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OPTIMISATION OF CONDITIONS FOR BARNYARD MILLET GERMINATION

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ABSTRACT

Development of foods that promote health and wellbeing is one of the key priorities of food industry. Barnyard millet, important minor millet is highly digestible (81.13 per cent) and contains fair amount of protein (12 per cent) coupled with low carbohydrate (58.56 per cent) of slow digestibility (25.88 per cent). The nutritive value and taste of barnyard milled can be improved by germination. The present study concentrates in the optimization of conditions for barnyard millet germination to maximise the nutritive value and overall acceptance. The barnyard millet was cleaned, soaked in water with varying time intervals followed by 24 hrs germination. The dried grains were powdered, sieved and then subjected to organoleptic evaluation. The parameters such as moisture absorption, sprout length, malt yield and germination percentage were worked out. Based on organoleptic evaluation, the germinated barnyard millet flour, 10hrs soaking and 24 hrs germination was found to be the best and utilized for the production of value added products. As the soaking time increases (4 to 18hrs) the moisture absorption increases from 35.16 and 54.12 per cent. The sprout length reaches a maximum of 0.4 cm at 18hrs of soaking. The malt yield differs from 59.62 to 71.54 per cent with respect to soaking time.

Keywords: Barnyard millet, Soaking time, Germination, sprout length, malt yield and organoleptic evaluation

INTRODUCTION

Millets are the staple food in arid and semi-arid regions of the world. Minor millets are a group of grassy plants and have an ability to withstand drought conditions. Millets can substitute major cereals and due to the nutritional properties; millets are designated as 'nutritious millets' (Rao and Prabhavathi, 1982). Millets are the nutri cereals with small seeded grains, rich in B vitamins, calcium, iron, potassium, magnesium, zinc, dietary fibre and phytochemicals. They also possess high amount of antioxidants and phenolic compounds. Millets act as a therapeutic food in controlling asthma, migraine, blood pressure, diabetes, heart diseases and atherosclerosis. India is the leading millet producer covering 38.6 per cent of total millet production of world and one of the major countries of higher millet utilization. Indian millet production mainly includes finger millet, kodo millet, foxtail millet, barnyard millet, proso millet and little millet. Out of 30 million tonnes of millet produced in the world, about 90 per cent is utilized in developing countries and only a tiny volume is used in the developed countries (FAO, 1990). Barnyard millet (*Echinochloa frumentacea*),also known as Japanese barnyard millet, *Ooda, Oadalu, Sawan* and *Sanwank,* is an important minor millet because of its fair amounts of protein (12 per cent) that is highly digestible (81.13 per cent) coupled with low carbohydrate content (58.56 per cent) of slow digestibility (25.88 per cent) (Veena, 2003). They are rich in dietary fibre (13 per cent), phytochemical and antioxidants (Bouis, 2000). A slow release of glucose to the blood stream during digestion of millet is beneficial to the diabetic patients (Chen *et al.*, 1984; Anderson *et al.*, 1991). Processing methods like soaking, germination, malting, fermentation, thermal and mechanical treatments of grains are said to increase the nutrient value, improves flour shelf life, decrease the anti-nutritional factors and reduce the bitterness (Ahmed, 2013). Germination is considered to be a processing method which activates the enzymes of the grains which converts the cereal sugars to fermented sugars. Though millets are nutritionally rich, the whole grain and the bi-product utilization in product development is limited. The germinated millet flour can be utilized in the value added products. Thus for the consumers with health concerns, the present investigation was carried out to evaluate physical characters of germinated barnyard millet and acceptability of the millet flour.

MATERIALS AND METHODS

Procurement of raw material

Barnyard millet was obtained from the local farmers in Pollachi for the preparation of the flours. Barnyard millet undergoes a process of cleaning and removal of chaff from the grains.

Physical parameters of the barnyard millet

The physical characters like moisture absorption sprout length, malt yield and germination percentage was analysed using the standard procedures as listed in Table1.

