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# INVESTIGATION OF PROTEINS ON KABULI, DESI AND GREEN DESI CHICKPEA

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## ABSTRACT

In the present communication, nutritional quality and levels of protein in different varieties of gram has been evaluated. For this purpose protein content of grain and dhal samples of 14 desi, 20 kabuli and 11 green seeded gram varieties were examined. The mean values of three categories of gram revealed that relatively kabuli gram (mean 21.61 %) holds significantly superior position over desi gram (mean 19.78 %) followed by green seeded gram (mean 19.78 %). The varieties containing lower values of seed coat percentage showed higher values in grain protein contents. Statistical analysis of grain protein of the three categories of chickpea varieties indicated the variations recorded by kabuli, desi and green seeded gram were significant at 5% level. The range and mean values of protein percent in dhal samples of the three categories showed that kabuli dhal samples contains highest protein content and lowest in green seeded gram varieties. It is interesting to note that the level of protein percent increased as the contents and intensity of colouration in seed coat is decreased.

**Key words**: Protein contents, Kabuli, Desi, Green seeded grams.

## INTRODUCTION

In vegetarian diets leguminous seeds, also known as legume grains or food legumes or pulses, occupy a prominent place owing to the presence of high content of edible grade proteins of biochemical significant[1,2]. Among various crops, chickpea [*Cicer arietinum* (L.)], also known as gram, Bengal gram or chana (in Hindi), occupies an important place in India. India is the leading chickpea producing country in the world. It grows 76% of the world's acrage and produces 80% of the total grain.

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Although, chickpea is an important pulse crop of India, its yield potential is very low. The lack of high yielding, disease and pest resistance are major factors for poor yielding of crop. Further, the utilization of the protein is not easy as chickpea proteins suffers from low digestibility because of the deficiency of S-containing methionone and other factors. Efforts are being made to overcome these problems and considerable success has been achived[3] in developing high yielding, disease resistant chickpea varieties.

Encouraged from our previous work[4,5], we now report, the biochemical composition of protein of different desi, kabuli and green seeded chickpea cultivars, grown in U.P.

## EXPERIMENTAL

Three types of seeds of chickpea cultivars comprised of fourteen desi gram (having brown coat), eleven green seeded gram (having green seed coat) and twenty kabuli gram (having salmon white seed coat) were selected for this study were obtained form the Economic Botanist (Legumes), Legume section and Deptt. of Genetics and Plant Breeding of C.S. Azad University of Agriculture and Technology, Kanpur, which were grown at Narain College farm under identical conditions. The following cultivars of desi, green seeded and Kabuli gram were taken up for this study.

**Desi gram cultivars:** K-999, K-1129, K-1122, K-1160, K-468, Avarodhi, T-3, K-850, K-3256, Radhey, K-9891-A, KPG-59, BGR-43 and 78526-2.

**Green seeded gram cultivars:** KSB-203**,** KSB-204, KSB-206, KSBB-207, KSB-209, KSB-210, KSB-211, KSB-214, KSB-220 and Heema.

**Kabuli gram cultivars:** GNG-504, HK-86-122, HK-86-176, DPC(K) 13, K-8, BG-267, K-6, G-635, BG-252, ICCC-25, ICCC-26, K-1032, K-1032, K-1032, K-482, K-4, K-7, K-1922, K-,1929 K-1934, BG-258 and ICCC-24.

For decortications, the seed samples were soaked in excess of water for overnight and their testa was removed manually. The decorticated material (dhal) was dried at 70$^{o}$C for overnight. The dried seed samples were ground in domestic grinder and passed through 120 mesh sieve. The powered seed material was defatted with hexane or petroleum ether and then used for biochemical analysis.

### Methods of analysis

### Protein content analysis

Protein content in whole grains and dhal samples were determined by the micro Kjeldahl procedure (AOAC 1975)[6] and crude protein content in standard was calculated

by using a factor 6.25 and the value thus obtained was used to determine the protein content of other samples by modified Biuret method described by Williams[7].

