

Amino Acid Quality and Performance Characteristics of “ji-oto” Traditional Food of Ikwerre of Rivers State, Nigeria.

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ABSTRACT

Amino acid quality and growth performance characteristics of “ji-otor” were investigated. Results obtained for amino acids revealed the presence of essential amino acids such as valine, methionine, lysine, etc., and non-essential amino acids such as asparagine, proline, glycine, etc. The amino acid scores showed high contents of phenylalanine, isoleucine, leucine, histidine and arginine in the studied food. Growth performances characteristic study was carried out using growing rats which were divided into three groups and fed formulated diets. Groups placed on nutrend and basal formulated diets were used as control 1 and control 2 respectively, while the group on “ji-otor” (test diet) was the test group. Results obtained revealed that body weight change, total nitrogen intake, protein efficiency ratio, net protein retention and biological value were significantly increased ($p < 0.05$) in test rats than those of control 2 (basal feed). Carcass nitrogen, food conversion ratio, protein efficiency ratio and true digestibility were significantly increased ($p < 0.05$) in test rats agents those of the control 1 (nutrend) whereas total feed consumed in test rats was comparable to that of rats placed on nutrend. The observed body weight change of rats on test diet could be related to the presence of arginine, histidine and phenylalanine amino acids which are important in infants.

(Keywords: amino acid quality, chemical score, “ji-otor”, protein efficiency ratio, performance characteristics)

INTRODUCTION

Man's existence on this planet Earth is centred on what he ingests as food for survival. Food is defined as any material which when ingested, digested, and assimilated, nourishes the body

through provision of growth, provision of energy, replacement of worn-out cells, etc. (British Human Foundation, 2010; Olusanya, 2008; Okaka and Okaka, 2005; Uwakwe and Ayalogu, 1998). Foods generally come in different forms, and are sometimes attached to continents, regions, countries, ethnicities, tribes, societies, etc. (Amadi *et al.*, 2013). Aside from nutritional functions, foods also perform traditional functions especially when they are associated with specific groups or ethnicities (Amadi *et al.*, 2011a; Amadi *et al.*, 2011b; Trichopoulou *et al.*, 2008).

Most foods that perform traditional functions are traditional foods (Amadi *et al.*, 2013a; Duru *et al.*, 2012; Amadi *et al.*, 2011a; Amadi *et al.*, 2011b). Amadi *et al.*, (2012b); and FAO (2008) noted that traditional foods are those foods which have a specific feature or features which distinguish them clearly from other similar products of the same category in terms of the use of traditional ingredients (material of primary products) or traditional composition or traditional type of product or processing method.

Duru *et al.*, (2012) noted that traditional foods are defined as foods that are eaten in their original form, not modernized, not processed, not packaged and have a long history of supporting good health. The same authors noted that such foods are consumed in the way our ancestors ate them and are peculiar to a particular group, locality, community, or society. Duru *et al.*, (2013a) noted that traditional foods are known to possess excellent qualities and have numerous advantages on consumption. The continent of Africa is made of different countries filled with different ethnic groups (Amadi *et al.*, 2013a). It is a known fact that each of these ethnic groups has one or two kinds of traditionally associated foods. Nigeria for instance is among such countries in Africa. She has more than two

hundred and fifty ethnic groups (Amadi *et al.*, 2013a). Each of these ethnic groups has at least a traditional food that showcases the pride of cutlery tradition (Amadi *et al.*, 2011a; Amadi *et al.*, 2011b; Achi, 2005).

“ji-otor”, a traditional food common among Ikwerre ethnic group is among such traditional foods that are used to showcase the pride of cutlery tradition. Ikwerre ethnic group is located within the coordinates 4°50'N, 5°15'N, 6°30'E and 7°15'E, covering a land mass of about 21,400 km² (Amadi *et al.*, 2013a; Amadi *et al.*, 2013b; Nduka, 1993). The people of Ikwerre are mostly farmers (Wahua, 1993). “ji-otor” food is prepared with food materials grown and harvested within Ikwerre locality.

Existing studies on “ji-otor” (Amadi *et al.*, 2013b; Duru *et al.*, 2013b) were mainly on its nutritional as well as anti-nutritional compositions. There is need to extend the studies on the food. The present study therefore investigated the amino acid quality and performance characteristics of “ji-otor” traditional food.

MATERIALS AND METHODS

The study on “ji-otor” was carried out in Isiokpo in Ikwerre Local Government Area of Rivers State, South-South, Nigeria where it is produced for domestic consumption.

Sample Collection

The ingredients used in the preparation of “ji-otor” were purchased from a local market in Isiokpo, Ikwerre Local Government Area of Rivers State, and South-South, Nigeria.

“ji-otor” Preparation

Seven hundred and twenty grams (720g) of peeled water yam was properly washed and crushed by scraping with a kitchen knife. Plantain leaves were collected, washed and placed over fire flame to soften the leaves. The crushed water yam was wrapped in different plantain leaves, tied with string and cooked for 5 minutes to harden the crushed water yam. The wrapped and cooked water yam was kept overnight for 12 hours under room temperature to ferment. After 12 hours, the wraps of fermented water yam were unwrapped and cut to smaller sizes into a clean cooking pot.

