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Research Article

A Review on Its Characterization, Processing, Applications and Health Benefits of Pearl Millet Protein

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Abstract:

Millets have more minerals and vitamins. They have a greater potential to health benefit, fodder, nutrition, livelihood, fibre, and the environment than rice and wheat do. because Millet is a popular seed crop all over the world due to its high amount of micro and macro nutrients such as fibre, protein, vital fatty acids, vitamins and minerals. One of the most significant grains in the world and a significant food crop is pearl millet (Pennisetum glaucum L.). The UN recently declared 2023 as the "International Year of Millet." This review was written with the intention of giving a brief review of the studies on the characterization, preparation, applications, and health benefits of millet-based proteins because grains are the majority of people's main source of nutrition and protein is the 2nd most abundance macronutrient in millet, suggesting that these cereals may be acceptable substitutes for plant-based protein. This knowledge will be crucial in finding research holes that prevent millet proteins from reaching their full potential. Researchers and the food business can use this information further to comprehend the variety of millet proteins that can be used as ingredients in the creation of novel cuisines. In order to increase millet production in India, the study concluded that the right trends, characterization, processing, food applications and health benefits should be provided.

Key words: trends, pearl millets, characterization, processing, food application, health benefits

Introduction

Millets are regarded as an old, nutritious grain and significant food source, especially among the underdeveloped, semi-arid regions of Africa and Asia (Gyawali et at., 2021). The greatest difficulties to food and nutritive security are found in emerging countries like India and Africa, where millets are particularly popular. A 27.8 million tonne production of millet was predicted for the entire world (Gowri et at., 2020). The highest global proportion of millets is produced by India, which has a market share of over 41%, accompanied by Africa. The consumption of millet has decreased by around 1% on a global scale, and is anticipated to increase from 2019 to 2024 (Anbukkani et al. 2017). Millets are essential grains that play a crucial role in the food and nutritional security of enlarge countries. Together, they account for 10% of whole grain manufacturing in Asia. India is the world's largest manufacturer of millets, accounting for more than 80% of Asia's total production (Rao et at., 2015). The scenario of millets using in the industry has been shown by Figure 1.

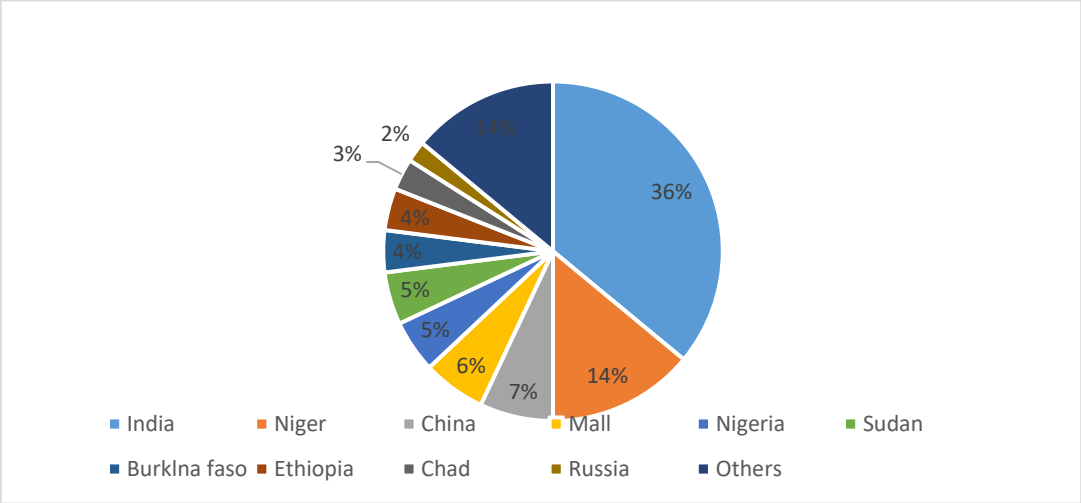

Figure 1: Scenario of Millet Industry

The majority of millets, also referred to as coarse cereals, are produced in India. However, because of their high nutritional content, these cereals are now referred to as "nutri-cereals." Small millets, also called as major millets (Maize, Jowar, and Bajra), are a verities of grain crops that include kodo millet (Varagu), finger millet (Ragi) and proso millet (Panivaragu) (Michaelraj et at., 2013)