## Statistical analysis

### 't' test for composition of group mean

The significance of the difference between any two group mean was tested by 't' test based on the error, degree of freedom as per following expression:

$$t = \frac{M_1 - M_2}{\sqrt{EMS\,1/r_1 + 1/r_2}}$$

Where,

$M_1$, $M_2$ = Two groups means

EMS = Error mean squares

$r_1$ , $r_2$ = No. of observations on which the mean $M_1$, $M_2$ are based.

### Critical difference

For testing the significance of differences between any two varieties within any group, the value of critical difference at 5% level of significant are used, any difference equal to or greater than the C.D. was declared as significant.

$$\text{Critical difference at 5\%} = \frac{\sqrt{2\,EMS}}{r} \text{ x t at 5\% level for Error D. F. Critical}$$

Where, EMS = Error mean square

r = Number of replications

### Correlation coefficient

The intensity of relationship between any two variables x and y was studied with the help of correlation coefficient (r), given by the following expression:

$$r = \frac{\varepsilon (x - x)(y - y^{-})}{\sqrt{(x - x)^2 \in (y - y^{-})^2}}$$

### Test of significance of r

The significant of correlation coefficient r was tested with the help of 't' given by the following expression:

$$t = \frac{r/D.F.}{(1-r^2)}$$

D.F. = (Error DF – 1)

The degrees of freedom given above are due to the fact the value of correlation coefficient was calculated with the help analysis of co-variance.

## RESULTS AND DISCUSSION

The importance of legume grain is primarily due to the high contents of edible grade protein. The first step in determining its nutritional quality would be to evaluate the levels of protein in different varieties of gram. With this purpose protein content of grain and dhal samples of 14 desi, 20 kabuli and 11 green seeded gram varieties were determined.

### Grain protein

Results on the grain protein content are reported in Table 1, which indicate that each category of gram showed wide varieties. Desi gram varieties showed variations form 17.10 to 21.94 %, whereas, kabuli gram varieties ranged form 18.60 to 24.06 % in respect of grain protein content. Green seeded gram varieties indicated variations from 17.45 to 23.0 %.

**Table 1: Grain protein content* in Kabuli, Brown and Green seeded Chickpea varieties**

| Kabuli | Protein % | Brown | Protein % | Green | Protein % |
|---|---|---|---|---|---|
| GNG-504 | 18.60 | K-999 | 20.90[c] | KSB-203 | 18.00 |
| HK-86-122 | 18.60 | K-1129 | 19.90 | KSB-204 | 17.50 |
| HK-86-176 | 19.50 | K-1122 | 21.85[c] | KSB-206 | 18.60 |
| DPC (K)-13 | 20.40 | K-1160 | 20.25 | KSB-207 | 19.20[a] |
| K-8 | 19.50 | K-468 | 21.94[a] | KSB-209 | 17.45 |
| BG-267 | 21.30 | Avarodhi | 17.10 | KSB-210 | 18.05 |
| K-6 | 21.30 | T-3 | 19.00 | KSB-211 | 18.90[c] |
| G-635 | 21.30 | K-850 | 21.10[b] | KSB-213 | 18.30 |
| BG-252 | 22.20 | K-3256 | 17.10 | KSB-214 | 19.20[b] |
| ICCC-25 | 19.50 | Radhey | 19.90 | KSB-220 | 18.30 |

Cont…

| Kabuli | Protein % | Brown | Protein % | Green | Protein % |
|---|---|---|---|---|---|
| ICCC-26 | 20.40 | K-9891-A | 19.00 | Heema | 23.00[b] |
| K-1032 | 23.10[b] | KPG-59 | 20.90[c] | | |
| K-482 | 23.10[b] | BGR-43 | 19.00 | | |
| K-4 | 24.00[a] | 78526-2 | 19.00 | | |
| K-7 | 23.1[b] | | | | |
| K-1922 | 24.06[a] | | | | |
| K-1929 | 23.10[b] | | | | |
| K-1934 | 23.10[b] | | | | |
| BG-258 | 22.20 | | | | |
| ICCC-24 | 24.00[a] | | | | |
| Mean | 21.61 | Mean | 19.78 | Mean | 18.77 |
| S.E. of diff. | 0.51 | | 0.15 | | 0.15 |
| (CD) 5 % | 0.31 | | 0.31 | | 0.31 |