Table 1: Physical parameters of the barnyard millet

Physical Parameters	Methods
Moisture absorption	Abu-Ghannan and McKenna, 1997
Sprout length	ISTA (1999)
Malt yield	Singh and Sosulski (1985)
Germination Percentage	ISTA (1999)

Preparation of germinated millet flour

The cleaned barnyard millet was washed in water followed by soaking in varying time intervals from 4 to 18hrs with

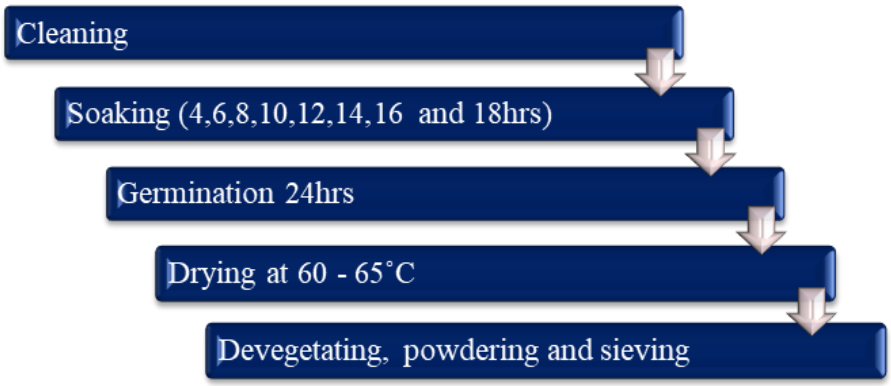

Figure 1: Preparation of flour

intermittent replacement of water. The excess water is drained and the millet was allowed to germinate under a wet muslin cloth for 24hrs at ambient temperature. The germinated seeds were dried in hot air oven at 60 - 65˚C. The dried seeds were de vegetated to remove the rootlets from the dried grains by hand rubbing. Further the grains were powdered and sieved through 40 mesh size.

For the standardization of germination the treatments T_1 to T_9 were prepared with different soaking time as follows.

- T_1 – Un germinated BMF
- T_2 - 4hrs soaking +24hrs germinated BMF
- T_3 - 6hrs soaking +24hrs germinated BMF
- T_4 - 8hrs soaking +24hrs germinated BMF
- T_5 - 10hrs soaking +24hrs germinated BMF
- T_6 - 12hrs soaking +24hrs germinated BMF
- T_7- 14hrs soaking +24hrs germinated BMF
- T_8 - 16hrs soaking +24hrs germinated BMF
- T_9 - 18hrs soaking +24hrs germinated BMF

* Barnyard Millet Flour - BMF

The treatments T_1 un germinated barnyard millet served as the control

Organoleptic Evaluation

A series of acceptability trails were carried out using simple triangle test at the laboratory level and selected a panel of ten judges between the age group of 18 – 35 years as suggested by Jellinek, 1985.

Statistical Analysis

The data was analysed using suitable statistical techniques. The best treatments were selected by applying Kendall's coefficient of concordance.

RESULTS AND DISCUSSION

Physical characters of germinated barnyard millet

a. Moisture absorption

The barnyard millet grains were soaked in water (1:3) for 4, 6, 8, 10, 12, 14, 16 and 18 hrs time interval. The water absorbed was calculated at the end of the soaking period. It was found that as the soaking time increased, the amount of moisture absorbed also gradually increased (Table 2). The moisture absorption varied from 35.16 per cent to 54.12 per cent in the present study. This finding was similar to that of Agarwal *et al.,* (2013). Deshpande (1987) found that the increase in temperature will strongly influence the moisture uptake.

b. Sprout length

The sprout length was measured and the result is presented in Table 2. The maximum sprout length (0.4 cm) was seen in millets soaked for 18 hours. The millet soaked for 4 hours did not have any sprouts. Germination was initiated at the 8 hour of soaking and had a sprout length of 0.1 cm. It was also noticed that the sprout length did not go beyond 0.5cm. As reported by Nout and Davies (1982)

