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QUANTITATIVE AND QUALITATIVE TRAITS FROM SELECTED BREEDS OF CATTLE AND THEIR RELATIONSHIP IN SEMI ARID ZONE OF NIGERIA

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ABSTRACT

This study was conducted to characterize quantitative and qualitative traits from selected breeds of cattle and their relationship in semi-arid zone of Nigeria. A total of 60 lactating cows comprising of 20 each of Bokoloji, Rahaji and Bunaji breeds of first parity were used. The cows were milked three times in the late rainy season August to September in two weeks interval by the same person across the breed. The milk yield was measured with a graduated cylinder and 20 ml milk sample was used for protein and fat contents analysis. The data obtained were subjected to Analysis of Variance (ANOVA) using Statistical Analysis System (SAS) and significant means were compared using Duncan Multiple Range Test (DMRT). The degree of relationship between all pairs of variables was computed using CORR Procedure of the SAS. The result showed breed had a significant ($P < 0.05$) effect on milk yield, protein content, fat yield and protein content with Bokoloji having a superiority in milk yield (2.18), protein content (4.93), fat yield (6.64) and protein yield (10.78) while Rahaji and Bunaji were statistically same in milk yield (1.56 and 1.82), protein content (4.25and 4.28) and protein yield (6.56 and 7.84) respectively except fat yield (4.70) which was least in Rahaji. There were both positive and negative significant ($p<0.05$-0.01) correlation between milk yield and compositions likewise positive and significant ($p<0.05$-0.01) correlation were observed between milk yield with protein composition, fat yield, protein yield while a negative significant ($p<0.05$) correlation between milk yield and fat in all the three breeds. It was concluded that Bunaji breed was found to be the best in milk improvement programme in the semi-arid zone in Nigeria as it excelled in milk yield (2.18 kg), protein content (4.92%) and protein yield (0.11 kg).

Keyword: Breeds, Milk yield, Cattle, Correlation, Effect

INTRODUCTION

Milk is one of the most valuable foods that contain practically all the nutrients required by human beings for normal growth and development (Walshe *et al*., 1991). Milk is sometimes referred to as the 'nature's complete food'(Barłowska *et al*., 2011). It plays a fundamental role in providing nourishment and immunological protection for the mammalian young (Igbabul *et al*., 2014). Milk earned this reputation by providing many of the essential nutrients that human beings require for normal functioning of the body. Milk serve as an excellent source of proteins and have abundant minerals, particularly, calcium, and vitamins (Igbabul *et al*., 2014).

Cow milk is the most universal raw material for processing dairy products resulting in the broadest spectrum of manufactured dairy products (Igbabul *et al*., 2014). At present, the number of animals bred for dairy purposes abound which include Cattle, Goat, Sheep, Horse, Donkey and Camel (Barłowska *et al*., 2011). In Nigeria, cattle (cow) provide more than 90% of the total animal milk output while goats and sheep provides less than 10% and are kept for production of meat, hides and skin (Walshe *et al*., 1991).

Milk production from indigenous breeds of cattle in Nigeria represents an important component of the agribusiness sector of the smallholder economy with great economic, nutritional, and social implications (Oladapo and Ogunekunn, 2015).

One of the primary goals of the dairy industry has always been to improve the technological properties of milk, including its chemical composition. Milk processing suitability is significantly affected by the proportions of milk components. It has been shown that the quality of milk intended for consumption and processing varies subject to cattle breed (Barłowska *et al*.,2011; Poulsen *et al*., 2012). Therefore, this study was to evaluate the effect of breeds on milk yield and some milk composition traits in selected breed of cattle.

MATERIALS AND METHODS

Study Location

Kano lies on longitude 9°30' and 12°30' North and latitude 9°30 and 8°42' East on an elevation 468m. It has a mean daily temperature range of 30°C to 33°C and annual rainfall ranges between 787 and 960 mm (KNARDA, 2001).

