Websites:
http://www.sciencepub.net/nature
http://www.sciencepub.net

Emails:
naturesciencej@gmail.com
editor@sciencepub.net

Nature and Science

MARSLAND PRESS
Multidisciplinary Academic Journal Publisher

Phytochemical And Amino Acid Profiling Of Different Cowpea Varieties

Sunmonu[1], B.A., Salawudeen[1], J.R., Akinsola[2], A.O., Muhammad[3], L.B., Taiwooshin[2], M.A. & Segilola[2], V.O.

[1]Department of Food Technology, Federal Polytechnic Offa, Kwara state, Nigeria
[2]Department of Home Economics, Federal College of Education (Special), Oyo, Oyo State, Nigeria.
[3]Department of Biochemical/ Chemical Science, Federal Polytechnic Offa, Kwara state, Nigeria
Corresponding author: akinsola4gold@gmail.com

Abstract: Phytochemical and amino acid profile of different cowpea varieties were studied. The cowpea varieties were coded as sample BWB (Big white cowpea), sample SWB (Small white cowpea), sample OBN ("Oyin" (sweet) cowpea) and sample DBN (Drum cowpea). Antinutritional factors and amino acid profile of the cowpea varieties were evaluated using standard procedures. The phytochemical properties of the cowpea varieties indicated that flavonoid ranged from 4.41–5.70 mg/100g, saponin from 0.10-0.59 mg/100g, tannin from 0.25–1.10 mg/100g, phytate from 4.33-10.42 mg/100g, polyphenol from 0.36-0.54 mg/100g and trypsin inhibitor from 6.47-18.90 mg/100g, respectively. The essential amino acids result showed that leucine ranged from 6.68–8.12 g/100g, lysine from 3.04–7.16 g/100g, isoleucine from 3.74-6.29 g/100g, phenylalanine 3.91–6.33 g/100 g, arginine 3.82–6.21 g/100g, valine 3.82–6.02 g/100g, methionine 0.91–1.94 g/100g, histidine 2.15–4.23 g/100g, threonine from 2.92-4.92 g/100g, respectively. Threonine not detected in sample DBN. Non-essential amino acids results of the cowpea revealed that glycine varied from 2.87-5.22 g/100g, serine from 3.04-8.13 g/100 g, aspartic acid 4.61–13.45 g/100 g, glutamic acid 2.86–5.88 g/100g, alanine from 3.21-5.19 g/100g, cysteine from 0.45-1.15 g/100 g, tyrosine from 3.31-3.69 g/100g and proline from 2.45-6.45 g/100g, respectively. The study result showed that total amino acid of the cowpea samples values ranged from 54.88-93.77, total essential amino acids from 31.84-51.13% and total non-essential amino acids 23.04–45.36 %, respectively. The results showed that antinutritional factors were lowest in BWB sample while essential, non-essential and total essential amino acids were abundant in SWB sample.

[Sunmonu, B.A., Salawudeen, J.R., Akinsola, A.O., Muhammad, L.B., Taiwooshin, M.A. & Segilola, V.O. **Phytochemical And Amino Acid Profiling Of Different Cowpea Varieties.** *Nat Sci* 2025,23(4):16-25]. ISSN 1545-0740 (print); ISSN 2375-7167 (online). http://www.sciencepub.net/nature 02. doi:10.7537/marsnsj230425.02

Keywords: Amino acids profile; antinutritional factor; cowpea varieties; phytochemical; standard procedures

Introduction

Cowpea (*vigna ungucuilata*) is probably the most popular legume in West Africa unlike other legumes such as soybean and groundnut which are oil-protein seeds, cowpeas are starch-protein seeds offering a wide pattern of utilization than any other legume which contribute toward its functionality (Darfour *et al.*, 2012). In Nigeria, cowpea seeds are boiled with condiments and eaten alone with stew or in combinations with cereal grains or as a stemming (*moin-moin*, *ekuru*.) delicacy beany soup and fried cowpea cakes (*akara*). Awoyinka et al. (2016) emphasized that all parts of cowpea plant used as food are nutritious providing protein and vitamins, immature pods and peas are used as vegetables while several snacks and main dishes are prepared from the grains. The mineral contents of cowpea such as calcium and iron are higher than that of meat, fish and egg

Cowpea (*Vigna unguiculata* L) seed color is diverse and varies from white, cream to red to black to mottle and could be consumed as boiled vegetables using fresh or rehydrated seeds or processed into flour to make other food products. However, major limiting factors to the utilization of protein quality include beany flavour, poor digestibility, deficiency of sulphur amino acids and presence of anti-nutritional factors such as trypsin inhibitors, oligosaccharides and phenolic compounds (Elhardallou *et al.*, 2015). Cowpea has also been reported to contain essential amino acids including histidine, cysteine, methionine, isoleucine, leucine, threonine, lysine and tryptophan; thus, it has been considered as a complete food (Jayathilake *et al.*, 2018). Cowpeas are also good sources of fibre, iron, zinc, and contain substantial amounts of bioactive compounds (Adjei-Fremah *et al.*, 2019). Therefore, research efforts have been made towards promotion of cowpea utilization as a high-quality protein constituent of the daily diet among economically depressed communities in developing countries such as Nigeria, with the aim of reducing the high prevalence of protein and energy malnutrition (Elhardallou *et al.*, 2015). However, little attention has been paid to the possible quantitative and qualitative alterations of the essential nutrients such as amino acids and its phytochemical properties. Thus, this study was aims to analyze four varieties of cowpea with respect to their amino acid and phytochemical properties of the whole seeds.

Materials and methods

Source of materials

Four varieties of cowpea grains (both big and small white seed bean, drum bean and honey bean) were purchased from Owode Market in Offa Local Government Area of Kwara State and transported immediately to the Food Processing Laboratory, Department of Food Technology, Federal Polytechnic Offa, Kwara State, Nigeria.

