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MILLET BASED FOOD PRODUCTS - A FUTURE FOOD

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Introduction:

Cereals called millets are members of the Poaceae grass family is widely used as a food and forage. The most popular varieties of millets are Pearl, Proso, and Finger millet. In general, millets contain 7–12% protein, 65–75% carbohydrates, 15–20% dietary fiber, and 2–5% fat in addition to a sizable number of vitamins, minerals, and bioactive compounds. Crop productivity is restricted by changing climatic conditions, which has a significant effect on food security. As a result, nutritionists and technologists need to reconsider problems associated with low on-field yield, with the goal of identifying suitable crops that could be used as food. A healthy substitute that can meet the dietary needs of a growing number of people is millet. Millets are often overlooked crops that may be grown in arid, hot, and humid climates with low chance of supporting other crops. Because they are high in essential amino acids, millet proteins have drawn interest as a possible replacement for traditional plant- and animal-based proteins. Given their digestibility, emulsification qualities, solubility, and functional qualities, millet proteins can be used in a variety of ways in the food sector. The high glutamate concentration of millet protein is accompanied by high contents of leucine, aspartic acid, alanine, phenylalanine, valine, proline, and lysine. Compared to popular cereals like wheat and rice, millets have larger concentrations of sulfur-containing amino acids (cysteine and methionine). Moreover, millet is free of gluten, making it a good substitute for wheat for those who have celiac disease or gluten sensitivity. A variety of bioactive substances, including flavonoids and hydroxybenzoic and hydroxycinnamic acids, are found in millets and are known to offer multiple health advantages due to their antimicrobial and antioxidant properties.

Millet is used to make a variety of food products because of its nutritional qualities. Millets are used in alcoholic and non-alcoholic drinks, probiotics, and prebiotics. A variety of food products, like bread, biscuits, and cookies, are made with millet. Millets are also integrated with milk and milk products which leads to development of nutrient rich novel millet-based food products.

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Unlocking millet's potential, we can create food that ensures global food security and promotes healthy diets.

Nutritive Composition of Millets

One of the oldest foods in the world is millets and currently cultivated in more than 130 nations, millets represent a staple diet for a billion people in Asia and Africa. Compared to other related staples, millets require less water and agricultural inputs, making them primarily a kharif crop in India.

When it comes to nutrients, millets are equivalent to other cereal grains like wheat, rice, and corn. Different millet grains (pearl millet, finger, foxtail, little, barnyard, kodo, little) have different nutritional contents after milling and 65–75% carbohydrates, 7–12% protein, and 15–20% dietary fibres are found in millets. and 3-5 percent fats. The starch content of millet varies from 60 to 75%, whereas the percentages of amylopectin and amylose range from 16 to 28%. Non starchy polysaccharides (15–20%) and 72% to 84% and sugars (two to three percent).

Consequently, the main energy source in millets is millet starch.

Ranks sixth in the world's grain production after maize, wheat, rice, barley, and sorghum, pearl millet is an important crop and it is the most commonly farmed variety of millet, which is a staple crop in many African and Indian countries. Of all the millets, pearl millet (Bajra) contains the highest concentration of dietary fibers, starch, soluble and insoluble dietary fibers, and macronutrients like iron, zinc, magnesium, phosphorus, and riboflavin. The African finger millet, also known as ragi millet, is the fourth most produced kind of millet. It has eight times the calcium content of other grains and is high in fiber, minerals, and vitamins. Malted and fermented ragi flour is frequently used to make drinks, quick mixes, weaning foods, and pharmaceutical products. It is well known that foxtail millet has a high protein and fiber content.

Novel Protein from Millet

As a crop and in the food industry, millet protein offers a number of potential advantages. However, millets' protein digestibility is not as good as that of many other cereals. This is especially difficult because millet is a staple meal in underdeveloped countries. Furthermore, because each kind of millet has a distinct flavor profile, adding bitterness and a grassy taste to the food is possible. Various modification strategies have been developed globally to overcome these limitations. The fundamental process of millet protein modification entails utilizing many strategies in addition to comprehending the properties and structure of proteins. These alter the amino acid content, shape, and interactions of millet

proteins through physical and chemical changes along with enzymatic breakdown. These changes enhance the food applications' functional qualities and performance.

