DR-2092
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RESEARCH ARTICLE Asian Journal of Dairy and Food Research

Nutritional Analysis of Raw, Cooked and Sprouted Cowpea Genotypes

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10.18805/ajdfr.DR-2092

ABSTRACT

Background: Four cultivars of cowpea NCK-15-01, NCK-15-05, NCK-15-08 and NCK-15-09 had been chosen for analysis in experiment. The raw cowpeas have been amassed from Pulse Research Station, Navsari Agricultural University, Navsari.

Methods: After collection, samples were analysed under three exceptional processed states like raw, pressure cooking and sprouting. For the study the analysis of variance of the observed data was done using factorial complete randomized design (Factorial concept). The observations for every parameter had been taken with three repetitions. The critical difference at 5% level of the significance was worked out to compare the treatment means. Among the biochemical parameters some nutrient compositions like crude protein, albumin, globulin, prolamine, glutelin, total soluble sugar, crude fat, antioxidant activity, moisture content and crude fiber were analysed using standard methods.

Result: The existing study found that, the cultivar NCK-15-09 contained maximum amount of albumin, prolamine, crude fat, antioxidant activity and crude fiber whereas NCK-15-08 showed highest quantity of crude protein and glutelin. NCK-15-05 had highest amount of globulin and NCK-15-01 is the richest cultivar for total soluble sugar, moisture content.The genotype NCK-15-09 confirmed the highest globulin content (4.84%) in sprouting treatment. Among the different cooking methods, the pressure cooking revealed highest crude protein (23.04%), albumin (3.93%), prolamine (4.04%), glutelin (5.41%), total soluble sugar (58.12 mg/g) and moisture content (12.25%). The highest crude fiber content was determined in sprouting (3.39%).

Key words: Cowpea, Crude fibre, Crude protein, Total soluble sugar.

INTRODUCTION

Cowpea (*Vigna unguiculata* L.) belongs to family Leguminosae, other names commonly used include catjang, black-eyed bean or china pea (Taiwo, 1998). The crop is widely cultivated in Africa, Asia and America as sole or intercrop with yam, cassava, maize, sorghum, millet and rice. The crop is heat, drought and salinity tolerant. Cowpea is one of the most ancient human food sources and has been used as a crop plant since Neolithic times (Summerfield *et al.*, 1974). Cowpea originated in Central Africa and was introduced from Africa to the Indian sub-continent approximately 2000 to 3500 years ago, at the time of introduction of sorghum and millet. The slave trade from West Africa resulted in the crop reaching Southern USA in the eighteenth century. At present, cowpea is grown throughout the tropics and subtropics. In Indian context, it is a minor pulse cultivated mainly in arid and semi-arid tracts of Rajasthan, Karnataka, Kerala, Tamil Nadu, Maharashtra and Gujarat. In North India, it is grown in pockets of Punjab, Haryana, Delhi and West UP along with considerable area in Rajasthan (Kushwaha and Kumar, 2013).

Cowpea is traditionally processed in different ways and the impacts of these traditional cooking methods on the nutritional composition of cowpea were yet unknown. This work tends to investigate the effects some traditional processing methods on the nutritional composition. India, primarily a handful of conventional legumes have dominated the production and market chains and thus still playing crucial role in eradicating protein malnutrition. Some of the minor legumes like, cowpea hold great significance in the nutritional security of rural, tribal and underprivileged masses. Cowpea is one of the highly nutritious grain and vegetable pulse crop with nutraceutical values in India. Although it represents an economical source of protein, calories and B-vitamins, its consumption in the past two decades implied poverty and was associated with the low-income groups to the extent that it was regarded as the “poor man’s meat” (Asiamah, 2004). Being tolerant to drought famine and dry season, cowpea can make a significant contribution to the diet of the rural households (Magbagbeola *et al.*, 2010). Besides, in many cases these are the life-savers for millions of resource poor people in the regions where ensuring food and nutritional security is

