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Reproductive and lactation performance of *Kenana* and *Butana* crossbred cows, Gezira State, Sudan

Tilal M. A. Mudawi, Hyder O. Abdalla and Tasabeeh E. M. Gasmalla

Faculty of Agricultural Sciences, University of Gezira, Wad Medani, Sudan

ABSTRACT

Kenana and *Butana* cattle are the main indigenous dairy breeds in the Sudan. However, their productive performance is generally low compared to exotic breeds. This necessitates the crossbreeding with high milk producing breeds to meet the increasing demand for milk and dairy products through improving the genetic potential of the indigenous dairy cattle breeds. The objectives of this study were to determine the overall performance of *Kenana* and *Butana* 50% crosses with Friesian bulls, to estimate selected reproductive and lactation traits and to study the effects of dam breed, parity, lactation number, season and year of calving on those traits. A total number of 120 records for 30 dairy cows, each for four lactation seasons were used. Data were collected from the master records of Elbashaier dairy farm, about 10 km south of Wadmedani. They covered the years 1990- 2005. The overall means of crossbred dairy cows (days) for age at first calving, calving interval, open period, dry period and lactation period were 970, 400, 122, 65 and 332, respectively. Lactation, daily and standard yields (kg) were 3771, 12 and 3505, respectively. *Kenana* crossbred cows had higher calving interval, open, dry, lactation periods and lactation yield. *Butana* crossbred cows had higher age at first calving, daily and standard lactation yields. However, the effect of dam breed was not significant. Dam parity had significant effects ($P \leq 0.05$) on all traits except dry period. Age at first calving increased gradually while calving interval and lactation period decreased gradually with parity. Lactation yield was higher in the first and second parities, and daily and standard lactation yields were higher in the fourth parity. Lactation number had significant effects ($P \leq 0.05$) on all traits, except open period. Lactation period was higher in the first lactation, while dry period, lactation, daily and standard yields were least in the first lactation and increased with advanced lactation. Season of calving had significant effects ($P \leq 0.05$) on calving interval, open period, daily and standard lactation yields. Calving interval, open and lactation periods were longer, while, daily and standard lactation yields were lower during winter. Year of calving had significant effects ($P \leq 0.05$) on all traits except dry period. Age at first calving increased gradually with age.

INTRODUCTION

The income from livestock exceeds that from crops in five States of the Sudan, and in four States it formed over 40% of agricultural income (Faki and Nur, 2008). Livestock contributes significantly to poverty alleviation and food security. Cows are the main milk producers in the country contributing 85% of milk production (MARF, 2011). *Kenana* and *Butana* are the main indigenous dairy breeds in Sudan and other indigenous breeds such as *Baggara* are considered beef producers.

Milk is the most complete food for humans, and dairy products are favored due to high nutritive value and flavor. The demand for milk and dairy products increased substantially in the Sudan in the last decades due to the improved living standard, urbanization and nutritional awareness among consumers (Guvele *et al*., 2004). Dairy production is mainly traditional in the Sudan based on local breeds, nomadism and rangeland which deteriorated for many factors (Fadlelmoula *et al*., 2007). Improving dairy production is important to attain self-sufficiency in dairy products and for dairy processing and export.

Famous foreign dairy breeds, mainly Friesian, were imported to improve milk production. However, tropical environment have negative impacts on expressing the genetic potential of improved European breeds. Improvement programs are necessary to increase and sustain the productivity of these cattle breeds to meet the increasing demands for consumption. Generally, cross breeding improved the performance of local breeds and is preferred at 50% foreign blood. Higher percentages of foreign blood are not recommended due to the negative impacts on animal adaptation, health and performance (Ageeb and Hillers, 1991).

This study was carried out in the Gezira State to determine the performance of *Kenana* and *Butana* crossbred cows with Friesian bulls, to estimate selected reproductive and lactation traits and to study the effects of dam breed, parity, lactation number, season and year of calving on those traits.

MATERIALS AND METHODS

Study area

Data were collected from the master records of Elbashaer private farm, 10 km south of wadmedani city, Gezira State. The climate is characterized with a rainy season during July to October and with a temperature of less than 25ºC during winter and more than 45º C during summer from March to June. The rain is 450 - 650 mm (Elfagir, 2002).

Animals management

Animals received concentrate rations in addition to green fodders and dry roughage twice a day. The amount fed to each cow differed depending on the stage of growth and level of production and water was available all the time. Lactating cows were milked twice a day, early in the morning and late afternoon (12-13 hours apart). Large pens (30 × 30 m) were used to accommodate all mature cows. Small pens (6 × 12 m) were used for the lactating cows. Half of the open area was shaded using local materials. The herd was usually vaccinated annually against epidemic diseases and other diseases were being treated simultaneously.

