

Physical Characteristics and Proximate Composition of Different Cultivars of Kidney Beans Grown in Himachal Pradesh

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Abstract – Six kidney bean (*Phaseolus vulgaris* L.) Cultivars grown in himachal p were studied for their physical properties, proximate composition, nutritional composition, mineral composition and antinutritional factors. The various cultivars studied were Himgiri, Local Landrace 1, Local Landrace 2, Local Landrace 3, Baspa and Kailsah procured from different districts of Himachal Pradesh. The physical properties analysed included colour, shape, length, breadth, L/B ratio, 100-seed weight, density and Bulk density. The proximate composition studied were moisture, ash, crude protein, crude lipid, crude fiber, crude fat, total carbohydrates and fatty acid. The moisture content and crude protein content was maximum in Baspa i.e. 12.40 per cent and 27.59 per cent respectively, which was procured from district Kinnaur. The ash content in various kidney bean cultivars ranged from 3.92 to 5.53 per cent whereas fat ranged from 1.23 to 4.85 per cent. Crude fat content was maximum in Local Landrace 2 (4.85 %), procured from Chamba district.

Keywords – Kidney Beans, *Phaseolus Vulgaris* L., Crude Protein, Crude Fat, Energy Value, Physical Chraterstics, Proximate Composition.

I. INTRODUCTION

Legumes belonging to the family leguminaceae are produced and consumed widely throughout the world, particularly in tropical and sub tropical areas of Africa, Asia and Latin America. For people who live in these areas, legumes constitute as an important source of protein, vitamin B-complex & minerals (Barampama and Simard,1995). A significant part of the world population also relies on legumes as a staple food for subsistence, particularly in combination with cereals. India is one of the major pulse producing country in the world, contributing about 25-28 per cent of the total global production. The production of total pulses in India is presently about 15 million tonnes covering an area of about 22-23 million hectare. The estimates for 2010-2011 indicated that the total pulse production was 17.29 million tonnes from 25.51 million hectare area (IIPR, 2011). Legumes also provide good amount of carbohydrates and minerals (Gopalan *et al.* 2005). They improve the nutritional quality of predominantly cereal based diets of large segments of population, as cereal proteins are deficient in lysine. Rajmash (*Phaseolus vulgaris* L.) is a potential cash crop grown extensively in dry temperate region of Himachal Pradesh. Kidney is an excellent source of vegetable protein, starch, soluble and insoluble fiber, vitamins (especially B group) and minerals

(particularly potassium, iron, zinc, magnesium and manganese). They are very low in fat (Eknayake *et al.*, 1999). Kidney beans (*Phaseolus vulgaris*) are one of the neglected tropical legumes that can be used to fortify cereal based diets, especially in developing countries because of its high protein content. It contain moisture (12%), protein (22.9%), fat (1.3%) and minerals (3.2%) (Gopalan *et al.* 2005). In Himachal Pradesh Kidney beans are grown in different areas and there are different agroclimatic zones which might effect the nutritional composition of legumes. Much work has not been reported on the physical and nutritional composition of different cultivars of Kidney beans grown in different districts of Himachal Pradesh. So present study was planned to analyse the physical and proximate composition of kidney beans grown in different altitudes in H.P.

II. MATERIALS AND METHODS

Collection and preparation of sample:

The two cultivars of Kidney bean viz. Baspa and Kailash were procured from KVK, Sangla, district Kinnaur, another two cultivars viz. Himgiri and Local Landrace 1 were procured from local farmers of Chamba districts, one cultivar viz. Local Landrace 2 was obtained from local farmer of Mandi district and one cultivar i.e. Local Landrace 3 was procured from local farmer of Kullu district. The seeds were cleaned and the extraneous materials carefully removed by hand sorting. Then, the seeds were ground in to fine powder with the help of mixer grinder, stored in airtight containers and kept under refrigerator till further analysis. All the analysis was carried out in triplicate.

Physical Characteristics:

Physical characteristics observed were colour, shape, Size, Density and bulk density. The colour and shape of the seeds were observed from their physical appearance through visual perception. One hundred seeds in triplicate from each variety were randomly selected and weighed on an electrical weighing balance. Twenty seeds in triplicate were taken and length and breadth was measured with the help of vernier caliper.

