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Studies on malting characteristics of Finger millet (*Eleusine coracana* L.)

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Abstract

Malting of seeds enhance its nutritional value through induced hydrolytic activity. Local variety of finger millet was selected to evaluate the various malting characteristics including protease and amylase activities occur during malting period of 4 days. Results showed that flour obtained from the 2nd day of germinated finger millet grain had high protease and amylase activities. Malting characteristics of finger millet from 1st to 4th day of malting were germinative energy (73%, 82%, 89%, 91%), germinative capacity (89%, 91%, 92.5%, 94%), water sensitivity (3%, 5%, 8%, 12%), total malting loss (14.25%, 12.56%, 10.27%, 8.03%) and malt yield (85.75%, 87.44%, 89.73%, 91.97%).

Keywords: Finger millet, malting, protease, amylase, germinative energy, germinative capacity, water sensitivity, rootlet and malt yield

Introduction

Finger millet (*Eleusine coracana*) also known as ragi, nachani or nagli is an exceptional grain with high nutritive value, rich dietary fibre and phytochemicals. Finger millet production of India in 2013-14 was 1.59 million tonnes from the area of 1.36 million hectare. The major producers of ragi are Tamil Nadu (224.9 thousand tonnes), Uttarakhand (174 thousand tonnes) and Maharashtra (138 thousand tonnes).

Finger millet has got good malting properties and hence is being used in the preparation of malt based bakery items, Indian snacks and weaning foods. Ragi malt and millet based beverages are very popular in South India. Many traditional foods are made from finger millet. It is one of most nutritious millet and it is easy to digest as well. Since it does not contain gluten, it is a wonderful grain alternative for people who are gluten-sensitive. It is low fat cereal and most of the fats are in the unsaturated form.

Malting has been suggested as an inexpensive and effective method for improving the overall nutritional quality of cereals and legumes, by enhancing their digestibility [1] and reducing the contents of anti-nutritional factors thus improving the availability of nutrients of the malt. It has also been reported to improve the sensory quality and extend the shelf life of the product [2].

The present work was carried out with a view to evaluate the malting properties of finger millet grains and their malts.

Materials and Methods

The finger millet was procured from the local market of Parbhani district (Maharashtra). Malt was prepared from millet as per following procedure. Finger millet grains and malted flour were evaluated for malting characteristics like protease and amylase activity, germinative energy (%), germinative capacity (%), water sensitivity (%), total malting loss (%) and malt yield (%).

Preparation of malted flour

Finger millet seeds were washed with water for 2-3 times and soaked in water (10% sodium hypochlorite) for 15 minutes. Grains were rinsed with fresh water to remove the smell of sodium hypochlorite. Then, grains were soaked in water for 8 hr. Remove the seeds from water and excess water was drained, seeds were tied in a muslin cloth and 5 kg weight was kept on it. These seeds were germinated at 27±3 °C for 24 hr to 96 hr and dried in shade for 2

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days. Devegetation was done by hand rubbing and separated by winnowing off. The malted ragi seeds were ground into flour by using the electric grinder. The flour thus obtained was the malt from millets.

Preparation of enzyme extract

Two grams of the germinated finger millet flour were suspended in 10 ml of distilled water for 1 hr at room temperature ($27 \pm 3^\circ\text{C}$) with occasional shaking and centrifuged (10,000 RPM, 10 min). The supernatant was taken for the enzyme assay^[3].

Estimation of protease activity

The protease activity was assayed by the scientific method^[4,5]. One millilitre of the above enzyme extract was added to 1 ml of 1% casein and incubated for 1 hr at 40°C in a shaking water bath. Then 2 ml of 10% TCA were added to the enzyme mixture, allowed to stand for 30 min at room temperature ($27 \pm 2^\circ\text{C}$) and filtered through Whatman filter paper No. 1 and the absorbance of the filtrate was read at 240 nm in a Spectrophotometer.

