DOI: 10.53469/jissr.2022.09(07).20

Improving the Processing and Nutritional Quality of Millet and Food

Eli Barry

Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.), India

Abstract: ***The most recent study done to date with the goal of improving the processing and nutritional quality of millet grains and their food products. According to the findings of research, millet grains include a variety of health-promoting components such as dietary fiber, minerals, vitamins, and phytochemicals, including phenolic compounds that are equivalent to those found in major grains and offer a number of potential health advantages. Dehydrogenase enzymes found in live tissue convert tetrazolium chloride to formazan, a crimson, water-insoluble chemical, in a Tetrazolium experiment. The impact of variety and moisture content on various physical attributes of two enhanced kodo millet varieties is beneficial in the development of more effective harvesting, handling, cleaning, and processing machinery for improved millet grain cultivars in order to increase their quality and added value. The moisture content of kodo millets ranges from 13.47 to 50.60 percent. The Bradford technique for protein quantification is based on the premise that attaching protein molecules to Coomassie Blue Dye under acidic circumstances causes a colour shift from brown to blue. In the protein estimate experiment, the average is 109.72 g/ml for sample 1 and 114.29 g/ml for sample 2.***

Keywords: Kodo millet, *Paspalum scrobiculatum*, Moisture content, Tetrazolium

1. Introduction

The kodo millet (*Paspalum scrobiculatum L.)* is a tiny grain cereal crop that belongs to the Graminae family of grasses (Poaceae). It was domesticated about 3000 years ago in India and is now found in moist environments all across the world's tropics and subtropics. It is a small grain crop in India, but a significant crop on the Deccan plateau. It is a very old crop, the coarsest of all food grains, and is drought resistant. It is thought to have originated in Southeast Asia, although it is also found in America, Australia, and South Africa. From Kerala and Tamil Nadu in the south to Rajasthan, Uttar Pradesh, and West Bengal in the north, it is cultivated (1).

Minor millets are a family of annual grasses that thrive in dry and semi-arid environments. Paspalum (Gramineae) is a genus of 400 species found across the world's warmer climates. It is grown on 71.9 million acres in India, representing for roughly a quarter of all grain crop land. *Paspalum scrobiculatum L.* is found in moist environments across the old-world tropics, where it grows from sea level to 3000 metres above sea level and is collected as a wild cereal in West Africa and India. They are grown as a grain and fodder crop in South Asia, India, China, and Japan, as well as in the United States (2).

It is a group of small seeded cereal species that have been cultivated in India for over 3000 years. Its wide adaptability, ease of cultivation, and ability to withstand biotic and abiotic stresses have made this crop a key component of the dry farming ecosystem. However, it is not as important in terms of the agro ecosystem. Kodo millet may be cultivated in a variety of soil and climatic conditions, has a short growing season, and can be easily integrated into a variety of cropping systems, both irrigated and dry farming. They can produce nutritious grain and fodder in a short period of time, and their extended storability under normal conditions has earned them the moniker "famine reservoir" (3).

Millets grown for their little grains that are borne on short, thin grassy plants are known as minor millets or small millets, as opposed to large millets (Maize, Jowar, and Bajra). In other words, they are a collection of tiny seeded cereal crops that are widely farmed in arid and semiarid regions across the world and consumed in a variety of forms after cooking by people of all ages. Millets are highly prized by the rural and tribal populations in the drylands. Millets are separated into two categories: Sorghum, Perl millets, Barnyard millets, Kodo millets, Finger millets, Italian millets, Foxtail millets, Proso millets, Fanio millets, and other minor millets (4).

Kodo millet is a monocotyledonous annual grass that reaches a height of four feet. It features a thin, light green inflorescence with 4-6 racemes that are 4-9 cm long, and leaves that are 20 to 40 centimetres long. The seeds it produces are tiny and ellipsoidal, measuring 1.5 mm in width and 2 mm in length, and ranging in colour from light brown to dark grey. The shallow root structure of kodo millet makes it excellent for intercropping. Millets just only a small amount of water to grow. Millets are adaptable to a broad range of ecological circumstances, frequently growing on skeletal soils less than 15 cm deep, and they do not require rich soils to flourish (5).

