



EFFECT OF POTASH AND ONION ON THE NUTRITIONAL AND ANTI-NUTRITIONAL COMPOSITION OF COOKED BROWN-EYED COWPEA.

*¹Abdulazeez, R., ²Akhadelor, M.O., ³Danazumi, I.B. ³Aliyu, A., ¹Bayero, U. and ¹Auta, J.

¹Department of Biology, Ahmadu Bello University, Zaria, Nigeria

²Dept. of Crop Production, Federal College of Forestry Mechanisation, Afaka Kaduna

³Department of Botany, Ahmadu Bello University, Zaria, Nigeria

*Corresponding Author's Email: rashidat.int@gmail.com

ABSTRACT

An assessment on the effect of potash and onion on the nutritional and anti-nutritional composition of cooked brown-eyed cowpea was conducted using standard analytical methods. Cowpea seeds were cooked with potash, onions and a mixture of potash and onion. The nutritional composition ranged between 4.66% - 6.96% moisture, 19.69% - 21.88% crude protein, 4.77% - 5.75% lipid, 2.79 - 4.07% ash, 1.00 - 2.00% crude fibre, 64.18 - 67.81% carbohydrate, 0.30 - 0.48mg/100g thymine and 0.8 - 1.40mg/100g riboflavin. The phytate, saponin, oxalate, and tannin of anti-nutrients valued between 0.0002 - 0.0006mg/100g, 0.60 - 2.20mg/100g, 0.0062 - 0.093mg/100g and 0.033 - 0.066mg/100g respectively. This study revealed that onion increased the nutrients and decreased the anti-nutrients as opposed to potash which decreased the nutrients while increasing the anti-nutrients. Hence, the use of onions is recommended as an additive for cooking brown-eyed cowpea.

Keywords: Potash, onions, proximate composition, anti-nutrients, Brown-eyed cowpea

INTRODUCTION

Cowpea (*Vigna unguiculata* L Walp) is one of the most important high quality leguminous crops which belongs to the family *Fabaceae* and tribe Phaseole, grown in tropical and subtropical regions of the world, primarily in sub-Saharan Africa (Singh, 2003). The legumes possess health beneficial properties which include anti-hypertensive, anti-diabetic, anti-inflammatory and anti-cancer properties (Jayathilake *et al.*, 2018). It serves as a very important and cheap source of protein in Nigerian diets and a source of animal feed (Langyintuo *et al.*, 2003). Nigeria is one of the largest producer and consumer of cowpea and accounts for 61% production in Africa and 58% worldwide (IITA, 2010).

Potash is the common name for various mined and manufactured salts that contains potassium in water soluble form. The world's largest consumers of potash are China, United States, Brazil and India (Cameron, 2008). Potassium carbonate, potassium chloride in potash activates the enzymes in grains by 50% while a special case of intracellular hydrogen bonds with proteins increases its solubility in water, hence promoting their own dehydration called dehydrons (Fernandez and Scott, 2003).

Onion (*Allium cepa*) belongs to the family *Liliaceae* with flavanoid (catechin) as its main constituent. Flavanoid is a class of polyphenols which binds to protein to form protein-polyphenols complexes modified by intestinal micro-flora enzymes (Skrabanja *et al.*, 2000), allowing the derived compounds formed by ring fission to be better digested and absorbed (Fulgencio, 2007).

Cowpea seeds are sold in various Nigerian markets and take a long time to cook. The cooking time is reduced when potash is added to the water which alters the pH of the solution (Ogunmodede, 1972). Cooking of cowpea using additives such as potash and onion have been a long standing practice aimed at reducing the cooking time; but whether this has any significant effect on the nutritional and anti-nutritional composition of cowpea is not known. This research provides information on the effect of additives on the nutritional and anti-nutritional composition of brown-eyed cowpea.

