Birth weight, milk production and mortality rate in crossbred cattle (Dwarf taurine × Zebu) in Togo

S. Boma[1*], G-K. Dayo[2], Y. Lombo[3], A. Kossoga[3], Y.A. Djagba[3], E. Mollong[4], T. N'Féidé[3], K. Seme[5], K.S. Omasaki[6]

[1]Institut Togolais de Recherche Agronomique (ITRA-Togo), Centre International de Recherche-Développement sur l'Elevage en zone Subhumide (CIRDES Bobo-Dioulasso), 01 B.P. 454 Bobo-Dioulasso ; [2]Centre International de Recherche-Développement sur l'Elevage en zone Subhumide (CIRDES Bobo-Dioulasso, Burkina Faso), 01 B.P. 454 Bobo-Dioulasso 01 – Burkina Faso ; [3]Institut Togolais de Recherche Agronomique (ITRA-Togo), BP: 1163 Lomé-Cacavéli ; [4]Université de Lomé, Faculté des Sciences, Sciences et Technologies, BP: 1515 Lomé ; [5]Université de Lomé, Ecole Supérieure d'Agronomie, BP: 1515 Lomé ; [6]Animal Breeding and Genomics Group, Department of Animal Sciences, Kisii University, Kisii, Kenya, Phone: +254 702 50 63 02
*Corresponding author: Tel: 00226 52978731, E-mail: bomasoudah@gmail.com

Abstract

Somba cattle is one of the two trypanotolerant West-African Dwarf (WAD) breeds. Crosses between taurine (*Bos taurus*) and Zebu (*Bos indicus*) breeds are reported in various localities in West-Africa. The aim of this study was to assess the birth weight, the milk production and the mortality rate in crossbred cattle (Dwarf taurine × Zebu) in Togo. The study was carried out between 2015 and 2017 in February (dry season), May and September (rainy season) of each year in two Prefectures (Mô and Tchaoudjo) located in Central Administrative region of Togo. A total of 207 calves and 290 milking cows were randomly sampled for the study. Calves consisted of 72 WAD, 67 Zebu and 68 crossbred (WAD × Zebu) phenotypically taurine. The male calves weigh 17.70 ± 2,6 kg against 16.59 ± 1.97 kg for the female in crossbreeds; 13.76 ± 1.07 kg and 12.37 ± 1.16 kg in WAD and 22.55 ± 3.34 kg and 19.66 ± 2.15 kg in Zebus cattle. The milk production was significantly higher in the crossbreed (0.68 ± 0.27 L) than in WAD (0.46 ± 0.15 L) on the one hand and it was influenced by the rank of calving ($P = 0.000$) on the other hand. The mortality rates were 10.98 ± 3.41%; 11.85 ± 4.19% and 12.17 ± 5.06% in Crossbred, WAD and zebus respectively and no significant difference was observed among the three phenotypes. However, the calving-season had significant effect ($P = 0.003$) on the mortality rates. In the light of the foregoing figures, we come to conclusion that Somba breed performs far less compared to the crossbreed (Dwarf taurine × Zebu) and Zebus phenotypes in terms of birth weight and milk production.

Keywords: Dwarf taurine**;** crossbreed; birth weight; milk production; mortality; Togo.

Introduction

Beef and milk production in the Gulf of Guinea is based on the selection of different life-history traits of two subspecies of cattle, namely: *Bos taurus* (humpless cattle or taurine) and *Bos indicus* (humped cattle or Zebu) (Okeyo *et al.*, 2015). Taurine cattle differ fundamentally from Zebu with their easy adaptation to the humid and sub-humid environments which are infested with tsetse flies on the one hand and their trypanotolerance behavior (Santoze and Gicheha, 2019) on the other hand. Morever, Zebu cattle on their part are considered trypanosusceptible but are better adapted to sub-sahelian environment. Each group of West-African cattle is unique based on the agro-ecological zones they inhabit. Since the major droughts of 1970's, Zebu cattle have been increasing in number in the North. Very recently they have spread into the southern part, especially in the West African coastal region where there is abundant grazing and naturally, a natural raising ground of humpless cattle (Okeyo *et al.*, 2015; Courtin *et al.*, 2009; Hanotte *et al.*, 2003).