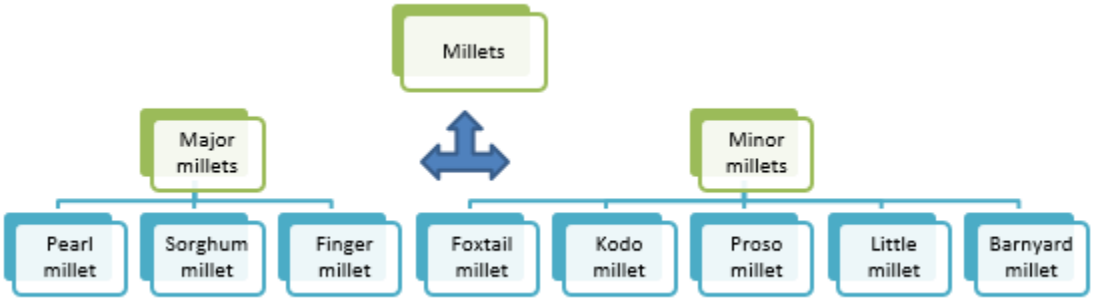

Figure 2: Various types of Millets

The type of millet that is most frequently farmed as a food crop is pearl millet (Pennisetum glaucum L.) (Andrews et at., 1992). More than 95 percent of the world's productivity of goods and area of millet (Pearl) are produced in developing nations. Although though the acreage in the historical production zones of Gujarat, Rajasthan, and Haryana has been diminishing, India remains the world's global producer of pearl millet. While it is occasionally harvested in India, particularly during the summertime production grown largely as a feeding crop, Pearl is typically growing as a dry land multipurpose food crop and gains. Sudan, Malawi, Ethiopia, Zimbabwe, Uganda, Tanzania, Kenya, Zambia, Somalia, Botswana, Pakistan and India are among the nations that grow this crop. It is a harvest with a short develop season (88 to 96 days), fitting into many crop rotation schemes. India cultivates around 13.64 Mha, or 30% of the crop's total world acreage, and this region yields more than 7 Mt of grain annually given by Jain and Bal (1997). As compared to the most widely grown cereal harvesting, such as rice, wheat, and sorghum, pearl millet exhibited greater protein (14.1%), fat (5.6%), fibre (2.1%), and ash (2.0%) contents (Rani et al., 2018). Due to its high levels of linoleic acid (46.3%) and unsaturated fatty acids (75%) compared to sorghum and brown rice, pearl millet has a higher energy content (Jaybhaye et at., 2014). As the amounts of lysine and tryptophan in pearl millet's protein are low, there is an increasing focus on enhancing the quantity and quality of protein in cereal crops (Ali et al., 2003). The study's goal is to Characterized, Preparation, and Pearl millet protein used in food applications.

Materials and Methods

Methodology

The review was organized on the basis of the methodology previously data's with as light modification (Gowda et al., 2022). The point of the survey was to estimate the development of millets and pearl millet protein - characterization, preparation and food applications. Common search terms are characterization, processing, food application and benefits of millets.

Characterization of Millet Proteins

''The Proteins of pearl and Millets: improving Functional and Nutritional Properties for Africa (AFRIPRO)'' was carry in Pretoria in South Africa in April 2003. Millet proteins are nutritionally significant and they feel to have special functional properties that could lead to the production of value-added goods such as environmentally friendly films (Belton et al, 2004). Pearl and tiny millet are the most widely consumed millet varieties. Small millet varieties include finger, proso, foxtail, barnyard, small and kodo millets (Bora et al., 2019). Millets own a specific protein make-up that includes high amounts of important amino acids and a variety of health-promoting properties. Through differ in vitro and animal research assessments, a variety of millet-based bioactive peptides derived from

millets have given important authentication of their health-improving qualities. The structure, amount, and function of macro and micro millet protein are changed by various processing methods (Punia et al., 2022).

