International Journal of Life Science Research Updates

Journal homepage: https://orionjournals.com/ijlsru/

(RESEARCH ARTICLE)

Milk yield, milk composition and reproductive performance of Baggara cattle as affected by parity under traditional system, Sudan

Huda Hamid Abakar Bashir [1], Hind Abdelrahman Salih [2], Ibrahim Omar Elimam [3] and Ibrahim Bushara Mohammed [2,*]

[1] *Ministry of Animal Resources, West Kordofan State, Sudan.*
[2] *Department of Animal Production. Faculty of Natural Resources and Environmental Studies, University of Kordofan El-Obied, Sudan.*
[3] *Department of Animal Biotechnology. Faculty of Animal Production, University of East Kordofan, Sudan.*

International Journal of Life Science Research Updates, 2022, 01(01), 018–027

Publication history: Received on 30 November 2021; revised on 29 December 2021; accepted on 31 December 2021

Article DOI: https://doi.org/10.53430/ijlsru.2022.1.1.0024

Abstract

This study was conducted to evaluate parity order on milk yield and milk components and calving interval of Baggara cattle as affected by parity in West Kordofan State, Sudan. Forty eight cows were selected from the herd of Baggara cattle. The cows were weighed and divided into four groups A, B, C and D, each group comprised of (12) cows according to parity order, first, second, third and fourth parity. Data were analyzed by using F test for analysis of variance procedures and Duncan's multiple range test (DMRT) for mean separation. All cows were raised on natural grazing. The results revealed that parity order significantly ($p<0.05$) affected daily, monthly and total milk yield. Milk production increased with advance parity. High ($p<0.05$) milk yield, monthly and daily milk scored by 3rd parities as 668.47 kg, 133.73kg and 4.49kg respectively. Results showed significant differences ($p<0.05$) between different parities for the milk composition during first and third month of lactation period, with high fat percentages in first month for 2nd parities (6.21) and 3rd parities (6.26) in 3rd month of lactation. The results indicated that calving days to first estrus and days to conceive were significantly ($P<0.05$) effected by parity number. Shorter days to show estrus was obtained by primiparous cows (56.19 ±8.72 days), also Days to conceive exerted significant ($P<0.05$) effect parity order. Results showed a significant differences ($p<0.05$) between different parities order for calving interval, that short days of calving interval scored by primiparous parities (10.04 months) and long days by 4th parities (13.17month). In conclusion, Baggara cows that depended on natural grazing reached its peak milk production in third parity with considered that the main purpose of these animals for meat production.

Keywords: Baggara cattle; Milk production; Milk composition; Parity order; Reproductive performance; Sudan

1 Introduction

Livestock are an important component of nearly all farming systems and provide draught power, replacement stock, social security, prestige, milk, meat and serve as a capital asset against risk. In addition, livestock are important source of cash income and play an important role in ensuring food security and alleviating poverty [19].In developing countries, smallholder dairy production attracts minimum investment in housing, feed and health-care. The majority of Sudanese cattle breeds are kept by nomadic or semi-nomadic people. Baggara cattle are known for their ability to stay under harsh environmental climate and their effectively utilize poor quality feed resources. They are cattle- herders, migrating seasonally between grazing lands in the wet season and river areas in the dry season [17].Baggara cattle usually pass through a very long and tough migratory process. Baggara cows represent 80% of cattle in the Sudan [63].

* Corresponding author: I Bushara
Department of Animal Production. Faculty of Natural Resources and Environmental Studies, University of Kordofan El-Obied, Sudan.

Cattle in tropical Africa are used for several purposes, and in many cases cannot be separated into classes of beef, dairy, and work animals. So milk production is one of main issue for the production system. Milk production in a smallholder dairy system is very low and below the genetic potential of the indigenous dairy cattle. The milk production of the Sudanese indigenous cattle breeds, Kenana and Butana *(B.indicus)* was found to be lower than that of *B.taurus* cattle[3]. Among the numerous constraints to milk production, inadequate feed supplies remain a major constraint to sustainable cattle production in general, and milk production and milk components in particular[43]. Better reproductive performance and milk production increased with increasing age of the dam, parity was observed to be one of the major sources of variation in milk yield and effect return to ovarian function of post-partum period [59]. The increased demand for milk and milk products because of burgeoning population growth, rapid urbanization, needed to study factors that affect breed production in different systems. The aim of this study is to evaluate the effects of parity order on body weight and milk yield and milk components and calving interval of Baggara cattle kept under traditional in tropic conditions in West Kordofan state, Sudan.

2 Material and methods

2.1 Study area

The experiments were conducted in Elfula area, West Kordofan state (9-12^{o} and 12-30^{o} N, 15-27^{o} and 30^{o} E). The study included three district seasons (rainy, cool dry and hot dry) the rainy season (May-October), cool dry (December-February) and hot dry season (March-May). The mean monthly temperature ranged from 25.8 C° in July to 31.3 C° in April. The mean maximum is about 39 C° in the three months prior the rainy season with peak temperature in May. The mean minimum temperature varied between 17 C° in January to more than 20 C° at the onset of the rains in May (SKDP, 2000). Annual rainfall of a range 450-650 mm, with peak rain in August. The relative humidity of 35% rise to 75% during the rainy season. Soil types varied from sandy (goz) in north to heavy clays (vertisoil) and the lighter clay (gardoud) in the south. The dominant vegetation varies with soil and rainfall patterns, with mixture of grasses and herbs with scattered shrubs and browsing trees [60].

