Physicochemical and Organoleptic Characteristics of Different Parts of Vegetable Cowpea [Vigna unguiculata (L.)Walp]

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ABSTRACT

All parts of the cowpea crop are nutritious and edible. The present study analyzed the nutritional, anti-nutritional and organoleptic qualities of vegetable cowpea pods, shells and seeds. Two varieties of vegetable cowpea viz. PusaSukomal and PVCP-20 were studied in three parts (pods/shells/seeds). Proximate composition, seven minerals, dietary fiber and two anti-nutrients were analyzed. The study showed that both varieties of vegetable cowpea are nutritious with PusaSukomal being rich in macronutrients and PVCP-20 rich in micronutrients. The three different parts of cowpea differed from each other nutritionally as well as in their anti-nutrient content. Among the different parts analyzed shells were rich in dietary fiber. Seeds were nutrient dense as compared to pods and shells, but more in anti- nutrients. Organoleptically seeds of PusaSukomal were preferred over other forms. It is revealed from the study that PusaSukomal seeds are nutritionally and organoleptically superior to the other samples studied.

Key words: Nutritive value, Organoleptic characteristics, PVCP-20, PusaSukomal, Vigna unguiculata.

INTRODUCTION

Vegetables constitute one of the most important components of the human diet. They are an excellent source of macro and micronutrients (Prodanov et al., 2004). However, in recent years consumption of fresh vegetables became inadequate, especially among the resource poor population. Cowpea [Vigna unguiculata (L.) Walp] is one of the most ancient crops known to human. It is an annual herbaceous legume. It has several names such as Frijole, Black eye pea, Lobia, Asparagus beans, Niebe, Coupe, Yard long beans and Sitao etc. (Pasquet, 1999). Pottorff et al. (2012) stated that it is a profitable crop as all the parts of the plant are edible such as leaves, green pods and seeds. Venkatesan et al. (2003) reported that cowpea contains, 1.8% fat, 60.3% carbohydrates and 23.4% protein and also it is a good source of vitamins and phosphorus. In the tropical and sub-tropical regions cowpea is produced for vegetable and seed purposes. Cowpea is a versatile crop because it is drought tolerant and it has soil restoring properties (Lesly, 2005).

The proteins in cowpea seeds are rich in amino acids, lysine and tryptophan in comparison to cereal grain. However it is deficient in methionine and cystein in comparison to animal protein (Davis et al., 2008).

Choice of cowpea as a vegetable is due to it being palatable, highly nutritious and relatively free from metabolites or other toxins. Fresh leaves and fast growing twigs are often picked up and eaten like spinach. Immature pods are used in the same way as snap beans often being mixed with other foods. Both dried and green seeds are suitable for canning and boiling as well (Tiwari and Shivhare, 2016). Cowpeas are a major food staple in many parts of Africa where every part of the plant is eaten. Green seeds are roasted and used like peanuts. The green leaves are boiled and eaten like spinach, while in parts of Sudan and Ethiopia the roots are roasted and eaten. In India, cowpea is eaten in the form of vegetable or curry made from green pods and dry seeds respectively (Preet and Punia, 2000). Thus, cowpea can be used in all stages of growth as a vegetable crop. The objective of the study was to carry out physicochemical and organoleptic evaluation of different parts of vegetable cowpea, in order to establish their nutritional and commercial potential.

MATERIALS AND METHODS

Freshly harvested cowpea varieties viz PusaSukomal and PVCP-20 were procured in the month of October, 2017 from Breeders Seeds Production center of Govind Ballabh Pant University of Agriculture & Technology Pantnagar, Uttarakhand, India. The three different parts (pods/shells/seeds) of vegetable cowpea were used for nutritional, anti-nutritional and organoleptic evaluation.

