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Research Journal of Agricultural Sciences

ISSN: 0976-1675 (P)
ISSN: 2249-4538 (E)

International Conference on "Millets- Ensuring Food Security and Sustainable Farming"
Volume 14; Issue 04 (July-Aug 2023); pp 1015–1018

Full Length Research Article

Effect of Soaking, Germination and Drying on Anti Nutritional Factors and Antioxidant Assay in *Pennisetum glaucum*

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Abstract

Numerous varieties of millets are grown in India. Among them Pearl millet is a small but mighty grain prosperous in nutrients and are green foods of future. Pearl millet was subjected to different soaking intervals such as 8 hours, 12 hours, 16 hours, 20 hours and 24 hours. Soaking improves the texture and decreases the anti-nutritional properties of pearl millet. In this research, it was found that pearl millet which was soaked for 24 hours contained less anti-nutritional factors. Hence, it was chosen for further process of germination at four different intervals such as 24 hours, 48 hours, 72 hours and 96 hours. Germination leads to greater bioavailability of nutrients and increases the antioxidant activity. The germinated samples were partitioned equally and subjected to sun drying at 30-40°C and hot air oven drying at 45°C. The dried samples were powdered finely. The main objective of the present study was to evaluate the effect of physical dimensions, anti-nutritional factors and antioxidant activity of the pearl millet subjected to different soaking, germination and drying methods. The result indicated that the germination process showed the maximum influence on the antioxidant assay. The comparative analysis of the soaking and germinating period showed that 24 hours soaking and 96 hours germination was found to be the best method to process the pearl millet due to its increased antioxidant activity and decreased anti-nutritional factors. The consumption of germinated pearl millet increases the nutritional status of the human being.

***Key words*:** Pearl millet, Soaking, Germination, Antioxidant assay

Our ancestors consume millets as their staple food. Millets have significant role on their livelihood. During the publish green revolution, the exceptional upward rise in the production of wheat and rice has occurred, resulting in the acceptance of these cereals as the staple food. Unfortunately, the nutritious millets have lost their identity. Millets are low water consuming crops with small sized monocotyledonous grains, prosperous in nutrients and are green foods of future. Enormous varieties of millets are grown in India. Nutritional profile of millet makes it as extraordinarily useful for human food (Sachdev and Goomer, 2018). Among them Pearl millet (*Pennisetum glaucum*) is a staple food for large segment of the population in Asian and African countries where it contributes a predominant part of listing nutrients (Burton et al., 1972). The rainfall needed for Pearl Millet is less than 25% of sugarcane and banana, and 30% that of rice. To grow one kg of rice 4000 litres of water is needed, while pearl millet can grow without irrigation (DDS). In developing countries, pearl millet is identified as a necessary crop, which helps with meals shortages and meeting the dietary demands of an increasing population. It constitutes a vital source of dietary calories and protein in the daily eating regimen of a giant segment of the negative populace (Patni and Agrawal, 2017).

In India, pearl millet is the major source of dietary energy (360 kcal/kg) for rural population and 4th most essential cereal after rice, wheat and sorghum. It consists of high amount of thiamine, riboflavin and niacin (Gupta et al., 2022). Pearl millet grains are nutritionally related or even ideal to most important cereals such as wheat and rice owing to higher levels of protein with greater balanced amino acid profile, dietary energy, vitamins, several minerals especially micro nutrients such as iron, zinc and insoluble dietary fibre which helps to decrease glycemic index and phytochemicals with antioxidant properties (Raj et al., 2008). The processing treatments such as milling, malting, blanching and fermentation reduces the anti-dietary elements and extend the digestibility (Raj et al., 2008). The bioavailability of the vitamins are inhibited by way of naturally occurring anti-nutritional compounds present in the pearl millet. The most commonly mentioned anti-nutritional compounds in pearl millet are phytate, phenolic compounds, tannins and enzyme inhibitors (Gustavsson and Jacobsson, 2020). Soaking improves the texture and decreases the anti-nutritional properties of pearl millet.