Wheat, which is a very thermally sensitive crop, may perish from our midst as a result of the anticipated 20-degree temperature rise. Rice, too, is a problematic crop under climate change circumstances because of the manner it is produced in standing water. Millets are year-round crops, but wheat is only grown during certain seasons. Millets, unlike wheat and rice, provide many security benefits (food, fodder, health, nutrition, livelihood, and environmental), making them agricultural security crops (6).

At maturity, the kodo millet is prone to lodging, which results in grain loss.To avoid this, minimal fertilisation is advised, but a lot of fertiliser substantially enhances yields, and there is a danger of lodging with strong development.

Kodo millet is collected by cutting the grass stalk and drying it in the sun for a day or two before grinding it to remove the husk. Weather is a key concern when it comes to appropriate harvesting and storage. Furthermore, threshing on highways destroys the grains, and husking is a time-consuming operation; farmers say that kodo millets are the most difficult grain to dehusk (7).

The kodo millet may thrive in poor soils; var. scrobiculatum, for example, takes very little water to develop and hence has excellent drought resistance. It can be grown without irrigation. On terms of providing fertiliser, farmyard manures are sufficient, although kodo millets can still thrive in low-nutrient soils. The wild variant thrives in humid environments and can tolerate flooded regions and marshy soils (8).

2. Methodology

2.1. Collection of samples

Collect seeds via farm in Kumarganj, Faizabad's Narendra Deva University of Agriculture and Technology.

2.2. Tetrazolium Seed Germination and Viability Test (TZ)

The tetrazolium test is widely accepted as a reliable tool for determining seed viability. It's also a useful research tool for assessing seed viability and figuring out why certain seeds don't germinate.Soak approximately 20 Kodo millet seeds in 1 ml scarification solution for 15 minutes at room temperature. To remove the bleach, wash at least five times with distilled water. Remove excess water after scarification and incubate the seeds in a 1 percent TZ solution at 30 °C for 24 to 48 hours in the dark. Wash the seeds 2-3 times with distilled water after dyeing. Using a magnifying glass or a microscope, the condition was observed and diagnosed (9, 10).

2.3. Germination of Kodo millet

Two genotypes of Kodo millet seeds were surface sterilised by soaking them for 15 minutes at room temperature in a solution of 2.0 percent aqueous sodium hypochlorite and then thoroughly rinsing them with distilled water. For fast germination, the seeds were soaked in distilled water at room temperature for 24 hours prior to germination. The seeds were germinated for 5 days in distilled water on Petri plates with double filter paper (11,12).

2.4. Moistures of Kodo millet

The soil moisture content is a measure of how much water is present in a given area of land. Millets are one of the first meals known to humans, and they may have been the first cereal grain eaten in the home. Millets are resilient, small-seeded grasses that thrive as rain-fed crops in arid climates with little soil fertility and moisture. Millets are also distinct in that they have a very short growth season. In as little as 65 days, they may grow from seed to mature, harvestable plants. When properly kept, whole millets can last two or more years in densely populated places (13, 14).

2.5. Protein estimation by Bradford Methods

A 100 µl protein sample was combined with 2.5 ml Bradford reagent, which was made by dissolving 100 mg of Coomassie Brilliant Blue dye G 250 in 50 ml of 95 percent ethanol and 100 ml of 85 percent orthophosphoric acid in 50 ml of 95 percent ethanol and allowing it to sit for 5-10 minutes. 2.5ml Bradford reagent was added to 0.1ml of standard solution (bovine serum albumin 0.1mg/ml) and maintained for 5-10 minutes. Using the produced blank, the sample's absorbance was measured at 595nm (15).

3. Results

3.1 Germination

The seeds submitted have the following standards of seed germination:

a) Germination 80% (minimum)
b) Moisture content 12% (minimum)
c) Physical purity 97% (minimum)

Figure 1: Germinated seeds in petri dishes

Table 1: Show the germination ratio

S. No.	Day							
Day	0	1	2	3	4	5	6	7
I	0/10	1/10	2/10	2/10	4/10	5/10	7/10	8/10
II	0/10	1/10	2/10	2/10	4/10	6/10	7/10	7/10

The seed approved data on germination tests conducted within one month of the submission date. It also meets all national requirements for genetic purity, homogeneity, hygienic, and phytosanitary standards. No chemical or biophysical treatment has been applied to the seeds' substance. Germination of millet grains boosted free amino acids and total sugars while decreasing dry weight and starch content, according to research.

