Amino Acids Profile of Selected Five Genotypes of Cowpea and Mung Beans Grown in Awka, Rain Forest Zone

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KEYWORDS

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ABSTRACT

A comprehensive analysis was done at the Food Profiling Biotechnology Laboratory, National Root Crops Research Institute (NRCRI) Umudike, Umuahia to explore, as well as to compare the amino acid components of five cowpea (Vigna aunguiculata) (ITA 1,2,3,4,5) and five mung bean (Vigna radiata) (TVR 72,73,77,8,98) genotypes that were grown at the Research Farm of Crop Science and Horticulture, Nnamdi Azikiwe University. The results showed that the mung bean genotypes were high in alanine, glycine and valine while the cowpea genotypes were high in tryptophan, methionine and other sulfur-containing essential amino-acids. Both crops have relatively similar arginine, isoleucine, lysine, serine and tyrosine contents. While they reduce flatulence, the tested mung beans genotypes values for threonine, tryptophan and total sulphur-containing amino acids (methionine and cysteine) were nutritionally inadequate but this can be compensated by consuming mung bean in combination with cereals. Based on individual genotypes contents of essential amino-acids, we recommend cowpea genotypes:ITA 1,2, 5 and mung bean genotypes:TVR 72,73 and 98.

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INTRODUCTION

Legumes belongs to the family Fabaceae,while edible legumes are called pulses. Legumes are grown primarily for human consumption, for livestockforage and silage, and as soil-enhancing green manure (Elbert, 2014).Mungbean (Vigna radiata L. Wilczek) is an important annual leguminous crop mainly cultivated in the tropical, subtropical and temperate zones of Asia.It is a short duration legume, hence grown solely as well as in inter and multiple cropping system under rain fed and irrigated conditions. It is an excellent source of easily digestible high quality protein for the predominant vegetarian population of India (Tomooka *et al*., 2003). It contains 3.5-4.5% fiber, 22-28% total protein, 21-25% of total amino acid and 1.53-2.63% lipids, 1.0-1.5% fat, ash content ranges from 4-5% and 59-65% carbohydrate on dry weight basis and provide 334-344 kcal energy (Aguogu and Aguogu, 2010). Mungbean is known to be high source of manganese, potassium, magnesium, copper, zinc, and phosphorus. It is also rich in various B vitamins and also serves as a food filter high in protein, resistant starch and dietary fibre (DOA., 2013).

Mungbean is widely used as human food, green manure and forage for livestock.it also serves for medicinal purpose (Hujjie *et al*., 2003). Due to good taste easy digestibility, better palatability and acceptable market

price may be the first choice of farmers (Aguogu,2017). It increases farmers income and improves soil fertility through symbiotic nitrogen fixation (Malik *et al*., 2000).It is a vital crop in developing countries where it is consumed as dry seeds, fresh green pods or leaves due to its high protein, vitamin and mineral content. It is also consumed as green pods and seeds as vegetables (Tang *et al*., 2014).Cowpea, (*Vigna aunguiculata* [L.] Walp.) is an important pulse found in the tropical as well as subtropical countries..Cowpea belongs to the family Fabaceae, sub-family Papilionoideae, tribe Phaseoleae and genus,vigna.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.The chemical composition of the cowpea seeds corresponds with those of most edible legumes(Boukar *et al.,*2018).Nutritionally, cowpea grain is more or less same as other pulses, with a relatively low fat content and high total protein. Cowpea is considered as nutrient dense food with low energy density. An average cowpea grain contains 23-32% ofprotein, 50-60% carbohydrate and about 1% fat in dry basis. The total protein content of cowpea is approximately two to four times greater than cereal and tuber crops(Khalid and Elharadallou,2013).

Moreover the protein in cowpea is rich in amino acids like lysine and tryptophan,.Kirse and Karklina,(2015) suggested that mature seeds contain per 100 gram edible portion as follows : carbohydrate 56-66g, 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 nonessential amino acids. Both groups are absolutely essential for life. Amino acids contain carbon, hydrogen,oxygen and nitrogen, and some contain sulphur(Ukpene and Imade,2015). The body needs to use about twenty common forms of amino acids to function. They are all important but eight of them cannot be synthesized by the body. They are essential(indispensable) and therefore must be obtained from food. The other ten amino acids are considered to be nonessential (also called dispensable), are not necessarily consumed because the body synthesizes them from other amino acids consumed(Ukpene and Imade,2015).Cowpea and Mung bean are among the pulse's species of greatest economic and social importance,and strategic for the food security and health of millions especially in Africa owing to the high and ever increasing cost of animal-based protein foods. This Research is imperative as it was geared towards the proper identification and evaluation of the proteins and their amino acids components in some selected genotypes of these pulses. This will enhance the selection of superior genotypes for food production and breeding. The objectives of this study was to evaluate and compare the selected amino acid of mung bean and cowpea"