In Benin and Togo, Somba and Lagune cattle are the main local Dwarf taurine breeds (Belemsaga *et al.,* 2005). Laguna breed is located in the South, littoral areas while Somba breed is found in the northern, dry savannah area (Atacora mountain region) and wet savannah (middle center of the rural area) (Santoze and Gicheha, 2019; Boma *et al.*, 2018; Koudandé *et al.*, 2009; Adanléhoussi *et al.*, 2003). In addition, Borgou cattle breed (a genetically stabilized crossbreed between Somba and Zebu) and the Fulani Zebu breed (*Bos indicus*) are also found in the Somba breeding zones. In wet savannah, two phenotypic crossbreeds can be distinguished: Dwarf taurine (phenotypically pure Somba breed) and humpless crossbreeds (Dwarf taurine × Zebus). Dwarf taurine phenotype cattle are recognized by their small size, height at the withers of about 96 cm, while the crossbreed animals with humpless phenotype are large in size with height at the withers size of 99.3 ± 3.9 cm (Boma *et al.*, 2018; Adanlehoussi *et al.*, 2003). According to information collected from farmers, humpless crossbreed phenotypes have better survival fitness among the offspring from crossbreeding between local taurine cows and Zebu bulls. These crossbreeds are characterized by their humpless, small horns, docility and rusticity and are therefore used, like the Somba cattle, for traditional rites, engagement/weeding and various celebrations (Santoze and Gicheha, 2019; Dossa and Vanvanhossou, 2015).

Previous surveys have evidenced that the need for livestock products is ceaselessly increasing. Nonetheless, both the indigenous and commercial livestock industry is however facing several challenges arising from climate change today. These challenges include the harsh environment conditions (heat and drought), poor pasture, scarce water and parasitic infectious diseases (ticks and tick-borne diseases and animal trypanosomiasis) among others (Santoze and Gicheha, 2019). Although, indigenous livestock are adapted to the local environments, the quality of milk and meat they produce is low compared to the commercial breeds. Most indigenous African cattle breeds have not been selected consistently for productivity gains, but the main selective focus has been on survival, in often unpredictable, harsh and changing environmental conditions. West-African taurine cattle are known to be genetically well adapted to such epidemiological and environmental conditions. Crossbreeds (Dwarf taurine × Zebu) are thus very attractive genetic material for farmers, as they are considered to have earlier parturition and better dairy production than the local *Bos taurus* (Youssao *et al.,* 2000). Therefore, developing breeding programs on the targeted crossbred population to improve specific productivity traits in response to the demands of the farmer's and to the local ecological conditions may be crucial (Tano *et al.,* 2003).

The present study aims to evaluate the unique characteristics of taurine crossbred cattle while unfolding the opportunities and the requisite to exploit these resources in response so as to answer the needs of the farmers. The study focuses mainly on the birth weight, milk production and mortality rate in Somba crossbred cattle under traditional breeding conditions in the Guinea Savannah of Togo.

Materials and methods

The survey was conducted between 2015 and 2017 in February, May and September of each year in two prefectures (Prefecture of Mô and Prefecture of Tchaoudjo) in the Central Administrative region of Togo (Figure 1). The two prefectures are 120 km apart. In the area under this study, June to October are the wettest months with a rainfall range from 1,074 to 1,649 mm per annum. The dry season, from November to April, is punctuated by the Harmattan, a northeast wind characterized by warm days and cold nights. The utilization of natural pasture throughout the year is the main feeding practice for the cattle herds.

The two-phenotypes (Dwarf × Zebu and Somba) included in the survey are presented in figure 2. Sampling of the two taurine phenotypes was performed with the help of animal breeders using the information on the animal's genealogy. The evaluation of the calf weight performance and mortality rate was carried out on a sample of 207 individuals randomly selected (Table 1), which were the offspring of Dwarf taurine (72 calves), Zebu (67 calves) and crossbred cattle (Dwarf taurine × Zebu) (68 calves). For milk performance, only crossbred cattle (156 cows) and Dwarf taurine (134 cows) were randomly sampled.

Physical performance data collection

Physical performance measurements included Birth Weight (BW) and Chest Girth (CG) of the calves of two to three days old after calving. The BW were measured using a scale (Constant hanging scale: 14192 - 64;

accuracy 200g) while the measurements of CG were performed using a barometric tape. Other non-genetic parameters identified were the calf sex and the calving season.

Mortality

The mortality rate was assessed using calves from zero to one year old in conjunction with the series of BW surveys between 2015 and 2017 from February (dry season) to May and in September (rainy season) of each year. This survey started by counting calves from zero to one year old in the herds where calving was recorded.