Powders of different plant parts of cowpea were prepared by drying fresh cowpea pods/shells/seeds at 50–55°C for 6-8 hours and then grinding in an electric grinder. The samples were stored in clean double sealed polyethylene bags. The prepared powder was used for analysis of nutrients, anti-nutrients. For the proximate composition AOAC (1995)
RESULTS AND DISCUSSION

Proximate composition: It includes the analysis of the sample for moisture, total ash, crude protein, crude fat and crude fiber. The maximum amount of moisture content among the different parts of vegetable cowpea was found in PVCP-20 shells (89.41%) followed by PusaSukomal Shells (88.77%), PVCP-20 pods (85.83%) PusaSukomal pods (84.29%), PVCP-20 Seeds (62.66%) and lowest amount of moisture was recorded in PusaSukomal seeds (61.67%) (Table 1). Statistical analyses revealed that moisture content of all parts of vegetable cowpea were significantly different from each other. The highest amount of total ash content was found in PVCP-20 seeds (4.63%), followed by PVCP-20 pods (3.81%), PusaSukomal seeds (3.61%) PusaSukomal pods (3.46%), PVCP-20 shells (2.88%) while the lowest ash content was found in PusaSukomal shells (2.56%). According to Deol and Bains (2010) the total ash content of immature pods of vegetable cowpea was 2.6% which was found to be lesser than the total ash content of vegetable cowpea PusaSukomal pods and PVCP-20 pods (3.46-3.81%). Ojimelukwe et al., (2014) reported that the total ash content of vegetable cowpea seed varieties ranged from 4.7 to 6.0% which was found to be higher than that reported in the present research. Statistically the differences were insignificant.

The crude fiber content of different parts of vegetable cowpea ranged from 4.6-37.4%. The highest crude fiber content was recorded in shell of PusaSukomal as 37.4%, followed by shell of PVCP-20 (33.4%), Pods of PusaSukomal (15.60%), Pods of PVCP-20 (12.8%), seeds of PusaSukomal (5.0%) and least content was found in seeds of PVCP-20 (4.6%). Statistical analysis of the crude fiber content of the vegetable cowpea revealed that the difference between PusaSukomal seeds and PVCP-20 seeds was non-significant. Deol and Bains (2010) reported that crude fiber content of cowpea pods was 4.2 per cent which was found to be less than the crude fiber content of pods of PVCP-20 and PusaSukomal (12.8-15.60%). Similar findings were also found by Ojimelukwe et al., (2014). The crude fat content of different parts of vegetable cowpea ranged from 0.25-1.90%, with the highest content in seeds of PVCP-20 (1.90%) were at top, followed by PusaSukomal seeds (1.05%), PVCP-20 pods (0.88%), PusaSukomal pods (0.70%), PVCP-20 shells (0.30%). The lowest crude fat content was observed in PusaSukomal shells (0.25%). Statistical analysis of the crude fat content revealed that the difference between PusaSukomal shells and PVCP-20 shells was non-significant, as in the case for PusaSukomal pods and PVCP-20 pods. Deol and Bains (2010) also found similar results in their study done on cowpea. Similar to our findings, Ojimelukwe et al., (2014) also obtained fat content ranging from 0.7 to 2.5%.

Crude protein content of different parts of vegetable cowpea varied ranging from 9.16-19.34%. The highest crude protein content was found in PusaSukomal seeds (19.34%) followed by PVCP-20 seeds (18.46%), PusaSukomal pods (15.21%), PVCP-20 pods (14.15%), PusaSukomal, shells (10.32%) and PVCP-20, shells (10.11%). Statistical analysis of the crude protein content of the vegetable cowpea revealed that the difference between PusaSukomal shells and PVCP-20 shells was non-significant. According to Ojimelukwe et al., (2014) crude protein content of pods of vegetable cowpea ranged from 26.4-32.0 per cent was higher than the crude protein content of PVCP-20 and PusaSukomal (14.15-15.21 per cent). Deol and Bains (2010) reported crude protein content of cowpea pods was 7.2 per cent, which was lesser than that reported in this investigation. The data on carbohydrate by difference of different parts of vegetable cowpea varieties ranged from 49.5-71%. The