[*]Mean of three replications
a,b and c are significant at 5% level
Difference between the means bearing the same latter is non-significant at 5% level

The mean values of the three categories of gram revealed that relatively Kabuli gram (mean 21.61%) holds significantly superior position over desi gram (mean 19.78%) followed by green seeded gram (mean 18.78%) (Table 2). The varieties K-4, K-1922, ICCC-24 in kabuli group, Heema in green seeded gram and K-468 in brown seeded group were identified to be high grain protein containing varieties in respective groups.

**Table 2: Range and mean values of protein content, IVPD % and Dhal processing % of chickpea cultivars**

| S. No. | Parameter | Seed coat | No. of samples | Range of variations | Mean | Best varieties |
|---|---|---|---|---|---|---|
| **1** | Grain protein (%) | White | 20 | 18.60-24.00 | 21.61 | K-4, |
| | | brow | 14 | 17.10-21.94 | 19.78 | K-1922 ICCC-24 |
| | | green | 11 | 17.45-23.00 | 18.77 | Heema |
| **2** | Dhal protein (%) | White | 20 | 21.73-27.00 | 24.47 | K-4 |
| | | brown | 14 | 22.00-27.50 | 24.29 | K-1160 |
| | | green | 11 | 20.60-25.03 | 21.86 | Heema |

Cont…

| S. No. | Parameter | Seed coat | No. of samples | Range of variations | Mean | Best varieties |
|---|---|---|---|---|---|---|
| **3** | IVPD (%) | White | 20 | 68.60-77.60 | 72.90 | K-8 |
| | | Brown | 14 | 53.10-66.20 | 60.60 | Radhey |
| | | Green | 11 | 50.00-68.50 | 57.20 | Heema |
| **4** | Dhal (%) | White | 20 | 90.25-97.00 | 94.8 | K-1934 |
| | | Brown | 14 | 63.79-87.76 | 75.90 | K-850 |
| | | Green | 11 | 67.00-86.00 | 75.20 | Heema |
| **5** | Seed coat (%) | White | 20 | 2.00-7.25 | 4.21 | K-1934 |
| | | Brown | 14 | 9.82-17.87 | 13.29 | K-999 |
| | | Green | 11 | 10.00-25.00 | 20.90 | Heema |
| **6** | Weight loss | White | 20 | 0.0-3.54 | 1.21 | K-Avarodhi |
| | | Brown | 14 | 0.0-40.82 | 11.62 | KSB-204, |
| | | Green | 11 | 0.2-13.00 | 5.70 | KSB-206,KSB-210 |

The differences in the mean values (Table 3) of grain protein content in between kabuli, desi and green seeded gram varieties may be attributed to the interference of seed coat colouration and seed coat content[8].

**Table 3: Comparataive means for grain protein in Kabuli, Desi and Green seeded Chickpea groups**

| Group | Mean | Group | Mean | Diff. | S. E. of Distt. | T value |
|---|---|---|---|---|---|---|
| **Kabuli** | 21.67 | Brown | 19.78 | 1.83 | 0.04 | 48.29*** |
| **Kabuli** | 21.67 | Green | 18.77 | 2.84 | 0.04 | 69.44*** |
| **Brown** | 19.78 | Green | 18.77 | 1.01 | 0.04 | 22.93*** |

***Significant at 0.1% level of significant

The contents of seed coat (Table 4) in kabuli gram varieties was lowest as compared to green seeded and desi gram varieties. The varieties containing lower values of seed coat percentage showed higher values in grain protein content as indicated by the data of the mean values of seed coat and grain protein content of the varieties belonging to three colour groups (Table 2).

