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Effect of malting and pregelatinisation on nutrition and functional properties of bajra flour

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Abstract
Native bajra grains were procured from local market and they are subjected to malting and pregelatinization. Malting was done for a time period of 14hrs after malting the grains were pregelatinized by using pressure cooker up to 9minutes.These grains were dried under sunlight for a time period of 12hours, roasted and then milled into fine flour. The obtained flour was evaluated for functional, sensory and nutritional properties. The pregelatinized bajra flour shown high swelling profile than compared to native flour and opposite trend was observed in their solubility profile. Malting increases the nutritional quality by breaking down complex substances down to simple substances and ease the digestion process and also helps in increasing the bioavailability of micronutrients like iron and calcium.

Keywords: Pregelatinisation, malting, water-solubility, swelling power

Introduction
Millets are generally considered minor crops. The millets are classified into five genera of the *Poaceace* family (*Panicum, Setaria, Echinochloa, Pennesetum and Eleusine*). Pearl millet is the sixth largest cultivated crop in the world. It is an annual plant which is grown widely in Africa and India (Rachie, 1975) [1], the fruit is cylindrical and pearl in shape. The cultivation of pearl millet requires very less amount of water and the plant is well adapted to sandy or light looms and moist but well drained soils. Pearl millet (Pennisetum glaucum) commonly called as bajra in English and Sajjalu in Telugu. It is the staple food for the people living in the semi-arid regions of Africa and Asia. It provides major proportion of nutrients like calories and proteins to the diet. it is also rich in micronutrients like calcium and iron (Sehgal,2003) [2]. Pearl millet is almost similar to wheat. It is having high protein content and superior to that of wheat in iron and calcium (Gopalan, 1990) [3]. But because of its anti-nutritional factors and poor keeping qualities it is not much used for consumption. However, some pre-treatment steps like malting, pregelatinization that are done before processing of grains into flour reduce the anti-nutritional factors content and increases the bio availability of nutrients. (Inyang,2008) [4].

Before processing into flour, it is subjected to some pre-treatment processes like malting and pregelatinization. Germination is a common household technique which is practised by our ancestors since from ages. Germination helps in reducing some antinutritional factors like phytates and tannins and increases the bioavailability of certain micronutrients like Calcium and Iron. Besides lowering of antinutrients, germination for 72hours significantly increased HCl extractability of minerals which represents mineral bioavailability. It is allowed to germinate by tying the grains in a muslin cloth for 14 hours and periodically the bag is wetted by sprinkling some water on it. Malting increases the nutrients content by breaking down complex substances into simple substances and also ease the digestion process. Malting also helps in increasing the bioavailability of micronutrients like iron and calcium. (Ekta singh, 2018) [9] Iron helps in increasing blood levels and preventing anaemic disorders where calcium helps in increasing bone strength and strong teeth formation.

Pregelatinisation helps in reducing the cooking time and also it reduces the nutritional loss while cooking i.e., reducing the water solubility index of the flour (Alebiowu, 2002) [8]. Roasting helps in developing characteristic flavour to the flour, ease removal of the sprouts from grain and also reduces the moisture content from the grains.

Materials and Methods
The following experiment was done in Oil Technology and Pharmaceutical Research Institute

(OTPRI), JNTU-Anantapur. Bajra grains were procured from local wholesale market in Anantapur, the grains were cleaned and soaked for 12 hours, and it is allowed to germinate for 14 hours by tying the grains in a muslin cloth tightly. After germination the grains were further pregelatinized in a pressure cooker for the time period of 18 minutes until the grains did not lose their original shape. The grains were then allowed to dry until the moisture content of the grains reached 11.5%.