Three hundred millilitres (300 mL) of water was added to the pot and transferred to an already lit cooking gas. After 3 minutes, 185 mL of palm oil and 30.0 g of ground prawn were added and stirred. Thereafter, 40g of ground crayfish, 120g of chopped onion, 80.0g of “ugba” (fermented oil bean seed), 10.0 g of pepper and 13.0 g of salt were added one after the other with continuous stirring of the entire contents of the pot. Some more water to make up the required volume was added along with 1g of “ogiri” (fermented melon) with a continuous stirring for about 10 min to get a homogenous mixture and the food “ji-otor” was ready.

720 g crushed water yam wrapped in flame softened plantain leaves, cooked for 5 min and kept overnight (12hrs) to ferment.

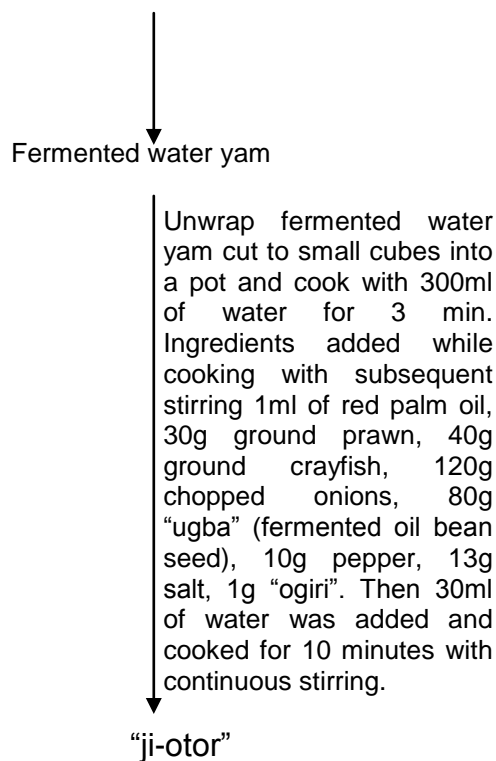


Figure 1: Flow-chart for Preparation of “ji-otor”

Preparation of Sample for Analysis

The prepared sample of “ji-otor” was dried in an oven at 70°C for 48 hours. The dried sample was ground with a hand mill into powdered form and stored in air tight container at 40°C until required for analysis.

Amino Acid Analysis

Amino acid profile was determined using Speckman *et al.*, (1958) with the modifications described by Onyeike *et al.*, (2005). Amino acid quality determined using chemical score method was done as describe by Olusanya (2008). Chemical scores of the individual amino acids were obtained as the ratio of the individual essential amino acids found in "ji-otor" to that of the same amino acid in a reference protein (whole egg of hen). Reference proteins used in the present study were those of whole hen`s egg, cow milk, and casein.

GROWTH PERFORMANCE CHARACTERISTIC STUDIES

Basal Diet

The protein free or basal diet (D₂) was formulated by adding 120g sucrose, 150g cellulose powder, 80g red palm oil, 10g of vitamin and mineral mixture to 640g of corn flour in a bowl and mixed homogenously to give one kilogram of the basal diet.

Reference Diet

The commercial infant food, Nutrend™ (from Nestle Foods Nigeria PLC) served as the reference diet (D₁).

Rat Feeding Study

Onyeike *et al.*, (1995) method was adopted for rat feeding study. Eighteen disease free stocks of weanling albino rats of the Wistar strain were used in the feeding, which lasted for twenty eight days. The rats were weighed and allowed to acclimatize to their new environment with a commercial rat feed for four days and reweighed. Their initial weights were however taken after acclimatization. The rats were then allocated on the basis of weight and litter origin to three diet groups (D₁, D₂, and D₃) of six rats each in such a way that the groups mean weight did not differ by more than $\pm 2.00\text{g}/\text{mean rat weight}$. Each of the rats was housed in a single cage with facilities for food, water, faecal and urine collection. Each diet group was given one of the three diets; the compositions of the diets are presented in Table 1.

Table 1: Composition of Formulated Diets (g/kg) Assigned to the Different Diet Group of Rats.

Components	Diets		
	D ₁	D ₂	D ₃
Nutrend™	1000	-	-
Corn Flour		640	
Sucrose	-	120	-
Vitamin and mineral mixture	-	10	-
RPO	-	80	-
Cellulose powder	-	150	-
"ji-otor"	-	-	1000
Total (kg)	1.0	1.0	1.0

Key=D₁: Nutrend; D₂: Basal diet; D₃: "ji-otor" (test diet). RPO: Red Palm Oil

D₁ received the reference diet consisting of 1000g Nutrend™, D₂ received the basal diet; and D₃ received the test diet "ji-otor". Feed and water were administered to the rats *ad libitum* for a period of twenty-eight days. The rats were weighed weekly. The daily feed intake was recorded, while the faeces were collected daily and dried for analysis. At the end of the feed and water administration period (28 days), the rats were finally weighed and then sacrificed with the help of chloroform. Their carcasses were weighed and appropriately labeled. Incisions were made into thoracic and body cavities of the rats to excise their liver, kidneys, heart, spleen, lungs and pancreas. Their weights were also taken. The organs were returned into the individual carcasses and each carcass was dried in an oven at 80°C for 72h, weighed, ground and stored in a desiccator for further nitrogen determination. The feed, fecal, and carcass nitrogen contents were analyzed according to standard methods (AOAC, 2006). The methods described by Onyeike and Morris (1996) were used for food conversion ratio (FCR), protein efficiency ratio (PER), net protein utilization (NPU), true digestibility (TD) and biological value (BV).

Statistical Analysis

Results were presented as means and standard error of mean (SEM). Significant differences values were established at 5% significant levels using using SPSS 17.0 software programme.