| Nutrients          | PusaSukomal Pods | PVCP-20 Pods | PusaSukomal Seeds | PVCP-20 Seeds | PVCP-20 Shells | C.D. at 5% |
|--------------------|------------------|--------------|-------------------|---------------|----------------|------------|
| Total ash          | 3.5±0.02         | 3.8±0.04     | 2.6±0.06          | 2.9±0.0       | 3.6±0.01       | 4.6±0.1   |
| Crude fiber        | 15.6±0.3         | 12.8±0.1     | 37.4±0.1          | 33.4±0.3      | 5.0±0.04       | 4.6±0.1   |
| Crude fat          | 0.7±0.02         | 0.9±0.07     | 0.3±0.05          | 0.3±0.1       | 1.1±0.01       | 1.9±0.3   |
| Crude protein      | 15.2±0.5         | 14.2±0.4     | 10.3±0.4          | 10.1±0.6      | 19.3±0.09      | 18.5±0.2  |
| Carbohydrate       | 65.0±1.9         | 68.4±0.3     | 49.5±0.3          | 53.3±0.3      | 71.0±0.7       | 70.4±0.2  |
| Physiological energy | 327.3±9.9      | 338.0±0.4    | 241.4±0.5         | 256.4±1.8     | 370.8±4.0      | 372.6±1.1 |

Values are presented as mean ± SD and expressed as g kg⁻¹ dry weight. Data in the same row with different letters are significantly different (p<.05).
highest content of carbohydrate was observed in PusaSukomal seeds (71.0%), followed by PVCP-20 seeds (70.4%), PVCP-20 pods (68.36%), PusaSukomal pods (65.03%), PVCP-20 shells (53.31%) and least content of carbohydrate was found in PusaSukomal shells (49.5%). Statistical analysis of the carbohydrate content of the vegetable cowpea revealed that all the different parts of vegetable cowpea were significantly different from each other. When the results were compared with the value obtained from Ojimeluwe et al., (2014), it was found that the carbohydrate content of immature pods of cowpea ranged between 28.9-44.2% per cent and was found to be less than the carbohydrate content of PusaSukomal and PVCP-20 pods (65.03-68.36% per cent). Deol and Bains (2010) estimated 81.3 % carbohydrate content in the pods of vegetable cowpea which is higher than our study. The results of Ojimeluwe et al. (2014) showed 38.7-54.8 % carbohydrate in the seeds of vegetable cowpea slightly lesser than our study (70.4-71.0%). The data on the physiological energy value of different parts of vegetable cowpea varieties ranged from 241.4-372.6 Kcal/100g. The highest amount of physiological energy was found in PVCP-20 seeds followed by PusaSukomal seeds (370.8 Kcal/100g), PVCP-20 pods (338.0 Kcal/100g), PusaSukomal pods (327.3 Kcal/100g), PVCP-20 shells (256.4 Kcal/100g) and lowest amount of physiological energy was recorded in PusaSukomal shells. Statistical analysis of the physiological energy of the vegetable cowpea revealed that different parts of vegetable cowpea showed significant difference.

**Mineral Content:** The minerals are the inorganic constituents of food. These are needed for the growth and maintenance of body. The mineral composition of the different parts of vegetable cowpea is presented in Table 2.

The calcium content of different parts of vegetable cowpea ranged from 54.7-102.7mg/100g. The highest calcium content was found in PVCP-20 seeds (102.7mg/100g) followed by PVCP-20 pods (97.7mg/100g), PusaSukomal seeds (84.6mg/100g), PusaSukomal pods (72.56mg/100g), PVCP-20 shells (64.3mg/100g), whereas lowest calcium content was recorded in PusaSukomal shells (54.7mg/100g). Statistical analysis revealed that the different parts of vegetable cowpea were significantly different from one another. The findings of Deol and Bains (2010) showed 60.1 mg/100g calcium in pods of cowpea that is less than reported in the present investigation i.e. (72.56-97.66mg/100g). Iron content of different parts of vegetable cowpea ranged from 1.84-3.61mg/100g. The highest amount of iron was recorded in PusaSukomal seeds (3.61mg/100g) followed by PVCP-20 pods (3.55mg/100g), PVCP-20 seeds (3.36mg/100g), PusaSukomal pods (3.02mg/100g), PVCP-20 shells (2.7mg/100g) and lowest iron was recorded in PusaSukomal shells (1.84mg/100g). Statistical analysis revealed non-significant differences between PVCP-20 pods and PusaSukomal seeds. Deol and Bains (2010) reported that the iron content of pods of cowpea was 4.0mg/100g which was found to be slightly higher than the pods of PusaSukomal and PVCP-20 (3.02-3.55mg/100g) reported in the present study. Zinc content of different forms of vegetable cowpea ranged from 1.83-3.45 mg/100g. The highest amount of zinc was found in PVCP-20 pods (3.45mg/100g) followed by PVCP-20 shells (2.58mg/100g), PVCP-20 seeds (2.57mg/100g), PusaSukomal pods (2.53mg/100g), PusaSukomal seeds (2.33mg/100g), whereas the lowest amount of Zinc was recorded in PusaSukomal shells (1.83mg/100g). Statistical analysis revealed that the difference among PusaSukomal pods, PVCP-20 shell and PVCP-20 seeds were non-significant. The zinc content of pods of cowpea was 56.25mg/kg. In Gerrano et al. (2017) study zinc content was found lesser than that reported in the present research (2.5-3.4mg/100g). Phosphorus content of different parts of vegetable cowpea ranged from 38.7-66.0mg/100g. The highest amount of phosphorus was found in PVCP-20 seeds (66.0mg/100g) followed by PusaSukomal seeds (64.8mg/100g), PusaSukomal pods (53.8mg/100g), PusaSukomal shells (48.1mg/100g), PVCP-20 pods (45.0mg/100g) and the lowest amount of phosphorus was recorded in PVCP-20 shells (38.7mg/100g). Statistical analysis revealed the difference among PVCP-20 pods, PusaSukomal shells, PusaSukomal pods PVCP-20 seeds were non-significant. Similar findings were also observed by Gerrano et al. (2017) in cowpea pods. The magnesium content of different parts of vegetable cowpea ranged from 34.36-131.33 mg/100g.