Preparation of coarsely milled cowpea

Different cowpea varieties were sorted and coarsely milled using traditional mortar and pestle. The coarsely milled cowpea of different varieties was packaged in airtight containers for further analysis.

Methods

Determination of phytochemical property of the cowpea varieties flour samples

Phytate, saponins, tannins and trypsin inhibitor contents in the cowpea varieties flour samples were determined as described by Nwosu et al. (2013) while trypsin inhibitor of the composite flour was determined as described by the method of Famakin et al. (2016). Polyphenol and flavonoid substances were estimated by Folin-Denis method as modified by Nwosu (2013).

Amino acids determination

About 2.5 g of each sample were weighed into the extraction thimble and fat was extracted with a chloroform/methanol (2:1 v/v) mixture using a Soxhlet apparatus (AOAC, 2005). The extraction lasted for 5 – 6 hr. The amino acid analysis was by the High Performance Liquid Chromatography (HPLC) specifically using the TSM (Technicon Sequential Multisample) Amino Acid Analyser (Technicon Instruments Corporation, New York). The period of analysis was 76 min for each sample. The gas flow rate was 0.50 mL/min at 60 ºC with reproducibility consistent within ±3 %. The net height of each peak produced by the chart recorder of the TSM (each representing an amino acid) was measured and calculated. The amino acid values reported were the averages of two determinations. Norleucine was the internal standard.

Statistical Analysis

A one-way analysis of variance and Duncan's test were used to establish the significance of differences among the mean values at the 0.05 significance level. Results were expressed as mean of triplicate analyses. The statistical analyses were performed using SPSS software (Systat statistical program version 21, SPSS Inc., USA).

Results and discussions

Results

Phytochemical property of the different cowpea flour samples

Table 1 presents the results for the phytochemical composition of different cowpea varieties flour samples. Phytochemical have been considered to be of crucial nutritional importance in preventing chronic diseases such as cancer, cardiovascular diseases and diabetes (Aruoma, 2003). The flavonoid contents of the cowpea samples ranged from 4.41 – 5.70 mg/100g with sample OBN ("oyin" cowpea) having the highest flavonoid (5.70 mg/100g) while the least value for flavonoid (4.41 mg/100g) was observed in sample BWB (big white cowpea). Significant differences ($p < .05$) were observed between the flavonoid contents of the cowpea sample. The flavonoid contents of the cowpea varieties are higher than 0.46 – 0.71 mg/100g for different cowpea seeds studied by Joy *et al.* (2021), 0.212 – 0.232 mg/100g reported for flavonoid contents of six different African yam bean varieties by Chikaodiri *et al.* (2017) and 1.21 – 4.81 mg/100greported for flavonoid contents of five legume seeds (soybean, red bean, black bean, lentil and chickpea) studied by Khatun and Kim (2021). Nutritionally, flavonoid is considered as an anti-nutrient as its polyphenol structure is a metal chelator therefore capable of binding iron and facilitating its removal from the body (Sood *et al.*, 2012).

The saponin contents of the cowpea samples had significant variation ($p<0.05$) with values varying from 0.10 to 0.59 mg/100g. The highest saponin content (0.59 mg/100g) was observed in sample SWB (small white cowpea) while the least saponin content (0.10 mg/100g) was observed in sample OBN ("oyin" cowpea). Saponin was not detected (ND) in the big white cowpea variety (BWB) sample. The values reported in the current study are lower than that of 1.13 – 1.14 mg100g reported for saponin contents of different cowpea varieties studied by Joy *et al.* (2021), 0.09 – 1.22 mg/100g reported for saponin contents of some selected wild and edible bean in Nigeria studied by Awoyinka *et al.* (2015) but higher than 0.128 – 0.146 mg/100g reported for six different sample seeds of African yam bean researched by Chikaodiri *et al.* (2017). Varietal differences could have resulted in differences in saponin contents of the different cited literatures and those in the current study.

Tannin content of the different cowpea varieties ranged from 0.25 – 1.10 mg/100g with sample DBN (Drum cowpea) having the highest tannin content (1.10 mg/100g) while the least value for tannin (0.25 mg/100g) was observed in sample BWB (Big white cowpea). Significant variation ($p<0.05$) was observed between the tannin contents of the different cowpea varieties. The findings of the current work are higher than 0.011 – 0.014 mg/100g reported for tannin contents of two cowpea varieties studied by Joy *et al.* (2021), 0.005 – 0.008 % reported for tannin contents different varieties of African yam bean by Okorie (2018) and 0.00 – 2.23 % for processed and 0.66–3.88 % unprocessed African yam bean flour studied by Adegboyega *et al.* (2020).Tannins is one of the polyphenolic compounds that chelate with proteins, starches and digestive enzymes to form complexes compounds thereby reducing the nutritional value of foods if eaten in large content.

The mean values for phytate contents of the different cowpea varieties ranged from 4.33 to 10.42 mg/100g. Significant differences ($p<0.05$) were observed between the phytate contents of the cowpea sample Sample SWB (small white cowpea) had the highest phytate content (10.68 mg/100g) while the least value for phytate (4.33 mg/100g) was observed in the big white cowpea variety (sample BWB). The values reported in the current study are higher than 0.215 – 0.314 mg/100g reported for phytate contents of different African yam bean varieties researched by Chikaodiri *et al.* (2017). Contrarily, the findings of Awoyinka *et al.* (2016) for phytate contents 2.98 – 6.41 mg/100gof some selected wild and edible in Nigeria are higher than the result of the current study. The study polyphenol contents of the different cowpea varieties had significant differences ($p<0.05$) ranged from 0.36 - 0.54 mg/100g. Sample DBN (Drum cowpea) had the highest polyphenol content (0.54 mg/100g) while the least polyphenol content (0.36 mg/100g) was observed in sample SWB (small white cowpea). Polyphenol was not detected (ND) in sample BWB (Big white cowpea). The report of the current study are lower than 17.0 – 21.9 mg/g reported for polyphenol contents of selected legumes (soybean, red bean, black bean, lentil and chickpea) reported by Khatun and Kim (2021) but slightly in agreement with 1.2 mg/g for polyphenol contents of soybean researched by Sharma *et al.* (2014).