RESULTS AND DISCUSSION

The essential amino acids in “ji-otor” (Figure 1) showed the presence of valine, isoleucine, methionine, leucine, phenylalanine, threonine, lysine, histidine and arginine while the non-essential amino acids (Figure 2) revealed the presence of asparagine, serine, glutamine, proline, glycine, alanine, cysteine and tyrosine. The observed amino acids are important for healthy living in organisms. Okaka and Okaka (2005) noted that amino acids are important in the synthesis of many biologically active molecules including hormones, enzymes and structural components. The same authors further noted that tyrosine and phenylalanine give rise to hormones such as thyroxine and adrenaline. Glycine is part of the porphyrin ring of haemoglobin and along with serine, provides part of the structure of the purines and pyrimidine bases of nucleic acids. Sulphur containing amino acids give rise to taurine, a component of the bile acids (Olusanya, 2008; Okaka and Okaka, 2005).

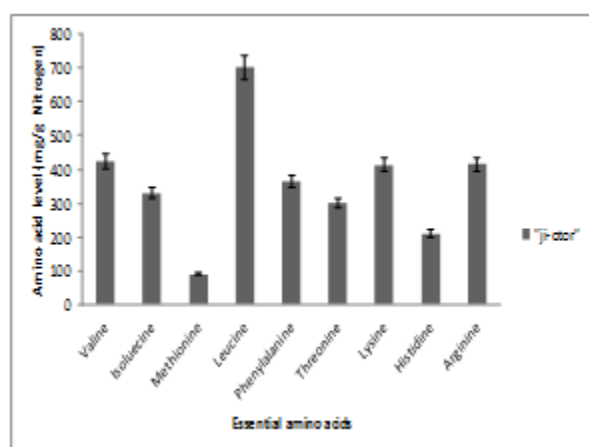


Figure 1: Essential Amino Acids in “ji-otor”.

Different authors have reported the importance of one or more of the observed amino acids in their previous studies in foods (Amadi *et al.*, 2013a; Amadi *et al.*, 2013b; Amadi *et al.*, 2013c; Nwoguikpe 2010; Olusanya, 2008). “ji-otor” produced the highest levels of leucine, phenylalanine, histidine and arginine amino acids when compared to those of reference proteins (whole hen’s egg, casein and cow milk) (Figure 3). Levels of valine and isoleucine amino acids in “ji-otor” were higher than those of cow milk reference protein (Figure 3). Asparagine and glycine non-essential amino acid levels of “ji-otor” in the present study were highest against the reference proteins (Figure 4) while alanine level in

“ji-otor” could be compared to that of whole hen’s egg (Figure 4).

The observed valine, isoleucine and lysine amino acids in “ji-otor” were highest when compared to those of “onunu” and “mgbam” traditions foods (Figure 5). Methionine and phenylalanine contents of the studied food were comparable to those of “onunu” while the leucine and threonine contents were comparable to those of “mgbam” (Amadi *et al.*, 2011b). Glycine and tyrosine non-essential amino acids were highest in the studied food sample when compared to those of “onunu” and “mgbam” foods (Figure 6). Serine content in “ji-otor” was comparable to that of “onunu” while its asparagine and proline contents were comparable to those of “mgbam” traditional foods (Amadi *et al.*, 2011b).

According to Olusanya (2008), the use of chemical score is among the ways of determining the protein quality of a food sample. The same author further noted that amino acid in food with the least score is known as limiting amino acid. The chemical scores of amino acids found in the studied food sample (Figure 7) revealed that the order histidine > leucine > arginine > isoleucine > phenylalanine > valine > lysine > threonine > methionine was followed by the observed amino acids. Methionine was the limiting amino acid in the present study.

The chemical scores of valine, isoleucine, phenylalanine and lysine of “ji-otor” were the highest when compared to those of “onunu” and “mgbam” traditional foods (Figure 8). The chemical scores of methionine, threonine, histidine and arginine were higher than those of “onunu” but lower than those “mgbam” traditional foods (Figure 8). Leucine score in “ji-otor” was comparable to that of “mgbam” traditional food (Figure 8).

Olusanya (2008) noted that any method used to measure quality of protein must either determine growth promoting ability or its essential amino acid content. The same author further noted biological method as one of the ways of measuring protein quality in food. Osborne *et al.*, (1919) attributed the growth index of protein quality to gain in weight of experimental animals per gram of protein consumed. The growth performance characteristics of rats fed “ji-otor” are presented in Figure 9.

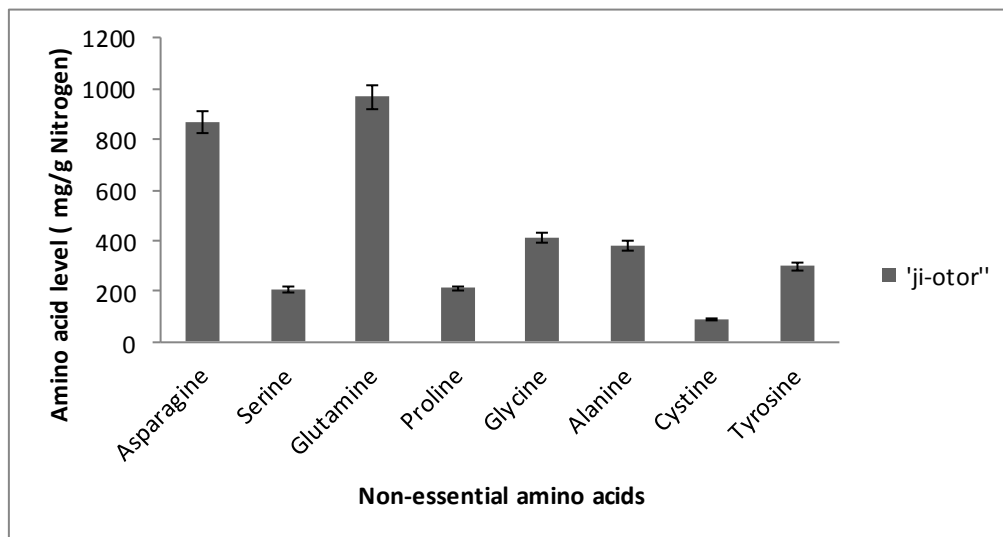


Figure 2: Non-Essential Amino Acids in “ji-otor”.

