

## Cooking Quality and Acceptability of Coloured Horse Gram (*Macrotyloma uniflorum*) Varieties

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**ABSTRACT:** Horse gram (*Macrotyloma uniflorum*) which is also known as poor man's pulse is one of the underutilized pulse. The main objective of the study was to analyse the cooking quality of coloured horse gram varieties. Three different genotypes of horse gram with different colours viz., black (CRHG-22), white (Kalaghatagi local) and brown (GPM-6) were procured from Seed Unit, University of Agricultural Sciences, Dharwad and were analysed for cooking characteristics of unsoaked, soaked and boiled and soaked and pressure cooked grains. There was significant difference between the coloured horse gram varieties for all the cooking quality parameters in all the three methods. Cooking time in unsoaked grains ranged from 91- 110 min, 50-58 min in soaked and boiled grains and 44 to 49 min in soaked and pressure cooked grains. Pressure cooking was found to have better cooking characteristics compared to soaked and boiled and unsoaked grains. Pressure cooked grains showed higher sensory scores for all the sensory parameters in all the three coloured horse gram varieties compared to boiled grains.

**Keywords:** Horse gram, unsoaked, boiling, pressure cooking, cooking time, sensory parameters.

### INTRODUCTION

Legumes/pulses are plants belonging to the family *Fabaceae* (or *Leguminosae*), bearing edible seeds borne in pods. India is the largest consumer and importer of pulses in the world, and they are consumed regularly in every household, at least with one meal. They enhance the protein content of cereal-based diets and improve the nutritional status of these diets. Legumes not only add variety to the human diet but also serve as an economical source of supplementary proteins in a vegetarian diet for a large population in developing countries like India. Pulses play a significant role in mitigating protein malnutrition among millions of poor vegetarians in tropical and subtropical regions worldwide. Hence, legumes are considered as the "poor man's meat."

Horse gram (*Macrotyloma uniflorum* (Lam.) Verdc.) is one of the underutilized pulses originating from the South-East Asian subcontinent and tropical Africa. It is extensively grown in dry areas of China, the Philippines, Bhutan, Pakistan, Australia, Burma, India, and Sri Lanka. In India, it is an extensively cultivated pulse in South India, covering the maximum area in the states of Andhra Pradesh, Karnataka, and Tamil Nadu. Horse gram is generally called a protein-rich poor

man's crop that has the ability to grow well even under dry conditions (low rainfall) and marginal soil fertility (Kiranmai *et al.*, 2016). Horse gram is known by several names in local languages such as *Kutlihi* (Hindi), *Kollu* (Tamil), *Ullavalu* (Telugu), *Mudhira* (Malayalam), *Kurti-kalai* (Bengali) and *Huruli* (Kannada).

Cooking is one of the most common processing methods used in pulses, required to remove several antinutritional factors and to increase the palatability with improved acceptability and sensory quality of pulses. Legumes are usually soaked in water overnight prior to cooking, which saves time and energy needed in the cooking process. During cooking, the grains undergo several important physical as well as chemical changes involving gelatinization of starch, denaturation of protein, solubilization of some of the polysaccharides, softening of structure, etc., which result in a palatable texture (Stanley and Aguilera 1985). Thus, the present study was undertaken to evaluate the cooking quality and acceptability of colored horse gram varieties.

### MATERIAL AND METHODS

Three different genotypes of horse gram with different colours viz., black (CRHG-22), white (kalaghatagi

local) and brown (GPM-6) were procured from Seed Unit, University of Agricultural Sciences, Dharwad.

**Cooking quality of horse gram varieties. Weight of raw and cooked grains:** Weight of cooked grains was recorded in grams using electronic balance with a sensitivity of 0.01 mg (Sareepuang *et al.*, 2008).

**Volume of raw and cooked grains:** The volume of cooked grains was measured using water displacement method in triplicate. Cooked grains were put in a measuring cylinder containing known volume of distilled water. The difference in volume was recorded in ml (Khatoun and Prakash 2005). Average volume was expressed as ml per 100 grains.