MATERIALS AND METHOD

Study Area.The seeds of cowpea and mung bean were planted at the Teaching and Research Farm,Faculty of Agriculture, Nnamdi Azikiwe University Awka, Anambra state, Nigeria. Anambra state consists of twenty-one local government areas within the latitude 6.2209^{o}N and longitude 6.9370^{o}E. It covers an estimated land area of 4,844 km^{2}. The state has two main climatic seasons, the dry and wet season, with peak of raining season between June and July. Annual rainfall ranges between 2062mm while the average temperature lies between 26.1^{o}C.The cowpea and mung bean seeds were planted separately on 1m x1m ridges and at 50cmx50cm spacing.Manure application and weedings were done as need be nd the pods were harvested at physiological maturity.

The samples preparation: The cowpea genotypes were :i. ITA-813 ii. ITA-814 iii. ITA-816 iv. ITA-888 v.ITA-817 (All from IITA Ibadan,Nigeria)while the mung bean were :i. IVC-112 ii. IVC-137 iii. IVC-32 iv. IVC-71 v. IVC-162(All from International Vegetable Centre,Taiwan).LABORATORY ANALYSIS: The dried mung bean and cowpea seeds were cleaned, sorted to remove defective and foreign matters. The cleaned seeds were soaked in potable water for just 20 min to soften the seed coat for easy dehulling. The dehulled seeds were dried in hot air oven at 65°C for 24h and milled into flour. The flour were stored in air-tight polythene until needed. The known samples were dried to constant weight, defatted, hydrolyzed, evaporated in a rotary evaporator and loaded into the Applied Biosystems PTH Amino Acid Analyzer.

Data Analysis: All the data collected were analyzed using Genstat 12 edition and means were separated using Least significance difference (L.S.D) at 0.05 level of significance.

RESULTS

Table 1 showed that**:** Alanine **co**ntents varied significantly among the tested genotypes. Mung bean genotype TVR98 (5.24g/mg) was the highest followed by cowpea genotypes ITA1 (4.58g/100g) and ITA5 (4.39g/100g).The genotype ITA2 (1.55g/100g) had the least Alanine content.Argnine contents varied significantly among the tested genotypes. Mung bean genotype TVR98 (6.67g/mg) was the highest followed by cowpea genotypes ITA1 (6.03g/100g) and ITA5 (5.45g/100g).Other genotypes were not significantly different. The genotype ITA2 (4.28g/100g) had the least Argnine content.

Glycine contents slightly varied among the tested genotypes. Mung bean genotype TVR98 (5.53g/mg) was the highest although not significantly different from other mung bean and cowpea genotypes.Isoleucine contents varied significantly among the tested genotypes. Cowpea genotype ITA1 (4.50g/mg) was the highest followed by cowpea genotypes ITA2 (4.25g/100g) and higher than ITA4 (2.57g/100g) and TVR8 (2.84g/mg).Other genotypes were not significantly different.

Lysine contents varied significantly among the tested genotypes. Cowpea genotype ITA1 (7.78g/100g) and Mung bean genotype TVR72 (7.69g/mg) were the highest followed by cowpea genotype ITA2 (7.23g/100g).and ITA5 (5.45g/100g).The genotype ITA5 (3.99g/100g) had the least Lysine content.

Table 1 Alanine, Argnine, Glycine, Isoleucine and Lysine (g/100g) content of the tested pulses

Cowpea genotypes	Alanine	Argnine	Glycine	Isoleucine	Lysine
ITA 1	4.58	6.03	4.98	4.50	7.78
ITA 2	1.55	4.28	4.35	4.25	7.23
ITA 3	4.11	5.37	4.64	3.33	6.85
ITA 4	3.24	5.74	4.28	2.57	4.95
ITA 5	4.39	5.45	4.54	3.43	3.99
Mung bean genotypes					
TVR72	3.10	4.96	4.56	3.78	7.69
TVR 73	4.08	4.73	4.04	3.83	4.85
TVR 77	3.28	5.13	4.48	3.81	5.17
TVR 8	2.18	5.37	4.20	2.84	5.98
TVR 98	5.24	6.67	5.35	3.82	7.11
LSD	1.401	1.47	1.72	1.62	0.30