2.2 Experimental animals and management

Forty eight Baggara cow were selected from the herd (1- 4 parity orders) from nomadic flock for the purpose of this study. The cows were settling around Elfula area. The cows were monitored from last trimester of pregnancy to calving through conception to parturition. The target cows were divided into four groups each group comprise of (12) cow according to number of parity as first, second, third and fourth parity (Table 1). All groups were eared tagged and treated against endo-and ecto-parasites. The animals were vaccinated against foot and mouth disease, Anthrax and Hemorrhagic Septicemia. All animals depended on pasture to maintain their roughage, were allowed free grazing on an early pasture from 8.00 am to 6.00 pm. The four groups were housed in partially shaded pens, constructed from traditional local material.

Table 1 Experimental animals

Animal Group	No. of animal	Mean body weight(kg)
1st parity(primiparous)	12	274.42
2nd parity	12	278.12
3rd parity	12	279.75
4th parity	12	287.08

2.3 Milk yield

The newly born calves were left to suckle their dams freely up to their first 7 days after birth. The cows were milked twice a day, in the morning and in the evening for 150 consecutive days. Daily milk yield by each cow was measured. The average daily, monthly and total milk yield per lactation (kg) was calculated for each cow.

2.4 Milk composition

Fresh milk samples were taken monthly interval for chemical analysis. The Milk samples were collected in sterile containers (25 ml) and kept in a refrigerator adjusted at 4 C^{0} pending the analysis at the laboratory of the Department of Dairy Production, Faculty of Animal Production, University of Khartoum. Chemical analysis of milk samples were

determined by using milk analyzer Lacto scan 90 according to the manufacture instructions to determine fat, protein, lactose, SNF and density of the milk samples.

2.5 Statistical analysis

The data were analyzed statistically according to the analysis of variance procedures using the General Linear Model (GLM) applicable to the complete randomized design. Duncan's multiple range test (DMRT) for mean separation was used to identify significant differences. All techniques of the statistical analysis were conducted using Statistical Package for the Social Sciences, software package (SPSS) [55].

3 Results

3.1 Effect of parity order on milk yield

The data highlighting the effect of parity order on milk production displayed in (Table 2).The results suggested that parities order had significant ($P < 0.05$) effect on milk production during five month of lactation period. Dams in 3rd parity recorded higher milk production during first month of lactation (133.27±16.94 kg) then primiparous (105.37±17.05 kg) and the lower milk production was obtained by dams in 4th parity.

During second month of lactation dams in all parities started to increase their milk production with advance of lactation period except dams in 1st parity, where high amount of milk yielding was recorded in third month by dams in 3rd parity (147.39±29.79 kg) and lower by dams in primiparous (132.81±5.44 kg). But in fourth month of lactation cows in parity four produced higher amount of milk 138.64±10.88 kg followed by cows in 3rd parity 146.85±26.65 kg and lower observed in 1st parity animals (122.07±11.78 kg).

The lactation curve of all dams began to go down and the milk production decreased significantly ($P < 0.05$). The amount of milk yielding was 107.92±28.24, 111.82±12.86, 131.95±15.77 and 129.18±18.47 kg for primiparous, 2nd, 3rd and 4th parities respectively. Dams in 3rd parity significantly ($P < 0.05$) had higher total and daily milk production as 668.47±62.21kg and 4.49±0.42 kg respectively compared with dams in primiparous parity (599.67±34.60 and 3.99±0.23), 2nd parity (613.24±47.99 and 4.08±0.32 kg) and 4th parity (636.49±31.27 and 4.14±0.56 kg) for total and daily production respectively.

3.2 Effect of parity order on milk composition

The effect of parity order on milk composition of experimental cows is illustrated in (Table 3). The data indicated that parity order had exerted a significant ($P<0.05$) effect on fat, lactose, crude protein and SNF during first and third month of lactation period. Lactose, fat and protein were not different during second month. The fat content during first 30 days of lactation was highest in the primiparous parity group (6.15±0.44) and lower in 4th parity group (5.12±0.16). The lactose content was significantly ($P<0.01$) higher in the 2nd parity (5.12 ± 0.04) and lower in 4th parity animals (4.53±0.49). Crude protein and SNF content were higher in 2nd parities animals (3.80 ±0.03 vs. 9.65 ± 0.08) and lower in 4th parity (3.53 ±0.26 vs. 8.98 ± 0.44). The data also indicated no significant effects of parity number on fat, protein and SNF content during second month of lactation. During third month of lactation, high fat content was secured by primiparous parity (6.26). High lactose, protein and SNF was recorded by cows in 2nd parity, the respective values were 5.43±0.02, 4.01± 0.05 and 10.22±0.04 for lactose, protein and SNF respectively. Lowered fat and protein content were observed in 3rd parity animals (Table 3).