Studied traits

The reproductive traits studied were age at first caving, calving interval and open period (days between calving and the next effective insemination dates). Lactation traits consisted of dry period (days between last milking and subsequent calving), lactation period (days between calving and next dry date), total lactation yield, daily milk yield (total lactation yield per lactation period divided by lactation period) and standard lactation yield, which was calculated for the 305 standard lactation period (Makawey and Ahmed. 2005), as follows:

$$\text{Standard lactation yield} = \frac{\text{Total lactation yield} \times 305}{\text{Lactation period}}$$

Data collection

Collected data covered the period from 1990 to 2005. A total number of 120 records for 30 dairy cows, each for four lactations, were used with equal numbers of 50% *Kenana* and *Butana* crossbred cows.

Statistical analysis

Data were analysed using SPSS software (version 20) to obtain the descriptive statistics for all traits. Linear model procedure was used to test the effects of fixed factors on the traits studied, as follows:

$\hat{Y}_{ijklm} = \mu + D_i + P_j + L_k + S_l + Y_m + I_n + e_{ijklm}$, where:

$\hat{Y}_{ijklmn}$ = observation of the trait in question.

μ = the overall mean.

D_i = the effect of i^{th} dam breed (i = 1-2).

P_j = the effect of j^{th} dam parity (j = 1-5).

L_k = the effect of k^{th} lactation number (k = 1-4).

S_l = the effect of l^{th} season of calving (l= 1-3).

Y_m = the effect of m^{th} year-group of calving (m = 1-4).

I_n = the effect of n^{th} season x year-group interaction (n = 1-12).

e_{ijklmn} = residual effect.

The period of the study was divided into three seasons:

1- Dry summer (March-June),

2- Wet summer (July-October), and

3- Winter (November-February).

Using the year of calving as a criterion, the data were also classified into four year-groups of calving, four years each. Namely, 1990-1993, 1994-1997, 1998-2001 and 2002-2005. Duncan's Multiple Range Test was used for means separation.

RESULTS AND DISCUSSION

Analysis of variance

Mean square for the effect of the fixed factors on the selected reproductive and lactation traits are shown in Table 1. Age at first calving was significantly ($P \leq 0.05$) affected by dam parity. Calving interval was significantly ($P \leq 0.05$) affected by all factors tested except dam breed. Open period was significantly ($P \leq 0.05$) affected by all factors tested except dam breed and lactation number.

Dry period was significantly ($P \leq 0.05$) affected by lactation number. Lactation period was significantly ($P \leq 0.05$) affected by all factors tested except dam breed and season of calving. Lactation yield was significantly ($P \leq 0.05$) affected by dam parity and lactation number. While, daily and standard yields were significantly ($P \leq 0.05$) affected by all factors tested except dam breed.

Table 1. Mean square for the effect of dam breed, dam parity, lactation number, season and year of calving and season × year on selected reproductive and lactation traits.

SOV	AC	CI	OP	DP	LP	LY	DY	SY
DB	91411	8721	7479	6825	18007	1072197	0.87	47174
DP	385499*	25217*	24633*	5171	21632*	3043938*	27.15*	2624656*
LN	-	19604*	17251	10470*	13261*	4400668*	76.14*	6849733*
SC	91768	14462*	13415*	519	4542	703417	12.78*	1057327*
YC	468146	10843*	10661*	1235	7988*	826086	2.50*	193798*
S ×Y	23557	4978*	5742*	798	6442*	170187	3.75*	321193*

*Significant at P≤0.05, SOV= Source of variation, DM= Dam breed, DP= Dam parity, LN= Lactation number, SC= Season of calving, YC= Year of calving, S ×Y= Season × year, AC= Age at 1st calving, CI= Calving interval, OP= Open period, DP= Dry period, LP=Lactation period, LY= Lactation yield, DY= Daily yield, SY= Standard yield.

Reproductive and lactation traits

Tables 2 shows the overall mean, standard error and coefficient of variation for the reproductive and lactation traits. Age at first calving was less than those reported by Ali *et al*. (1988) for 37.5%, 50% and 75% crossbred cows. Calving interval compared favorably with that of crossbred dairy cows in tropical countries (Mureda and Zeleke, 2007). The mean length of days-open was longer than that for imported Holstein–Friesian cows and their locally born daughters (Elfagir, 2002). The variation might be due to nutritional and reproductive differences in the different farms.

