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Effect of soaking on physical functional and cooking time of cowpea, horsegram and mothbean

C.K. BHOKRE AND A.A. JOSHI

The effect of different soaking media on physical parameter such as hundred seed weight , bulk density, density, functional characteristics *viz.*, hydration capacity, swelling capacity and cooking time of cowpea, horsegram and mothbean were studied. The study was carried out in year 2014 at the college of Food Technology Vasantrao Naik Marathwada Krishi Vidyapeeth Parbhani. The seeds were soaked in three different solution at room temperature *viz.*, normal drinking water (T_1), 1 per cent NaCl solution (T_2) and 1 per cent $NaHCO_3$ solution (T_3) separately for 12 hr and one was kept untreated (T_0). In cowpea significant increase in hundred seed weight from 6.82 g (T_0) to 9.40 g (T_1), 9.54 (T_2) and 10.54g (T_3) was found. Similar results observed for horsegram and mothbean of significant increase in Hundred Seed Weight after soaking. The highest bulk density (0.633 gml^{-1})was observed in cowpea seeds soaked in sodium bicarbonate solution(T_3) compared T_2 (0.622gml^{-1}) and T_1 (0.59gml^{-1}). Likewise in cowpea density of T_0 was significantly highest (1.24 gml^{-1}) followed by T_3 (1.05 gml^{-1}) and T_2 (0.95 gml^{-1}).The similar trend of decrease in bulk density and density compared to samples without soaking was observed in mothbean and cowpea. The T_3 sample gave significantly higher hydration capacity 0.037 g $seed^{-1}$ of cowpea, 0.055 g $seed^{-1}$ of horsegram and 0.027 g $seed^{-1}$ of mothbean than T_2 and T_1 in all three legume. In cowpea the soaking treatment did not show significant difference in swelling power for T_2 (0.045g $seed^{-1}$), T_3 (0.045g $seed^{-1}$) and T_1 (0.044g $seed^{-1}$).While sample T_3 had maximum value for swelling power in both horse gram(0.50 $gseed^{-1}$) and mothbean (0.035 g $seed^{-1}$)compared to T_2 and T_1 treatment . Soaking study revealed that there is significant reduction in cooking time of three legume soaked . For cowpea the treatment T_1, T_2 and T_3 showed 51.42 per cent, 65.71 per cent and 85.71 per cent reduction in cooking time, respectively compared with unsoaked seed samples (T_0). In horsegram the soaking treatment T_3 , T_2 and T_1 had 45.45 per cent, 30.90 per cent and 12.72 per cent decrease in cooking time, respectively. Similarly in mothbean decrease in cooking time of T_3 (80%), T_2(50%) and T_1 (20%) was found . Among three legume the lowest cooking time recorded in mothbean followed by cowpea and horsegram.

Key Words : Cowpea, Cooking time, Functional attributes, Horsegram, Moth bean, Physical properties

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INTRODUCTION

Legumes are good sources of cheap and widely available proteins for human consumption . They are staple foods for many people in different parts of the world (Youseff *et al.*, 1989) Legume's seeds have an average of twice as much protein as cereals and nutritive value of the proteins are usually high (Vijayakumari *et al*., 1997). They are widely cultivated and distributed in Africa, Asia, West Indies, Latin America and India. The legumes can be grown in marginal soils and in arid or semi arid regions. Their deep penetrating root system

MEMBERS OF RESEARCH FORUM

Author for correspondence :
A.A. JOSHI, Department of FCN, College of Food Technology, Vasantrao Naik Marathwada Krishi Vidyapeeth, PARBHANI (M.S.) INDIA
Email : lakha02-cft@rediffmail.com

