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Nutritional analysis of millet milk (Foxtail millet, barnyard millet and finger millet) and it's product

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Abstract

Three millets namely Foxtail Millet, Barnyard Millet and Finger Millet were used in the present study to extract milk and product was also developed from the extracted milk. The residues left after the milk extraction was used in making into bars. Nutrient analysis was done for the products made. Significant difference was observed in treatments of millet milk and control milk. The moisture content of millet milk of all the millets used were comparable to the moisture content of control milk (cow milk). The amount of the parameters of proximate analysis was decreasing with increasing dilution with water (T₁ having highest concentration and T₄ having lowest concentration). All the other nutrients were also in comparable amount from control milk (cow milk) except fat and protein. Fat in millet milk was comparatively less than cow milk and protein content was higher in millet milk than cow milk. The millet residue energy bar was also having good nutritional qualities. Highest protein content was in Barnyard millet residue energy bar (8.5±1.4%), moisture content in foxtail millet residue energy bar (8.4±0.1%), ash in foxtail millet residue energy bar (4.2±0.1%), carbohydrate in finger millet residue energy bar (75.3±0.1%), fibre in foxtail millet residue energy bar (4.0±0.1%). Foxtail and Barnyard millet residue energy bar was having similar fat content (3.2±0.1%).

Keywords: Millet milk, chapati spread, proximate analysis

Introduction

One of the ancient cereals, millet, has been grown in African countries since 2700 BC. The term "millet" refers to a group of little seeded grains that belong to the Poaceae family. Due to its shorter growth season than other major grains, resistance to pests and diseases, and ability to endure drought, millet is a crop of great importance. Millet is a gluten-free food. Sorghum, finger millet, pearl millet, minor millets (barnyard millet, proso millet, kodo millet, small millet, and foxtail millet), maize, and barley are examples of coarse grains that have historically been cultivated in warm climates and utilized as food and fodder. Because millets are a sustainable food source that helps fight hunger in a world where climate change is happening, their cultivation provides food security. Because millets are highly resistant to climate change and need little initial investment, they are a crop that helps farmers maintain economic security. Millet can be used as a substitute for those who suffer from celiac disease (Singh & Singh, 2016) [15]. Vegetarian diets are becoming more and more popular worldwide as concerns about environmental and personal health issues grow (Messina & Mangels, 2001) [10]. This has made it easier to create plant-based milk substitutes. In the past, the majority of plant-based milk substitutes, including soymilk and ragi milk made from finger millet, were manufactured on a small scale for household use or on a large scale for business use, with the intention of benefiting the community or the family (Jeske *et al.*, 2019) [5].

A plant's seeds or edible sections are dissolved and broken down by soaking or wetting them in water extracts to create plant-based milk substitutes; alternatively, the raw material can be ground dry and the flour can be recovered with water; the resulting slurry is then filtered or decanted to remove insoluble plant parts and ground debris (Jeske *et al.*, 2018) [6]. The first commercially available plant-based milk substitute was soymilk. In the process of creating non-dairy milk alternatives, other plant ingredients such as cereals, pseudocereals, and grains like oats, barley, almond, coconut, rice, millet, corn, sorghum, quinoa, and chia were added (Pineli *et al.*, 2015; Salmerón *et al.*, 2015; Sethi *et al.*, 2016) [11, 13, 14]. Plant-based milks are an excellent alternative to dairy products because they lack some of the components found in dairy products, such as cholesterol, saturated fats, antigens, and lactose.

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They are also a good source of minerals, non-allergic proteins, essential fatty acids, and other nutrients (Das *et al.*, 2012) ^[13]. More and more underprivileged people in developing nations are searching for less expensive options, such plant-based milk alternatives. It is now recognized that plant supplies of vitamins, dietary fiber, minerals, and antioxidants can be found in grains and legumes, which can serve as dairy milk substitutes (Das *et al.*, 2012) ^[13].

Materials and Methods

The study was carried out in the food science and nutrition department's research labs at the Chandra Shekhar Azad University of Agriculture and Technology. The millets that were used, finger millet, barnyard millet, and foxtail millet, were bought at the Kanpur, Uttar Pradesh, local market. The local Kanpur, Uttar Pradesh, market was the source of all other consumables.

Formulation of Products

Millet Milk

Each millet weighed 200g was steeped for 12 hours. Extra water was emptied after soaking. Four treatments—referred to as treatments 1 (T₁), 2 (T₂), 3 (T₃), and 4 (T₄)—were created using varying ratios of millet to water. In T₁, T₂, T₃, T₄, and T₅, the millet to water ratios were as follows (1:2), (1:3), and (1:5). After the 200g of soaked millet was split into 4 equal portions of 50g each, water was used to grind the grain in order to prepare the various treatments. With the aid of muslin cloth, filtration was carried out following grinding. To achieve homogeneity, the extracted milk was ground for ten more minutes.

Millet Residue Energy Bar

Ghee was used to roast the leftovers from the milk extraction process. Sesame seeds and roasted peanut powder were combined with it. Cooking jaggery with water produced jaggery syrup. Fourteen percent of the residual left was jaggery. After all the ingredients were combined, the food was cooked over a medium heat. It was then given the shape of an energy bar.