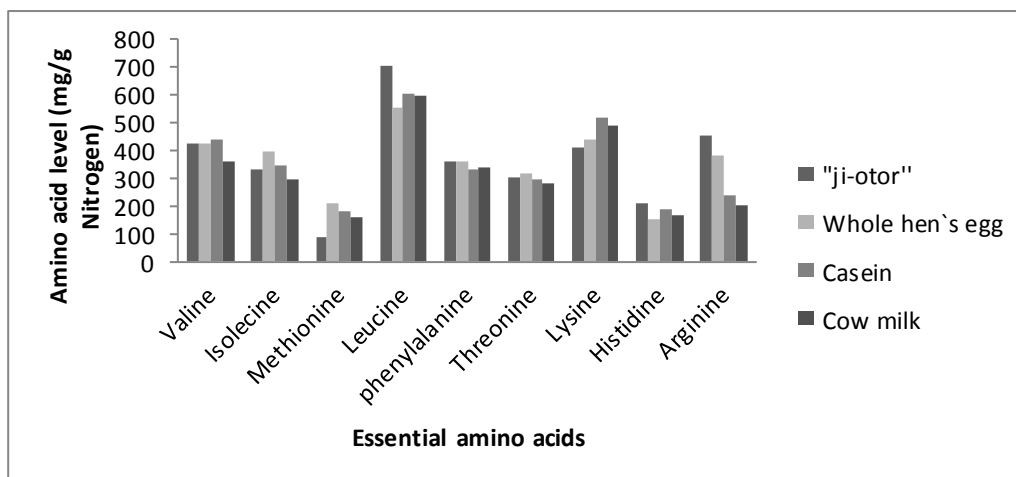


Figure 3: Essential Amino Acid in “ji-otor” compared to those of Reference Proteins. Reference Foods sourced from FAO (1972).

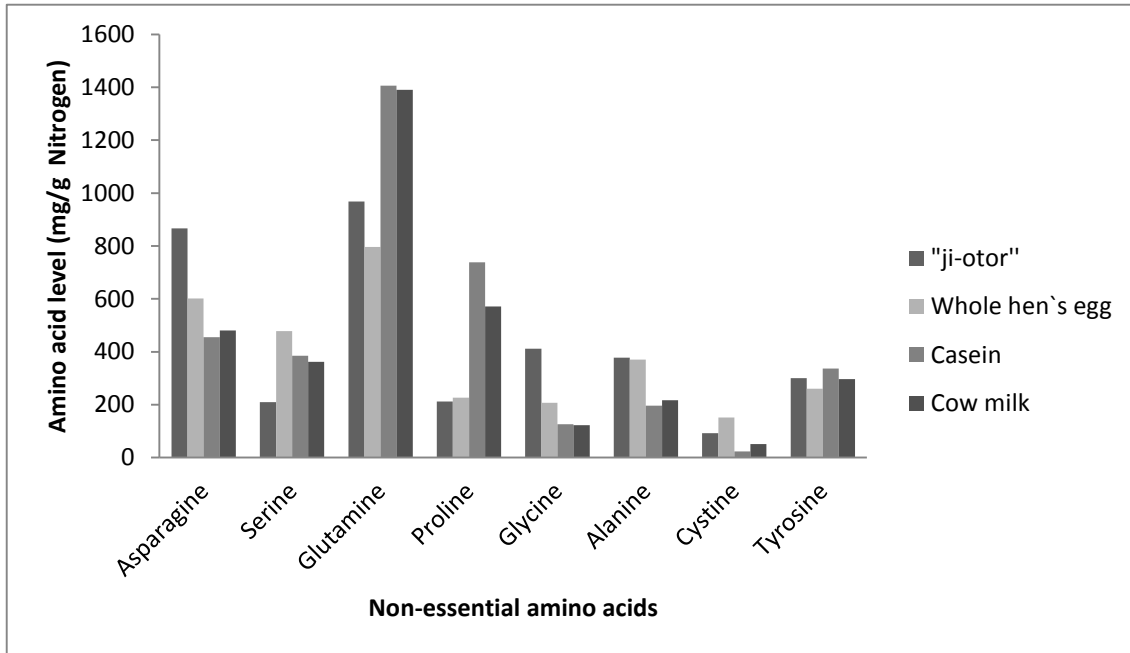


Figure 4: Non-essential Amino Acids in "ji-otor" compared to those of Reference Proteins. Reference Foods sourced from FAO (1972).