Figure 2: Germinated of seeds in pots

3.2 Moisture contents on Kodo millets

The moisture content of seeds may be reliably measured either experimentally or through scientific methods. Because determination is harmful to the seeds utilised, and because predictions are often sufficient, determination should only be employed when absolutely necessary. A slight variation in seed moisture content has a significant impact on seed storage life. As a result, it's critical to know the moisture content in order to create a relatively accurate forecast of each accession's probable storage life.

3.3 Protein estimation

The protein content of kodo seeds was determined using the Bradford technique. Despite its youth, this is arguably the most commonly used protein assay. The technique is based on the Coomassie Brilliant Blue Dye's capacity to bind to protein in an acidic solution, causing the dye's absorption maximum to change from 465 to 595 nm.

Table 2: Average of protein estimation

Protein estimation	
S. No.	Average of protein
Sample 1	109.72 µg/ml
Sample 2	114.29 µg/ml

4. Discussion

The tetrazolium (TZ) test is a rapid method for determining seed viability and an alternate approach for determining seed germinability (16).

Tetrazolium penetrates both live and dead cells, but only living cells catalyze the synthesis of formazan, which is non-diffusible and color the viable seeds red, but the lack of respiration inhibits formazan production, leaving the dead seeds (aged tissue) uncolored. Verma et al. have published a brief explanation of this technique. In the case of kodo millet, the tetrazolium test is a useful research tool for assessing seed viability and finding reasons for poor germination (17).

Millet germination may cause biochemical changes, resulting in malt of higher nutritional content that may be utilised in a variety of traditional recipes. Physical, biochemical, and antinutritional characteristics such as seed colour, germinations, and protein estimates are analysed using the two kinds as experimental material. Millets were shown to be an excellent source of protein, fibre, and minerals, as well as having a low-fat level, according to this study. As a result, a variety of new goods might be produced to meet the requirements of consumers while also ensuring nutrition security (18-20).

Some physical characteristics of enhanced millet grains are affected by variety and starting moisture content. The physical characteristics of improved millet cultivars were evaluated after they were conditioned to varied moisture levels (10, 20, and 30%). Regardless of millet variety, grain length, breadth, thickness, and effective geometric mean diameter rose as moisture content increased, but aspect ratio dropped as moisture content increased. The moisture content of kodo millets ranges from 13.47 to 50.60 percent.

The Bradford protein assay is used to measure the concentration of total protein in a sample. In kodo millet the obtained the average of protein is 109.72 µg/ml in sample 1 and 114.29 µg/ml in sample 2.

5. Conclusion

Millets are still a staple meal for millions of African and Asian impoverished people. Millets, like many other cereals, have a high carbohydrate energy content and are nutritious, making them valuable components of a balanced diet. Millets, when processed and used in product development, offer promise nutritional, quality, and health advantages, and may be used as a cereal substitute, but their full extent and use have yet to be determined. More research employing cutting-edge methodologies and a variety of cooking methods is needed to analyse the bioavailability of micronutrients, such as minerals and B vitamins, in order to determine their nutritional benefit *in vivo*.

Although some of the studies listed above addressed the processes and health advantages of small millets, it appears that more study is needed on scientific rationale, positive features, and the production of health foods before these millets may be widely used. Future trends should concentrate on millet consumption in developed countries, which may aid the country's industrial transformation. Seed's breakdown protein, according to the research. Millet seed should be kept with a moisture content of no more than 13%. For millet, no federal grain standards have been developed. Good grade millet seed, on the other hand, should have few broken kernels and be generally free of weed seed.

References

[1] Anoma and Shahidi, F.(2010) Content of insoluble bound phenolics in millet and their contribution to antioxidant capacity. *Journal.of Agric. and Food Chemistry*58(11):6706 -6714.