Table 2 Effect of parity order on milk yield (mean ± SE kg)

Animal Group	No.	1st month	2nd month	3rd month	4th month	5th month
1st parity	12	105.38 ± 17.05^{B}	132.99± 17.65^{A}	132.81 ± 5.44^{C}	122.07 ± 11.78^{C}	107.92 ± 28.24^{B}
2nd parity	12	100.00 ± 9.58 ^{C}	121.30±14.95^{B}	145.95 ± 17.15 ^{AB}	141.29± 26.46 ^{B}	111.82± 12.86^{B}
3rd parity	12	133.27± 16.94 ^{A}	129.50 ± 20.18 ^{A}	146.85± 26.65 ^{A}	147.39±29.79 ^{B}	131.95± 15.77^{A}
4th parity	12	88.85 ±11.28 ^{D}	116.91± 21.06 ^{B}	161.05 ±28.36^{B}	138.64 ±10.88^{A}	129.18± 18.47^{A}
		total yield	monthly yield	daily yield		
1st parity	12	599.68 ± 34.60 ^{C}	119.93 ± 6.92 ^{C}	3.99 ± 0.23 ^{C}		

2nd parity	12	613.24± 47.99 C	122.63± 9.65 BC	4.08 ± 0.32 BC		
3rd parity	12	668.47± 62.21 A	133.73± 12.44 A	4.49± 0.42 A		
4th parity	12	636.49± 31.27 B	124.96± 16.26 B	4.14 ± 0.56 B		

ABC Values in same column with different superscripts differ at P<0.05

Table 3 Effect of parity order on milk composition (mean ± SE %)

Animal Groups	No.	F	L	CP	SNF
		First month of lactation period			
1st parity	12	6.15±0.44A	4.68 ±0.44BC	3.59± 0.06B	9.18 ±0.19BC
2nd parity	12	6.21±0.04A	5.12 ± 0.04A	3.80 ±0.03A	9.65 ± 0.08A
3rd parity	12	5.55±0.49B	4.94 ±0.09AB	3.64±0.05B	9.25±0.14B
4th parity	12	5.12±0.16C	4.53±0.49C	3.53 ±0.26B	8.98 ± 0.44C
		Second month of lactation period			
1st parity	12	5.29±0.69	5.03 ± 0.45	3.70± 0.35	9.35± 0.60A
2nd parity	12	4.95±0.54	4.79 ±0.33	3.53 ±0.18	8.98±0.47AB
3rd parity	12	5.19± 0.43	4.98± 0.32	3.69 ±0.13	9.43± 0.37A
4th parity	12	4.78± 0.41	4.74±0.26	3.59±0.16	8.78 ± 0.45B
		Third month of lactation period			
1st parity	12	6.26± 0.77A	4.78±0.58 B	3.58± 0.45B	9.05 ±1.12B
2nd parity	12	5.58 ±0.06B	5.43±0.02A	4.01± 0.0 5A	10.22±0.04 A
3rd parity	12	4.38 ±0.23C	4.83± 0.23B	3.53 ±0.18B	9.05 ±0.45 B
4th parity	12	6.02± 0.13A	5.023± 0.03B	3.74 ±0.02B	9.49 ±0.05 B

ABC Values in same column with different superscripts differ at P<0.05 Where F, L, CP and SNF were Fat, Lactose, crude protein and solid not fat respectively.

3.3 Effect of parity order on open period and calving interval

Table 4 Effect of parity order on open period and calving interval

Animal Group	No.	Open period/day		calving interval/month
		first estrous	service interval	
1st parity	12	56.19 ± 8.72 A	92.92± 26.59 A	10.04 ±0.99 A
2nd parity	12	61.44 ±11.26 B	119.92± 34.21C	11.34±1.35 A
3rd parity	12	90.90 ±5.26C	125.00±28.80 AB	12.03±1.01 B
4th parity	12	113.58 ±10.18 D	129.60±38.68 D	13.17 ±1.23 C

ABDC Values in same column with different superscripts differ at P<0.05

The data pertinent the effect of parity order on appearance of days open (first estrus and service period) is presented in (Table 4). The results indicated that calving days to first estrus and days to conceive were significantly (P<0.05) effected by parity number. Shorter days to show estrus was obtained by cows in their 1st parity (56.19 ±8.72 days) than that of the second, third and fourth parity animals with value of 61.44 ± 11.62, 90.90 ±5.26 and 113.58 ±10.18 days respectively. Days to conceive exerted significant (P<0.05) effect parity order. Cows that had first calvers have shorter days to service interval compared with other cows in 1st and 4th parties (92.92± 26.59 vs 129.60 ±38.68 days) respectively. Animals in 4th parity had scored longer days to service interval (129.60±38.68 days). The effect of parity

order on calving interval is illustrated in (Table 4). The parity order exerted significant (P<0.05) effect on calving interval, whereby that 4th parity cows had the highest calving interval compared with other parties' calvers. The longer open period were scored by parity four as 243.18 day and shorter one to 1st parity cow 149.11 day.

