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AMINO ACID PROFILES OF SEVEN COWPEA VARIETIES GROWN IN AGBOR

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ABSTRACT

Seven varieties of cowpea (*Vigna unguiculata*), Ife Brown, IT98K-128-3, IT98K-506-1, IT93K-452-1 and IT95K-1072-57, IT06K-149-1, and IT06K-136 were obtained from the International Institute of Tropical Agriculture, Ibadan (IITA) and evaluated at the Biological Garden of the College of Education, Agbor, for profiles of their amino acids. The results obtained revealed higher contents oftryptophan inIT98K-506-1 (6.22 mg/100^{-1}),IT93K-452-1 (5.01 mg/100^{-1}) andIfe Brown (4.73 mg/100^{-1}), and formethionine:, IT98K-128-(2.61mg/100^{-1}),IT95K-1072-57 (2.51 mg/100^{-1}),IT06K-149 (2.54 mg/100^{-1}) being the amino acids highly obtained from cowpea, and they were consequently recommended for cultivation by farmers in Agbor, Delta State.

Key words: Cowpea, Essential amino acids, non-essential amino acids.

INTRODUCTION

Cowpea, (*Vign aunguiculata* [L.] Walp.) is an important pulse found in the tropical as well as subtropical countries covering about 65 countries in Asia and Oceania, the Middle East, Southern Europe, Africa, Southern USA, Central and South America (Chinma *et al.,* 2008). Mahalakshmi *et al.,* (2007) reported that cowpea belongs to the family Fabaceae, sub-family Papilionoideae, tribe Phaseoleae and genus, *Vigna.*

By 1981, cowpea was traditionally considered as food legume of the poor in Nigeria, but recent survey showed that this perception has changed (Nnanyelugo *et al.,* 1997). Cowpea is now considered to be food for the rich, the informed, the salaried worker and those who can afford it.

Cowpea performs well in agro ecological zones where the rainfall range is between 500 and 1200 mm/year. However, with the development of extra-early maturing cowpea varieties, the crop can thrive in the Sahel where the rainfall is less than 500mm/year. Ehlers and Hall (1996) added that the crop grows on a wide range of soil pH and temperature (18-28ºC) compared to other legumes, and has a considerable adaptation to sandy and poor soils, high temperatures and drought compared to other crop species. According to Dugje *et al.* (2009), best yields are obtained in well-drained sandy loam to clay loam soils with the pH between 6 and 7.

The chemical composition of the cowpea seeds corresponds with those of most edible legumes. Asante *et al.* (2006) suggested that mature seeds contain per 100 gram edible portion as follows : carbohydrate 56-66 g, protein 22-24 g, water 11g, crude fibre 5.9-7.3 g, ash 3.4-3.9 g, fat 1.3-1.5 g, phosphorus 0.146 g, calcium 0.104-0.076 g and iron 0.005 g.

Amino acids are the monomers of proteins as well as the end-products of protein digestion in the alimentary canal. Usually they are classified into essential and non-essential amino acids. Both groups are absolutely essential for life. Amino acids contain carbon, hydrogen, oxygen and nitrogen, and some contain sulphur. The body needs to use about 20 common forms of amino acids to function. They are all important but 8 of them cannot be synthesized by the body. They are essential (indispensable) and therefore must be obtained from food. The other 10 amino acids are considered to be nonessential (also called dispensable), are not necessarily consumed because the body synthesizes them from other amino acids consumed.

The essential amino acids comprises of valine, methionine, isoleucine, leucine, phenylalanine, threonine, histidine and tryptophan while the non-essential amino acids include glycine, alanine, cysteine, tyrosine, proline, glutamic acid, serine, aspartic acid, arginine and lysine. Legumes are important major sources of plant proteins and fats in tropical countries. They are good sources of essential amino acids and fats. Their industrial application depends on the knowledge of their nutritional importance and functional properties.

According to the Food and Nutrition Board (2002), two

amino acids- cysteine and tyrosine are synthesized in the body from methionine and phenylalanine respectively. Both methionine and phenylalanine are essential amino acids. Cysteine and tyrosine must be made from their essential amino acid counterparts unless they are consumed in the diet. If they are consumed, the body can synthesize protein from them directly.

Two main functions of proteins in our diets are:-

i. To provide the eight essential amino acids needed by our bodies.
ii. To provide either the nonessential amino acids that our bodies use, or nitrogen from an amino acid that in turn can be used to make the nonessential amino acid.

Objective of the Study

The study seeks to evaluate the amino acid contents of selected cowpea varieties grown under the ecological climates of Agbor, Ika land of Delta state, Nigeria.