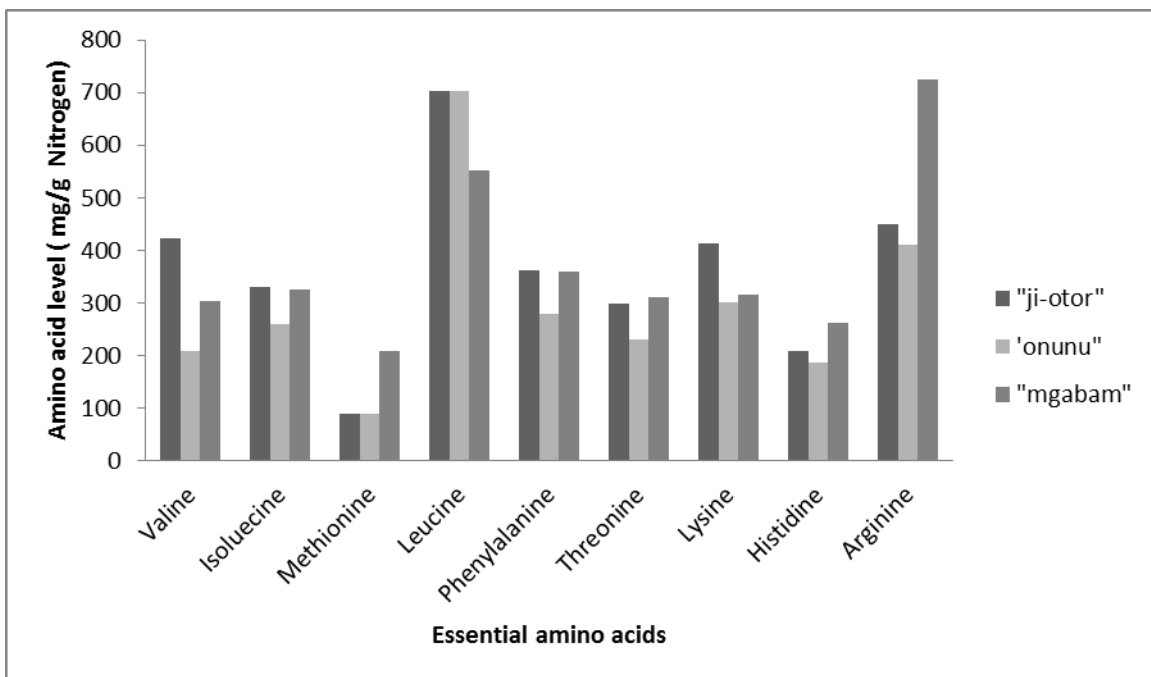


Figure 5: Essential Amino Acids in "ji-otor" (mg/g Nitrogen) compared to those of "onunu" and "mgbam" traditional foods (Data for "onunu" and "mgbam" sourced from Amadi *et al.*, 2011b).

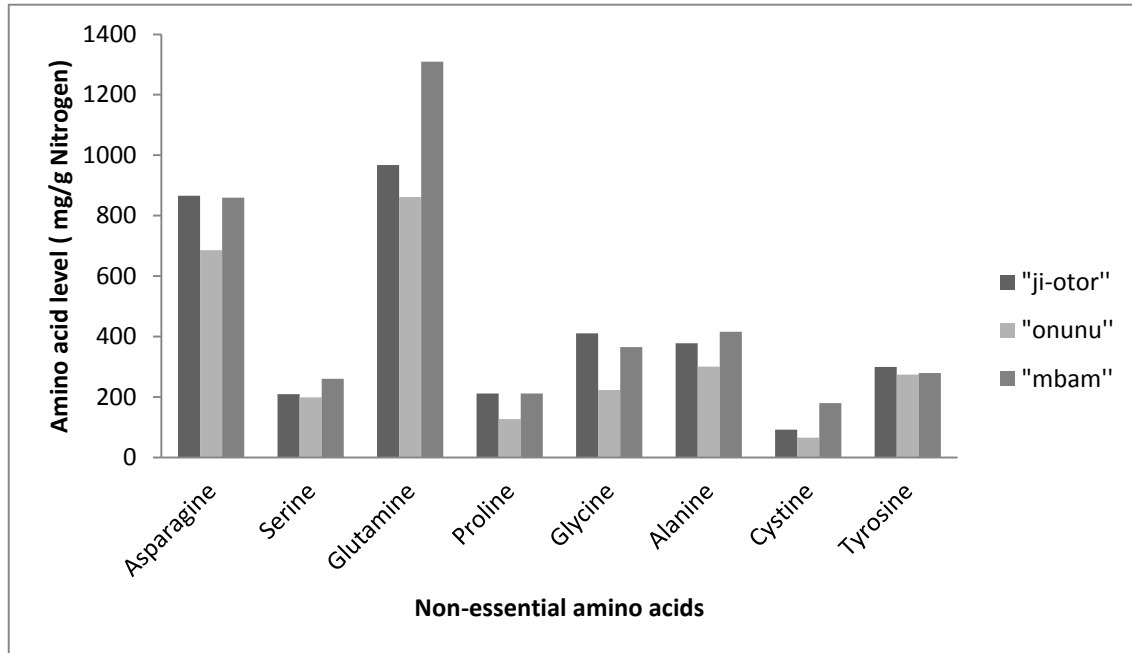


Figure 6: Non-essential Amino Acids in “ji-otor” (mg/g Nitrogen) Compared to those of “onunu” and “mbam” Traditional Foods (Data for “onunu” and “mbam” sourced from Amadi *et al.*, 2011b).

