Nor. Afr. J. Food Nutr. Res. 2022; 6(13): 22-28 https://doi.org/10.51745/najfnr.6.13.22-28

https://www.najfnr.com

ORIGINAL ARTICLE

Amino acid profile and scores of some selected traditional diets commonly consumed in northwest zone, Nigeria

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Abstract

Background and aims: Amino acids composition of local and regional dietary proteins determines the protein quality. The study was aimed at evaluating amino acid profiles of some selected traditional diets commonly consumed in Jigawa (JG), Kano (KN) and Katsina (KT) States, Northwest Zone-Nigeria. **Methods:** The selected prepared diets (four per state) include; JG *Tuwon masara* using white maize served with *Kuka* soup (JG TMW SWKS), JG *Tuwon masara* using yellow maize served with *Kuka* soup (JG TMY SWKS), JG *Danwake* served with groundnut oil and pepper (JG *Danwake* SWGOP), JG *Moimoi*, KN *Tuwon masara* using white maize served with *Kuka* soup (KN TMW SWKS), KN *Tuwon masara* using yellow maize served with *Kuka* soup (KN TMY SWKS), KN rice and beans served with groundnut oil and pepper (KN Rice and Beans SWGOP), KN *Danwake* served with groundnut oil and pepper (KN *Danwake* SWGOP), KT *Tuwon masara* using white maize served with *Kuka* soup (KT TMW SWKS), KT *Tuwon masara* using yellow maize served with *Kuka* soup (KT TMY SWKS), KT *Danwake* served with groundnut oil and pepper (KT *Danwake* SWGOP) and KT *Dambu*. The preparations were dried and grounded into powdered form and analyzed using standard methods. **Results:** The amino acid profile of the diets consumed in the three states show higher content of total non-essential amino acids (NEAA) compared with essential amino acids (EAA). The amino acid score of the prepared diets though higher than the standard amino acid score by WHO/FAO/UNU (2007), may support the normal growth of all age groups except lysine. The limiting amino acid score was found to be either lysine or SAA (cysteine + methionine) in all the 3 states' diets. Histidine was found to have the highest score in all the diets except in JG *Moimoi* and KN *Danwake* served with groundnut oil and pepper (SWGOP) respectively. The low levels of lysine and SAA in some of the diets may be due to low contents of these amino acids in the ingredients used. **Conclusion:** This study showed that, the amino acid score of the prepared diets though higher than the standard amino acid score established by WHO/FAO/UNU may support the normal growth of infants, children as well as adults except lysine.

Keywords: traditional diets, amino acids, amino acid profile, amino acid score.

Received: August 19, 2021 / **Accepted:** December 19, 2021 / **Published:** January 14, 2022

1 Introduction

The nutritional value of any protein is directly related to the amino acid composition. Dietary proteins in form of amino acids are needed for growth, metabolism, and maintenance of the body especially in young ones [1]. Differences in protein value of human diets are in protein quality, not quantity. Diets in the developing world, such as Nigeria, are based largely on cereals, with minor contributions from legumes and little if any low animal protein hence, these diets are of low quality. Protein quality is a measure of the efficiency with which dietary protein is converted to body protein. Proteins of higher quality are required in lesser amounts compared to proteins of lower quality. According to National Academy Press (NAP) [2], protein quality is assessed in relation to a reference amino acid pattern with adjustment made for digestibility. Access to sufficient food of an adequate quality to maintain normal body composition and function throughout the life-cycle is fundamental to maintaining health. The amount of protein needs to be consumed, as part of nutritionally adequate diet, to achieve the desired structure and function is identified as the requirement [3]. Amino acids (AA) based on growth or nitrogen balance (namely net synthesis of protein in the whole body) are classified as nutritionally essential (indispensable) or nonessential (dispensable) for humans [4, 5]. Nutritionally essential amino acids (EAA) must be provided from the diet, whereas nonessential amino acids (NEAA) are those synthesized *de novo* [5]. Some proteins, especially plant origin proteins, are incomplete, because they do not contain all of the essential amino acids at the recommended level, while others, especially animal sourced proteins, typically contain higher levels of essential amino acids and are often classified as complete [6]. Proteins are a diverse and abundant class of biomolecules, constituting more than 50% of the dry weight of cells. This diversity and abundance reflect the central role of proteins in virtually all aspects of cell structure and function [7]. If the molecular weight and the exact amount of the protein analyzed are known (or the number of amino acid residues per molecule is known), the molar ratios of amino acids in the protein can be calculated [7]. Amino acid score is defined as the ratio of a gram of the limiting amino acid in the food to the same amount of the same amount of the corresponding amino acid in the reference diet multiplied by 100 [3]. This score provides a way to predict how efficiently protein will meet a person's amino acid needs [3]. Amino acid scoring has involved transition from a pattern based on the amino acid composition of high-quality food proteins