Density

One thousand seeds in triplicate from each variety were weighed and put in graduated cylinder containing known quantity of water and rise in water level was noted. Density was calculated by the following formula:

$$\text{Density (g/ml)} = W \text{ (g)} / V \text{ (ml)}$$

Where, W = Weight of 100 seeds and V= Rise in water level after adding seeds

Bulk Density

The bulk density was measured according to the method given by Narain et al. 1978. A calibrated graduated cylinder (1000 ml) was filled with seeds up to the mark. The contents of the cylinder were weighed. The bulk density of individual sample was calculated by dividing the weight by 1000 and expressed as g/ml.

Proximate analyses:

The proximate analyses of sample for moisture, crude fat, crude fibre and total ash were carried out in triplicate according to the methods of Association of Official Analytical Chemists (AOAC, 2010). Nitrogen was determined by the micro-Kjeldahl method and was multiplied by the factor of 6.25 for converting it in to crude protein AOAC (2010). The total carbohydrate content was determined by difference (AOAC, 2010). Energy content was estimated by the method of O'shea and Maguire (1962).

The experiments were carried out in triplicate and the data so obtained data were subjected to Analysis of Variance (ANOVA) using statistical method of Sendecor and Cochran (1994)

III. RESULTS AND DISCUSSION

Physical Characteristics;

Table 1 shows the physical characteristics of different Kidney bean cultivars. The physical characteristics analysed were color, shape, length, breadth, L/B Ratio, 100 seed weight, density and bulk density. As is clear from data that there was difference in the colour and shape of kidney bean cultivars procured from different districts. Seeds obtained from Chamba and Mandi districts were dark red in colour with small size whereas seeds procured from Kullu and Kinnaur districts had large size seeds with spots on them. A non significant difference was observed in the length, breadth and length breadth ratio of all the cultivars of kidney beans obtained from different places. Significantly ($P < 0.05$) higher seed weight was observed in kidney bean samples procured from Baspa and Kailash district Kinnaur when compared with other cultivars. Seed weight was minimum in local land race 3 from Kullu area. Similar was the trend for density and bulk density. The difference in physical characteristics might have been due to different agro-climatic zones. Modgil et.al (2005) analyzed kidney beans and reported the average density to be 1.23 g/ml. The difference in the bulk density of different cultivars might have been due to the reason that bulk density is weight volume ratio so more the weight, higher will be the bulk density.

Proximate composition:

Proximate composition gives useful information about the nutritional and biochemical quality of food. Nutritive value of any food and food products depends mainly on their proximate composition which includes determination of percentage of moisture, ash, crude fat, crude protein, crude fibre and total carbohydrate.

Moisture content:

The highest moisture content was present in Baspa cultivar (12.40 %) and the lowest was in the Local Landrace 2 (8.12 %). The moisture content of different cultivars ranged from 8.12 (Local Landrace 2) to 12.40 (Baspa) per cent. A significant ($p \leq 0.05$) difference was observed in moisture content of Baspa, Local Landrace 2, Local Landrace 3, Himgiri and Kailash when these were compared with each other. Sasanam et al. (2011) evaluated red kidney bean and reported the moisture content to be 12.39 per cent. The variations in moisture content of six different cultivars may be because of various factors like stage of maturity, time of harvesting, agro-climatic conditions and the cultivar differences.

Ash

The estimation of ash in foods also reveals the mineral constituents of food which plays an important role in human nutrition. The ash obtained is not necessarily of exactly the same composition, as there may be losses due to volatilization or some interaction in between the constituents. The maximum ash content was present in Himgiri (5.53 %) and minimum was in Local Landrace 2 (3.92 %). A significant ($p \leq 0.05$) difference was observed in the ash content of all cultivars except Local Landrace 3 and Baspa which differed non-significantly from each other. A slight variation in the ash content from the work of other scientist might have been due to the inherited quality of *Kidney beans*, varietal difference and agroclimatic condition. The minimum ash content in ash content of Local Landrace 2 might have been due to the reason that this cultivar had less 100 seed weight and small size which affected its nutrient quality. Audu and Aremu (2011) analyzed red kidney bean (*Phaseolus vulgaris*) flour and reported the ash content to be 4.4 per cent. Sasanam et al. (2011) evaluated red kidney bean and found that ash content was 3.90 per cent. Ash content is the inherited quality of kidney bean and least affected by varietal variations, topography and cultural practices.

