# AMINO ACID PROFILE OF MILK FROM THREE INDIGENOUS BREEDS OF GOATS RAISED UNDER SEMI-INTENSIVE MANAGEMENT SYSTEM

**[2]Dauda, D., [1]Henry, A. J*.,[1]Ohakposim, V. C. and [1]Khaizer, F. A[+].**
[1]Department of Animal Science, Faculty of Agriculture, University of Calabar, Cross River State, Nigeria.
[2]Department of Animal Production and Health, Faculty of Agriculture and Life Sciences, Federal University Wukari, Taraba State, Nigeria.
*Corresponding Author: fimmahenry@gmail.com

## ABSTRACT
*A study was conducted to evaluate the amino acid profile of milk from three indigenous breeds of goats. A total of thirty goats, comprising ten each of Sahel, Red Maradi, and West African dwarf, were used for the study. The animals were carefully selected from those that had gone through their first parity. For the study, five (5) milliliters of milk were collected from each of the experimental animals and carefully identified according to their breeds for milk amino acid profiling. Results from the study showed that West African dwarf goat milk had significantly (p<0.05) higher values in all eighteen milk amino acids (essential and non-essential) profiled. Leucine was most abundant among the amino acids in the milk collected, with values of 7.75 g/100g, 8.68 g/100g, and 10.86 g/100g for Sahel, Red Maradi, and West African Dwarf, respectively. Whereas methionine had the least values of 1.28 g/100g (Sahel), 2.00 g/100g (Red Maradi), and 3.21 g/100g (WAD). The principal component of milk amino acids in experimental goats showed higher loading for all the traits in the West African dwarf goat, followed by the Sahel and Red Maradi goats. Therefore, West African dwarf goats can be considered the best for milk amino acid composition. This study therefore recommends that farmers use more of the West African dwarf goat breed from the indigenous breeds available to obtain good-quality milk owing to its superiority in most of the milk amino acids evaluated in this study. This will make for better exploration and improvement of the breeding potential.*
**Key words: Amino acid, indigenous goats, milk, management**

## INTRODUCTION
The ability of goats to scavenge from the limited resources available and generate milk and meat makes them extremely vital in nations with limited animal food supplies (Iastate, 2021). According to Mahony *et al.* (2014), milk is a fluid that is released by female mammals and is essential for meeting the nutritional needs of newborns. Vitamins, fatty acids, necessary amino acids, water, inorganic elements, and energy (lipids and lactose) are the primary components of milk (Geocache *et al*., 2014). A great source of many important elements, goat milk is a highly healthy beverage. Proteins are made up of amino acids, which are also necessary for many bodily physiological functions. One of the key elements in assessing the nutritional value of milk is its amino acid makeup. Variances in the amino acid profiles of different breeds of goats can be attributed to dietary variances, environmental influences, and genetic variants (Kamara and Afolayan, 2010). This study was designed to provide information on the amino acid profile of milk obtained from three indigenous breeds of goats for the purposes of nutritional assessment, breed comparison, and consumer health.

## MATERIALS AND METHODS
The study was carried out in Calabar and its environs. A total of thirty (30) does, comprising ten (10) each of West African dwarf, Red Maradi, and Sahel goats, were used for the study. The animals were randomly selected from doe populations that had gone through the phase of first parity. These animals were raised under semi-intensive conditions. About 5 mL of milk was collected each from the goats and carefully identified according to their breeds. The milk samples were collected into free EDTA sample bottles for amino acid profiling. The amino acid profiling was performed as described by AOAC (2000). The amino acids analyzed were the essential amino acids (histidine, phenylalanine, lysine, methionine, threonine, arginine, leucine, isoleucine, valine, and tryptophan) and non-essential amino acids (proline, cysteine, tyrosine, alanine, serine, aspartic acid, and glutamic acid). The calculation of the amino acid value was obtained from the chromatogram. The amount of each amino

acid present in each sample was calculated in g/100g as described by Spackman and Moor (1958). Data obtained from the laboratory on the amino acid profiles of the three indigenous breeds of goats were subjected to one-way analysis of variance (ANOVA) using the general linear model of SAS (2004) version 9.0. The significant mean for the amino acid profile of milk samples was separated using least significant differences (LSD). The principal component analyses were computed using the data reduction procedures of SPSS 16. The statistical model used for the study was

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

where $Y_{ij}$ is the observation, $\mu$= overall mean, $B_i$= fixed effect of $i^{th}$ breed (B=3) and $E_{ij}$ = experimental error.

