African Journal of Biotechnology Vol. 11(36), pp. 8790-8793, 3 May, 2012
Available online at http://www.academicjournals.org/AJB
DOI: 10.5897/AJB11.2940
ISSN 1684–5315 © 2012 Academic Journals

Full Length Research Paper

The relationship estimates amongst milk yield and milk composition characteristics of Bunaji and Friesian × Bunaji cows

Alphonsus, C.* and Essien, I. C.

Department of Animal Science, Ahmadu Bello University, Zaria, Kaduna State, Nigeria.

Accepted 23 November, 2011

The milk yield of 24 Bunaji and 26 cross breed (Friesian × Bunaji) cows were analyzed for milk yield characteristics [Initial milk yield (IY), peak week yield (PWK), peak yield (PY), end of lactation yield (ENLY), lactation length (LL) and total milk yield (TMY)] and milk composition [fat, crude protein (CP), solid-not- fat (SNF), total solid (TS) and ash]. The relationship within and between the milk yield characteristic and milk composition was analyzed. The results show that PY, PWK, ENLY and LL were positively and significantly correlated with TMY ($P < 0.05$; $P < 0.01$; $r = 0.353 - 0.797$). Also, LL was significantly and positively correlated with PWK and ENLY ($P < 0.05$; $r = 0.309 - 0.361$). Although not-significant, IY was negatively correlated with PY, ENLY and LL. The correlation between CP and milk fat, SNF, TS was negative ($r = -0.026$ to -0.181) but not significant ($P>0.05$) except with ash ($r = 0.267$). The relationships of milk fat with ash, SNF and TS was significant and positive ($P < 0.05$; $P < 0.01$; $r = 0.385$ – 0.606). The correlation between milk fat and milk yield characteristics were negative and not-significant ($P < 0.05$; $r = -0.076$ to -0.263) except with IY ($P < 0.05$; $r = 0.302$). Milk CP content was not-significantly ($P > 0.05$) correlated with milk yield characteristics; the relationship was positively low for IY and PY and negatively low for PWK, ENLY, TMY and LL. Milk ash was significantly ($P < 0.05$) and negatively correlated with PY, ENLY, TMY and LL ($r = 0.315$ to 0.0577). In view of the relationship that exists within and between milk yield and milk composition characteristics, it is therefore suggested that, a milk selection index that will incorporate both milk yield and milk composition characteristics in a more balanced manner would help in improving the milk yield and milk composition characteristic of the dairy cows.

Key words: Bunaji, Friesian × Bunaji, milk yield, milk composition.

INTRODUCTION

Characteristics or traits which have been considered important in dairy cattle have been those which contribute primarily to the profitability of the dairy herd (Webster, 1993); such traits include milk production, milk composition, reproduction rate and several others. The relationship amongst these traits is very important in selection programme. The knowledge of the relationship between these traits is necessary in the formulation of programmes for selection and improvement of milk quality and quantity of dairy cattle, and in predicting the direct and correlated responses due to selection (Alade et al., 1999). Since one trait in animal is often associated with others, it may therefore be necessary to consider more than one trait for selection and improvement at a time. In general, the correlations between traits of economic importance as stated by Wattiaux (2002) are essential to; predict the change in one trait in response to selection for another; determine the feasibility of selecting for multiple traits at once; anticipate the overall results of a selection programme. For example, the negative correlation between milk yield and milk fat content makes it very difficult to select cow for both high milk yield and high fat content in the milk.

The objective of this study therefore, was to determine

*Corresponding author. E-mail: mcdyems@gmail.com.

Table 1. Phenotypic correlation amongst milk yield characteristics.

Parameter	IY	PY	PWK	ENLY	TMY	LL
Initial (IY)	-					
Peak yield (PY)	0.230	-				
Peak week (PWK)	-0.135	0.167	-			
End of lactation yield (ENLY)	-0.267	0.237	0.443*	-		
Total milk yield (TMY)	0.009	0.797**	0.353*	0.498*	-	
Lactation length (LL)	-0.242	0.230	0.309*	0.361*	0.559*	-

* = P < 0.05; **= P < 0.01.

the relationship amongst the milk yield and milk composition characteristics of Bunaji cows and their crosses (Friesian × Bunaji).