Associate Authors' :
C.K. BHOKRE, Department of FCN, College of Food Technology, Vasantrao Naik Marathwada Krishi Vidyapeeth, PARBHANI (M.S.) INDIA

enables them to withstand moisture stress. Cowpea [*Vigna unguiculata* (L.) Walp] provide essential nutrients and high level of protein (about 25%) making it extremely valuable where many people cannot afford protein foods such as meat and fish (Akpapunam and Sefa-Dedeh, 1997). It is a good food security item as it mixes well with other recipe (Singh and Rachie, 1985 and Muoneke *et al*., 2012). Cowpea fixes atmosphere nitrogen through symbiosis with nodule bacteria (Shiringani and Shimeles, 2011). It does well and most popular in the semi-arid of the tropics where other food legumes do not perform well (Sankie *et al*., 2012). Cowpea contains protein 24.0 per cent, carbohydrate 56-68.0 percent, starch 31.5-48.0 per cent, Fibre 9.8 per cent, ash 1.45 per cent (Acharya *et al.*, 2008). Horsegram [*Macrotyloma uniflorum* (Lam.) Verdc.] is a pulse crop native to the south-east Asian subcontinent and tropical Africa. It is extensively cultivated, especially in dry areas of Australia, Burma, India, and Sri Lanka (Duke and Reed, 1981). The use of dry seeds of horsegram is limited due to their poor cooking quality. However, it is consumed as sprouts in many parts of India. However, the US National Academy of Sciences identified this legume as a potential food source for the future (Anonymous, 1978). Moth bean (*Vigna aconitifolia* L.) is the most drought-tolerant pulse crop grown in arid and sandy tracts of Rajasthan, India's driest state (Anonymous, 1979). It is an exceptionally hard legume thrives in South Asia in hot, dry, tropical conditions. Moth bean seeds contained 24.1 per cent protein, 0.8 per cent crude fibre, 1.3 per cent fat and 3 per cent ash (Bhattacharya, 2010). It is rich source of iron which is about 9.6mg/100 mg (Sathe and Venkatachalam, 2007).

The major drawback in the use of the legume is that they, are not easily rehydrated and difficult to cook, the seed coat is difficult to remove and long cooking time is required by traditional processing methods to tenderize the grain (Urga *et al.*, 2006). Extended cooking time of the legume does not encourage its consumption due to lack of convenience, fuel cost and nutritive value (Urga *et al.*, 2006). Soaking, usually an overnight operation, is an important step prior to cooking because it reduces the time necessary for tenderizing the texture. The use of soaking solutions containing different inorganic salts is a traditional method, used in home processing for quick cooking, as the most serious drawback in the utilization of legumes is their long cooking time (Clemente *et al*., 1998). Several studies have reported the beneficial effects of soaking in salt before cooking or using various salt solutions in the cooking of pulses (Erskine *et al*.,1985, Black *et al*.,1998 and Rockland *et al*., 1979). Presoaking pulses in salt solutions before cooking has been suggested as a means of shortening cooking time (Rockland *et al*., 1979 and Singh *et al*., 2000). Neelam *et al.* (2005) studied the effect of presoaking soybean with salt solutions such as sodium carbonate and sodium bicarbonate on the cooking time and organoleptic characters of soybean. Results showed that the cooking time of untreated soy dhal was 162 min; it reduced significantly by 58-98 per cent when soaked in salt solutions. Like other legumes cowpea, horsegram and moth bean are hard to cook and hence require soaking prior to cooking. The present investigation was undertaken to study effect of different soaking media on physical parameter, functional characteristics and cooking time of cowpea, horsegram and mothbean.

METHODOLOGY

The research work was carried out at All India Co-ordinated Research Project on Arid Legume, College of Food Technology, Parbhani in the year 2012. The Cowpea genotype HG-98-64, horsegram genotype VLG-31 and mothbean genotype CMM-12 seed samples were procured from All India Co-ordinated Research Project on Arid Legume, Parbhani.

Soaking treatment :

Cowpea, horsegram and mothbean seeds were soaked at room temperature in different soaking solution. Four lots of each crop were prepared, soaked in plane water, 1 per cent NaCl, 1 per cent $NaHCO_3$ solution separately for 12 hr and one was kept untreated. Selected 100 seeds were added to 150 ml of the different soaking media, which was discarded after finishing the soaking process.

Measurement of physical characteristics :

The raw and soaked seed samples were analysed for 100 seed weight, bulk density, seed density, hydration capacity, swelling power and cooking time. A one hundred seed weight was determined by weighing 100 randomly selected raw seeds of each crop as suggested by A.O.A.C. (Anonymous, 1984). Bulk density was determined by taking weight and volume of hundred

seeds and expressed as g per ml.