Evaluation of milk yield

Milk production measurements were conducted for three months for each cow in the sampled population. Milking was done by trained herdsmen/animal owners to read the volumes in the test tubes. These measurements were taken individually for each cow, once daily, between 6:00 and 7:30 a.m. starting on the 5th day after calving using a graduated bottle. The calves were used to initiate the flow of the milk. The cows were manually milked until the apparent dry-out. Due to seasonal mobility and inaccessibility to some Zebu herds in the localities surveyed, the milk production assessment was focused exclusively on Dwarf taurine and crossbred phenotype cows.

Data analysis

The statistical software SPSS 20 was used for the data analyses. The "General Linear Model" (GLM) for the multiple comparisons of parameters (birth weight, milk production and mortality rate) was applied. Tukey's multiple-rang test was performed to test the difference among quantitative values (weight performance and milk production) and the *Chi-square* statistical to test for the mortality rate distribution for each phenotype.

Results

Physical performance of the calves

Single births were noted at 100% in crossbred cattle (68 births) and Dwarf taurine (72 births). Among the Zebus, 97.01% of the calves of the sample were single-born against 3% (2 cases out of 67) for the twin births. In global, the Zebu calves were more overweight compared to both Dwarf taurine and crossbred cattle.

The lowest weight performance was obtained in Dwarf taurine breed (13.01 ± 1.32) and the highest in Zebu (20.69 ± 3.43 kg). The average weight of the crossbred cattle (17.09 ± 2.34 kg) was between the values obtained for Somba cattle and Zebu. Overall, male calves were heavier (17.92 ± 4.39 kg) than females (15.97 ± 3.47 kg) (Table 2). The lowest weight performance (14.50 ± 1.22 kg) was recorded in Zebu in twin birth (female sex). The average weights for males and females were respectively 17.70 ± 2.3 kg and 16.59 ± 1.97 kg for crossbreds, 13.76 ± 1.07 kg and 12.37 ± 1.16 kg for Dwarf taurine, 22.55 ± 3.34 kg and 19.66 ± 2.15 kg for the Zebus. The CG recorded was 55.92 ± 1.72 cm, 58.91 ± 1.82 cm, 61.07 ± 3.40 respectively for Dwarf taurine Somba, crossbred cattle and Zebu. A positive and significant correlation was found between BW and CG traits, Linear R² equal to 0.592 (Dwarf taurine), 0.494 (humpless crossbred cattle) and 0.640 (Zebus) (Figure 3). High phenotypic variance of BW for calves together with medium CG was observed (Table 3). The multiple comparison test indicated a positive difference from 4.08 kg (31%; ES: 0.42) in the BW of crossbred calves compared to Dwarf calves. BW depends significantly of the calf sex and the calving season, whereas CG was similar regardless of the season. Yet, by season, the survey indicates the absence of interactions regardless of villages and the animal phenotype.

Milk production performance of the cows studied

The average daily milk production over a 90-day period in the Dwarf taurine cattle population was 0.58 ± 0.25 L, with a monthly average of 17.24 ± 7.63 L. Crossbred cows had a better milk production (0.68 ± 0.27L) than that of Dwarf taurine cows (0.46 ± 0.15 L) (Figure 4). The milk production recorded in both types was influenced by lactation rank ($P = 0.000$) with a maximum average of 0.96 ± 0.24 L and a minimum of 0.52 ± 0.25 L for the 6th and 2nd lactation respectively. However, although the milk production during the dry-season was relatively low (0.56 ± 0.23 L) compared to the rainy season (0.6 ± 0.28 L), both were statistically similar ($P = 0.171$).

Mortality rate

Mortality rates were not different (*Chi-square*: 0.2, ddl: 2) in the three phenotypes in the study area: 10.98 ± 3.41% for crossbreed; 11.85 ± 4.19% for Dwarf taurine and 12.17 ± 5.06% for Zebus, with an average of 11.66 ± 4.23%. Nevertheless, a significant effect ($P = 0.003$) of the calving season was noted. The mortality rates were 17.9% in the rainy period (August to October), 11.1% in the dry period (November to March) and 7.3% during the vegetative re-growth (April to May).