Germination is a natural occurring improvement segment of grains and is used as a manner where activation of endogenous enzymes is utilized with the aid of their ability to

alternate the composition and decorate dietary houses (Krishnan and Meera, 2018). It is practiced to enlarge the palatability and nutritional price with the aid of the breakdown of anti-nutrients of the pearl millet (Bhuvaneshwari et al., 2020). Now-a day's people are more aware about millets and its benefits. But they failed to process it in a proper way. It may result in loss of nutrients in it. The nutritional bioavailability of millets is quite larger than the other grains when it is subjected to the process of reducing anti-nutritional factors in it. Hence the present study was aimed to evaluate the suitable soaking and germinating interval for preparing pearl millet and its flour. The main objective of the present study was to evaluate the effect of physical dimensions, anti-nutritional factors and antioxidant activity of the pearl millet subjected to different soaking, germination and drying methods.

MATERIALS AND METHODS

Collection of raw materials

The pearl millet grains (*Pennisetum gluacum)* were purchased from the local market in Virudhunagar.

Soaking of Pearl millet at various interval

The pearl millet grains were cleaned and divided into five equal parts and subjected to soaking it in water at different intervals such as 8 hours, 12 hours, 16 hours, 20 hours and 24 hours.

Determination of physical dimensions of the raw and soaked grain

Physical dimensions of the raw and soaked pearl millet grains were evaluated in terms of length, breadth and thickness before germination. The length, breadth and thickness of 10 randomly selected grains from 10 different lots were measured by using a measuring scale, vernier caliper and screw gauge. Then average was calculated. This process has been repeated for three times to calculate the mean value.

Determination of anti-nutritional factors

The soaked samples were subjected to sun drying at 30-40 °C and hot air oven drying at 45 °C. Dried millet grains were powdered finely. The extraction of prepared pearl millet flour was obtained by dissolving 10g sample in 100ml of solvent ethanol. Then it was subjected to centrifuge at 3000rpm for about 15 minutes. The supernatant was collected. The ethanol extracts were subjected to preliminary qualitative anti-nutritional factor investigation such as tannin, saponin and phytic acid by using standard procedure.

Preparation of sprouted pearl millet flour

The soaked pearl millet which contains less anti-nutritional factor was used for further analysis. 24 hours-soaked grains were allowed to sprout for about 24 hours, 48 hours, 72 hours and 96 hours respectively by tying in muslin cloth. The sprouted millets were subjected to sun drying at 30-40 °C and hot air oven drying at 45 °C. Dried millet grains were powdered finely.

Determination and comparison of the antioxidant activity

The extraction of sprouted pearl millet flour was prepared by dissolving 10g sample in 100ml of solvent ethanol. Then it was subjected to centrifuge at 3000rpm for about 15 minutes. The supernatant was collected. The ethanol extract was used to undergone DPPH (1,1Diphenyl – 2 – Picrylhydrazyl) assay. The free radical DPPH stable at room temperature is reduced to the presence of antioxidant molecule (Gyoanfi, Aniya et al. 1999). Obtained results has been undergone for comparative analysis.

RESULTS AND DISCUSSION

Effect of Soaking on weight of the Pearl millet

Soaking is the process of softening a hard pearl millet grain by immersing it in liquid, preferably water, for hours. Soaking improves the texture of the millet.

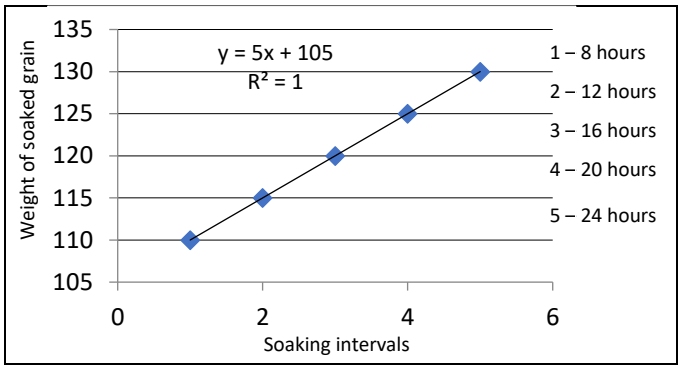

Fig 1 Soaking intervals of the sample

Table 1 depicts the final weight of the pearl millet samples soaked at various intervals. It was found that the weight of the soaked pearl millet gradually increases with the increase in time of soaking. This phenomenon showed that the water absorption capacity increases with the increase of soaking time. Figure 1 establishes the relation between the soaking intervals of the sample shows the positive correlation with moisture content. It showed the significance of moisture content on size of the grain when the pearl millet was soaked.