The mean values for trypsin inhibitor of the cowpea samples were of range 6.47 - 18.90 mg/100g with sample SWB (small white cowpea) significantly ($p<0.05$) having the highest trypsin inhibitor (18.90 mg/100g) while the least value for trypsin inhibitor (6.47 mg/100g) was observed in sample BWB (big white cowpea). There were significant variations ($p<0.05$) between trypsin inhibitors of the cowpea samples. The report of the current study are higher than 0.69 – 0.98 mg/l reported for four varieties of African yam bean studied by Okorie (2018), 0.0023 g/kg reported for trypsin inhibitor of soy cake flour by Ari *et al.* (2012). The trypsin contents of the different cowpea varieties in the current study are lower than 2.50 g/kg reported for permissible level of trypsin contents in food for human consumption (Nwosu et al., 2013). Trypsin inhibitor is a protein that interferes with protein nutrient absorption by reducing the activity of proteolytic enzymes (trypsin and chymotrypsin). The amount and activity of trypsin inhibitor in the diet have been shown to be inversely related to the availability of energy and protein (Krogdahl *et al.*, 2005).

Table.1: Phytochemical property of the different cowpea flour samples

Phytochemical (mg/100g)	Sample BWB	Sample SWB	Sample OBN	Sample DBN
Flavonoids	4.82 ± 0.01^{c}	5.40 ± 0.01^{b}	5.70 ± 0.01^{a}	4.41 ± 0.01^{d}
Saponins	ND	0.59 ± 0.01^{a}	0.10 ± 0.01^{c}	0.41 ± 0.01^{b}
Tannin	0.25 ± 0.01^{d}	0.44 ± 0.01^{c}	1.10 ± 0.01^{a}	0.96 ± 0.01^{b}
Phytate	4.33 ± 0.01^{d}	10.42 ± 0.01^{a}	9.11 ± 0.01^{b}	4.63 ± 0.01^{c}
Polyphenol	ND	0.36 ± 0.01^{c}	0.40 ± 0.01^{b}	0.54 ± 0.01^{a}
Trypsin Inhibitors	6.47 ± 0.01^{d}	18.90 ± 0.01^{a}	6.87 ± 0.01^{c}	7.58 ± 0.01^{b}

Values are mean ± standard deviation. Values with different superscripts along the same row are significantly different
at $p< 0.05$. Sample BWB = Big white cowpea, Sample SWB = Small white cowpea, Sample OBN = “Oyin” cowpea, Sample DBN = Drum cowpea.

Essential amino acids result of cowpea samples

The essential amino acids result of different cowpea varieties are as indicated in Table 2. The study result shows that leucine contents of the cowpea varieties ranged from 6.68 – 8.12 g/100g with sample SWB (small white cowpea) having the highest value for leucine (8.12 g/100g) while the lowest leucine value (6.68 g/100g) was observed in sample BWB (big white cowpea). Significant differences ($p<0.05$) were observed between the leucine contents of the cowpea varieties. The leucine contents of the cowpea varieties conform to with 6.34 – 8.37 g/100g reported for leucine contents of *masa* produced from maize, acha and soybean studied by Malomo and Abiose (2019), slightly in agreement with 6.01 – 7.26 g/100g protein reported for leucine contents of cowpea varieties by Celestine *et al.* (2015) but higher than 0.72 – 3.40 mg/100g reported for leucine content of wheat-velvet bean flour biscuit by Ezegbe *et al.* (2023). Lysine content of the cowpea varieties ranged from 3.04 – 7.16 g/100g with sample SWB being the highest in lysine (7.16 g/100g) while the least value for lysine (3.04 g/100g) was observed in sample BWB (big white cowpea). There were significant variations at 95 % confidence level between the lysine contents of sample BWB (big white cowpea), SWB (small white cowpea) and sample OBN ("oyin" cowpea) respectively. Cowpea has been reported to contain lysine, a supplement that is moderately lacking in most stable weight control plans and this makes them a decent supplement to maize, rice, vegetables, banana, cassava or potatoes to give a fair eating routine (Joy *et al.*, 2021).The values reported in this study are in line with 6.64 – 7.59 g/100g reported for lysine contents of different cowpea varieties by Celestine *et al.* (2015), 2.38 – 6.69 mg/100 g reported for lysine contents of wheat-velvet bean composition flour biscuit studied by Ezegbe *et al.* (2023) but lower than 15.78 – 22.99 g/16 g reported for cowpea protein isolates by Elhardallou *et al.*(2015).