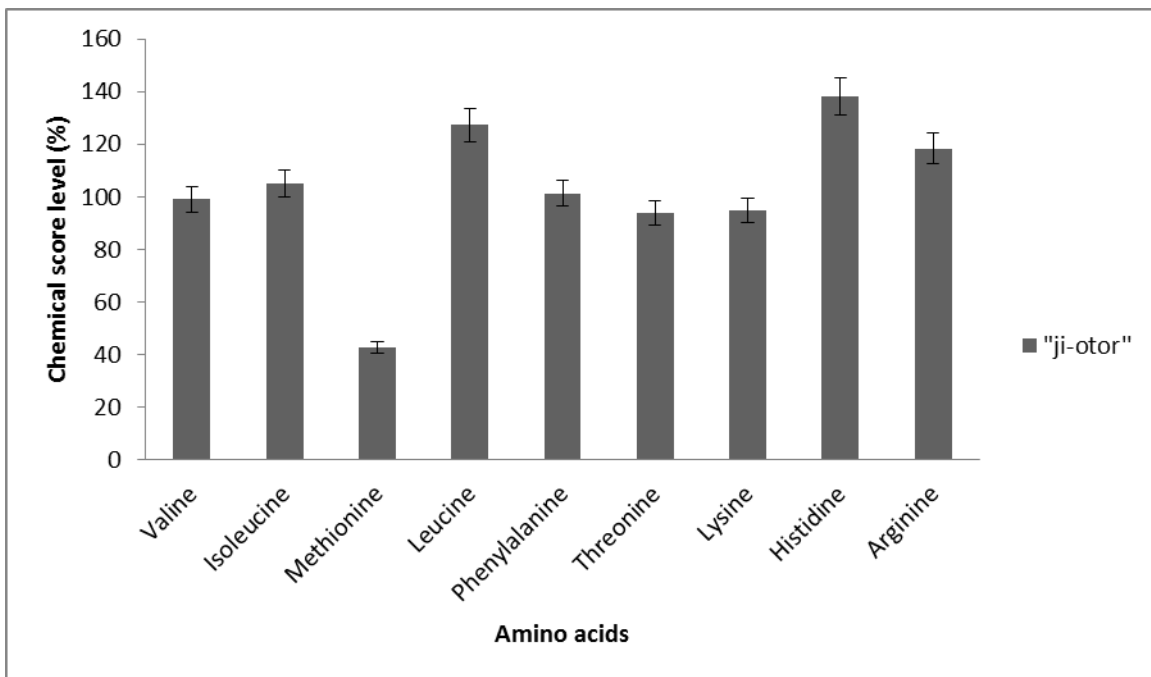


Figure 7: Chemical Scores (%) of “ji-otor”

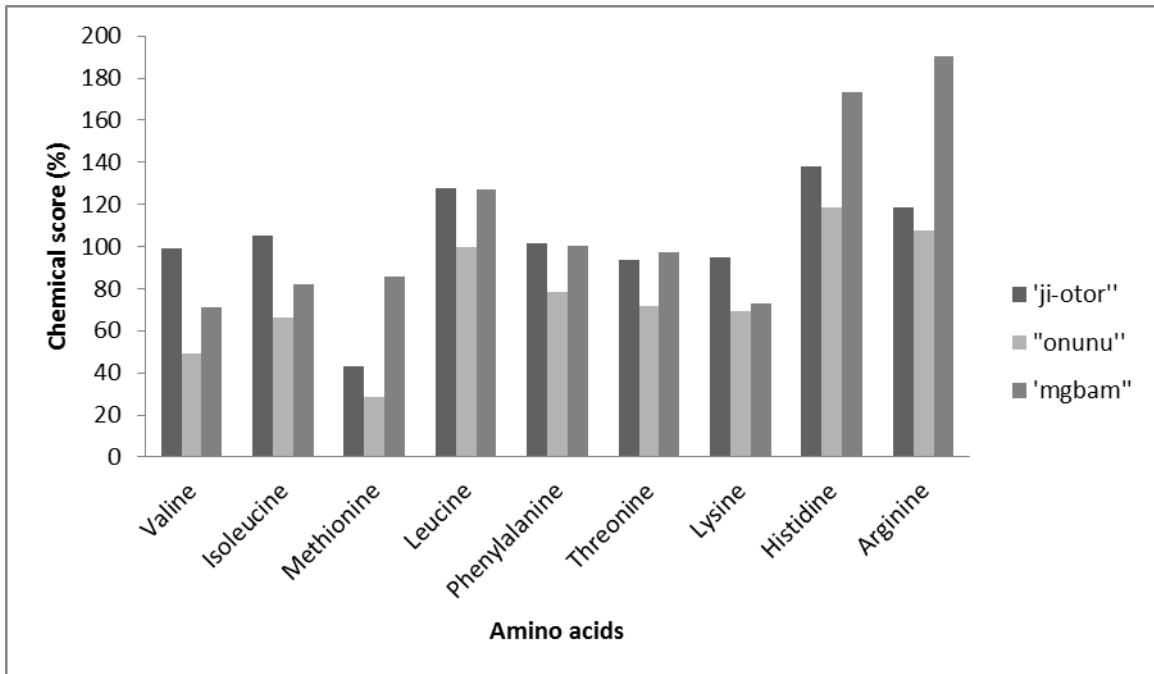


Figure 8: Chemical Scores of “ji-otor” Compared to those “onunu” and “mgbam” (Data for “onunu” and “mgbam” sourced from Amadi *et al.*, 2011b).