Sources of experimental animals and management

Sixty (60) lactating cows made up of twenty (20) each of Bunaji, Rahaji, and Bokoloji breeds of first parity in selected farms of Kano and its environs were used for the experiment. The animals were under semi intensive management system, with little provision for shelter in the day and night. The animals were allowed to graze on natural pasture. Occasionally, supplements such as groundnut haulm, beans shell, cereal offal and crop residues were sometimes provided prior and/or after grazing of natural pastures especially during feed scarcity and mineral blocks were also available.

Milk collection

Milk samples of the experimental animals were collected three times in the late rainy season (August to September) in 50mL falcon tubes from the experimental animals and immediately taken to the Nutrition Biochemistry Laboratory of Bayero University Kano for milk composition analysis. The milk was analyzed for milk protein content and milk fat content while protein and fat yields were determined by multiplying the respective contents with the m,ilk yield as described by Bradely *et al*., (1992).

Milk yield and composition traits determined

For Milk Yield (MY), the cows were hand milked early in the morning and its equivalent were measured using a measuring cylinder calibrated in liters on the farm. Milk Protein Content (PC) was obtained by determining the total nitrogen using Kjeldahl method and the nitrogen content was converted into equivalent protein content using N×6.38 as conversion factor (Karman and Van Boekel, 1986). Milk Fat Content (FC) was determined using Gerber method (Bradely *et al*., 1992). Fat Yield (FY) was obtained by multiplying the milk fat content with the milk yield while Protein Yield (PY) was determined by multiplying the milk protein content with the milk yield (Bradely *et al*., 1992).

Statistical model

The statistical model for the experiment is given as;

$Y_{ijk} = \mu + G_i + e_{ijk}$

Where; Y_{ijk}= milk yield and compositions

μ = overall mean;

G_i = fixed effect of breed (Bunaji, Rahaji and Bokoloji);

e_{ijk} = random residual.

e_{ijk} = nid $(0, \delta^2)$

Statistical Analysis

The data collected on milk traits were subjected to analysis of variance (ANOVA) using General Linear Model of (SAS, 2009) while significant differences were separated using Duncan Multiple Range test (Duncan, 1955). The degrees of relationship between all pairs of variables were computed for all the animals within each breed groups using CORR procedure of the (SAS, 2009) statistical package.

The formula for correlation is;

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

RESULTS AND DISCUSSION

The effect of breeds on milk components are presented in Table 1. The results revealed that breed had a significant ($P < 0.05$) effect on milk yield, protein content, fat yield and protein content. Bokoloji was superior in milk yield (2.18), protein content (4.93), fat yield (6.64) and protein yield (10.78). Besides, Rahaji and Bunaji were statistically the same in milk yield (1.56 and 1.82), protein content (4.25and 4.28) and protein yield (6.56 and 7.84) respectively except fat yield (4.70) which was least in Rahaji. The result of this study disagreed with the report of (Alphonsus *et al*., 2012; Adesina, 2012) who also reported that among the indigenous cattle breeds in Nigeria, Bunaji was identified as the principal milk producer. The superiority of Bokoloji in milk yield and fat yield than Rahaji and Bunaji in this study also disagreed the work of Belewu, (2006) who opined that breeds with higher fat content produce less milk quantity than those with low fat content. The variations in milk yield and composition observed in this study could be as a result of breed distinct composition profiles due to genetic

background, physiological status and management. Milk yield is largely determined by genetic factors that depict low genotypic potential of the indigenous animals (Millogo, 2010). According to Johnson (1991), milk yields are product of animal genetic and environmental interactions (Dandare *et al*., 2014; Oladapo and Ogunekun, 2015). Pagot (1992) contended that cattle breeds which originate from the tropics generally have limited genetic potential for milk production and remain mediocre producers (500-1500 kg per lactation) even when the best possible husbandry condition have been provided for them. The superiority of Bokoloji in milk protein over other indigenous breeds suggest that the breed has the best milk composition because proteins are required for body building and repair (Oladapo and Ogunekun, 2015).

