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Lactation length, lactation milk yield and dry off period of exotic and local crossed cows in Cameroon

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Data on of 403 genetic crossed cows obtained from the database of the Bambui Centre of the Institute of Agricultural Research for Development (IRAD) in the Sudano-guinean altitude zone of West of Cameroon were used to evaluate effect of parity and season on lactation length, lactation milk yield and dry off period. These animals reared between 1985 and 1998 were crosses between imported Jersey (J) and Holstein (H) bull semen with local White Fulani (WF) and Gudali (G) cows. Results obtained revealed that lactation length (LL), lactation milk yield (LMY) and dry off period (DOP) varied significantly between the different genetic crossed groups of cows. Lactation number and season simultaneously affected these traits. Cows with 75% of Holstein exotic blood (75% H x 25% G) recorded the longest LL (265 ± 27.0 days) and the highest LMY (1995 ± 317 kg) being the shortest DOP (82.7 ± 41.3 days) was in 50% H x 50% G genetic crossed group. Genetic crossed group II (75% J x 25% WF) registered the shortest LL (215 ± 6.35 days), lowest LMY (1149 ± 89.7 kg) and longest dry off period (166 ± 10.4 days). Performances obtained for both LL, LMY and DOP with Holstein-Gudali (50% H x 50% G and 75% H x 25% G) crossed as compared to Jersey-White Fulani crossed revealed their high productive potential through their adaptability capacity to harsh conditions of tropics.

Key words: crossed cows, Cameroon, dry off period, exotic and local breeds, lactation length, lactation milk yield

INTRODUCTION

One of the major challenge of the world is the fast population growth. As one of the consequences of fast growing population is food security. Indeed, already a very high proportion of the world population (821 million people) specially in African countries with the highest population growth estimated at 2.5 to 3.0 percent per year are undernourished (239.1 million of whom are located in south-Sahara) particularly as protein more specifically animal proteins are concerned (FAO, 2017).

In fact, the level of consumption of animal proteins is already below 20 kg/capita/year compared to 45 kg proposed by the World Health Organization. Meat and milk are the two major sources of animal protein (FAO, 2019). Despite the importance of the African cattle herd (1/3 the world cattle population), their production and productivity are still very low. Indeed, milk production remains insufficient and constitutes only 4.7 % of world production (FAO, 2017). This level of milk production does not reach the level of efficiency required to meet the needs of a growing population. To offset the dairy deficit, Africa imports 50% of the dairy products it consumes, mainly in form of powdered milk.

Despite the considerable number of African cattle heads, their level of production and productivity is still very low due to the limited genetic potential of local breeds, diseases, management and climatic conditions (Kouamo et al., 2014).

In Cameroon, the level of production per animal or per production unit is still low to effectively meet the needs of population. Annual milk production represents only 42.1 percent (125,000 tons) against an annual demand estimated at 297,000 tons with a deficit of 57.9 percent (172,000 tons) per year (INS, 2015).

Low cattle productivity can be improved trough selection during a long period or shorter term crossbreeding (Kouamo et al., 2009). Therefore, genetic improvement of local breed by crossing with exotic dairy breeds is one of the solutions put in place in many countries.

In Cameroon, to improve milk production, high performing exotic dairy cattle breeds like Jersey and Holstein Friesian were introduced in the early seventies (Mbah et al.,1987). These cattle were crossed with local breeds in Wakwa Agricultural Research Centre in the high Guinea Savannah zone. This was also the case of Bambui in the Sudano-guinean altitude zone where important researches in terms of duration and number of animals involved were conducted with the aim of identifying productive and adapted genotypes for the enhancement of dairy production in Cameroon. The objective of this study was to evaluate effect of parity and season on lactation length, lactation milk yield and dry off period of crossed cows.

MATERIAL AND METHODS

Period and study site

Data for a period of 13 years (1985-1998) obtained from the available database of Bambui Regional Centre of the Institute of Agricultural Research for Development (IRAD) were used in the present study. The geoclimatic characteristics of Bambui in to the Sudano-guinean altitude zone of West Cameroon are shown in table 1.