Proximate Composition

Moisture content of products was determined using AOAC (1990) and IS-2785-1975. Ash content was determined by IS:SP 18 (Part IX) 1981. Crude fibre was determined using the method used by Madu *et al.*, (2021) ^[8]. Fat content was determined by using IS 1224-2 (1997) and AOAC 2000. Protein content was determined using method used by Markwell *et al.*, (1978) ^[9]. Total carbohydrate content was determined using AOAC 1990.

Statistical Analysis

Three parallel replicates were used to obtain the mean and standard deviation. Values are expressed as Mean $\pm$ SD of three determinations. S/NS shows whether treatments differ significantly or non-significantly statistically at $p < 0.05$ from control. Control cow milk (T₀), T₁ (millet to water ratio 1:2), T₂ (1:3 millet to water ratio), T₃ (1:4 millet to water ratio), T₄ (millet to water ratio 1:5). Microsoft Excel's Completely Randomized Design (CRD) tool was used for all of the

analysis. For every aspect in the sensory evaluation, an ANOVA was calculated to ascertain the significance (Johnson, 1972).

Results and Discussions

Millet Milk

The results indicate that the moisture content of foxtail millet milk of different treatments (T₁-T₄) ranged from 83.4 $\pm$ 0.3 to 87.7 $\pm$ 0.3. The moisture content of barnyard millet milk of different treatments (T₁-T₄) ranged from 84.4 $\pm$ 0.2 to 87.5 $\pm$ 0.3. The moisture content of finger millet milk of different treatments ranged from 84.6 $\pm$ 0.1 to 89.0 $\pm$ 0.2. Control milk (cow milk) was having moisture content 84.6 $\pm$ 0.2. The results obtained are similar to cow milk moisture content (85.98 $\pm$ 0.02%) as reported by Dhankhar *et al.*, (2019) ^[4].

The results indicate that protein content of foxtail millet milk of different treatments (T₁ to T₄) ranged from 6.1 $\pm$ 1.4% to 4.9 $\pm$ 1.4%. The protein content of barnyard millet milk of different treatments (T₁ to T₄) ranged from 7.7 $\pm$ 1.9% to 5.1 $\pm$ 1.2%. The protein content of finger millet milk of different treatments (T₁ to T₄) ranged from 7.0 $\pm$ 1.8% to 5.0 $\pm$ 1.4%. The protein content of cow milk (control, T₀) was 3.0 $\pm$ 0.1% similar to cow milk protein (3.24 $\pm$ 0.03%) as reported by Kundu *et al.*, (2018) ^[7].

The fat content of foxtail millet milk for different treatments (T₁-T₄) ranged from 0.06 $\pm$ 0.02% to 0.3 $\pm$ 0.05%. The fat content of barnyard millet milk for different treatments (T₁-T₄) ranged from 0.2 $\pm$ 0.05% to 0.5 $\pm$ 0.05%. The fat content of finger millet milk for different treatments (T₁-T₄) ranged from 0.3 $\pm$ 0.05% to 0.5 $\pm$ 0.05%. The fat content of control group (cow milk, T₀) was obtained 3.8 $\pm$ 0.2% similar to fat content (4.3 $\pm$ 0.006%) obtained by Dhankhar *et al.*, (2019) ^[4].

The ash content in different treatments (T₁-T₄) of foxtail millet milk ranged from 0.1 $\pm$ 0.05% to 0.5 $\pm$ 0.05%. The ash content in different treatments (T₁-T₄) of barnyard millet milk ranged from 0.7 $\pm$ 0.1% to 0.5 $\pm$ 0.05%. The ash content in different treatments (T₁-T₄) of finger millet milk ranged from 0.06 $\pm$ 0.02% to 0.5 $\pm$ 0.1%. The ash content of control group (cow milk, T₀) was 0.6 $\pm$ 0.05. The obtained results are in line with the findings of Dhankhar *et al.*, (2019) ^[4] and Punniyamoorthy, (2018) ^[12].

The crude fibre content in different treatments (T₁-T₄) of foxtail millet milk ranged from 0.4 $\pm$ 0.1% to 1.6 $\pm$ 0.2%. The crude fibre content in different treatments (T₁-T₄) of barnyard millet milk ranged from 0.2 $\pm$ 0.1% to 1.3 $\pm$ 0.05%. The crude fibre content in different treatments (T₁-T₄) of finger millet milk ranged from 0.1 $\pm$ 0.05% to 0.9 $\pm$ 0.1%. The crude fibre content in control group (cow milk, T₀) was 0.5 $\pm$ 0.1.

The carbohydrate content of different treatments (T₁-T₄) of foxtail millet milk ranged from 5.9 $\pm$ 0.1% to 9.2 $\pm$ 0.1%. The carbohydrate content of different treatments (T₁-T₄) of barnyard millet milk ranged from 4.1 $\pm$ 0.1% to 6.5 $\pm$ 0.05%. The carbohydrate content of different treatments (T₁-T₄) of finger millet milk ranged from 4.0 $\pm$ 0.05% to 7.2 $\pm$ 0.1%. Control group (cow milk, T₀) carbohydrate content was 4.9 $\pm$ 0.1 which was similar (4.81%) to result reported by Antunes *et al.*, (2023) ^[1].