**Cooking time:** Cooking time was assessed by following the procedure of Sareepuang *et al.* (2008). Ten gram of sample were taken in a beaker and cooked in 50 ml of distilled water on hot plate. The cooking time was determined by removing a few cooked grains at different time intervals during cooking and pressing them between two glass slides until chalky white colour disappeared. Finally, the time taken for cooking was noted.

**Solid loss:** Samples (10 g) were cooked in 100 ml distilled water for minimum cooking; the gruel was transferred in pre weighed petriplate ( $W_1$ ) and was evaporated at 105°C in a hot air oven until completely dry. The petriplates were placed in desiccator for cooling and weight ( $W_2$ ) was noted. The amount of solids leached was calculated as gram of solids per gram of dry grain (Sareepuang *et al.*, 2008).

$$\text{Solid loss (\%)} = \frac{W_2 - W_1}{\text{Weight of raw grain (g)}} \times 100$$

**Water uptake ratio of cooked grains.** About ten grams of grains were cooked in 100 ml of distilled water for minimum cooking time. The cooked grains were then removed, drained and surface water on seeds was removed by using filter paper. Then the samples were weighed and the water uptake ration was calculated as the ratio of weight gained after cooking to weight before cooking (Sareepuang *et al.*, 2008).

#### **Acceptability of horse gram varieties**

##### **Cooking of horse gram for sensory evaluation.**

**A. Boiling method:** Boiling was done cooking 25 g of grains in boiling water. Cooking was checked by pressing the grains between glass slides for 10 min boiling and continued at 2 min interval. Cooking would be completed when 80-100 per cent of grains become soft (Badashah *et al.*, 2003).

**B. Pressure cooking:** Pressure cooking was done by cooking 50 g of grains in 250 ml of water in pressure cooker for 10 min (Mubarak, 2003).

**Sensory profile of cooked horse gram varieties.** The boiled and pressure cooked horse gram were subjected to sensory evaluation by a panel of 15 semi trained panel members. The cooked sample was evaluated for appearance, color, texture, flavour, taste and overall acceptability of a nine-point hedonic scale (Navaratne, 2013).

## **RESULTS AND DISCUSSION**

Cooking quality of unsoaked coloured horse gram varieties is presented in Table 1. There was significant

difference ( $p < 0.01$ ) between the coloured horse gram varieties for all the cooking quality parameters except weight of grains before cooking. Weight of grains after cooking ranged from 21.56 to 23.39 g. Highest cooked weight was observed in black coloured variety followed by cream and brown coloured variety (control). Volume of grains before and after cooking ranged from 7.66 to 8.33 ml and 18.33 to 22.33 ml respectively. Highest cooking time and solid loss was observed in black coloured variety (110.33 min, 6.82 %) followed by brown (107 min, 5.56 %) and cream coloured variety (91 min, 5.13 %) respectively. Water uptake ratio was found to be highest in black coloured variety (2.34) followed by cream (2.24) and brown coloured variety (2.16).

Cooking quality of soaked and boiled coloured horse gram varieties is shown Table 2. Significant difference ( $p < 0.01$ ) was found between the coloured horse gram varieties for all the cooking quality parameters except volume of grains before and after cooking. Weight of grains before cooking was highest in brown coloured variety (21.21 g) followed by cream (21.06 g) and black coloured variety (20.45 g). Weight of grains after cooking was highest in brown coloured variety (23.39 g) followed by and black (22.42 g) and cream coloured variety (22.05 g). Cooking time of grains ranged from 50.66 to 58.66 min highest being in black (58.66 min) followed by brown (52.33 min) and cream coloured variety (50.66 min) respectively. The solid loss and water uptake ratio was highest in black coloured variety (4.57 %, 1.18) followed by brown (4.36 %, 1.11) and cream coloured variety (4.14 %, 1.03) respectively.