Table 1: Effect of breeds on milk components

Parameters	Bokoloji	Rahaji	Bunaji
Milk yield	2.18[a]	1.56[b]	1.82[b]
Fat content	3.06	3.00	3.15
Protein content	4.93[a]	4.25[b]	4.28[b]
Fat yield	6.64[a]	4.70[c]	5.68[b]
Protein yield	10.78[a]	6.56[b]	7.84[b]

[abc] *Means in the same row with different superscripts are significantly different* (P<0.05)

Genetic correlation relates to the relationship, how one trait varies with the other. If the correlated trait increases with the original trait, the traits are positively correlated. If the other trait decreases with an increase in the first trait, then the traits are negatively correlated and the basic causes are pleiotropy and or linkage disequilibrium. Correlation between milk components among the three studied breeds are presented in Table 2 below. The correlation among the milk yield and composition according to the breeds indicated that the traits considered were both positive and negative significantly (p<0.05-0.01) correlated with each other in all the three breeds. Rahaji showed positive significant correlation between MY and FY (r=0.95***), MY and PY (r= 0.85***), F and P (r=0.45*), P and PY (r=0.40*) and FY and PY (r=0.78**) while a negative significant correlation existed between MY and F (r=-0.37*) and F and PY (r=-0.36*). This suggests that an increase in the quantity of milk will automatically bring about an increase in fat yield and protein yield since fat yield and protein yields are products of milk yield and the corresponding percentages of fat and protein contents (Bradely *et al*., 1992). This result concurred with the findings of Abbaya *et al*. (2020) that milk yield showed positive correlations with fat yield and protein yield, protein yield and fat yield, fat and protein in Rahaji cow milk. The negative correlations of milk yield and fat, fat and protein yield in this study agreed with the report of (Alphonsus and Essien, 2012) who reported a negative

relationship between milk yield and fat content in Rahaji, Adamawa Gudali and Bokoloji. Any trait that showed positive and negative relationships are controlled by different gene and are not linked together (Fayeye, 2014). This by implication means that whenever there is a significant increase in milk yield, there will be a corresponding decrease in milk fat (Alphonsus and Essien, 2012; Abbaya*et al*., 2017). Bunaji showed positive significant correlation between MY and FY (r=0.95***), MY and PY (r=0.98***), MY and P (r=0.88***), P and PY (r=0.96***), P and FY (0.86***) and FY and PY (r=0.94***) while a negative significant correlation existed between MY and F (r=-0.87***), F and PY (r=-0.84**) and MY and FY (r=-0.87***). These results also agreed with report of Abbaya *et al*. (2020) that milk yield and fat yield, milk yield and protein yield, fat yield and protein yield are positively correlated while a negative correlation existed between milk yield and fat, fat and protein yield in Bunaji cow milk. Similar negative correlation between milk yield and fat content were also reported by Alphonsus and Essien, (2012) in Bunaji and Bunaji X Friesian cows in Nigeria. Belewu (2006) also reported that, breeds with higher fat content produce less milk quantity than those with low fat content. Contrary to this, the relationship between milk yield and fat yield in Bunaji in this study was positive ($p<0.05$: r =0.42). Variations in the associations between milk yield and fat in Bunaji with other reports (Belewu, 2006; Alphonsus and Essien, 2012) could be due to several factors such as breed and management which can cause variations in the yield and relative milk constituents (Rafiq *et al*., 2018). Bokoloji also showed positive significant correlation between MY and FY (r=0.35*), MY and PY (r=0.99***), MY and P (r=0.81**), P and PY (r=0.89***), F and FY (0.76**) and FY and PY (r=0.30*) while a negatively significant correlation existed between MY and F (r=-0.35*), F and P (r=-0.42*) and F and PY (r=-0.39*). This results was also in tandem with report of Abbaya *et al*. (2020) who reported a positive significant ($p<0.05$-0.01) correlation between MY and FY, MY and PY and MY and P and a negatively significant ($p<0.05$-0.01) correlation between MY and F and F and P in Bokoloji cow milk. This findings also disagreed with aforementioned author's report on a positive correlations between FY and F and P and PY. The favorable relationship amongst the milk yield characteristics had also been reported by Akpa *et al*. (2006) and it implies that the traits are dependent on each other, thus an improvement in one of the traits would bring about a correlated response on the others. Therefore, the positive relationship between MY, PY, FY, P and F indicates that an increase in any of these characteristics will increase the total milk yield of the cows. The negative correlation between milk yield and other milk composition in this breed at different levels is in agreement with the reports of other authors (Ezekwe and Machebe, 2005; Alphonsus and Essien, 2012) that genetic relationship between milk yield and milk composition are highly negative. Hence if milk quality is ignored in a programme that includes selection for high milk, some milk composition may tend to decline (Alphonsus and Essien, 2012).