Density, hydration and swelling capacities, were determined by the techniques used by Bishnoi and Khetarpaul (1993).

Density:

Raw whole grain sample weighing 100g were transferred to a measuring cylinder, where 100ml distill water was added. Seed volume was obtained after subtracting 100ml from the total volume (ml). Density was recorded as g/ml.

Hydration capacity:

A hundred seeds were counted and transferred to a measuring cylinder and 100ml water was added. The cylinders were covered with aluminum foil and left overnight at room temperature. Next day seeds were drained, superfluous water removed with filter paper and swollen seeds reweighed. Hydration capacity per seed was determined by using the following formula:

$$\text{Hydration capacity} = \frac{\text{Weight of soaked seed - Weight of seed before soaking}}{\text{Number of seeds}}$$

Hydration capacity was expressed as g/seed.

Swelling capacity :

A hundred seeds were counted, their volume noted and soaked overnight. The volume of the soaked seeds was noted in a graduated cylinder. Swelling capacity per seed was calculated as:

$$\text{Swelling capacity} = \frac{\text{Volume after soaking - Volume before soaking}}{\text{Number of seeds}}$$

Swelling capacity was expressed as ml/seed.

Cooking time determination :

Cooking time was determined as per method given by Coskuner and Karababa (2003). Cowpea, horsegram and mothbean seeds were cooked without soaking and also with the solutions mentioned above using a seed/ water ratio of 1:10 (w/v). During cooking, samples at definite time intervals were withdrawn and tested for uniformity and softness. Seeds were cooked until soft. Essentially, cooking time means the time taken between starting to cook (boil) the seeds until the time when they are ready to eat, that is at least 90 per cent of the seeds are soft enough to masticate without having to chew excessively.

OBSERVATIONS AND ASSESSMENT

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Effect of soaking media on physical, functional characteristics and cooking time of cowpea :

The results on effect of different soaking media on physical, functional characteristic and cooking time of cowpea depicted in Table 1. Hundred seed weight of cowpea seeds soaked in $NaHCO_3$ solution was significantly highest (10.54g) among over all treatment followed by seeds soaked in salt solution (9.54 g). The Nilgun (2011) reported that soaking in 0.5 per cent $NaHCO_3$ had highest 1000 seeds weight value in comoon bean than other soaking medium distill water $NaHCO_3$ and 0.5 per cent Ascorbic acid solution. The Bulk Density of untreated sample was found statically significant over other treatment. The seeds soaked in sodium bicarbonate solution had highest bulk density (0.633 g ml^{-1}) compared to (0.622gml^{-1}) and T_1(0.590 gml^{-1}).

Likewise density of T_0 was significantly highest (1.24 gml^{-1}) followed by T_3 (1.05 gml^{-1}) and T_2 (0.95 gml^{-1}).Similar results reported by Nilgun (2011) that comoon bean sees soaked 0.5 per cent $NaHCO_3$ had

Table 1 : Effect of soaking media on physical, functional characteristics and cooking time of cowpea

Sr. No.	Sample code	Hundred seed weight(g)	Bulk density (g/ml)	Density (g/ml)	Hydration capacity (g/ seed)	Swelling capacity (ml/seed)	Cooking time (minute)
1.	T_0	6.82	0.786	1.24			35
2.	T_1	9.40	0.59	0.83	0.020	0.044	17
3.	T_2	9.54	0.622	0.95	0.027	0.045	12
4.	T_3	10.54	0.633	1.05	0.037	0.045	5
S.E.±		0.022	0.005	0.011	0.0007	0.0008	0.577
C.D. (P=0.05)		0.073	0.018	0.036	0.002	0.002	1.87

where

T_0 -Control (seeds not soaked) T_1 - Seeds soaked in distill water for 12 Hr,

T_2 -Seeds soaked in 1% NaCl solution for 12 Hr, T_3-Seeds soaked in 1% $NaHCO_3$ solution for 12 Hr