MATERIALS AND METHODS

The research was an evaluation study of seven cowpea varieties for the purpose of establishing their amino acid profiles. The research was carried out at the Biological Garden of the College of Education Agbor, Delta StateDelta State has a mean annual rainfall of 2000mm, a mean annual temperature of 27^{o}C, lies on latitude 6^{o}00'N to 6^{o}25'N and longitude 6^{o}05'E and 6^{o}25'E. The seeds for the experiments were obtained from the plant breeding unit of the International Institute for Tropical Agriculture (IITA), Ibadan, Nigeria and evaluated for proximate amino acid compositions. Planting was done on July 13, 2013.

Field experiments

The experiments comprised of seven cowpea varieties of *Vigna unguiculata (L.) Walp.* namely: Ife Brown, IT98K-128-3 , IT98K-506-1, IT93K-452-1 and IT95K-1072-57, IT06K-149-1, and IT06K-136 that were laid out in a complete randomized block design (CRBD) with seven replications .

Biochemical Analysis

Amino acids (AA) were analysed by a reverse-phase HPLC (model L 7400, HITACHI, Japan) fitted with a denali C_{18} 5 micron column (4.6 x 150 mm). The flow rate was 1 ml min^{-1} with fluorescence detector. The cysteine content of protein sample was separately obtained by the method of Liddell and Saville, (1959). In other to determine the tryptophan content of the proteins, aliquots containing known amounts of proteins were dispersed into glass ampoules together with 1 ml 5M NaOH. The ampoules were flame sealed and incubated at 110^{o}C for 18 hours. The tryptophan contents of the alkaline hydrolysates were determined calorimetrically using the methods of Spies and Chambers (1949) as modified by Rama Rao *et al.* (1974).

Other amino acids were determined via measurement on hydrolysates using an amino acid analyzer (Sykam-S7130) based on high performance liquid chromatography technique. Sample hydrolysates were prepared following the method of Moore and Stein (1963), in: Ijarotimi and Olopade (2009). Two hundred mg of sample were placed in a hydrolysis tube. Then 5 ml 6M HCl were added to sample into the tube, tightly closed and incubated at 110ºC for 24 hours. After incubation, the solution was filtered and 200 ml of the filtrate was evaporated to dryness at 140ºC for an hour. Each hydrolysate after dryness was diluted with one ml of 0.12 M, pH 2.2 citrate buffers, the same standard applied to amino acids. An aliquot of 150 µL of sample hydrolysate was injected in a cation separation column at 130ºC. Ninhydrine solution and an eluent buffer (the buffer system contained sodium acetate 90%) and acetonitrile (10%) were delivered simultaneously into a high temperature reactor coil (16 m length) at a flow rate of 0.7 ml/min. The buffer / ninhydrine mixture was heated in the reactor at 130ºC for 2 minutes to accelerate chemical reaction of amino acids with ninhydrine. The products of the reaction mixture were detected at wavelengths of 570 nm and 440 nm on a dual channel photometer. The amino acid composition was calculated from the areas of standards obtained from the integrator and expressed as percentages of the total protein. The essential amino acids were compared with FAO/WHO (2007) reference pattern. The essential amino acid score was calculated thus:

$$\text{Essential amino acid score} = \frac{\text{Essential AA in g/100g of total protein}}{\text{Essential AA in g/100g of FAO/WHO (2007) reference pattern}} \times 100$$

RESULTS AND DISCUSSION

The amino acid profile of total seed proteins indicating the essential and non-essential amino acid contents was presented in Table 1. The result showing the different amino acids was presented as follows:

Glycine

From Table 1 the value of this amino acid ranged from 2.71 g/100g^{-1} to 3.14 g/100g^{-1} across the cowpea

Table 1. Amino acid profile of total seed proteins (g/100g^{-1}).

	Ife Brown	IT93K–452–1	IT98K–506–1	IT95K–1072– 57	IT98K–128–3	IT06K–136	IT06K–149–1
Glycine	3.00	2.71	2.84	3.13	2.94	2.66	3.14
Alanine	3.41	3.48	3.33	3.10	3.22	3.61	3.45
Cysteine	2.41	2.10	2.31	2.21	2.83	2.00	2.41
Valine*	3.30	3.41	3.00	2.87	3.61	3.20	3.33
Methionine*	2.44	2.24	2.38	2.51	2.61	2.41	2.54
Isoleucine *	3.00	3.19	3.11	2.81	2.75	3.52	2.66
Leucine*	7.50	8.11	8.44	6.31	5.42	6.52	6.33
Tyrosine	6.00	5.73	6.11	5.91	6.22	5.12	4.81
Phenylalanine*	5.51	4.82	5.77	6.21	4.94	5.44	6.21
Proline	3.10	2.97	3.50	4.00	3.64	4.36	4.71
Glutamic acid	17.01	16.52	16.71	15.00	17.44	15.11	16.22
Serine	3.11	3.07	2.98	3.81	2.76	3.51	3.48
Threonine*	3.36	3.04	2.11	2.97	3.28	2.78	3.05
Aspartic acid	8.55	7.45	9.10	8.21	8.00	7.64	8.75
Arginine	4.18	5.12	4.94	5.53	5.81	6.11	4.91
Histidine*	2.81	3.01	2.44	1.97	2.13	2.54	1.88
Lysine	6.26	5.77	5.68	4.11	5.27	6.18	4.27
Tryptophan*	4.73	5.01	6.22	4.66	3.82	3.11	4.51