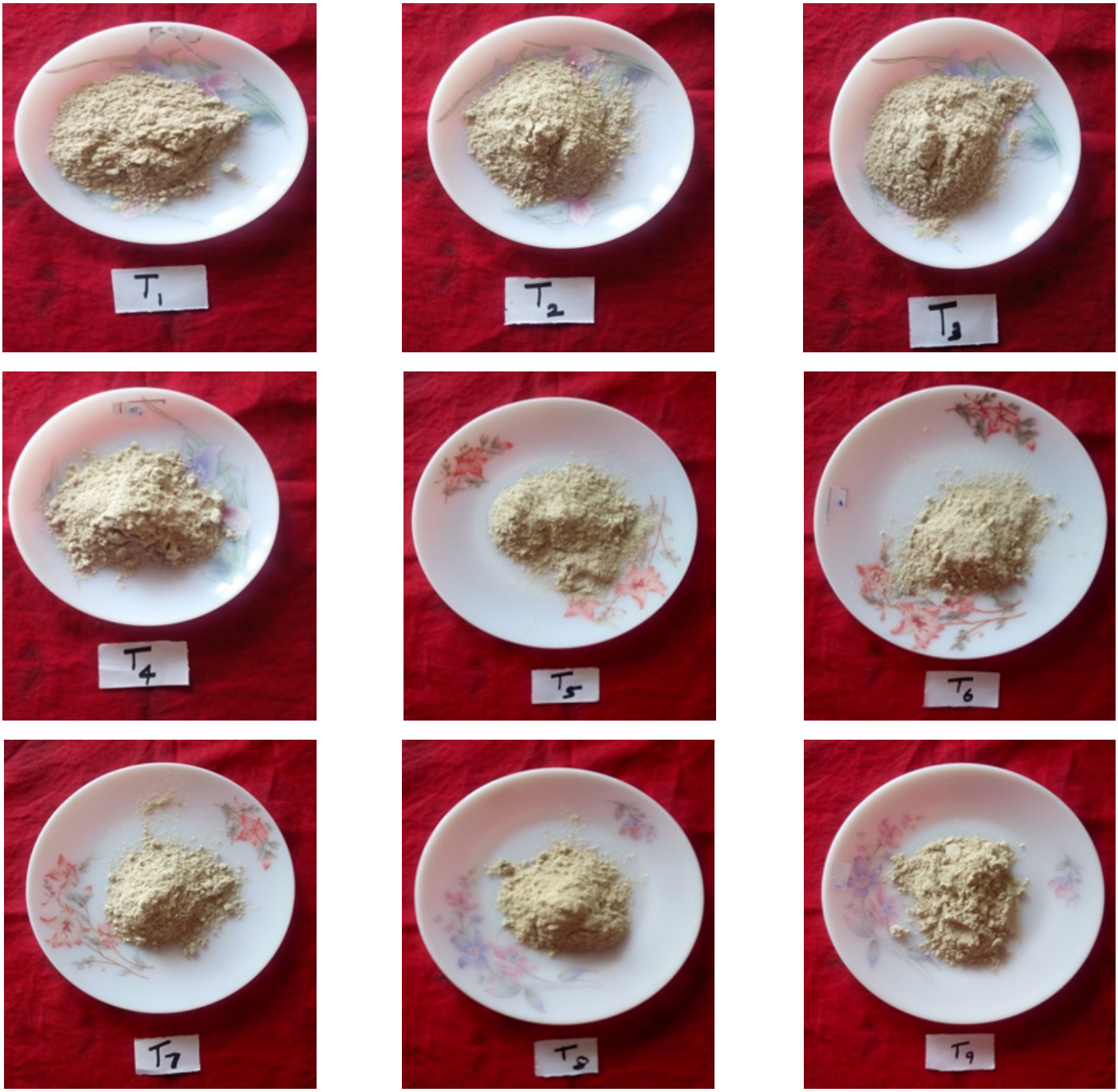

Figure 2: Barnyard Millet Flour with different soaking time

as the rootlets increases, there is a loss in malting.