Isoleucine content of the cowpea varieties varied from 3.74 - 6.29 g/100g with sample SWB (small white cowpea) having the highest value for isoleucine (6.29 g/100g) while the lowest isoleucine (3.74 g/100g) was observed in sample BWB (big white cowpea). Significant differences ($p<0.05$) were observed between the isoleucine contents of the cowpea samples. The values are higher than the findings of Harmankaya *et al.* (2016) whose study reported3.07 – 3.76 g/100g for isoleucine contents of varieties of cowpea and 2.19 – 3.87 g/100g reported for isoleucine contents of maize-acha-soybean flour masa studied by Malomo and Abiose (2019). Isoleucine is required for children's optimum growth and maintenance of nitrogen balance in adults (Kamble *et al.*, 2021). The findings of the current study are higher than 2.8 g/100g reported for recommended dietary intake for isoleucine by FAO/WHO/UNU (1985) cited by Malomo and Abiose (2019). Its phenylalanine content ranged from 3.91 – 6.33 g/100g with sample SWB (small white cowpea) having the highest value (6.33 g/100g) while the lowest value for phenylalanine (3.91 g/100g) was observed in sample OBN ("oyin" cowpea). Significant differences ($p<0.05$) were observed between the phenylalanine contents of the cowpea varieties. The results are in line with 2.73 – 5.48 g/100g reported for phenylalanine contents of maize-acha-soybean *masa* by Malomo and Abiose (2019) and contrary to the values (11.96 – 12.47 g/16N) reported for phenylalanine contents of cowpea protein isolates researched by Elhardallou *et al.* (2015). Phenylalanine has been reported to be viable for treatment of depression, Parkinson's illness, multiple sclerosis, pain, acupuncture anesthesia, and osteoarthritis (Kamble *et al.*, 2021).

The mean values for arginine content of the cowpea varieties varied between 3.82 – 6.21 g/100g with drum cowpea variety (sample DBN) being the highest in arginine (6.21 g/100g) while the least value for arginine (3.82 g/100g) was observed in big white cowpea variety (sample BWB). Significant differences ($p<0.05$) were observed between the arginine contents of the cowpea varieties. The arginine contents of the cowpea varieties are slightly in line with 5.29 – 8.3 mg reported for arginine contents of selected legumes (soybean, peas, chickpea and white bean) studied by Kefale *et al.* (2022), 2.09 – 4.19g/100g for arginine contents of different cowpea varieties researched by Hermankaya *et al.* (2016) and 4.92 – 5.70 g/100g reported for arginine contents of different cowpea varieties by Celestine *et al.* (2015). The amino acid values reported were the averages of three determinations. Valine content of the cowpea varieties ranged from 3.82 – 6.02 g/100g with small white cowpea variety (sample SWB) having the highest value for valine (6.02 g/100g) while the least value (3.82 g/100g) was observed in the big white cowpea variety (sample BWB). Significant differences ($p<0.05$) were observed between the valine contents of the cowpea varieties. The report of the current study are higher than 0.35 – 1.35 g/100g protein for valine contents of cowpea-sorghum-millet flour blends studied by Bagirei *et al.* (2022) but slightly in line with 3.49 – 4.86 g/100 protein reported for valine contents of acha-soybean-maize *masa* researched by Malomo and Abiose (2019) and 2.44 – 4.65 g/100g protein reported for biscuit from wheat-velvet bean composite flour by Ezegbe *et al.* (2023).

Methionine is used to prevent and cure a variety of ailments, including depression, inflammation, liver illness and muscle discomfort (Kamble *et al.*, 2021). Methionine values of the cowpea varieties ranged from 0.91 – 1.94 g/100g. The highest value for methionine (1.94 g/100g) was observed significantly (p<0.05) in big white cowpea variety (sample BWB) while small white cowpea variety (sample SWB) had the least value (1.94 g/100g). The findings of the current work are lower than 27.22 – 30.60 g/16gN reported for methionine contents of cowpea protein isolates studied by Elhardallou *et al.* (2015), slightly in line with 1.25 – 3.64 g/100g reported for methionine contents of cowpea-sorghum-millet flour blends researched by Bagirei *et al.* (2022) and 1.23 – 4.68 mg/100g reported for methionine contents of biscuits from wheat-velvet bean composite flour blends studied by Ezegbe *et al.* (2023). Histidine content of the cowpea varieties varied from 2.15–4.23 g/100g with drum cowpea variety (sample DBN) having the highest histidine (4.23 g/100g) while the least value for histidine (2.15 g/100g) was observed in the big white cowpea variety (sample BWB). Significant differences (p<0.05) were observed between the histidine contents of other cowpea varieties. The values are higher than 8.18 – 31.7 mg/kg reported for histidine contents of lupine, egg and meat by Kefale *et al.* (2022), 0.63 – 1.19 g/100g protein for histidine contents of cowpea-sorghum-millet flour blends reported by Bagirei *et al.* (2022) and 1.74 –2.94 g/100g of reported for histidine contents of masa from maize-acha-soybean researched by Malomo and Abiose (2019). The findings of the current work are also higher than the Food and Agricultural Organization (FAO) standard 1.9 g/100g for histidine content but slightly in conformity with histidine content 2.40 g/100 g of egg protein (Malomo & Abiose, 2019).

The threonine content of the cowpea varieties ranged from 2.92 - 4.92 g/100g with small white cowpea variety (sample SWB) significantly being the highest in threonine (4.92 g/100g) while the least value for threonine (2.92 g/100g) was observed in “oyin” cowpea variety (sample OBN). Threonine was not detected (ND) in the drum cowpea variety (DBN). The values are higher than the findings of Kefale *et al.* (2022) whose study reported 12.41 – 34 mg/kg for threonine contents of lupine, egg and meat but in conformity with FAO standard 3.40 g/100 g for threonine contents in foods (Malomo & Abiose, 2019) and 4.18 – 7.18 g/1gN reported for threonine contents of cowpea protein isolates studied by Elhardallou *et al.* (2015).