*Essential amino acid

genotypes. The value of glycine was highest in IT06K149-1 (3.14 g/100g^{-1}) followed by IT95k-1072-57 (3.13 g/100g^{-1}) and Ife Brown (3.00 g/100g^{-1}) respectively. This amino acid was relatively lower in IT98K-128-3 (2.94 g/100g^{-1}), IT98K-506-1 (2.84 g/100g^{-1}), IT93K-452-1 (2.71 g/100g^{-1}) and IT06K-136 (2.66 g/100g^{-1}) respectively (Appendix 1). Glycine acts as an inhibitory neurotransmitter in the brain. It is also converted to serine which is used in foliate reactions. The values of this amino acid agreed with the reports of Aremu *et al.* (2006).

Alanine

From Appendix 1, the alanine contents of the various cowpea genotypes ranged from 3.10 g/100g^{-1} to 3.61 g/100g^{-1}. The highest value was recorded in IT06K-136 (3.61 g/100g^{-1}), followed by IT93K-452-1(3.483.61 g/100g^{-1}), IT06K-149-1 (3.45 g/100g^{-1}), Ife Brown (3.41 g/100g^{-1}) and IT98K-506-1 (3.33 g/100g^{-1}) respectively. The least values were recorded in IT98K-128-3 (3.22 g/100g^{-1}) and IT95K-`072-57 (3.10 g/100g^{-1}) respectively. The values agreed with Aremu *et al.* (2006). Alanine is important in the intertissue transfer of amino groups generated from amino acid catabolism.

Cysteine

The value of this amino acid was comparatively low across the cowpea genotypes. However, the highest value of 2.83 g/100g^{-1} was recorded in IT98K-128-3 and was followed by both Ife Brown and IT06K-149-1 (2.41 g/100g^{-1} each). Other

results recorded were: - IT98K-506-1 (2.31 g/100g^{-1}), IT95K-1072-57 (2.21 g/100g^{-1}), IT93K-452-1 (2.10 g/100g^{-1}) and IT06K-136 (2.00 g/100g^{-1}) respectively (Fig.1). The values of cysteine were lower than the values recorded by Amata and Lebari (2011) for three browse plants in the tropics. Cysteine transports iron across the mucosal cell. Cysteine is also required for the synthesis of both protein and the non-protein nitrogen-containing compound glutathione(Gropper *et al*.,2005).

Valine*

Appendix 1 showed that the value of valine in the cowpea genotypes ranged from 2.87 to 3.61 g/100g^{-1}. The highest value was recorded in IT98K-128-3 (3.61 g/100g^{-1}), followed by IT93K-452-1 (3.41 g/100g^{-1}), IT06K-149-1 (3.33 g/100g^{-1}), Ife Brown (3.00 g/100g^{-1}) and IT06K-136 (3.20 g/100g^{-1}), while the least values were recorded in IT98K-506-1 (3.00 g/100g^{-1}) and IT95K-1072-57 (2.87 g/100g^{-1}) respectively. The values agreed with the reports of Aremu *et al*. (2006) on cowpeas but were below the recommended FAO/WHO provisional pattern of 4.2.

Methionine*

Appendix 1 showed that the value of methionine in all the cowpea genotypes ranged from 2.24 to 2.61 g/100g^{-1}. The highest value of this amino acid was noted in IT98K-128-3 (2.61 g/100g-1), followed by IT06K-149-1 (2.54 g/100g-1), and IT95K-1072-57 (2.51 g/100g-1) respectively. Similar moderate values were recorded in IT06K-136 (2.41 g/100g-1) and Ife Brown (2.44 g/100g-1) respectively, while the least values were observed in both IT93K-452-1 (2.24 g/100g-1) and IT98K-506-1 (2.38 g/100g^{-1}). These values were in agreement with the FAO/WHO provisional pattern of 2.2. This amino acid is very essential for humans. It is always the first amino acid to be incorporated into a protein, sometimes removed after translation. Like cysteine, it contains sulfur, but with a methyl group instead of hydrogen. This methyl group can be activated, and is used in many reactions where a new carbon atom is being added to another molecule.

Isoleucine*

This amino acid ranged between 2.81 g/100g^{-1} and 3.52 g/100g^{-1}(Table 1). The highest value was recorded in IT06K-136 (3.52 g/100g^{-1}), followed by IT93K-452-1 (3.19 g/100g^{-1}), IT98K-506-1 (3.11 g/100g^{-1}) and Ife Brown (3.00 g/100g^{-1}). Lower values of this amino acid were observed in IT95K-1702-57 (2.81 g/100g^{-1}), IT98K-128-3 (2.75 g/100g^{-1}) and IT06K-149-1 (2.66 g/100g^{-1}) respectively. The values of this amino acid agreed with the reports of Amata and Lebari (2012), and Aremu *et al*. (2006) but were slightly below the recommended FAO/WHO provisional pattern of 4.2. Hendrickson (2015) noted that this amino acid is used for different purpose including providing cells with energy.

