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BREED EFFECT ON MILK AMINO ACIDS PROFILE OF SELECTED INDIGENOUS BREEDS OF CATTLE IN NIGERIA

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ABSTRACT

Milk from the indigenous breeds in Nigeria is the most consumed by the populace. The certainty of the quality of the milk produced from this traditional pastoralists in Nigeria are unknown to most consumers. This work aimed at investigating the differences caused by breeds on the amino acid constituents of the milk of four breeds of cattle (Red Bororo, Adamawa Gudali, White Fulani and Sokoto Gudali) in Mubi. A total of eighty (80) milk samples (20 each per breed) were collected and analyzed for amino acids profile. The result indicated a significant($P<0.05$) effect of breed on means of Lysine, Methionine, Isoleucine, phenylalanine, Valine, Tryptophan, Tyrosine, Aspartic acid and Glutamic acid while Threonine, Leucine, Histidine, Arginine, Serine, Cysteine, Alamine, Glycine and Proline were not significantly ($P>0.05$) affected by the breed. White Fulani recorded the highest in Glutamic acid, Red Bororo recorded the highest in Isoleucine), Valine, Tryptophan while Adamawa Gudali had the highest in Phenylalanine. Principal component (PC) 1 and 2 in each of the breeds accounted for over 90% percent cumulative variance suggesting that most of the amino acids in the milk of cows studied are varied within PC1 and PC2. There is no significant ($p>0.05$; $r = -0.10 – 0.22$) correlation between lysine with threonine, phenylalanine and serin and glutamic acid; valine with aspartic acid; threonine with valine and glutamic acid but a perfect correlation ($p<0.001$: $r = 1.00$) exist between tryptophan with isoleucine; histidine with glycine and valine with cysteine. It is therefore concluded that milk from Red Bororo had a better immune property than the other counterparts. The component 1 and 2 should be maximized in choosing the lantern variables that codes for amino acids profile in Nigerian cattle.

Keywords: Milk, Amino acids, Nigerian cattle, Breed effect

INTRODUCTION

The quantity and quality of milk available for human consumption from ruminant breed is still a global concern because food composition has a direct relationship with human health (Jauhiainen and Korpela, 2007; Rafiq *et al*., 2016). Milk has been considered to be complete food for both man and animal. Milk is vital in nutrition and for building healthy society that can be used as a tool for rural development especially where diets are mostly cereal-based (Rafiq *et al*., 2016; Zhou *et al*., 2018). Dietary wise, milk is regarded as "the most nearly perfect food" (Alade *et al*., 2013. It supplies essential nutrients in a valuable amounts than most single food. As a food, milk is important for reproduction, growth, maintenance, supply of energy, repair and appetite satisfaction (Alade *et al*., 2013; Dandare *et al*., 2014; Oladapo and Ogunekun, 2015). Milk as a perfect food is composed of a complex mixtures of proteins, carbohydrates, minerals, vitamins and other compositions in definite proportions (Nickerson, 1999; Heinrichs *et al*., 2005; Matei *et al*., 2010; Dandare *et al*., 2014)

Proteins are the most essential composition of the human diet that is important for nutritional, biological, and functional properties (Rafiq *et al*., 2016). Amino acids are precursors for the synthesis of many nitrogenous substances with various biological significance (Wu, 2009, 2010). They are the building blocks of protein and are high in biological values that have several functions such as antimicrobial, growth factors, enzymes, some bioactive, peptides cytokinines, nucleotides as well as acting as hormones, growth factors, antibodies, enzymes, and immune stimulants (Schaafsma, 2000; Haug *et al*., 2007). Milk products are good alternate sources of essential and non-essential amino acid as a way of improving protein nutrition (Haug *et al*., 2007; Barłowska *et al*., 2011)

Cow milk is the universally and most acceptable commercial milk. Milk supply from indigenous breeds of cattle in Nigeria forms an important aspect of the agricultural business of the smallholder economy with great financial, nutritional, and social advantantages (Hang *et al*., 2007; Oladapo and Ogunekun, 2015). Local breeds of cattle are the major suppliers of milk, providing about 90% of the total domestic milk output (Walshe *et al.*, 1991; Oladapo and Ogunekun, 2015) and the white Fulani breed is said to be the principal milk producer (Adeneye, 1989; Alphonsus *et al*., 2012; Adesina, 2012).