c. Malt yield

The study clearly showed that the soaking time and the malt yield is inversely proportional. When the soaking time increased, the malt yield was found to be decreased. The malt yield was maximum (71.54 per cent) at 4 hrs of soaking with 24 hrs germination and minimum (59.62 per cent) at 18 hrs of soaking with 24 hrs germination. This malt yield varies from 71.54 to 59.62 per cent due to the over growth of the rootlets and subsequent removal of vegetative part improved the taste. This yield result was similar to the findings of (Malleshi and Desikachar 1979, and Agarwal *et al.,* 2013). The malt yield directly influences the malt loss.

Germination Percentage

The germination percentage is calculated and the result is presented in Table 3. The germination percentage depicts that number of seed growth. It was found that germination percentage was maximum at 48 hours. In 24 hours the germination percentage was found to be only 86 per cent (Table 3). Sripriya *et al.,* 2007 revealed in her study that germination and fermentation will decrease the antinutrient levels and enhance mineral availability.

Organoleptic evaluation of the barnyard millet flour

The un germinated (T_1) and germinated barnyard millet (T_2 to T_9) were subjected to organoleptic evaluation. The

mean score for different treatments were calculated and presented in Table 4.The results revealed that, the mean score for sensory attributes like appearance, colour, flavour, texture, taste and overall acceptability of T_5 were ranked as best by the Kendall's coefficient of concordance.

Table 2: Effect of soaking time on oisture absorption, sprout length, malt yield of barnyard millet

Soaking Time (hr)	Moisture absorption (%)	Sprout length (cm)	Malt yield (%)
4	35.16	No sprouts	71.54
6	36.08	>0.1	69.91
8	37.84	0.1	69.50
10	40.04	0.1	69.17
12	45.00	0.2	68.95
14	51.28	0.2	67.87
16	51.80	0.2	67.38
18	54.12	0.4	59.62

Table 3: Effect of germination percentage on barnyard millet

Germination time (hr)	Germination percentage (%)
24	80
48	96

Barnyard millet is bitter due to presence of phenolic compounds. Nomura *et al.,*1969 reported that germination helps to reduce the phenolic content and increase the free sugars. Saker (2015) reported that sweetness of proso millet to increase significantly as the germination time increased. The high sweetness may reduce and help mask the off flavours associated with millet, including bitterness. However, bitterness also increased as germination time increased. Germination appears to have enhanced the bitter taste. This may have been due to protein degradation occurring during this process. Partial protein digestion by proteolytic enzymes can produce bitter peptides. These bitter peptides are known to impart a bitter taste that decreases the sensory quality of a food (Maehashi and Huang, 2009).

CONCLUSION

The barnyard millet flour is slightly bitter in taste due the presence of phenolic compounds. To overcome this problem germination was carried to increase the consumer's acceptance. The present study revealed that 10 hrs soaking followed by 24 hrs of germination reduced the bitterness to some extent. The study also revealed that soaking time strongly influences the parameters like moisture absorption, sprout length, germination percentage and malt yield of millet.

Table 4: Mean score for organoleptic evaluation of millet flour

Treatments	Sensory Attributes					
	Appearance	colour	Flavour	Texture	Taste	Overall acceptability
T_1	6.66 (3.77)	6.00 (2.40)	6.73 (3.33)	6.26 (2.37)	6.66 (2.87)	6.16 (3.57)
T_2	6.73 (4.00)	6.66 (5.37)	6.73 (3.00)	6.70 (3.47)	7.16 (5.10)	6.30 (3.70)
T_3	6.93 (5.00)	6.53 (4.37)	6.96 (4.20)	7.03 (5.07)	7.10 (4.57)	6.43 (4.53)
T_4	6.90 (4.77)	6.73 (5.60)	7.26 (5.47)	6.80 (3.77)	6.80 (3.33)	6.63 (5.73)
T_5	7.40 (6.63)	7.16 (7.10)	7.80 (7.00)	7.83 (7.67)	7.53 (6.50)	6.90 (6.40)
T_6	7.10 (5.53)	6.83 (5.87)	7.40 (5.93)	7.10 (5.87)	7.20 (5.07)	6.59 (5.80)
T_7	7.00 (5.67)	6.66 (5.10)	7.20 (5.50)	6.83 (4.97)	7.40 (6.17)	6.70 (5.93)
T_8	6.80 (4.57)	6.46 (4.43)	7.13 (4.93)	7.00 (5.60)	7.26 (5.43)	6.46 (4.50)
T_9	6.86 (5.07)	6.53 (4.77)	7.36 (5.63)	7.10 (6.23)	7.33 (5.97)	6.53 (4.83)
Kendalls W	0.199	0.315	0.293	0.394	0.270	0.182

