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Chemical Composition of Ricebean (*Vigna Umbellata*): Effect of Domestic Processing

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ABSTRACT *The effect of various processing methods viz., soaking, pressure cooking, open pan cooking, germination followed by pressure cooking and roasting of whole ricebean and pressure cooking, open pan cooking and fermentation and frying of fermented batter of dehulled rice bean was assessed for its chemical composition. The moisture, crude protein, total ash, ether extract, crude fibre and available carbohydrate content of whole raw ricebean were 8.60, 26.03, 5.50, 1.76, 4.65 and 62.06 per cent, respectively. The overall nutrient content was lowered significantly on dehulling. In case of whole ricebean, sprouted and pressure cooked samples and in case of dehulled legume, fermented and fried vadas had the best nutritional value.*

INTRODUCTION

The importance of food legumes, especially in the diets of the population of developing nations is well established. Legumes not only add to the variety in human diet, but also serve as an economical source of supplementary proteins for a large human population in developing countries like India. There has been a progressive decline in per capita availability of pulses from 69 grams in 1961 to 32 grams in 2005. The requirement of pulses was estimated to be 21.3 million tonnes by 2012 but the actual production of pulses in 2011-12 was reported to be 17.09 million tonnes, indicating a wide gap in demand and supply (Swaminathan & Bhavani, 2013).

In order to meet the requirements of pulse proteins many non-traditional underutilized legumes are being exploited by Agricultural Universities and Research Institutes for cultivation. Among the new crops, Ricebean is attracting attention throughout the world as a potential source of high quality protein for the future. A few studies have been carried out on the nutritional quality of some strains of ricebean (Kaur & Mehta, 1993; Igbedioh, et. al, 1995; Srivastava, et. al, 2001 & Katoch, R, 2013) but the information on the changes in the chemical composition on processing and cooking of ricebean is negligible. So, the present study was taken up to find out the effect of various domestic processing methods on the proximate composition of ricebean.

MATERIALS AND METHODS

Ricebean variety 'RBL – 6' was procured from the Department of Seed Science and Technology, Punjab Agricultural University, Ludhiana. The samples for analysis were withdrawn from the same stock. The beans were cleaned, freed of extraneous substances and whole and dehulled beans were subjected to various processing methods described below:

Whole Ricebean:
A part of the raw whole ricebean was analysed for moisture, total ash, crude protein, ether extract and crude fibre.

Soaking:
Ricebean was washed thoroughly and soaked (12h) at room temperature. The seed to water ratio was 1:5 (w/v). The unimbibed water was discarded and the soaked seeds were rinsed thoroughly.

Pressure Cooking:
The soaked (12h) and unsoaked seeds, were pressure cooked at 15 lbs pressure. The ratio of seed to water in case of soaked and unsoaked seeds was 1:4 and 1:6 (w/v), respectively. The cooking time for soaked and unsoaked seeds was 5 and 10 minutes, respectively.

Open Pan Cooking:
The soaked (12h) and unsoaked seeds, were cooked in an open pan. The ratio of seed to water in case of soaked and unsoaked seeds was 1:6 and 1:10 (w/v), respectively. The cooking time for soaked and unsoaked seeds was 20 and 30 minutes, respectively.

Germination and Pressure Cooking:
The soaked seeds (12h) were taken in sterile petri plates lined with wet filter paper and kept in an incubator at 37 ± 1° c for 24h and 48h. A part of the sprouted seeds were analysed as raw sample and the rest were pressure cooked (seed: water, 1:1) for a period of 4 minutes.

Roasting:
Ricebean was roasted in sand at 250° c for 2 minutes.

Dehulled Ricebean *(Dhal)*:
Whole ricebean was split in a grain pearler and soaked (12h). The beans were rubbed between the palms to remove the outer covering and dried in the sun. A part of the raw sample was stored for further analysis.

Pressure Cooking of *Dhal:*
The soaked (12h) and unsoaked ricebean *dhal* was pressure cooked at 15 lbs pressure. The ratio of *dhal* to water in case of soaked and unsoaked seeds was 1:2 and 1:4 (w/v), respectively. The cooking time for soaked and unsoaked seeds was 4 and 8 minutes, respectively.

Open Pan Cooking of *Dhal:*
The soaked (12h) and unsoaked seeds, were cooked in an open pan. The ratio of *dhal* to water in case of soaked and unsoaked seeds was 1:7 and 1:8 (w/v), respectively. The cooking time for soaked and unsoaked seeds was 20 and 25 minutes, respectively.

Fermentation and Frying:
The soaked *dhal* (12h) was ground to a coarse paste (*peethi*) which was naturally fermented for 12 and 18h at 37 ± 1° c in an incubator. A part of the fermented batter was analysed as raw sample and the rest was shaped into small balls and fried in medium hot (190° c) refined groundnut oil for 2 minutes.

The samples were dried in a hot air oven at 60 ± 2° c, ground to a fine powder and stored in airtight containers till further analysis.