MATERIALS AND METHODS

Sample collection

Samples (brown-eyed cowpea, potash and red onion) were purchased from Samaru market, Zaria (11.16114°N, 007.64710°E) in Kaduna State, Nigeria. Seeds were cleaned of debris and broken seeds



Plate I: Brown-eyed cowpea (Kananado)



Plate II: Potash (kanwa)

Sample treatments

Four 1000ml Borosilicate glass (3.3) beakers and a six-surfaced Gerhardt hot plate was used to cook the samples simultaneously. Each beaker contained 400ml of tap water and one hundred grams (100g) of cowpea seeds. To first beaker, 10g of potash was added (Sample treatment A); to the second beaker, 10g of onion was added (sample treatment B); to the third beaker, a

mixture of the additives in a ratio of 1:1 (5g of potash: 5g of onion) was added (sample treatment C) and to the fourth beaker, no additive was added (sample control D). Samples were oven dried using Gallenkamp oven until cracked. The dried cooked cowpeas were grinded using a blender to obtain homogenous mixture.



Plate III: brown-eyed cowpea after cooking and oven drying, from left to right

(Sample A-D)

Proximate analyses

The moisture content, ash, lipid, crude fibre, and protein contents were determined using the AOAC (2006) method. The percentage carbohydrate was obtained by difference, that is;

% carbohydrate = 100 – (% moisture + % crude protein + % ash + % lipids + % fibre) (Mbah *et al.*, 2012; Mathew *et al.*, 2018).

Vitamins analyses

The Thiamine and Riboflavin contents of the cooked cowpeas were analysed using the methods described by Adegbe (2009).

Determination of Riboflavin

Five grams (5g) of the sample was dissolved in 100ml of 50% ethanol solution and shaken for 1 hour on an electric shaker. The solution was filtered into a 100ml flask. Ten ml of the filtrate, 10ml of 5% potassium permanganate and 10ml of 30% H₂O₂ were pipetted into a 100ml volumetric flask, mixed by stirring and allowed to stand over a hot water bath for about 30minutes after which 2ml of 40% sodium sulphate was added. Distilled water was added to make up 50ml of the sample solution and the absorbance measured at 510nm using a spectrophotometer (Adegbe, 2009).

Determination of thiamine

In a 250ml volumetric flask, one gram (1g) of the sample was dissolved in 65ml of 0.1N HCl, and then heated on a boiling water bath for 45-60 minutes with frequent shaking. The solution was allowed to cool and made up to 100ml mark using distilled water. Ten ml of the extract was pipette into a 100ml volumetric flask and 5ml of alkaline potassium ferricyanide solution was added and mixed gently for 2-3 minutes. Two ml of H₂SO₄ was then added and cooled under running tap water. After cooling, 5ml of 10% potassium iodide solution and few crystals of zinc sulphate were added. The solution was titrated against standard thiosulphate solution. A blank titration was carried out using 10ml of water with concentrated HCl added in advance so that solution remains acidic even after addition of potassium ferricyanide solutions (Adegbe, 2009).

Anti- nutritional analyses

The phytate, tannin and oxalate contents were determined using the A.O.A.C (2006) standard methods. Determination of saponin was according to the method described by Onwuka, (2005).

Data analysis

Duplicate values of analyses were subjected to Analysis of variance (ANOVA) and where significant, least significant difference (LSD) test was used to separate the means at P<0.05 using the Statistical Package for the Social Sciences (SPSS) version 17.0 (Mbah *et al.*, 2012; Arinola and Adesina, 2014).