REFERENCES

Abu-Ghannam, N., and McKenna, B. (1997). Hydration kinetics of kidney beans. *J. Food Sci*. 62 (3): 520–523.

Agrawal, D., Upadhyay, A., Sagar, P., and Nayak. (2013). Functional characteristics of malted flour of foxtail, barnyard and little millets. *Food Sci. Tech.* 14(1): 44-49.

Ahmed S.M., Saleh. P., Zhang, Q., Chen, J., and Shen, Q. (2013). Millet Grains: Nutritional quality, processing, and potential health benefits. *Comprehensive Rev. Food Sci. Food Saf*. 281- 295.

Bouis, H. E. (2000). Enrichment of food staples through plant breeding: a new strategy for fighting micronutrient malnutrition. *Nutr.*16: 701–4.

Chen, W. L., Anderson, J. W., and Gould, M. R. (1984). Effect of oat bran, oat gum and pectin on lipid metabolism of cholesterol fed rats. *Nutr. Rep. Internat.* 24: 93-98.

Deshpande S. (1987). Study on the effect of a wheat Amylase-rich-food on wheat based young child foods. M.Sc. (Foods and Nutrition) thesis. M.S. University, Baroda.

FAO (Food and Agriculture Organization). (1995). Sorghum and millets in human nutrition. Rome, Italy: FAO.

ISTA (International Seed Testing Association). (1999). International rules for seed testing. *Seeds Sci.Technol*. 27:3-33.

Jellinek, G. (1985). *Sensory evaluation of food. Theory and practice*. Ellis Horwood, Chichester. England, 596p.

Maehashi, K., and Huang, L. (2009). Bitter peptides and bitter taste receptors. *Cellular and Molecular Life Sci*. 66(10): 1661–1671.

Malleshi, N.G. and Desikachar, H.S.R. (1985). Milling, popping and malting characteristics of some minor millets. *J. Food Sci. Technol*. 22: 400-403.

Nourma, T., Kono, Y., and Akazawa, T. (1969). Enzymatic mechanism of starch breakdown in germinating rice seeds II. *Plant Physiol*. 44: 765-769.

Nout, M. J. R. and Davies, B. J. (1982). Malting characteristics of finger millet, sorghum and barley. *J. Inst. Brew*. 88: 157-163.

Rao, B.S.N., and Prabhavathi, T. (1982).Tannin content of foods commonly consumed in India and its influence on ionisable iron. *J. Sci. Food Agri*. 33: 89–96.

Saker, A. (2015). Effect of pre-processing on the nutritive, physical, and sensory properties of proso millet. M. Sc. (Food Science) thesis. Guelph, Ontario, Canada. 131p.

Singh, T., and Sorsulski, F.W. (1985). Malting of hullers barley (*Hordeum vulgare*) cultivars. *J. Food Sci*. 50 (2): 342.

Sripriya, G., Usha, A., and Chandra, T.S. (1997). Changes in carbohydrate, free amino acids, organic acids, phytate and HCl extractability of minerals during germination and fermentation of finger millet (*Eleusine coracana*). *Food Chem*. 58(4): 345- 350.

Veena, B. (2003). Nutritional, functional and utilisation studies on barnyard millet. M.Sc. thesis, University of Agricultural Sciences, Dharwad. 69p.