Importance of morphological and nutritional characters of foxtail millet (*Setariaitalica*(L.) P. Beauv)

Abstract:

Setariaitalica(L.) P. Beauv. is a modest plant which has international focus of its nutritional values, which can reduce the world problem malnutrition. Focus, research and development of major crops are encouraged than regional crops like millets. Foxtail millet stands second largest cultivated species in millets.India is the largest producer of millets in the world. It accounts for 20% of global production & 80% of Asia's production. One of oldest crop and been growing in East Asia since sixth millennium BC.As per the nutritional content is concerned, it has substantial amount of protein(12.3 g), carbohydrates (60–65 g), fiber (6 g), minerals (Phosphorous, calcium, iron, zinc, magnesium, sodium),Foxtail millet is very rich in high nutritious like high fiber, quality protein mineral composition &nutri-ceuticals and owns a very important medicinal values, Reducing Blood pressure & protects against heart diseases, prevents diabetes & breast cancer, Helps to optimize kidney, liver and immune system of health.

Key words: foxtail millet, photochemical, nutritional.

Introduction

Since the era of cultivation, few grains are cultivated for both human and animal consumption, mostly cultivated, produced and consumed crops are rice, wheat and maize. Millets have become a vital part of today'sdiet[3] .Millets characteristically produces small seed and refered as the annual cereal crops [9].Millets are typify of perennial small weeds and of*Poaceae* grass family comes under minor cereal species [22]. Greatly combating malnutrition and beneficial to human health. Millets are enhanced as nutri-cereals with high value of proteins, minerals, vital amino acids and vitamins, with 15% India shares highest world total production accompanied by China, Mali, Senegal, Nigeria, Ethiopia, [11].In semi-arid tropical regions and climaticconditions like Asia and Africa, millets are cultivated and remain the major source of energy. Millets are well suited for cultivation in all Agro-climatic zones and ideal crops for climate resilience of Agriculture. Millets are cultivated with minimal water & inputs hence called as Super foods.Millets can be cultivated in 4 acres, with irrigation water sufficient for one acre of Paddy. Millets requires very less amount of water for cultivation and do not require irrigation or power for production[7]

Foxtail millet (*Setariaitalica*) belongs to the family *Poaceae* and subfamily *Panicoideae* [20], it is an oldest self pollinated crop growing since 5000 BC in China and 3000 BC in Europe [9]. Foxtail millet is cultivated, grown and produced in Europe, China, India, Indonesia and Korea [23]. As compared to rice and wheat, foxtail millet is nutrient-rich whole-grain packed with high level of protein and gluten-free [24]. In India cultivation practices of foxtail millet crop is in (table 1)

Table 1: Foxtail millet varieties cultivated in different states of India

State	Vatieties of foxtail millet
Andhra Pradesh	SiA 2644, SiA 3085, SiA 3088, SiA 3156, SiA 3085, Lepakshi, SiA 326, Narasimharaya, Krishnadevaraya, PS-4, Srilaxmi
Karnataka	SiA 326, HMT 100-1, PS 4,Narasimharaya, SiA 3088, SiA 3156, SiA 3085, DHFt-109-3
Tamil Nadu	TNAU 43, TNAU-186, TNAU 196, CO 1, CO 2, CO 4, CO 5, K2, K3, SiA 3088, SiA 3156, SiA 3085, PS-4
Rajasthan	PrathapKangani (SR 1) and SR 51, SR 11, SR 16, SiA 3085, SiA3088, SiA-3156, PS 4
Uttar Pradesh	PRK 1 and PS 4, SiA 326 (PRASAD), SiA 3156, SiA 3088, SiA 3085, Sreelaxmi, Narasimharaya, S-114, PS-4
Uttarakhand	PS 4 and PRK 1, Sreelaxmi, SiA 326, SiA 3088, SiA 3156, SiA 3085, PS 4
Bihar	RAU-1, SiA 3088, SiA 3156, SiA 3085, PS 4

Source: [4]

1.Morphological characters:

