

RESEARCH PAPER

Assessment of Functional Properties of Flour Mix

Aditi and Arivuchudar. R*

Department of Clinical Nutrition and Dietetics, Periyar University, Salem-11, Tamil Nadu, India

*Corresponding author: achudar24@gmail.com

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ABSTRACT

The present study was carried out to assess the functional properties of the flour mix, prepared from the combination of millet flours (*ragi*, *bajra* and *jowar*), pulses flour (green gram, whole bengal gram (black) and horse gram) and curry leaves flour subjected to processing methods like sprouting and roasting. The unprocessed samples were also included. The functional properties like swelling capacity, water absorption capacity, oil absorption capacity, water solubility index, moisture, true density, hydration capacity, hydration index and bulk density content of flours were evaluated. Roasted flour mix had the lowest moisture content while sprouted flour mix had highest the value of bulk density, hydration capacity, swelling capacity, water absorption capacity, oil absorption capacity, and hydration index compared to others. Sprouted millets, pulses and curry leaves flour mix showed good functional properties, which could also enhance the nutritional quality of the value added products formulated by incorporating them.

Keywords: Millets & Pulses Flour Mix, Value Addition, Functional Properties

The use of cereal flour especially wheat or rice is in practice for the preparation of breakfast recipes, bakery products in the Indian subcontinent. These cereals contain carbohydrates in major proportion with protein around 6% and fibre in traces. Most of the micronutrients which help in alleviating non-communicable diseases and diseases arising out of aging are absent. Hence, the concept of value addition to these daily consumed cereals will benefit to a greater extent in preventing or treating such conditions. The millets which are widely available at low cost and are underutilised namely *ragi*, *bajra* and *jowar* are treasure of nutraceuticals. The pulses namely green gram, whole bengal gram (black) and horse gram are rich in protein and fibre, and curry leaves are rich source of beta- carotene, iron, fibre and calcium is locally grown and least expensive. Therefore, the flour mix is prepared using these ingredients as a means for value addition. A variation from unprocessed ingredients, another

from sprouted and third from roasted ingredients were formulated. The popularity of millets, pulses and curry leaves powder mix can be attributed to its functional properties like water absorption capacity, bulk density, oil absorption capacity, swelling capacity, moisture content and hydration capacity as these affect the gluten formation of the flour. These functional properties help in deciding the blends of different flours for various products. The nutritional quality of these millets and pulses can maximize when subjected to germination and roasting. Hence, the impact of these techniques on the functional and nutritional properties of the flour mix was studied.

MATERIALS AND METHODS

1. Preparation of Value Added Flour Mix

(a) Preparation of Unprocessed Flour Mix

The millets *ragi*, *bajra* and *jowar*, the pulses green

gram, whole bengal gram (black) and horse gram were cleaned, washed with water, dried in shade and ground separately.

(b) Preparation of Sprouted Flour Mix

The millets *ragi*, *bajra* and *jowar*, the pulses green gram, whole bengal gram (black) and horse gram were cleaned, washed with water, soaked individually for 12 hours at room temperature. The excess water was discarded and the seeds were tied in a muslin cloth and allowed to germinate. The ingredients were dried under shade and ground separately. The millets *ragi*, *bajra* and *jowar* germinated in 8 - 10 hours, while the green gram and horse gram took 24 hours for germination and whole Bengal gram took a slightly higher germination time i.e. 48 hours.

(c) Preparation of Roasted Flour Mix

The millets *ragi*, *bajra* and *jowar*, the pulses green gram, whole bengal gram (black) and horse gram were cleaned, washed with water, roasted at 130 °C for 5-7 minutes each, cooled and ground separately.

(d) Preparation of Curry Leaves Powder

The curry leaves were cleaned and washed with water, dried in shade and ground.

PROPORTION OF FLOURS TO DEVELOP FLOUR MIX

Three types of flour mix (Unprocessed, Sprouted and Roasted) was developed by mixing 5gms of flours from each ingredient viz. *Ragi*, *bajra*, *jowar*, Green gram, Black *channa*, Horse gram and Curry leaves after conditioning them accordingly.