Leucine

Table 1 showed that the value of leucine was relatively high among the cowpea genotypes, ranging from 5.42 g/100g^{-1} to 8.44 100g^{-1}. It was further observed that the value of the amino acid was high in IT98K-506-1 (8.44 g/100g^{-1}), IT93K-452-1 (8.11 g/100g^{-1}) and Ife Brown (7.50 g/100g^{-1}), moderate in IT06K-136 (6.52 g/100g^{-1}), IT06K149-1 (6.33 g/100g^{-1}) and IT95K-1072-57 (6.31 g/100g^{-1}), but low in IT98K128-3 (5.42 g/100g^{-1}). Values of leucine measured up to those reported by Kalidass and Mohan (2012) in some *Rhynchosia species*, but exceeded the recommended FAO/WHO provisional pattern of 4.8. Studies both in vivo and in vitro have shown that leucine at a very high dose can stimulate muscle protein synthesis, an effect that is enhanced in vivo by insulin secreted in response to the leucine dose. High leucine can also inhibit protein degradation in skeletal muscle, as well as in liver (Garlick, 2005).

Tyrosine

Tyrosine was highest in IT98K-128-3 (6.22 g/100g^{-1}). Other cowpea genotypes with high values of this amino acid were IT98K-506-1 (6.11 g/100g^{-1}) and Ife Brown (6.00 g/100g^{-1}) respectively. It was moderately comparable in IT95K-1072-57 (5.91 g/100g^{-1}), IT93K-452-1 (5.73 g/100g^{-1}) and IT06K-136 (5.12 g/100g^{-1}) but lower in IT06K-149-1 (4.81 g/100g^{-1}) (Fig.2). These values were similar to the reports of Amata and Lebari (2006) on *Gmelina arborea*. Tyrosine is used in the body to synthesize epinephrine and norepinephrine which have major effects on nutrient metabolism. It can also be degraded to form fumarate which can be used to synthesize glucose.

Phenylalanine*

The content of phenylalanine was moderate among the seven cowpea genotypes studied. It ranged between 4.82 and 6.21 g/100g^{-1}, with the highest value recorded in IT95K-1072-57 (6.21 g/100g^{-1}) and IT06K-149-1 (6.21 g/100g^{-1}) respectively. Other genotypes with moderate value of this amino acid include IT98K-506-1 (5.77 g/100g^{-1}), Ife Brown (5.51 g/100g^{-1}) and IT06K-136 (5.44 g/100g^{-1}) while the least was recorded in IT98K-128-3 (4.94 g/100g^{-1}) and IT93K-452-1 (4.82 g/100g^{-1}) respectively (Appendix 2). Similar values were recorded by Kalidass and Mohan (2012). The value exceeded the

recommended FAO/WHO provisional pattern of 2.8.According to Nootriment (2015), it is critical to the normal functioning of the central nervous system, especially regarding symptoms like depression and chronic pain along with a number of additional diseases that have been linked to a malfunctioning nervous system. It is also used in the formation and synthesis of a number of different neurotransmitters like epinephrine, dopamine, and norepinephrine. All of these chemicals are vital for the proper functioning of the nervous system.

Proline

Table 1 also showed that the value of proline was moderate across the cowpea genotypes, ranging from 2.97 to 4.71 g/100g^{-1}. Relatively high values were found among IT06K-149-1 (4.71 g/100g^{-1}), IT06K-136 (4.36 g/100g^{-1}), IT95K-1072-57 (4.00 g/100g^{-1}) and IT98K-128-3 (3.64 g/100g^{-1}). Others were IT98K-506-1 (3.50) and Ife Brown (3.10), while the least value was observed in IT93K-452-1 (2.97 g/100g^{-1}). The values of this amino acid were similar to the reports of Kalidass and Mohan (2012) on total seed proteins for two species of *Rhynchosia*. They were also within the recommended FAO/WHO provisional pattern of 3.4. Proline is a constituent of many proteins. Found in high concentrations in collagen, proline constitutes almost a third of the residues. Collagen is the main supportive protein of skin, tendons, bones, and connective tissue and promotes their health and heeling (Pubchem, 2015).

