

Original Research Article

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Physical and Functional Properties of Buckwheat

R. Latha Rani¹ and Uma N. Kulkarni^{2*}

¹Department of Food Science and Nutrition, UAS, GKVK, Bangalore, India

²Department of Food Science and Nutrition, College of Community Science, UAS, Dharwad-580005, Karnataka, India

*Corresponding author

ABSTRACT

Buckwheat (*Fagopyrum esculentum*) an annual crop, is a pseudo cereal and a member of the polygonaceae family. A major benefit of buckwheat compared to other grains is that it has a gluten free property and unique amino acid composition that gives special biological activities. These include cholesterol-lowering effects, anti-hypertension effects and improving digestion by relieving constipation. Though the physiological importance of pseudo cereal is laid since ancient times, the physicochemical properties of buckwheat studies are in vague. Hence the present study was taken up with the objective is to assess the physical and functional properties of buckwheat varieties. Buck wheat varieties were selected from wheat scheme, MARS, Agricultural University Dharwad. Two buckwheat varieties viz., PRB-1, Nelagiri along with one bread wheat were selected for the study. The buckwheat varieties did not very much, PRB-1 variety had highest 100 kernel weight (1.97 g/100 g), volume (2.66 g/100 g), bulk density (0.74) while Nelagiri variety had highest grain length (4.02 mm) and length/width ratio (1.53). The width was same for both the varieties (2.89 mm). Hydration capacity (1.22 g/100 g) and Hydration index (0.79) were highest in Nelagiri variety. Swelling capacity (0.37 ml/100 g) and swelling index (0.94) were highest in PRB-1 variety. Water absorption capacity was found to be highest in buckwheat (2.23 ml/g) whereas highest oil absorption capacity was observed in bread wheat (2.20 ml/g).

Keywords

Buckwheat,
Bread wheat,
PRB-1, Nelagiri

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Introduction

Buckwheat (*Fagopyrum esculentum*) is a broad-leafed herbaceous annual plant. Like cereals, the seed of the buckwheat plant contains germ, endosperm, aleurone layer and hull. However, it does not belong to cereal family (Graminae), but belongs to the family of Polygonaceae. It is neither a cereal nor a legume; rather it is a pseudo cereal

because of its resemblance with cereals in having starchy endosperm. It is dicotyledonous like legumes and nuts.

Pseudo-cereals are defined as starchy food grains excluding those currently classified as cereals, legumes, oilseeds and nuts. These pseudo-cereals are ancient crops cultivated in different countries like Africa, Asia, Central and South America, which has been

rediscovered in the last thirty years. Pseudo-cereals are being used extensively for the development of functional foods. Components of pseudo-cereals identified to exhibit the health benefits are dietary fiber, proteins, lignin's, essential amino acids, fatty acids, minerals, phenolic compounds, vitamins etc. Screening varieties for its utility paves way for its popularization. Hence present study was put forth with the objective to analyze the physical and functional properties of buck wheat varieties.

Materials and Methods

Procurement of buckwheat varieties

Nelagiri, PRB-1 along with bread wheat (UAS-304) as control, were procured from AICRP, Wheat scheme, MARS, UAS, Dharwad and analyzed for quality parameters in triplicates Though bread wheat is a cereal, comparison was made with buckwheat variety. As there was a need to convince wheat growing farmers that buckwheat is also nutritious which can be grown, there by promote cultivation of buckwheat varieties among the farmers of north Karnataka.

Physico chemical properties of buck wheat varieties

Physical characteristics

Weight

Weight of 100 grains was recorded using electronic weighing balance. Mean weight per 100 grains was expressed in g.

Volume

The volume of 100 grains was measured using seed displacement method. Average volume was expressed as ml/100 grains.

Bulk density

Bulk density of grains was calculated using hundred grain weight and volume (Sangeetha and Grewal, 2018).

$$\text{Bulk density} = \frac{\text{Seed weight (g)}}{\text{Seed volume (ml)}}$$

Length

Length of grains was measured by using slide caliper. Mean length was expressed in mm.

Width

Width of selected 10 grains was measured by using slide caliper. Mean width was expressed in mm.

Length/Width ratio

Length/width ratio was calculated by using length and width values of respective grains.