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e.g., egg to patterns that are assumed to reflect actual human needs for each age group [3]. The main focus of this research is to provide amino acid profiles and amino acid scores of some commonly consumed traditional diets in northwest geopolitical zone, Nigeria. This can provide added value to the national food composition tables and international food databases which can be used for the assessment of the protein quality in the nutrition of all populations.

2 Material and Methods

2.1 Documentation and selection of commonly consumed diets

Documentation and selection of commonly consumed diets in each state (Jigawa, Kano, and Katsina) were performed by administration of questionnaire (unstructured/open questionnaire). After questionnaire administration, based on respondents' responses on the frequency of consumption of the traditional diets, most highly-, moderately-, and the least-consumed diets were selected for the study. Recipe, quantity, and type of processing applied to the recipe and most common method of cooking the commonly consumed diets in each state were also adopted based on their responses.

2.2 Sample collection and preparation

All the recipes (food samples) were purchased from the main markets in each of the three states (Jigawa from Kachako market, Kano from Dawanau and 'Yan kaba markets, and Katsina from Dutsin-ma market) from months of January-February, 2016. The diets were prepared, dried, and grounded into powder using mortar and pestle planed for the amino acids analysis. The powdered samples were stored in tight plastic containers at room temperature prior to analysis.

2.3 Aminoacids determination

2.3.1 Principle

The amino acids in the sample were determined using methods described by Benitez [8] by hydrolyzing the sample in 6N HCl. The hydrolysate was then loaded into the analyzer to separate and analyze free acidic, neutral, and basic amino acids of the hydrolysate. An integrator attached to the analyzer calculates the peak area proportional to every amino acid concentration.

2.3.2 Procedure

a. Defatting sample

The sample was defatted using a chloroform/methanol mixture of ratio 2:1. Exactly 300mg of the sample was transferred into extraction thimble and extracted for 15 hours using Soxhlet extraction apparatus [9].

b. Nitrogen determination

A small amount of sample (0.15g) was weighed, wrapped in Whatman filter paper (No. 1), and transferred into a Kjeldahl digestion flask. Concentrated sulfuric acid (10 cm^3) was added and a catalyst mixture (0.5g) containing sodium sulfate (Na_2SO_4), copper sulfate ($CuSO_4$), and selenium oxide (SeO_2) in the ratio 10:5:1 was added into the flask to facilitate digestion. Four pieces of anti-bumping granules were added. The mixture in the digestion flask was transferred into the Kjeldahl digestion apparatus and heated for three (3) hours until the liquid turned light green. The digested sample was cooled and diluted with distilled water to 100 cm^3 in a standard volumetric flask. An aliquot (10 cm^3) of the diluted solution was mixed with 15 cm^3 of 45% NaOH and put into the Markham distillation apparatus and distilled into 10 cm^3 of 2% boric acid containing 4 drops of bromocresol green/methyl red indicator until about 70 cm^3 of distillate was collected. The distillate was then titrated with standardized 0.01N hydrochloric acid to the grey colored endpoint.

Calculation

$$\%Nitrogen = \frac{(a-b)*0.01*14*V*100}{W*C}$$

Where: a= titer value of the digested sample, b= titer value of blank sample, V= volume after dilution (100 cm^3), W= weight of dried sample (mg), C= aliquot of the sample used (10 cm^3), 14= nitrogen constant in milligram.