Table 1: Geoclimatic characteristics of Bambui

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Characteristics	Values
Altitude	1350 meters
Latitude	4°50’ and 5°20’N,
Longitude	10°35’ and 11°59’E
Soil	Clay ferritic
Rainfall	2310.9 ± 196.3 mm
Temperature	Dry season (November-mid-March) 15.50°C, rainy season (mid-March-October) 24.5°C
Humidity	52% for dry season, 70% for rainy season

Source: Balgah and Maluh, 2017

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Experimental Animals

A total of 403 genetic crossed cows distributed into six groups as represented in table 2 were used in this study. These crossed cows were obtained through importation from USA of Jersey and Holstein bull semen, which was used to inseminate local cow breeds (Gudali and White Fulani).

Table 2: Experimental genetic crossed cows

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Groups	Crossed cows	n for LL	n for LMY	n for DOP
I	50%Jx50%WF	135	135	79
II	75%Jx25%WF	117	117	81
III	87.5%Jx12.5%WF	8	8	65
IV	50%Hx50%G	130	130	5
V	75%Hx25%G	13	13	-

J=Jersey, H=Holstein, G=Gudali, WF=White Fulani, n= Number of observations, LL=lactation length, LMY=lactation milk yield, DOP=dry off period

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Animals involved in this study were born and raired at the IRAD Bambui research center farm. They were all subjected to the semi-intensive system and grouped as follows.

- calves lodging were made of boxes of 1.5 x 2m each

- lactating cows lodging was a parlor of 20 x 12m

- heifers and the pregnant cows lodgings

- bulls lodging constituted of boxes of 3 x 4m each

Cow's feeding

During the rainy season, cows were grazing in rotation on pastures from 9 AM to 4 PM and they were receiving ad libitum forage (Pennisetum clandestinum, Stylosanthes and Bracharia sp) and hay (Bracharia sp) when they were in the pens. In the dry season, in addition to grazing, cows received ad libitum Guatemala silage and elephant grass. Water supply was ad libitum in concrete water troughs placed in pasture or in pens. During milking, each lactating cows received 4 kg (2kg morning at 7 AM and 2kg evening at 5 PM) of concentrate made of 38% of corn, 30% rice or wheat bran, 30% cotton seed cake, 1% bone meal and 1% common salt. The calculated chemical composition of the concentrate showed a rate of 74.6% for digestible total nutrients and 16 % of crude protein.

Milk production and evaluation

Milking was done with a milky machine twice daily (morning at 7 AM and in the evening 5 PM) after disinfection (with warmed water) of cows' udders. During milking, calves were used only to stimulate milk ejection. The collected milk was measured with graduated containers.

Herd health

Animals were de-wormed once or twice a month respectively in dry and rainy season with Panacur® (fenbendazole) to a dose of 5 mg/kg (2.3 mg/lb.). Prophylaxis against trypanosomiasis, was done using Berenil® (3.5 mg/kg of body mass) and Trypamidium® (3.5 mg/kg and 0.5-1 mg/kg of body mass repectively) every two months. Animals were sprayed once a week in rainy and monthly in the dry season with Supona or Tigal (0.5 ml for 1000 ml of water). Daily cleaning of livestock premises was practiced throughout.

Characteristics studied

- Lactation length (LL)

LL (days) = total production / number of days of lactation x 305

- Lactation milk yield (LMY)

LMY (kg) = total amount of milk produced from the beginning to the end of lactation

- Dry off period (DOP)

DOP (days) = date of beginning of lactation - date of cessation of last lactation.

Statistical analysis

Data were subjected to analysis of variance using the multifactor analysis of variance (ANOVA). Tukey test was used to determine significant difference between means. Differences with P-values less than 0.05 ($P<0.05$) were considered to be significantly different. Software SPSS version 23.0. was used.

RESULTS

Comparative effect of seasons on lactation length (LL), lactation milk yield (LMY) and dry off period (DOP) of the five different genetic crossed groups of cattle are summarized in tables 3 to 5 show the below results.

Lactation length

Effect of seasons and lactation numbers on lactation length (LL) of different genetic crossed groups is summarized in table 3.

Independently of seasons and lactation numbers, the table revealed a significant difference among crossed groups. Therefore, genetic group II registered the lowest LL but comparable (p˃0.05) to groups I and IV. Crossed cattle of group V performed the longest LL obtained with a difference of 40.20 days (1.38 months) between the shortest and the longest LL.