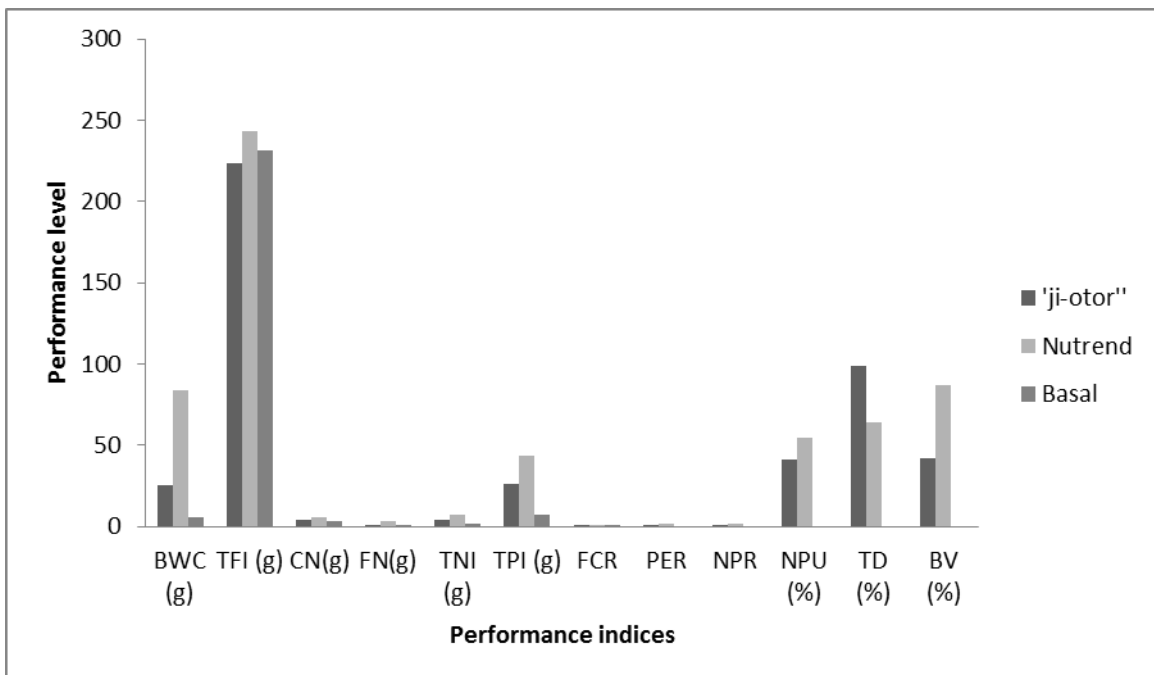


Figure 9: Growth Performance Characteristics of Rats fed “ji-otor”

Key: Body weight change (BWC); total food intake (CN); carcass nitrogen (CN); faecal nitrogen (FN); total protein intake (TPI); food conversion ratio (FCR); protein efficiency ratio (PER); net protein utilization (NPU); true digestibility (TD) and biological value (BV).

The body weight gain of rats fed “ji-otor” (test diet) was significantly ($p < 0.05$) lower than that of rats placed on nutrend and significantly ($p < 0.05$) higher than that of rats placed on basal feed. Ayalogu *et al.*, (2003) and Essen *et al.*, (2010) had similar observations. The observed increase in body weight of rats given “ji-otor” against the basal diet could be that processing (heating) inactivated the anti-nutritional factors such as trypsin inhibitors, etc, present in the test diet (Onyeike *et al.*, 1995).

Obizoba (1985) reported that animals are known to eat more food when it has good organoleptic appeal. Total food intake (TFI) of rats fed “ji-otor” compared to those of nutrend and basal feed. It could be that the studied food is palatable. The observed body weight change (BWC) of rats in the present study followed the order nutrend > “ji-otor” > basal feed while total food intake followed the order nutrend > basal > “ji-otor”. Hence body weight change (BWC) and total food intake (TFI) were not related in this study. The ability of the rats to utilize the foods could be behind this observation. The observed body weight gain and total food intake of rats placed on “ji-otor” in the present study were the lowest when compared to

those of “onunu” and “mgbam” traditional foods (Figure 10) as reported by Amadi *et al.*, (2011a).

The carcass nitrogen (CN) of rats fed “ji-otor” was higher than that of rats fed basal feed and lower than that of rats fed nutrends. The observed carcass nitrogen (CN) increase in rats fed “ji-otor” against that of rats placed on basal diet could be related to the observed amino acids (proteins) in the food. The carcass nitrogen of rats placed on “ji-otor” compared to that of rats placed on “onunu” and was higher than that of rats placed on “mgbam” (Figure 10) traditional food of Ikwerre people (Amadi *et al.*, 2011a). Faecal nitrogen (FN), total nitrogen intake (TNI) and total protein intake (TPI) of rats placed on the test diet were higher than those of rats on basal feed and lower than those of rats on nutrend (Figure 9). Higher protein content could be behind the observed increase in faecal nitrogen, total nitrogen intake, and total protein intake of rats placed on test diet against those of rats on basal diet in the present study. Faecal nitrogen of rats placed on test diet in the present study was lower than that of rats placed on “mgbam” and compared to that of rats placed on “onunu” (Figure 10) (Amadi *et al.*, 2012a).