4 Discussion

4.1 Effect of parity order on milk production

Parity order had significant effect on milk production during lactation period. Where increasing in milk production found in the present study as parity increased, as dams in 3rd and 4th parities recorded higher milk production during lactation and the lower milk production was obtained by dams in 1st and 2nd parity. This result was consisted with Mohamed (2004) and Meikle *et al*. (2004) who showed that primiparous cows produced less milk than multiparous cows. Also confirms the results of Mech *et al.* (2008) whom concluded that milk yield increased up to 90 days and remain high for a while and then declines in late stage of lactation. Generally the present study revealed that milk yield increased with advanced lactation and then gradually decreased.

In this study Baggara cows in different stages of lactation and in all parities obtained lower milk production (total milk and daily milk yield). Higher milk yield in third parity during early and mid lactations was observed, while during the late lactation, fourth parity showed significantly higher milk yield compared to first, second and third parties. This is partially agree with Shuiep *et al*. (2016) who reported that higher daily milk yield in third and fourth parity during early and mid lactations was observed. The different of milk production reported here by other authors may be due to genetic factors and management practice as supplementation during pre-partum and post-partum period since Baggara cow depend on natural grazing and were not selected genetically for milk production. Generally the stage of lactation is one of the major factors influencing milk yield and composition in cattle.

4.2 Effect of parity order on milk composition

In this study parity order had a significant effect on milk composition. The mean of milk fat during the present study was higher than those obtained by Ibrahim (1989), Ibrahim and Samaha (1986) and Hamid (1994). This might be attributed to genetic variations, plane of nutrition and yield of cows. High milk fat is a typical characteristic of Zebu cattle as they produce more milk fat compared to temperate cows (Barbosa *et al.,* 2008). This phenomenon indicates that milk fat as quantitative trait is genetically influenced by set of genetic factors. Milk fat in dairy cattle is affected by the amount of roughage and the ratio of forage to concentrate in addition to meal frequency. Moreover, reduction in the dietary forage-to-concentrate ratio decreases milk fat (Sutton, 1989). Wang *et al.* (2004) added that supplementation of fat ration effectively increases milk fat.

The fat content during first month of lactation was highest in the 1st parity and lower in 4th parity. This result is in completely agreement with Shuiep *et al.* (2016). Decrease in milk fat content of cows in the later parity may be attributed to age factor as local cows gave first calves at age of 5 to 7 years (Abdel-Aziz *et al.,* 2005). The result obtained from Baggara cows is supporting Nyamushamba *et al.* (2014) who reported a linear relationship between age at calving and milk fat. On the other hand, the data also indicated no significant effects of parity number on fat content during second month of lactation.

In this study parity order had exerted a significant effect on milk solid not fat content (SNF). The overall mean of milk solid not fat content (SNF) obtained in the present study was similar to that reported by Bashir (2011). Variation of SNF content between 2nd parities 4th parity is agreement with Shuiep *et al.* (2016). These results could be attributed to age factor as the elder cow; has lower efficiency of feed utilization. Smith *et al.* (1961) concluded that utilization of feed is a linear function of body weight. On the other hand, non significant variations were obtained in SNF in second month of lactation in different parities. This result is in partial agreement with Sudhakar *et al.* (2013). However, it disagreed with Singh and Pratap (2014) who reported different SNF profile.

Protein content in this study was affected by parity order. The overall mean of milk protein obtained in the present study was similar to that reported by Bashir (2011). However, it disagrees with the findings of Klungel *et al* (2000). These differences may be due to stage of lactation and genetics variations (Mustafa and Serdar, 2009). In this study it was observed that protein content was higher in early parities and lower in later parities, these results were in agreement with Shuiep *et al.* (2016), this observation could be attributed to the age of cows. On the other hand, the non significant differences of milk protein content during second month of lactation were in accordance with results of Ahmed and El Zubeir (2007).

Parity order had effected on lactose during first and third month of lactation period. The overall mean of lactose of milk from Baggara cows were in agreement with those reported by Ibrahim (1989) and Bashir (2011). Also this result was conflicting with that reported by Mech *et al.* (2008) and Shuiep *et al.* (2016) who reported parity order has no influence on lactose content of milk. Lactose synthesis is highly correlated to the amount of water drawn into milk. Secretion rates of lactose and water are nearly constant throughout lactation (Pollott, 2004). Therefore, compared to other milk constituents, lactose is the most stable component. This could explain the less influence of lactation stages on this constituent.

4.3 Effect of parity order on some reproductive traits

The resumption of bovine ovarian cyclicity after parturition is an important physiological process for cattle breeding, and attaining pregnancy of dairy cows in the post-partum period**.** It has obvious economic importance of reproductive parameters because a longer service period increases the calving interval, resulting in a reduced life time production. The interval to first post-partum (PP) ovulation is related to the period of NEB, as metabolites and metabolic hormones convey information from the cow's metabolic status to her central nervous system (Butler, 2003).