MATERIALS AND METHODS

Location

The study was conducted with the dairy herd of the National Animal Production Research Institute (NAPRI) Shika, Nigeria, located between latitude 11° and 12°N at an altitude of 640 m above sea level, and lies within the northern guinea savannah zone. The mean annual rainfall in this zone is 1100 mm which commence from May and last till October, of which 90% falls during the wet rainy season (June to September). Following the wet season is a period of dry, cool weather called harmattan, which marks the onset of the dry season; this extends from mid-October to January. The dry season (February to May) is characterized by very hot weather conditions. At this period, daily temperature range from 21 to 36°C, the mean relative humidity is 21 and 72% during “harmattan” and the rainy season, respectively (Malau-Aduli and Abubakar, 1991).

Experimental animal management

The experimental animals consisted of 24 Bunaji and 26 cross breed (Friesian × Bunaji) which were managed at the dairy research farm of the NAPRI, Shika, Zaria. The animals were allowed free grazing on mixed pasture under the supervision of herdsmen for about 7 to 9 h daily. Two kilograms of concentrate mixture (88% dry matter, 15% crude protein (CP) and 55% total digestible nutrient) fortified with a mineral mixture and salt was offered to each animal daily. The animals had free access to water throughout the day, and regular spraying against ticks was done while vaccination was carried out against contagious diseases.

Milk yield and milk composition analysis

Cows were milked twice daily (morning and evening) commencing three to four day postpartum. The cows were hand-milked. The daily milk yield of the cows was measured in liters using calibrated measuring cylinder, total of their yields was summed on weekly bases. The milk yield records were used to calculate the milk yield characteristics: initial milk yield (IY), peak week yield (PWK), peak yield (PY), end of lactation yield (ENLY), lactation length (LL) and total milk yield (TMY).

The milk composition analysis was carried out at the General Laboratory, NAPRI Shika, to determine total solid, ash, fat, solid not fat and CP. For the determination of fat, 10 ml of milk was precipitated with 20% tricarboxylic acid [TCA (15 ml)], filtered through a filter paper (Whatman, No.40) and the precipitate was subjected to ether extraction (Mech et al., 2007). CP content was estimated according to the method described by DePeters and Cant (1992). Total solid (TS) content was determined by gravimetric method (I.S.I. 1961) and solid-not-fat (SNF) content was derived by subtracting fat from TS. The ash content was estimated according to the standard methods (I.S.I. 1961).

Relationship analyses

A correlation analysis procedure of SAS (2002) was carried out to determine the relationship within the related milk yield characteristics and milk composition traits, as well as between milk yield and milk composition characteristics.

RESULTS

The phenotypic correlations amongst milk yield characteristics are presented in Table 1. TMY was positively and significantly correlated with PY, PWK, ENLY and LL (P < 0.05; P < 0.01; r = 0.353 - 0.797). LL was significantly and positively correlated with PWK and ENLY (P < 0.05; r = 0.309 - 0.361). Also, ENLY was significantly and positively correlated with PWK (P < 0.05; r = 0.443). Although not-significant, IY was negatively correlated with PY, ENLY and LL.

The phenotypic correlation amongst milk composition characteristics are presented in Table 2. CP, although not significant (P > 0.05) but negatively correlated with milk fat, SNF and TS (r = -0.026 to – 0.181) except with ash (r = 0.267). The relationships of milk fat with ash, SNF and TS was significantly positive (P < 0.05; P < 0.01; r = 0.385 – 0.606). Also, milk ash was significantly and positively correlated with SNF (P < 0.01; r = 0.953).