Sample hydrolysis

A known weight of the defatted sample was weighed into glass ampoule followed by addition of 7 cm^3 of 6N HCl and oxygen was expelled by passing nitrogen into the ampoule (this is to avoid possible oxidation of some amino acids during hydrolysis, e.g., methionine and cystine). The glass ampoule was then sealed with Bunsen burner flame and transfer yellow into an oven preset at 105°C for 22 hours. The ampoule was allowed to cool before broken open at the tip and the content was filtered to remove the humins (It should be noted that tryptophan is destroyed by 6N HCl during hydrolysis). The filtrate was then evaporated to dryness using rotary evaporator. The residue was dissolved with 5 cm^3 acetate buffer (pH 2.0) and stored in plastic specimen bottles, which were kept in the freezer until needed for the analysis.

c. Tryptophan Principle

Tryptophan is destroyed by 6N HCl during hydrolysis. Therefore, tryptophan in the sample was hydrolyzed with 4.2M Sodium hydroxide [10]. The known sample was dried to constant weight, defatted, hydrolyzed, evaporated in a rotary evaporator and loaded into the analyzer. An integrator attached to the analyzer calculates the peak area proportional to the concentration of tryptophan in the sample.

Sample hydrolysis

A known weight of the defatted sample was weighed into glass ampoule. Ten ml (10 cm^3) of 4.2M NaOH was added and oxygen was expelled by passing nitrogen into the ampoule. The glass ampoule was then sealed with Bunsen burner flame and put in an oven preset at 105° ± 5°C for 22 hours. The ampoule was allowed to cool before breaking open at the tip and the content was filtered to remove the humins. The filtrate was neutralized with 6N HCL and evaporated to dryness at 40°C under vacuum in a rotary evaporator. The residue was dissolved with 5 cm^3 of acetate buffer (pH 7.0) and stored in plastic specimen bottles, which were kept in the freezer.

Hydrolysate loading into analyzer

The amount loaded was 60 microliters. This was dispensed into the cartridge of the analyzer. The analyzer is designed to separate and analyze free acidic, neutral, and basic amino acids of the hydrolysate.

Calculation

An integrator attached to the analyzer calculates the peak area proportional to the concentration of each of the amino acids.

2.4 Statistical analysis

All data were mean of triplicate determinations and were subjected to analysis of variance (ANOVA) and independent sample test using SPSS software version 20.0 with P value <0.05 considered significant.

Table 1: Amino acid profile (mg/g protein) of prepared diets commonly consumed in Jigawa State-Nigeria

Amino acids	JG TMW SWKS	JG TMY SWKS	JG *Danwake* SWGOP	JG *Moimoi*
Leucine*	69	73	86	75
Lysine*	32	31	24	54
Isoleucine*	35	32	37	43
Phenylalanine*	42	40	34	44
Valine*	50	36	41	46
Methionine*	22	14	16	16
Histidine*	23	22	23	21
Threonine*	31	31	32	39
Tryptophan	12	10	10	15
Proline	55	40	42	46
Arginine	53	50	48	70
Tyrosine	31	33	34	46
Cysteine	13	16	22	10
Alanine	62	50	55	46
Glutamic acid	158	150	145	143
Glycine	39	41	44	45
Serine	37	34	40	43
Aspartic acid	88	78	79	92
Total EAA	**304**	**280**	**292**	**339**
Total NEAA	**547**	**501**	**520**	**556**
Total AA	**852**	**780**	**812**	**894**

KEY : JG : Jigawa, TMW WSKS : *Tuwon masara* (white) served with *Kuka* soup, TMY SWKS : *Tuwon masara* (yellow) served with *Kuka* soup, SWGOP : served with groundnut oil and pepper. EAA : essential amino acids, NEAA : non-essential amino acids, AA : amino acids, *: Essential amino acids.

3 Results

Tables 1, 2 and 3 show the amino acid profile of commonly consumed diets in Jigawa, Kano and Katsina states, northwest Zone-Nigeria. All the diets were found to present higher content of NEAA when compared to EAA with JG *Moimoi* having the highest. Table 2 shows that, all the diets contain the highest content of NEAA when compared with their EAA contents with TMY SWKS displaying the highest and *Danwake* SWGOP displaying the least values. From Table 3, it can be observed that, TMW SWKS possesses the highest total EAA followed by TMY SWKS, *Danwake* SWGOP and *dambu*. However, the highest total NEAA was found in TMY SWKS followed by *dambu*, *Danwake* SWGOP and TMW SWKS respectively.

