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Evaluating the effect of breed and calf sex on milk production and its components in cows raised in southern Iraq

Muayad Abdulwahid Jaber Al-Fayad

Department of Animal Production, Faculty of Agriculture and Marshlands, University of Thi-Qar, 64001, Iraq

ABSTRACT

This study was conducted in Al-Haboush Village, Nasiriyah District, Thi-Qar Governorate, Iraq, from October 2024 to May 2025 to evaluate the effects of breed and calf sex on milk yield and milk composition traits in dairy cows. A total of 26 lactating cows representing three breeds (Al-Janobi, Friesian, and Holstein) were included in the study. Daily milk yield, total milk yield, and several chemical and physical milk components were recorded and analyzed. The results revealed significant effects ($P < 0.05$) of breed on both daily and total milk production. Holstein and Friesian cows produced higher daily milk yields (16.43 and 16.22 kg/day, respectively) and total milk yields (3450.30 and 3406.20 kg, respectively) In terms of milk production, Holstein and Friesian cows outperformed Al-Janobi cows (6.50 kg/day and 1365.00 kg). Other breeds also showed significant differences in various milk composition traits. However, Al-Janobi cows recorded higher fat and total solids percentages, while lactose and protein contents were higher in Holstein cows. The sex of the calves significantly influenced both milk production and composition. Cows feeding female calves produced higher daily and total milk yields than cows feeding male calves. It can be concluded that under the conditions of southern Iraq, Holstein and Friesian cows are better in terms of milk production, while Al-Janobi cows are good in terms of milk quality. These results can be used in the formulation of breeding and selection programs aimed at boosting dairy cattle productivity and milk quality in Iraq..

Keywords: *Breeds; Calf Sex; Milk Production; Milk Components*

Corresponding Author: Muayad Abdulwahid Jaber Al-Fayad
E-mail: muaeid@utq.edu.iq
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INTRODUCTION

Milk and dairy products are an important source of animal protein, fat, vitamins, and minerals in human nutrition. Milk yield and milk composition are influenced by several genetic and environmental factors; the breed is considered one of the most important determinants because of the differences in genetic potential among cattle populations. Dairy production in Iraq is based on indigenous cattle, mostly Al-Janobi cattle, and on imported dairy breeds such as Friesian and Holstein cattle. Exotic breeds are generally associated with higher milk production, whereas local cattle manifest adaptive characteristics that enable them to survive under the environmental conditions of southern Iraq. A few studies have reported the effect of the calf-related factor, among them the sex of the calf on milk yield in different physiological and hormonal mechanisms related to pregnancy and lactation (Hinde, 2007; Hinde et al., 2014; Hess et al., 2016). No data are available on the combined effects of breed and calf sex on milk production traits under the environmental conditions of southern Iraq. Therefore, this research was carried out to study the effects of breed and calf sex on daily and total milk yield and some chemical and physical properties of milk in dairy cows raised in southern Iraq..

MATERIALS AND METHODS

This research was conducted in Iraq, Thi Qar, Nasiriyah District, Al Haboush Village, covering the period from October 1, 2024, to May 1, 2025. It was carried out to observe the effects of cow breed and calf sex on daily and total milk production as well as some chemical and physical properties of milk from cows kept in Nasiriyah, Al Haboush Village. The research involved 26 dairy cows (10 Al Janobi, 7 Friesian, and 9 Holstein), aged between 3 and 7 years and belonging to parities 1-5. Sampling was performed on cows representing different lactation stages (early, mid, and late lactation) and all cows received similar feeding and management conditions during the entire period of the experiment.

Feeding

The cows were given a diet of concentrate feeds, roughage, and green fodder based on what was available during the different seasons. Dry roughage and green fodder were supplied on a weight basis, while the concentrate ration was adjusted according to milk production — at a rate of 1 liter of concentrate for every 2 kg of milk produced. All animals were kept under good health conditions and received regular veterinary attention.

Milk Quantity Estimation

Milk yield was determined using an electronic scale of Chinese make. Daily milk production was recorded after complete emptying of the udder. The cows were manually milked twice a day, in the morning and in the evening.

Milk Sample Analysis

Raw milk samples were collected twice a month for the entire duration of the experiment 100 ml each time. Samples were brought to the laboratory immediately in an insulated container packed with crushed ice to prevent spoilage and maintain the quality of milk. Milk components were analyzed using a Lacto Flash Funke Gerber analyzer made in Germany.