## RESULTS AND DISCUSSION

### Influence of breeds on milk amino acids profile of goats

Table 1 shows the influence of breeds on goats' milk amino acid profiles. The means of all the amino acid compositions in the three goat breeds (Sahel, Red Maradi, and West African Dwarf) showed significant ($p < 0.05$) variations. When compared to Sahel and Red Maradi goats, the West African dwarf (WAD) goats performed better in all eighteen (18) milk amino acids. When it came to non-essential amino acids like serine (4.62 g/100g) and glutamic (7.08 g/100g), the Red Maradi goat outperformed the Sahel goat, with respective values of 3.71 g/100g and 3.57 g/100g. However, compared to Red Maradi goat and WAD milk, Sahel goat milk had a lower concentration ($p < 0.05$) of all important amino acids. With values of 7.75 g/100g, 8.68 g/100g, and 10.68 g/100g for Sahel, Red Maradi, and WAD goats, respectively, leucine was the most abundant milk amino acid. Methionine, on the other hand, had the lowest levels, at 1.28 g/100g, 2.00 g/100g, and 3.21 g/100g. According to Ayadi *et al*. (2014), there may be a low concentration of sulfur amino acids in the milk, which could explain this. WAD is preferred for milk quality due to its superiority in the majority of important amino acids, particularly glutamic acid, which is the most prevalent amino acid and necessary for intestinal mucosal integrity (Zhou *et al.*, 2018). Aspartate, glutamine, and glutamate are crucial for immunity, the anti-oxidative response, and cell signaling (Wu, 2009). Because WAD milk has the highest levels of aspartic and glutamic acids, it can be regarded as the finest milk for immunity and anti-oxidative response. The breed effect can be defined as the result of a species' adaptation to environmental factors (such as food, climate, and water availability) that have an impact on the content and output of milk.

Table 1. Influence of breed on milk amino acids profile of experimental goats

| | Breeds of goats | | | |
|---|---|---|---|---|
| Parameters (g/100g) | Sahel | Red Maradi | WAD | SEM |
| Lysine | $3.06^{b}$ | $3.77^{b}$ | $5.33^{a}$ | 0.32 |
| Methionine | $1.28^{b}$ | $2.00^{b}$ | $3.21^{a}$ | 0.23 |
| Threonine | $3.09^{b}$ | $3.60^{b}$ | $5.48^{a}$ | 0.37 |
| Isoleusine | $3.15^{b}$ | $4.20^{b}$ | $4.46^{a}$ | 0.24 |
| Leusine | $7.75^{b}$ | $8.68^{b}$ | $10.86^{a}$ | 0.43 |
| Phenylalanine | $4.10^{b}$ | $4.63^{b}$ | $5.71^{a}$ | 0.25 |
| Valine | $4.37^{b}$ | $4.64^{b}$ | $6.67^{a}$ | 0.30 |
| Tryptophan | $3.93^{b}$ | $4.61^{b}$ | $5.76^{a}$ | 0.26 |
| Histidine | $2.58^{b}$ | $3.40^{ab}$ | $4.29^{a}$ | 0.26 |
| Arginine | $4.60^{b}$ | $5.25^{b}$ | $6.99^{a}$ | 0.31 |
| Serine | $3.57^{c}$ | $4.62^{b}$ | $7.72^{a}$ | 0.46 |
| Cysteine | $1.37^{b}$ | $2.43^{b}$ | $3.86^{a}$ | 0.33 |
| Tyrosine | $5.10^{b}$ | $5.84^{ab}$ | $7.75^{a}$ | 0.41 |
| Alanine | $2.67^{b}$ | $3.04^{b}$ | $7.05^{a}$ | 0.50 |
| Aspartic acid | $6.66^{b}$ | $7.61^{b}$ | $9.23^{a}$ | 0.36 |
| Glutamic acid | $3.71^{c}$ | $7.08^{b}$ | $9.92^{a}$ | 0.77 |
| Glycine | $3.69^{b}$ | $4.84^{b}$ | $7.63^{a}$ | 0.49 |
| Proline | $2.57^{b}$ | $3.47^{ab}$ | $4.95^{a}$ | 0.35 |

$^{abc}$= means within the row with different superscript are statistically different ($p< 0.05$), SEM = standard error of mean, WAD = West African dwarf