Table 4, 5 and 6 summarize the amino acid scores of the prepared diets commonly consumed in Jigawa Kano and Katsina states northwest Zone-Nigeria which were compared with that of WHO/FAO/UNU (2007) for all age groups. It was observed that the calculated amino acid score of the prepared diets may support the normal growth compared with reference standard amino acids score established by WHO/FAO/UNU (2007) except lysine of JG *Danwake* SWGOP and KT *Danwake* SWGOP. Even though lysine of KN *Danwake* SWGOP and rice and beans can provide the mg/g protein requirement for three years and above age groups as compared with that of WHO/FAO/UNU (2007), it appeared to present the lowest amino acid score compared to the remaining diets of Kano.

Table 2: Amino acid profile (mg/g protein) of prepared diets commonly consumed in Kano state- Nigeria

Amino acids	KN TMW SWKS	KN TMY SWKS	KN Rice and beans SWGOP	*KN Danwake* SWGOP
Leucine*	63	80	92	74
Lysine*	33	52	31	32
Isoleucine*	35	50	31	33
Phenylalanine*	38	48	41	41
Valine*	42	42	40	33
Methionine*	12	12	20	12
Histidine*	22	24	27	17
Threonine*	30	33	35	28
Tryptophan	12	13	12	9
Proline	53	39	31	40
Arginine	47	69	56	52
Tyrosine	33	41	36	29
Cysteine	13	9	12	10
Alanine	40	46	39	38
Glutamic acid	163	136	127	106
Glycine	36	38	40	35
Serine	35	40	30	31
Aspartic acid	65	103	82	74
Total EAA	275	341	317	269
Total NEAA	498	534	465	424
Total AA	773	875	782	694

KEY: KN: Kano,TMW WSKS: *Tuwon masara* (white) served with *Kuka* soup, TMY SWKS: *Tuwon masara* (yellow) served with *Kuka* soup, SWGOP: served with groundnut oil and pepper. EAA: essential amino acids, NEAA: non-essential amino acids, AA: amino acids,*: Essential amino acids.

Table 3: Amino acid profile (mg/g protein) of prepared diets commonly consumed in Katsina state- Nigeria

Amino acids	KT TMW SWKS	KT TMY SWKS	KT *Danwake* SWGOP	KT *Dambu*
Leucine*	72	74	66	64
Lysine*	33	32	31	33
Isoleucine*	32	33	42	36
Phenylalanine*	40	37	32	35
Valine*	35	40	36	33
Methionine*	12	13	13	12
Histidine*	23	23	22	22
Threonine*	41	30	33	29
Tryptophan	11	9	9	12
Proline	35	40	34	31
Arginine	57	60	53	63
Tyrosine	33	29	34	36
Cysteine	11	22	13	12
Alanine	38	42	44	38
Glutamic acid	120	133	116	123
Glycine	33	38	34	40
Serine	32	36	42	37
Aspartic acid	81	85	77	83
Total EAA	287	282	274	265
Total NEAA	448	493	457	474
Total AA	736	775	731	739

KEY: KT: Katsina, TMW WSKS: *Tuwon masara* (white) served with *Kuka* soup, TMY SWKS: *Tuwon masara* (yellow) served with *Kuka* soup, SWGOP: served with groundnut oil and pepper. EAA: essential amino acids, NEAA: non-essential amino acids, AA: amino acids, *: Essential amino acids.

4 Discussion

The nutritional value of any protein is directly related to the amino acid composition. Dietary proteins in form of amino acids are needed for growth, metabolism, and body maintenance especially in the young individuals [1]. The amino acids contents of the prepared diets of the three states shows eighteen amino acids out of the common twenty amino acids found in proteins due to glutamine and asparagine which were respectively converted into glutamate and aspartate, hence the higher concentration of the later [1].