[2] Anoma and Shahidi, F.(2010) Content of insoluble bound phenolics in millet and their contribution to antioxidant capacity. *Jour. of Agric. and Food Chemistry*58(11):6706 -6714.

[3] Antony, M. Shukla, Y. and Janardhanan, K.K. (2003 a) Potential risk of acute hepatotoxicity of kodo poisoning due to exposure to cyclopiazonic acid. *Journal of Ethnopharmacology*, 87(2-3):21-214

[4] Antony, M. Shukla,Y. and Janardhanan, K.K (2003 b) Potential risk of acute hepatotoxicity of kodo poisoning due to exposure to cyclopiazonic acid. National environmental engineering research institute (NEERI), CSIR complex South kalamassery, Cochin 109:693, India.

[5] de Wet, J. M. J. Rao, Prasada E. K. Mengesha H. M.and Brink.E.D. (1983) "Diversity in Kodo Millet". New York Botanical Garden Pressv. *Journal of Agriculture Sciences*, 14**(**3):754-757.

[6] Dhomne, M.B., Lande, S.S. and Deshmukh, S. N.(2009) Nutritional composition of millet grains. *Animal of Plant Physiology*, 23(1):133.
[7] FAO/WHO. (2001)Health and nutritional properties of probiotics in food includingpowder milk with live lactic acid bacteria. Cordoba, Argentina: Food and Agriculture Organization of the United Nations and World Health, Organization Expert Consultation Report.
[8] Gayathry, G. and Jothilakshami, K. (2012) Development of value added beverages from under utilized millets. *Madras Agriculture Journal*, 99(4/6):407-409.
[9] Geervani, P. and Eggum, O.B. (1989 a) Effect of heating and fortification with lysine on protein quality of minor millets. *Plant Foods for Human Nutrition*, 39(4):349-357.
[10] Geervani, P. and Eggum, O.B. (1989 b) Nutrient composition and protein quality of minor millets. *Plant Foods for Human Nutrition*, 39(2):201-208
[11] Gélinas, P., C. M. McKinnon, M. C. Mena and E. Méndez.(2008) Gluten contamination of cereal foods in Canada. Int. J. Food Sci. Technol. 43(7):1245–1252.
[12] Heuzé, V. Tran, G. and Giger- Reverdin S. (2012 Scrobic (*Paspalum scrobiculatum*L.) forage and grain.
[13] Kulkarni, L. R. and Naik, R. K. (1998) Biological evaluation of minor millets. *Karnataka Journal of Agriculture Sciences*, 11(4):1039-1042.
[14] Kulkarni, L. R. and Naik, R. K.(2000) Nutritive value, protein quality and organoleptic quality of kodo millet (Paspalum scrobiculatum L.). *Ethanopharmacol*, 127(2):125-129.
[15] Kumari, K. K. and Thayumanavan, B. (1998) Characterization of starch of kodo millets. *Plant Foods for Human Nutrition*,53(1):47-56.
[16] Kumar, V.T.P. and Kumar, M.J.B. (2011 a) Value addition by processing of kodo millet (*Paspalum Scrobiculatum*) as a functional foods. *PeryarUniversity, Department of food Science, Coimbatore India*; 699.
[17] Pradhan, A. Nag, SK. and Patil, K.S. (2011) Effect of different nitrogen levels on kodo millet (*Paspalum scrobiculatum* L.) under rainfed condition. *Journal of Agricultural Sciences*, 2(1):138-138.
[18] Sreeramulu, D., Reddy, K.V. and Raghunath, M. (2010) Antioxidant activity of commonly consumed cereals, millets, pulses and legumes in India.Antioxidant activity of commonly consumed cereals, millets, pulses and legumes in India publish in *Indian j. Biochemistry, Biophysics*. 46:112-115.
[19] Vijay kumar, T. P. and Mohan kumar, J.B. (2011 a) Value addition by processing of kodo millet (*Paspalum Scrobiculatum*) as a functional foods. *Peryar University, Department of food Science, Coimbatore India*; pp. 699.
[20] Vijay, N. (2012) Enrich bakery products with millets to increase nutritional value. *University of Agriculture Science.*