**Table 4: Seed coat content* of Kabuli, Desi and Green seed varieties**

| Kabuli | Seed coat (%) | Brown | Seed coat (%) | Green | Seed coat (%) |
|---|---|---|---|---|---|
| GNG-504 | 7.25 | K-999 | 9.82 | KSB-203 | 20.0 |
| HK-86-122 | 5.20 | K-1129 | 11.92 | ,,-204 | 23.0 |
| HK-86-176 | 3.00 | K-1122 | 15.19 | ,,-206 | 22.0 |
| DPC(K)-13 | 5.62 | K-1160 | 16.61 | ,,-207 | 24.0 |
| K-8 | 2.73 | K-468 | 13.18 | ,,-209 | 23.0 |
| BG-267 | 4.00 | Avarodhi | 13.24 | ,,-210 | 22.0 |
| K-6 | 4.35 | T-3 | 12.16 | ,,-211 | 25.0 |
| G-635 | 3.23 | K-850 | 10.69 | ,,-213 | 22.0 |
| BG-252 | 3.00 | K-3256 | 12.25 | ,,-214 | 20.0 |
| ICCC-25 | 3.00 | Radhey | 11.01 | ,,-220 | 19.0 |
| ICCC-26 | 3.75 | K-9891-A | 14.49 | Heema | 10.0 |
| K-1032 | 5.00 | KPG-59 | 17.61 | | |
| K-482 | 4.62 | BGR-43 | 9.95 | | |
| K-4 | 5.00 | 78526-2 | 17.87 | | |
| K-7 | 6.55 | | | | |
| K-1922 | 4.75 | | | | |
| K-1929 | 3.25 | | | | |
| K-1934 | 2.00 | | | | |
| BG-258 | 4.70 | | | | |
| ICCC-24 | 3.30 | | | | |
| Mean | 4.21 | Mean | 13.29 | Mean | 20.9 |

*Mean of three replications

Statistical analysis of grain protein content of the three categories of (Table 3) chickpea varieties indicated the variations recorded by kabuli, desi and green seeded gram were significant at 5% level. Highest grain protein containing kabuli variety K-1922 exhibited significantly higher values over other kabuli varieties expect varieties K-4 and

ICCC-24 which were statistically at per with variety K- 1922. Similarly desi gram variety K-468 possessing highest value for grain protein differed significantly with rest of the varieties except variety Heema also exhibited significantly higher values of garin protein content over varieties in the group.

**Dhal protein**

The impact of seed coat content and colouration on protein content was also determined in dhal samples obtained by removing seed coat from whole grain of different varieties and analyzing protein content in dhals (decorticated cotyledons) of three categories of chickpea seeds.

While preparing the dhal samples of different varieties, it was worthwhile to record relevant processing characteristic, such as percentage dhal recovery, seed coat percentage and percentage loss in processing which are tabulated as below in Table 4.

The results of protein contents in dhal samples and a comparative value of dhal protein in different chickpea groups is recorded in Tables 5 and 6 respectively.

**Table 5: Dhal protein content* of Kabuli, Desi and Green seeded Chickpea varieties/ cultivars**

| Kabuli | Protein % | Brown | Protein % | Green | Protein % |
|---|---|---|---|---|---|
| GNG-504 | 21.73 | K-999 | 22.90 | KSB-203 | 20.80 |
| HK-86-122 | 21.80 | K-1129 | 22.00 | ,,-204 | 20.60 |
| HK-86-176 | 22.50 | K-1122 | 25.70[b] | ,,-206 | 21.40 |
| DPC(K)-13 | 24.60 | K-1160 | 27.50[a] | ,,-207 | 22.80[b] |
| K-8 | 23.40 | K-468 | 25.70[b] | ,,-209 | 20.60 |
| BG-267 | 23.30 | Avarodhi | 22.00 | ,,-210 | 21.88 |
| K-6 | 24.20 | T-3 | 23.82 | ,,-211 | 22.00[c] |
| G-635 | 24.20 | K-850 | 22.90 | ,,-213 | 22.50[b] |
| BG-252 | 25.20[d] | K-3256 | 22.90 | ,,-214 | 22.00[c] |
| ICCC-25 | 23.67 | Radhey | 23.82[c] | ,,-220 | 20.87 |
| ICCC-26 | 23.40 | K-9891-A | 25.70[b] | Heema | 25.03[a] |

