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Protein, methionine and tryptophan content of food legumes as influenced by processing treatments

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Abstract
Whole grain, dhal and germinated grains of certain important varieties of chickpea and pea were analyzed for nutritional characteristics to determine the impact of dehusking and germination on the nutritional quality of different varieties of food legumes. Whole grain samples of all the varieties of chickpea and pea were also analyzed for physical and processing characteristics. Results showed wide and significant differences within and between the groups. It was found that chickpea varieties contained maximum levels of protein in grains (24.16%), dhal (27.28%) and germinated grain (24.90%), while among different varieties of pea it was 20.25% in grains, 21.37% in dhals and 24.90% in germinated grains. Similar trends were noticed in mean methionine and mean tryptophan content which indicated the superiority of chickpea varieties over pea varieties.

Keywords: Protein, methionine, content, food, varieties

Introduction
Among various vegetable foods, food legumes or pulses (dry edible seeds of leguminous crops) occupy a prominent position owing to their high nutritive value. Besides the moderate presence of certain vitamins and minerals [1], food legumes are an especially valuable source of protein and energy and provide about 1/3rd of total dietary protein nitrogen for human consumption [2].
Recent reports suggest that food legumes produce health-promoting secondary compounds that can protect against cancer [3, 4] and reduce blood cholesterol level [5] and have a hypoglycemic effect. However, the nutritive value of the food legumes has been found to be adversely affected owing to the deficiency of methionine and tryptophan and the presence of certain anti-nutritional constituents [6].
Most commonly, legume grains are utilized as such in the form of whole grains or dehusked split cotyledons (dhals) and or germinated grains for end-product use in a variety of food preservation. It involves processing treatments like dehusking and germination etc. which alters the level of chemical constituents present in legume seed thereby producing an either positive or negative impact on its nutritive value [7, 8, 9].
Keeping above facts in view the present work was planned for determining the nutritional status of certain important varieties of chickpea and pea as affected by dehusking and germination treatments. Efforts have also been made to determine the relative nutritional merits of grains of different leguminous species.

Material and Methods
Five varieties of pea and six chickpea were obtained from field trials conducted by the legume section of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. Data on grain yield were recorded and protein, methionine and tryptophan production per hectare was worked out on that basis in corresponding grain samples using standard techniques (AOAC) [10].

Whole Grains
Over-dried (70 degree Celsius for 3 hours) whole-grain samples were powdered in a domestic grinder and passed through a 20-mesh sieve and used for analysis.

Dhal
The samples were cleaned, washed with glass distilled water to remove contamination and soaked in 5 volumes (W/V) of tap water for 24 hours. Thoroughly washed seeds were dried to a constant weight in a hot air oven at 70 degree Celsius.

The soaked seeds were manually dehulled to remove the seed coat. Dried, cooled seeds were powdered and passed through a 20-mesh sieve and stored in screw-capped containers. The calculated amount was subsequently used for biochemical analysis.

Cooking

Dry seeds were boiled in 3 volumes (W/V) of distilled water in a beaker, until soft, as judged by pressing them between the thumb and the fingers.

Germination

Bold and healthy seeds of different varieties were washed and then soaked for 12 hours. The soaked seeds were placed on germination paper and were covered with butter paper and kept at room temperature for 24 hours. The germinated seeds were taken out, dried in the oven and powdered along with sprouts.

Biochemical Analysis

Whole grain, dhal and germinated grain samples of different varieties of leguminous species were analyzed for protein (AOAC) [10], methionine (Horn *et al*. 1946) [11] and Tryptophan (spies and chambers 1946) [12] content as per the methods given.

Results and Discussion

A perusal of the data presented in Table 1 and 2 showed that chickpea contained higher mean values (24.16, 27.28 and 24.90%) for protein content in whole gram, dhal and germinated grains. Differences in the mean value of dhal protein and grain protein content of corresponding varieties of leguminous species clearly revealed that dhal samples contained higher mean protein content as compared to corresponding grain samples and marked 12.91% and 5.53% enhancement of protein in dhal samples over corresponding grain samples of chickpea and pea respectively. It clearly indicated the superior status of dhals over grain samples at the statistical level also. Similar variations in dhal protein content have also been recorded by Vinila and Pushpamma (1985) [13], Singh and Jambunathan (1982) [14]. On comparing the status of protein in the samples of ungerminated and germinated grains on the basis of mean values, it was observed that germinated grain samples marked a marginal increase in protein content over corresponding ungerminated ones in respective groups. However, treatment of dehusking marked significant enhancement in respect of proteins in dhal samples (%) as compared to corresponding ungerminated and germinated grains. Chickpea (27.28%) contained a higher mean dhal protein followed by pea (21.37%). The findings of Obizoba (1991) [15] are also in agreement with the results obtained by us.