Table 3: Effect of lactation number and season on lactation length (days) of different genetic crossed groups of cows

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Table 3: Effect of lactation number and season on lactation length (days) of different genetic crossed groups of cows

Lactation numbers, seasons	Genetic crossed groups				
	I	II	III	IV	V
Lactation numbers					
1	226.9±14.3 $^{a\alpha}$ (18)	225.4±15.0 $^{a\alpha\beta}$ (28)	261.5 ± 25.4 ^{a} (8)	237.5 ±15.6 $^{a\beta}$ (20)	255.3 ± 29.5 ^{a} (9)
2	235.3±11.9 $^{a\alpha}$ (26)	227.4±16.9 $^{a\alpha\beta}$ (22)	-	255.9±13.1 $^{a\alpha\beta}$ (28)	-
3	217.3±14.3 $^{ab\alpha}$ (18)	197.1±14.7 $^{b\beta}$ (29)	-	254.1 ±14.2 $^{a\alpha\beta}$ (24)	-
4	252.8±13.6 $^{a\alpha}$ (20)	239.5±20.4 $^{a\alpha\beta}$ (15)	-	263.3±16.4 $^{a\alpha\beta}$ (18)	-
5	235.7±15.2 $^{a\alpha}$ (16)	242.0±28.0 $^{a\alpha}$ (8)	-	273.4±21.0 $^{a\alpha\beta}$ (11)	-
6	239.2±15.2 $^{b\alpha}$ (16)	236.86±29.9 $^{b\alpha\beta}$ (7)	-	289.2±20.1 $^{a\alpha}$ (12)	-
7	225.1±13.3 $^{b\alpha}$ (21)	200.4±28.0 $^{b\alpha\beta}$ (8)	-	278.8±16.9 $^{a\alpha\beta}$ (17)	-
Seasons					
Dry	207.3 ± 9.2 $^{b\beta}$ (54)	187.2 ± 9.8 $^{c\beta}$ (47)	-	246.1 ± 10.4 $^{a\beta}$ (42)	247.3 ± 25.5 $^{a\beta}$ (8)
Rainy	250.6 ± 7.49 $^{b\alpha}$ (81)	243.2 ± 8.05 $^{b\alpha}$ (70)	261.5 ± 25.4^{ab} (8)	268.6 ± 7.2 $^{ab\alpha}$ (88)	283.5 ± 37.6 $^{a\alpha}$ (5)
Overall mean (days)	**229.0 ± 5.92 ^{b} (135)**	**215.2 ± 6.35 ^{b} (117)**	**261.5 ± 25.4^{a} (8)**	**257.3 ± 6.32 ^{ab} (130)**	**265.4 ± 27.0 ^{a} (13)**

a,b,c: values carrying the same superscript in the same line are not significantly different (p>0.05), α, β, γ: values carrying the same superscript in the same column do not significantly differ (p>0.05), ( )= number of observations, I=50%Jx50%WF, II=75% Jx25%WF, III=87.5%Jx12.5%WF, IV=50%Hx50%G, V=75%Hx25%G, J= Jersey, WF=White Fulani, H=Holstein, G= Gudali, Dry=November to mid-March, Rainy=mid-March to October

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Lactation numbers were found to have significant effect on LL among genetic crossed groups. Genetic crossed group III registered the longest lactation length at the first lactation whereas genetic group IV recorded the longest LL from the second to the seventh lactation. Genetic crossed group II recorded the shortest LL from the first to the seventh lactation except at the fifth lactation where the shortest LL was obtained by crossed cows of group I. Genetic crossed groups I and II registered shortest lactation length at parity 3 while genetic group IV the longest LL at the first lactation. The longest LL recorded by genetic crossed groups I, II and IV were respectively at the lactation numbers 4, 5 and 6.

Calving seasons had a significant effect (p˂0.05) on the lactation length. During dry and rainy seasons, genetic crossed group V recorded the longest LL compared to genetic group II where the shortest LL were recorded for the both seasons. Crossed cattle that calved during dry season had a lactation length shorter compared to rainy season lactation length.

Lactation milk yield

Comparative effects of seasons and lactation numbers on lactation milk yield (LMY) of different genetic crossed groups is summarized in table 4.

Independently of lactation numbers and seasons, overall means of milk yield varied significantly ($p < 0.05$) among crossed groups. Therefore, crossed cattle of group II registered the lowest LMY. Genetic crossed groups I, II and III recorded comparable ($p > 0.05$) LMY with group III performing better by having higher LMY as compared with genetic groups I and II. Crossed cattle of group V obtained the highest LMY but comparable to genetic groups III and IV.