Statistical Analysis

Data were analyzed using the General Linear Model (GLM) procedure of the SPSS software. The statistical model included breed, calf sex, age, and parity as fixed effects to check and adjust for the potential sources of variation that might influence milk production and milk composition traits. However, since the main objective of this study was to evaluate the effects of breed and calf sex, only the results related to these two factors are presented and discussed.

The statistical model was:

$$Y_{ijklm} = \mu + B_i + S_j + A_k + P_l + e_{ijklm}$$

Where Y_{ijklm} represents the observation of the studied trait, μ is the overall mean, B_i is the fixed effect of the ith breed, S_j is the fixed effect of the jth calf sex, A_k is the fixed effect of the kth age group, P_l is the fixed effect of the lth parity, and e_{ijklm} is the random residual error. Significant differences among means were determined using the Least Significant Difference (LSD) test at a probability level of $P < 0.05$.

RESULTS AND DISCUSSION

Table 1 shows the effect of cattle breed on milk produced per day and total milk produced over a long period. The present results clearly indicate that breed type had a statistically significant effect ($P < 0.05$) on milk produced both per day and in total. Holstein and Friesian cows gave more milk than Al Janobi cows in both daily and total amounts. Average daily milk production levels across all breeds (6.5±1.01, 16.22±2.78, and 16.43±3.06) and total milk amounts (1365±356.29, 3406.2±737.54, and 3450.3±663.60) were similar to those cited in the literature for Janzekovic et al. (2009), Budimir et al.

(2011), Mlynek et al. (2018), Hadad (2020), Koknaroglu et al. (2021), Al-Fayad (2025b), and Deku et al. (2025). The higher daily and total milk production in Holstein and Friesian cows could be due to their higher genetic potential for milk synthesis and secretion. This has been achieved through long-term selection programs based on dairy performance, as mentioned by Al-Qudsi and Elia (2010) and Hadad (2020). On the other hand, the Al-Janobi cattle have not been exposed to intensive genetic selection for milk production. They have only been adapted to local environmental conditions..

Table (1) Effect of Breed on Daily and Total Milk Production (Mean ± S.E.)

Breed	Daily milk (kg)	Total milk (kg)
Al Janobi	6.5±1.01 [b]	1365 ±356.29 [b]
Frisian	16.22±2.78 [a]	3406.2 ±737.54 [a]
Holstein	16.43±3.06 [a]	3450.3 ±663.60 [a]

Different letters within the same column indicate significant differences at $P < 0.05$

The data presented in Table (2) indicate a highly significant ($P<0.05$) effect of cattle breeds upon TS%, F%, and P%, with Al Janobi producing significantly more TS% and F% than Holstein and Friesian with (12.02±0.221, 11.1±0.253, 10.53±0.297) and (4.28±0.180, 2.68±0.266, 2.56±0.356), while Holsteins produced significantly more P% and L% than Friesians and Al Janobi with averages of (2.87±0.102, 2.93±0.056). The averages for these values were 3.10±0.065, 4.34±0.155, 4.43±0.084, 4.71±0.096 respectively. The percentage values of SNF%, ASH%, and D were not significantly different (P<0.05) between cattle strains, but both Friesians and Holsteins produced a significantly greater W% ($P<0.05$) than Al Janobi with average values of 87.97±0.219, 88.9±0.253, and 89.51±0.284 respectively.

These results agree with those found by Bigler (2001), Koc (2007), Budimir et al., (2011), Ozhan et al. (2015), and Koknaroglu et al. (2021). In addition, these findings also support those published by Mlynek et al., (2018)) and Hadad (2020) and Al-Fayad (2025b). This partially agrees with the study conducted by Deku et al. (2025), but Hussein and Ali (2024) study showed no effect of breed on milk components other than the non-fat solid content. The higher percentages of fat and total solids observed in Al-Janobi cows may be associated with the well-documented inverse relationship between milk yield and milk component concentration, whereby lower milk volume is often accompanied by higher concentrations of milk constituents (Bucci et al., 2002; Deku et al., 2025).

Table (2) Effect of Breed on Chemical and Physical Components of Milk (Mean ± S.E.)