Dry period agreed with many researchers (Ali *et al*., 1988; Fadlelmoula *et al.*, 2007). Lactation period was similar to the finding of Ali *et al.* (1988) for 50% Friesian in Sudan. Lactation yield was higher than that reported by Fadlelmoula *et al.* (2007) for Friesian crosses in the Sudan. Mean daily milk yield was close to the findings of Ali *et al*. (1988) for different Friesian blood percentages.

Overall mean standard lactation yield was higher than that reported by Ageeb and Hillers (1991) for *Kenana* and *Butana* breeds in *Elnisheishiba* farm of the University of Gezira. Higher C.V% values of some traits, mainly open and dry periods, might be due to variation in husbandry practices beside the genetic and environmental factors.

Table 2. Overall mean, standard error (S.E.) and coefficient of variation (C.V. %) of the reproductive and lactation traits in *Kenana* and *Butana* crossbred cows.

Trait	No. of records	Mean	S.E	C.V.%
Age at 1st calving (days)	30	969.67	46.68	26.4
Calving interval (days)	120	400.05	7.74	20.5
Open period (days)	120	121.59	7.76	66.8
Dry period (day)	120	64.55	3.55	58.2
Lactation period (day)	120	331.55	5.94	19.0
Lactation yield (kg)	120	3771.03	101.23	28.5
Daily yield (kg)	120	11.52	0.28	25.3
Standard yield (kg)	120	3504.57	82.59	24.9

Effect of dam breed on reproductive and lactation traits

Kenana crossbred cows had higher calving interval, open, dry and lactation periods and lactation yield. *Butana* crossbred cows had higher age at first calving, daily and standard milk yields. However, the effects of dam breed were not significant (Table 3). These results agreed with those of Musa *et al*. (2005) who stated that differences between sires in their rate of maturity did not affect their daughters' performance.

Table 3. Effect of dam breed on reproductive and lactation traits in *Kenana* and *Butana* crossbred cows.

Dam breed	AC (days)	CI (days)	OP (days)	DP (days)	LP (days)	LY (kg)	DY (kg)	SY (kg)
Kenana	914.47	417.10	137.45	79.63	356.05	3960.08	11.35	3464.91
Butana	969.67	400.05	121.59	64.55	331.55	3771.03	11.52	3504.57

AC= Age at 1st calving, CI= Calving interval, OP= Open period, DP= Dry period, LP=Lactation period, LY= Lactation yield, DY= Daily yield, SY= Standard yield.

Effect of dam parity on reproductive and lactation traits

Dam parity had significant effects ($P \leq 0.05$) on all traits, except dry period (Table 4). Age at first calving increased gradually while calving interval and lactation period decreased gradually with parity. These findings agreed with those of Ageeb and Hillers (1991) for Friesian x *Kenana* and Friesian x *Butana* crossbreds, and Musa *et al*. (2005) who reported that calving interval had been shortened with advanced parity number and cows in the first parity had significantly ($P \leq 0.05$) longer calving interval. Crossbred cows in the Sudan tended to show a distinct earlier age at first calving (Mureda and Zeleke, 2007). Average daily and standard milk yields were higher in the fourth parity, while lactation period and lactation milk yield decreased with parity.

Table 4. Effect of dam parity on reproductive and lactation traits in *Kenana* and *Butana* crossbred cow

Dam parity	AC (days)	CI (days)	OP (days)	DP (days)	LP (days)	LY (kg)	DY (kg)	SY (kg)
1st	825.83c	443.94a	163.94a	88.69a	377.77a	4005.31a	10.83ab	3286.99ab
2nd	963.20bc	399.05ab	119.65ab	63.05a	330.03ab	4017.95a	12.25a	3742.08a
3rd	997.50b	362.75b	78.25b	59.38a	308.88b	3585.13ab	11.74ab	3587.63ab
4th	1030.33b	366.67b	86.67b	64.50a	306.92b	3870.08ab	12.76a	3894.90a
5th	1211.33a	371.33b	100.00ab	51.92a	314.00b	2981.00b	9.63b	2939.21b

AC= Age at 1st calving, CI= Calving interval, OP= Open period, DP= Dry period, LP=Lactation period, LY= Lactation yield, DY= Daily yield, SY= Standard yield.
Means within each column followed by different letters are significantly different (P≤0.05).

Effect of lactation number on reproductive and lactation traits

Lactation number had significant effects (P≤0.05) on all studied traits except open period (Table 5). Dry period, lactation and daily and standard milk yields increased with advanced lactation. These results agreed with the findings of Fadlelmoula *et al.* (2007) with similar significant effects of lactation number on lactation performance of crossbred dairy cows in the Sudan.