Glutamic acid

Furthermore, Table 1 showed that the value of glutamic acid was high among the cowpea genotypes. The highest value was noted in IT98K-128-3 (17.44 g/100g^{-1}), followed by Ife Brown (17.01 g/100g^{-1}), IT98K-506-1 (16.71 g/100g^{-1}), IT93K-452-1 (16.52 g/100g^{-1}) and IT06K-149-1 (16.22 g/100g^{-1}). The lower values were recorded in IT06K-136 (5.11 g/100g^{-1}) and IT95K-1072-57 (15.00 g/100g^{-1}) respectively. These values were higher than those reported by Kalidass and Mohan (2012) on total seed proteins for six food legumes of the genus *Rhynchosia*. Glutamic acid functions in the excretion of ammonia generated from cells other than the liver. In extra hepatic tissues ammonia or ammonia ions generated in the cell from amino acid reactions generally combine with glutamic acid to form glutamine, which functions to carry the generated ammonia safely out of the cell (Gropper *et al*., 2005*)*.

Serine

The value of this amino acid was moderate in all the cowpea genotypes (Table 1) and ranged from 2.98 to 3.51 g/100g^{-1}. IT95K-1072-57 (3.81 g/100g^{-1}) recorded the highest value of serine, followed by IT06K-136 (3.51 g/100g^{-1}), IT06K-149-1 (3.48 g/100g^{-1}), Ife Brown (3.11 g/100g^{-1}) and IT93K-452-1 (3.07 g/100g^{-1}). However, low values were recorded in IT98K-506-1 (2.98 g/100g^{-1}) and IT98K-128-3 (2.76 g/100g^{-1}) respectively. The value of this amino acid across the cowpea genotypes agreed with the reports of Kalidass and Mohan (2012). Gropper *et al*., (2005) noted that serine is synthesized from glycine and it is a major source of one-carbon unit for use in foliate reactions.

Threonine*

Table 1 showed that this amino acid was also moderately distributed among the various cowpea genotypes with Ife Brown (3.36 g/100g^{-1}) recording the highest value. High values were equally observed among IT98K-128-3 (3.28 g/100g^{-1}), IT06K-149-1 (3.05 g/100g^{-1}) and IT93K-452-1 (3.04 g/100g^{-1}).The values decreased considerably among IT95K-1072-57 (2.97 g/100g^{-1}), IT06K-136 (2.78 g/100g^{-1}) and IT98K-506-1(2.11g/100g^{-1}). The value of this amino acid agreed with the reports of Aremu *et al*., (2006) and Wardlaw and Hampl (2007). Threonine is found in mucus glycoprotein and can be metabolized in three different pathways to form succinyl COA, pyruvate and acetyl COA (Gropper *et al*., 2005).

Aspartic acid

The value of aspartic acid was generally high in all the cowpea genotypes studied (Table 1). The highest value observed in IT98K-506-1 (9.10 g/100g^{-1}), followed by IT06K149-1 (8.75 g/100g^{-1}), Ife brown (8.55 g/100g^{-1}) and IT98K-128-3 (8.00 g/100g^{-1}) (Table 1). Furthermore, a slightly lower value of aspartic acid was noted in IT06K-136 (8.75 g/100g^{-1}) and IT93K-452-1 (7.45 g/100g^{-1}) respectively (Appendix 3). The value of this amino acid was similar to those reported by Kalidass and Mohan (2012). Gropper *et al*. (2005) reported that the metabolism of aspartic acid occurs within intestinal cells. Aspartic acid undergoes transamination with α-ketoglutaric acid or pyruvic acid to generate oxaloacetic acid and either glutamic acid or alanine respectively.

Arginine

It was also shown that the value of arginine ranged between 4.18 to 6.11 g/100g^{-1}. It was noted that IT06K-136 (6.11 g/100g^{-1}) recorded the highest value and was closely followed by IT98K-128-3 (5.81 g/100g^{-1}) and IT95K-1072-57 (5.53 g/100g^{-1}) respectively (Table 1). The amino acid was comparatively moderate in

IT93K-452-1 (5.12 g/100g^{-1}) and similarly lower in IT98K-506-1 (4.94 g/100g^{-1}), IT06K-149-1 (4.91 g/100g^{-1}), and Ife Brown (4.18 g/100g^{-1}). The result exceeded those recorded by Aremu *et al.* (2006) on two cowpea varieties. The values of this amino acid also exceeded the recommended FAO/WHO daily provisional pattern of 2.0. Arginine is catabolized in the liver and generates urea as part of the urea cycle, and ornithine. In the kidney arginine is used with glycine in the first reaction of creatine synthesis (Gropper *et al*., 2005).

Histidine*

Histidine was generally low among the cowpea varieties, especially in IT06K-149-1 (1.88 g/100g^{-1}) and IT95K-1072-57 (1.97 g/100g^{-1}) where the least values were recorded. The value was similar in Ife Brown (2.81 g/100g^{-1}), IT06K-136 (2.54 g/100g^{-1}), IT98K-506-1 (2.44 g/100g^{-1}), and IT98K-128-3 (2.13 g/100g^{-1}) but was higher in IT93K-452-1 (3.01 g/100g^{-1}) (Table 1). These values agreed with the reports of Aremu *et al.* (2006) Kalidass and Mohan (2012). They also corresponded with the recommended FAO/WHO daily provisional pattern of 2.4. Histidine forms an amine histamine when decarboxylated. Histamine is found in neurons, in the cells of the gastric mucosa and in mast cells. Histamine release causes dilation of capillaries, constriction of bronchial smooth muscles, and increased gastric secretions.