Lactation number was found to have a significant effect on LMY. Genetic crossed group V recorded the highest LMY at the first lactation being the highest milk yield from the second to the seventh lactations in genetic crossed group IV. Whereas group II recorded the lowest LMY from the second to the fourth in one hand, and at the sixth and seventh parities in the other hand. At the first and fifth lactations, genetic crossed group I obtained the lowest LMY. When considering effect of lactation number in the same genetic crossed group, the highest LMY assessed in genetic groups I, II and IV were at the parity 4, 5 and 6 respectively. The lowest milk yield were registered at the lactation 1 in genetic crossed groups I and IV in one hand, and at the lactation 7 in genetic crossed group II in the other hand. Non-linear increase of LMY with lactation number was observed in genetic crossed groups I and IV.

Table 4: Effect of lactation number and season on lactation milk yield (kg) of the different genetic crossed groups of cows

Table 4: Effect of lactation number and season on lactation milk yield (kg) of the different genetic crossed groups of cows

Lactation numbers, seasons	Genetic crossed groups				
	I	II	III	IV	V
Lactation numbers					
1	1131 ± 125$^{b\beta}$ (19)	1218 ± 122$^{b\beta}$ (28)	1573±227.2 ^{a} (8)	1508 ± 160.1$^{a\beta}$ (20)	1667 ± 227.2 ^{a} (9)
2	1392 ± 106$^{ba\beta}$ (25)	1233 ± 137$^{b\beta}$ (22)		1875 ± 135.3$^{a\alpha\beta}$ (28)	
3	1316±125 $^{b\beta}$ (18)	1135 ± 120 $^{b\beta}$ (29)		2037 ± 146.2 $^{a\alpha}$ (24)	
4	1708 ± 119 $^{a\alpha}$ (20)	1104 ± 167 $^{b\beta}$ (15)		1792 ± 168.8$^{a\alpha\beta}$ (18)	
5	1322 ± 133 $^{b\beta}$ (16)	1778 ± 228$^{ab\alpha}$ (8)		1937 ± 215.9$^{a\alpha\beta}$ (11)	
6	1280 ± 133 $^{b\beta}$ (16)	1132 ± 244 $^{b\beta}$ (7)		2080 ± 2-06.7 $^{a\alpha}$ (12)	
7	1275 ± 116 $^{b\beta}$ (21)	915 ± 228 $^{b\beta}$ (8)		1820 ± 173.7$^{a\alpha\beta}$ (17)	
Seasons					
Dry	1164 ± 81.8$^{bc\alpha}$ (54)	896 ± 87.7 $^{c\alpha}$ (47)	-	1489 ± 92.7$^{ab\beta}$ (42)	1667±227.2^{a} (7)
Rainy	1482 ± 66.8 $^{b\alpha}$ (81)	1400 ± 71.8$^{b\beta}$ (70)	1560 ± 226.3^{b} (7)	2028 ± 64.1$^{a\alpha}$ (88)	-
Overall mean (kg)	**1291 ± 82.7 ^{b} (135)**	**1148 ± 89.6 ^{b} (117)**	**1573 ±227.2 ^{ab} (8)**	**1742 ± 85.0 ^{a} (130)**	**1995 ± 317 ^{a} (13)**

a,b,c: values carrying the same superscript in the same line are not significantly different (p>0.05), α, β, γ: values carrying the same superscript in the same column do not significantly differ (p>0.05), ( )= number of observations, I=50%Jx50%WF, II=75% Jx25%WF, III=87.5%Jx12.5%WF, IV=50%Hx50%G, V=75%Hx25%G, J= Jersey, WF=White Fulani, H=Holstein, G= Gudali, Dry=November to mid-March, Rainy=mid-March to October

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Lactation numbers, seasons

When effect of calving season was considered, a significant effect (p˂0.05) of season on the lactation milk production was registered. Genetic crossed of groups IV and V recorded the highest LMY for rainy and dry season respectively whereas genetic crossed group II recorded the lowest LMY both for dry and rainy seasons. Whatever the case, genetic crossed cattle that calved during dry season had a LMY lower compared with the rainy production.

Dry off period

Comparative effects of seasons and lactation numbers on dry off period (DOP) of different genetic crossed groups of cattle summarized in table 5.