The current study showed that the prepared diets of the three states contain higher content of total NEAA when compared with total EAA contents. When dietary protein is relatively high in NEAA, down-regulation of insulin and up-regulation of glucagon is a logical consequence. Insulin antagonizes hepatic glucagon activity by activating cyclic adenosine monophosphate (cAMP) phosphodiesterase and additional mechanism. cAMP down-regulates the synthesis of a number of enzymes required for *de novo* lipogenesis and cholesterol synthesis and up-regulates key gluconeogenic enzymes [11]. Most of the EAA of Jigawa state *Moimoi* was found to be higher compared with *tuwo, danwake,* and *dambu*. The variations in amino acids (both EAA and NEAA) content of these prepared diets may be due to composition of diets. According to some literature data [6], animal sourced proteins, contain higher levels of EAA. This may be a reason that, in some of the state, especially Katsina state, where the most highly selected prepared diets (TMW SWKS and TMY SWKS) contain the higher EAA levels compared to moderately- and the least selected diets, since meat was used in preparing the *kuka* soup served with *tuwo*.

Table 4: Comparison of amino acid score (mg/g protein) of prepared diets commonly consumed in Jigawa state- Nigeria with WHO/FAO/UNU) for age groups

Amino acids	JG TMW SWKS	JG TMY SWKS	JG *Danwake* SWGOP	JG *Moimoi*	Egg Scoring pattern (mg/g)	WHO/FAO/UNU (2007) Score (mg/g protein requirement) for age groups					
						0.5yrs	1-2yrs	3-10yrs	11-14yrs	15-18yrs	>18yrs
Leucine	80	85	100	87	86	66	63	61	60	60	59
Lysine	46	45	34	77	70	57	52	48	48	47	45
Isoleucine	65	60	68	80	54	32	31	31	30	30	30
Valine	76	55	62	70	66	43	42	40	40	40	39
Histidine	105	102	105	97	22	20	18	16	16	16	15
Threonine	67	65	69	84	47	31	27	25	25	24	23
Tryptophan	69	57	59	89	17	8.5	7.4	6.6	6.5	6.3	6.0
Phenylalanine + tyrosine (AAA)	78	78	73	98	93	52	46	41	41	40	38
Methionine + Cysteine (SAA)	61	53	65	44	57	28	26	24	23	23	22

KEY: JG: Jigawa, TMW WSKS: *Tuwon masara* (white) served with *Kuka* soup, TMY SWKS: *Tuwon masara* (yellow) served with *Kuka* soup, SWGOP: served with groundnut oil and pepper, AAA; aromatic amino acids, SAA; sulfur amino acids..

Table 5: Comparison of amino acid score (mg/g protein) of prepared diets commonly consumed in Kano state- Nigeria with WHO/FAO/UNU) for age groups

Amino acids	KN TMW SWKS	KN TMY SWKS	KN Rice and beans SWGOP	KN *Danwake* SWGOP	Egg Scoring pattern (mg/g)	WHO/FAO/UNU (2007) Score (mg/g protein requirement) for age groups					
						0.5yrs	1-2yrs	3-10yrs	11-14yrs	15-18yrs	>18yrs
Leucine	73	93	107	85	86	66	63	61	60	60	59
Lysine	48	74	45	45	70	57	52	48	48	47	45
Isoleucine	65	93	57	61	54	32	31	31	30	30	30
Valine	64	64	61	50	66	43	42	40	40	40	39
Histidine	100	109	120	79	22	20	18	16	16	16	15
Threonine	64	69	74	60	47	31	27	25	25	24	23
Tryptophan	69	79	71	52	17	8.5	7.4	6.6	6.5	6.3	6.0
Phenylalanine + tyrosine (AAA)	76	96	83	75	93	52	46	41	41	40	38
Methionine + Cysteine (SAA)	45	38	57	38	57	28	26	24	23	23	22

KEY : KN : Kano, TMW WSKS : *Tuwon masara* (white) served with *Kuka* soup, TMY SWKS: *Tuwon masara* (yellow) served with *Kuka* soup, SWGOP : served with groundnut oil and pepper, AAA ; aromatic amino acids, SAA ; sulfur amino acids.