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How to cite this article: Korant, N.P., Ramani, H.R., Narwade, A.V. and Patel, P.S. (2023). Nutritional Analysis of Raw, Cooked and Sprouted Cowpea Genotypes. Asian Journal of Dairy and Food Research. DOI: 10.18805/ajdfr.DR-2092

Submitted: 16-03-2023 **Accepted:** 03-11-2023 **Online:** 16-11-2023

one of the significant problems, particularly in traditional subsistence farming systems. By considering above facts, this experiment entitled "Nutritional Analysis of Raw, Cooked And Sprouted Cowpea Genotypes" planned with the objective of effect of cooking methods on nutritional composition of cowpeas.

MATERIALS AND METHODS

Experiment was conducted at Department of Soil Science and Agriculture chemistry, N. M. College of Agriculture, Navsari Agricultural University, Navsari during *Kharif*- 2022. Four cultivars of cowpea NCK-15-01, NCK-15-05, NCK-15-08 and NCK-15-09 had been chosen for analysis in experiment. The raw cowpeas have been amassed from Pulse Research Station, Navsari Agricultural University, Navsari. After collection, samples were analysed under three exceptional processed states like raw, pressure cooking and sprouting. For the study the analysis of variance of the observed data was done using factorial complete randomized design (Factorial concept). The observations for every parameter had been taken with three repetitions. The critical difference at 5% level of the significance was worked out to compare the treatment means. Among the biochemical parameters some nutrient compositions like crude protein, albumin, globulin, prolamine, glutelin, total soluble sugar, crude fat, antioxidant activity, moisture content and crude fiber were analysed.

Sample processing techniques

After collection, sample was taken to lab and washed properly before processing. Processing techniques such as pressure cooking, sprouting as well as raw cowpea used in the experiment. Pressure cooking treatment was performed pressure cooker. For that 100 gm seeds were soaked for 12 hr in water and then pressure cooked at 105°C for 15 min. LPG gas cylinder was used for the treatment having gas pressure 5.5 kg/m^2. Diameter of burner head was 85 mm and burner pore size was 1.7mm. For sprouting treatment, 100 gm seeds were soaked overnight in fresh water for 12 hr. On the following morning, the seeds were rinsed and water drained off. Then it was allowed to germinate in petri-plate with moistened germination paper until the sprouts were seen (16-18 hr). Raw cowpea seeds was analysed as it was.

Crude protein

Protein analysis was done by micro-Kjeldahl method as described in Sadasivam and Manickam (1992) with minor modification. Powdered sample of raw, cooked and sprouted seeds (0.5 g) was taken in a conical flask and 10 ml of H_2SO_4 was added and incubated overnight. Digestion of sample was done on hot plate. Sample was cooled at room temperature and 2.5 ml of 50% chromic acid was added. Sample was again heated until fumes produced and transferred the solution in 1000 ml volumetric flask. One molar NaOH (100 ml) was added with some amount of water. Few drops of mix indicator were added and 1000 ml volumetric flask was attached with distillation chamber on burner. On the other side distillation chambers outlet was dipped in 25 ml 4% boric acid. Distillate was collected after turning into blue colour. Distillate was titrated against $0.1NH_2SO_4$.

$$N\ (\%) = \frac{\text{Volume of acid used for complete nutralization of } NH_3 \times \text{Normality of } H_2SO_4 \times 1.4}{\text{Weight of sample (g)}}$$