**Table 2:** Minerals composition of various parts of both varieties of cowpea.

| Minerals     | Pods       | Shells     | Seeds       | C.D. at 5% |
|--------------|------------|------------|-------------|------------|
| (mg/100g)    | PusaSukomal| PVCP-20    | PusaSukomal| PVCP-20    |
| Calcium      | 72.6 ±0.7  | 97.7 ±2.5  | 54.7 ±0.8  | 64.3 ±0.3  | 84.6 ±0.4  | 102.7 ±0.6 | 2.0 |
| Phosphorus   | 53.9 ±0.2  | 45.0 ±0.4  | 48.1 ±0.02 | 38.7 ±0.4  | 64.8 ±0.3  | 66.0 ±1.0  | 0.8 |
| Magnesium    | 40.7 ±0.8  | 45.0 ±0.2  | 34.4 ±0.1  | 35.1 ±0.7  | 120.0 ±0.1 | 131.3 ±0.9 | 1.0 |
| Iron         | 3.0 ±0.1   | 3.6 ±0.2   | 1.8 ±0.02  | 2.7 ±0.1c  | 3.6 ±0.1   | 3.4 ±0.1   | 0.2 |
| Zinc         | 2.5 ±0.3   | 3.5 ±0.3   | 1.8 ±0.02  | 2.6 ±0.1   | 2.3 ±0.3   | 2.6 ±0.2   | 0.1 |
| Sodium       | 4.3 ±0.1   | 5.5 ±0.1   | 2.0 ±0.4   | 5.4 ±0.2   | 1.2 ±0.4   | 4.0 ±0.3   | 0.3 |
| Potassium    | 23.8 ±0.1  | 26.4 ±0.02 | 5.2 ±0.04  | 7.7 ±0.05  | 46.4 ±0.02 | 55.3 ±0.3  | 3.2 |

Values are presented as mean ± SD and expressed as g kg⁻¹ fresh weight. Data in the same row with different letters are significantly different (p<0.05).
The highest amount of magnesium was found in PVCP-20 seeds (131.33 mg/100g) followed by PusaSukomal seeds (120.03 mg/100g), PVCP-20 pods (44.95mg/100g), PusaSukomal pods (40.71 mg/100g), PVCP-20 shells (35.11mg/100g), where as the lowest amount of magnesium was recorded in PusaSukomal shells (34.36mg/100g). Statistical analysis showed non-significant differences between PusaSukomal shells and PVCP-20 shells. These results were at par with the results of Gerrano et al. (2017). These results were at par with the results of Gerrano et al. (2017).