Factors that affect milk quality and composition include the stage of milking methods, lactation, , season, environmentdiet, feeding system, breed, species among many others (Kittivachra *et al*., 2007; Adesina, 2012; Dandare *et al*., 2014; Rafiq *et al.,* 2016). Milk contains eighteen (18) amino acids:the essential (Histidine, Leucine, Phenylalanine, Valine, Threonine, lysine, Methionine, Arginine, Isoleucine, and Tryptophan) and non-essential amino acid (Proline, Cysteine, Tyrosine, Alanine, Serine, Aspartic acid, Citrulline, Glutamic acid)(U.S Department of Agriculture Nutrient Database, 2013).Thus, the analyses of the amino acids profile in milk is essential for the quality evaluation of proteins and peptides that can affect the chemical and nutritional properties of milk (Marino *et al*., 2010).

The use of Principal Component Analysis as a data reduction procedure helps researchers to organize variables into specific informative lantern variables. Principal Component Analysis is a mathematical method that reorganizes information in a data set of sample into a number of limited hidden lantern variables that are extracted to explain correlation among the observed variables, (Ogah *et al*., 2009; Macciotta *et al*., 2015). Principal component analysis considers a group of attributes that may be used for achieving a specific purpose (Ogah *et al*., 2009). Accurate knowledge of correlations that exist for reproductive traits is important for the construction of selection indices that can be used to maximize the response in genetic improvement. Furthermore, the multivariate analysis is an excellent tool for identifying traits that can be selected for genetic improvement purposes (Abdul-Rafiu *et al*., 2018). According to Beiragi *et al.* (2012), selection based on the result of Multivariate analysis is more effective than when such traits are studied individually (Abdul-Rafiu *et al*., 2018).

Although, several researches have been carried out on the amino acids profile of milk of different cattle breeds and localities, yet, there is dearth of literature on the milk amino acids of cows reared in the traditional/pastoral management setting of the tropic in Nigeria. Therefore, this study was carried out to evaluate the effect of breed on the amino acids profile of indigenous cattle under extensive system of rearing with a view to providing updated information and scientific data to develop a baseline for dairy farming in the study area.

MATERIALS AND METHODS

Study Location

The study was carried out at Digil ward of Mubi North Local Government Area of Adamawa State, Nigeria. Mubi is located between latitude 10°16N of the equator and longitude 13°16E of the Greenwich meridian, and has an elevator of 580.95 meters above sea level. Mubi lies on the west bank of Yedzaram River, a streams that flows into Lake Chad and is situated on the western flanks of the Mandara Mountain. The area falls under the Sudan Savannah belt of Nigerian vegetation (Adebayo *et al*., 2020). Mubi is characterized by wet and dry, tropical climate. The temperature regime is warm to hot throughout the year, however, there is usually a slight cool period between November and February. There is gradual increase in temperature from January to April. The minimum and maximum temperature of the area are 18.1°C and 32.8°C and the mean annual rainfall normally commences in June and end around October. Mubi is bounded in the north by Borno state, in the west by Hong local government area, in the southern by Maiha local government area and in the east by Republic of Cameroun, Mubi is predominated by farmers, traders and cattle rearers (Ovimaps, 2018; Adebayo *et al*., 2020).

Experimental Animal and Management

Four breeds of indigenous cattle were used for the study, comprising White Fulani (WFC), Red Bororo (RBC), Sokoto Gudali (SGC) and Adamawa Gudali (AGC).These cattle are owned by the pastoralist of the same herd and are reared extensively in a temporary settlement in the study area. Supplementary feeding is uncommon in the study area. Routine grazing is carried out; they were fed on natural pasture mainly of guinea grass and other forages. A total of eighty (80) (20 from each breed) lactating cows were used for the experiment. The lactating cows were within their first parity and early lactation stage.

Data Collection

Conventional hand-milking was used by the Fulani herdsman on the farm between 06.00h and 07.30h at point of data collection. Fresh milk samples for amino acids profile analysis were collected in some labeled hygienic plastic containers. Routine veterinary care was given to each cow and their nipples were also sterilized with cotton diluted with ethanol prior to milking. Samples were collected before morning grazing where the young ones were allowed to suckle for few minutes to initiate milk letdown. The samples were then transported to the Nutrition laboratory of the Department of Animal Production, Adamawa State University, Mubi in an ice-filled box for Amino acid profile analysis.

