, gelatinization temperature, and peak viscosity during heating Bharati and Hardeep (2019) [11].

Final multigrain functional beverage of 7 g barnyard, 10 g foxtail and 8 g kodo millet was prepared with 1.2 g/100 g w/v fructose oligosaccharide, containing 5.72 g/100 g total dietary fiber, 47.69 mg ferulic acid equivalent (FAE)/100mL total phenolic content of 1.56 and 45.07 glycaemic index (GI) prebiotic activity, which can be classified as low GI functional beverage (GI < 55) Arya and Naveen (2020) [12].

Barnyard millet is historically used in the Indian Himalayan region as a replacement for rice. Dehulled, fried and eaten as rice are the grains. Barnyard millet porridge is a popular sweet dish in Uttarakhand (locally called madira ki kheer). Barnyard millet is used in southern India in traditional preparations such as idli, dosa and chakli. The millet was also used to produce products such as biscuits, candy, noodles, rusk, ready mix, popped products and some other specialty foods (Arora and Srivastava 2002 [15], Poongodi *et al*. 2003), but in order to commercialize the products internationally, large-scale manufacturing requires industry participation.

For the diabetics, infants and pregnant women, Barnyard millet is highly appropriate for commercial foods due to its high iron content. However, despite its nutritional superiority, the non-availability of ready-to-use processed goods has restricted the usage and acceptability of barnyard millet. To meet the demands of today's customers, there is a need to grow millet-based food products in the form of ready-to-use products and functional foods. In addition to small millets, value not only provides customers with variety, comfort and quality food, but is also essential for the revival of barnyard millet cultivation. Barnyard millet in the Himalayan region is also an important source of fodder. Barnyard millet leaves are wide, and in a short time, the plant regains good growth and thus produces voluminous fodder. Barnyard fodder may be used for making hay or silage and is extremely palatable.

The amylose-rich barnyard millet starch has now gained interest as an antioxidant packaging material in the biodegradable film making industry (Cao *et al*., 2017) [17].

The introduction of borage seed oil into barnyard millet starch increases the elongation range and decreases the properties of the starch's tensile strength, water permeability, and moisture content, making it ideal for the development of biofilm. In the food industry, these biofilms are found to be resistant to various microbes and block light transparency and free radical formation (Cao *et al*., 2017) [17].

The use of an aqueous extract from the aerial sections proposed the use of an aqueous extract from the aerial sections of the aerial sections. A modern eco-friendly approach to bio-synthesizing nanoparticles in plants is the colona plant in the synthesis of silver nanoparticles (AgNPs). As a new eco-friendly approach to nanoparticle bio-synthesizing in plants. Such a synthesis of AgNPs from plant extracts could be a stable and environmentally friendly solution with application possibilities. In the near future, in the fields of medicine, engineering, and agriculture, large-scale research on nanoparticle by Kumar *et al*. (2016) [4, 8].

This property could be exploited for the synthesis of novel antimicrobials in the agricultural and pharmaceutical industries in future protein engineering technologies. In addition to all these, even at several cuttings, Barnyard millet has a greater straw yield and fodder value Mosovska *et al*. (2010) [19].

A decent amount of protein (7.6 percent), digestible fiber (23 percent), ash (12 percent), and fat are found in food (2.0 percent). In addition to its superior feed quality, greater digestibility and nitrogen concentrations have meant that barnyard millet is used in the dry areas of the Deccan plateau to the extreme hills of the temperate sub-Himalayan region as a possible livestock feed crop (Singh and Singh, 2005) [21].

Conclusion

Barnyard millet has remained an underutilized crop, considering its nutritional benefits, and has received very little attention from researchers around the world. This review paper show that the barnyard millet grain is a good source of protein, fiber, carbohydrates, and contains more micronutrients than other essential cereals. For use in the formulation of food. Nutritionally, barnyard millet is a superior grain with decent levels of dietary fiber and macronutrients. It is an essential grain with good cooking and sensory characteristics. Low in terms of calories. Barnyard millet is a good source of highly digestible protein and, relative to all other cereals, is at the same time less dense in calories.

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