Re-initiation of post-partum ovarian activity is closely related to the feeding and management during the transition period and the metabolic and physiological changes that it implies (Bell, 1995). The mean of service period obtained in the present study was similar to Brahmstaedt and Schonmuth, (1983**)** who suggested that service period in cattle should not be less than 40 days, Basak and Das (2018) who found overall mean service period and calving interval were estimated at 158.78 ± 3.5 and 445.97 ± 3.67 days, respectively of Deoni cattle. Bushara (2016) reported first progesterone rise 79.9 ±48.86 day and days to conception 133.12±59.46 d 133.12±59.46 day. Mackey *et al*. (2000) the first estrus occurs between 41 and 70 days post-partum, and lower than that reported by Singh *et al*. (2002), Poncheki *et al*. (2015) and Reist *et al*. (2003) observed in their study that the average number of days to conception for dairy cows with satisfactory milk yield was 100.4 days. De Vries and Veerkamp (2000) investigated the return of luteal activity in dairy cows and found that animals returned to ovarian activity on average at 29.7 days, ranging from 10 to 97 days. The milking/suckling system is probably one important cause of the long post-partum anoestrous periods and long intervals between calving exhibited by the cows. The suckling stimulus is one of the main factors affecting the duration of post-partum anoestrus in dual purpose cows (Das *et al*., 1999).

In this study calving parity had significant effect on days open (days to estrus and days to service interval), same results obtained by Goshu *et al*. (2007) and Dhaware *et al.* (2008) they reported significant effect of parity on service period. On contrast Gifawosen *et al*. (2003) and Basak and Das (2018) reported non-significant effect parity of the cows on service period. Early parities obtained shorter days to show estrus and shorter days to service interval than cows in their later parities. These results in line with Asseged and Birhanu (2004) and Goshu *et al*. (2007) who documented those days open decreased as parity number increased until 3, Cows in their first parity demanded 35 more days than the average for days open. Hammoud *et al*. (2010) stated that the highest days open was in the 1st and 2nd parities (142.6±4.8 and 148.3±4.8 days), then days open declined from the 3rd parity and over ranged between 121.1±9.6 and 127.8±5.9 days. Stahl *et al*. (1999) demonstrated that first-lactation cows have lower energy balance because they eat less and have energy requirements for growth in addition to lactation. Lower energy balance in first lactation cows was associated with delayed intervals to first ovulation. Several investigators have documented the fact that negative energy balance causes a delay in interval to first ovulation and a delay in interval to first estrus (Lucy *et al*., 1992). The reason for the delay in interval to first ovulation can be explained partially by greater negative energy balance in modern dairy cows. The days open found in the current study is about twice the limit given to a well managed herd and may be related to the change in management and feeding.

The effect of low level of nutrition on extended post-partum period due to weight loss was noted by Gebreegziabher *et al*. (2005). Nutrition and suckling are the major factors influencing the resumption of post-partum ovarian cycles (Motlagh *et al*., 2013). Moreover, Tadesse and Zelalem (2003) reported that increasing the level of protein supplementation from low (2kg/day) to high (4 kg /day) reduced the post- partum interval from 159 to 100 days. The highest days open required for the first and second parity cows in this study could be due to the nutritional requirements for growth and their inability to quickly initiate post-partum ovarian activity because of low level of body reserves.

In this study calving interval (CI) were affected by parity number, different authors reported the effect of parity order in calving interval (CI) as Mureda and Mekuriaw (2007), Asimwe and Kifaro (2007) and Abou-Bakr *et al*. (2006) found that the parity order significantly affected calving interval. The data of the present study revealed that the mean of calving interval reported for Baggara cow's was11.65±1.15 month. This results is lower of reported of Kamdasamy *et al. (*1993) (12 months) and El-khalil (2001) (13.4±2.3 months). Ali (2011) reported that the longest calving interval was

(442.21±14.8) day in the 4th parity, while the shortest calving interval was (411.9±19.2) day in the 5th parity. Other works reported longest calving interval than the present study, Ismail (2002) (432.3±2.23 days), Asimwe and Kifaro (2007) (480.4±2.4 days) in dairy cattle in Tanzania and Haile *et al.* (2009) (439.0 days) for Boran cattle in Central Ethiopia. The difference in the length of the calving interval between the present study and the cited authors may be justified by the different breeds and management systems in the different studies.

The results revealed that calving interval is longest in second and fourth parities cows and shortest in cows with first and third parity. Similarly results obtained by Mukasa- Mugrewa (1989). This could be associated with the improvement in reproductive management and it also indicates that physiological maturity is attained with advanced age of cows. The prolonged CI for first calvers has been reported to be physiologically necessary to allow animals to replenish their fat reserves depleted during lactation and this allows them to put on weight prior to the next calving.

From the present study it was observed that calving interval decrease with increasing parity order. This is in partial agreement with Yousif *et al*. (1998). It is disagrees with Sattar *et al.* (2005**)** and Ali (2011) who reported that the length of calving interval increased with parity in Swiss Brown Cattle. These variations might be attributing to breed, nutrition and environmental conditions. Generally many studies have reported that higher milk yield was associated with longer time to resumption of ovarian activity and longer post-partum intervals (Lopez-Villalobos *et al*., 2005) as a consequence of lower production of progesterone (Stadnik *et al*., 2009), or irregular estrous cycles in cows selected for high milk yield (Walsh *et al*., 2011).