Table 1 Weight of soaked samples

Soaking Interval (Hours)	Initial weight (g)	Final weight (g)
8	100	110
12	100	115
16	100	120
20	100	125
24	100	130

Table 2 Average length, width and thickness of the samples soaked at different intervals

Soaking interval / Average	Raw	8 Hours	12 Hours	16 Hours	20 Hours	24 Hours	R^2
Length (cm)	0.35	0.36	0.38	0.39	0.41	0.43	0.988
Width (cm)	0.23	0.26	0.27	0.28	0.29	0.31	0.956
Thickness (mm)	1.03	1.04	1.1	1.2	1.28	1.34	0.965

Physical dimensions of soaked samples

The variations in the linear measurements with respect to the soaking time are depicted in Table 2. It shows the average values of Length, Width and Thickness varies from 0.36 – 0.43cm, 0.26-0.31cm and 1.04-1.34 mm respectively. The length, width and thickness found to be increasing with increase in moisture content. This phenomenon is due to the water absorption capacity.

The established relations between these linear dimensions show very high values of $R^2$and a positive correlation with moisture content as shown in (Fig 2-4).

L = y =0.016x + 0.3307, R^2 = 0.9882
W= y = 0.0143x + 0.2233, R^2 = 0.9566
T = y = 0.0677x + 0.928, R^2 = 0.965

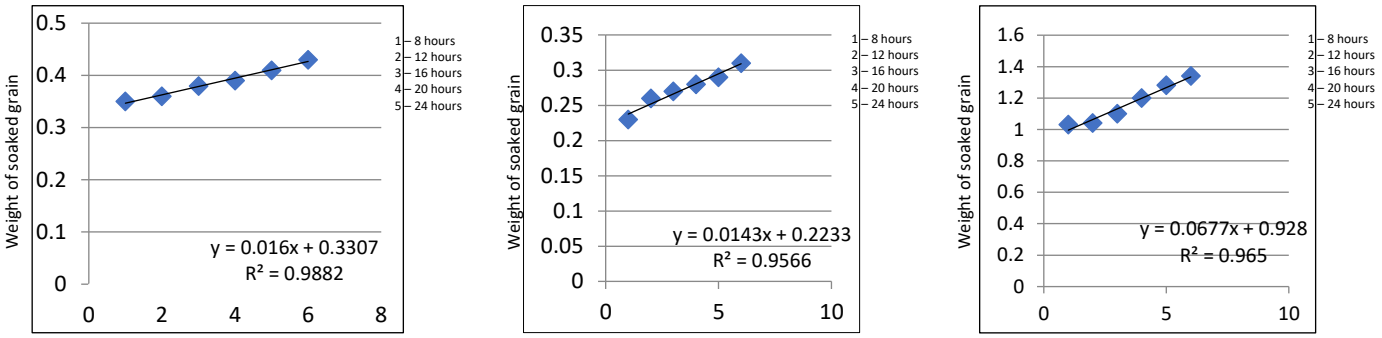

Fig 2-4 Shows the average length, width and thickness of the samples soaked at different intervals

Effect of soaking and drying on anti-nutrient factors in pearl millet

The anti-nutritional factors are the substances generated in natural food substances by the normal metabolism of species and by different mechanisms which interfere with the absorption of nutrients.

Effect of germination and drying on antioxidant activity in pearl millet

Anti-oxidant is a substance which inhibits the process of excessive oxidation and diminishes the presence of free radicals. It may prevent or delay cell damage.