Table 5: Effect of lactation number and season on dry off period (days) of different crossed groups of cows

Table 5: Effect of lactation number and season on dry off period (days) of different crossed groups of cows

Lactation numbers, season	Genetic crossed groups I	II	III	IV
Lactation numbers				
1	188.0 ± 25.4 $^{a\alpha}$ (12)	206.2 ± 22.5 $^{a\alpha}$ (16)	113.2 ± 23.9 $^{b\beta}$ (12)	82.7 ± 41.3 ^{b} (5)
2	138.1 ± 24.4 $^{a\gamma}$ (13)	129.4 ± 23.9 $^{a\beta}$ (14)	119.6 ± 21.4 $^{a\beta}$ (15)	-
3	180.8 ± 27.8 $^{a\alpha}$ (10)	200.73 ± 20.39 $^{a\alpha}$ (20)	99.5 ± 33.8 $^{b\beta\gamma}$ (6)	-
4	119.7 ± 24.4 $^{b\gamma}$ (13)	120.6 ± 27.6 $^{b\beta\gamma}$ (12)	160.4 ± 29.3 $^{a\alpha}$ (8)	-
5	116.3 ± 35.9 $^{b\gamma}$ (6)	95.3 ± 39.0 $^{b\gamma}$ (7)	153.4 ± 31.3 $^{a\alpha}$ (7)	-
6	148.5 ± 26.5 $^{a\beta}$ (11)	105.2 ± 41.8 $^{b\beta\gamma}$ (6)	153. 6± 27.6 $^{a\alpha}$ (9)	-
7	118.1 ± 23.5 $^{a\gamma}$ (14)	113.7 ± 45.2 $^{a\beta\gamma}$ (6)	71.1 ± 31.3 $^{a\gamma}$ (7)	-
Seasons				
Dry	165.2 ± 16.5 $^{ab\alpha}$ (30)	189.8 ± 16.5 $^{a\alpha}$ (30)	140.9 ± 19.8 $^{b\alpha}$ (21)	-
Rainy	131.5 ± 12.9 $^{a\beta}$ (49)	142.9 ± 12.7 $^{a\beta}$ (51)	116.6 ± 13.7 $^{ab\alpha}$ (44)	82.7 ± 41.3 ^{b} (5)
Overall mean (days)	**148.4 ± 10.5 ^{ab} (79)**	**166.3 ± 10.4 ^{a} (81)**	**128.8 ± 12.0 ^{b} (65)**	**82.7 ± 41.3 ^{c} (5)**

a,b,c: values carrying the same superscript in the same line are not significantly different (p>0.05), α, β, γ: values carrying the same superscript in the same column do not significantly differ (p>0.05), ( )= number of observations, I=50%Jx50%WF, II=75% Jx25%WF, III=87.5%Jx12.5%WF, IV=50%Hx50%G, V=75%Hx25%G, J= Jersey, WF=White Fulani, H=Holstein, G= Gudali, Dry=November to mid-March, Rainy=mid-March to October

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Overall means of dry off period independently of lactation numbers and season varied significantly (p˂0.05) among difference genetic crossed groups. Therefore, genetic crossed group II recorded longest DOP values as compared to groups IV and III that recorded the shortest dry off period respectively. Groups I and II recorded comparable (p˃0.05) DOP.

Lactation number was found to affect dry off period. When comparing the same lactation among genetic crossed groups, the shortest dry off period was recorded at the lactation 1 genetic in group IV. Crossed of group III recorded the shortest DOP at the second, third and seventh lactations. While genetic group I recorded the shortest DOP at the fourth parity. Similarly, genetic crossed group I registered longest dry off period at the lactations 2 and 7 respectively. At the lactations 1 and 3 longest dry off period were obtained in genetic crossed group II whereas genetic crossed group IV registered longest DOP from lactation 4 to 6 respectively.

Results revealed a non-linear decrease of dry off period with lactation numbers. However, this period decreased as the lactation numbers increased from the first lactation with heifers having the longest DOP in genetic groups I and II compared to lactation 5 where the shortest dry off periods were registered. However, the longest and shortest DOP were recorded respectively at the lactations 6 and 7 in genetic group III.

Calving seasons were found to affect significantly dry off period in this study. Thus, genetic crossed groups III and IV recorded the shortest DOP for dry and rainy season respectively being the longest in group II for both dry and rainy season. Considering effect of season in the same genetic crossed group, whatever the genetic group, crossed cattle calving during the dry season recorded longest dry off period while in rainy season this period was shorter as compared to dry season.

DISCUSSION

This study was conducted to assess the effect of season on lactation length (LL), lactation milk yield (LMY) and dry off period (DOP) of the different genetic crossed groups.