Determination of amino acid value

Labeled milk sample collected were defatted and utilized to estimate amino acids profile. The sample (30 mg) was hydrolyzed with ON HC1 at 110°C for 24 hours according to AOAC, (2000). Amino acid analysis was performed on reverse phase-high pressure liquidchromatography (HPLC) (Buck Scientific BLC 10/11 USA). The post column samples were derivatized with o-phthaldialdehyde and data was integrated using peak simple chromatography data system (Buck Sci. Chromatopac data processor) (AOAC, 2000).

Parameters analyzed

The parameters analyzed were the essential (Histidine, Phenylalanine, lysine, Methionine, Threonine, Arginine, Leucine, Isoleucine, Valine and Tryptophan) and non-essential amino acid (Proline, Cystein, Tyrosine, Alanine, Serine, Aspartic acid and Glutamic acid) amino acids.

Calculation of the Amino Acid Value from the Chromatogram: The amount of each amino acid present in each sample will be calculated in g/100g as described by Spackman and Moor (1958).

DATA ANALYSES

Statistical Model

$Y_{ij} = \mu + B_i + e_{ij}$

Where, μ = general mean, B_i = i^{th} fixed effect of breed (B = 4), and e_{ijk} = experimental error.

Statistical Analysis

Data gotten from the Laboratory analysis of the milk amino acids profile of the selected indigenous breeds of cattle were subjected to analysis of variance (ANOVA) using General Linear Model of SAS, 9.0 (2004). Means with significant differences were separated using Duncan Multiple Range Test (Duncan, 1955). Principal Component analysis and correlation coefficients were computed using the data reduction procedure of SPSS. 16.

RESULTS AND DISCUSSION

Table 1 shows the effect of breed on milk amino acid profile of some selected indigenous breeds. Significant ($P<0.05$) difference was observed among the means of lysine, Methionine, Isoleucine, Phenylalanine, Valine, Tryptophan, Tyrosine, Aspartic acid and Glutamic acid while the means of

Threonine, Leucine, Histidine, Anginine, Serine, Cystein, Alamine, Glycine and Prolinewere not significant (P>0.05).White Fulani cattle milk recorded the highest (11.77g/100g) in Glutamic acid. Glutamic acid is the most abundant of all amino acids and it is reported that dietary glutamine is pre-requisite for intestinal mucosal integrity (Abu-Tarboush and Ahmed, 2005; Wu, 2010; Salmen *et al*., 2011; Zhou *et al*., 2018). Also, Glutamate, glutamine and aspartate play important roles in regulating gene expression, cell signaling, ant oxidative responses and immunity (Yao *et al*., 2008; Bruhat *et al*., 2009; Wu, 2010). Therefore, milk from White Fulani can be considered the best for anti-oxidative responses and immunity since it recorded the highest values in Glutamic and aspartic acids. White Fulani has been reported to be the principal milk producer (Adeneye, 1989; Adesina, 2012). The finding in this study contradict the report of Adesina, (2012) who reported non-significant breed variations in Glutamic acids of Red Bororo ,White Fulani and Muturu breeds of cattle in Ado Ekiti, Nigeria. Glutamic acid was reported to be higher in Czech Flekvieh (6.02 than in Holstein (5.83). Differences in the amino acid profile of milk proteins of milk between cattle breeds and their crosses in several other studies were also mentioned (Mapekula *et al*., 2011; Ren *et al*., 2015; Rafiq *et al*., 2016). Higher Glutamic acid was reported in Shami and Jamnapari and it was reported to be important amino acids necessary in healthy brain functions (Hall *et al*., 2003; Mohsin *et al*., 2019). The discrepancies observed may be due to differences in vegetative zones and weather conditions of the milking location, herd management, stage of lactation, animal health status, milking method, diet and feeding system (Smith *et al*., 2000; Kittivachra*et al*., 2007; Adesina, 2012; Rafiq *et al*., 2016).