Table 5. Effect of lactation number on reproductive and lactation traits in *Kenana* and *Butana* crossbred cows.

LN	CI (days)	OP (days)	DP (days)	LP (days)	LY (kg)	DY (kg)	SY (kg)
1st	435.23[a]	155.43[a]	57.93[b]	374.57[a]	3378.53[b]	9.186[b]	2807.58[b]
2nd	383.23[b]	107.55[b]	54.27[b]	329.93[b]	3742.30[ab]	11.43[a]	3491.57[a]
3rd	425.33[a]	144.13[a]	85.13[ab]	340.07[ab]	4197.70[a]	12.43[a]	3790.63[a]
4th	390.50[b]	110.50[b]	91.03[a]	330.63[b]	4143.70[a]	12.69[a]	3849.18[a]

LN = Lactation number,CI= Calving interval, OP= Open period, DP= Dry period, LP=Lactation period, LY= Lactation yield, DY= Daily yield, SY= Standard yield.
Means within each column followed by different letters are significantly different (P≤0.05).

Effect of season of calving on reproductive and lactation traits

Season of calving showed significant effects (P≤0.05) on calving interval, open period, daily and standard lactation milk yields (Table 6). Calving interval and open and lactation periods were longer, and daily and standard lactation milk yields were least during winter. This agreed with the findings of Tawfik *et al*. (2000) and Sattar *et al*. (2005) who stated that the shortest calving interval was during autumn calving with significant effects of season, year of calving and parity on calving interval.

A significant effect was detected for season of calving on lactation period, daily and standard milk yields and cows calved in dry and wet summer secured higher milk yield in shorter lactation period compared to winter calvings. This may be due to physiological adaptation to save newborns during high ambient temperature.

Table 6. Effect of season of calving on reproductive and lactation traits in *Kenana* and *Butana* crossbred cows.

SC	AC (days)	CI (days)	OP (days)	DP (days)	LP (days)	LY (kg)	DY (kg)	SY (kg)
DS	944.92[a]	399.87[b]	120.26[b]	74.46[a]	334.80[b]	3881.26[a]	11.63[a]	3550.65[a]
WS	998.57[a]	390.68[b]	113.59[b]	69.72[a]	337.25[b]	4082.96[a]	12.42[a]	3763.97[a]
W	885.42[a]	441.87[a]	161.87[a]	69.58[a]	367.42[a]	3638.29[a]	10.15[b]	3102.83[b]

SC= Season of calving, DS= Dry summer, WS= Wet summer, W= Winter, AC= Age at 1st calving, CI= Calving interval, OP= Open period, DP= Dry period, LP=Lactation period, LY= Lactation yield, DY= Daily yield, SY= Standard yield.

Means within each column followed by different letters are significantly different ($P \leq 0.05$).

Effect of year of calving on reproductive and lactation traits

Year of calving had significant effects ($P \leq 0.05$) on all traits, except dry period (Table 7). Age at first calving increased gradually with year-group. Calving interval, open and lactation periods increased during the last period of calving, with a drop in daily and standard lactation milk yields. The environment limited animal productivity *via* the quantity and quality of feed available to the animal. Limited feed supply affected animal productivity in both short and long terms (Berman and Wolfenson, 1988).

Table 7. Effect of year of calving on reproductive and lactation traits in *Kenana* and *Butana* crossbred cows.

Year of calving	AC (days)	CI (days)	OP (days)	DP (days)	LP (days)	LY (kg)	DY (kg)	SY (kg)
1990-1993	741.47^{b}	447.73^{ab}	167.93^{ab}	68.27^{a}	384.80^{ab}	3439.33^{a}	9.06^{b}	2767.26^{b}
1994-1997	899.72^{b}	407.49^{bc}	127.29^{bc}	74.36^{a}	343.31^{bc}	3989.61^{a}	11.76^{a}	3580.57^{a}
1998-2001	1132.32^{a}	371.00^{c}	94.95^{c}	64.96^{a}	307.44^{c}	3709.52^{a}	12.20^{a}	3720.89^{a}
2002-2005	1227.80^{a}	495.20^{a}	215.20^{a}	85.20^{a}	410.00^{a}	4063.60^{a}	9.88^{ab}	3018.99^{ab}

AC= Age at 1st calving, CI= Calving interval, OP= Open period, DP= Dry period, LP=Lactation period, LY= Lactation yield, DY= Daily yield, SY= Standard yield.

Means within each column followed by different letters are significantly different ($P \leq 0.05$).

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