The correlation between milk yield and milk composition characteristics is shown in Table 3. The SNF and TS were negatively but not-significantly (P < 0.05) correlated with IY, PY, PWK, ENLY and TMY (r = -0.003 to -0.136) and positively correlated with LL (r = 0.004 - 0.113). The correlation between milk fat and milk yield characteristics were negative and non-significant (P < 0.05; r = -0.076 to –0.263) but significantly correlated with IY (P < 0.05; r = 0.302). Milk CP was not-significantly (P > 0.05) correlated with milk yield characteristics; the relationship was positively low for IY and PY and

Table 2. Phenotypic correlation amongst milk composition traits.

	CP (%)	FAT (%)	ASH (%)	SNF (%)	TS (%)
Crude protein (CP)	-				
Fat	-0.181	-			
Ash	0.267	0.385*	-		
Solid not fat (SNF)	-0.026	0.386*	0.352*	-	
Total solid (TS)	-0.064	0.606**	0.434*	0.953**	-

* = P < 0.05; ** = P<0.01.

Table 3. Phenotypic correlation between milk yield and milk composition characteristics.

Milk yield	Milk composition				
	CP	FAT	ASH	SNF	TS
IY	0.079	-0.302*	0.017	-0.054	-0.136
PY	0.075	-0.179	-0.315*	-0.043	-0.075
PW	-0.115	-0.144	-0.233	-0.083	-0.151
ENLY	-0.078	-0.263	-0.410*	-0.053	-0.171
TMY	-0.018	-0.235	-0.577**	-0.003	-0.085
LL	-0.019	-0.076	-0.358v	0.113	0.004

IY, Initial yield; PY, peak yield; PW, peak week; ENLY, end of lactation yield; TMY, total milk yield; LL, lactation length; CP, crude protein; SNF, solid not fat; TS, total solid; * = P < 0.05; ** = P<0.01.

negatively low for PWK, ENLY,TMY and LL. Milk ash was significantly (P < 0.05) and negatively correlated with PY, ENLY, TMY and LL (r = 0.315 to 0.0577).

DISCUSSION

The relationships amongst the milk yield characteristics were positive, except between IY and the other milk yield characteristics (PY, PWK, ENLY, TMY and LL). 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 in the others. Therefore, the positive relationship between PY, PWK, ENLY, LL and TMY indicates that an increase in any of these characteristics will increase the total milk yield of the cows. This is probably because persistency (the extent to which PY is maintained), PWK, ENLY and LL depends on each other, thus, cows with high persistency would have a longer LL which in turn would result in higher TMY. Initial yield was hardly correlated with total milk yield, this suggest that initial yield may not be a good predictor of total milk yield. The negative correlation between IY, LL and ENLY suggests that cows with high initial yield may have short LL and low lactation yield. The strong positive correlation between TMY and PY can be attributed to the fact that high yielding cows tend to have higher PY, and this may subject them to a stressful condition and negative energy balance in the event of poor management (Sondergard et al., 2002). Similarly, high positive correlation of PY and TMY as well as moderate but positive correlation between PY and LL were reported by Aduli (1992) and Tekerli et al. (2000) in Friesian- Bunaji crossbred cows and Antolian buffaloes, respectively.

Milk composition (fat, CP, SNF and TS) is an important characteristic in dairy cattle, and considerable selection pressure is placed on this trait. It has the economic value since dairy men are paid a premium for milk of higher than average mentioned composition (Ezekwe and Machebe, 2005).

In this study, most of the milk composition measures are positively correlated except the negative correlation between CP with fat, SNF and TS. The positive correlation between fat, ash, SNF and TS indicate that these traits depend on each other, thus selection in one of these trait may lead to an increase in the other. The negative correlation between CP and fat, SNF and TS indicates an unfavourable relationship whereby selection for increase in CP content of milk may lead to decrease in fat and TS of the milk.

The positive correlation between the fat and total solid is expected, given the fact that fat is one of the important milk composition measures that determine the total solid content of the milk.