Crude Fat:

Significantly highest value in Local Landrace 2 cultivar (4.85 %) and lowest in Local Landrace 3 cultivar (1.23 %). A significant ($p \leq 0.05$) difference was observed in the fat content of Local Landrace 1, Local Landrace 3, Baspa and Kailash Himgiri when compared with each other. The higher fat content was observed in the cultivars procured from Chamba and Kullu district. Fat content was low in the cultivar procured from Mandi and Kinnaur district which might have been due to the agroclimatic condition, genetic make up and nutritional characteristics.

Crude Protein:

A significant ($p \leq 0.05$) difference was observed in the protein content of Baspa when compared with Himgiri, Local Landrace 1, Local Landrace 2, Local Landrace 3, and Kailash whereas, the protein content of Baspa and Kailash and Local Landrace 2 and Local Landrace 3 varied non-significantly from each other. The high protein content was observed in the two cultivars obtained from Kinnaur and minimum protein content was present in the cultivars obtained from mid hills. The results of present investigation are in accordance with Sai-Ut et al. (2010)

who investigated red kidney beans, navy beans and adzuki beans and reported that protein content was 17.37, 18.15 and 19.91 per cent respectively.

Crude Fiber:

The maximum crude fiber content was present in Himgiri cultivar which varied significantly ($p \leq 0.05$) with Local Landrace1, Local Landrace2, Local Landrace3, Baspa and Kailash when compared with each other whereas the crude fiber content of Local Landrace 1 and Local Landrace 2 varied non-significantly from each other. However, Shimelis and Rakshit (2004) investigated eight improved dry bean varieties and reported a range of crude fiber content between 4.66 to 5.95 g/100g whereas, Adu and Aremu (2011) found that red kidney bean (*Phaseolus vulgaris*) flour contained 3.6 per cent crude fiber.

Total Carbohydrates:

A significant ($p \leq 0.05$) difference was observed in total carbohydrate content of Local Landrace 3 when compared with Himgiri, Local Landrace1, Local Landrace 2, Baspa and Kailash however, the carbohydrate content of Baspa and Himgiri differed non-significantly. Adu and Aremu (2011) found carbohydrate content in red kidney bean (*Phaseolus vulgaris*) flour to be 49.0 per cent whereas, Sasanam et al. (2011) reported that carbohydrates content in red kidney bean was 60.65 per cent.

Energy Value:

A significant ($p \leq 0.05$) difference was observed in the energy content of Local Landrace 2 when compared with Himgiri, Local Landrace1, Local Landrace3, Baspa and Kailash whereas, the energy content of Himgiri and Local Landrace 1 differed non-significantly. Singh et al. (1996) reported the energy content of rajmash varieties in the range between 376.47 to 378.94 per 100 g dry weight whereas, Modgil et al. (2005) analyzed kidney beans and reported the energy content (Kcal/100g) to be 365.76. The highest calorific energy content in Local Landrace 2 might have been due to the reason that this cultivar had high fat content and carbohydrate content which are the main contributing factor for calorific value.

IV. CONCLUSION

From the present study it can be concluded that physical characteristics like length was highest in Local Landrace 3 whereas breadth was highest in Himgiri. 100 seed weight and bulk density were highest in Baspa cultivar of Kidney bean as compared with other five cultivars. This cultivar seeds also contained higher amount of proximate constituents. Kidney beans grown in different agro-climatic zones have difference in their nutritional composition.