$$\text{Protien } (\%) = N\ (\%) \times 6.25$$

Protein fractions: albumin, globulin, prolamine and glutelin

Protein fractions determination was done by standard method of Makeri *et al.* (2017). 100 g sample was suspended in 600 mL distilled water and extracted at room temperature (~25°C) for 2 hr and then centrifugedat 1250 rpm for 10 min to obtain albumin fractions. The supernatant was decanted and the residue extracted with 600 ml of 25 g/kg NaCl for 2 hr to yield globulin extract. Resulting residue was further extracted with 600 ml of 0.1 MNaOH (adjusted to pH 9.0), then followed with 70% ethanol extraction for 2 hr each to obtain glutelin and prolamin fractions, respectively. Prolamin was precipitated by adding threefold acetone. Precipitated proteins were washed twice with distilled water, neutralized, then stored below 4°C until analysis. True protein was quantified by Folin Lowry's method. In this, 0.5 g fresh sample was extracted in 10 ml borate buffer of pH 7.0. The extracted sample was centrifuged @ 1000 rpm for 30 minute and the supernatant was used for estimation of protein. Sample aliquot of 0.1 ml was pipetted out into two test tubes and diluted to 1 ml with distilled water. A separate tube containing 1 ml distilled water was used as blank. To this 5 ml of alkaline copper solution was added, mixed thoroughly and was allowed to stand for 10 minutes.(prepared by mixing 50 ml of 2% Na_2CO_3 in 0.01N NaOH and 1 ml 0.5% $CuSO_4.5H_2O$ in 10% potassium sodium tartrate). Then 0.5 ml of Folin-Ciocalteau reagent was added and mixed thoroughly. The tubes were kept in dark for 30 minutes for the development of colour. The absorbance was read subsequently at 660 nm and the amount of protein was estimated from standard curve prepare using standard solution of bovine serum albumin (200 µg/ml).

Total soluble sugar content

Total soluble sugar was analysed by spectrophotometer with the reaction of anthrone as described by Hedge and Hofreiter (1962). Powdered sample (100 mg) was mixed with 5 ml of 2.5N HCl in test tube and boiled over water bath at 85-90°C for 3 hours followed by cooling of the sample material. After that the sample was crushed in a mortar and centrifuged the mixture @ 5,000 rpm for 10 min. Supernatant were collected and the volume was made up to 100 ml with water. Aliquot (0.1 ml) taken in test tube and volume was made up to 1 ml with distilled water. Distilled water (1 ml) in another test tube was also taken as blank. Anthrone (4 ml) reagent (200 mg anthrone was dissolved in 100 ml of ice cold 95% H_2SO_4) was added to the tube and heated for 8 min in boiling

water bath. Then the tube was cooled and the intensity of the green colour was read at 630 nm in spectrophotometer. The amount of soluble sugar was determined from the standard curve of glucose and expressed as mg/g dry weight.

Crude fiber

Crude fiber estimation was carried out according to the method described by (Maynard, 1970). 2g of sample was extracted with ether or petroleum ether to remove fat and boil 2 g of dried sample with 200 ml of H_2SO_4 for 30 min and then filtered through muslin cloth and washed with boiling water until washing was free of acid. The residue was boiled with 200 ml of NaOH for 30 min and filtered through muslin cloth again and washed with 25 ml of boiling H_2SO_4, three 50 ml portion of water and 25 ml alcohol. The residue was removed and transfered into pre-weighed ash dish. Then the residue was dried for 2 h at 130±20°C, cooling a desiccator and weighed. Ignited for 30 min at 600±150°C then cooled in a desiccator and reweighed.

Crude fiber content was calculated by the following formula:

$$\text{Crude fiber (\%)} = \frac{(W2 - W1) \times (W3 - W1)}{\text{Weight of sample (g)}} \times 100$$

Where,
W1 = Weight (g) of residue with pre-weighed ash dish.
W2 = Weight (g) of dried residue with ash dish.
W3 = Weight (g) of ignited with ash dish.

Crude fat

Fat content was determined by using the soxhlet apparatus as described by the (Sadasivam and Manickam, 1992). Cowpea powder samples of 2 gm were weighed in a thimble and then placed it in the soxhlet apparatus. Connected a dry pre-weighed solvent flask beneath the apparatus and added the required volume of solvent (petroleum ether or ethyl ether or hexane) and connect the condenser. The heating rate was adjusted to give a condensation rate of 2-3 drops and extracted for 16 hr. The thimble was removed and the solvent along with dissolved fat was preserved. The ether from solvent flask was evaporated on the hot water bath and then the flask was dried at 105°C for 30 min. Flask was then cooled in desiccator and weigh.