Red Bororo cattle recorded the highest in lysine (5.09 g/100g), Methionine (1.90 g/100g), Isoleucine (3.91 g/100g), Valine (6.21 g/100g), and Tryptophan (5.01 g/100g). This implied that milk of Red Bororo breed of cattle has the highest composition of the essential amino acids. In addition, Cysteine and Methionine are sulfur-containing amino acids which can be utilized in a many important dietary manipulation to improve immune system by serving as antioxidant (Hall *et al*., 2003; Mohsin*et al*., 2019). The milk of Red Bororo may be a good source of antioxidants because sulphur containing amino acids (Methionine and Cysteine) are good boosters of immune functions through intracellular conversion to glutathione. These proteins are the subject of great attention for specific dietary manipulations that aim to enhance host defenses (Hall *et al*., 2003; Rafiq *et al*., 2016). Also, this breed seems to have a better source of branched chained amino acids (Valine and leucine) which are important for maintenance of body tissue, growth, repair and prevention of many catabolic actions during exercise (Ha and Zemel, 2003; Rafiq *et al*., 2016). Also, lysine, Methionine and Threonine are the most limiting amino acids in various protein sources. They are strictly indispensable, sensitive to catabolism and important for protein synthesis (Rafiq*et al*., 2016). Adesina, (2012) also observed breed differences in lysine, Glycine, Isoleucine with Red Bororo having the highest values. They also reported that the red bororo had the highest recorded total amino acids followed by Muturu then White Fulani. Also, Krizova *et al*. (2013) also observed breed differences in amino acid composition of Czech Fleckvieh and Holstein breeds of cattle.

Adamawa Gudali cattle milk had the highest (6.23 g/100g) in Phenylalanine. Adesina (2012) also reported breed difference in phenylanine of White Fulani, Red Bororoand Muturuand reported Phenylalanine content in Red Bororo was higher in value than White Fulani.

Table 2 shows the principal component analyses of amino acid profile of different the four breeds. Two principal components were extracted each. Principal component (PC) 1 and 2 in each of the breeds accounted for over 90% percent cumulative variance (Table 2). In White Fulani, PC 1 has high loading for most of the measured amino acids except for lysine and Leucine which has high loadings in PC 2. In Red Bororo, all traits measured has high loading in PC 1. In Adamawa Gudali, all traits measured had high loading in PC 1except for Isoleucine that has high loading in PC2. In SokotoGudali, PC 1 had high loading for most of the traits except for Threonine, Aspartic acid and Glutamic acid that has high loading in PC 2.

The principal component analysis provides essential information by identifying major characters contributing to the observed variation (Abdul-Rafiu*et al*., 2018). The first PC is the direction through the data that explains the most variability in the data (Smith *et al.,* 2000). From the PCs extracted, most of the amino acids in the milk of cows studied are varied within PC1. Amino acids have been classified into groups using different criteria (Horovitz and Pasca, 2017). These groups are aliphatic, aromatic, basic, acidic and nutral (Horovitz and Pasca, 2017). Based on the PCs in SokotoGudali,PC2 could serve as an index for acidic amino acids (Glutamic and Aspartic acids) (Horovitz and Pasca, 2017) and therefore serve as an index for anti-oxidative and immune responses because of the roles they play in regulating gene expression, cell signaling, antioxidative responses and immunity (Yao *et al*., 2008; Bruhat*et al*., 2009; Wu, 2010). Lysine and Methionine are having high loading in all the breeds which are the two most important amino acids in cows associated with increase protein synthesis for health and fertility, growth and nitrogen balance (National Research Council, NRC, 2001). Valine, Leucine and Isoleucine had high loading in all the breeds in PC1. Alanine, Valine, Isoleucine, and Leucine are aliphatic chains which are regarded as positive factors for the increase of thermos-stability (Dauda*et al*., 2017).

Correlation coefficients of the pooled amino acids profiles of the four genotypes are presented in table 3. There is no significant ($p>0.05$; $r = -0.10 – 0.22$) correlation between lysine with threonine, phenylalanine and serine; leucine with glutamic acid; phenylalanine with valine and glutamic acid; valine with aspartic acid; threonine with valine and glutamic acid. There is a perfect correlation ($p<0.001$: $r = 1.00$) between tryptophan with isoleucine; histidine with glycine and valine with cysteine. There is little information on the correlation that exists among the amino acids profile. However, Horovitz and Pasca, (2017) reported a significant correlation among some properties of amino acids. By implication also, those amino acids that had perfect correlation are said to be controlled by the same gene (Pleoitropy) (Fayeye, 2014; Adedibu *et al*., 2016; Abbaya *et al*., 2018). Also, difference observed in the magnitude and direction of relationship between the various breeds studied could be as a result of fact that breed can influence these traits particularly that they are moderately to highly correlated and inherited together (MCphee, 2001; Kosum *et al*., 2004; Adedibu *et al*., 2016; Abbaya *et al*., 2018)