Cont…

| Kabuli | Protein % | Brown | Protein % | Green | Protein % |
|---|---|---|---|---|---|
| K-1032 | 24.50 | KPG-59 | 25.70[b] | | |
| K-482 | 25.13 | BGR-43 | 23.82[c] | | |
| K-4 | 27.00[a] | 78526-2 | 25.70[b] | | |
| K-7 | 26.20[d] | | | | |
| K-1922 | 25.83[c] | | | | |
| K-1929 | 26.20[b] | | | | |
| K-1934 | 25.70[c] | | | | |
| BG-258 | 24.30 | | | | |
| ICCC-24 | 26.50[b] | | | | |
| Mean | 24.47 | Mean | 24.29 | Mean | 21.86 |
| S.E. of Diff. | 0.26 | | 0.26 | | 0.26 |
| (CD) 5 % | 0.52 | | 0.52 | | 0.52 |

*Mean of three replications

a,b and c are significant at 5% level

Difference between the means bearing the same latter is non-significant at 5% level

**Table 6: Comparataive means of dhal protein Kabuli, Desi and Green seeded Chickpea groups**

| Group | Mean | Group | Mean | Diff. | S. E. of Distt. | T value |
|---|---|---|---|---|---|---|
| Kabuli | 24.47 | Desi | 24.29 | 0.16 | 0.06 | 2.64** |
| Kabuli | 24.47 | Green | 21.86 | 2.16 | 0.07 | 37.31*** |
| Brown | 24.29 | Green | 21.86 | 2.44 | 0.07 | 32.48*** |

**Significant at 1% level of significance.

***Significant at 0.1% level of significance

On an average basis seed coat % is highest in green seeded gram (mean 20.90 %) than desi gram (mean 13.29 %) and lowest in kabuli gram (mean 4.21 %). Whereas, average dhal % of kabuli (mean 94.58 %) was highest than desi (mean 75.90 %) followed by green (mean 75.20 %).

The range and mean values of protein % in dhal samples (Table 2) of the three categories indicated that kabuli dhal samples contains highest protein content and lowest values of dhal protein were obtained in green seeded gram varieties.

The mean values of grain varieties and dhal protein content showed similar trend in having and lowest in green seeded gram indicating probable influence of seed coat colour and content of protein content of grain and dhal protein in green seeded gram variety may be attributed to green colour of dhal samples in this group. The adverse effect of seed coat content on the protein extraction and quality of desi and kabuli chickpea cultivars has also been reported[9], which are in agreement with that obtained by us.

It is interesting to note that as the contents and intensity of colouration in seed coat is decreased, the level of protein % is decreased. On comparing the values of grain and dhal protein, it was found that the dhal samples of all the three categories possessed higher levels of protein content as compared to respective whole grain samples. Differences in the mean values of protein content of grain and dhal samples were found to be 2.86, 4.51 and 8.90 in kabuli, desi and green seeded gram type respectively, marking respective increase of 13.2, 22.8 and 16.4 % of protein content in dhal samples over grain samples.

Comparison of the three groups (Tables 3 and 6) on the statistical level revealed that kabuli gram exhibited significantly superior performance over desi and green seeded gram group. Green seeded group also possessed significantly lower values than desi group. Results on grain and dhal protein content of grain legumes including chickpea. Similarly results on grain and dhal protein content of kabuli and desi gram varieties reported[10] earlier are in good support with our findings.

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