Foxtail millet (*S. italica* L.) is a significantly used both for food and fodder and it is cultivated in semiarid, dry, temperate, warm regions of Africa and Asia [17]. Morphologically foxtail millet is a few tillerand single stack plant. Plant height reaches up to120–200 cm [19]. A single inflorescence can produce hundreds of small convex seeds measuring about 2 mm in diameter, encased in a thin, papery hull [10] .A Full matured plant of foxtail millet has a thin, leaf stems, silky, hairless leaves. The leaves are smooth and hairless, arc-broad and the culms are erect, slender with hollow internodes. The stems are topped by a bristly panicle which is 5–30 cm long and mostly reddish or purplish [19]. The seed head is 5–30 cm long, thick, hairy panicle, seed color may vary amongst genotypes and variety, The color of the seeds varies greatly between varieties,that can be red, brown, black and also pale yellow colour[10, 15]. The non-dormant seeds germinate readily in a glass house at densities up to 100 plants per square meter or in field conditions in temperate or tropical regions [10].

Fig: 2. Black and orange color seed in foxtail millet.

Table 2. Structural comparison of foxtail millet

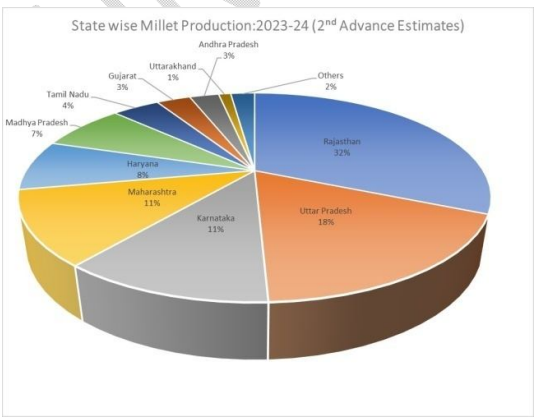
Attribute	Foxtail Millet
Seed type	Caryopsis
Kernel wt (1000 kernels)	2.0
Aleurone (layers)	1
Starch Granules	5-25
Starch type Granule	Simple
Waxy type	Yes
Protein body size (mm)	1-2

Source: [4].

2. Production and consumption:

Foxtail millet is an unrecognized traditional crop where as in many regions it is unaware of its agricultural practices being a traditional and lesser-known grain in many regions, dietary preferences has been overshadowed by more popular options, limited awareness consumption of foxtail millet and also processing facilities[11].However the promotions, availability, cultural factors, regional factors, these factors have contributed to a awareness in foxtail millet consumption, it is important to recognize that consumption benefits would help for certain regions[14].

According to data of 2023-2024in both productionand consumption of wheat, rice and other cereals, India owns the largest production of 309 million tons. Crops like rice wheat and maize are dominating the significance of minor millets with advanced technologiesfor production and cultivation [12].India has the largest producer of millets in the world. Mainly India most grown crops namely Foxtail Millet, Bajra, Sorghum and Bulk wheat together contribute more than 18 per cent in world production in 2022 and states account for around 98 per cent in Millet's production in India during the period 2023-24 But despite their nutritional qualities and climate resilience, the consumption of small millets in India has a declined by 83% in the last five decades probably due to easy availability of Rice and Wheat. The total world production of millets rate was 863 lakh ha according to the Ministry of Agriculture & Farmers Welfare [14], Africa, followed by America, Asia, Europe, Australia, and New Zealand was ranking in production.



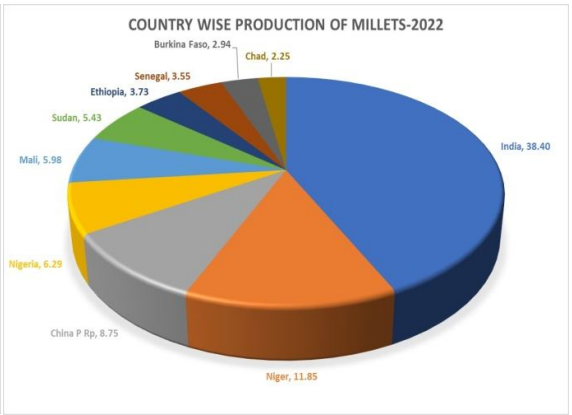


Fig: 2. Millet production in state (2023-2024) and country wise production - 2022

3.Nutritional components of foxtail millet:

The primary constituents of foxtail millets include protein, minerals, dietary fibers, vitamins, carbohydrates, and fat [20]. Foxtail millet grains are rich in protein content (10%–15%), minerals (Fe, Ca, and Zn) dietary fiber (6%–8%), crude fat (7%–8%)[16]. Major millets varieties comparing with foxtail millet , it is shown the higher protein content, it is also having higher number of essentials amino acids including cystein, methionine, and sulfur-containing amino acids.Comparison to the popular cereal like rice, maize and wheat, with the range of 13% to 15% flour starch resistant has been noticed in Foxtail Millet, considered to be outstanding performance for diabetic profile requirement. According to Yang performing with 259 samples colleted from china six provinces of foxtail millet revealed that protein content ranged between 11.85 and 20.58 g/100 g, starch was 65.59–74.12 g/100 g, fat content was ranged between 2.82–4.47 g/100 g. which shows the minimum richly fat and gluten free it outstand with rest of the cereal grains in terms of nutritional evaluation [26].

The major storage proteins in foxtail millet are, albumin, glutelin Prolamin [27] 41% and 77.5% of the total protein in foxtail millet which may vary from varieties to varieties. An average of total protein content is 11.54 g/100 g. The albumin shows the highest protein fraction, followed by gliadin, globulin, glutein, and other proteins, forming [20]. By using chromatographic methods, the researchers frequently studied the amino acid (AA) composition of foxtail millet protein.Fat serves as a major source of energy for people, providing 9 Kcal/g of the energy. Foxtail millet contains both saturated 84%–88% and unsaturated fatty acids [13].

Foxtail millet has both primary and secondary processing operations involved in foxtail millet. Wetting, de-hulling, and milling comes under primary operation and grinding, fermentation, extrusion, malting, gelatinization, popping, and roasting are secondary operation, which help to transfer the seed to millet grain [1, 13].

4. Health benefits by consuming foxtail millet:

According to World Health Organization (WHO), the condition where body do not produce enough insulin is known to be hyperglycemia is having high blood sugar level. Numerious studies have shown the reduction of chronic illnesses; hyperglycemia and hyperlipidemia can be controlled by adding foxtail millet in daily diets [20].They function as anticarcinogens, antihyperglycemic, antihypertensive, antioxidants and anti-inflammatory agents against life threatening disorders such as cancer, cardiovascular diseases, diabetes, and high blood pressure High nutritious like high fiber, quality protein mineral composition &nutri-ceuticalsfoxtail millet is a insoluble dietary fibers could delay the diffusion of glucose and promote its absorption in the gastrointestinal tract [2]. Foxtail Millets are anti acidic, gluten free and detoxify body. Niacin (vitamin B3) in millet can help lower cholesterol.Helps to optimize kidney, liver and immune system of health. Aids in treating respiratory conditions such as asthma.Specifically, the millet protein concentrate was observed to significantly

increase levels of plasma adiponectin and HDL cholesterol, while also leading to significant reductions in insulin levels when compared to a casein diet [1,13]

5. Utilization trends of foxtail millet:

Foxtail millet flour is composite with wheat flour to make chapatti, bread which increases the nutritional properties, [20]. Bakery goods like bread shows the study that high nutrient content with low glycem index [5]. Cookies, promotes the best formulation of nutrient content like protein (11.8%), carbohydrate(45%), fiber (4.6%), water (5%) and ash (1.25%) [17]. Beverages, fermented wine, a Korean fermented wine with rice and foxtail millet increases the quality and flavor [28] and also a traditional sweet gamju usually served as dessert made of beverage [10], branoil,SCFE extracted branoil and also subcritical propane extracted bran oil where SCFE gave maxmimum oil of 7.97%at 47 degrees celcus[18]. Incorporations of foxtail millet with peanuts to prepare peanut [20]. Fermentedsoy and foxtail millet (soybean fermented paste) resulting in great nutritional content and increased self life. [8].

Conclusion

Foxtail millet is very rich in high nutritious like high fiber, quality protein mineral composition &nutri-ceuticalsand owns a very important medicinal values, Reducing Blood pressure & protects against heart diseases, prevents diabetes & breast cancer, Helps to optimize kidney, liver and immune system of health.

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1.

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