Table 3 depicts the cooking quality of soaked and pressure cooked coloured horse gram varieties. There was significant difference ( $p < 0.05$ ) between the coloured horse gram varieties for all the cooking quality parameters except volume of grains before cooking. Weight of grains before cooking ranged from 20.45 to 21.21 g highest being in brown (21.21 g) followed by cream (21.06 g) and black coloured variety (20.45 g) respectively whereas weight of grains after cooking ranged from 23.18 to 24.41 g highest being in brown (24.41 g) followed by black (23.45 g) and cream coloured variety (23.18 g) respectively. Volume of grains after cooking was highest in brown and cream coloured variety (21.12 ml, 21.08 ml) followed by black coloured variety (20.02 ml). Cooking time of grains ranged from 49.43 to 44.12 min highest being in black (49.43 min) followed by brown (46.76 min) and cream coloured variety (44.12 min) respectively. The solid loss and water uptake ratio was highest in black coloured variety (3.98 %, 1.25) followed by brown (3.76 %, 1.15) and cream coloured variety (3.67 %, 1.12) respectively.

From the present study, it was concluded that the maximum softness when observed by physical method was achieved within 91–110 min of cooking time in unsoaked grains, 50-58 min in soaked and boiled grains and 44-49 min in soaked and pressure cooked grains. Study conducted by Bhokre and Joshi (2015) shown that the variation in cooking time among pulses might be attributed to penetration of water and rate at which cell separation occurs due to loosening of intercellular

matrix of the middle lamella during cooking and also reported that the variation of cooking quality does exist in varieties of same legume itself. The reason for variations in cooking time, water uptake and gruel solid loss may be attributed to the dimensions and seed coat quality of grain as previously reported by Jain *et al.* (2012) and separation of cells accompanies the softening of legumes in soaking and cooking process resulting in increased separated cells in to the cooked water may be contributing to the dispersed solids (Sasikala *et al.*, 2011). Hard seed coat of grains and no softening and solubility of starch and solid substances in unsoaked grains as seen in the soaking process may also be the reason for variation in solid loss. Reason for reduction in cooking time after soaking process could be due to the leaching of the solid substance and softening of the starch and further soaking decreases cooking and increase the solid loss (Patil and Kasturiba 2018).

Table 4 shows the sensory profile of soaked and boiled horse gram varieties. There was significant difference ( $p < 0.01$ ) between the coloured horse gram varieties for the sensory parameters like colour, flavour, taste, texture and overall acceptability. Also there was significant difference ( $p < 0.05$ ) between the coloured horse gram varieties for appearance. The sensory score for appearance was highest for cream coloured variety (8.01) followed by brown (7.81) and black coloured variety (7.61) respectively. Highest score for colour parameter was observed in cream coloured variety (8.50) followed by brown (8.00) and black coloured variety (7.51). The sensory score for flavour was highest for black and brown coloured variety (8.00, 7.90) followed by cream (7.40) coloured variety respectively. Brown coloured variety has highest sensory score for taste (8.00). The sensory score for flavour was highest for black and brown coloured variety (8.00, 7.90) followed by cream (7.40) coloured variety respectively. Brown coloured variety has highest sensory score for taste (8.00) followed by black (7.80) and cream coloured variety (7.61). Black and brown coloured variety has highest sensory score for texture (7.80, 7.70) followed by cream coloured variety (7.10). Brown and black coloured variety has highest sensory score for overall acceptability (7.90, 7.80) followed by cream coloured variety (7.30).

Table 5 shows the sensory profile of soaked and pressure cooked horse gram varieties. Significant difference ( $p < 0.01$ ) was found between the coloured horse gram varieties for the sensory parameters like colour, taste, texture and overall acceptability. Also there was significant difference ( $p < 0.05$ ) between the

coloured horse gram varieties for appearance. Highest sensory score for appearance (8.50) was for cream colour variety followed by brown (8.00) and black coloured variety (7.80) respectively. Highest score for colour parameter was observed in cream coloured variety (8.60) followed by brown (8.00) and black coloured variety (7.91). Highest sensory score for taste (8.70) was for black colour variety followed by brown (8.50) and cream coloured variety (7.82) respectively. Brown coloured variety got the highest sensory score for texture (8.90) followed by black (8.20) and cream coloured variety (8.00). Brown coloured variety got the highest sensory score for overall acceptability (8.60) followed by black (8.30) and cream coloured variety (8.00).