Functional characteristics

Hydration capacity and hydration index

About 10 g of seeds were counted and transferred to a measuring cylinder. Water (50 ml) of water was added to cylinder, covered with aluminum foil and left overnight at room temperature. The seeds were drained, superfluous water was removed with filter paper and swollen seeds were reweighed. Hydration capacity and hydration index was calculated (Sangeetha and Grewal, 2018) using the following formula.

$$\text{Hydration capacity (g/100 grains)} = \frac{\text{Weight of grains after soaking (g)} - \text{Weight of grains before soaking (g)}}{\text{Total number of grains (N)}}$$

Hydration index

Hydration index was calculated using the following formula:

$$\text{Hydration index} = \frac{\text{Hydration capacity per 100 grains}}{\text{Weight of total number of grains}}$$

Swelling capacity and swelling index

Seeds weighing 10 g were counted and transferred to a measuring cylinder and total volume was recorded. For soaking, 50 ml of water was added. The cylinder was covered with aluminum foil and left overnight at room temperature. The water was drained and volume of soaked seeds was noted in graduated cylinder. Swelling capacity and swelling index was calculated (Sangeetha and Grewal, 2018) using the following formula.

$$\text{Swelling capacity} = \frac{\text{Volume of seeds after soaking (ml)} - \text{Volume of seeds before soaking (ml)}}{\text{Total number of seeds (N)}}$$

Swelling index

Swelling index was calculated by using the formula,

$$\text{Swelling index} = \frac{\text{Swelling capacity per 100 seed}}{\text{Volume of 100 seeds}}$$

Water absorption capacity (WAC)

A suspension of 1.0 g of flour in 10 ml distilled water was agitated 4 times allowing 10 min resting periods between each mixing and centrifuged at 3250 rpm for 25 min. The supernatant was decanted and tubes were air dried and then weighed (Sindhu and Khatkar, 2016).

WAC (ml/g) = Volume of water absorbed/weight of sample

Oil absorption capacity (OAC)

Flour weighing 0.5 g with 3 ml refined groundnut oil was stirred for 1 min. After 30 min at room temperature, the tubes were centrifuged at 3200 rpm for 25 min. The volume of unabsorbed oil was determined (Sindhu and Khatkar, 2016).

OAC (ml/g) = Volume of fat /weight of sample

Results and Discussion

Physical characteristics of dehusked buckwheat varieties

A. Physical characteristics of dehusked buckwheat varieties are represented in Table 1. The hundred kernel weight ranged from 1.96 – 1.97 g. No significant difference was found in hundred kernel weight between buckwheat varieties. The bread wheat had significantly ($p < 0.01$) highest hundred kernel weight (4.74 g) compared to buck wheat varieties.

Hundred kernel volume was found to be highest in PRB-1 variety (2.66 ml) followed by Nelagiri (2.50 ml). No significant difference was observed between buckwheat varieties. The bread wheat had significantly ($p < 0.01$) high hundred kernel volume (8.00 ml) compared to both the buck wheat varieties. Bulk density was found to be highest in Nelagiri variety (0.80) and lowest was observed in PRB-1 (0.74). In comparison with bread wheat, significant difference ($p > 0.05$) was found in both the varieties.

Dehusked grain length was found to be highest in Nelagiri variety (4.02 mm) followed by PRB-1 variety (3.72 mm). Highly significant ($p < 0.01$) difference was found in length of bread wheat (6.39 mm) in comparison to buck wheat varieties.

There was no significant difference in width of buck wheat grains. Both the buckwheat varieties - Nelagiri and PRB-1 revealed same width (2.89 mm).

Compared with buckwheat, bread wheat had significantly ($p < 0.01$) higher width (3.26 mm). Length/width ratio ranged between 1.28- 1.53 among the buckwheat varieties. Bread wheat had significantly ($p < 0.01$) high length/width ratio when compared with buckwheat varieties.

The results pertaining to physical characteristics of buckwheat grains reported by Kumari and Raghuvanshi (2015) revealed higher values for hundred kernel weight (2.19 g/100 g) but similar values for bulk density (0.73 mg/ml).

Sangeetha and Grewel (2018) reported higher hundred kernel weight (2.37) and lower bulk density (0.69 g/ml) for buckwheat varieties. The bulk density (0.68 g/ml) reported by Sindu and Khatkar (2016) was lower than those obtained for buckwheat in this present study. Variation in physical characteristics in buckwheat may be attributed to varietal differences which is influenced by the size of the grains, moisture content etc (Chandrashekar *et al.*, 2010).

Functional characteristics of buckwheat varieties

Functional characteristics of grain and flour viz., Hydration capacity, hydration index, swelling capacity, swelling index of dehulled grains and water absorption capacity and oil absorption capacity of buckwheat flour along with bread wheat are given in Table 2.

Hydration capacity and hydration index of grains ranged from 1.21-1.22 g/100 grain and 0.78- 0.79 respectively among the buckwheat varieties. Compared to buckwheat,

bread wheat had significantly ($p < 0.01$) higher hydration capacity (1.81g/ 100 grains) and hydration index (0.85).