Analysis:
The moisture, total ash, ether extract, crude fibre and crude protein content (N x 6.25) of both the raw and processed samples was estimated using AOAC (1985). The content of available carbohydrates was calculated by difference. The results were statistically analysed for analysis of variance using Sigma Plot 10, computer software.

RESULTS AND DISCUSSION
The moisture, crude protein, total ash, ether extract, crude fibre and available carbohydrate content (Table 1) of raw whole ricebean were observed to be 8.60, 26.03, 5.50, 1.76, 4.65 and 62.06 per cent, respectively.

Table 1 about here
The moisture content in all the samples was significantly (P< 0.01) lower than the raw legume. The lowest moisture content was found in the roasted legume. This reduction in the moisture content upon roasting may have been caused by the application of high temperature. The moisture content was found to be highest for sprouted ricebean followed by open pan cooked and then pressure cooked ricebean. The protein content of 26.03% was found to be higher as compared to that reported by Katoch (2013) who observed the crude protein content to range from 23.17 % to 25.57 % in sixteen ricebean genotypes. The protein contents of all the cooked samples was significantly (P < 0.01) lower than the raw legume except for sprouted raw (24 and 48 h) and roasted ricebean. Improvement in protein content in mung bean and chickpea seeds was recorded with the advancement in germination time (Khalil, et. al, 2007; Shah, et. al, 2011). Rise in crude protein could be attributed to the synthesis of new proteins by germinating seeds and to the compositional change after degradation of other constituents (Bau, et. al, 1997). The protein contents of soaked pressure cooked and open pan cooked ricebean were significantly (P < 0.01) lower than the unsoaked pressure cooked and open pan cooked samples, respectively. This shows that soaking tends to extract the soluble proteins from the cells and interstitial spaces and causes leaching of protein into the soak medium and as the soak water was discarded; hence the loss.

The total ash content of the cooked samples was significantly (P < 0.01) lower than the raw ricebean except for the sprouted raw (24 and 48 h) and sprouted (24 and 48 h) and pressure cooked samples where no significant differences were observed. Padmashree, et. al. (1987) also found no significant changes in the ash content on germination of cowpeas. The ash contents of pressure cooked and open pan cooked ricebean were also significantly (P < 0.01) lower than the soaked ricebean. Similar results have been reported by Bakr and Gawish (1991). No significant differences were observed in the fat content on processing of ricebean by various methods. However, a significantly (P < 0.01) lower fat content was observed only in sprouted raw (24 and 48 h) and sprouted and pressure cooked samples. A decrease in the total fat content may occur during germination as fat forms a major energy source for the developing embryo. The bulk of the fatty acids are broken down by β- oxidation.

The crude fibre content of all the cooked samples was found to be significantly (P < 0.01) higher when compared to the raw legume. This is supposed to be an apparent increase due to the loss of protein, ash and ether. Sprouting (24 and 48 h) followed by pressure cooking caused a significant (P < 0.01) increase in the crude fibre contents. Germination of mung bean and chickpea for 12, 16, 20 hours and 36, 48, 60 hours at room temperature, respectively resulted in significant increase in crude fibre contents (Uppal and Bains, 2011). The per cent increase in the crude fibre contents of soaked pressure cooked and open pan cooked ricebean was significantly (P < 0.01) higher than the increase observed for unsoaked pressure cooked and open pan cooked ricebean. Similar results have been reported by Bakr and Gawish (1991) where the increase was markedly higher when the cowpeas were soaked and cooked.

The available carbohydrate contents of all the pressure cooked, open pan cooked and roasted ricebean were significantly (P < 0.01) higher than the raw ricebean. The contents in soaked and unsoaked, pressure cooked and open pan cooked samples were significantly (P < 0.01) higher than the sprouted ricebean samples. In case of germinated ricebean samples, the available carbohydrate content was found to be significantly (P < 0.01) higher than the raw only in sprouted (24 h) and pressure cooked legume.

On dehulling of the whole ricebean the moisture, crude protein, total ash, ether extract, crude fibre and available carbohydrate contents (Table 2) were 6.20, 23.75, 4.85, 1.53, 1.16 and 68.71 per cent, respectively.

Table 2 about here
The moisture contents of all the cooked and fermented ricebean *dhal* samples were significantly (P < 0.01) lower than the raw legume except for the soaked and unsoaked open pan cooked legume. The crude protein content of pressure cooked and open pan cooked ricebean *dhal* was found to be significantly (P < 0.01) lower than the soaked sample. However, the crude protein contents of unsoaked – pressure cooked and open pan cooked ricebean *dhal* was found to be significantly (P < 0.01) higher than the soaked legume. Similar results have been reported by Chavan, et. al. (1983) who found a significant decrease in the protein content after cooking of soaked mung bean, black gram, pigeon pea and chickpea. The protein content of fermented (12 and 24 h) and fried *vadas* were found to be significantly (P < 0.01) lower than their respective fermented raw batters but was observed to be significantly (P < 0.01) higher when compared to the raw. Padmashree, et. al. (1987) have also found significant increase in the protein content in cowpea flour upon fermentation of raw batter.