Table 2 showed that:Lysine contents varied significantly among the tested genotypes. Cowpea genotype ITA1 (7.78g/100g) and Mung bean genotype TVR72 (7.69g/mg) were the highest followed by cowpea genotype ITA2 (7.23g/100g) and ITA5 (5.45g/100g). The genotype ITA5 (3.99g/100g) had the least Lysine content.Methionine contents varied significantly among the tested genotypes. Cowpea genotype ITA2 (3.85g/100g) was the highest followed by Mung bean genotype TVR72 (2.79g/mg) and cowpea genotype ITA1 (2.64g/100g). The genotypes that had the least Methionine contents were ITA5 (0.94g/mg) and ITA4. (0.89g/mg).

Serine contents did not vary significantly among the tested genotypes. A typical value for Mung bean genotype TVR98 was (3.72g/mg) and that for cowpea genotype ITA1 was (4.67g/100g).

Tryptophan contents varied significantly among the tested genotypes. Cowpea genotype ITA2 (3.22g/100g) was the highest followed by Mung bean genotype TVR98 (1.74g/mg). Both pulses were generally low in Tryptophan. The genotype ITA4 (0.18g/100g) had the least Tryptophan content.

Tyrosine contents were significantly the same among three tested Mung bean genotypes TVR72 (3.30g/mg), TVR73 (3.44g/mg) and TVR8 (3.11g/mg) and also in three cowpea genotypes ITA1 (3.68g/100g), ITA3 (3.26g/mg) and ITA4 (3.02g/mg), the genotype ITA2 (2.04g/100g) had the least Tyrosine content followed by TVR98 (2.10g/100g).

Valine contents varied significantly among the tested genotypes. Mung bean genotype TVR98 (5.46g/mg) had the highest value and significantly the same with other genotypes other than ITA2 (2.30g/100g) which had the least Valine content.

Table 2: Methionine, Serine, Trytophane, Tyrosine and Valine (g/100g) content of the tested pulses

Cowpea genotypes	Methionine	Serine	Tryotophane	Tyrosine	Valine
ITA 1	2.64	4.67	0.74	3.68	4.76
ITA 2	3.85	3.69	3.22	2.04	2.30
ITA 3	1.79	3.03	0.64	3.26	4.66
ITA 4	0.89	2.87	0.18	3.02	5.01
ITA 5	0.94	3.27	0.74	2.41	4.85
Mung bean genotypes					
TVR72	2.79	3.29	1.03	3.30	3.90
TVR 73	1.36	3.82	1.04	3.44	3.91
TVR 77	2.09	3.53	1.16	2.44	3.99
TVR 8	2.14	3.13	0.54	3.11	4.31
TVR 98	1.71	3.72	1.74	2.10	5.46
LSD	1.18	1.92	0.73	0.74	1.74

DISCUSSIONS

A comprehensive analysis was done at the Food Profiling Biotechnology Laboratory, National Root Crops Research Institute (NRCRI) Umudike, Umuahia to investigate the amino acids components of five cowpea (*Vigna aunguiculata*) and five mung bean (*Vigna radiata*) genotypes that were grown at the the Research Farm of Crop Science and Horticulture, Nnamdi Azikiwe University, Awka. The present project was designed to explore, as well as to compare the amino acids components.

Alanine contents of the tested pulses 4.58-1.55g/100g for cowpea genotypes and 5.24-2.18g/100g for mung bean genotypes signifying that mung bean has higher alanine content than the tested cowpea genotypes. This result is in line with that of Ukpene and Imade, (2015) that recorded Alanine range of 3.10-3.61g/100g on nine cowpea genotypes. The values agreed also with Aremu *et al*(2006). Alanine is important in the inter tissue transfer of amino groups generated from amino acid catabolism. Arginine contents of the tested pulses 4.28-6.05g/100g for cowpea genotypes and 4.73-6.67g/100g for mung bean genotypes showed that the two pulses have similar Arginine contents. This result is in line with that of Ukpene and Imade, (2015) that recorded Arginine range of 4.18-6.11g/100g.06) 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 (Elhardallou *et al*., 2015).Glycine contents of the tested pulses was 4.28-4.98g/100g for cowpea genotypes and 4.04-5.53g/100g for mung bean genotypes signifying that mung bean has higher Glycine content than the tested cowpea genotypes. This result is in line with that of Ukpene and Imade, (2015) that recorded Glycine range of 2.71-3.14g/100g for cowpea genotypes.