RESULTS AND DISCUSSION

The nutritional compositions of cooked brown-eyed cowpea using potash (A), onion (B), potash and onion (C) and control (D) are presented in Table 1. The moisture contents ranged from 4.075% (D) to 5.660% (A) which was much lower than the report of Mathew *et al.* (2018) for unfermented (18.07%) and fermented (22.78%) African custard apple seeds and the 15% moisture content required for safe storage of plant materials (Sena *et al.*, 1998). This implies that even after treatment of cowpea seeds, seeds can be air-dried and stored for a long time. The ash content was significantly higher (4.075%) in the control than that of other samples; however no significant difference was observed in the treated samples with sample B having the least ash content (2.755%). The reduction in the ash content may be an indication that the treatments facilitated the leaching of some mineral nutrients. The values were however lower than the 6.21- 6.91% of locust beans seeds reported by Aremu *et al.* (2015).

The lipid content was between the ranges of 4.775 (D) and 5.750% (B) with the treated samples having higher values which

were not significantly different from the control. This could imply that the use of additives facilitated the release of oil from the cowpea seeds. The increase in lipid content after treatments was in agreement with the study on crude fat content of raw and fermented soybean seeds (19- 23%) by Thigom and Chhetry (2011). Although no significant difference was observed for crude fibre, sample B had the highest value (2.00%) while sample D had the least (1.00%). Crude fibre in diet is known to enhance digestibility, slow down the release of glucose into blood stream, aid bowel movement, and prevent bowel cancers (Arinola and Adesina, 2014). This implies that the treatments could be used to increase the crude fibre content of cowpea seeds. The fibre values were lower to the report of Babalola and Giwa (2012) for raw and fermented soybean seeds (4.05 to 7.34%).

There was no significant difference in the crude protein content of the samples. Sample B had a higher protein (21.88%) when compared with the other treatments (19.690%). This showed that the treatments had no effect on the activity of proteolytic enzymes, therefore the increase observed in the case of sample B could be as a result of the protein content in the red onion (Bjarnadottir, 2015). The protein contents were similar to the report of Mathew *et al.* (2018) for unfermented (16.90%) and fermented (25.89%) African custard apple. The values were however higher when compared to the 15.07% protein content of *Potiskum* cowpea pottage reported by Otitoju *et al.* (2015). The carbohydrate content valued between 64.175% (B) and 67.805% (D). The use of additives decreased the carbohydrate content of cooked brown-eyed cowpea; implying that the treatments facilitated the hydrolysis of the carbohydrate and leaching of its by-product (sugar) into the cooking medium. The decrease in the carbohydrate content agrees with the report of Otitoju *et al.* (2015) who recorded a carbohydrate content of 45.68 – 54.74% to 29.00 – 36.35% in raw and four varieties of cowpea pottage respectively.

Sample C had the highest thiamine and riboflavin content of 0.480mg/100g and 1.400mg/100g respectively while sample A had the least in both thiamine and riboflavin content (0.300 mg/100g and 0.800mg/100g respectively). The significant decrease observed between sample A and sample D showed that potash destroys vitamins resulting from the increase in pH level while the significant increase in the vitamin values as observed in sample C could be due to the presence of these vitamins in onion which compensated for the increased leaching effect of the potash. The thiamine values reported in this study were lower than the 0.853 mg/100g of raw mature cowpea seeds but the riboflavin contents were higher than those of raw cowpea seeds (0.226 mg/100g) reported by the USDA, (2018).

Table 1: Effect of potash and onion on the proximate composition of cooked brown-eyed cowpea