Characteristics of Major millets protein

The pearl millet is one of the world's eight major grains, ranking fourth in significance in India in front of wheat, rice and sorghum. The amount of Protein is mainly available in the aleurone layer and endosperm ranged 8.6 to 17.4% and has higher lysine content when compared to other types of grains (Yadav et al., 2019). Prolamins from pearl millet, maize and sorghum, two polypeptide groups may be detected in pearl millet, which are constituted of two main protein categories with Mr's of generally 27, 22, and 27 kD (Marcellino et al., 2002). The major nutritious profile of millets is equal to that of other grains, but millets contain greater amount of fat. There is a lot of variance depending on the species and the growing conditions. They have a high antioxidant and nutritious fibre content, as well as a large amount of various critical essential amino acids, vitamins and minerals (Bagdi et al., 2011). Protein properties were determined by SDS-PAGE (sodium dodecyl sulphate polyacrylamide gel electrophoresis) and LOC (lab-on-a-chip) methods.

Characteristics of Minor millets protein

Minor millets (Foxtail, Barnyard, Finger, Little, kodi, Proso) 6th rank in production after rice, maize, wheat, pearl and sorghum in India. They are superior to other grain crops such as rice and wheat grains in terms of many nutritious qualities such as fiber, vitamins, minerals, content, particularly B1 and B2 and are therefore called as 'NUTRI-CEREALS' Besides giving calories from protein and carbohydrate, the health advantages of ingesting millets have been widely documented, including a lower risk of heart attack or stroke, diabetes and cancer (Sharma at et., 2020). In all five millets, lysine is the most restricting protein. It was significantly lower than that in millets such as sorghum millet and pearl millet, which are similarly deficient in lysine. However, the threonine and methionine amount in these micro millets were higher than those found in grains of cereal. Tryptophan values were close to the levels of sorghum. Leucine material was greater in comparison with different branched chain amino acids in the five millets, the contents being in the ranges observed in pearl and sorghum millet. Except for the lack of lysine and the amino acid content was compared to that of other grains and millets. (Geervani at et., 1989). All millets are high in protein and have protein content is equal to different millet protein with the few deviations of Italian millet. At the current rate of usages, these millets may offer over 90% of the protein requirement of populations using these millets as a staple meal. When compared to macro millets, the amino acid concentration was greater and the lysine level was down.

Characteristics of Pearl millets protein

The protein amount in pearl millet varies from 9 to 21% is similar to that of Wheat (11.7 g/100 g) but is greater than in Sorghum (10.5 g/100 g), Rice (6.7 g/100 g), and Corn (4.8 g/100 g). Amino acid of pearl millet made up of glutelin and glutelin-like compounds (28–33%), albumins and globulins (22–27%), prolamin and prolamin-like (22–35%). The protein composition is also superior to that of sorghum. Pearl millet has 8-60% more crude protein than maize and has 40% more in the amino acid methionine and lysine (Nambiar et al. 2011). Lysine concentration is 21% greater than in maize and 36% greater than in sorghum (Krishnan at et., 2018). It has little Lysine, Tryptophan, Threonine, or Sulfur-holds amino acids. Pearl millet protein is well-balanced, with a higher amount of Threonine and a lower (but acceptable) concentration of leucine than protein of sorghum. Tryptophan content in pearl millet is often greater than in other cereals (Elyas et al., 2002). Figure 3 gives a brief review of the nutritive profile and health benefits of pearl millet. A standardized calibration curve containing bovine serum albumin was used to determine protein content. Lyophilized protein was re-dissolved in water (1 mg/mL), and 5 L of it was combined with distilled water (35 L) and Bradford reagent (160 L). A micro-plate reader was used to measure absorbance at 595 nm against a reagent blank (Agrawal et al., 2016).

Fig. 3 Nutritive profile of Pearl millet

Effect of Processing on Millets

Why should millets be processed? As uncooked whole seeds, coarse cereals are tough to consume. Millets are processed to make them fit for food, as well as to extend their period of storage and nutritional content. Actually, we learned that millets have protein and energy contributions that are beneficial to us; later, we discovered that millets are also an important source of fibre; and finally, we emphasis that millets are a splendid source of phytonutrients. Three principal components of millets – the protective pericarp, the endosperm carrying starch, and the germ, are partially divided or transformed during processing (Birania et al., 2020). Millet and other whole cereals are typically de-hulled and exposed to various procedures prior to taking in order to enhance their sensory and nutritional attributes. Ancient explanation of pearl millet and white sorghum by hand-pounding or using a electronic instruments was done and compared in the laboratory using the identical kernel lots to abrasive decortication. The composition of nutrients (zinc, iron, phytates, lipids, starch, and fibre) and decortication features of decorticated cereals were evaluated (Saleh et at., 2013).