Fig. 1 shows the acceptability indices of boiled and pressure cooked coloured horse gram varieties. Significant difference ( $p < 0.01$ ) was found between the boiled and pressure cooked coloured horse gram varieties for acceptability index. Pressure cooked grains showed highest acceptability index for all the three coloured horse gram varieties compared to boiled grains. Acceptability index of pressure cooked brown, cream and black coloured variety was 95, 87.03 and 88.51 respectively whereas acceptability index of boiled brown, cream and black coloured variety was 87.59, 82.59 and 85.18 respectively.

Sensory profile of soaked and boiled horse gram varieties and sensory profile of soaked and pressure cooked horse gram varieties is illustrated in Table 4 and 5 respectively. There was significant difference ( $p < 0.01$ ) in all the sensory parameters. Brown coloured variety had higher scores compared to black and cream coloured variety in taste, overall acceptability and acceptability index whereas cream coloured had higher scores for colour and appearance and black coloured variety had higher scores for flavour and texture for soaked and boiled horse gram. Brown coloured variety had significantly higher scores for texture, overall acceptability and acceptability index whereas cream coloured had significantly higher scores for colour and appearance and black coloured variety had significantly higher scores for flavour and texture for soaked and boiled horse gram. The reason may be attributed to black colour of varieties when compared to brown and cream colour of other varieties. All the sensory parameters including acceptability index were high for pressure cooking when compared to boiled grains (Fig. 1). This may be due to better retention of colour, texture and flavour in pressure cooking than boiling and also may be due to higher retention of nutrients in pressure cooking.

**Table 1: Cooking quality of unsoaked coloured horse gram varieties.**

Horse gram variety	Weight (g)		Volume (ml)		Cooking time (min)	Solid loss (%)	Water uptake ratio
	Before cooking	After cooking	Before cooking	After cooking			
Brown (Control)	10.00 ± 0.01	21.56 ± 0.01 <sup>c</sup>	7.66 ± 0.57 <sup>b</sup>	20.33 ± 0.57 <sup>b</sup>	107.00 ± 2 <sup>b</sup>	5.56 ± 0.02 <sup>b</sup>	2.16 ± 0.01 <sup>c</sup>
Cream	10.00 ± 0.02	22.31 ± 0.01 <sup>b</sup>	7.66 ± 0.57 <sup>b</sup>	18.33 ± 0.57 <sup>c</sup>	91.00 ± 1 <sup>c</sup>	5.13 ± 0.02 <sup>c</sup>	2.24 ± 0.05 <sup>b</sup>
Black	10.01 ± 0.02	23.39 ± 0.01 <sup>a</sup>	8.33 ± 0.57 <sup>a</sup>	22.33 ± 0.57 <sup>a</sup>	110.33 ± 1.52 <sup>a</sup>	6.82 ± 0.01 <sup>a</sup>	2.34 ± 0.05 <sup>a</sup>
C.D.	NS	0.01 <sup>**</sup>	1.15 <sup>**</sup>	1.15 <sup>**</sup>	3.12 <sup>**</sup>	0.01 <sup>**</sup>	0.01 <sup>**</sup>
S. Em. ±	0.05	0.05	0.33	0.33	0.90	0.05	0.05
F value	30.33	1347.58	1.33	36.00	131.09	6118.79	1135.00

**Note:** Values are mean ± S.D. of three replications, Values with same superscript in the same column are not significantly different from each other, S.Em: Standard Error of Mean, C. D: Critical Difference, <sup>\*\*</sup>Significant @ 1%, NS-Non significant