Lysine

The value of lysine was variable among the cowpea varieties. On one hand, the value was relatively high in Ife Brown (6.26 g/100g^{-1}) and IT06K-136 (6.18 g/100g^{-1}). On the other hand, it was moderate and similar in IT93K-452-1 (5.77 g/100g^{-1}), IT98K-506-1 (5.68 g/100g-1) and IT98K-128-3 (5.27 g/100g-1) respectively but low in IT06K-149-1 (4.27 g/100g^{-1}) and IT95K-1072-57 (4.11 g/100g^{-1}) respectively (Appendix 3). While the value of lysine in Ife Brown (6.26 g/100g^{-1}) and IT06K-136 (6.18 g/100g^{-1}, IT93K-452-1 (5.77 g/100g^{-1}), IT98K-506-1 (5.68 g/100g-1) and IT98K-128-3 (5.27 g/100g-1) agreed with the reports of Kalidass and Mohan (2012) on five food legume of the genus *Rhynchosia*, the value of this amino acid in IT06K-149-1 (4.27 g/100g^{-1}) and IT95K-1072-57 (4.11 g/100g^{-1}) agreed with the reports of Aremu *et al*. (2006) on two cowpea varieties. These two genotypes also corresponded with the recommended FAO/WHO daily provisional pattern of 4.2. Furthermore, the catabolism of lysine generates acetyl COA, a useful element in the citric acid cycle (Gropper *et al*., 2005*)*.

Tryptophan*

From Appendix 3 it was shown that the value of tryptophan ranged from 3.11 to 6.22 g/100g$^{-1.}$ The highest values occurred between IT98K-506-1 (6.22 g/100g^{-1}) and IT93K-452-1 (5.01 g/100g^{-1}). A moderate value of it was further recorded among Ife Brown (4.73 g/100g^{-1}), IT95K-1072-57 (4.66 g/100g^{-1}) and IT06K149-1 (4.51 g/100g^{-1}), but it was comparatively low in IT98K-128-3 (3.82 g/100g^{-1}) and IT06K-136 (3.11 g/100g^{-1}) respectively. These values of tryptophan in various cowpea genotypes were higher than those reported by Aremu *et al*. (2006). They were also exceedingly higher than the recommended FAO/WHO daily provisional pattern of 1.4. According to Gropper *et al*. (2005) tryptophan is used in the synthesis of the hormone melatonin and the neurotransmitter serotonin. Melatonin is made in the pineal gland, which lies in the centre of the brain. Melatonin synthesis and release corresponds with darkness and is thought to be involved with the regulation of circadian rhythms and sleep. Serotonin functions as an excitatory neurotransmitter and as a potent vasoconstrictor and stimulator of smooth muscle contraction.

Conclusion

All the cowpea genotypes showed the presence of both essential and nonessential amino acids. However, it was noted that tryptophan was higher in IT98K-506-1 (6.22 mg/100^{-1}) IT93K-452-1 (5.01 mg/100^{-1}) and Ife Brown (4.73 mg/100^{-1}), while methionine was also higher in IT98K-128-(2.61 mg/100^{-1}), IT95K-1072-57 (2.51 mg/100^{-1}), IT06K-149 (2.54 mg/100$^{-1)}$. Both amino acids are the most highly sourced amino acids from cowpea. They could equally be easily substituted for each other during selection and are therefore recommended for cultivation by farmers in Agbor, in Ika land of Delta State.

REFERENCES

Amata, I.A and Lebari, T.A. (2012). Comparative evaluation of the amino acid profile and anti-nutritional content of the leaves of four selected browse plants in the tropics. *Int. J. Plant Anim. Environ. Sci.* 2(1): 107-111.

Aremu, M.O., Olaofe, O. and Akintayo, T.E. (2006). A comparative study on the chemical and amino acid composition of some Nigerian under-utilized legume flours. *Pak.J. Nutr.* 5(1): 34-38.

Asante, I.K., Adu-Dapaah, H. and Acheampong, A.O. (2006). Determination of some mineral components of cowpea, (*Vigna unguiculata* (L.) Walp) using instrumental neutron activation analysis. *WAJAE* Vol. 11 (1).

Chinma, C.E., Alemede, I.C. and Emelife, I.G. (2008). Physiochemical and functional properties of some Nigerian cowpea varieties. *Pak. J. Nutr.* 7 (1): 186-190.

Dugje, I.Y., Omoigui, L.O., Ekeleme, F., Kamara, A.Y.

and Ajeigbe, H. (2009).Farmers' guide to cowpea production in West Africa. IITA, Ibadan, Nigeria. 20 p.