Crude fat content was calculated by the following formula.

Total fat content in sample (% dry wt. basis) =

$$\frac{(b - a) \times 100}{\text{Wt. of sample (g)}}$$

Where,
a = Weight (g) of dry pre-weighed solvent flask.
b = Weight (g) of cooled solvent flask after evaporation and drying.

Antioxidant activity (DPPH)

The total antioxidant activity was determined using the 1,1-diphenyl-2-picrylhydrazyl (DPPH) free radical scavenging assay by Sombié *et al*. (2018). DPPH solution (0.004% w/v) was prepared in 95% methanol. The crude extracts of seeds were mixed with 95% methanol to prepare the stock solution (10 mg 100 ml^{-1}). The concentration of extract solution was 10 mg 100 ml^{-1}. From stock solution 2 ml, 4 ml, 6 ml, 8 ml and 10 ml of this solution were taken in five test tubes and by serial dilution with methanol and was made the final volume of each test tube up to 10 ml whose concentration was then 20 µg ml^{-1}, 40 µg ml^{-1}, 60 µg m^{-1}, 80 µg ml^{-1} and 100 µg ml^{-1} respectively. Freshly prepared DPPH solution (0.004% w/v) was added in each of these test tubes containing extract of cowpea seed sample (20 µg ml^{-1}, 40 µg ml^{-1}, 60 µg ml^{-1}, 80 µg ml^{-1} and 100 µg ml^{-1}) and after 10 min, the absorbance was taken at 517 nm using a spectrophotometer. Ascorbic acid was used as a reference standard and dissolved in distilled water to make the stock solution with the same concentration (100 µg ml^{-1}) of extract of tissues. Control sample was prepared containing the same volume without any extract and reference ascorbic acid. 95% methanol was used as blank. The means of three values were obtained, expressed as mg of ascorbic acid equivalent per 100 g of dry seeds weight (mg AAE/100 g seeds dw).

Moisture content

Moisture was determined by the method of AOAC (1965). Clean and dried empty dishes with open lid were kept at oven at 105°C for 3 hours and after that transfer to the desiccator for cooling. Weigh the empty dish and lid. Weigh about 3 g of sample to the dish and spread the sample uniformly and place the dishes in oven for drying at 105°C for 3 hours. After drying transfer the dishes with partially covered lid to the desiccator to cool. Reweigh the dishes and its dried sample.

Moisture content was analysed by the following formula.

$$\text{Moisture (\%)} = \frac{(W1 - W2)}{W1} \times 100$$

Where,
W1 = Weight (g) of sample before drying.
W2 = Weight (g) of sample after drying.

RESULTS AND DISCUSSION

The result obtained in the present investigation entitled "Nutritional analysis of raw, cooked and sprouted cowpea genotypes" experiment was carried out at the Department of Soil Science and Agricultural Chemistry, N. M. College of Agriculture, Navsari Agricultural University; Navsari, had been presented and discussed in this chapter. Samples of different genotypes of cowpea were collected from Castor and Pulse Research Station, Navsari Agricultural University, Navsari.

Crude protein (%)

The experimental outcomes showed that, the different cowpea genotypes distinct in their crude protein content. The maximum crude protein content was determined in NCK-15-08 (22.92%) whereas the lowest crude protein content

used to be found in the NCK-15-01 (21.73%) (Table 1). The highest crude protein content was found in pressure cooking (23.04%) and lowest crude protein content was found in raw genotypes (21.17%). The maximum crude protein content was found in sprouting of NCK-15-08 genotype (23.63%) whereas the lowest crude protein content was discovered in raw cowpea of NCK-15-01 genotype (20.38%). The protein content of different genotypes under different treatments did not differ significantly. In the current experiment, the pressure cooked cowpea produced the highest quantity of crude protein. The previously studies resulted improvement in sprouted cowpea proteins by Zia-ur Rehman *et al.* (2004) which matched with our result.