Table 2: Essential amino acids result of cowpea samples

Essential Amino Acids (g/100g)	Sample BWB	Sample SWB	Sample OBN	Sample DBN
Leucine	6.68±0.01^{d}	8.12±0.01^{a}	7.76±0.01^{b}	7.29±0.01^{c}
Lysine	3.04±0.01^{d}	7.16±0.01^{a}	6.52±0.01^{b}	6.10±0.01^{c}
Isoleucine	3.74±0.01^{d}	6.29±0.01^{a}	4.27±0.01^{c}	5.33±0.01^{b}
Phenylalanine	3.99±0.01^{d}	6.33±0.01^{a}	3.91±0.01^{c}	4.98±0.01^{b}
Arginine	3.82±0.01^{d}	6.02±0.01^{b}	5.92±0.01^{c}	6.21±0.01^{a}
Valine	3.25±0.01^{d}	7.15±0.01^{a}	4.49±0.01^{c}	5.08±0.01^{b}
Methionine	1.94±0.01^{a}	0.91±0.01^{d}	1.39±0.01^{c}	1.67±0.01^{b}
Histidine	2.15±0.01^{d}	4.23±0.01^{a}	3.21±0.01^{c}	3.79±0.01^{b}
Threonine	3.22±0.01^{b}	4.92±0.01^{a}	2.92±0.01^{c}	ND

Values are mean ± standard deviation. Values with different superscripts along the same row are significantly different at p < 0.05. Sample BWB = Big white cowpea, Sample SWB = Small white cowpea, Sample OBN = “Oyin” cowpea, Sample DBN = Drum cowpea.

Non-Essential amino acids result of cowpea samples

The result for the non-essential amino acids in the different cowpea varieties are as indicated in Table 3. Glycine content of the different cowpea varieties varied from 2.87 - 5.22 g/100g with small white cowpea variety (sample SWB) having the highest glycine (5.22 g/100g) while the least value (2.87 g/100g) was observed significantly (p<0.05) in big white cowpea variety (sample BWB). The results are within 4.34 – 4.80 g/100 g protein reported for glycine contents of maize-acha-soybean masa studied by Malomo and Abiose (2019), 0.21 – 3.47 mg/100g reported for glycine contents of wheat-velvet bean composite flour biscuit researched by Ezegbe *et al.* (2023) and the findings of Celestine *et al.* (2015) whose study reported 2.97 – 3.42 g/100g for glycine contents of different cowpea varieties. The mean result for serine content of the cowpea varieties ranged from 3.04 - 8.13 g/100g. Drum cowpea variety (sample DBN) had the highest serine content (8.13 g/100g) while the least value for serine (3.04 g/100g) was observed in big white cowpea variety (sample BWB). Significant differences (p<0.05) were observed between the serine contents of the cowpea varieties. The values are in higher than 3.12 – 3.39 g/100 reported for serine contents of the cowpea varieties studied by Celestine *et al.* (2015) but slightly in line with 4.15 – 4.75 g/100g reported for serine contents of three cowpea genotypes researched by Hermankaya *et al.* (2016) and 4.13 – 5.56 mg/kg for serine contents of soybean, peas, chickpea and white bean reviewed by Kefale *et al.* (2022).

Aspartic acid is occasionally used to treat stress and exhaustion. It aids in the generation of energy from carbohydrates as well as the manufacturing of RNA and DNA (Kamble *et al.*, 2021).The aspartic acid of the different cowpea varieties varied from 4.61 – 13.45 g/100g with drum cowpea variety (sample DBN) having the highest aspartic acid content (13.45 g/100g) while the least value for aspartic acid (4.61 g/100g) was observed in big white cowpea variety (sample BWB). There were significant variations ($p<0.05$) between the aspartic acid contents of the different cowpea varieties. High aspartic acid observed in sample DBN is a pointer to high aspartic acid being a predominant amino acid in cowpea (Vasconcelos *et al.*, 2010). The values 12.69 – 14.04 g/100 g reported for aspartic acid of three cowpea genotypes studied by Hermankaya *et al.* (2016) are in line with the report of this study. The glutamic content of the different cowpea varieties were of range 2.86 – 5.88 g/100g. The highest value for glutamic content (5.88 g/100g) was observed significantly ($p<0.05$) in small white cowpea variety (SWB) while the least glutamic content (2.86 g/100g) was observed in the big white cowpea variety (sample BWB). Significant variation ($p<0.05$) was observed between the glutamic contents of the cowpea varieties. The values are lower than 168.6 – 196.7 g/kg reported for glutamic acid of three cowpea varieties studied by Vasconcelos *et al.* (2010) and 20.06 – 22.53 g/100g for glutamate contents of maize-acha-soybean *masa* researched by Malomo and Abiose (2019) but in line with 3.32 g/16N reported for glutamic acid of defatted cowpea flour by Elhardallou *et al.* (2015). Glutamic acid serves as a source of energy for the brain. Its improves brain clarity, mental alertness and mood. As a result, it's utilized treat Parkinson's, fatigue and schizophrenia (Kamble et al., 2021).

The mean result for alanine contents of the cowpea varieties ranged from 3.21 - 5.19 g/100g with small white cowpea variety (SWB) having the highest alanine (5.19 g/100g) while the least value (3.21 g/100g) was observed in "oyin" cowpea variety sample (OBN). Significant differences ($p<0.05$) were observed between the alanine contents of the different cowpea varieties. The values are within the range 4.15 – 6.24 g/100g reported for alanine contents of maize-acha-soybean masa by Malomo and Abiose (2019), slightly in line with 3.08 – 3.69 g/100g reported for alanine contents of four cowpea varieties researched by Celestine *et al.* (2015) Contrarily, the results are higher than 0.29 – 2.48 mg/100g reported for alanine contents of biscuits from wheat-velvet bean composite flour studied by Ezegbe *et al.* (2023). Cysteine is used to boost the efficiency of corticosteroid medications (Kamble *et al.*, 2021). The cysteine contents of the cowpea varieties were observed to be ranged from 0.45 - 1.15 g/100g. The highest value for cysteine (1.15 g/100g) was observed in drum cowpea variety (sample DBN) while the least cysteine content (0.45 g/100g) was observed in big white cowpea variety (sample BWB). Sample DBN differed significantly ($p<0.05$) from other cowpea varieties in respect to cysteine content. The report of the current study are slightly in line with 0.23 – 1.42 g/100g reported for cysteine contents of wheat-velvet bean composite flour biscuit researched by Ezegbe *et al.* (2023), 2.16 – 2.89 g/100g for cysteine contents of three cowpea genotypes by Hermankaya *et al.* (2016) and 1.17 – 1.70 g/100g reported for cysteine contents of maize-acha-soybean *masa* by Malomo and Abiose (2019).Varietal differences could have resulted in differences in cysteine contents of the different cowpea varieties reported in the current study and those reported in the cited literatures.