2. Evaluation of Functional Properties of Different Flour Mix

The following procedures were adopted to determine the functional indices of the different flour mix:

Moisture Content

The powdered material (2 g) was placed in a moisture dish and dried to a constant weight in an oven at 100-

105 °C. The loss of weight (in mg/g) of air dried was calculated as follows:

$$\% \text{ of moisture content} = \frac{\text{Initial Weight of sample} - \text{Final Weight of sample}}{\text{Weight of sample}} \times 100$$

Bulk Density

A 50g quantity of the sample was placed in a 10ml measuring cylinder and the volume occupied by the material was noted as the bulk volume. The bulk density was obtained by dividing the mass of the material by the bulk volume as shown in Equation (Momoh *et al.* 2012):

$$\text{Bulk Density} = \frac{\text{Mass of the materials (M)}}{\text{Volume of the materials (V}_B)}$$

True Density

The true density (D_t) of the sample was determined by the liquid displacement method using kerosene as the immersion fluid as described by Ohwoauvorhua *et al.* (2004) and was computed according to the following equation.

$$D_t = W / [(a+w) - b] \times SG$$

Were w is the weight of the powder, SG is specific gravity of liquid, a , is Weight of bottle + liquid and b is weight of bottle + solvent + powder.

Water Absorption and Water Solubility Index

Water absorption index (WAI) and water solubility (WSI) determine by the method of Suraiya Jamal *et al.* (2016). 1 g of sample was weighed and placed in a centrifuge tube. Then 6 ml of distilled water was added for suspension. The tubes along with the samples were heated in shaking water bath at the temperature of 80°C for 30 minutes. The solution was centrifuged at 2500rpm for 10 minutes. After the centrifugation, the supernatants were carefully poured into Petri dish for drying at 105 °C for 10 hours in an oven, while the sediments were weighed

as such. Water absorption index was calculated on the basis of wet sediments, while water solubility index was calculated on the basis of difference in the weight of dried supernatant and initial sample.

$$\text{WAI} = \frac{\text{Wt. of wet sediment}}{\text{Dry wt. of sample}}$$

Water Solubility Index (WSI)

The water solubility index of starches was carried out as described by Anderson and Sefa-dede (2001) with little modification. 1 g each of the starches and 10 ml of water were mixed in a 15 ml plastic centrifuge tube and were immersed in water bath for 30 min at 37 °C. This was then centrifuged at 4000 rpm for 10 min after which the supernatant was collected in a pre-weighed beaker and the residue was weighed after the water was evaporated at 105 °C; the percentage of residue with respect to the amount of starch used was taken as the water solubility index.

$$\text{WSI (\%)} = \frac{\text{Wt. of dried supernatant}}{\text{Dry wt. of sample}}$$

Swelling Capacity

The method of Okaka and Potter (1977) with some modifications was used for determining the swelling capacity. The sample filled up to 10 ml mark in a 100 ml graduated cylinder was added with water to adjust total volume to 50 ml. The top of the graduated cylinder was tightly covered and mixed by inverting the cylinder. The suspension was inverted again after 2 min and allowed to stand for further 30 min. The volume occupied by the sample was taken after 30 min.

$$\text{Swelling capacity (g/ml)} = \frac{\text{Final volume of sample}}{\text{Initial volume of sample}}$$

Hydration Capacity

The method of Kornblum and stoopak (1973) was used. A 2g sample was placed in 15ml plastic

centrifuge tube and 10ml distilled water was added. The contents were mixed on a vortex mixer for 2 min. The mixture was then allowed to stand for 10min and immediately centrifuged. The supernatant was carefully decanted and the sediment weighed. The hydration capacity was taken as the ratio of the weight of the sediment to the dry sample weight.

Hydration capacity =

$$\frac{\text{Wt. of sediment} - \text{Weight of tube}}{\text{Dry wt. of sample}}$$

Hydration index =

$$\frac{\text{Hydration capacity}}{\text{Dry wt. of sample}}$$

Oil Absorption Capacity (OAC)

One gram of sample was weighed, 10 ml of Soyabean oil of a known density (Sp. Gravity 0.9092) was added to the sample and the mixture stirred on a magnetic stirrer at 1000 rpm for 5 min. The mixture was centrifuged at 3500 rpm for 30 min and the supernatant removed and measured with 10 ml measuring cylinder (Sathe and Salunkhe, 1982). The OAC was calculated using the following equation.

$$\text{OAC} = \frac{\text{Volume of oil absorbed} \times \text{density}}{\text{Dry wt. of sample}}$$

RESULTS AND DISCUSSION

The results obtained are presented in the Table 1.