Table 2: Correlation between milk components among the three selected breeds

		MY	F	P	FY
Rahaji					
	F	-0.37*			
	P	-0.14	0.45*		
	FY	0.95***	-0.08	-0.15	
	PY	0.85***	-0.36*	0.40*	0.78**
Bunaji					
	MY				
	F	-0.87***			
	P	0.88***	-0.75**		
	FY	0.95***	-0.67**	0.86***	
	PY	0.98***	-0.84**	0.96***	0.94***
Bokoloji					
	MY				
	F	-0.35*			
	P	0.81**	-0.42*		
	FY	0.35*	0.76**	0.14	
	PY	0.99***	-0.39*	0.89***	0.30*

MY=milk yield, F=fat content, P=protein content, FY=fat yield, PY=protein yield, *= $p < 0.05$, ** = $p < 0.01$, ***= $p < 0.001$

Pooled correlation between milk components of the selected breeds of cattle are presented in Table 3. There were both positive and negative significant ($p<0.05$-0.01) correlation between milk yield and compositions. There were positive significant ($p<0.05$-0.01) correlation between milk yield and protein ($r=0.26$*), milk yield and fat yield ($r=0.86$**) and milk yield and protein yield ($r=0.91$**) while a negative significant ($p<0.05$) correlation between milk yield and fat (-0.26*). This concurred with the report of Belewu (2006) that breeds with higher fat content produce less milk quantity than those with low fat content. The positive relationship between milk yield and protein yield, protein

and fat yield suggests that there are controlled by the same gene (Pleiotropy). This is also in agreement with the report of Ahmed and El-Zubairu (2007) and Dandare *et al*. (2014) that milk protein and fat are positively correlated. The implication of the correlated relationships between milk yield with fat and protein which are the important components (Hossain and Dev, 2013) that determine the quality of milk is that these traits could be difficult to be improved the same time. However, the knowledge of relationship amongst these traits can help in the formulation of programmes for selection and improvement of milk quality and quantity of dairy cattle (Alade *et al*., 1999; Alphonsus and Essien, 2012).

Table 3: Pooled correlation between milk components of the selected breeds of cattle

	MY	**F**	**P**	**FY**
F	-0.26*			
P	0.26*	-0.11		
FY	0.86**	0.26*	0.20	
PY	0.91**	-0.27*	0.61**	0.77**

MY=milk yield, F=fat content, P=protein content, FY=fat yield, PY=protein yield, *=$p < 0.05$; **= $p < 0.01$

CONCLUSION

The study revealed that Bokoloji was superior in milk yield (2.18 kg), protein content (4.93%), fat yield (6.64 kg) and protein yield (10.78 kg) than Rahaji and Bunaji. The correlation between milk and compositions revealed milk yield had a positive correlation with protein yield (0.91 kg) and fat yield (0.86 kg) in all the breeds. Thus, correlation between milk yield and composition should be maximized in formulating selection programmes for improvement of milk yield and composition of the Nigerian indigenous breeds of cattle.

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