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Browntop Millet (*Brachiaria ramosa*): An Overview of the Underutilized Miraculous Multifunctional Millet

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ABSTRACT

Millets are the crops that flourish magnificently even with minimum input requirements and adverse climatic conditions. These gluten-free ingredients stand out from other ingredients in terms of high nutritive value and low price point. The consumption of millets not only provides superior nutrients but also embarks an important role in agricultural stability. Browntop millet (BTM) is a characteristic member of the Poaceace (millet) family which possesses nutritional properties like high protein, iron, phosphorus and fibre content. The nutrient load of this small millet could be positively increased by applying processing methods like soaking, germination, extrudation and sundrying which therefore gives a tough competition to its family members in terms of nutritional and phenolic load. This is a comprehensive review which aims to provide information about ethnobotanical characteristics, nutritional profile, pharmacological benefits and culinary importance of Brown top millet. The health promoting benefits such as anti-inflammatory, cardioprotective, anti-diabetic, anti-oxidative, detoxification and anti-ulcerogenic helps to qualify browntop millet as an efficacious functional food. It may prove as a great alternative to wheat for people with gluten sensitivity and those suffering from obesity issues.

Keywords: *Gluten-free, Agricultural stability, Soaking, Nutritional profile, Culinary, Functional food.*

INTRODUCTION

Millet is a collective term for nutri-rich seeded grasses that belong to *Poaceae* family. They preferably thrive in temperate and tropical regions but can also withstand adverse weather conditions. Millets are broadly classified as major, minor and pseudo millets. Major millets include sorghum, pearl, finger millet; minor millet groups little, foxtail, proso, browntop, kodo, barnyard, fonio, teff and pseudo millet comprises buckwheat and amaranth.[1]Earlier, millets were referred as coarse grains but due to their growing importance, they are now called as 'nutri-cereals' which have the aim to combat malnutrition, provide food security and palatability at the same time.[2,3] Although it is a food crop of great importance in Asia and Africa but they require certain processing mechanisms to make it fit for consumption.[4] They are also being used as animal and bird feed throughout the globe.[5] India is the largest producer and consumer of millets on the global scale whilst United States of America is the largest exporter of millets. Millet

cultivation is predominantly indigenous to African continent but its overall global production has increased by 36% from 1961(575 kg/ha) to 2018 (900 kg/ha) whereas the share of cultivable land for them has seen a gradual decline. Niger occupies the second position in production and consumption followed by China, Nigeria and Mali.[6]

Millets also referred as miracle grains, have a storehouse of nutrients in them ranging from macro to micro nutrients. They contain carbohydrates, high quality protein, dietary fibre, antioxidants, phenols and minerals. They are more nutritious than cereals in some nutrient parameters like energy, fibre and micronutrients. It proves itself as a wonderful replacement of cereals in various foods, not only in terms of nutrient profile but also organoleptic acceptability.[7] They have considerable amounts of nutrients that impose significant health benefits on humans and reduce the risk of lifestyle disorders.[8] Millets have an efficacious role in treating type-2 diabetes and maintaining blood cholesterol level in postmenopausal females and scavenging the free radicals in the body.[9] They have several health promoting properties associated with its name like boosting immune system, prevention of cardiovascular system, cancer treatment, curing anti-ageing related issues and lifestyle disorders prevention.[10,11] The protein concentrates of proso, foxtail and Japanese millet have shown their ability to lessen the effect of type 2 diabetes and instances of cardio vascular diseases.[12] Largely, millets are consumed after their processing as its direct consumption may lead to digestive issues in some individuals.[13]

General characteristics of BTM:

Browntop millet (BTM) is an annual spikelet grass majorly cultivated in Africa, Australia, Western Asia, China and Arab countries. In India, it is grown in southern parts including Karnataka, Tamil Nadu and Andhra Pradesh.[14] It has an efficient action against anti-fungal activity in the growth of seedlings.[15] It is brown-coloured millet commonly known as Sridhanya, Korale, Choti kangni and Karlakki in different regions.[16] BTM flour depicts acceptable shelf life of about 60 days[17] and 90 days, when incorporated into food products due to low moisture content.[18] This ingredient along with some other millet has managed to secure a place in the pool of SMART food categorised by ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). These foods are nutritionally superior and can be incorporated easily in the dishes.[19]