Lactation length and dry off period

Lactation lengths registered in this study were higher than the values obtained by Bayemi et al., (2005) with local breeds (140, 175 and 114 for Gudali, White Fulani and Red respectively) in Cameroon. The lactation periods recorded with the different crossed groups in this study was 1.5 time higher compared to local breeds. This result was close to the observations of Galukande et al., (2013) and could be explained by present of exotic blood.

In fact, crossing local breeds with exotic breeds with high milk production potential could result trough heritability of exotic genes to crosses capable to have lactation length longer than their local breeds' parents could. This heritability is better expressed in Holstein crossed more specifically in crossbreds having 75 percent of exotic Holstein blood. In fact, in harsh climatic conditions, lactation length of exotic breeds and therefore for their counterpart crossed could be altered with heat stress. This study the performance of crossbreds having 75 percent of exotic Holstein blood (75%Hx25%G) showed the better adaptability to hot environment of tropics.

Lactation period and dry off period were significantly different among cows with different levels of exotic blood. Djoko et al., (2003) found similar results while Kamga et al., (2001) and Doko et al., (2012) found that the degree of inheritance of exotic blood did not affect the LL. Increase of dry off period was correlated to an increase of parity, among Jersey crossed cows, while the opposite effect was observed with Holstein-Gudali crossed cows.

The longest dry off period was recorded with the genetic group having 87.5% of Jersey blood (87.5% Jx12.5%WF). These observations were different from the findings of Doko et al., (2012). Results also revealed that, genetic group of Jersey crossed cows had low LL than Holstein crossed cows. These findings were similar to the findings of Galukande et al., (2013) in the tropical wet and dry climatic zones.

Lactation periods of the various crossed cows in this study were higher than the findings of Djoko et al., (2003) with the same genetic breeds and Doko at al., (2012) with Girolando cattle in Benin. Nevertheless, these results on LL were lower than the results obtained by Kamga et al., (2001). The shortest LL recorded was performed by crossbred cattle having 75% of Jersey exotic blood (75% Jx25%WF) while the longest LL obtained was performed by crossbred cattle having 75% of Holstein exotic blood (75%Hx25%G) with a difference of 50.2 days (1.67 month) between the shortest and the longest LL. These observations in the genetic variability materialized by indefinite fluctuations of the lactation periods between crossbreds with different inheritance genetic groups found in this study were been observed by others authors (Kiwuwa et al., 1983 and Kamga et al., in 2001). Breeding conditions compiled with climatic and zootechnical factors could mentioned as responsible of these variations. Values obtained with Holstein crossed cattle confirmed their high potential of and their adaptability in tropical milieu.

Lactation number was found to have a significant effect on LL and dry off period. Results revealed a non-linear increase of lactation period with the lactation number whereas dry off period decreasd. This could be explain in this particular case by the extension of LL. The increase observed with lactation length was also found to be related to parity by Djoko et al., (2003), Doko et al., (2012) and Bayou et al., (2015). They attributed it to the increase in body weight combined with advancing age at full development of secretory tissues of the udder. Contrary to these findings, Kiwuwa et al., (1983), Kamga et al., (2001), M'hamdi et al., (2012), Wondifraw et al., (2013), Bolacali and Ozturk (2018) found that LL significantly decreased with the increase of parity and attributed it to the gain in age of animals.

Calving season was found to have an effect on lactation length and dry off period. This observation was similar to the findings of Doko et al., (2012), M'hamdi et al., (2012), Bayou et al., (2015), Bolacali and Ozturk (2018). However, these results were different from results obtained by Kamga et al., in 2001, Djoko et al., (2003) and Wondifraw et al., (2013). Crossed cows that calved during the dry season registered a lactation length shorter compared with the rainy season lactation length with 31.7 days of difference between the two seasons. Fluctuations of forage availability due to seasonal variations affect the expression of animal's genetic potential (Malau-Aduli et al., 1996).

High temperature during dry seasons negatively influence milk production and thus lactation period through a reduction of voluntary food intake and digestibility coupled to an increase pulmonary evaporation (Meyer et Denis, 1999). Cattle with high milk potential are not adapted to tropical climatic conditions. Due to their important milk production, they produce large extra-heat quantity, calorific production difficult to evacuate when hygrometric air degree is important. Temperature Sudano-guinean zone of Cameroon and in particular Bambui varied between 15.50°C and 24.5°C, respectively with temperature possible to go above 30°C. These crossed cows although tropical animals do not really support high temperature and long dry seasons (Doko et al., 2012). However, crossed cows with 75% Holstein blood performed better than other crossed and this may be due to their adaptability and resistance to heat stress of tropics.