Table 1: Number of animal sampled per phenotype and location (Administrative Prefecture)

Study Parameter	Phenotype /gender	Animal number per location (Prefecture)		
		Mô	Tchaoudjo	Totals
Weight performance of calves	Crossbreed (Dwarf taurine × Zebu)	31 (15%)	37 (17.9%)	68 (32.9%)
	Taurine	41 (19.8%)	31 (15%)	72 (34.8%)
	Zebus	13 (6.3%)	54 (26.1%)*	67 (32.4%)
	Calving	46 (22.2%)	64 (30.9%)	110 (53.1%)
	Calf	39 (18.8%)	58 (28%)	97 (46.9%)
Milk performance	Dwarf taurine x Zebus	72 (24.8%)	84 (29.0%)	156 (53.8%)
	Dwarf taurine	66 (22.8%)	68 (23.4%)	134 (46.2%)

(): percentage of the total; *: number comprising two female dipoles

**Table 2:** Average birth weights and Chest Girths of calves by phenotype and gender

| Variables	Phenotype	Gender	Average	*P-value*
Birth weight (kg)	Crossbred cattle (Dwarf taurine × Zebu)	Female	16.59 ± 0.35	0.063
		Male	17.71 ± 0.39	
	Dwarf taurine	Female	12.33 ± 0.35	0.000*
		Male	13.73 ± 0.36	
	Zebu	Female	19.67 ± 0.38	0.000*
		Male	22.55 ± 0.39	
		Twin female	14.50 ± 1.07	
Chest Girth (cm)	Crossbred cattle (Dwarf taurine × Zebu)	Female	58.70 ± 0.38	0.3
		Male	59.16 ± 0.41	
	Dwarf taurine	Female	55.93 ± 0.38	0.991
		Male	55.91 ± 0.39	
	Zebu	Female	60.19 ± 0.40	0.003*
		Male	62.52 ± 0.41	
		Twin Female	57.00 ± 1.14	

*: significant

Table 3: Analysis of the effect of genetic and environmental factors on the calf birth weight and the Chest Girth

Factors	Variables	SCE	ddl	ECM	D	*P*
Genetic factors						
Phenotype	BW	1085.19	2	542.59	138.17	0.000*
	CG	457.05	2	228.53	61.94	0.000*
Gender	BW	164.68	2	82.34	20.97	0.000*
	CG	50.361	2	25.18	6.825	0.002*
Environmental factors						
Season	BW	19.24	1	19.24	4.99	0.029*
	CG	1.92	1	1.92	0.52	0.472
Location	BW	1.05	1	1.05	0.27	0.606
	CG	4.68	1	4.68	1.27	0.26
Calving number	BW	15.60	4	3.90	0.99	0.41
	CG	7.65	4	1.91	0.52	0.72
Genetic × Environmental factors interactions						
Season × location	BW	0.33	1	0.33	0.08	0.77
	CG	6.12	1	6.13	1.66	0.20
Season × phenotype	BW	6.02	2	3.01	0.76	0.47
	CG	5.61	2	2.8	0.76	0.47

BW: birth weight (kg); CG: Chest Girth (cm); SCE: Sum of squares of gaps; ddl: degree of freedom; ECM: Mean of squares of deviations; D: Anderberg similarity coefficient; *p**: statistically significant Fisher values.
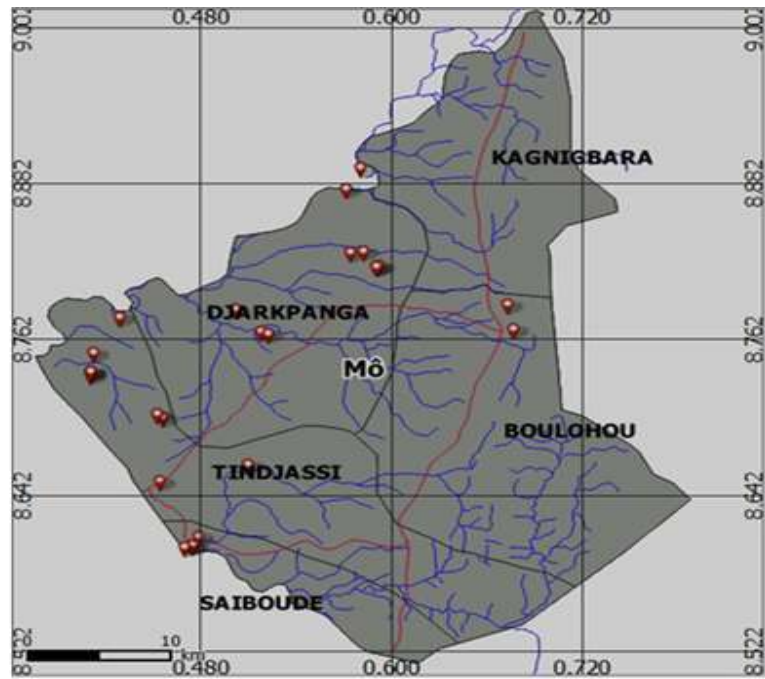
Locality of Mô