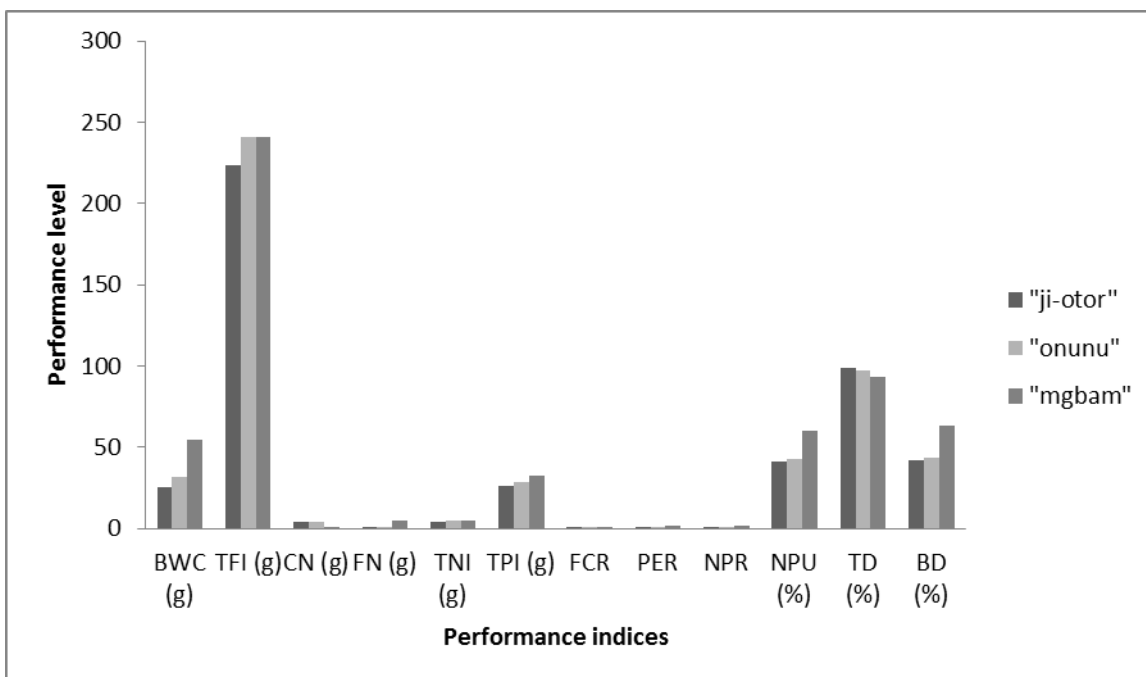


Figure 10: Growth Performance Characteristics of Rats fed “ji-otor” Compared to those “onunu” and “mgbam” (Data for “onunu” and “mgbam” sourced from Amadi *et al.*, 2011a).

Key: Body weight change (BWC); total food intake (TFI); carcass nitrogen (CN); faecal nitrogen (FN); total protein intake (TPI); food conversion ratio (FCR); protein efficiency ratio (PER); net protein utilization (NPU); true digestibility (TD) and biological value (BV).

Different food utilization rate could be the cause of the observed difference. Total nitrogen intake and total protein intake of rats placed on “ji-otor” compared to those of rats placed on “onunu” and “mgbam” traditional foods (Figure 10).

Feed conversion ratio (FCR) also known as feed conversion rate or feed conversion efficiency (FCE), is a measure of an animal's efficiency in converting feed mass into increased body mass (Knott *et al.*, 2003; Fahmy *et al.*, 1992). The Feed conversion ratio of rats placed on test diet was lower than that of nutrend and significantly ($p < 0.05$) higher than that of rats placed on basal feed. Studies have shown that animals with low feed conversion ratio are efficient users of feed. The observed FCR value of rats fed “ji-otor” in the present study compared to those “onunu” and “mgbam” traditional foods (Figure 10) of Ikwerre ethnic national in Nigeria (Amadi *et al.*, 2012a). Protein efficiency ratio (PER) is based on the fact that weight gain in a growing animal is proportional to the gain in body protein (Mortimore, 1982).

The protein efficiency ratio of rats placed on “ji-otor” is lower than those of rats placed on nutrend (Figure 9), “onunu” and “mgbam” (Figure 10). Olusanya (2008) noted that protein efficiency ratio may vary with the levels of protein in the diet and amount of food intake. The same author also noted that net protein ratio (NPR) takes care of maintenance requirements and evaluation of poor quality proteins which do not promote any growth. NPR of rats placed on “ji-otor” in the present study was lower than those of rats on nutrend (Figure 9) and “mgbam” (Figure 10) but compared to that of rats placed on “onunu” (Figure 10).

Nitrogen protein utilisation (NPU) addresses retained nitrogen in the body under specific condition (Olusanya, 2008), and biological value (BV) is a two-point assay procedure. The nitrogen protein digestibility (NPU) and biological value (BV) of rats placed on “ji-otor” were lower than those of rats placed on nutrend and higher than those of rats on basal feed. The observed differences were significant ($p < 0.05$). The observed nitrogen protein utilisation (NPU) and biological values of rats on test diet in the present study were comparable to those of rats on “onunu” and lower than those of rats on “mgbam” (Figure 10).

True digestibility (TD) is nitrogen consumed and absorbed in the body (Olusanya, 2008). The true

digestibility value of rats fed “ji-otor” was highest when compared to those of rats on nutrend (Figure 9); “onunu” and “mgbam” (Figure 10).

CONCLUSION

Conclusively, the amino acid quality of “ji-otor” compared favourably with those of reference proteins. Its growth performance characteristics assessment compared favourably with those of nutrend and other traditional foods such as “onunu” and “mgbam”. The presence of arginine, histidine and phenylalanine amino acids which are important in infants could be behind these observations. The present study has shown the amino acid quality and growth performance characteristics of “ji-otor”.

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