5 Conclusion

The results obtained in this study indicated that Baggara cows depend on natural grazing in their natural habitat with different parities, showed increased of milk production with advanced parity. Baggara cows reached its peak milk production on third parity with considered that the main purpose these animals for meat production Also according to the results related to reproductive parameters, the parity order had significant effect on the reproductive performance of Baggara cattle in western Sudan.

Compliance with ethical standards

Acknowledgments

I would like to thank Mohammed El-Amin and Abu El gassim for their assistance with livestock handling and management. I would like to send sincere thanks to all people working at the laboratory of the Department of Dairy Production, Faculty of Animal Production, University of Khartoum. The authors would like to thank all the farmers and cattle herders in West Kordofan State who participated in the project.

Disclosure of conflict of interest

There are no conflict of interest.

References

[1] Abdel-Aziz BE, Ali TE, Ahmed FA. A study of some factors affecting the age at first calving and the calving interval of different Sudan zebu breeds. Journal of Animal and Veterinary Advances. 2005; 4(7): 668- 675.

[2] Abou-Bakr S, Alhammad HOA, Sadek RR, Nigm AA. The productive and reproductive characteristics of Holstein cows raised under intensive farming system in Egypt. Egypt. J. Anim. Prod. 2006; 43: 91-98.

[3] Ageeb AG, Hayes JF. Genetic and environmental effects on the productivity of Holstein-Friesian cattle to the climatic conditions of central Sudan. Trop. Anim. Health Prod. 2000; 32: 33-49.

[4] Ahmed Mahboba IA, El Zubeir, Ibtisam EM. The hygienic quality of raw milk produced by some dairy farms in Khartoum State, Sudan. Res. J. Micro. 2007; 2 (12): 988-991.

[5] Ali SMI. Effect of calving season and parity order on some reproductive traits in the University of Khartoum Dairy Herd. M.Sc. Thesis. University of Khartoum. Khartoum. Sudan. 2011.

[6] Asimwe L, Kifaro GC. Effect of breed, season, year and parity on reproductive performance of dairy cattle under smallholder production system in Bukoba district, Tanzania. Livestock Research for Rural Development. 2007; 19: 152.

[7] Asseged B, Birhanu M. Survival analysis of calves and reproductive performance of cows in commercial dairy farms in and around Addis Ababa, Ethiopia. Tropical Animal Health and Production. 2004; 36: 663-672.

[8] Barbosa SP, Ramalho RP, Monardes HG, Dias FM, dos Santos DC, Batista AV. Milk and fat production of crossbred Holstein-Gir cows (Bos Taurus taurus-Bos taurus indicus) in the Agreste region of the Brazilian State of Pernambuco. Genetics and Molecular Biology. 2008; 31(2): 468- 474.

[9] Basak S, Das DN. Effect of parity, period and season of calving on production and reproduction traits on Deoni cattle. J. Anim. Health Prod. 2018; 6(1): 1-4.

[10] Bashir HHA. The impact of some socio- economic aspects on production of Baggara cattle under extensive and semi- extensive systems in Southern Kordofan State. M.Sc. Thesis. University of Khartoum. Khartoum. Sudan. 2011.

[11] Bell A. Regulation of organic nutrient metabolism during transition from late pregnancy to early lactation. J. Anim. Sci. 1995; 73: 2804–2819.

[12] Brahmstaedt U, Schonmuth G. Effect of herd, AI technician and service period on fertility in cattle. Tierzucht. 1983; 37(1): 12-14.

[13] Bushara I. Effect of season of birth and genetic on post-partum anestrous period of Sudanese cattle. American Research Journal of Agriculture. 2016; 2:1-10.

[14] Butler WR. Energy balance relationships with follicular development, ovulation and fertility in postpartum dairy cows. Livest. Prod. Sci. 2003; 83: 211–218.

[15] Das SM, Forsberg M, Wiktorsson H. Influence of restricted suckling and level of feed supplementation on postpartum reproductive performance of Zebu and crossbred cattle in the semi-arid tropics. Acta Vet. Scand. 1999; 40: 57–67.

[16] De Vries MJ, Veerkamp RF. Energy balance of dairy cattle in relation to milk production variables and fertility. J. of dairy science. 2000; 83(1): 62-69.

[17] De Waal A, Julie F. Darfur: A short history of a long war, Zed Books, London, ISBN. 2006; 1-84277-697-5, 9.

[18] Dhaware SA, Deshpande KS, Thombre BM, Deshmukh DS, Chauhan DS. Factors affecting productive and reproductive traits in Khillar breed of cattle in Maharashtra. Indian J. Anim. Res. 2008; 42(1): 57-59.

[19] Ehui S, Benin S, Williams T, Meijer S. Food Security in Sub- Saharan Africa to 2002, Socio-economic and Policy research working paper 49, ILRI (International Livestock Research Institute), Nairobi, Kenya. 2002; 60p.

[20] El-khalil AO. The reproductive and productive performance of Holstein – Frisian cattle under Libyan conditions. M.Sc. Thesis. University of Khartoum. Sudan. 2001.

[21] Gebregziabher, Gebreyohannes, Azage, Tegegne, Diedhion, ML, Hegde BP. Days to first service, conception rate and service period of indigenous and crossbred cows in relation to post-partum body weight change at Bako, Ethiopia. Ethiopian Journal of Animal production. 2005; 5(1): 83-90.