**Principal component analysis of milk amino acids of goats**

Table 2 presents the results of principal component analyses of the amino acid profiles of three distinct goat breeds. Each of the two primary components was extracted. With the exception of alanine in Red Maradi, which accounted for more than 70% of the cumulative variation, principal components (PCs) 1 and 2 in each breed explained more than 90% of the variance. PC 1 has substantial loading for all tested amino acids in Sahelian goats. For the majority of the tested amino acids in Red Maradi, PC1 has high loadings; however, PC 2 has high loadings for lysine, methionine, and glutamic acid. Each trait tested in West African dwarf goats exhibited a high loading in PC 1. The communalities are estimates of the variance in each variable that the components can account for. It varied across Sahelian, Red Maradi, and West African dwarf goats, ranging from 0.950 to 0.996, 0.744 to 0.999, and 1.000. The communality values calculated for the three goat breeds verify that PCA was suitable for the sets of data. Any amino acid with a lower communality shows that its ability to explain the entire diversity in the amino acid profile is limited. PC1 generally possessed the highest percentage of the total variance among the three goat breeds. According to Abdul-Rafiu *et al.* (2018), the principal component analysis identifies the main characters that contribute to the observed variation, hence providing crucial information. According to Smith *et al*. (2000), the first PC is the path through the data that most fully explains its variability. The majority of the different amino acids found in the goat milk under study are found in PC1 of the extracted PCs. Using various criteria, amino acids have been divided into five groups: aliphatic, aromatic, basic, acidic, and neutral (Horovitz and Pasca, 2017). Given that PCs in Sahel goats play important roles in regulating gene expression, cell signaling, anti-oxidative responses, and immunity, PC2 may be used as an index for acidic amino acids (aspartic and glutamic acids) based on the PCs in Sahel goats (Horovitz and Pasca, 2017). All breeds exhibited high loading levels of the two most critical amino acids for cow health and fertility, increased protein synthesis, development, and nitrogen balance: lysine and methionine (NRC, 2001). In PC1, all breeds had elevated levels of valine, leucine, and isoleucine loading. Some aliphatic chains that are thought to contribute positively to an increase in thermostability are leucine, alanine, valine, and isoleucine (Dauda, 2021).

Table 2. Principal component analysis of milk amino acids of experimental goats

| | Sahel | | | Red Maradi | | | WAD | | |
|---|---|---|---|---|---|---|---|---|---|
| Parameters (g/100g) | PC1 | PC2 | COMM | PC1 | PC2 | COMM | PC1 | PC2 | COMM |
| Lysine | 0.989 | -0.068 | 0.984 | -0.032 | 0.986 | 0.973 | 1.000 | 0.000 | 1.000 |
| Methionine | 0.991 | 0.100 | 0.990 | 0.539 | 0.840 | 0.996 | 1.000 | 0.000 | 1.000 |
| Threonine | 0.973 | 0.047 | 0.950 | 0.970 | -0.241 | 0.999 | 1.000 | 0.000 | 1.000 |
| Isoleusine | 0.974 | 0.056 | 0.952 | 0.325 | -0.942 | 0.993 | 1.000 | 0.000 | 1.000 |
| Leusine | 0.975 | -0.159 | 0.976 | 0.824 | -0.553 | 0.985 | 1.000 | 0.000 | 1.000 |
| Phenylalanine | 0.977 | -0.203 | 0.995 | 0.968 | -0.013 | 0.937 | 1.000 | 0.000 | 1.000 |
| Valine | 0.934 | 0.320 | 0.975 | 0.962 | -0.221 | 0.975 | 1.000 | 0.000 | 1.000 |
| Tryptophan | 0.967 | -0.229 | 0.987 | 0.971 | -0.066 | 0.948 | 1.000 | 0.000 | 1.000 |
| Histidine | 0.969 | 0.202 | 0.979 | 0.951 | 0.024 | 0.906 | 1.000 | 0.000 | 1.000 |
| Arginine | 0.967 | -0.192 | 0.971 | 0.970 | 0.165 | 0.967 | 1.000 | 0.000 | 1.000 |
| Serine | 0.981 | -0.029 | 0.964 | 0.928 | 0.342 | 0.977 | 1.000 | 0.000 | 1.000 |
| Cysteine | 0.914 | 0.399 | 0.994 | 0.944 | -0.137 | 0.910 | 1.000 | 0.000 | 1.000 |
| Tyrosine | 0.970 | -0.230 | 0.995 | 0.959 | -0.268 | 0.992 | 1.000 | 0.000 | 1.000 |
| Alanine | 0.927 | -0.316 | 0.960 | 0.857 | 0.096 | 0.744 | 1.000 | 0.000 | 1.000 |
| Aspartic acid | 0.944 | -0.325 | 0.996 | 0.987 | 0.157 | 0.999 | 1.000 | 0.000 | 1.000 |
| Glutamic acid | 0.979 | 0.187 | 0.993 | 0.672 | 0.713 | 0.959 | 1.000 | 0.000 | 1.000 |
| Glycine | 0.985 | 0.099 | 0.979 | 0.952 | 0.239 | 0.964 | 1.000 | 0.000 | 1.000 |
| Proline | 0.919 | 0.368 | 0.980 | 0.967 | -0.200 | 0.976 | 1.000 | 0.000 | 1.000 |