The process through which changes in temperature, pH, or other variables modify the three-dimensional structure of proteins is known as denaturation. Due to the breakdown

Table 1. Impact of various modification approaches on properties of Millet-based proteins

S. No.	Type of modification	Modification techniques	Modulation in protein characteristics
1.	Physical modification	Conventional heating	Reduced antinutrients like trypsin inhibitors; increased gelling, emulsifying, foaming, and rheological qualities; improved protein hydrophobicity; and improved digestibility.
		Microwave heating	Better emulsification and enhanced gelling qualities.
		Ohmic heating	enhanced emulsifying qualities. reduced foaming qualities and protein solubility.
		Extrusion	Reduced in water holding capacity but enhanced protein hydrophobicity nitrogen solubility and oil holding capacity.
		UV treatment	Improved solubility, increased sulfhydryl content, and improved mechanical characteristics of the produced film.
2.	Chemical modification	Glycation,	Enhances the protein's functionality, solubility, immunomodulatory qualities, foaming and emulsifying ability, flavor profile, and thermal stability.
		Cationization	Enhance encapsulation, solubility, and emulsifying capabilities; improve techno-functional properties.
3.	Biological modification	Enzymatic hydrolysis	Decreases bitterness, improves plant protein's bioactivity, solubility, technological functioning, emulsifying and foaming ability, and interfacial characteristics.
		Fermentation	Improve oil and water holding capacity, digestibility, nutritional value, antioxidant characteristics, solubility, foaming, and functional attributes. reduces allergens, beany, harsh flavors, and anti-nutrient chemicals.

of the initial contacts between the functional groups of amino acids and the creation of new bonds, this may alter the solubility and functional characteristics of the proteins. Protein molecules are broken down into smaller fragments during the protein hydrolysis process as a result of chemical events during roasting or the activation of endogenous enzymes during sprouting. This may cause significant alterations to the protein solubility and amino acid content. Different methods have been devised to handle and alter the millet proteins. These approaches can be broadly divided into four categories: physical, chemical, biological.

Millet Based Food Products

Due to their notable protein content and balanced levels of minerals, fatty acids, carbs, amino acids, and phytochemicals, millets are classified as "Nutri-cereals". Millets are a viable alternative for refining and adding into a variety of food products due to their nutritional profile, particularly for making gluten-free functional foods.

Bakery Based Millet Products

According to studies, millet flour can take the place of up to 40% of wheat flour in baked goods. Products like chocolate cake, soup sticks, masala cake, and gel cake continue to have excellent taste, look, texture, and general acceptability when finger millet is included as an ingredient. Bread can be substituted with foxtail tail upto 30% in the flour. The sensory score revealed that the cookies with the highest degree of satisfaction were those made using a blend of germinated foxtail, barnyard, and Kodo millets in a 70:20:10 ratio.

Fermented Millet Products

Millets are a promising raw material for beverages that are both prebiotic and probiotic. Finger millet is frequently used in beverage preparation. Using 1% (v/v) Lactobacillus rhamnosus in a prebiotic beverage made with 2% pineapple crown powder (PCP), is found to be the ideal white finger millet probiotic beverage.

Alcoholic and Non-Alcoholic Millet Beverages

Drinks made from millet, including clear or kafr beer, pombe, Bantu, and malwa, are more common than other products. In Nepal, Jandh is a traditional alcoholic beverage made from fermented flour millet. Kunun-zaki is a popular fermented non-alcoholic drink made from maize, sorghum/millet, spices, and sugar.

Millet- Milk based Beverages

The number of persons with celiac disease is rising rapidly, and the only way to exclude wheat from their diets is if they use millets. The National Dairy Research Centre in Karnal developed bajra lassi, which combines

the health benefits of lactic bacteria with the improved nutritional value of pearl millet.

Millet based Meat analogues

Millets have been employed as meat substitutes in non-vegetarian dishes to enhance their nutritional value and functionality. These goods combine plant-based materials with proteins derived from animals and other sources, which are deemed to be nutritious and fulfills the customer's craving for meat, especially when they are unable to afford the expensive meat in this way.

Conclusion

A potential candidate for future foods is millet, a drought-resistant grain with a unique nutritional profile and notable agronomic performance. However, millet's undesirable characteristics—bitterness and astringency—make it challenging to create food products. As a feasible alternative to conventional plant- and animal-based proteins, millet proteins are gaining popularity due to their high quantity of essential amino acids. A growing number of people are interested in producing composite millet foods, such as drinks, lassi, probiotic foods, snacks, supplementary foods, extruded foods, and various sweets, by combining millet with other food products. Millets have the power to enhance balanced meals and the nutritional status of populations fighting malnutrition all over the world.