[22] Gifawosen, Tessema, Alemu, Geberewold, Azage, Tegegne, Diediou, ML, Hegde BP. Study on reproductive efficiency of Boran and its crosses at Holetta research farm: Effect of genotype, management and environment. Ethiopian Journal of Animal Production. 2003; 3(1) :89-108.

[23] Goshu,Gebeyehu, Kelay, Belihu, Abebe, Berihun. Effect of parity, season and year on reproductive performance and herd life of Friesian cows at Stella private dairy farm, Ethiopia. Livestock Research for Rural Development . 2007;19 (7).

[24] Haile, A, Joshi BK, Ayalew W, Tegegne A, Singh A. Genetic evaluation of Ethiopian Boran cattle and their crosses with Holstein Friesian in central Ethiopia: reproductive traits. J of Agricultural Sci. 2009; 147: 81 – 89.

[25] Hamid RH. Thermal, haematological and lactational responses of graded dairy cows. M.Sc. Thesis, University of Khartoum, Sudan. 1994.

[26] Hammoud MH, El-Zarkouny SZ, Oudah EZM. Effect of sire, age at first calving, season and year of calving and parity on reproductive performance of Friesian cows under semiarid conditions in Egypt. Archiva Zootechnica. 2010; 13: 1:60-82.

[27] Ibrahim MT. Study of milk composition and some production traits of Friesian and Sudanese grade dairy cattle. M.Sc. Thesis, University of Khartoum, Sudan. 1989.

[28] Ibrahim S, Samaha H. The effect of some environmental conditions on milk yield and its constituents in dairy farms. Assiut Veterinary Medical Journal. 1986; 197: 145-149.

[29] Ismail M, Elfagir. The evaluation of the performance of Holstein –Friesian cows in the Gezira dairy production and processing project. M.Sc. Thesis. University of Khartoum. Khartoum. Sudan. 2002.

[30] Kamdasamy MK, Thorsness MK, Rundle SJ, Goldberg ML, Nasrallah JB, Nasrallah ME. Ablation of papillar cell function in Brassica flowers results in the loss of stigma receptivity to pollination. Plant Cell. 1993; 5: 263-275.

[31] Klungel GH, Salghuis BA, Hogeveen H. The effect of introduction of automatic milling system on milk quality. J. Dairy Sci. 2000; 83 (9): 1998-2003.

[32] Lopez-Villalobos N, McNaughton LR, Spelman RJ. The relationship between lactation persistency and reproductive performance in New Zealand dairy cattle, Session 35 CPh6. 4 in Proc. The 56th Annual Meeting of the EAAP. June 5-8, Uppsala, Sweden. 2005.

[33] Lucy MC, Staples CR, Thatcher WW, Erickson PS, Cleale RM, Firkins JL, Murphy MR, Clark JH, Brodie BO. Influence of diet composition, dry matter intake, milk production, and energy balance on time of post-partum ovulation and fertility in dairy cows. Anim. Prod. 1992; 54: 323-331.

[34] Mackey DR, Wylie AR, Sreenan JM, Roche JF, Diskin MG. The effect of acute nutritional change on follicle wave turnover, gonadotropin,and steroid concentration in beef heifers. Journal of animal science. 2000; 78(2): 429-442.

[35] Mech A, Dhali A, Prakash B, Rajkhowa C. Variation in milk yield and milk composition during the entire lactation period in Mithun cows (Bos frontalis). Livestock Research Rural Development. 2008; 20 (5).

[36] Meikle A, Kulcsar M, Chilliard Y, Febel H, Delavaud C, Cavestany D, Chilibroste P. Effects of parity and body condition at parturition on endocrine and reproductive parameters of the cow. Reproduction. 2004;127:727-737.

[37] Mohamed AM. Studies of some performance traits of Butana cattle in Atbara live-stock research station. M.Sc. Thesis, University of Khartoum, Sudan. 2004.

[38] Motlagh M Khodaei, Roohani Z, Zare Shahne A, Moradi M. Effects of age at calving, parity, year and season on reproductive performance of dairy cattle in Tehran and Qazvin Provinces, Iran. Res. Opin. Anim. Vet. Sci. 2013; 3(10): 337-342.

[39] Mukasa-Mugerewa E. A review of Reproductive Performance of Female Bos indicus (Zebu) Cattle. ILCA Monograph N 6, ILCA, Addis Ababa, Ethiopia. development. 1989; 19: 161.

[40] Mureda E, Mekuriaw Zeleke Z. Reproductive performance of crossbred dairy cows in Eastern lowlands of Ethiopia. Livestock Research for Rural Development. 2007; 19.

[41] Mustafa T, Serdar K. Relationships between production and fertility traits in first lactation and life time performances of Holstein cows under subtropical condition. Research Institute for the Biology of Farm animals (FBN). Dummerstorf, Germany. 2009; 52 (4): 364-370.

[42] Nyamushamba GB, Halimani TE, Imbayarwo-Chikosi VE, Tavirimirwa B. Comparative evaluation of non-genetic factors affecting milk yield and composition of Red Dane and Jersey cattle in Zimbabwe. SpringerPlus. 2014; 3:88.