Lactation milk yield

Lactation milk yield registered with the different genetic crossed groups were higher than the values reported by Bayemi et al., (2005) with local breeds in Cameroon and Bayou et al., (2015) with Sheko cattle in Southwest of Ethiopia. These values were therefore 3.5 time higher than the milk yield per lactation of local breeds and higher than the findings of Galukande et al., (2013). The high lactation milk yield assessed in the study showed that, genetic crossing between local breeds characterized by low milk yield per lactation with exotic breeds with high milk production could result to genetic crossed cows with high milk production as compared to local breeds.

Lactation milk production differed significantly among animals with different levels of exotic. Kamga et al., (2001) and Djoko et al., (2003) with the same crossed reported that, LMY increased with exotic blood level whereas Doko et al., (2012) in Benin with Girolando cattle reported a decrease of LMY with increase of exotic blood. LMY performances of the various crossed cows in this study as far as the Jersey and Holstein inheritance of dams were involved were lower than the findings of Tawah et al., (1999), Kamga et al., (2001), Djoko et al., (2003) with the same genetic breeds. Results revealed that, Jersey crossed recorded lower LMY values than the group of Holstein crossed cows.

The recorded lowest LMY was produced by crossed cows having 75% of Jersey exotic blood (75%Jx25%WF) whereas the highest LMY obtained by crossed cows having 75% of Holstein exotic blood (75%Hx25%G). Jersey and Holstein are European Bos taurus breeds more adapted to high temperature. The high potential of Holstein crossed observed trough high values of LMY compared with Jersey crossed in this study might be due to the better capacity of Holstein and thus their crossed to adapt in difficult environment as in the tropics where exotic dairy cattle have a low resistant capacity to harsh conditions (Galukande et al., 2013).

Lactation number was found to have a significant effect on LMY with crossed cows having 75% (75%Hx25%G) of Holstein blood recording higher lactation milk yield as compared to Jersey crossed cows. This result although in disagreement with the results of Bayou et al., in 2015, was comparable to the findings of Wondifraw et al., (2013). This could the due to the fact that young lactation cows have lower energy balance for growth and lactation as they cannot consume adequate energy in the diet (Bayou et al., 2015).

Calving season affects significant lactation milk yield. Crossed cows that calved during the dry season had a production lower compared to the rainy season production, with crossed cows having 50% (50%Hx50%G) of Holstein blood having the highest LMY during both dry and rainy seasons. These results were different to the findings of Kamga et al., (2001), Djoko et al., (2003) with the same breeds that revealed no significant difference of LMY with the season. However, Melaku et al., (2011), Doko et al., (2012), Wondifraw et al., (2013) and Tancin et al., (2018), found similar results to the present study. The difference in season could be due to the fact that, rainy season is characterized by an excess succulence forages with high nutrient content, low fiber content, high digestibility and high voluntary intake by animals (Bayou et al., 2015). Thus, when nutrition is sufficient, cows become productive for high milk yield. Low availability of natural forage coupled to heat stress and diseases during the dry season may have contributed to the observed trend in LMY. Moreover, during the dry period, heat stress results in impaired mammary growth, leading to reduced milk yield in the subsequent lactation (Tao et al., 2018).

Whatever the season considered, values of total milk yield obtained with Holstein crossed cows were significantly higher than Jersey crossed cows. This confirms the high potential of Holstein crossbreds and their adaptability in tropical milieu.

CONCLUSION

Lactation length, lactation milk yield and dry off period were significantly influenced by the genetic background of the different groups in one hand, and were simultaneously affected by lactation number and season in the other hand. Lactation length and lactation milk yield increased with exotic blood period increased in Jersey-White Fulani crossed and decreased in Holstein-Gudali crossed. Cows with 75% of Holstein (75%Hx25%G) recorded the longest LL and highest LMY being the shortest DOP in the genetic crossed group of cows with 50% of Holstein (50%Hx50%G). Values obtained with Holstein-Gudali crossed cows show the high potential of these crossed and their adaptability in tropical milieu due to the complementarity of characters (precocity of Holstein and roughness of Gudali).

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