The values agreed also with Aremu *et al.*,(2006).Glycine acts as aninhibitory neurotransmitter in the brain. It is also converted to serine which is used in foliate reactions. Isoleucine contents of the tested pulses was 2.57-4.25g/100g for cowpea genotypes and 2.84-3.52g/100g for mung bean genotypes signifying equal ranges for the tested genotypes. The values of this amino acid agreed with Ukpene and Imade,(2015) that recorded Isoleucine range of 2.81 3.14g/100g for cowpea genotypes, the reports of Amata (2012), and Aremu *et al*.(2006) but were slightly below the recommended FAO/WHO provisional pattern of 4.2.for mung bean genotypes but the same for the cowpea genotypes .Jayathilake*et al*.,(2018) noted that this amino acid is used for different purpose including providing cells with energy. Lysine contents of the tested pulses was 4.95-7.78g/100g for cowpea genotypes and 4.85-7.69g/100g for mung bean genotypes signifying equal ranges for the tested genotypes. 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 4.2g/100g. Furthermore, the catabolism of lysine generates acetyl COA, a useful element in the citric acid cycle.

Methionine contents of the tested pulses was 0.89-3.85g/100g for cowpea genotypes and 1.36-2.79g/100g for mung bean genotypes which showed that the cowpea genotypes contained more Methionine than mung bean genotypes .The 1.30mg/100g mung bean genotypes average agreed with the findings of ZhuYi shen *et. al.,* (2018).Also the tested cowpea genotypes range agreed with Ukpene and Imade, (2015) finding that ranged from 2.24 to 2.61 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. Indeed, the total essential amino acid content of MBPI exceeds the FAO/WHO recommendations (FAO/WHO.,1991,2018). Conversely, values for threonine, tryptophan and total sulphur-containing amino acids (methionine and cysteine) were nutritionally inadequate which can be compensated by consuming mung bean in combination with cereals.(ZhuYi shen *et. al.,* 2018).

Serine contents of the tested pulses 2.87-4.67g/100g for cowpea genotypes and 3.13-3.83g/100g for mung bean genotypes showed that the two pulses have similar Serine contents. This result is in line with that of Ukpene and Imade,(2015) that recorded Serine range of 4.18-6.11g/100g.06) on two cowpea varieties and ZhuYi shen *et. al.,* (2018) 3.8g/100g average of for mung bean genotypes. The value of this amino acid across the cowpea genotypes agreed with the reports of Kalidass and Mohan (2012). Serine is synthesized from glycine and it is a major source of one-carbon unit for use in foliate reactions. Tryptophan contents of the tested pulses 0.18-3.22g/100g for cowpea genotypes and 0.54-1.74g/100g for mung bean genotypes showed that the two pulses have low Tryptophan contents. 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. 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. Tyrosine contents of the tested pulses were 2.04-3.68g/100g for cowpea genotypes and 2.40-3.44g/100g for mung bean genotypes showed that the two pulses have similar Tyrosine contents. These values of tyrosine in various cowpea and mung bean genotypes were higher than those reported by Aremu *et al*. (2006)(4.81-6.22g/100g). 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. Valine contents of the tested pulses 2.30-5.01g/100g for cowpea genotypes and 3.90-5.46g/100g for mung bean genotypes showed that the two pulses have moderately high valine contents. The value of this amino acid across the cowpea genotypes agreed with the reports of Ukpene and Imade, (2015) that ranged from 2.87 to 3.61 g/100g-1.The values agreed with the reports of Aremu *et al*. (2006) on cowpeas but were below the recommended FAO/WHO provisional pattern of 4.2g/100g. This is also in line with the average of 4.6g/100g recorded by ZhuYi shen *et. al.,* (2018) on mung bean cultivars. Isoleucine contents of the tested pulses was 2.57-4.25g/100g for cowpea genotypes and 2.84-3.52g/100g for mung bean genotypes signifying equal ranges for the tested genotypes.

CONCLUSION

The present project was designed to explore, as well as to compare the amino acids components. The results showed that the tested mung bean genotypes were high in alanine, arginine, glycine, isoleucine, lysine and valine. While the tested cowpea genotypes were high in methionine, serine tryotophane, and tyrosine.

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