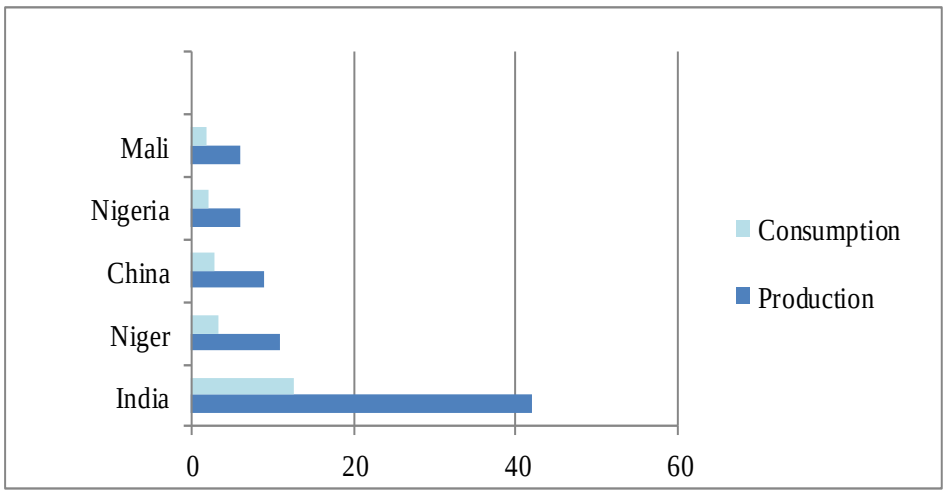

Figure 1: Production and Consumption index of millets globally
Source: Indexmundi.com

Ethno botanical characteristics of BTM:

Brachiaria ramosa or 'Dixie signal grass'[20] is a seeded, tetraploid, warm-season annual grass having its origin in South-East Asia.[21] It is an annual warm-season crop which has an average yield of 12.13 g per plant. It is majorly grown in sandy soil with a combination of organic and inorganic manure[22] but also grows fairly well in *entisols* of Chhattisgarh.[20] Browntop is a good alternative cover plant to manage soil erosion. It is mainly sown in late spring or early summers in well-drained sandy loamy soil that receives adequate sunlight throughout the day.[23]

Kingdom: Plantae
Phylum: Tracheophytes
Class: Liliopsida
Order: Poales
Family: Poaceae
Genus: Brachiaria
Species: *B. ramosa*

Figure 2. Taxonomic classification of BTM

Table 1: Macroscopic description of the BTM plant

Part of the plant	Description
Type	Loosely clustered annual grass
Leaf	linear leaves of 2-25 cm length and 4-14 mm width
Stem	Erect or prostrate along the ground
Root	2 feet fibrous roots
Flower	White in colour
Inflorescence	Indeterminate, open and spreading
Seeds	Tan coloured; ellipsoid in shape
Elevation	200-1800 m
Flowering season	July-October

Source: USDA plants database[24]

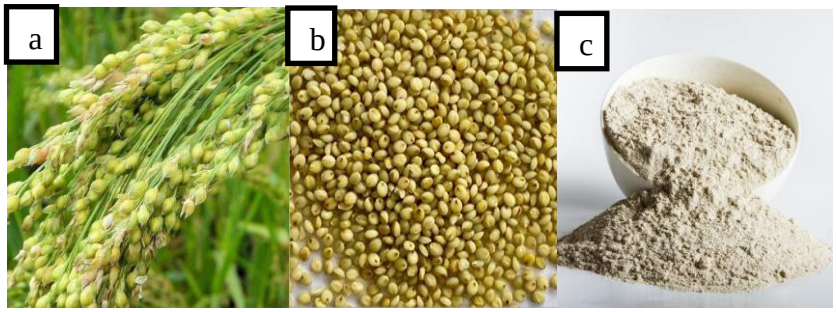

Figure 3: (a) Plant showing seeds (b) BTM seeds (c) BTM flour

Nutritional, Anti-nutritional and Chemical composition of BTM:

They are regarded as nutri-cereals, known to be packed with Proteins, Fatty acids, Calcium, Potassium, Zinc, Magnesium and Vitamin B complexes. The fibre content of the Brown top millet surpasses the fibre composition of all other millets available. They too contain flavonoids like tannins, flavonoids and quinones. The external processes like germination, fermentation and roasting these millets increase the nutritional content and impose positive health benefits. The calcium and iron content this millet possess, provides significant health benefits to pregnant, lactating mothers and adolescents.[25,26] The seeds of the plant contain essential micronutrients like calcium, iron, zinc, phosphorus, magnesium, manganese and copper.[9] According to a study, the extruded four of the browntop millet possess comparatively more nutrients than the non-extruded seed flour.[17]

Overconsumption of browntop millet leads to some complications as it contains phytic acids, goitrogens, tannins and various classes of enzyme inhibitors which reduce

the bioavailability of other nutrients consumed.[27] Majorly, the anti-nutrient content is limited to the seed coat of the millet, which can be removed by implying external processing methodologies.[28]