Albumin (%)

The highest concentration of albumin was found in the genotype NCK-15-09 (3.53%), While the lowest concentration was found in the genotype NCK-15-01 (3.11%) (Table 1). The raw cowpea had the lowest albumin concentration (2.78%) and the pressure cooking treatment had the highest albumin concentration (3.93%). The genotype NCK-15-09 showed maximum albumin content (4.21%) in pressure cooking whereas genotype NCK-15-01 showed lowest albumin content (2.53%) in raw. The pressure cooking treatment produced the highest albumin content according to the results of the current experiment. Our findings could be explained by the fact that heating increases protein solubility.

Globulin (%)

The results of the experiment indicated that, the highest globulin content was found in NCK-15-05 (4.16%) genotype andNCK-15-08 (3.88%) genotype had the lowest globulin level (Table 2). The lowest globulin content was found in raw (3.55%) and highest globulin content was found in sprouting (4.52%). The lowest globulin content was found in NCK-15-01 (3.35%) genotype in raw cowpea. The highest globulin content was found in NCK-15-09 (4.84%) genotype under sprouting treatment. The current study indicated that sprouting enhanced globulin content, which makes up a bigger fraction of legume proteins that are resistant to denaturation. The current result supports the findings of (Deol *et al.,* 2010).

Prolamine (%)

The most extreme prolamine content was found in NCK-15-09 (3.60%) genotype, whereas least prolamine content

Table 1: Effect of different processing methods on crude protein content and albumin content of cowpea genotypes.

	Crude protein content (%)				Albumin content (%)			
	Processing (P)				Processing (P)			
Genotype (G)	Raw	Pressure cooking	Sprouting	Mean (G)	Raw	Pressure cooking	Sprouting	Mean (G)
NCK-15-01	20.38	23.17	21.64	21.73	2.53	3.94	2.87	3.11
NCK-15-05	21.40	22.58	22.14	22.04	2.71	3.98	3.56	3.42
NCK-15-08	21.71	23.41	23.63	22.92	3.11	3.59	3.24	3.31
NCK-15-09	21.17	22.99	22.36	22.17	2.76	4.21	3.63	3.53
Mean (P)	21.17	23.04	22.44		2.78	3.93	3.32	
	G	**P**		**G×P**	**G**	**P**	**G×P**	
SEm ±	0.22	0.19		0.39	0.06	0.05	0.10	
CD at 5%	0.67	0.58		NS	0.17	0.15	0.31	
CV (%)		3.08				5.46		

Table 2: Effect of different processing methods on globulin content and Prolamine content of cowpea genotypes.

	Globulin content (%)				Prolamine content (%)			
	Processing (P)				Processing (P)			
Genotype (G)	Raw	Pressure cooking	Sprouting	Mean (G)	Raw	Pressure cooking	Sprouting	Mean (G)
NCK-15-01	3.35	3.91	4.49	3.92	2.93	4.04	2.65	3.20
NCK-15-05	3.75	4.11	4.63	4.16	3.49	3.84	3.14	3.49
NCK-15-08	3.65	3.88	4.13	3.88	3.13	4.31	2.76	3.40
NCK-15-09	3.44	4.17	4.84	4.15	3.62	3.98	3.20	3.60
Mean (P)	3.55	4.02	4.52		3.29	4.04	2.94	
	G	**P**		**G×P**	**G**	**P**	**G×P**	
SEm ±	0.06	0.05		0.10	0.05	0.04	0.09	
CD at 5%	0.18	0.16		0.31	0.16	0.14	0.28	
CV (%)		4.67				4.83		

was found in the genotype NCK-15-01 (3.20%) (Table 2). The maximum prolamine content was found in pressure cooking treatment (4.04%) while the lowest prolamine content was found in sprouting treatment (2.94%). The highest prolamine content was found in NCK-15-08 (4.31%) genotype under pressure cooking while the least prolamine content was found in NCK-15-01 (2.65%) genotype under sprouting. The current experiment presumed that the most noteworthy measure of prolamine was found in pressure cooking treatment, which increased because of solvency of protein part.