Anti-nutritional factors (ANF): These are the compounds which reduce the nutrient utilization and/or food intake of plants or plant products used as human foods or animal feeds and they play a vital role in determining the use of plants for humans and animals (Soetan and Oyewole, 2009). Trypsin inhibitor activity of the samples ranged from 2.43-12.32 mg/100g. The highest amount of trypsin inhibitor activity was observed in PusaSukomal pods (12.32mg/100g) followed by PVCP-20 pods (10.65mg/100g), PVCP-20 seeds (5.53mg/100g), PusaSukomal shells (4.55mg/100g), PusaSukomal seeds (3.63mg/100g) whereas lowest amount of trypsin inhibitor activity was reported in PVCP-20 shells (Table 4). Statistical analysis showed non-significant difference between only PusaSukomal seeds and PVCP-20. Deol and Bains (2010) found similar results in cowpea. Phytic acid content ranged from 105.8-899.16 mg/100g in the six samples. The highest amount of phytic acid was recorded in PVCP-20 seeds (899.16mg/100g) followed by PusaSukomal seeds (846.36mg/100g), PVCP-20 pods (734.31mg/100g), PusaSukomal pods (687.16mg/100g), PVCP-20 shells (110.93mg/100g) and lowest content was found in PusaSukomal shells (105.8mg/100g). Statistical analysis revealed that the difference between PusaSukomal seeds and PVCP-20 seeds was non-significant. The phytic acid content of cowpea pods was 833mg/100g as per recorded by Deol and Bains (2010), which was found to be slightly higher than comparative results for vegetable cowpea i.e. 734.31-687.16 mg/100g.

Table 3: Dietary fiber analyzed in various parts of both varieties of cowpea.

| Dietary fiber          | Pods          | Shells         | Seeds          | C.D.         |
|------------------------|---------------|----------------|----------------|--------------|
| PusaSukomal            | PVCP-20       | PusaSukomal    | PVCP-20       | PusaSukomal  | PVCP-20       | at 5%          |
| Insoluble dietary fiber| 22.4±0.1      | 23.4±0.07      | 33.6±0.4      | 37.5±0.3     | 18.9±0.02     | 16.1±0.6      | 1.6            |
| Soluble dietary fiber  | 4.6±0.06      | 4.6±0.05       | 3.1±0.03      | 3.4±0.9      | 6.2±0.01      | 4.4±0.6       | 0.5            |
| Total dietary fiber    | 27.0±0.08     | 28.0±0.06      | 36.7±0.4      | 40.9±1.1     | 25.0±0.03     | 20.5±0.06     | 1.2            |

Values are presented as mean ± SD and expressed as g kg⁻¹ fresh weight. Data in the same row with different letters are significantly different (p<.05).

Table 4: Anti-nutritional content analyzed in various parts of both varieties of cowpea.

| Anti-nutrients          | Pods          | Shells         | Seeds          | C.D.         |
|-------------------------|---------------|----------------|----------------|--------------|
| PusaSukomal             | PVCP-20       | PusaSukomal    | PVCP-20       | PusaSukomal  | PVCP-20       | at 5%          |
| Trypsin inhibitors      | 12.3±0.5      | 10.7±0.6       | 4.6±0.1       | 2.4±0.1      | 3.4±0.1       | 5.5±0.1       | 2.6            |
| activity (mg/100g)      |               |                |                |              |               |                |                |
| Phytic acid (mg/100g)   | 687.2±0.2     | 734.3±0.1      | 105.8±0.7     | 110.9±0.5    | 846.4±1.1     | 899.2±1.2     | 6.7            |

Values are presented as mean ± SD and expressed as g kg⁻¹ fresh weight. Data in the same row with different letters are significantly different (p<.05).
Organoleptic evaluation: All the 6 samples were steamed and sautèd bringing the sample size to 12. Various organoleptic parameters were evaluated for all the samples and the details are represented in Table 5.

Color: Organoleptic score for color of different parts of vegetable cowpea ranged from 5.53-8.03. Maximum score of 8.03 was obtained by sautèd Pusa Sukomal seeds and minimum score of 5.53 was observed in steamed PVCP-20 shells.

Flavor: Organoleptic score for flavor of different parts of vegetable cowpea ranged from 5.46-8.25. Maximum score of 8.25 shown by sautèd PVCP-20 seeds and minimum score of 5.46 observed in steamed PVCP-20 shells.