Table 1: Proximate composition of foxtail millet milk

Proximate Composition (%)	Foxtail millet milk					S. Em.	C.D. @ 5%	S/NS
	T ₀	T ₁	T ₂	T ₃	T ₄			
Moisture	84.6±0.2	83.4±0.3	84.9±0.2	86.2±0.1	87.7±0.3	0.15	0.47	S
Ash	0.6±0.05	0.5±0.05	0.4±0.05	0.2±0.05	0.1±0.05	0.03	0.11	S
Protein	3.0±0.1	6.1±1.4	6.0±1.1	5.6±1.2	4.9±1.4	0.07	0.22	S
Fat	3.8±0.2	0.3±0.05	0.2±0.05	0.1±0.05	0.06±0.02	0.06	0.19	S
Fibre	0.5±0.1	1.6±0.2	1.2±0.2	0.9±0.05	0.4±0.1	0.09	0.28	S
Carbohydrate	4.9±0.1	9.2±0.1	8.1±0.1	7.4±0.1	5.9±0.1	0.07	0.21	S

Note: Control cow milk (T₀), T₁ (millet to water ratio 1:2), T₂ (1:3 millet to water ratio), T₃ (1:4 millet to water ratio), T₄ (millet to water ratio 1:5)

Table 2: Proximate composition of barnyard millet milk

Proximate Composition (%)	Barnyard millet					S. Em	C.D. @ 5%	S/NS
	T ₀	T ₁	T ₂	T ₃	T ₄			
Moisture	84.6±0.2	84.4±0.2	85.1±0.2	86.0±0.1	87.5±0.3	0.14	0.45	S
Ash	0.6±0.05	0.7±0.1	0.6±0.1	0.4±0.1	0.2±0.1	0.06	0.18	S
Protein	3.0±0.1	7.7±1.9	6.9±1.1	6.0±1.2	5.1±1.2	0.08	0.25	S
Fat	3.8±0.2	0.5±0.05	0.4±0.05	0.3±0.05	0.2±0.05	0.06	0.19	S
Fibre	0.5±0.1	1.3±0.05	1.0±0.1	0.6±0.05	0.2±0.1	0.05	0.16	S
Carbohydrate	4.9±0.1	6.5±0.05	6.1±0.1	5.4±0.1	4.1±0.1	0.07	0.22	S

Note: Control cow milk (T₀), T₁ (millet to water ratio 1:2), T₂ (1:3 millet to water ratio), T₃ (1:4 millet to water ratio), T₄ (millet to water ratio 1:5)

Table 3: Proximate composition of finger millet milk

Proximate Composition (%)	Finger millet milk					S. Em.	C.D. @ 5%	S/NS
	T ₀	T ₁	T ₂	T ₃	T ₄			
Moisture	84.6±0.2	84.6±0.1	85.8±0.2	87.4±0.3	89.0±0.2	0.14	0.44	S
Ash	0.6±0.05	0.5±0.1	0.4±0.05	0.2±0.1	0.06±0.02	0.04	0.13	S
Protein	3.0±0.1	7.0±1.8	6.2±0.9	5.5±1.4	5.0±1.4	0.05	0.16	S
Fat	3.8±0.2	0.5±0.05	0.5±0.05	0.4±0.05	0.3±0.05	0.06	0.19	S
Fibre	0.5±0.1	0.9±0.1	0.5±0.05	0.3±0.05	0.1±0.05	0.05	0.17	S
Carbohydrate	4.9±0.1	7.2±0.1	6.2±0.1	5.2±0.1	4.0±0.05	0.07	0.22	S

Note: Control cow milk (T₀), T₁ (millet to water ratio 1:2), T₂ (1:3 millet to water ratio), T₃ (1:4 millet to water ratio), T₄ (millet to water ratio 1:5)

Table 4: Proximate composition of millet residue bar

Proximate Composition (%)	Foxtail millet	Barnyard millet	Finger millet
Moisture	8.4±0.1	8.9±0.3	8.3±0.3
Ash	4.2±0.1	3.5±0.1	4.0±0.2
Protein	8.2±1.2	8.5±1.4	8.4±1.3
Fat	3.2±0.1	3.2±0.1	3.0±0.1
Fibre	4.0±0.1	3.7±0.1	3.8±0.1
Carbohydrate	75.2±0.1	74.9±0.1	75.3±0.1

Note: Values are expressed as Mean ± SD of three determinations.

Conclusion

For people with lactose intolerance who are unable to consume dairy milk or its derivatives, millet milk is a great substitute. It was discovered that people could tolerate the created millet milk and its byproducts. Most of the nutrients in millet milk was in comparable amount to the dairy milk. The millet residue bar was also a good idea for handling food waste. It increased the value of millet residue and also made a good use of it.

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