Glutelin (%)

The genotype NCK-15-08 (5.11 %) found maximum glutelin content. The genotype NCK-15-09 (4.08%) contained lowest glutelin content (Table 3). The most note worthy glutelin content was found in pressure cooking treatment (5.08%) while the least glutelin content was found in sprouting (3.93%) treatment. The genotype NCK-15-08 showed highest glutelin content (5.41%) in pressure cooking treatment, while the minimum glutelin content was found in NCK-15-09 (3.60%) genotype under sprouting treatment.

In present study, the pressure cooked cowpea resulted high amount of protein fraction compared to raw and sprouting.

Total soluble sugar (mg/g)

Highest total soluble sugar content was determined in NCK-15-01 (55.93mg/g) genotype. The lowest total soluble sugar content was found in NCK-15-08 (49.13 mg/g) genotype (Table 3). The maximum total soluble sugar content was found in pressure cooking (58.12 mg/g) treatment, while lowest was found in raw (46.28 mg/g). The highest total soluble sugar content was found in NCK-15-01 (61.47 mg/g) genotype in pressure cooking treatment, whereas the lowest content was found in NCK-15-08 (42.18 mg/g) genotype in raw. The total soluble sugar content of different genotypes underneath distinct cooking strategies did not vary significantly. Possible hydrolysis of starch to oligosaccharides and then mono saccharides, resulting from cooking and autoclaving, may be responsible for increased concentration of sugars in cooked cowpea. Jood *et al.* (1988) also determined comparable consequences in black gram.

Crude fat (%)

Maximum crude fat content was found in NCK-15-09 (1.67%) genotype while the lowest crude fat content was found in NCK-15-05 (1.36%) genotype (Table 4). The highest crude fat content was found in sprouting (1.74%) treatment while

Table 3: Effect of different processing methods on glutelin content and total soluble sugar of cowpea genotypes.

	Glutelin content (%)				Total soluble sugar (Mg/G)			
	Processing (P)				Processing (P)			
Genotype (G)	Raw	Pressure cooking	Sprouting	Mean (G)	Raw	Pressure cooking	Sprouting	Mean (G)
NCK-15-01	4.29	5.17	3.67	4.38	50.37	61.47	55.94	55.93
NCK-15-05	4.54	4.85	3.67	4.35	46.86	59.82	54.60	53.76
NCK-15-08	5.14	5.41	4.77	5.11	42.18	53.41	51.80	49.13
NCK-15-09	3.78	4.87	3.60	4.08	45.70	57.77	48.47	50.64
Mean (P)	4.44	5.08	3.93		46.28	58.12	52.70	
	G	**P**		**G×P**	**G**	**P**		**G×P**
SEm ±	0.07	0.06		0.12	0.79	0.69		1.38
CD at 5%	0.21	0.18		0.37	2.34	2.02		NS
CV (%)		4.98				4.13		

Table 4: Effect of different processing methods on crude fat content and Antioxidant activity of cowpea genotypes.

	Crude fat content (%)				Antioxidant activity (mg AAE/100 g)			
	Processing (P)				Processing (P)			
Genotype (G)	Raw	Pressure cooking	Sprouting	Mean (G)	Raw	Pressure cooking	Sprouting	Mean (G)
NCK-15-01	1.69	1.19	1.95	1.61	10.20	8.85	10.03	9.69
NCK-15-05	1.38	1.09	1.61	1.36	10.22	8.85	10.14	9.74
NCK-15-08	1.97	1.84	1.61	1.81	9.58	8.16	9.37	9.04
NCK-15-09	1.62	1.59	1.80	1.67	10.45	8.92	10.10	9.82
Mean (P)	1.66	1.43	1.74		10.11	8.69	9.91	
	G	**P**		**G×P**	**G**	**P**		**G×P**
SEm ±	0.02	0.02		0.04	0.13	0.11		0.22
CD at 5%	0.06	0.06		0.12	0.38	0.33		NS
CV (%)		4.37				4.10		

Table 5: Effect of different processing methods on crude fiber content and moisture of cowpea genotypes.