Table 1: Effect (Means ± SE) of breed on milk amino acid profile of four indigenous breeds of cattle

Traits (g/100g)	White Fulani	Red Bororo	Adamawa Gudali	Sokoto Gudali

Lysine	2.57± 0.18^{b}	5.09±0.31^{a}	3.65±0.28^{b}	2.93±0.77^{b}
Methionine	1.22± 0.16^{ab}	1.90±0.31^{a}	1.10±0.26^{b}	1.33±0.21^{ab}
Threonine	2.64± 0.32	2.70±0.15	2.12±0.36	2.54±0.27
Isoleucine	2.86± 0.13^{b}	3.91±0.44^{a}	2.95±0.06^{b}	3.18±0.39^{ab}
Leucine	7.10± 0.34	7.90±0.42	7.66±0.47	7.52±0.34
Phenylalanine	4.07± 0.21^{ab}	4.15±0.28^{ab}	6.23±1.45^{a}	3.73±0.26^{b}
Valine	4.37± 0.24^{b}	6.21±0.70^{a}	4.70±0.43^{ab}	4.79±0.72^{ab}
Tryptophan	3.88± 0.15^{b}	5.01±0.26^{a}	3.58±0.41^{b}	4.23±0.48^{ab}
Histidine	2.12± 0.18	3.22±0.39	2.17±0.24	2.71±0.49
Arginine	4.52± 0.22	5.48±0.44	4.54±0.41	5.09±0.55
Serine	3.49± 0.22	3.73±0.18	3.11±0.31	3.32±0.17
Cysteine	0.82± 0.11	1.09±0.18	0.59±0.09	1.24±0.44
Tyrosine	4.97± 0.36^{a}	5.09±0.33^{a}	3.40±0.14^{b}	5.02±0.50^{a}
Alanine	3.05± 0.29	4.46±0.53	3.64±0.16	3.70±0.74
Aspartic acid	9.75± 0.23^{a}	5.56±0.35^{b}	8.95±0.83^{a}	6.38±0.49^{b}
Glutamic acid	11.77± 0.45^{a}	5.95±0.63^{c}	8.94±0.67^{b}	5.25±1.48^{c}
Glycine	3.79± 0.30	4.75±0.74	3.96±0.37	4.61±0.63
Proline	2.05± 0.17	2.22±0.33	2.67±0.34	2.28±0.28

abc means within the row with different Superscripts are statistically different ($p < 0.05$), SE = Standard error

Table 2: Share of total Variance along with Factor Loadings and Communalities of milk Amino acids profile of some selected Indigenous breeds of cattle

	White Fulani			**Red Bororo**			**Adamawa Gudali**			**Sokoto Gudali**		
Trait	PC1	PC2	COMM	PC1	PC2	COMM	PC1	PC2	COMM	PC1	PC2	COMM
Lysine	0.53	.847	.995	.973	.027	.947	.963	.251	.991	.774	-.466	.962
Methionine	0.99	-.104	.990	.993	-.039	.988	.881	.430	.962	.903	-.366	.987
Threonine	0.97	-.231	1.000	.959	.202	.960	.850	.065	.726	.633	.667	.973
Isoleucine	.957	.240	.974	.989	.057	.981	.096	.957	.925	.951	.007	.997
Leucine	.322	.943	.994	.969	.226	.990	.952	-.041	.909	.860	.497	.996
Phenylalanine	.996	.070	.998	.903	.351	.939	.950	-.300	.991	.682	.658	.945
Valine	.980	-.183	.994	.929	-.264	.932	.988	-.133	.994	.752	-.591	.996
Tryptophan	1.000	.011	1.000	.970	-.027	.941	.997	-.034	.994	.962	.068	.999
Histidine	.992	-.095	.994	.968	-.218	.984	.981	.168	.990	.933	-.081	.974
Arginine	.988	-.154	1.000	.938	-.330	.989	.969	-.226	.990	.956	.000	.984
Serine	.834	.132	.714	.740	.606	.915	.955	-.147	.934	.742	.597	.978
Cysteine	.998	.043	.997	.854	.443	.926	.946	-.262	.965	.804	-.519	.998
Tyrosine	.994	-.089	.996	.824	-.544	.975	.968	-.086	.944	.928	.371	.999
Alanine	.975	-.219	.999	.828	.450	.888	.991	-.004	.982	.975	-.190	1.000
Aspartic acid	.999	-.030	.999	.870	-.421	.934	.978	-.180	.989	.679	.695	.971
Glutamic acid	.993	-.007	.987	.948	-.273	.972	.973	.231	1.000	.650	-.717	.999
Glycine	.986	-.164	.999	.938	-.335	.992	.957	.258	.983	.934	-.059	.953
Proline	.994	.042	.989	.969	.213	.985	.975	-.044	.953	.912	-.324	.995
%variance	87.29	87.29		85.106	10.650		86.733	8.944		71.087	20.785	