Texture: Organoleptic score for the texture of different parts of vegetable cowpea ranged from 5.39-8.06. Maximum score of 8.06 was shown by sautèd Pusa Sukomal seeds and minimum score of 5.39 observed in steamed Pusa Sukomal shells.

Taste: Organoleptic score for the taste of different parts of vegetable cowpea prepared by different cooking method ranged from 5.05-8.18. Maximum score of 8.18 was shown by steamed PVCP-20 seeds and minimum score of 5.05 observed in steamed PVCP-20 shells.

Appearance: Mean organoleptic score for the appearance of different forms of vegetable cowpea prepared by different cooking methods ranged from 5.43-7.94. Maximum score of 7.94 was shown by sautèd PVCP-20 seeds and minimum score of 5.43 observed in steamed Pusa Sukomal shells.

Crunchiness: Mean organoleptic score for the crunchiness of different forms of vegetable cowpea prepared by different cooking method ranged from 5.33-7.90. Maximum score of 7.90 was shown by steamed PVCP-20 seeds and minimum score of 5.33 observed in steamed Pusa Sukomal shells.

Table 5: Organoleptic evaluation using nine point hedonic scale.

| Variety       | Vegetable cowpea forms | Liked extremely | Liked very much | Liked moderately | Liked slightly | Neither liked nor disliked | Disliked slightly | Disliked moderately | Disliked very much | Disliked extremely |
|---------------|------------------------|-----------------|-----------------|------------------|---------------|---------------------------|------------------|--------------------|-------------------|-------------------|
| Pusa Sukomal  | A.                     | -               | 60              | 26.3             | 3.3           | 7.2                        | 6.5              | 5.0                | 7.5               |
|               | B.                     | -               | 3.3             | 40               | 43.3          | 6.7                        | 3.3              | 3.3                | 3.3               |
|               | C.                     | -               | 13.3            | 33.3             | 40            | 6.7                        | 3.3              | 3.3                | 3.3               |
|               | D.                     | -               | 6.7             | 3.3              | 56.7          | 23.3                       | -                | -                  | 10                |
|               | E.                     | 43.3            | 40              | 3.3              | -             | 3.3                        | -                | -                  | -                 |
|               | F.                     | 3.3             | 60              | 26.7             | 10            | -                          | -                | -                  | -                 |
| PVCP-20       | G.                     | 3.3             | 50              | 30               | 6.7           | 3.3                        | -                | 3.3                | 3.3               |
|               | H.                     | -               | -               | 26.7             | 56.7          | 3.3                        | 6.7              | 3.3                | 3.3               |
|               | I.                     | -               | 23.3            | 20               | 43.3          | 3.3                        | 3.3              | 6.7                | -                 |
|               | J.                     | -               | 6.7             | 66.7             | -             | 20                         | 3.3              | 3.3                | -                 |
|               | K.                     | 16.7            | 46.7            | 26.7             | 6.7           | -                          | 3.3              | -                  | -                 |
|               | L.                     | 3.3             | 26.7            | 26.7             | 40            | -                          | 3.3              | -                  | -                 |

Table 6: Organoleptic evaluation of vegetable cowpea using score card method.