The total ash content of cooked *dhal* was found to be significantly (P < 0.01) lower than the raw except in fermented (18 h) and fried *vadas*. The ash content of pressure cooked and open pan cooked ricebean *dhal* was found to be significantly (P < 0.01) lower than the soaked *dhal* except in unsoaked and pressure cooked ricebean *dhal*. Similarly, the ash content was found to increase significantly (P < 0.01) on frying of 12 and 18h fermented batters when compared to soaked *dhal*. The ether extract was found to

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be significantly (P < 0.01) lower than the raw content except in unsoaked pressure cooked and open pan cooked *dhal* where the differences were non-significant. Khalil, et. al. (1986) found that cooking of *dhal* decreased the fat contents. The average crude fat increased significantly (P < 0.01) on frying of *vadas* due to absorption of fat by the fermented batter. Similar results have been reported by Kaur and Mehta (1993).

The crude fibre contents were significantly (P < 0.01) higher in all the cooked samples when compared to the raw ricebean *dhal*. Abbey and Ibeh (1988) have reported similar results on heat processing of cowpea flour. The available carbohydrate contents varied significantly (P < 0.01) when compared to the raw *dhal*.

The results of the present study revealed that ricebean may be ranked above the traditional pulses with respect to the contents of crude protein and mineral matter. It was found that dehulling of ricebean lowered the overall nutrient content significantly. Among the whole ricebean samples, sprouted and pressure cooked samples were found to have the best nutritional profile while in case of dehulled ricebean samples, fermented and fried *vadas* had the best nutritional value. Sprouting and fermentation procedures significantly improved the already high protein content of ricebean. Therefore, ricebean can be processed by these procedures which are simple, inexpensive and effective for improvement in the nutritional quality of legumes. These methods can be easily adopted at domestic level to obtain maximum utilization of the pulse proteins and contribute to the nutrition of the masses.

TABLE 1: Chemical Composition (g/ 100g) Of Raw And Cooked Whole Ricebean Samples

Sample	Moisture	Crude Protein[a]	Total Ash[a]	Ether Extract[a]	Crude Fibre[a]	Available Carbohydrates[a]
Raw	8.60	26.03	5.50	1.76	4.65	62.06
Soaked	8.20	25.65	5.46	1.75	4.99	62.59
Soaked + Pressure Cooked	8.06	23.89	5.30	1.74	5.41	63.73
Unsoaked + Pressure cooked	8.08	23.99	5.36	1.75	4.80	64.23
Soaked + Open Pan Cooked	8.20	22.75	5.20	1.75	5.36	65.06
Unsoaked + Open Pan Cooked	8.10	22.31	5.34	1.75	4.75	65.96
Sprouted (24h) Raw	8.20	26.60	5.50	1.70	5.15	61.13
Sprouted + Pressure Cooked	8.13	25.64	5.50	1.69	5.44	61.76
Sprouted (48h) Raw	8.25	26.81	5.49	1.70	5.30	60.83
Sprouted + Pressure Cooked	8.22	25.75	5.49	1.68	5.60	61.51
Roasted	6.23	26.16	5.47	1.75	4.60	62.09
F Ratio	16970.07**	1128.98**	762.08**	33.29**	6214.0**	13732.4**
CD at 1%	0.019	0.164	0.015	0.020	0.017	0.043

a – On dry matter basis
**** Significant at 1% level.**

TABLE 2: Chemical Composition (g/ 100g) Of Raw And Cooked Dehulled Ricebean Samples

Sample	Moisture	Crude Protein[a]	Total Ash[a]	Ether Extract[a]	Crude Fibre[a]	Available Carbohydrates[a]
Raw	6.20	23.75	4.85	1.53	1.16	68.71
Soaked	6.18	23.00	4.80	1.51	1.47	69.22
Soaked + Pressure Cooked	6.15	22.97	4.76	1.50	1.89	68.88
Unsoaked + Pressure cooked	6.17	23.28	4.79	1.52	1.80	68.61
Soaked + Open Pan Cooked	6.21	22.81	4.75	1.50	1.75	69.19
Unsoaked + Open Pan Cooked	6.18	23.10	4.78	1.52	1.72	68.88
Fermented (12h) Raw	6.05	24.60	4.79	1.51	1.77	67.33
Fermented & fried	6.00	23.99	4.82	43.00	1.83	26.36
Fermented (18h) Raw	6.04	25.34	4.79	1.52	1.85	66.50
Fermented & fried	6.00	24.87	4.84	48.01	1.87	20.41
F Ratio	340.44	28564.4	38.46	4.48	2118.2	5826.2
CD at 1%	0.018	0.022	0.020	0.020	0.019	0.052

a – On dry matter basis
**** Significant at 1% level.**

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