Table 3 Comparison of qualitative analysis of Anti-nutrient factors present in Soaked pearl millet dried by sun drying and hot air oven drying

Anti-nutritional factors	Sun dried samples					Hot air oven dried samples				
	Soaking periods (in hours)					Soaking periods (in hours)				
	8	12	16	20	24	8	12	16	20	24
Saponin	(+) (+) (+) (+) (+)	(+) (+) (+) (+)	(+) (+) (+)	(+) (+)	(+)	(+) (+) (+) (+) (+)	(+) (+) (+) (+)	(+) (+) (+)	(+) (+)	(+)
Tannin	(+) (+) (+) (+) (+)	(+) (+) (+) (+)	(+) (+) (+)	(+) (+)	(+)	(+) (+) (+) (+) (+)	(+) (+) (+) (+)	(+) (+) (+)	(+) (+)	(+)
Phytic acid	(+) (+) (+) (+) (+)	(+) (+) (+) (+)	(+) (+) (+)	(+) (+)	(+)	(+) (+) (+) (+) (+)	(+) (+) (+) (+)	(+) (+) (+)	(+) (+)	(+)

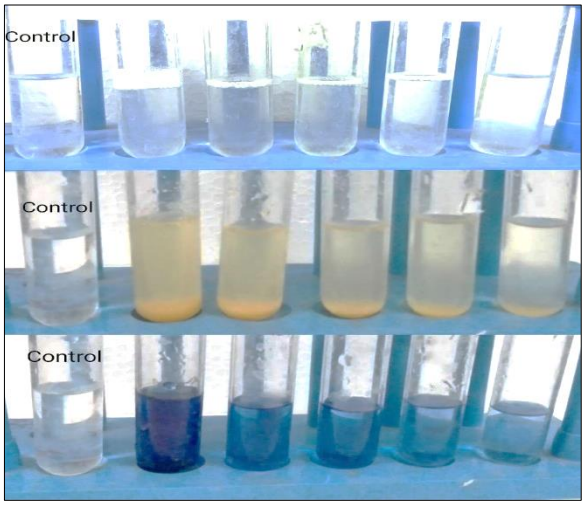

Fig 5 Qualitative analysis of Anti-nutrient factors

The results obtained exhibited that the increase in soaking time significantly reduces the anti-nutritional compounds such as saponin, tannin and phytic acid. This phenomenon was found in the soaking treatments attributed to the leaching of polyphenols as suggested by Jood *et al*. (1987). It was found that the activity of the enzyme and phytase increases with the duration of soaking. Also, it was observed that the phytic acid reduces in both the sun dried and hot air oven dried samples of pearl millet during soaking, by the increased activity of phytase degrading the phytic acid. Report on phytic acid reduction from soaking, germination and/or fermentation of cereals as documented by Nkama and Gbenyi, 2001 and Sutardi and Buckle, 1985. Since the value of anti-nutritional factors reduced significantly in 24 hours of soaking, it is decided to germinate the millet from 24 hours of soaking.

Table 4 Comparative analysis of antioxidant activity of germinated pearl millet dried by sun drying and hot air oven drying

S. No.	Germination interval (Hours)	Antioxidant activity (%)	
		Sun dried sample	Hot air oven dried sample
1	24	55.56±0.07	51.07±0.04
2	48	66.56±0.05	59.9±0.07
3	72	78.8±0.05	73.7±0.02
4	96	88.89±0.08	85.3±0.05

DPPH assay was conducted for the germinated pearl millet at different periods samples dried under sun and hot air drying. Antioxidant activity for the pearl millet germinated for 96 hours was noted to have the highest amount ranging 88.89±0.08% in sun drying and85.3±0.05% in hot air oven drying. The result also showed that the gradual increase of

antioxidant activity when the germination period increased. This study coincides with the study conducted by Bhuvaneshwari *et al*. (2020).

CONCLUSION

It is concluded from this study that soaking significantly increased the weight, improved the texture and decreased the anti-nutritional properties of the pearl millet. The process of germination showed the maximum influence on the antioxidant assay. The comparative analysis of the soaking and germinating period showed that 24 hours soaking and 96 hours germination was found to be the best method to process the pearl millet due to its increased antioxidant activity and decreased anti-nutritional factors. The consumption of germinated pearl millet increases the nutritional status of the human being.

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