Total solid which is the total amount of material dispersed in the aqueous phase was highly correlated with SNF. Pollott (2004) reported that increase in concentration of protein and fat in subsequent stages of lactation had a direct effect on the milk TS and SNF. The fat and protein content of the milk in this study are negatively correlated with TMY, this has also been reported by Kay et al. (2005) and Auldist et al. (2007). The negative correlation between milk yield characteristics and milk composition is in line with the earlier report of Ezekwe and Machebe (2005) that genetic relationship between the milk yield and milk composition is highly negative. Thus, if milk composition is ignored in a programmme that include selection for high milk yield, milk composition may tend to decline. Therefore, a milk selection index that will incorporate both the milk yield and milk composition characteristics in a more balanced manner would help in the improvement of milk yield and milk composition characteristics of the dairy cows.

REFERENCES

Aduli EOM (1992).Dairy performance of Friesian-Bunaji crosses and their growth to yearling Age. M.Sc Thesis, Ahmadu Bello University, Zaria, Nigeria.

Akpa GN, Galadima MA, Malau-Aduli AEO (2006). Factors affecting milk production traits of Friesian Bunaji Crossbred cows reared in Northern Nigeria. Production Agriculture and Technology. Nigeria, 2(1): 78-84.

Alade NK, Olutogun O, Igwebuike JU (1999). Genetic characterization of linear measurement of N'Dama cattle of various ages in the humid tropics. Proceedings of 26th Animal Nigerian Society of Annual Production (NSAP) conference 21-25 March 1999. pp. 315-318.

Auldist MJ, O'Brien GCD, Macmillan KL, Grainger C (2007). Effects of varying lactation length on milk production capacity of cows in pasture-based dairying systems. J. Dairy Sci. 90: 3234-3241.

DePeters EJ, Cant JP (1992). Nutritional factors influencing the nitrogen composition of bovine milk: A review. J. Dairy Sci. 75: 2043-2070 http://jds.fass.org/cgi/reprint/75/8/2043.pdf

Ezekwe AG, Machebe N (2005).Milk composition of Muturu cattle under the semi-intensive system of management. Nigerian J. Anim. Prod. 32(2): 287-292

ISI (1961) IS:1479, Part II. Methods of test for dairy industry. II. Chemical analysis of milk. Bureau of Indian Standards, New Delhi, India.

Kay JK, Weber WJ, Moore CE, Bauman DE, Hansen LB, Chester-Jones H, Crooker BA, Baumgard LH (2005). Effects of weak of lactation and genetic selection for milk yield on milk fatty acid composition in Holstein cows. J. Dairy Sci. 88:3886-3893.

Malau-Aduli AEO, Abubakar BY (1991). Estimation of 305-day yield from milk yield in Bunaji and Friesian-Bunaji Crosses. Nigeria J. Anim. Prod. 19(182): 141-143.

Mech A, Dhali A, Rajkhowa C (2007). Diurnal variation of different milk constituents and milk yield in Mithun. Ind. Vet. J. 84: 1095-1096.

Pollott GE (2004).Deconstructing milk yield and composition during lactation using biologically based lactation models. J. Dairy Sci. 87: 2375-2387 http://jds.fass.org/cgi/reprint/87/8/2375

SAS Institute Inc. (2002).SAS User's Guide: Statistics. Version 9.1 Edition. SAS Institute Inc.: Cary, NC.

Sondergaard E, Sorensen MK, Mao JL, Jensen J (2002). Genetics parameters of production, feed intake, body weight, body composition and udder health in lactating dairy cows. Livestock prod. Sci. 77: 23-34.

Tekerli M, Akinci Z, Dogan J, Akcan A (2000). Factors Affecting the Shape of the evaluation of test day records. Paper presented at the INTERBULL open meeting.

Wattiaux M (2002). Technical dairy guide: Reproduction and Genetic Selection. The Babcock Institute for International Dairy Research and Development. University of Wisconsin, pp. 111-132.

Webster J (1993).Understanding the dairy cows. Blackwell Scientific publication. London Edinburgh Boston 2nd Edition pp. 288-23.