PC1 and 2 = Principal Component 1 and 2, COMM = Communality

Table 3: Correlation Coefficients of pooled milk Amino Acids Profile of breeds of cattle

	Lys	**Meth**	**Thre**	**Isol**	**Leu**	**Phe**	**Val**	**Try**	**His**	**Arg**	**Ser**	**Cys**	**Tyr**	**Ala**	**Asp**	**Glu**	**Gly**
Meth	0.82**																
Thre	0.01	0.38*															
Isol	0.86**	0.80**	0.49*														
Leu	0.41*	0.62**	0.90**	0.80**													
Phe	0.18	0.44*	0.91**	0.60**	0.95**												
Val	0.76**	0.96**	0.17	0.63**	0.38*	0.20											
Try	0.82**	0.80**	0.55**	1.00***	0.84**	0.65**	0.61**										
His	0.85**	0.79**	0.45*	0.97**	0.72**	0.48*	0.65**	0.97**									
Arg	0.82**	0.80**	0.53*	0.98**	0.79**	0.56**	0.63**	0.98**	0.99**								
Ser	0.17	0.49*	0.99**	0.62**	0.95**	0.92**	0.27*	0.68**	0.59**	0.66**							
Cys	0.76**	0.98**	0.26*	0.68**	0.46*	0.28*	1.00**	0.66**	0.70**	0.69**	0.36*						
Tyr	0.56**	0.70**	0.82**	0.89**	0.98**	0.88**	0.48*	0.92**	0.84**	0.89**	0.90**	0.55**					
Ala	0.80**	0.97**	0.53*	0.89**	0.75**	0.56**	0.88**	0.89**	0.89**	0.90**	0.64**	0.92**	0.83**				
Asp	0.30*	0.35*	0.81**	0.71**	0.93**	0.92**	0.07	0.75**	0.60**	0.67**	0.85**	0.15	0.90**	0.51**			
Glu	0.73**	0.89**	0.03	0.54**	0.22	0.02	0.98**	0.51*	0.59**	0.56**	0.13	0.97**	0.33*	0.80**	-0.10		
Gly	0.81**	0.79**	0.49*	0.96**	0.74**	0.49*	0.64**	0.96**	1.00***	0.99**	0.62**	0.69**	0.84**	0.89**	0.60**	0.59**	
Pro	0.75**	0.98**	0.46*	0.79**	0.64**	0.45*	0.94**	0.79**	0.81**	0.81**	0.56**	0.97**	0.72**	0.98**	0.34*	0.89**	0.82**

Lys = lysine; Meth= methionine; Thr= threonine; iso= isoleucine; leu= leucine; phe= phenylalanine; val= valine; try= tryptophan; his=histidine; arg= arginine; ser= serine; cys= cysteine; tyr=tyrosine; ala= alanine; asp=aspartic acid; glutamic acid; gly=glycine; pro=proline; *= significant at 0.05; **= significant at 0.01; ***= significant at 0.00

CONCLUSION

It is therefore concluded that milk from Red Bororo had a better immune property than other indigenous cattle. Principal component (PC) 1 and 2 in each of the breeds accounted for over 90% percent cumulative variance suggesting that most of the amino acids in the milk of cows studied are varied within PC 1 and PC2. More researches on amino acids of the indigenous breeds is recommended with larger number of indigenous cattle to be able to have a more comprehensive properties of the milk of the Nigerian cattle

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