Estimation of amylase activity

Amylase activity of germinated finger millet was measured using the scientific method^[6]. One millilitre of the above enzyme extract was incubated for 1 hr with 0.5 ml of 1% soluble starch and 0.5 ml of 0.1 M acetate buffer, pH 4.5 in a water bath (37°C). Then 2 ml of dinitrosalicylic acid (DNS) was added and boiled for 20 min in a boiling water bath. After cooling the volume was made to 25 ml with distilled water and the absorbance of the solution was read at 550 nm in a Spectrophotometer.

Determination of germination energy

One hundred grains were allocated onto two filter papers (Whatman No. 1) soaked with 4 ml of distilled water positioned at the bottom of a Petri dish, ensuring that all the kernels were in proper contact with the damp filter papers. The petri dish was subsequently covered and incubated at a consistent temperature of 30°C for 24 to 48 hours. The kernels that sprouted at the conclusion of the incubation were tallied and reported as germinative energy.

$$\text{GE (\%)} = 100 - N$$

where; GE=Germinative Energy and N = number of ungerminated grains.

Determination of germinative capacity

One hundred finger millet seeds were added to a 100 ml glass beaker filled with 7.5% hydrogen peroxide (H_2O_2) solution and soaked at 30°C for 48 hours. The steep water was poured off, with the sprouted grains being separated from the un-sprouted ones and tallied. The un-sprouted grains were subsequently placed onto damp filter papers

(Whatman No.1) in petri dishes, which were covered with another damp filter paper and the lid put back on. The dishes were subsequently enclosed in a jute bag and left to germinate at room temperature ($32^\circ\text{C} \pm 2$) for roughly 24 hours, during which water was intermittently sprayed. Counted the newly sprouted grains and combined the result with the initial count. The capacity for germination (GC) was determined.

The germinative capacity (GC) was calculated as follows:

$$\text{GC\% (H}_2\text{O}_2) = (200 - N)$$

2

where; N =Number of ungerminated grains.

Determination of water sensitivity

Two sets of 100 grains each were cultivated on filter papers (Whatman No.1) placed in petri dishes (9 cm diameter); one was soaked with 8 ml and the other with 4 ml of water. The distinction in the quantity of grains that sprouted in the two petri dishes was recorded as the water sensitivity value.

Determination of total malting loss

Total malting loss was calculated according to the method described^[7]. The total malting loss (respiratory loss, vegetative loss and green malt moisture loss) was found by subtracting the weight of the final malt from the weight of the original finger millet grain expressed as a percentage.

$$\text{Total malting loss (\%)} = \frac{[\text{Initial grain dry weight} - \text{Dry malt weight}]}{[\text{Initial grain dry weight}]} \times 100$$

Determination of malt yield

Malt yield was calculated according to the method described⁷. Malt yield was found by subtracting the total malting loss of final malt from 100.

$$\text{Malt yield (\%)} = 100 - \text{Total malting loss}$$

Results and Discussion

Protease and amylase activity

The protease and amylase activities in extracts from germinated finger millet were shown (Fig. 1). Results indicated that the proteolytic and amylase activities of the extract increased significantly with increasing germination time, reaching a maximum on the 2nd day (Fig. 1). These results agree with the results obtained^{8,9} which reported that, in germinated sorghum, protease and amylase activity reached a maximum on the 3rd day of germination and on the 5th day of germination it declined to the base level. Germination triggers the enzyme system of sprouting seeds, leading to the breakdown of proteins, carbohydrates and lipids into simpler forms. As a result, malt samples contain free sugars and amino acids released during germination^[10].