**Table 2: Cooking quality of soaked and boiled coloured horse gram varieties.**

Horse gram variety	Weight (g)		Volume (ml)		Cooking time (min)	Solid loss (%)	Water uptake ratio
	Before cooking	After cooking	Before cooking	After cooking			
Brown (Control)	21.21±0.01 <sup>a</sup>	23.39 ±0.02 <sup>a</sup>	18.01±1.01	20.01±1.01	52.33±0.57 <sup>b</sup>	4.36± 0.03 <sup>b</sup>	1.11 ±0.03 <sup>b</sup>
Cream	21.06±0.02 <sup>b</sup>	22.05 ±0.04 <sup>c</sup>	18.00±1.01	20.01±1.01	50.66±0.57 <sup>b</sup>	4.14 ±0.02 <sup>c</sup>	1.03 ±0.02 <sup>c</sup>
Black	20.45±0.02 <sup>c</sup>	22.42±0.03 <sup>b</sup>	17.66±0.57	19.66±0.57	58.66±1.52 <sup>a</sup>	4.57 ±0.03 <sup>a</sup>	1.18±0.01 <sup>a</sup>
C.D.	0.06 <sup>**</sup>	0.06 <sup>**</sup>	NS	NS	1.99 <sup>**</sup>	0.06 <sup>**</sup>	0.06 <sup>**</sup>
S. Em.±	0.01	0.01	0.50	0.50	0.57	0.01	0.01
F value	9074.4	1109.46	0.14	0.143	53.444	152.711	2048.563

**Note:** Values are mean± S.D. of three replications, Values with same superscript in the same column are not significantly different from each other, S.Em: Standard Error of Mean, C. D: Critical Difference, \*Significant @ 5%, \*\*Significant @ 1%, NS-Non significant

**Table 3: Cooking quality of soaked and pressure cooked coloured horse gram varieties.**

Horse gram variety	Weight (g)		Volume (ml)		Cooking time (min)	Solid loss (%)	Water uptake ratio
	Before cooking	After cooking	Before cooking	After cooking			
Brown (Control)	21.21±0.01 <sup>a</sup>	24.41± 0.03 <sup>a</sup>	18.01±1.01	21.12 ±0.08 <sup>a</sup>	46.76±0.71 <sup>b</sup>	3.76 ± 0.05 <sup>b</sup>	1.15± 0.08 <sup>b</sup>
Cream	21.06±0.02 <sup>b</sup>	23.18 ± 0.05 <sup>c</sup>	18.00±1.01	21.08± 0.05 <sup>a</sup>	44.12± 0.54 <sup>c</sup>	3.67 ± 0.03 <sup>b</sup>	1.12 ± 0.07 <sup>b</sup>
Black	20.45±0.02 <sup>c</sup>	23.45± 0.08 <sup>b</sup>	17.66±0.57	20.02±0.07 <sup>b</sup>	49.43± 0.62 <sup>a</sup>	3.98± 0.04 <sup>a</sup>	1.25± 0.06 <sup>a</sup>
C.D.	0.06 <sup>*</sup>	0.18 <sup>*</sup>	NS	0.15 <sup>*</sup>	1.89 <sup>*</sup>	0.10 <sup>*</sup>	0.05 <sup>*</sup>
S. Em.±	0.01	0.05	0.50	0.08	1.89	0.25	0.22
F value	9074.4	537.89	0.14	1.56	59.88	98.32	88.27

**Note:** Values are mean± S.D. of three replications, Values with same superscript in the same column are not significantly different from each other, S.Em: Standard Error of Mean, C. D: Critical Difference, \*Significant @ 5%, NS-Non significant