Processing of Pearl millet protein

Millets have high grain characteristics that make them appropriate for preparation. Primary (wetting, de-hulling, and milling) and secondarily (culture, malting, extrusion, glazing, popping, and roasted) activities are involved in the processing of cereals for several final uses. Processing must be to consider at both traditional and commercial levels, engaging small, medium, and large-scale enterprises, as it is a staple and used at the household level (Amadou et al., 2013). De-braning, milling, roasting,

soaking, steaming germination, popping, flaking, ready-to-eat salted grains, and fermented products are examples of traditional handling methods (Gowda et al., 2022). Pearl millet processing methods such as milling, malting, fermentation, blanching, and acid as well as heat processing were found to be effective in achieving better mineral absorption, delayed off flavour, bitterness, and oxidation issues found during storage of flour (Rani et al., 2018). Furthermore, the digestibility of conventional and ugandi proteins improved to 79.1 and 78.6%, respectfully. Increased in vitro protein digestibility after de-hulling, possibly due to the elimination of anti-nutrients such as polyphenols that precipitate. Queen Mary University of London downloaded at 04:07 (PT) on January 7, 2018, proteins were reduced in digestibility, resulting in the manufacture of off-colored items (Jovanovic et al., 2007). The digestibility of proteins is basically a measure of a protein's susceptibility to proteolysis. A protein with greater digestibility has the ability to deliver more amino acids for absorption during proteolysis than one with a low digestibility. Protein digestibility is influenced by both exogenous (protein interactions with non-protein components such as polyphenols, non-starch polysaccharides, starch, tannins, dietary fibre, phytates, and lipids) and endogenous (changes within the proteins themselves) variables. Proteins may interact with non-protein components and with each other during the milling and cooking processes, altering their digestibility (Pushparaj et at., 2011). Because the protein digestibility of pearl millet is low, there is an increasing emphasis on improving protein digestibility by traditional processing techniques. Pearl millet food usage are typically traditional, and processing techniques may include boiling, pressure cooking, roasting, or serving raw after sprouting in salads (Pushparaj et at., 2011).

Food application of Pearl millet

Pearl millet was primarily used in the making of traditional cuisine dishes as well as a feed for poultry and livestock. Due to a lack of commercial applications, pearl millet is a less expensive and more economically viable source of starch separation. Its capacity to thrive in drought and salt-affected locations, as well as its lower growing costs, adds to its attractiveness as an industrial crop. Its collection and application as native and modified starch can give starch-based companies a new path (Punia et al., 2021). Millets are very useful for different types of Food products. It has been shown in Fig 4.