	Crude fiber content (%)				Moisture content (%)			
	Processing (P)				Processing (P)			
Genotype (G)	Raw	Pressure cooking	Sprouting	Mean (G)	Raw	Pressure cooking	Sprouting	Mean (G)
NCK-15-01	2.51	2.37	2.77	2.55	8.38	38.97	35.81	27.72
NCK-15-05	3.10	2.63	3.23	2.98	7.42	40.01	36.28	28.24
NCK-15-08	3.28	3.07	3.80	3.38	8.68	39.21	37.16	28.35
NCK-15-09	3.35	3.47	3.76	3.52	9.10	41.32	38.44	29.62
Mean (P)	3.06	2.88	3.39		8.39	40.13	36.92	
	G	**P**		**G×P**	**G**	**P**		**G×P**
SEm ±	0.05	0.04		0.09	0.29	0.25		0.50
CD at 5%	0.16	0.14		NS	0.85	0.74		1.48
CV (%)		5.48				3.07		

lowest was found in pressure cooking (1.43%). The maximum crude fat content was found in raw NCK-15-08 (1.97%) genotype, whereas the least content was found in NCK-15-05 (1.09%) genotype under pressure cooking treatment. In the current study's findings, there was substantial variance in the crude fat content of the genotypes of cowpea in response to various processing procedures, as Omenna *et al.* (2016) had also noted.

Antioxidant activity (mg AAE/100 gm)

The experimental results showed thatNCK-15-09 (9.82 mg AAE/100 g) genotype had the highest antioxidant activity, while the lowest antioxidant activity was found in NCK-15-08 (9.04 mg AAE/100 g) genotype (Table 4). The highest antioxidant activity was found in raw (10.11 mg AAE/100 g) cowpea genotypes, while lowest was found in pressure cooking (8.69 mg AAE/100 g). The maximum antioxidant activity was found in NCK-15-09 (10.45 mg AAE/100 g) genotype in pressure cooking treatment, whereas the least content was found in NCK-15-08 (8.16 mg AAE/100 g) genotype in raw cowpea. Under various cooking conditions, the antioxidant activity of various genotypes did not significantly change. As a result, there was a marginal decrease in the level of antioxidant activity in cowpea over the raw genotypes.

Crude fiber (%)

The genotype NCK-15-09 (3.52%) had the maximum crude fiber content, while the genotype NCK-15-09(29.06%) had lowest crude fiber content (Table 5). The highest crude fiber content was found in sprouting (3.39%), while the lowest crude fiber content was found inpressure cooking (2.88%) treatment. The maximum crude fiber was discovered in NCK-15-08 (3.80%) under sprouting treatment, whereas the lowest crude fiber content was found in NCK-15-01 (2.37%) genotype in pressure cooked cowpea. The highest crude fiber content was found in sprouting treatment. Omenna *et al.* (2016) found that sprouted cowpeas have the highest fibre content, which is comparable to our current finding.

Moisture conent (%)

The lowest mean moisture content was found in NCK-15-01 (27.72%) genotype. The highest mean moisture content was found in genotype NCK-15-09 (29.62%) (Table 5). The least moisture content was found in raw (8.39%) cowpea genotypes, while the highest moisture content was found in pressure cooking (40.13 %) treatment. The lowest moisture content was found in raw NCK-15-05 (7.42%) genotype, while the genotype NCK-15-09 had the highest moisture content (41.32%) under pressure cooking treatment. The present experiment resulted that the highest amount of moisture content was found in pressure cooking. Omenna *et al.* (2016) discovered similar results in cowpea.