Table 1: Variability in protein content* as affected by dehusking and germination in different varieties of food legume species

Entries	Grain	Dhal	Germinated Grain
Chickpea			
KWR-108	24.5	26.17	24.20
Avrodhi	24.73	28.02	25.19
K-850	24.01	28.74	25.77
Radhe	24.20	26.91	24.99
KGD-1168	23.79	27.50	24.21
Udai	24.10	26.32	25.02
Mean	24.16	27.28	24.90
Pea			
Sapna	20.10	20.88	23.28
Jai	20.71	21.77	21.77
Rachna	28.85	24.50	22.93
Indra	19.02	20.12	20.22
Shikha	18.59	19.57	20.10
Mean	20.25	21.37	21.66

The amino acid profile of proteins of different food legume species is closer to the amino acid of a profile of standard protein as recommended by FAO with the exception that it is deficient in methionine and tryptophan. As a result, the biological value of legume protein is relatively low as compared to animal protein. Similar trend was observed in methionine and tryptophan content which indicated the superiority of pea over other leguminous species in grain and dhal samples both. While in germinated grain sample maximum mean methionine was recorded by chickpea (0.96 g/16 g N). Based on the mean values comparison of the status of methionine in ungerminated, germinated and dhal samples of the same group revealed that in chickpea and pea, levels of methionine were maximum in dhal samples as compared to germinated grain samples followed by ungerminated ones. It clearly indicated that processing treatments like dehusking and germination are beneficial in the enhancement of the nutritive value of pulses specifically in respect of methionine content. Similar varietal variations have also been recorded by Sekhon *et al*. (1979) [16] and others (84, 168) [17, 18].

Table 2: Variability of methionine content* of different varieties of food legume species as influenced by dehusking and germination

Entries	Grain	Dhal	Germinated Grain
Chickpea			
KWR-108	1.00	1.21	1.32
Avrodhi	0.94	1.04	1.09
K-850	0.90	1.17	1.05
Radhe	0.88	1.09	0.99
KGD-1168	0.98	1.13	1.12
Udai	1.01	1.24	1.21
Mean	0.95	1.15	1.13
Pea			
Sapna	1.02	1.05	1.13
Jai	0.98	1.21	1.04
Rachna	0.86	1.29	0.97
Indra	0.81	1.00	0.97
Shikha	0.90	1.17	0.93
Mean	0.91	1.14	1.01

Data on grain, dhal and germinated grain tryptophan content of different varieties of food legumes species is given in the table. Comparison of mean values for grain tryptophan content among different food legume species depicted significant differences with each other indicating the relatively superior status of pea varieties in respect of grain tryptophan content while in germinated grain samples of varieties of different food legume species chickpea varieties managed an edge over rest of the group on tryptophan content.

Table 3: Status of tryptophan content* in whole grains, dhals and germinated grains of certain varieties of food legume species

Entries	Grain	Dhal	Germinated Grain
Chickpea			
KWR-108	0.89	0.94	1.09
Avrodhi	0.83	0.99	0.95
K-850	0.92	1.08	1.12
Radhe	0.75	0.90	0.85
KGD-1168	0.78	1.08	0.87
Udai	0.82	1.02	0.89
Mean	0.83	1.00	0.96
Pea			
Sapna	0.77	0.89	0.86
Jai	0.84	1.16	0.87
Rachna	0.94	1.09	0.99
Indra	0.91	0.97	0.93
Shikha	0.96	1.30	1.01
Mean	0.88	1.08	0.93

From the viewpoint of the growing population of India, major emphasis is always being laid upon increasing food grain production to achieve self-sufficiency in this respect. On the other hand, nutritional security is also emphasized from the nutritional point of view. It has been generally observed that high-yielding food grain varieties are negatively correlated with the protein content of food legumes. The protein content of food legume grain is also negatively associated with methionine and tryptophan content thereby adversely affecting its protein quality. Under such circumstances, it becomes a challenging task to identify high-yielding varieties with adequate nutritional quality. In this regard, it is important to identify varieties having yield–quality balance. Between the two-pulse group mean grain production/ha was maximum in pea (3208.20kg) followed by chickpea (2746.50kg). Data on the same is reported in the table. On an average basis, since the methionine content and protein production of both the crops. An almost similar trend was recorded in tryptophan production per hectare exhibiting a maximum mean of 5.68kg/ha in pea followed by chickpea 5.52kg/ha for tryptophan production.

Based on results emerging out of the present investigation, it may be inferred that different varieties f chickpea and pea differ significantly between and within the groups in respect of various nutritional characteristics due to mainly naturally gifted genetic makeup. No single variety in each group was found to possess superior levels of all the nutritional characteristics, however, Avrodhi in chickpea and Rachna in pea had excellent performance in respect of protein content which may be utilized for nutritional purposes.

Finally, it may be concluded that dhal and germinated grains of different varieties of both the leguminous crops chickpea should be preferred in diet over corresponding whole grain for the adequate supply of relatively superior levels of protein, methionine, and tryptophan to derive maximum benefits in nutritional aspects.

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