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

**CONCLUSION**

The observed variations in the milk amino acids of Sahel, Red Maradi, and WAD goats may be attributed to variations in their genetic composition, given that they were subjected to comparable management practices. Breeders, milk processors, and farmers ought to explore the superiority of WAD's milk amino acid profile in order to address the animal protein deficiency in Nigeria.

**REFERENCES**


Abdul-Rafiu, A.M., Adebisi, M.A., Oduwaye, O.O., Idowu-Agida O.O. and Olomide, O.A. K (2018). Multivariate evaluation of variations in fruit and seed yield components of different genotypes of cayenne pepper (*Capsicum frutescens*). *Nigeria Journal of Genetics,* 32: 68 - 74.

Association of official analytical chemist (AOAC) (2000). Official methods of analysis of AOAC international. Association of official analysis chemists international (17thed.).

Ayadi, M., Matar, A. M., Aljumaah, R. S., Alshaikh, M. A., Abouheif, M. A. (2014). Evolution of udder morphology, alveolar and cisternal milk compartment during lactation and their relationship with milk yield in Najdi sheep. *Spanish Journal of Agricultural Research,* 12: 1061 - 1070.

Dauda, A. (2021). Expression of Diacyglycerol Acyl transferase 1 (DGAT 1) and Alpha casein s1 genes in the breeds of cattle under extensive system of management. A dissertation Ph.D submitted to the Department of Animal Science University of Calabar Pp 275.

Guetouache, M., Guessas, B. and Medjekal, S. (2014). Composition and Nutritional Value of Raw Milk. *Issues on Biological Science and Pharmaceutical Resources*, 2: 115 - 122.

Horovitz, O. and Pasca, R. D. (2017). Classification of Amino Acids by Multivariate Data Analysis, Based on Thermodynamic and Structural Characteristics. *Studia Universitatis Babes-Bolyai Chemia*, 62(2):19-31

Iastate, E. (2021). Recent Trends in Ruminant Nutrition. *Journal of Animal Nutrition,* 60: 54 - 56.

Kamara M. T, and Afolayan, R. A. (2010). Amino acid profile of goat milk of three different Nigerian breeds. *African Journal Biotechnology,* (16): 2365 -2369.

Mahony, J. A. and Fox, P. F. (2014). *Milk: An Overview. In: Singh H., Boland M., Thompson A., editors. Milk Proteins from Expression to Food*. Elsevier; London, UK. Pp. 32 - 56.

National Research Council (NRC) (2001). Nutrient requirement of daily cattle. 7th Revised Edition. *National Academy of Sciences, Washington, DC.*

SAS (2004). *SAS User's Guide: Statistics.* SAS Institute Inc., Cary, NC., USA series, 3rd edition. McGraw Hill, New York. Pp 433

Smith, L. E., Schonfeldt, H. C., De beer, W. H. J. and Smith MF (2000). The effect of locality and season on the composition of South African whole milk. *Journal of food composition analyses*, 13: 34-367.

Spackman, M. R. and Moor, S. (1958). Automatic recording apparatus for use in the chromatography of amino acids. *Analytical Chemistry*, 30: 1190-1191

Wu, G. (2009). Amino acids: metabolism, functions, and nutrition. *Amino Acids*, 37:1â€“17.

Zhou, L., Tang, O., Iqbal, M. W., Xia, Z., Huang, F., Li, L., Liang, M., Bo-Lin, M., Qin, G. and Zou, C. (2018). A comparison of milk protein, fat, lactose, total solids and amino acid profiles of three different buffalo breeds in Guangxi, China. *Italian Journal of Animal Sciences*, 17(4): 873-878,