The tyrosine contents of the different cowpea varieties had significant variations ($p<0.05$) with values ranged from 2.45 - 6.45 g/100g. The highest value 6.45 g/100g was observed in small white cowpea variety (sample SWB) while the least tyrosine content 3.56 g/100g was observed in big white cowpea variety (sample BWB). Hermankaya *et al.* (2016) reported 0.36 – 0.54 g/100g for tyrosine contents of different cowpea varieties are lower than those obtained in the current work. The report of this study was also higher than 2.30 – 2.86 g/100 g reported for cowpea varieties by Celestine *et al.* (2015). The mean values for proline contents of the different cowpea varieties were of range 2.45 - 6.45 g/100g with small white cowpea variety (sample SWB) being the highest in proline (6.45 g/100g) while the least proline (2.45 g/100g) was observed in big white cowpea (sample BWB). There were significant variations ($p<0.05$) between the proline contents of the different cowpea varieties. The values are slightly in line with the ranged of 2.65 – 3.16 reported for proline contents of different cowpea varieties studied by Celestine *et al.* (2015) and 5.72 – 6.49 g/100 g for proline contents of maize-acha-soybean *masa* researched by Malomo and Abiose (2019).

Table 3: Non-Essential amino acids result of cowpea samples

Non-Essential Amino Acids (g/100g)	Sample BWB	Sample SWB	Sample OBN	Sample DBN
Glycine	2.87±0.35^{d}	5.22±0.35^{a}	3.86±0.38^{b}	3.31±0.49^{c}
Serine	3.04±0.35^{d}	7.53±0.35^{b}	3.52±0.35^{c}	8.13±0.35^{a}
Aspartic Acid	4.61±0.38^{d}	7.53±0.35^{b}	6.52±0.48^{c}	13.45±0.35^{a}
Glutamic Acid	2.86±0.35^{d}	5.88±0.37^{a}	3.80±0.49^{b}	3.68±0.37^{c}
Alanine	3.42±0.35^{d}	5.19±0.35^{a}	3.21±0.38^{c}	4.83±0.47^{b}
Cysteine	0.45±0.35d	1.15±0.35^{b}	0.79±0.40^{c}	2.83±0.37^{a}
Tyrosine	3.31±0.35^{d}	3.69±0.37^{a}	3.49±0.35^{c}	3.51±0.38^{b}
Proline	2.45±0.35^{d}	6.45±0.35^{a}	3.41±0.38^{c}	5.62±0.41^{b}

Values are mean ± standard deviation. Values with different superscripts along the same row are significantly different at $p < 0.05$. Sample BWB = Big white cowpea, Sample SWB = Small white cowpea, Sample OBN = "Oyin" cowpea, Sample DBN = Drum cowpea.

Total amino acid composition of the different cowpea varieties

The result for the total amino acids (TAA) and their percentage for the cowpea varieties sample are as presented in Figure 1. The total amino acid of the cowpea samples varied from 54.88 - 93.77 % with sample SWB (small white cowpea) being the highest in total amino acids (93.77 %) while the least total amino acid (54.88 %) was observed in sample BWB (big white cowpea). Significant differences ($p<0.05$) were observed between the total amino acid of the cowpea varieties. The values are lower than 192.21 – 216.52 % reported for cowpea protein isolates studied by Elhardallou *et al.* (2015) but slightly in line with 84.45 – 91.01 % reported by Malomo and Abiose (2019) for total amino acids of maize-acha-soybean *masa*. The total essential amino acids (TEAA) of the cowpea samples had significant variations ($p<0.05$) with values ranging from 31.84 - 51.13 %. Small white cowpea (sample SWB) had the highest value (51.13 %) for total essential amino acid while the lowest value (31.84 %) was observed in sample BWB (Big white cowpea). The findings of the current study are higher than 27.16 – 34.14 % reported for total essential amino acids of maize-acha-soybean *masa* studied by Malomo and Abiose (2019) and 37.8 – 39.1 % reported for total essential amino acids of different cowpea varieties by Teka *et al.* (2020). Varietal and agronomical characteristic differences could have resulted in variations in the respective total essential amino acids.

The mean result for the total non-essential amino acids (TNEAA) of the different cowpea varieties ranged from 23.04 – 45.36 %. The highest value for total non-essential amino acid (45.36 %) was observed in sample DBN (drum cowpea) while the lowest value for non-essential amino acids (23.04 %) was observed in sample BWB (big white cowpea). There were significant differences ($p<0.05$) between the total non-essential amino acids of the different cowpea varieties. The total non-essential amino acids (TNEAA) reported by Teka *et al.* (2020) for cowpea varieties ranged from 13.6 – 14.7 % are lower than the values obtained in the current study. Contrarily, the values reported in this study are lower than 57.30 – 61.97 % reported for total non-essential amino acids (TNEAA) of maize-acha-soybean *masa* flour studied by Malomo and Abiose (2019).