The phenols and flavonoids present in BTM extracts are gallic acid, ferulic acid, caffeic acid, myricetin and kaempferol. Different processing techniques of BTM like soaking, dehulling, germinating, extruding resulted the nutrients quantity to be carbohydrate content from 77-81 g,[29] protein between 8.8-10.77 g,[30] fat ranged from 3.78-6.27 g and fibre from 5.53-16.33 g.[31] The seeds have high fibre, high vitamin, low glycemic index and low simple carbohydrate content; which make it a must-have ingredient as a diet, that is quite rare in consumption.[32]

Table 2: Nutritional profile of BTM

Nutrients	Amount (per 100 g)
Moisture	11.55 g
Ash	0.81 g
Fat	4.88 g
Protein	11.5 g
Carbohydrates	71.6 g
Fibre	12.5 g
Phosphorus	276 mg
Zinc	2.5 mg
Magnesium	95 mg
Sodium	7 mg
Iron	8.85 mg
Calcium	0.01 mg

Source: IIMR 2020

Table 3: Phenols and Flavonoids of BTM flour extract in water[33]

Compounds	Water (µg/g)**
Gallic acid	30.5 ± 0.3
Vanillic acid	43.1 ± 0.8
Cafeic acid	35.8 ± 0.8
Chlorogenic acid	31.5 ± 0.5
Ferulic acid	46.5 ± 0.5
Myricetin	515.5 ± 0.15
Luteolin	25.1 ± 1.0
Quercetin	36.6 ± 0.5
Kaempferol	52.5 ± 0.5

**All the values mentioned in the above table are expressed as Mean±SD

Health-benefits of BTM:

Cardio protective effect

A study conducted mentions about the preparation of value added food products which consists resistant starch as functional ingredient. Browntop millet (BTM) is a natural ingredient which is rich in resistant starch (RS). It is known to protect against cardiovascular diseases by lowering fat absorption thereby increasing the faecal excretion. It also lowers the risk of obesity by managing blood cholesterol levels.[34] Niacin content of the millet makes it a potent cholesterol lowering component of the food family.[7]

Anti-oxidant activity

The flavonoids (myricetin, quercetin, kaempferol, apigenin) present in BTM have an active role in quenching the free radical formation to prevent or inhibit the cellular damage.[33] The reactive sites of ferulic acid have shown its ability to prevent oxidative DNA damage.[35] This millet is known to reduce the oxidative damage caused by free radicals which prevents the DNA, protein and lipid membrane damage.[36]

Anti-diabetic

The phenolic composition of the millet possesses α-amylase and α-glucosidase inhibitory properties, which prevents rise of blood glucose level by hydrolysing oligosaccharides into simple sugars.[33,37] The magnesium content of BTM (94.5 mg/100 g) helps to manage insulin action by increasing the efficiency of glucose receptors and supporting carbohydrate digesting enzymes.[38] A study reported the regulation of glycemic index due to the presence of phenolics in the browntop millet.[39]

Anti-ulcer activity

The regular consumption of browntop millet prevents gastric ulcers.[40] Its effectiveness has been proved through the study in preventing gastric ulcers and colon cancers.[17]

Culinary usage of BTM:

- The flour of this millet is being incorporated in traditional recipes like dosa, idli, nipattu and payasa across southern part of India.[41]
- BTM has been utilised in preparing convenience foods like Ready-to-Eat (RTE), Ready-to-Cook (RTC) and value-added foods (Singh, et al., 2022).
- BTM is being added as an ingredient in therapeutic food products as a potent functional aspect.[40]
- It can be utilised in foods made for celiac patients because of its gluten-free nature.[42]
- BTM can be added along with other flours to make composite flour, which can be used for making bakery and confectionery products.[16]

CONCLUSION

Browntop millet lies under the umbrella of small millets; that is predominantly known to provide excellent source of nutrition, agricultural stability, nutritional security and also open doors in the field of research study. The incorporation of BTM in food products opens up bountiful opportunities for food scientists and researchers due to its nutrient composition and sensory acceptability. Inclusion of millets in one's daily diet is the new repeated trend for commoners, athletes, influencers, health experts and celebrities to obtain the health benefits, which was traditionally used to satiate hunger as well as obtain the maximum possible nutrients. BTM shines bright in the culinary industry for developing convenience foods and also in replacing the regular flour to enhance the nutritional composition of the prepared recipes. The investigation of various studies revealed that the nutritional and chemical composition of BTM have contributed its part to the family of functional foods in supporting dietary health of individuals.

Declaration by Authors

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