Edeh, H.O. and Igberi, C.O. (2012). Assessment of vegetable cowpea production among small holder farmers in Ebonyi State, Nigeria. *APRN J. Agric. Biol. Sci.* 7(3): 215-222.

Egli, D.B and Bruening, W.P. (2005). Shade and temporal distribution of pod production
and pod set in soybean. *Crop Sci. J.* 45: 1764-1769.

Ehlers, J.D. and Hall, A.E (1996). Genetic classification of cowpea based on responses to heat and photoperiod. *Crop. Sci.* 36: 673-679.

FAO/WHO/UNU (2007). "Protein and amino acid requirements in human nutrition". Technical Report Series No. 935. Geneva. WHO Press. p 150.

Food and Nutrition Board (2002). Dietary reference intakes for energy, carbohydrate, fibre, fat, fatty acids, cholesterol, protein and amino acids. Washington D.C. The National Academy Press.

Garlick, P. J. (2015). The role of leucine in the regulation of protein metabolism. *J. Nutr.* 135(6).1553S – 1556S.

Gropper, S.S., Smith, J.L and Groff, J.L (2005). *Advanced Nutrition and Human Metabolism*. USA. Thomas Wadsworth. pp 123-221.

Hendrickson, K. (2015). The function of Isoleucine amino acids. Retrieved from livestrong.com at
www.livestrong.

Ijarotimi, O.S and Olopade, A.J (2009). Determination of amino acid content and protein quality of complementary food produced from locally available food materials in Ondo State, Nigeria. *Mal. J. Nutr.* 15(1): 87-95.

Kalidass, C. and Mohan, V.R. (2012). Biochemical composition and nutritional assessment
of selected under-utilized food legume of the genus *Rhynchosia. Int. Food Res. J.* 19 (3): 977-984.

Liddell, H.F. and Seville,B. (1959). Colometric determination of cysteine. *Analyst.*84: 133 -137.

Mahalakshmi, V., Ng, Q., Lawson, M and Ortiz, R. (2007). Cowpea (*Vigna unguiculata*) (L.) Walp.) : Core collection defined by geographical, agronomical and botanical descriptors. *Plant Genetic Resources: Characterization and Utilization* 5(3): 113-119.

Moore, S and Stein, W.H. (1963). Chromatographic amino acids determination by the use ofautomatic recording equipment. *Methods Enzymol*6: 819-831.

Murray, G.A and Swensen, J.B. (1985). Seed yield of Austrian winter field peas intercropped with winter cereals. Agron. J. 44: 121-129.

Nnanyelugo D.O., Ngoddy, P.O., Okeke, E.C. and Ngwu, E.K. (1997). Impact of cowpea research project in Nigeria, using the rapid rural appraisal technique. *In:* Singh BB., Mohan Ra,j D.R., Dashie, K.E and Jackai L.E.N. (eds). *Advances in cowpea research*, Co-publication of International Institute of Tropical Agriculture (IITA) and Japan
International Centre for Agricultural Sciences (JIRCAS). IITA Ibadan, Nigeria. 333 –340.

Nootriment (2015). Phenylalanine uses, benefits and possible side effect*. Nootriment .com/phenylalanine*

Pubchem (2015). Proline. nationalCentre for Biotechnology Information. Pubchem Compound Database ; CID= 145742. *https://pubchem.ncbi.nim.nih.gov/compound* 145742

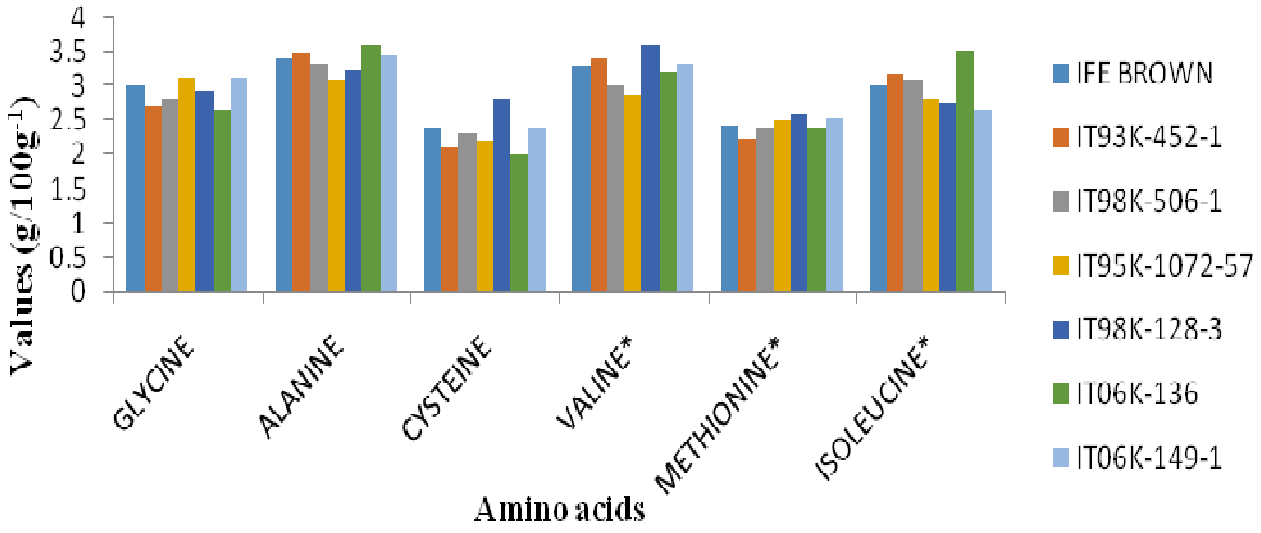
Rama Rao, M.V.,Tara, M.R and Krishnan, C.K. (1974). Colour imetric estimation of tryptophan content of pulses. *Journal of Food Science and Technology, (Mysore),* 11: 13-216.