| Vegetable cowpea variety | Forms of vegetable cowpea | Color | Flavor | Texture | Taste | Appearance | Crunchiness | Mouth feel | Over all acceptability |
|--------------------------|---------------------------|-------|--------|---------|-------|------------|-------------|------------|------------------------|
| Pusa Sukomal             | A.                        | 6.5^b | 7.3^a  | 7.3^a  | 7.3^a | 7.2^a      | 6.5^a       | 5.0^a      | 7.5^a                  |
|                          | B.                        | 6.7^b | 6.4^a  | 6.4^a  | 6.3^b | 6.6^b      | 5.8^b       | 6.0^a      | 5.03^b                 |
|                          | C.                        | 6.5^g | 6.1^c  | 6.1^c  | 6.1^c | 6.1^c      | 5.9^c       | 6.2^c      | 6.3^c                 |
|                          | D.                        | 5.5^k | 5.5^i  | 5.4^d  | 5.5^f | 5.4^d      | 5.3^f       | 5.4^i      | 5.4^d                |
|                          | E.                        | 8.03^j | 8.2^e | 8.1^e  | 8.1^e | 7.9^g      | 7.7^g       | 8.0^h      | 8.0^h               |
|                          | F.                        | 7.8^l | 7.4^q  | 7.3^p  | 7.8^o | 7.2^j      | 7.8^o       | 7.5^s      | 7.5^s                |
| PVCP-20                  | G.                        | 7.8^n | 7.4^t  | 7.2^r  | 7.3^v  | 7.2^a      | 5.4^q       | 5.0^e      | 7.7^l               |
|                          | H.                        | 7.7^s | 6.1^x  | 6.5^b  | 5.5^i  | 6.1^v      | 5.7^b       | 5.9^e      | 5.1^b             |
|                          | I.                        | 6.5^z | 5.3^z  | 6.2^z  | 6.4^z  | 6.7^b      | 6.6^b       | 6.3^e      | 6.3^e             |
|                          | J.                        | 5.5^v | 5.5^v  | 5.4^d  | 5.1^v  | 5.5^f      | 6.0^t       | 5.1^v      | 5.4^d               |
|                          | K.                        | 7.8^t | 8.3^q  | 7.8^p  | 7.8^q  | 7.9^o      | 7.9^o       | 7.6^l      | 7.7^l                |
|                          | L.                        | 7.9^t | 7.3^v  | 7.9^v  | 8.2^e  | 7.0^o      | 7.9^o       | 7.7^s      | 8.0^s              |
| C.D. at 5%               | 0.6                       | 0.5    | 0.3    | 0.5    | 0.3    | 0.4         | 0.3         | 0.6        |                      |

Mean in each column for different forms of vegetable cowpea followed by the different letter (a,b,c,d,e,f) are significantly different (P<0.05) and are mean of 30 observations.

A: Pusa Sukomal pods (sautèd), B: Pusa Sukomal pods (steamed), C: Pusa Sukomal shells (sautèd), D: Pusa Sukomal shells (steamed), E: Pusa Sukomal seeds (sautèd), F: Pusa Sukomal seeds (steamed), G: PVCP-20 pods (sautèd), H: PVCP-20 pods (steamed), I: PVCP-20 shells (sautèd), J: PVCP-20 shells (steamed), K: PVCP-20 seeds (sautèd), L: PVCP-20 seeds (steamed).
Mouthfeel: Mean Organoleptic score for mouth feel of different parts of cowpea prepared by different cooking method ranged from 5.0-7.96. Maximum score of 7.96 shown by sauted PusaSukomal seeds and minimum score of 5.0 was observed in sauted PVCP-20 pods.

Overall acceptability: Mean organoleptic score for the overall acceptability of different forms of vegetable cowpea prepared by different cooking method ranged from 5.03-7.72. Maximum score of 7.72 was shown by sauted PVCP-20 seeds and minimum score of 5.03 was observed in steamed PusaSukomal pods. Highest overall acceptability was seen for the forms G (sauted PVCP-20 pods), K (sauted PVCP-20 seeds) and L (Steamed PVCP-20). Lowest overall acceptability was seen for the form B (steamed PusaSukomal Pods) and H (steamed PVCP-20 pods) i.e. 5.03 and 5.08 respectively.

Analysis by using Nine point Hedonic Scale suggested that among the three different forms of vegetable cowpea, sauted PusaSukomal seeds were liked extremely by 43.33% sauted PVCP-20 seeds were liked extremely by 16.66%, while PusaSukomal shells was disliked extremely by 10% of respondents.

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CONCLUSION
The study reveals that the vegetable cowpea variety, PusaSukomal is nutritionally superior in proximate composition. PVCP-20 variety of vegetable cowpea was found to be rich in minerals. Among the different Parts of cowpea, seeds of both varieties were found to be more nutrient dense. Shells were found to be high in fiber content therefore they have a potential for being used as a fiber rich food. The cowpea varieties have high nutrient content as compared to other beans. Anti-nutrient content were equivalent to other varieties of cowpea. Sautéing was the preferred cooking technique for beans as the product was liked extremely by the sensory panel as compared to steaming. Sauted PusaSukomal seeds emerged as organoleptically superior to other forms evaluated. Both the varieties and their different forms show good potential and may be propagated for production.

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