Kumari and Raghuvanshi (2015) has outlined lower hydration capacity (1.05 g/100 g), swelling index (0.55), water absorption capacity (1.60 ml/g), oil absorption capacity (1.24 ml/g) and higher swelling capacity (1.33 ml/g) for buckwheat varieties. Sangeetha and Grewel reported lower hydration index (0.57) and similar values for swelling index (0.89).

Among the buckwheat varieties, PRB-1 variety had higher swelling capacity (0.37ml/ 100 grains) and swelling index (0.94). Nelagiri variety had least swelling capacity (0.27 ml/ 100 grains) and swelling index (0.90). However bread wheat had significantly ($p < 0.01$) highest swelling capacity (0.61 ml/ 100 grains) and swelling index (1.22) than buckwheat varieties.

The water absorption capacity and oil absorption capacity of buckwheat flours- PRB-1 and Nelagiri ranged between 2.22- 2.23 ml/g and 1.91-1.96 ml/g respectively. Buckwheat flours had significantly ($p < 0.01$) higher water absorption capacity (2.23 ml/g) and lower oil absorption capacity (1.91 ml/g) when compared to bread wheat flour. No significant difference was observed in oil absorption capacity of buckwheat flours when compared with bread wheat flour. In bread wheat, water absorption capacity (1.31 ml) and oil absorption capacity (0.88 ml) per 100 g reported by Alviola and Monterde (2018) are lower than those reported in the present study.

The difference observed in functional characteristics of buckwheat varieties may be due to difference in variety, seed size, structure of the grain, seed coat permeability, hydrophilic constituent and genetic endowment (Sindhu and Khatkar, 2016).

Table.1 Physical characteristics of dehusked buckwheat varieties

Varieties	Hundred kernel weight (g)	Hundred kernel volume (ml)	Bulk density	Length (mm)	Width (mm)	Length/ width ratio
PRB-1	1.97 ± 0.01	2.66 ± 0.28	0.74 ± 0.07	3.72 ± 0.16	2.89 ± 0.08	1.28 ± 0.09
Nelagiri	1.96 ± 0.03	2.50 ± 0.50	0.80 ± 0.15	4.02 ± 0.19	2.89 ± 0.08	1.53 ± 0.21
BRW (UAS-304)	4.74 ± 0.03	8.00 ± 1.00	0.59 ± 0.07	6.39 ± 0.17	3.26 ± 0.36	1.93 ± 0.03
t value						
a) PRB-1 X Nelagiri	0.169 ^{NS}	0.500 ^{NS}	0.643 ^{NS}	2.09 ^{NS}	0.01 ^{NS}	1.85 ^{NS}
b) PRB-1 X BRW	14.80**	8.87**	2.44*	19.14**	6.87**	11.27**
c) Nelagiri X BRW	11.44**	8.52**	2.10*	15.67**	6.87**	3.29*

PRB-1, Nelagiri- Buckwheat varieties, BRW- Bread wheat

Note: ** - Significant at 0.01 per cent level, * - Significant at 0.05 per cent, NS- Non significant

Table.2 Functional characteristics of buckwheat varieties

Varieties	Grains				Flour	
	HC (g/100 g)	HI	SC (ml/100g)	SI	WAC (ml/g)	OAC (ml/g)
PRB-1	1.21 ± 0.01	0.78 ± 0.01	0.37 ± 0.01	0.94 ± 0.01	2.22 ± 0.01	1.96 ± 0.07
Nelagiri	1.22 ± 0.04	0.79 ± 0.03	0.27 ± 0.01	0.90 ± 0.01	2.23 ± 0.01	1.91 ± 0.10
BRW (UAS-304)	1.81 ± 0.02	0.85 ± 0.01	0.61 ± 0.01	1.22 ± 0.02	1.85 ± 0.01	2.20 ± 0.17
t value						
a) PRB-1 X Nelagiri	0.598 ^{NS}	0.487 ^{NS}	32.00**	6.50*	0.80 ^{NS}	0.54 ^{NS}
b) PRB-1 X Bread wheat	46.47**	2.32 ^{NS}	31.75**	19.00**	35.41**	2.20 ^{NS}
c) Nelagiri X Bread wheat	19.68**	2.91 ^{NS}	51.50**	24.50**	36.36**	2.45 ^{NS}

PRB-1, Nelagiri- Buckwheat varieties, BRW- Bread wheat

HC- Hydration capacity, HI- Hydration index, SC- Swelling capacity, SI- Swelling index,

WAC- Water absorption capacity, OAC- Oil absorption capacity.

Note: ** - Significant at 0.01 per cent level, * - Significant at 0.05 per cent, NS- Non significant

The buckwheat can be blended with other cereals and pulse flour for its utility of different kind of food products because a grains have good physical and functional properties.

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