REFERENCES

- [1] AOAC. 2010. Official methods of analysis. Association of Official Analytical Chemist, Washington, D.C. UK. 14.068, 2057
- [2] Adu SS and Aremu MO. 2011. Effect of processing on chemical composition of red kidney bean (*Phaseolus vulgaris* L.) flour. *Pakistan Journal of Nutrition* 10: 1069-1075
- [3] Barampama S and Simard RE. 1995. Effect of soaking, cooking and fermentation on composition, *in vitro* starch digestibility and nutritive value of common beans. *Plant Foods for Human Nutrition* 40: 349-365
- [4] Eknayake, S., E.R. Jansz and B.M. Nasir, 1999. Proximate composition, mineral and amino acid content of nature *Canavalla gladiata* seeds. *Food Chem.*, 66: 119.
- [5] Gopalan C, Ramsastri BV and Balsubramaniam SC. 2005. *Nutritive Value of Indian Foods*. National Institute of Nutrition. ICMR, Hyderabad.
- [6] IIPR Vision-2030. 2011. Indian institute of pulses research (Indian Council of Agricultural Research) Kanpur. www.iipr.Res.In.July 2011 At Army Printing Press, 33, Nehru Road, Sardar Cantt. Lucknow
- [7] Modgil R, Mankotia K and Verma R. 2005. Effect of soaking, sprouting on the carbohydrate and mineral content of kidney beans (*Phaseolus vulgaris*). *Beverage and Food World* 28-29
- [8] Narain M, Siripurapu SCB, Jha H and Dwivedi VK. 1978. Physico-thermal properties of rice bran. *Journal of Food Science and Technology* 15:18-19
- [9] O'shea JO and Maguire MP. 1962. Determination of calorific value of food stuff by chromic acid oxidation. *Journal of the Science of Food and Agriculture* 13: 530
- [10] Sai-Ut S, Ketnawa S, Chaiwut P and Rawdkuen S. 2009. Biochemical and functional properties of red kidney, navy and adzuki beans. *Journal of Agro Food Industry* 2: 493-504
- [11] Samman N, Maldonado S, Alfaro ME, Farfan N and Gutierrez. 1999. Composition of different bean varieties (*Phaseolus vulgaris*) of north western argentina (Region NOA): cultivation zone influence 47: 2685-2689
- [12] Sasanam S, Paseephol T and Moongngarm A. 2011. Comparison of proximate compositions, resistant starch content and pasting properties of different coloured cowpeas (*Vigna unguiculata*) and red kidney bean (*Phaseolus vulgaris*). *World Academy of Science, Engineering and Technology* 81: 315-
- [13] Sendecor W and Cochran WG. 1994. Statistical methods. Sixth Edition, Oxford and IBH Publication, New Delhi.

Table 1: Physical Characteristics of Kidney Bean cultivars

Parameter/ cultivars	Himgiri	Local Landrace 1	Local Landrace 2	Local Landrace 3	Baspa	Kailash	CD (p<0.05)
Color	Dark red	Dark red	Dark red	White with red spots	Light red with white spots	White with red spots
Shape	Small, kidney shaped	Small, kidney shaped	Small, kidney shaped	Large, kidney shaped	Large, kidney shaped	Large, kidney shaped
Length (mm)	14.87	15.13	14.88	16.05	15.87	16.02	NS
Breadth (mm)	70.40	68.80	70.13	68.63	64.76	66.26	NS
L/B Ratio (mm)	0.21	0.22	0.21	0.23	0.24	0.24	NS
100 seed weight (g)	25.0	31.0	24.0	42.16	54.0	53.0	2.06
Density (g/ml)	1.31	1.29	1.26	1.26	2.66	2.56	0.05
Bulk density (g/ml)	1.94	1.91	1.89	4.75	5.69	5.46	0.07

Table 2: Proximate Composition (%) and Energy Value of Kidney Bean Cultivars

Parameter/ cultivars	Himgiri	Local landrace 1	Local landrace 2	Local landrace 3	Baspa	Kailash	CD (p<0.05)
Moisture	11.22	10.46	8.12	9.17	12.40	11.81	0.44
Ash	5.53	5.33	3.92	4.43	4.46	4.95	0.17
Fat	3.51	3.21	4.85	1.23	2.74	2.54	0.13
Crude fibre	4.40	4.11	4.10	3.29	2.87	2.09	0.19
Crude protein	25.75	24.26	24.59	19.19	27.59	27.41	0.43
Carbohydrates	49.60	52.63	54.42	62.69	49.88	51.20	0.54
Energy (Kcal/100g)	366.58	372.84	376.72	364.26	360.52	361.15	0.25