highest bulk density (1.14g/ml) than other treatment. The T_3 sample gave markedly higher hydration capacity 0.037 gseed^{-1} which was more than T_2 (0.027g seed^{-1}) and T_1 (0.020 g seed^{-1}). The soaking treatment did not show significant difference in swelling power for T_2 (0.045g seed^{-1}), T_3 (0.045g seed^{-1}) and T_1 (0.044g seed^{-1}) were at par each other. In the present study, type of soaking solution influenced the cooking time. A significant variation in cooking time is observed between untreated and soaked samples in different solution .Soaking study further revealed that there was significant reduction in cooking time of soaked cowpeas seeds The soaking treatment T_3 shows significantly decrease in cooking time (5 minute) compared with T_0 (35 minute), T_1 (17 minute) and T_3 (12 mintue). For cowpea the treatment T_1, T_2 and T_3 showed 51.42 per cent, 65.71 per cent and 85.71 per cent reduction in cooking time, respectively compared with unsoaked seed samples (T_0). Singh *et al.* (2000) observed maximum reduction in cooking time of chickpea pulse when it was soaked in $NaHCO_3$ sodium bicarbonate solution. Similar findings observed Unblanched grass pea seeds soaked for 12 hours in the three soaking solutions caused reduction of 30 per cent, 46 per cent and 40 per cent, respectively, in cooking time (Urga *et al.*, 2006)

Effect of soaking media on physical, functional characteristics and cooking time of horsegram :

The results on effect of different soaking media on physical, functional characteristic and cooking time of horsegram depicted in Table 2. There was significant increase in hundred seed weight of soaked seed samples of horse gram. Statically among treatment seeds soaked in sodium bicarbonate solution (1%) shows significantly maximum hundred seed weight 8.11g followed by salt soaked seeds samples 7.51g and water soaked seed samples 7.35g. The significantly highest bulk density (0.71 g/ml) and density (1.25g/ml) was recorded in unsoaked samples than rest of soaking treatment.

Hydration capacity of seed samples found significantly higher in sodium bicarbonate soaked (0.055 g seed^{-1}) and salt soaked (0.052 g seed^{-1}) solution. Swelling power of seed samples found significantly higher in sodium bicarbonate soaked (0.050 g seed^{-1}) and salt soaked (0.045 g seed^{-1}) solution. horsegram cooking study reveals that cooking time of horsegram reduced significantly in soaked solution compared to samples without soaking. In horsegram seeds soaked in 1 per cent

Table 2 : Effect of soaking media on physical, functional characteristics and cooking time of horsegram

Sr. No.	Sample code	Hundred seed weight(g)	Bulk density (g/ml)	Density (g/ml)	Hydration capacity (g/ seed)	Swelling capacity (ml/ seed)	Cooking time(minute)
1.	T_0	3.59	0.71	1.25	--	---	55
2.	T_1	7.35	0.60	1.10	0.049	0.040	48
3.	T_2	7.51	0.61	1.13	0.052	0.045	38
4.	T_3	8.11	0.67	1.17	0.055	0.050	30
S.E.±		0.007	0.008	0.012	0.0008	0.0005	0.763
C.D. (P=0.05)		0.024	0.027	0.039	0.002	0.001	2.486

where
T_0 -Control (seeds not soaked) T_1 - Seeds soaked in distill water for 12 Hr,
T_2 -Seeds soaked in 1% NaCl solution for 12 Hr, T_3-Seeds soaked in 1% $NaHCO_3$ solution for 12 Hr

Table 3 : Effect of soaking media on physical, functional characteristics and cooking time of Mothbean

Sr. No.	Sample code	Hundred seed weight(g)	Bulk density (g/ml)	Density (g/ml)	Hydration capacity (g /seed)	Swelling capacity (ml/ seed)	Cooking time (minute)
1.	T_0	2.12	0.78	1.18	--	--	20
2.	T_1	4.70	0.59	0.99	0.020	0.027	16
3.	T_2	4.84	0.62	1.08	0.025	0.030	10
4.	T_3	4.93	0.63	1.11	0.027	0.035	4
S.E.±		0.021	0.003	0.013	0.0006	0.0008	0.057
C.D. (P=0.05)		0.069	0.010	0.044	0.001	0.0002	1.87

where
T_0 -Control (seeds not soaked) T_1 - Seeds soaked in distill water for 12 Hr,
T_2 -Seeds soaked in 1% NaCl solution for 12 Hr, T_3-Seeds soaked in 1% $NaHCO_3$ solution for 12 Hr