Table 1: Functional properties of flour mix

Sl. No.	Functional Properties	Unprocessed flour mix	Sprouted flour mix	Roasted flour mix
1	Moisture content (%)	6.5	8.5	5.0
2	Bulk Density (g/ml)	0.555	0.625	0.550
3	True Density (g/ml)	1.41	2.09	1.71
4	Water absorption index (WAI) (%)	5.48	5.48	4.66

Water solubility index (WSI) (%)	1.34	1.82	1.67
Swelling capacity (g/ml)	0.92	0.96	0.88
Hydration capacity (g/ml)	2.23	2.45	2.25
Hydration index (%)	1.11	1.22	1.12
Oil absorption capacity (OAC) (%)	199.11	215.48	200.02
Porosity (PU)	0.607	1.79	0.678

The bulk density (g/ml) was found to be more in sprouted mix (0.625) and it was similar in unprocessed and roasted mix (0.555, 0.55). The true density (g/ml) was highest in sprouted mix (2.09) and least in unprocessed mix (1.41). The swelling capacity was less in roasted flour mix whereas it was the same in both unprocessed and sprouted flour mix. Hydration capacity was slightly -higher in sprouted flour mix.

The WAI is an indicator of the ability of flour to absorb water and swell for desirable consistency in food system, which improves yield and consistency, and gives body to the food product developed. The Water absorption capacity or index represent the ability of a product to associate with water under conditions where water is limited (Singh, 2001). The water absorption was high in unprocessed flour mix (5.48%) and low in sprouted flour mix, which could be attributed to the presence of higher amounts of carbohydrates.

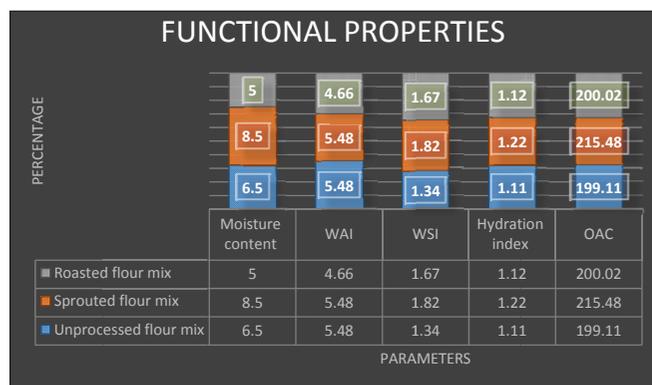


Fig. 1: Functional properties of flour mix (Moisture, WAI, WSI, HI, OAC)

The WSI is used to indicate starch degradation, and thus it determines the amount of free polysaccharide or polysaccharide released from the granule on the addition of excess water. The water solubility index was high in sprouted flour mix (1.82%), and low in unprocessed flour mix which could have resulted as an impact of polysaccharides released during germination.

The higher oil absorption in food is especially desirable for flavor retention, improvement of palatability and extension of shelf life particularly in bakery or meat products (Aremu *et al.* 2007). In this study, the oil absorption capacity was more in sprouted flour mix (215.48 %) compared to all other variations hence would promise to be more accepted flour mix for food product development.

It is evident from Fig. 1 that moisture content is high in sprouted flour mix (8.5%) and low in roasted flour mix (5%) and hence the hydration capacity and hydration index is high in sprouted flour mix, which reveals that the dough from sprouted flour mix may be little stickier when compared to dough formation from other flour mix.

CONCLUSION

This study reveals that of all the different processed and unprocessed flour mix, the sprouted flour mix contains all the functional properties in the right proportion to develop any leavened or unleavened breads, pastas, noodles, snack products and bakery products like cookies, pastries with sufficient nutrients from combination of sprouted millets and pulses and curry leaves incorporated into whole wheat flour or refined wheat flour.

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