Locality of Tchaoudjo

○ Geographical coordinates of the herds
— Road
— Rivers
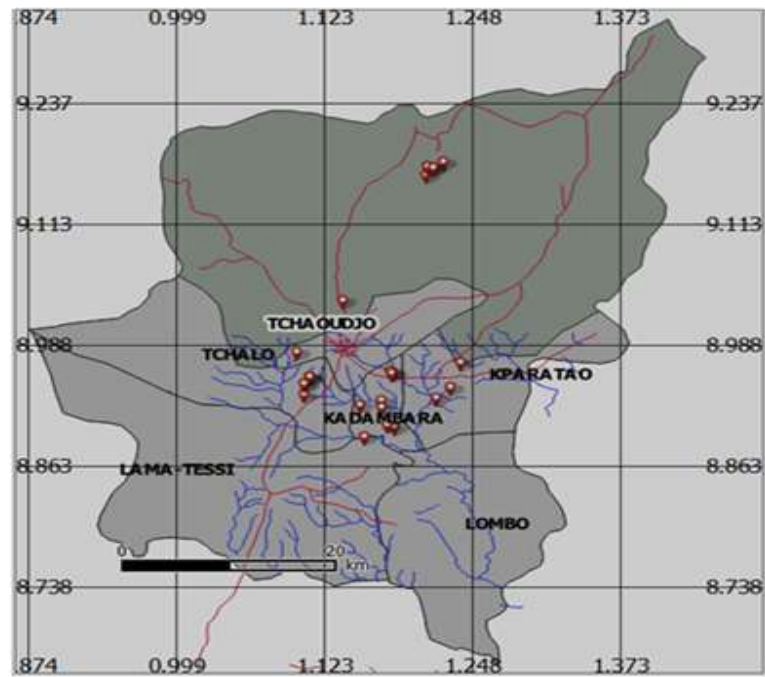
Fig 1: Maps of the study cattle localities and herds

Crossbred (Dwarf taurine × Zebu) bull   Dwarf taurine (Somba) bull

Crossbred (Dwarf taurine × Zebu) cow   Dwarf taurine (Somba pure breed) cow

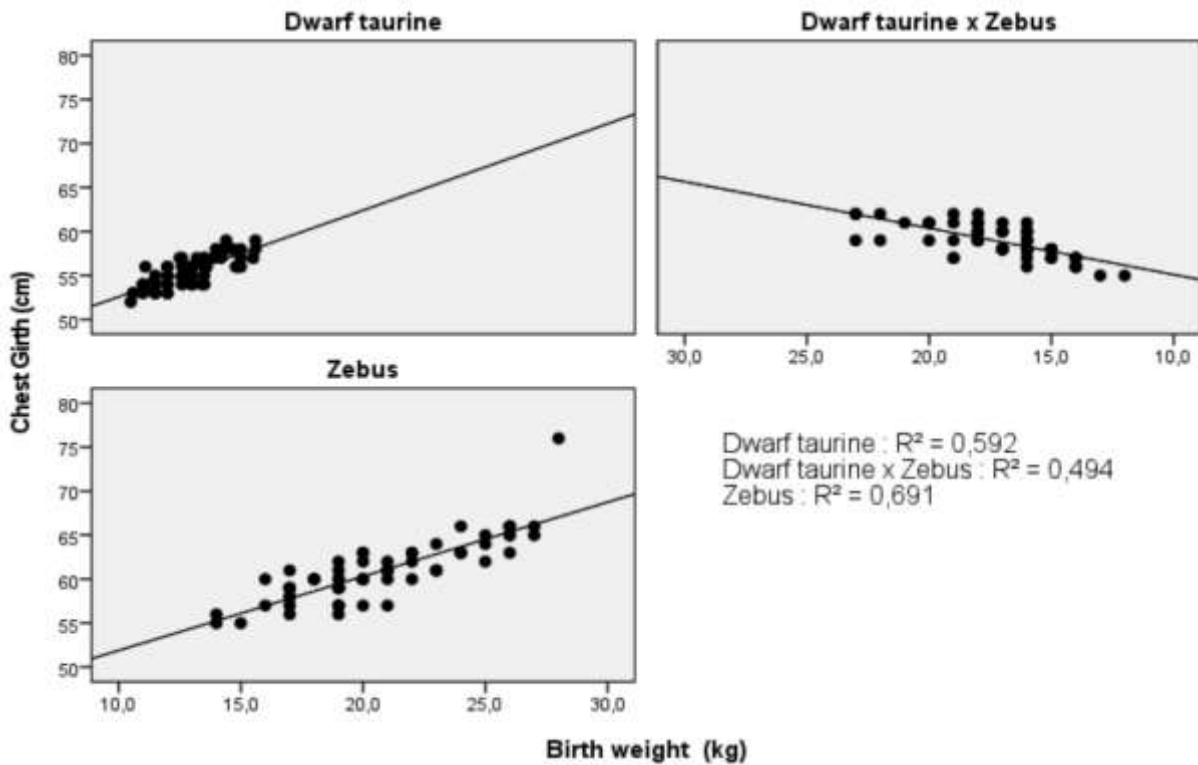**Fig 2:** The two-phenotypic taurine cattle (Dwarf taurine × Zebu and Somba pure breed) studied