[43] Olafadehan OA, Adewumi MK. Milk production and economic impact of strategic supplementation of prepartum Bunaji cows in the peri-urban areas of derived savanna of southwestern Nigeria. Livestock Research for Rural Development. 2008; 20(3). Electronic version

[44] Pollott GE. Deconstructing milk yield and composition during lactation using biologically based lactation models. J. Dairy Science. 2004; 87: 2375- 2387.

[45] Poncheki Jessica, Karina, Maria Luíza, Schultz Canha, Sandro, Luiz Viechnieski, Rodrigo de Almeida. Analysis of daily body weight of dairy cows in early lactation and associations with productive and reproductive performance. R. Bras. Zootec. 2015; 44 (5).

[46] Reist M, Erdin DK, Von-Euw D, Tschümperlin KM, Leuenberger H, Hammon HM, Morel C, Philipona C, Zbinden Y, Künzi N, Blum JW. Post-partum reproductive function: association with energy, metabolic and endocrine status in high yielding dairy cows. Theriogenology. 2003; 59:1707-1723.

[47] Sattar A, Mirza RH, Niazi AAK, Latif M. Productive and reproductive performance of Holstein Frisian cows in Pakistan. Pakistan Veterinary Journal. 2005; 25(2): 75-81.

[48] Shuiep ESI, Eltaher HA, El Zubeir IEM. Effect of stage of lactation and order of parity on milk composition and daily milk yield among local and crossbred cows in South Darfur State, Sudan. SUST Journal of Agricultural and Veterinary Sciences (SJAVS). 2016; 17(2): 1858 6775.

[49] Singh A, Pratap A. Comparison of physicochemical properties of raw milk from indigenous and exotic cows at Allahabad. International Journal of Science and Research. 2014; 3(8): 1566- 1568.

[50] Singh G, Gaur GK, Nivsarkar AE, Patil GR, Mitkari KR. Deoni cattle breed of India. A study on population dynamics and morphometric characteristics. AGRI. 2002; 32: 35- 43.

[51] SKDP. Southern Kordofan Development Program, Volume (1), Main Report. No. January, 2000.

[52] Smith G, O'Mary CC, Ensminger ME. Rate of gain and feed efficiency within specific weight increments in growing beef cattle. Journal of Animal Science. 1961; 20(911).

[53] Stadnik L, Jezkova A, Louda F. The relationships among recovery of ovarian functions after calving, level of progesterone in milk and reproduction results in dairy cows, Reproduction in Domestic Animals. 2009; 44: 126-126.

[54] Stahl TJ, Conlin BJ, Seykora AJ, Steuernagel GR. Characteristics of Minnesota dairy farms that significantly increased milk production from 1989–1993. J. Dairy Sci. 1999; 82: 45–51.

[55] SPSS, Windows for Version 11.5. (Microsoft corporation). Trends SPSS Inc. Michigan Avenue, Chicago, IL. 2000; 19-182.

[56] Sudhakar K, Panneerselvam S, Thiruvenkadan AK, Abraham J, Vinodkumar G. Factors effecting milk composition of crossbred dairy cattle in southern India. International Journal of Food, Agriculture and Veterinary Sciences. 2013; 3(1): 229- 233.

[57] Sutton JD. Altering milk-composition by feeding. Journal of Dairy Science. 1989; 72: 2801- 2814.

[58] Tadesse Bekele, Zelalem Yilma. Feeding noug 'Guizotia abyssinica' cake as protein source to lactating Borana ´ Jersey crossbred cows: performances in milk yield, reproduction and feed efficiency. Farm animal biodiversity: status and prospects. Proceedings of the 11th annual conference of the Ethiopian Society of Animal Production (ESAP). 28-30 August 2000, Addis Ababa, Ethiopia. 2003.

[59] Tomomi T, Mayumi A, Shohei O, Saya U, Takenobu K, Seungjoon K, Hideo K. Influence of parity on follicular dynamics and resumption of ovarian cycle in post-partum dairy cows. Anim. Reprod. Sci. 2008; 108: 134-143.

[60] Vogt Kees. A field workers guide to the identification, propagation and uses of: common trees and shrubs of dry land Sudan. Sos. Sahel international (UK). Ed. 1995; 167.

[61] Walsh SW, Williams EJ, Evans ACO. A review of the causes of poor fertility in high milk producing dairy cows. Animal Reproduction Science. 2011; 123: 127-138.

[62] Wang AS, Jan DF, Chen KJ, Yang DW, Fan YK. Dietary supplementation of fat increased milk fat percentage without affecting ruminal characteristics in Holstein cows in a warm tropical environment. Asian-Australian Journal of Animal Science. 2004; 17(2): 213- 220.

[63] Yousif IA, Fadl El Moula AA. Characterization of Kenana cattle breed and its production environment. Animal Genetic Resources Information. 2006; 38: 47-56.

[64] Yousif IA, Fadlel-Mula AA, Abu-Nikhaila AM. Productive performance of the crossbred cattle in the Sudan. I. Lactation performance. Proc. 8th Arab. Vet. Conf. Khartoum. March 1998; 524-539.