Treatments	Moisture	Ash	Lipid	Crude fibre	Crude protein	Carbohydrate	Thiamine (mg/100g)	Riboflavin (mg/100g)
	(%)	(%)	(%)	(%)	(%)	(%)		
Potash (Sample A)	5.660 ^a ± 0.83	3.190 ^{ab} ± 0.57	5.655 ^a ± 0.36	1.250 ^a ± 0.36	19.690 ^a ± 3.10	65.805 ^a ± 2.68	0.300 ^a ± 0.28	0.800 ^b ± 0.28
Onions (Sample B)	5.445 ^a ± 0.21	2.755 ^{ab} ± 0.73	5.750 ^a ± 0.73	2.000 ^a ± 0.00	21.875 ^a ± 9.19	64.175 ^a ± 6.48	0.420 ^a ± 0.14	1.100 ^{ab} ± 0.14
Mixture (Sample C)	5.955 ^a ± 0.32	3.590 ^{ab} ± 0.06	5.335 ^a ± 0.11	1.500 ^a ± 0.71	19.690 ^a ± 3.10	65.430 ^a ± 2.83	0.480 ^a ± 0.00	1.400 ^a ± 0.06
Control (Sample D)	4.655 ^a ± 0.12	4.075 ^b ± 0.79	4.765 ^a ± 1.10	1.000 ^a ± 0.00	19.690 ^a ± 3.10	67.805 ^a ± 0.04	0.440 ^a ± 0.00	1.200 ^{ab} ± 0.23
COEF.VAR.	8.511	9.811	13.838	5.748	20.233	5.748	33.442	0.550
Standard Error	0.327	0.236	0.526	2.675	2.896	2.675	0.097	0.112

Results are mean values of duplicate determination ± standard deviation

Means with the same superscripts within column are not significantly different at (P≥0.05)

The mean values of anti-nutritional composition of cooked brown-eyed cowpea are presented in Table 2. The oxalate values ranged between 0.062 mg/100g (B) and 0.095mg/100g (A) which were lower than the report of Babalola and Giwa (2012) for fermented (1.02 mg/100g) and unfermented (1.05 mg/100g) soybeans. Oxalate is found in nature in some plants in the form of soluble and insoluble salts, which are destroyed by heat and released as oxalic acids (Agada, 2006; Ilelaboye *et al.*, 2013). The study showed that potash inhibited the destruction of oxalate which could be attributed to the increase in the pH and the significant reduction in the cooking time (unpublished data of the study). In the case of saponin, significant difference was observed with sample A having the highest value of 22.400mg/100g and sample C having the least value of 6.050mg/100g. Values of saponin obtained from this study were however lower than 0.58 - 1.67g/100g of blanched cooked vegetables reported by Ilelaboye *et al.* (2013). Saponins are anti-nutrients known to have both beneficial effects such as modifying the permeability of the small intestine which may help in the absorption of specific drugs and deleterious properties known to cause hemolysis of blood (Mbah *et al.*, 2012; Ilelaboye *et al.*, 2013).

Tannin values ranged between 0.033mg/100g (sample A) to 0.066mg/100g (samples B, C, and D). Same values were obtained between the control and two treatments indicating that the treatments had no effect on tannin except in the case of treatment A, which showed a significant reduction in the tannin

content. Tannins are known to inhibit the activities of some digestive enzymes such as trypsin and precipitate proteins in the gut; thereby making them unavailable. Processing methods such as boiling and roasting are known to reduce tannin content of various seeds (Mbah *et al.*, 2012; Ilelaboye *et al.*, 2013). This study therefore showed that only the use of potash as an additive significantly increases protein bioavailability. The tannin values were however lower to the tannin content of soybeans (0.15mg/100g) as reported by Odumodu (1992) and 0.12% - 1.15% in four varieties of cowpea pottage reported by Otitoju *et al.* (2015).

The phytate values ranged from 0.0002 mg/100g (B) to 0.0006 mg/100g (A). These were higher than the 0.04 mg/100g 4-day fermentation and 0.01 mg/100g 14-day fermentation of African oil beans as reported by Balogun (2013). Phytate chelates mineral elements and makes them metabolically unavailable (Nduagu *et al.*, 2008). The increase observed in sample A could be as a result of an increase in the pH which negatively affects the concentration gradient, hence inhibiting the leaching out of the anti-nutrient into the cooking medium. The increase could also be due to the decrease in cooking time, which is known to influence phytase activities by hydrolytic cleavage of phytate phosphorous. Summarily, the significant increase in most of the anti-nutrients in sample A could be attributed to the reduction in cooking time for the sample. The longer the cooking time the more the reduction in the anti-nutrients (Abu, 2005).