Table 6: Comparison of amino acid score (mg/g protein) of prepared diets commonly consumed in Katsina State-Nigeria with WHO/FAO/UNU) for age groups

Amino acids	KT TMW SWKS	KT TMY SWKS	KT *Danwake* SWGOP	KT *Dambu*	Egg Scoring pattern (mg/g)	WHO/FAO/UNU (2007) Score (mg/g protein requirement) for age groups					
						0.5yrs	1-2yrs	3-10yrs	11-14yrs	15-18yrs	>18yrs
Leucine	84	86	77	75	86	66	63	61	60	60	59
Lysine	47	45	44	48	70	57	52	48	48	47	45
Isoleucine	59	62	77	67	54	32	31	31	30	30	30
Valine	52	61	55	50	66	43	42	40	40	40	39
Histidine	105	105	99	102	22	20	18	16	16	16	15
Threonine	87	64	70	61	47	31	27	25	25	24	23
Tryptophan	62	52	54	68	17	8.5	7.4	6.6	6.5	6.3	6.0
Phenylalanine + tyrosine (AAA)	77	71	71	76	93	52	46	41	41	40	38
Methionine + Cysteine (SAA)	40	61	46	43	57	28	26	24	23	23	22

KEY: KT: Katsina, TMW WSKS: *Tuwon masara* (white) served with *Kuka* soup, TMY SWKS: *Tuwon masara* (yellow) served with *Kuka* soup, SWGOP: served with groundnut oil and pepper, AAA; aromatic amino acids, SAA; sulfur amino acid.

The quality of the proteins can be determined in relation to the composition of a standard protein, which is recognized as the most relevant for the assessment of the protein quality in the nutrition of all population [1]. The Joint FAO/WHO/UNU Expert Consultation [12] has recommended that the composition of amino acids in local and regional diets should be taken into consideration to determine the chemical composition of diets and estimate of their protein quality. Therefore, in order to better assess the nutritional quality of the prepared diets, the indispensable amino acids of the diets were used to calculate the amino acid score [12]. The amino acid score of the prepared diets though higher than the standard amino acid score established by the Joint FAO/WHO/UNU Expert Consultation [12] may support the normal growth of infant, children as well as adults except lysine of JG and KT *Danwake* SWGOP. Though lysine of KN *Danwake* SWGOP and rice and beans may provide the mg/g protein requirement for all age groups when compared with the Joint FAO/WHO/UNU Expert Consultation [12], but it has the lowest amino acid score in relation to other prepared diets. Lysine content of TMW and TMY SWKS may help support normal growth of adults whereas that of JG *Moimoi* may support the normal growth of all age groups.

The limiting amino acid was found to be either lysine (Lys) or methionine + cysteine (SAA) in all the selected prepared diets of the three states. While, histidine (His) was found to be the amino acid with the highest score in all the diets except in JG *Moimoi* and KN *Danwake* where AAA (Phe + Tyr) and Leu were the highest score, respectively. The low levels of Lys and

SAA in some of the diets may be due to low contents of these amino acids in the ingredients used in preparing the diets. According to Graciela [13], beans was reported to have low nutritive value due to low contents of certain EAA, particularly sulfur-containing amino acids (e.g., Met) and Trp. The joint WHO/FAO/UNU

Expert Consultation [13] also reported Lys as the likely limiting amino acid in cereals. The first limiting amino acids; lysine and SAA (Met + Cys) in the selected prepared diets play important role to human health. A reduced supply of lysine in the diet may lead to mental and physical retardation because it constitutes an essential precursor for the *de novo* synthesis of glutamate, the most significant neuron-transmitter in the mammalian central nervous system [1]. Methionine is the major donor of the methyl group to affect DNA and protein methylation in cells [14]. Cysteine is a nutritionally semi-essential amino acid present mainly in the form of L-Cys in the extracellular space [15]. The balance between L-Cys and L-cystine plays a vital role in controlling redox potential, synthesis of other active substrates (GSH, H_2S, and taurine), oxidative stress, and inflammatory response [16]. Dietary intake of sulfur amino acids affects cell signaling via modulating intracellular concentrations of L-Cys and L-cystine, as well as L-cysteine/L-cystine redox state in the postprandial period [17]. Therefore, L-Cys is not only a building block of protein, but also a regulator of cell signaling pathways and hence, classified as a functional amino acid in nutrition [18].