Spies, J.R and Chamber, D.C. (1949). Chemical determination of tryptophan in proteins. *Anal. Chem.* 21: 1249-1266.

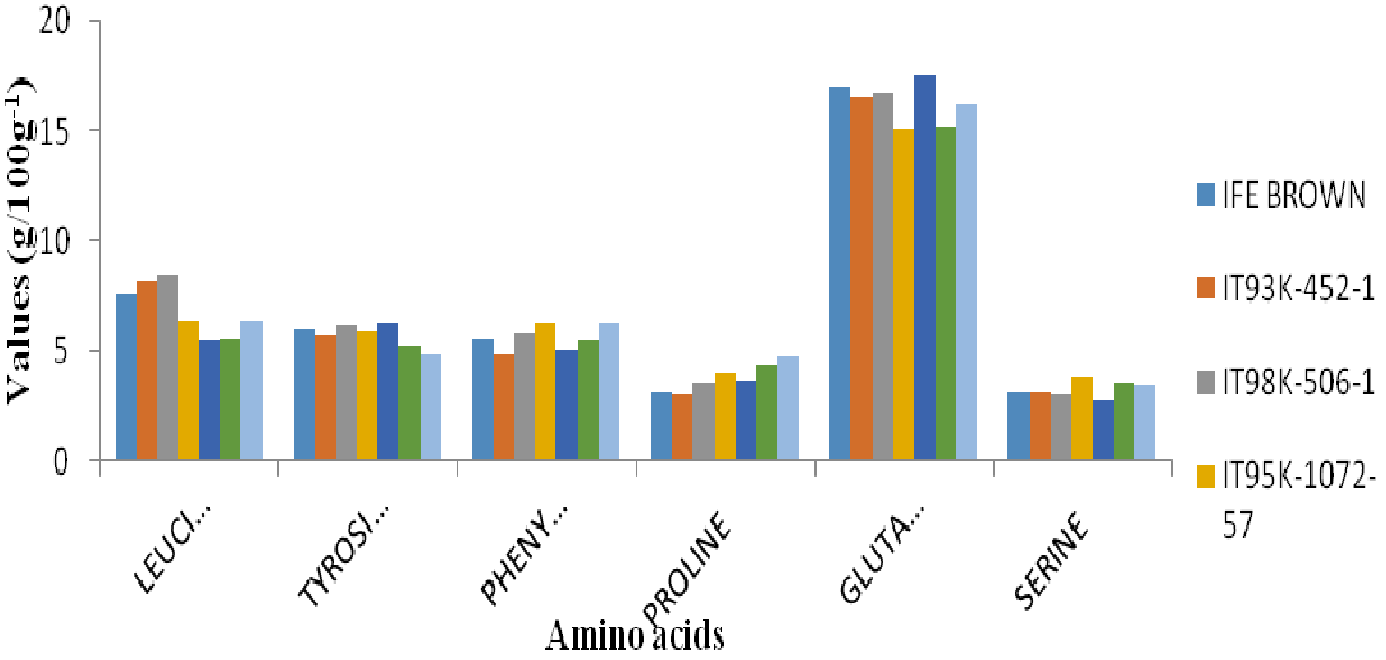
Wardlaw, G.M and Hampl, J.S. (2007). *Perspectives in Nutrition*. Seventh Edition. New York. McGraw-Hill higher Education. p7.

APPENDIX

Appendix 1. Values of glycine, alanine, cysteine, valine, methionine, and isoleucine in the seven cowpea genotypes studied.



Appendix 2. Value of leucine, tyrosine, phenylalanine, proline, glutamic acid, and serine in the seven cowpea genotypes studied.



Appendix 3. Values of threonine, aspartic acid, arginine, histidine, lysine, and tryptophan in the seven cowpea genotypes studied