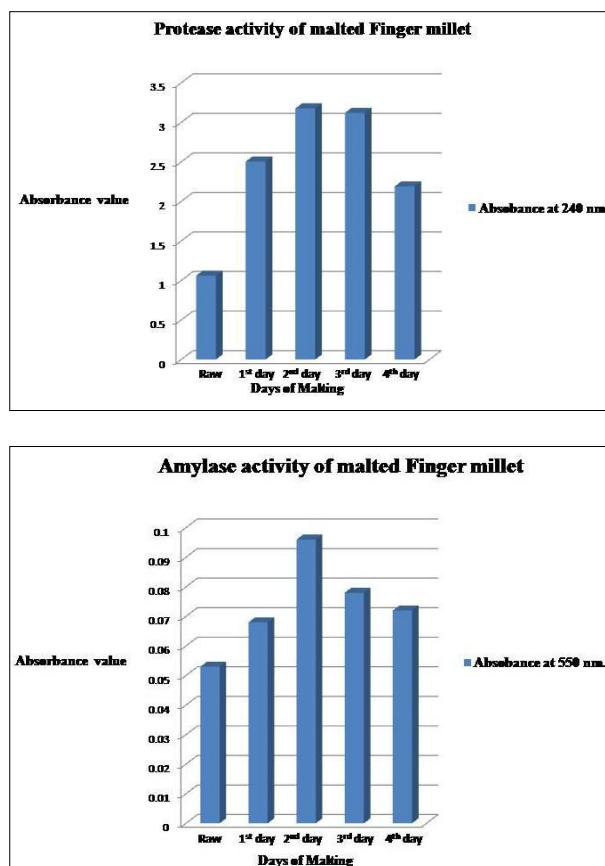


Fig 1: Protease and amylase activity during germination of Finger millet

Malting characteristics of finger millet

The data pertaining to malting characteristics of finger millet is given in Table 1.

The results regarding malting properties of finger millet indicated that the germinative energy were increased from 1st to 4th day as 73%, 82%, 89%, 91% during 1st, 2nd, 3rd and 4th day of malting which indicate that as malting duration proceeds then more grain started germination. Germinative capacity of malted finger millet found that the finger millet was best suitable for malting since its malting capacity was rises with time as 89%, 90%, 92.5%, 94% on 1st, 2nd, 3rd and 4th day of malting. Results for water sensitivity found that as

malting days proceeds water sensitivity also rises for finger millet (1st day-4%, 2nd day-10%, 3rd day-13% and 4th day-14%). The total malting loss (including respiratory loss, vegetative loss and green malt moisture loss) was found to be 14.25%, 12.56%, 10.27%, and 8.03% on 1st, 2nd, 3rd and 4th day of malting which showed that malting loss decreased from 1st to 4th day. Malt yield is indicative of final quantity of millet malt obtained while comparing initial quantity of grains used. So malt yield of finger millet was found to be 85.75%, 87.44%, 89.73% and 91.97% during 1st, 2nd, 3rd and 4th day of malting. Similar results were reported [11, 12] with slight modification.

Table 1: Malting properties of Finger millet

Sr. No.	Malting parameter	Measurement/Value
1	Germinative energy (%)	24 hr – 73 48 hr – 82 72 hr – 89 96 hr – 91
2	Germinative capacity (%)	24 hr – 89 48 hr – 91 72 hr – 92.5 96 hr – 94
3	Water sensitivity (%)	24 hr – 3 48 hr – 5 72 hr – 8 96 hr – 12
4	Total malting loss (%)	24 hr – 14.25 48 hr – 12.56 72 hr – 10.27 96 hr – 8.03
5	Malt yield (%)	24 hr – 85.75 48 hr – 87.44 72 hr – 89.73 96 hr – 91.97

Conclusion

Finger millet is nutritious indigenous minor millet used in the preparation of geriatric foods, infant foods and health foods both in natural and malted forms. The present study showed the various malting characteristics of finger millet during 1st to 4th day of germination. Results of the study shows about the protease and amylase activities of malt as affected during malting period. It also gives information about germinative energy, germinative capacity, water sensitivity, total malting loss and malt yield of finger millet as varied by malting duration.

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