Histidine (His) which was found to be the amino acid with the highest score in all the three states diets except in JG *Moimoi* and KN *Danwake* plays an important role in hemoglobin. According to he Joint WHO/FAO/UNU Expert Consultation [12], when a histidine-deficient diet is consumed for a prolonged period, a decrease in hemoglobin, in conjunction with a rise in serum iron is observed. Therefore, if there is limited dietary supply, histidine pools may be maintained through the release of histidine from the degradation of hemoglobin [12, 19], and also through the reduction in hemoglobin synthesis [12]. Histidine may also be released from carnosine (Alanyl-L-histidine), a dipeptide presents in large quantities in skeletal muscle [12].

The protein quality of foods for human consumption through the use of amino acid profiles and amino acid scores can provide added value to the national food composition tables and international food databases [13]. It can be observed that all the calculated amino acid score of the prepared diets is higher than the standard amino acid score established by Joint WHO/FAO/UNU Expert Consultation [12]. According to Munro [20], when excessive amounts of amino acids are consumed, catabolism by enzymes in the liver is accelerated indicating intake exceeds requirements. Intakes of large amounts of amino acids can produce toxicities, in which plasma concentrations of the administered amino acid rise to very high levels. Elevated levels of amino acids and their products (e.g., ammonia, homocysteine, and asymmetric dimethylarginine) are risk factors for neurological disorders, oxidative stress, and cardiovascular disease [1]. Increased ammonia in the body is toxic and may lead to brain malfunction and coma. Brain has a high capacity for active transport of neutral, dibasic, and dicarboxylic amino acids, e.g., elevation of phenylalanine or leucine, isoleucine and valine results in increased uptake of these amino acids into the brain, altering brain function leading to a variety of neurological problems such as impaired brain development and altered behavior and mental function [15]. Therefore, overconsumption of these selected prepared diets may results in neurological issues in the study area later in life. However, the increased uptake of some amino acids such as tryptophan and tyrosine by the brain is particularly important because these amino acids act as precursors for a variety of hormones and/or neurotransmitters or modulators of nerve function (e.g., melatonin, serotonin, and dopamine) [15]. In addition, changes in the free amino acid levels in the brain signal the nervous system centers regulating food consumption and eating patterns. This central nervous system mechanism may even determine the proportions of protein and of energy-yielding nutrients selected in the diet through a mechanism regulated by the entry of tryptophan and other neurotransmitter precursors into the brain [15]. In addition to neurological issues, amino acids in excess of requirement may also affect kidney function since one of the major functions of the kidney is the elimination of products of protein and amino acids metabolism [21]. It is not surprising, therefore, that protein intake exerts many diverse effects on the kidney. There are three ways in which high protein/amino acid intake may play a role in the development of renal disease: promotion of nephrolithiasis, enhancement of the morbidity of acute renal failure, and acceleration of glomerulosclerosis. Therefore, prolong consumption of these selected prepared diets may precipitate neurological and kidney problems in the study area.

5 Conclusions

This study showed that the prepared diets of the three states under study contain higher content of total NEAA when compared with total EAA contents. The amino acid score of the prepared diets though higher than the standard amino acid score established by WHO/FAO/UNU may support the normal growth of infant, children as well as adults except lysine. Further studies should determine protein digestibility-corrected amino acid score (PDCAAS) and digestible indispensable amino acid score (DIAAS) of the diets in addition to the evaluation of the amino acid profile and amino acid score of the diets.

Acknowledgments: None.

Author contribution: All authors contributed to writing and reviewing the manuscript.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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Cite this article as: Dangambo, M.A., Alhassan, A.J., Kano, A.M., Abubakar, H., Muhammad, Z.S. (2022). Amino acid profile and scores of some selected traditional diets commonly consumed in northwest zone, Nigeria. *The North African Journal of Food and Nutrition Research, 6*(13): 22-28. https://doi.org/10.51745/najfnr.6.13.22-28