sodium bicarbonate solution shows significant reduction in cooking time (30 min) followed by seeds soaked, soaked in 1 per cent NaCl solution (38 min) compared with water soaked (48 min) and unsoaked solution (40 min). In horsegram cooking time study the soaking treatment T_3, T_2 and T_1 had 45.45 per cent, 30.90 per cent and 12.72 per cent reduction in cooking time, respectively compared to untreated seed sample. Several studies have reported the beneficial effects of soaking in salt before cooking or using various salt solutions in the cooking of pulses (Erskine *et al.,* 1985, Black *et al.*, 1998 and Neelam *et al.,* 2005) studied the effect of presoaking soybean with salt solutions such as sodium carbonate and sodium bicarbonate on the cooking time and organoleptic characters of soybean. Results showed that the cooking time of untreated soy dhal was 162 min; it reduced significantly by 58-98 per cent when soaked in salt solutions. The time required for cooking was recorded highest in horse gram than cowpea and moth bean. It might be due to tough husk of horsegram.

Effect of soaking media on physical, functional characteristics and cooking time of mothbean :

The results on effect of different soaking media on physical, functional characteristic and cooking time of moth bean depicted in Table 3. The values for all parameter for moth bean are lowest than cowpea and horse gram. The highest 100 seeds weight value (4.93g) was observed in moth bean samples soaked in 1 per cent $NaHCO_3$ solution. Like cowpea and horse gram in moth bean also similar result found. The treatment T_0 shows maximum bulk density (0.78g/ml) and density (1.18g/ml). Soaking treatment shows significant effect on hydration capacity and swelling power. Soaking in $NaHCO_3$ solution(T_3) revealed markedly the highest values for hydration capacity (0.027 g $seed^{-1}$) and swelling power (0.035 g $seed^{-1}$) followed by T_2 which had hydration capacity 0.025 g $seed^{-1}$ and swelling power 0.035 g $seed^{-1}$. Soaking study revealed that there is significant reduction in cooking time of soaked moth bean seed samples.

The lowest cooking time was recorded for seeds samples soaked in sodium bicarbonate solution were 4 min. Soaking study revealed that there is 80 per cent reduction in cooking time(4 min) for seed soaked in 1 per cent sodium carbonate solution, followed by seeds soaked in 1 per cent NaCl solution had 50 per cent reduction in cooking time(10 min) and water soaked seeds had 20 per cent reduction in cooking time (16 min) compared with unsoaked samples have cooking time of 20 min.

Similar results were reported by Coskuner and Karababa (2003). He observed that during chick pea cooking study, the longest cooking time was required in the non-soaking treatment. The NaCl and $NaHCO_3$ soaking treatments had similar cooking times and decreased the cooking time significantly from, on average, 30.4 min for water soaking to 19.2 minute and 17.8 minute, respectively. Presoaking pulses in salt solutions before cooking has been suggested as a means of shortening cooking time (Singh *et al.,* 2000).

Conclusion:

Results of this study showed that all of the physical and functional characteristics of cowpea, horsegram and moth bean seeds that were measured were largely affected by the soaking media. The hundred seed weight values were increased and bulk density and density value were decreased by soaking treatment. Soaking in $NaHCO_3$ solution (1%) had maximum hydration capacity and swelling power than NaCl (1% solution) and water soaked seed samples. $NaHCO_3$ soaking treatments showed 85.71 per cent, 45.45 per cent and 80 per cent decreases in the cooking time compared with the nonsoaking treatment for cowpea, horsegram and moth bean, respectively. Similarly, 1 per cent NaCl soaking treatments showed 65.71 per cent, 30.90 per cent and 50 per cent decreases in the cooking time for cowpea, horse gram and moth bean, respectively compared with the untreated samples. The water soaking treatment also decreases cooking time but less than other two treatments. While water soaking treatments showed 51.42 per cent, 12.72 per cent and 20 per cent decrease in the cooking time for cowpea, horse gram and moth bean, respectively. Soaking seeds prior to cooking is more appropriate than cooking for half to one hour from the point of view of fuel consumption and texture. The soaking treatments examined in this study can thus be used for shortening cooking time.

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