Breed	D	W%	Ash%	L%	P%	SNF%	F%	TS%
Al Janobi	27.98±1.250[a]	87.97±0.219[b]	0.602±0.124[a]	4.34±0.155[b]	2.87±0.102[b]	7.75±0.268[a]	4.28±0.180[a]	12.02±0.221[a]
Frisian	30.29±0.323[a]	88.9±0.284[a]	0.601±0.057[a]	4.43±0.084[b]	2.93±0.056[b]	8.41±0.266[a]	2.68±0.266[b]	11.1±0.253[b]
Holstein	29.64±0.851[a]	89.51±0.284[a]	0.592±0.058[a]	4.71±0.096[a]	3.10±0.065[a]	7.92±0.159[a]	2.56±0.356[b]	10.53±0.297[b]

Different letters within the same column indicate significant differences at $P < 0.05$

Table 3 reflects the effect of the sex of the offspring (male versus female) on both the daily and total milk produced from cows. There was a statistically different (P=0.000) amount of milk produced per cow per day between cows producing milk from female (11.55±1.54, 14.75±3.88) and those producing from male (2425.5±257.31, 3097.5±325.26) calves. These findings corroborate with those of Chegini et al. (2015), Hess et al. (2016), Djedović et al. (2021), Cacic et al (2022), Al-Fayad (2025c). The larger amounts of milk produced are likely due to an intrinsic maternal preference to produce milk for female offspring which results in the production of more milk than for males. Additionally, the sex of the fetus affects the ability of the udder tissue to produce milk during the lactation period and other aspects of mammary gland function. A

greater quantity of milk is produced when there is an enhancement to the milk supply production due to the sex of the calf that has been born in the prior birth, as well as how a female calf born in the prior birth increases production by approximately 445 kg through its first and second lactation (Hinde et al., 2014).

Table (3) Effect of Calf Sex on Daily and Total Milk Production (Mean ± S.E.)

Sex	Total milk (kg)	Daily milk (kg)
Male	2425.5±257.31 [b]	11.55±1.54 [b]
Female	3097.5±325.26 [a]	14.75±3.88 [a]

Different letters within the same column indicate significant differences at $P < 0.05$

Table (4) Milk composition is affected by calf sex ($P<0.05$). Male calves produce more total solids, have greater fat %, non-fat solids %, protein %, lactose %, ash % and milk density than female-calved cows. The average milk composition for the seven variables are (11.60±0.17, 4.03±0.16, 8.22±0.26, 3.04±0.096, 4.60±0.145, 0.58±0.018 and 30.06±0.72). There was no effect on water content ($P<0.05$) due to calf sex (Table 4). Male calves are larger than female calves and have better postnatal growth (Minick et al., 2001). Males grow larger than females due to the male hormone (testosterone), which increases protein and mineral metabolism and results in increased muscle mass and bone mass (Al-Qudsi and Elia, 2010). Thus, the higher milk composition in male-calved cows compared to female-calved cows is attributed to their greater postnatal growth as compared to females (Hinde, 2007). Another hypothesis for the variation in composition is that hormones within the udder might vary depending on the sex of the cow and could have an effect on mammary development (Ivell and Bathgate, 2002). A second hypothesis is that the concentration of any biologically active components in milk (such as immune factors) or hormones that can impact growth patterns in the offspring could be different for a male versus a female calf (Neville et al., 2012). These results are in agreement with previously reviewed findings by Hind, (2007); Hind, (2009); Taher et al. (2011); Atashi et al. (2012); Chegin et al. (2015); and Al-Fartosi and Al-Moussawi (2017); Cacic et al. (2022); Al-Fayad and Shareef (2022); and Al-Fayad (2025c).

Table (4) Effect of Calf Sex on Chemical and Physical Components of Milk (Mean ± S.E.)

Sex	TS%	F%	SNF%	P%	L%	Ash%	W%	D
Male	11.60 ±0.17[a]	4.03±0.16[a]	8.22 ±0.26 [a]	3.04 ±0.096 [a]	4.60 ±0.145 [a]	0.58 ±0.018 [a]	88.5 ±0.18[a]	30.06 ±0.72[a]
Female	11.12 ±0.21[b]	2.9±0.27[b]	7.45 ±0.11[b]	2.76 ±0.041 [b]	4.17 ±0.062 [b]	0.52 ±0.016 [b]	88.86 ±0.26[a]	26.57 ±0.51[b]

Different letters within the same column indicate significant differences *at* $P < 0.05$

Although the present study provides useful information regarding the effects of breed and calf sex on milk production and milk composition traits, the relatively limited sample size may restrict the broader generalization of the findings. Consequently, further studies involving larger and more diverse cattle populations are recommended to confirm the observed relationships under different management and environmental conditions.

CONCLUSIONS

According to this study, there is a significant difference in both daily and overall milk production between cows from different breed groups; as well as with regards to some of the components of milk. Also significant is that sex of offspring can affect daily and total milk production, as well as the chemical and physical properties of milk obtained from a cow.

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