CONCLUSION

Raw cowpea has the highest of antioxidant activity among the three processing methods for cowpea. Among different types of processing pressure cooking treatment gave rise the highest amount albumin protein content. It was discovered that the pressure cooking method kept a high level of prolamine, glutelin, total soluble sugar and crude protein. When compared to other processing methods, sprouting treatment was shown to be the most effective in retaining significant amounts of globulin, crude fat and crude fiber. In comparison to other cowpea genotypes, NCK-15-09 had the highest concentrations of albumin, prolamine, crude fat, antioxidant activity, moisture content and crude fiber. Cowpea genotype NCK-15-08 had the highest concentrations of crude protein and glutelin. The cowpea genotype NCK-15-01 had the greatest total soluble sugar out of the four genotypes.

In summary, pressure cooking was shown to be the best approach because it could preserve the protein, protein fractions, soluble sugar however sprouting is effective for increasing the amount of crude fiber While, cowpea genotype NCK-15-09 is best for nutritional purpose.

ACKNOWLEDGEMENT

Authors are very much thankful to Pulse Research Station for providing the cowpeas genotypes for study. Authors are

also thankful to department of Soil Science and Agriculture chemistry for providing facility for experiments.

Conflict of interest: None.

REFERENCES

AOAC, (1965). Official Methods of Analysis of the Association of Official Agricultural Chemists, 10thedn., Washington, D.C.

Asiamah, K. (2004). Cowpea, the 'poor man's meat' is now food for all. African Journal of Food Agriculture and Nutrition and Development. 4(2): 231-232.

Deol, J.K. and Bains, K. (2010). Effect of household cooking methods on nutritional and anti nutritional factors in green cowpea (*Vigna unguiculata*) pods. Journal of Food Science and Technology. 47(5): 579-81.

Hedge, J.E. and Hofreiter, B.T. (1962). Methods in Carbohydrate Chemistry. 17th Edition Academic Press, New York.

Jood, S., Chauhan, B.M. and Kapoor, A.C. (1988). Contents and digestibility of carbohydrates of chickpea and black gram as affected by domestic processing and cooking. Food Chemistry. 30: 113-127.

Kushwaha, A. and Kumar, A. (2013). A comprehensive review on physical properties, nutritional composition, culinary uses and processing of cowpea (*Vigna unguiculata* L.). International Journal of Pure Applied Bioscience. 1(5): 51-69.

Magbagbeola, J.A.O., Adetoso, J.A. and Owolabi, O.A. (2010). Neglected and underutilized species (NUS), A panacea for community focused development to poverty alleviation/ poverty reduction in Nigeria. Journal Economic and International Finance. 2(10): 208-211.

Makeri, M.U., Mohamed, S.A., Karim, R., Ramkrishnan, Y. and Muhammad, K. (2017). Fraction, physicochemical and structural characterization of winged bean seed protein fractions with reference to soybean. International Journal of Food Property. 20(52): 52220-52236.

Maynard, A.J. (1970). Methods in Food Analysis, New York, London. Academic Press, 176.

Omenna, E.C., Olanipekun, O.T. and Kolade, R.O. (2016). Effect of boiling, pressure cooking and germination on the nutritional and antinutrients content of cowpea (*Vigna unguiculata*). ISABB Journal of Food and Agriculture Sciences. 6(1): 1-8.

Sadasivam, S. and Manickam, A. (1992). In: Biochemical Methods for Agricultural Sciences, Wiley Eastern Limited, New Delhi. 33-37.

Sombié, P.A., Compaoré, M., Coulibaly, A., Ouedraogo, J., Tignegre, J. and Kiendrébéogo, M. (2018). Antioxidant and Phytochemical Studies of 31 Cowpeas [*Vigna unguiculata* (L.) Walp.] Genotypes from Burkina. Foods. 77(9): 143. doi: 10.3390/ foods7090143.

Summerfield, R.J., Huxley P.A. and Steel, W. (1974). Cowpea (*Vigna unguiculata* L.). Field Crop Abstracts. 27: 301-312.

Taiwo, K.A. (1998). The Potential of cowpea as human food in Nigeria. Technovation Journal. 18: 469-481.

Zia-ur-Rehman and Shah, W.H. (2004). Thermal heat processing effects on antinutrient, protein and starch digestibility of food legumes. Food Chemistry. 91: 327-331.