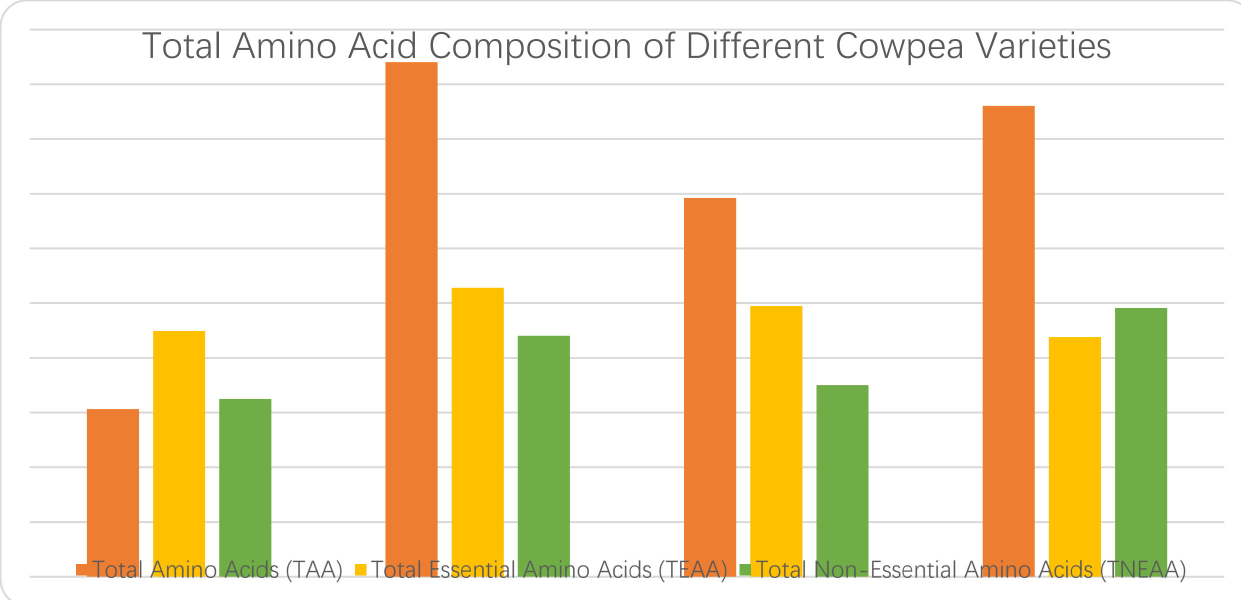

Figure 1: Total amino acid composition of the different cowpea varieties.

Conclusion

The phytochemical composition result showed that "oyin" cowpea variety was highest in flavonoid and tannin while small white cowpea varieties had the most saponin, phytate and trypsin inhibitor contents. However, saponins and polyphenol were not detected in big white cowpea variety. Essential amino acids such as leucine, lysine, isoleucine, phenylalanine, valine, histidine and threonine were abundant in small white cowpea variety. Drum cowpea variety had the most arginine but had no trace of threonine. Tryptophan was not detected (ND) in all cowpea varieties. Non-essential amino acids including glycine, glutamic acid, alanine, tyrosine and proline were abundant in small white cowpea (SWB) variety. However, serine, aspartic acid and cysteine were abundant in drum cowpea variety. The total amino acids result revealed that small white cowpea (sample SWB) variety was abundant in total amino acid acids (TAA) and total essential amino acids (TEAA), respectively. However, drum cowpea variety had the most total non-essential amino acids (TNEAA). It was observed that antinutritional factors were lowest in big white cowpea (BWB) variety while essential, non-essential and total essential amino acids were abundant in small white cowpea variety (SWB). Therefore, the study concludes that optimum nutritional quality could be obtained from drum cowpea (DBN) and small cowpea (SWB) varieties than other cowpea varieties.

Funding and conflict of interest

The project was self-funded; there was no direct funding for the research, and authors declare no conflict of interest.

References

1. Adegboyega, T.K.., Abberton, M.T., AbdelGadir, A.H., Dianda, M., Maziya-Dixon, B., Oyatomi, O.A., Ofodile, S. & Babalola, O.O. (2020). Evaluation of Nutritional and Antinutritional Properties of African Yam Bean (*Sphenostylisstenocarpa* (Hochst ex. A. Rich.) Harms.) Seeds. *Journal of Food Quality*, 1–11.
2. Adjei-Fremah, S., Worku, M., De Erive, M. O., He, F., Wang, T. & Chen, G. (2019). Effect of microfluidization on microstructure, protein profile and physicochemical properties of whole cowpea flours. *Innovative Food Science Emerging Technologies*, *57*, 102207.
3. AOAC (2005). Official Methods of Analysis 18th ed. Washington DC: Association of Official Analytical Chemists.
4. Ari, M.M., Ayanwale, B.A., Adama, T.Z. & Olatunji, E.A. (2012). Evaluation of the chemical composition and anti-nutritional factors (ANFs) levels of different thermally processed soybeans. *Asian Journal of Agricultural Research*, *6(2)*, 91–98.
5. Aruoma, O.L. (2003). Methodological considerations for characterizing potential

antioxidant actions of bioactive compounds in plant foods. *Mutat. Res.*, *52(4)*, 9 – 20.