Table 3: Effect of potash and onions on the anti-nutritional composition of cooked brown-eyed cowpea

Treatments	Oxalate (mg/100g)	Saponin (mg/100g)	Tannin (mg/100g)	Phytate (mg/100g)
Potash (Sample A)	0.095 ^a ± 0.02	2.200 ^a ± 0.57	0.033 ^b ± 0.00	0.0006 ^a ± 0.02
Onion (Sample B)	0.062 ^a ± 0.01	1.500 ^{ab} ± 0.42	0.066 ^a ± 0.00	0.0002 ^a ± 0.00
Mixture (Sample C)	0.078 ^a ± 0.02	0.600 ^{ab} ± 0.28	0.066 ^a ± 0.00	0.0004 ^a ± 0.00
Control (Sample D)	0.067 ^a ± 0.00	1.000 ^b ± 0.42	0.066 ^a ± 0.00	0.0004 ^a ± 0.00
Coeff. Var.	22.225	32.897	0.000	48.990
Standard Error	0.077	0.000	0.000	0.000

Results are mean values of duplicate determination ± standard deviation
Means with the same superscripts within column are not significantly different at (P≥0.05)

CONCLUSION

Nutritional and anti-nutritional contents of cooked brown-eyed cowpea were affected by the use of additives. The use of onion improved the bioavailability of most of the nutrients except in ash and carbohydrate, while the use of potash significantly increased most of the anti-nutrients and decreased most of the nutrients. From the study, the use of onion as additive in the cooking of cowpeas is highly recommended.

ACKNOWLEDGEMENT

We are thankful to Prof. I.H. Nock for his valuable contributions to the success of this work.

REFERENCES

Abu, E.A. (2005). Comparative study of the effect of natural fermentation on some biochemical and anti-nutrient composition of soya bean (*Glycine max*) and locust bean (*Parkia filicoidia*). *Journal of Tropical Biosciences*.1:6-11

A.O.A.C. (2006). Official Methods of the Association of Official and Analytical Chemists. Gaithersburg, MD, U.S.A 18th edition. pp. 1-70.

Adegbe, E. (2009). An Assessment of the nutrient and anti-nutrients values of ten IAR varieties of cowpea. Unpublished Postgraduate Diploma Thesis, Food Science Technology, IAR, A.B.U., Zaria 41 pp.

Agada, O. (2006). Nutrient and Anti-nutritional contents of raw and boiled Seeds of *Terminalia catappa* Lin. Unpublished B.Sc. project, Department of Biology. A.B.U., Zaria. 51pp.

Aremu, M.O., Awala, E.Y., Opaluwa, O.D. Odoh, R. and Bamidele, T.O. (2015). Effect of processing on nutritional composition of African locust bean (*Parkia biglobosa*) and mesquite bean (*Prosopis africana*) seeds. *Communications in Applied Sciences*, 3(1): 22-41

Arinola, S.O. and Adesina, K. (2014). Effect of Thermal Processing on the Nutritional, Antinutritional, and Antioxidant Properties of *Tetracarpidium conophorum* (African Walnut). *Journal of Food Processing*, 2014: Article ID 418380. <http://dx.doi.org/10.1155/2014/418380>

Babalola, R.O. and Giwa, O.E. (2012). Effect of fermentation on nutritional and anti-nutritional properties of fermenting soybeans and the antagonistic effect of the fermenting organism on the selected pathogens. *International Research Journal of Microbiology*, 3(10): 333- 338

Balogun, B.I. (2013). Evaluation of the nutritional potentials of fermented oil beans seed *Pentaclethra macrophyllah* Benth. *PAT Nsuka Journal*, 9(2): 73- 87

Bjarnadottir, A. (2015). Onions 101: Nutritional Facts and Nutrients. <https://www.healthline.com/nutrition/foods/onions#section7>. Retrieved April 1, 2019