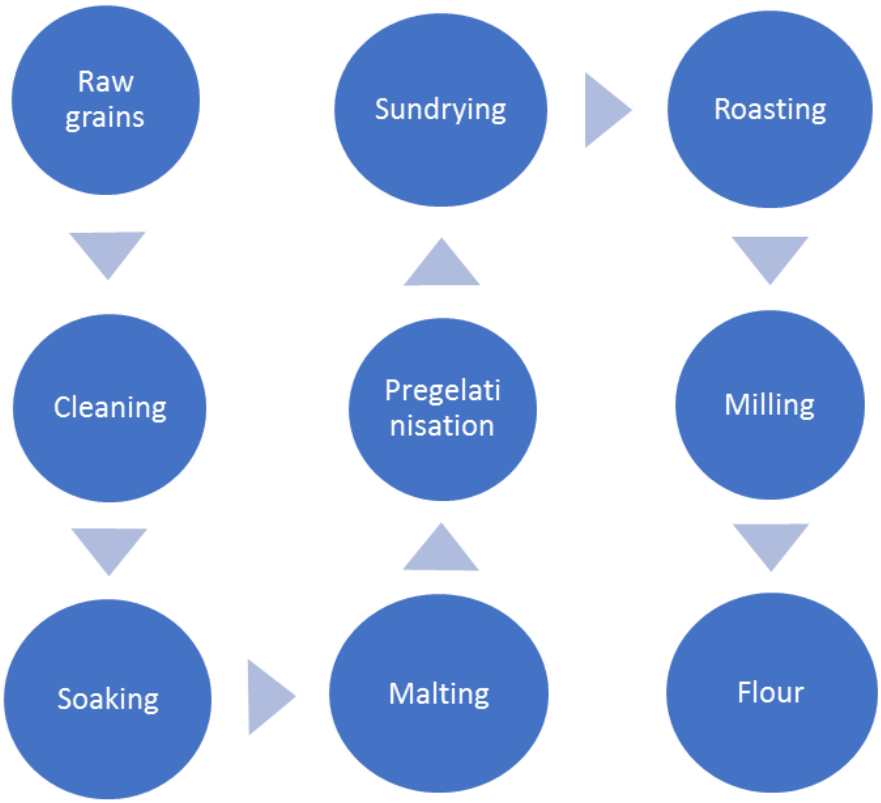

Fig 1: Flow chart of preparation of malted pregelatinized bajra flour

Functional properties determination

Functional properties were carried out to determine the behavioural and physical characteristics of the malted pregelatinized bajra flour. The parameters include: Water absorption capacity, bulk density, swelling index and water solubility.

Water absorption capacity (WAC): [Nargis Yousf 2017] [10]

1grams of each sample were weighed into different centrifugal tube of known weight. 6ml of distilled water was added and samples were stirred. After that those tubes were placed in water bath at room temperature 32^0 C for 30/minutes and they were stirred at 30 minutes intervals. Tubes were centrifuge at 250rpm for 15 minutes. Supernatant was decanted and the tubes containing the samples were reweighed.

Calculation:

$$WAC = \frac{\text{Weight of the sediment}}{\text{Dry weight of sample.}}$$

Bulk Density

2grams of each sample were weighed and poured into 100ml measuring cylinder. The cylinder was tapped constantly on a table gently until there was no further change in volume. The level of the sample was then noted.

Calculation: Bulk density = Mass / Volume (gcm^{-3})

Water Solubility Index (WSI): [Nargis Yousf 2017] [10]

Water solubility index determines the number of polysaccharides that are released from the flour on the addition of excess of water. 2grams of each sample were weighed into different centrifugal tube of known weight. 6ml of distilled water was added and samples were stirred. Tubes were then placed in water bath at room temperature 32^0 C for 30 minutes and they were stirred at 30 minutes intervals. Tubes were centrifuge at 250rpm for 15 minutes. Supernatant was poured into empty known weight Petri dishes. The dishes and their weights were noted. The dishes were dried by using hot air oven at 80ºC and the dishes are then weighed and their weights were noted down.

$$WSI = \frac{\text{Weight of dried supernant}}{\text{Dry weight of sample}}$$

Swelling Capacity

10grams of each sample were weighed and placed in 100ml of distilled water at room temperature in a graduated measuring cylinder. It was tapped gently to eliminate air and the volume was noted in Cylinder. The mixture was allowed to swell and then swirl round and then it was allowed to stand for 1 hour and final volume was noted.

Swelling capacity = final volume/initial volume

Estimation of micro nutrients

Estimation of Iron: (AOAC 1980)

Iron was determined by colorimetric method. When potassium thiocyanate was added to the sample it turned into red colour. It indicates the presence of iron in a sample of the micronutrient solution. Distilled water is added to make up the volume of 6.5 ml followed by 1ml of 30% H_2SO_4, 1.0 ml of saturated potassium per sulphate and 1.5 ml 40% KCNS solution. The red colour that developed is incubated for 20 min and observed at a frequency of 540 nm.

Estimation of calcium: (AOAC 1995)

Pipette an aliquot 40ml of the ash solution which is obtained by dry ashing into a 250ml beaker. To this solution add 30ml of water. Add 10ml of ammonium oxalate and 2 drops of methyl red indicator. Make the solution slightly alkaline by adding dilute ammonia and slightly acidic by adding few drops of acetic acid until faint pink colour appears, the Ph of solution will be 5.0. heat the solution and allow it to stand overnight. Filter the solution through Whatman no.40. wash the precipitate until it is oxalate free. Now wash the precipitate using dil.H2SO4. then wash with hot water and titrate the solution with 0.01N KMnO4 until pink colour appears. The pink colour should persist for at least 1min.

$$\text{Calcium mg/100g} = \frac{\text{Titer} \times \text{Normality of KMnO4} \times 20 \times \text{Total volume of ash solution}}{\text{ml of ash solution taken for estimation} \times \text{wt. of sample taken for ashing}}$$

Results

Table 1: Show the functional property

S. No	Functional property	Result	NBF
1.	Water absorption index	1.80(%)	1.71(%)
2.	Swelling capacity	2.45(gms/ml)	0.71(gms/ml)
3.	Water solubility index	2.01(gms)	4.13(gms)
4.	Bulk density	0.45(gcm^{-3})	0.52(gcm^{-3})
5.	Iron	9.5(mg)	8.0(mg)
6.	calcium	60(mg)	42(mg)

NBF=Normal Bajra Flour

***Source*:** Nutritive value of Indian Foods, NIN, Hyderabad, 2012

Discussion

Pregelatinisation technique increased water absorption index, and swelling capacity of the flour [8]. Water solubility index has greatly reduced which indicates minimal loss of nutrients during cooking. Germination process increased the micronutrient content like iron [6] and calcium [7] by breaking complex substances into simple ones and increasing their bioavailability thus enriching the flour.

Conclusion

Pearl millet is highly nutritious and underutilised grain because of its poor keeping qualities, enzymes that cause spoilage and anti-nutritional factors. The present experiment shows that pregelatinization and malting increases the shelf life and nutritional composition of the grains thereby increasing the utilisation.

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