6. Awoyinka, O.A., Ileola, A.O., Imeoria, C.N., Tijani, T.D., Oladele, F.C. & Asaolu, M.F. (2016). Comparison of Phytochemicals and Anti-Nutritional Factors in Some Selected Wild and Edible Bean in Nigeria. *Food and Nutrition Sciences*, *7,* 102 – 111.
7. Bagirei, S.Y., Nkama, I., Badau, M.H. & Idakwo, P. (2022). Production of Tuwo from Sorghum-Cowpea and Millet-Cowpea Composite Flours: Assessment of Flour Quality Parameters and the Textural Properties and Acceptability of *Tuwo*. *London Journals Press*, *22(7)*, 35–48.
8. Celestine, A.A., Emmanuel, E.C., David, I.O. & Onwuchekwa, O. (2015). A comparative study of the protein and amino acid composition of protein and selected mushroom species in Abakaliki, Nigeria. *Journal of Global Biosciences*, *4(5)*, 2289–2295.
9. Chikaodiri, I.O., Bassey, H.J. & Sunday, E.O. (2017). Evaluation of nutrients and anti-nutritional factors of different species of African yam bean *(Sphenostylis stenocarpa). European Journal of Basic and Applied Sciences*, *4(1),* 1 – 8.
10. Darfour, B., Whilson, D.D., Ofosu, D.O. & Ocloo, F.C.K. (2012). Physical, proximate, functional and pasting properties of flour produced from gamma radiated cowpea (*Vigna unguiculata*, L.Walp). *Radiation Physics and Chemistry*. *81*, 450–457.
11. de Souza, E.J.D., Pereira, A.M., Fontana, M., Vanier, N.L. & Gularte, M.A. (2020). Quality of gluten-free cookies made with rice flour of different levels of amylose and cowpea beans. *British Food Journal*, *123*, 1810– 1820.
12. Elhardallou, S.B., Khalid, I.I., Gobouri, A.A. & Abdel-Hafez, S.H. (2015). Amino acid composition of cowpea (*Vignaungiculata* L. Walp) flour and its protein isolates. *Food Nutr Sci*, *6*,790–797.
13. Ezegbe, C.C., Onyeka, J.U. & Nkhata, S.G. (2023). Physicochemical, amino acid profile and sensory qualities of biscuit produced from a blend of wheat and velvet bean (*Mucuna pruriens*) flour. *Heliyon*, 9(e15045), 1 – 14.
14. Famakin, O., Fatoyinbo, A., Ijarotimi, O.S., Badejo, A.A. & Fagbemi, T.N. (2016). Assessment of nutritional quality, glycaemic index, antidiabetic and sensory properties of plantain (Musa paradisiaca)-based functional dough meals. *J. Food Sci Technol, 53(11),* 3865–3875.
15. FAO/WHO/UNU (1985). Energy and Protein Requirements. WHO Technical Report Series. 724. pp. 13-205. Geneva: WHO.
16. Hermankaya, M., Ceyhan, E., Çelik, A.S., Kahraman, A. & Ozcan, M.M. (2016). Some chemical properties, mineral content and amino acid composition of cowpeas (Vigna sinensis (L.) Savi). *Quality Assurance and Safety of Crops & Foods*, *8(1),* 111 – 116.
17. Jayathilake, C., Visvanathan, R., Deen, A., Bangamuwage, R., Jayawardana, B.C., Nammi, S. & Liyanage, R. (2018). Cowpea: An overview on its nutritional facts and health benefits. *Journal of the Science of Food and Agriculture*, *98(13)*, 4793- 4806.
18. Joy, N.W., Joy, E.C. & Agbagwa, S.S. (2021). Nutritional composition of two cowpea varieties sold in Port-Harcourt. *International Journal of Advance Research and Innovation*, *9(2*), 57–60.
19. Kamble, C., Chavan, R. & Kamble, V. (2021). A Review on Amino Acids. *A Journal of Drug Design & Discovery*, *8(3)*, 19–27.
20. Kefale, B., Fanta, S.W. & Santheesh, N. (2022). Review on nutritional, anti nutritional content and effect of processing on Anti Nutritional content of lupine in Ethiopia. *European Journal of Agriculture and Forestry Research*, *10(1*), 56–81.
21. Khatun, S. & Kim, T. (2021). Phenolic Compound, Antioxidant Activity and Nutritional Components of Five Legume Seed. *American Journal of Biochemical Science and Research*, *12(4)*, 328–334.
22. Krogdahl, Å., Hemre, G. I. & Mommsen, T.P. (2005). Carbohydrates in fish nutrition: digestion and absorption in post-larval stages, *Aquaculture Nutrition*, *11(2)*, 103-122.
23. Malomo, A.A. & Abiose, S.H. (2019). Protein quality and functional properties of *masa* produced from maize, acha and soybean. *Food Research*, *3(5)*, 556–563.
24. Nwosu, J.N., Ojukwu, M., Ogueke C.C., Ahaotu I. & Owuamanam, C. (2013). The Antinutritional properties and ease of dehulling on the proximate composition of pigeon pea (*Cajanus cajan*) as affected by malting. *International Journal of Life Sciences*, *2(2*). 60-67.
25. Nwosu, J.N. (2013). Evaluation of the Proximate Composition and Antinutritional Properties of African Yam Bean (*Sphenostylis sternocarpa*) Using Malting Treatment. *International Journal of Basic and Applied Sciences*, *2*, 157-169.
26. Okorie, P.A. (2018). Assessing the Anti-Nutritional Composition of Four Varieties of African Yam Bean in Afikpo Town of Ebonyi State Nigeria. *International Journal of Modern*

Research in Engineering and Technology, *3(6)*, 1–4.

27. Sharma, S., Kaur, M., Goyal, R. & Gill, B.S. (2014). Physical characteristics and nutritional composition of some new soybean (Glycine max (L.) Merrill) genotypes. *J Food Sci Technol*., *51(3)*, 551-557.
28. Sood, P., Modgil, R., Sood, M. & Chuhan, P.K. (2012). Anti-nutrient profile of different *Chenopodium* cultivars leaves. *Annals. Food Science and Technology*, *13(1)*, 68–74.
29. Teka, T.A., Retta, N., Bultosa, G., Admassu, H. & Astatkie, T. (2020). Protein fractions, in vitro protein digestibility and amino acid composition of select cowpea varieties grown in Ethiopia, *Food Bioscience*, doi: https://doi.org/10.1016/j.fbio.2020.100634.
30. Vasconcelos, I.M., Maia, F.M.M., Farias, D.F., Canpello, C.C., Carvalho, A.F.U., Moreira, R.A. & de Oliveira, J.T.A. (2010). Protein fractions, amino acid composition and antinutritional constituents of high-yielding cowpea cultivars. *Journals of food composition and analysis*, *23*, 54–60.

2/4/2025