- Cameron, F. (2008). Potash: The New Goldrush. <http://www.reporttonbusiness.com/servlet>
- Fernandez, A. and Scott, R. (2003). Dehydron: a structurally encoded signal for protein interaction. *Biophysical journal*, 85:1914-1928.
- Fulgencio, S. (2007). Intake and bioassessibility of total polyphenols in a whole diet. *Public health*, 101:492-501.
- Ilelaboye N.O.A., Amoo I. A. and Pikuda O. O. (2013). Effect of cooking methods on mineral and anti-nutrient composition of some green leafy vegetables. *Archives of Applied Science Research*, 5 (3):254-260
- International Institute of Tropical Agriculture (2010). Research to nourish Africa-cowpea. www.iita.org/crops/cowpea/ retrieved February 12, 2019
- Jayathilake, C., Visvanathan, R., Deen, A. and Bangamuwage, R. (2018). Cowpea: an overview on its nutritional facts and health benefits: nutritional and health properties of cowpea. *Journal of the Science of Food and Agriculture*, 98 (13): 4793-4806. Doi:10.1002/jsfa.9074
- Langyintuo, A.S., Lowenberg-DeBoer, J., Faye, M., Lambert, D. and Ibro, G. (2003). Cowpea Supply and Demand in West and Central Africa. *Field Crops Res.*, 82: 215- 231
- Mathew, J.T., Dauda, B.E.N., Mann, A., Ndamitso, M.M., Etsuyankpa, M.B. and Shaba, E.Y. (2018). Assessment of the nutritive and anti-nutritive compositions of fermented and unfermented African custard apple (*Annona senegalensis*) seeds from Niger state, Nigeria. *FUW Trends in Science & Technology Journal*, 3(2a): 471- 477
- Mbah, B.O., Eme, P.E. and Ogbusu, O.F. (2012). Effect of Cooking Methods (Boiling and Roasting) on Nutrients and Anti-nutrients Content of Moringa oleifera Seeds. *Pakistan Journal of Nutrition*, 11 (3): 211-215
- Odumodu, C.U. (1992). Antinutrients content of some locally available legumes and cereals in Nigeria. *Tropical Geographical Medicine*, 44(3): 260-263
- Ogunmodede, B.K. (1972). Losses of protein and B –vitamins in grains during traditional Nigerian processing. *Nigerian Journal of Science*, 6(1):23-28.
- Onwuka, G.L. (2005). *Food analysis and instrumentation theory and practice*. Naphthali Publishers LTD, Surulere Lagos, 190pp.
- Otitoju, G.TO., Otitoju, O., Nwamarah, J.U. and Baiyeri, S.O. (2015). Comparative Study of the Nutrient Composition of Four Varieties of Cowpea (*vigna unguiculata*) and Their Products (Beans-Based Products). *Pakistan Journal of Nutrition*, 14: 540-546. Doi: 10.3923/pjn.2015.540.546
- Sena, L.P., Vandejagt, D.J. and Rivera, C. (1998). Determination of percentage moisture in plant food materials. *Journal of plant foods for human nutrition*. 52(1): 17-30.
- Singh, B. B. (2003). Improving the production and utilization of cowpea as food and fodder. *Field crops Research*, 84:150-169.
- Skrabanja. V., Nygaard, L.H and Kreft, I. (2000). Protein-polyphenol interactions and in vivo digestibility of Buckwheat groat proteins. *Journal of Public Medicine*, 440(5) :29 -31.
- Thingom, P and Chhetry, G.KN. (2011). Nutritional analysis of fermented soybean (*Hawaijar*). *Assam University Journal of Science & Technology*, 7(1): 96- 100
- United States Department of Agriculture (2018). Cowpeas (*Vigna unguiculata*), raw, mature seeds, nutritive value per 100g. <https://ndb.nal.usda.gov/ndb/show>. Retrieved February 12, 2019.