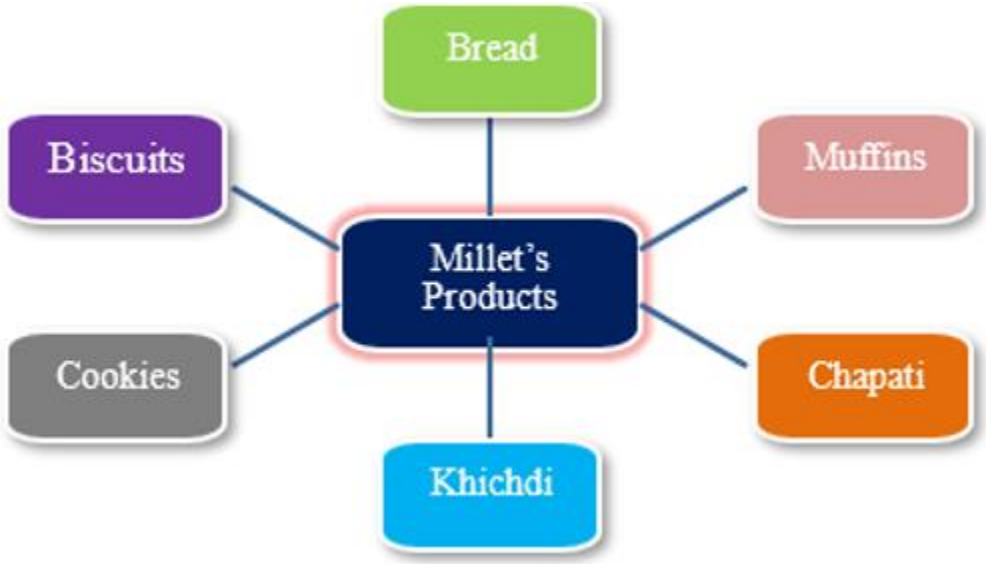

Figure. 4 Different types of Millet's Products

Protein is necessary for food structure maintenance through foaming, gelation, emulsifier and protein with a high liquid temperature is an ideal component for meat analogues, where good foaming qualities and a high water/oil capacity for absorption are ideal for torte, bread, and the sausages. Protein's functional qualities serve as the foundation for product development and food processing, and they are crucial in defining its possible uses. However, there is a paucity of application of pearl millet protein or its protein component as a dietary additive, probably due to a lack of knowledge about its chemical and physical characteristics, structure, and activity (Wang et al., 2021). Although Pearl millet is frequently utilized as an ancient traditional food in the form of sweets, couscous, flatbreads, porridges, aruthi paal, and their nutritive characteristics are well-described in previous studies, the biochemical data regarding Pearl millet available in the database is very scanty and dispersed, particularly for popularly developed Indian cultivars and connections. Furthermore, thorough information on the nutritive, anti-nutritive, bioactive, and mineral content of this grain is still absent, particularly in the Indian context (Tomar et al., 2021). Millets are used to make a variety of food preparation and beverage products, including fermented, non-fermented flatbreads, porridge, beer and non-alcoholic beverages (Mahajan et. al, 2021).

Benefits of Millets

Protein of millets lacks gluten, making it inappropriate for use as the only ingredient in bakery items. Muddle is made from millet flour by heating the dough and shaping it into balls. Millet flours are steeped overnight in cold water including a little butter milk, and the resulting slurry is used to make porridge. Millets and black-gram are wet ground and cultured overnight in a 3:1 ratio before being steamed to produce Idli or cooked on a hot pan to make Dosa or wet pancakes. Millets can be used to make non-traditional foods such as flakes, extruded goods, or by par boiling, popping, and malting. Pearled millets are soaked in water before being steamed under pressure for complete gelatinization of the starch and dried to around 18% moisture. The flakes are then dried after being pressed to the required thickness between high duty rollers. They hydrate fast when added to warm water or milk. Millet flours can be used to make noodle-like items (Michaelraj et at., 2013). There are many benefits of Pearl millet has been shown in Figure 5.

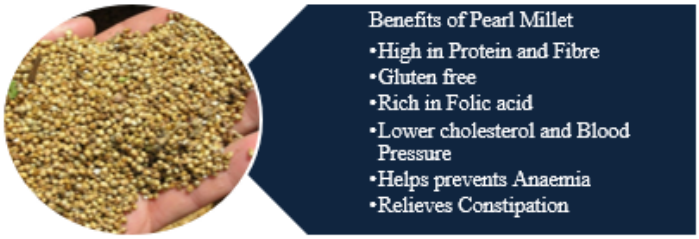

Figure. 5 Benefits of Pearl Millet

Conclusion

Millets continue to be a staple consumption for millions of African and Asian poor people. Millets, like many other grains, have a high carbohydrate energy amount and are nutritive, making them useful components of food dietary and nutritional balance. The combined consumption of millets with other protein sources might compensate for the lack of specific amino acids, such as lysine. Millets are nutritionally richer than other cereals, thus product development based on processing and using millets has undeniable prospects in terms of health benefits, nutrition, and quality. The high protein content of millet flour is advantageous in the formulation of weaning food products. Looking at the variety of the impact of preparation on the nutritional properties of millets, there is still an essential focus on improving minor millet processing procedures to make them more appealing without losing the health advantages. Furthermore, in order to address food shortages and malnutrition, awareness must be raised at both the industrial and household levels about the influence of method of processing on the nutritional properties and health benefits of millets.

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