**Table 4: Sensory profile of soaked and boiled horse gram varieties.**

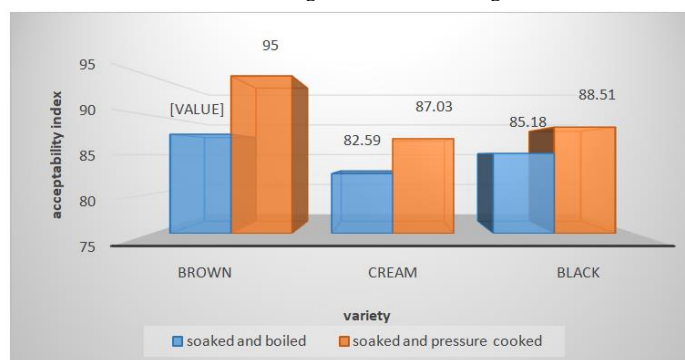
Horse gram variety	Appearance	Colour	Flavour	Taste	Texture	Overall acceptability
Brown (Control)	7.81±0.42 <sup>ab</sup>	8.00 ± .50 <sup>b</sup>	7.90 ± 0.31 <sup>a</sup>	8.00 ±0.51 <sup>a</sup>	7.70±0.48 <sup>a</sup>	7.90±0.31 <sup>a</sup>
Cream	8.01 ±0.51 <sup>a</sup>	8.50± 0.50 <sup>a</sup>	7.40 ± 0.51 <sup>b</sup>	7.61 ±0.31 <sup>c</sup>	7.10 ±0.31 <sup>b</sup>	7.30 ±0.51 <sup>b</sup>
Black	7.61±0.51 <sup>b</sup>	7.51± 0.42 <sup>c</sup>	8.00 ± 0.51 <sup>a</sup>	7.80 ±0.51 <sup>b</sup>	7.80 ±0.42 <sup>a</sup>	7.80±0.42 <sup>a</sup>
C.D.	0.35 <sup>*</sup>	0.22 <sup>**</sup>	0.32 <sup>**</sup>	0.32 <sup>**</sup>	0.37 <sup>**</sup>	0.27 <sup>**</sup>
S. Em.±	0.12	0.07	0.11	0.11	0.13	0.09
F value	2.71	36.01	8.45	16.63	8.41	26.28

**Note:** Values are mean ± S.D. of ten replications, Values with same superscript in the same column are not significantly different from each other, S.Em: Standard Error of Mean, C. D: Critical Difference, \*Significant @ 5%, \*\*Significant @ 1%

**Table 5: Sensory profile of soaked and pressure cooked horse gram varieties.**

Horse gram variety	Appearance	Colour	Flavour	Taste	Texture	Overall acceptability
Brown (Control)	8.00±0.52 <sup>b</sup>	8.00± 0.51 <sup>b</sup>	8.00±0.51	8.50±0.52 <sup>a</sup>	8.90±0.31 <sup>a</sup>	8.60±0.51 <sup>a</sup>
Cream	8.50±0.51 <sup>a</sup>	8.60± 0.50 <sup>a</sup>	7.90±0.31	7.82±0.51 <sup>b</sup>	8.00±0.3 <sup>c</sup>	8.00±0.48 <sup>c</sup>
Black	7.80±0.48 <sup>b</sup>	7.91± 0.31 <sup>c</sup>	8.00±0.48	8.70±0.48 <sup>a</sup>	8.20± 0.51 <sup>b</sup>	8.30±0.48 <sup>b</sup>
C.D.	0.37 <sup>*</sup>	0.32 <sup>**</sup>	NS	0.46 <sup>**</sup>	0.16 <sup>**</sup>	0.25 <sup>**</sup>
S. Em.±	0.13	0.11	0.05	0.16	0.05	0.15
F value	9.58	11.72	10.00	18.9	81	11.04

**Note:** Values are mean ± S.D. of ten replications, Values with same superscript in the same column are not significantly different from each other, S.Em: Standard Error of Mean, C. D: Critical Difference, \*Significant @ 5%, \*\*Significant @ 1%, NS-Non significant



**Fig. 1.** Acceptability index of soaked and boiled and soaked and pressure cooked coloured horse gram varieties.



## CONCLUSIONS

Cooked weight, pre-cooked volume, cooked volume, cooking time, solid loss and water uptake ratio was high in black coloured varieties compared to other two varieties in unsoaked grains. Pre-cooked weight and cooked weight was high in brown coloured variety than other two varieties whereas cooking time, solid loss and water uptake ratio was high in black coloured varieties compared to other two varieties in soaked and boiled grains. Pre-cooked weight, cooked weight and cooked volume was high in brown coloured variety than other two varieties whereas cooking time, solid loss and water uptake ratio was high in black coloured varieties compared to other two varieties in soaked and pressure cooked grains. Pressure cooked grains showed higher sensory scores for all the sensory parameters in all the three coloured horse gram varieties compared to boiled grains.

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**Conflict of Interest.** None.

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