Fig 3: Correlation between birth weight (kg) and Chest Girth (cm) of the phenotypic calves
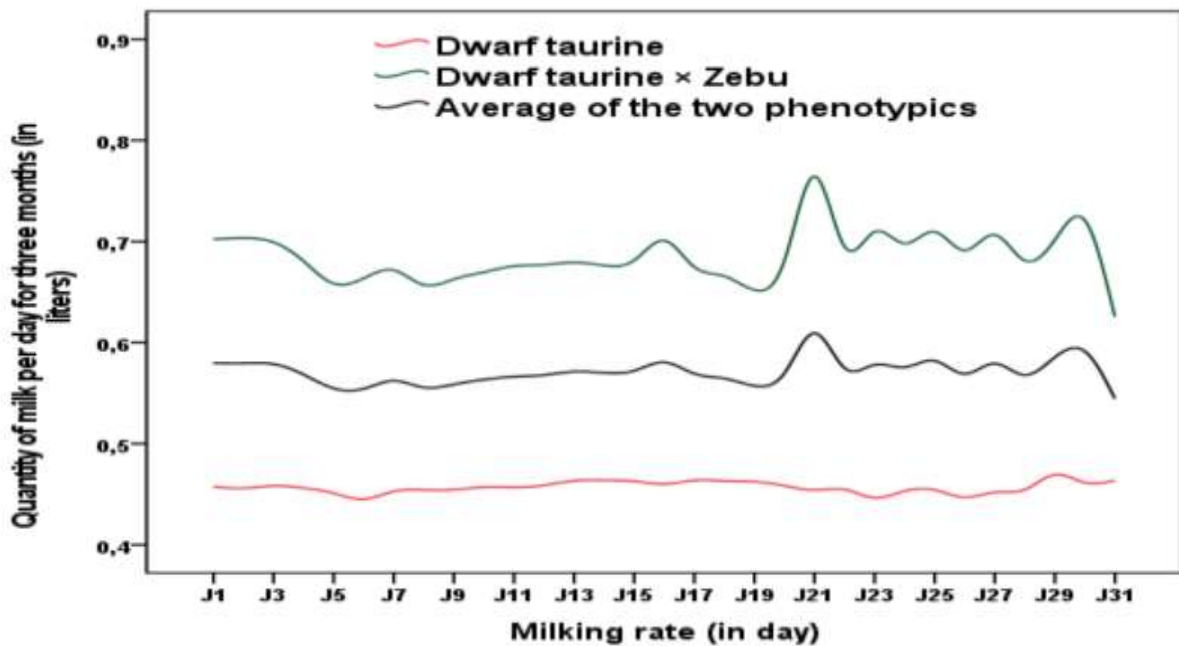
Fig 4: Average daily production of Dwarf taurine and humpless crossbred cattle (Dwarf taurine × Zebu)

Discussion

The current survey revealed that the birth weight and the milk production from the local crossbreed (Dwarf taurine × Zebu) are better than those recorded in the Somba pure breed, but the crossbred cattle daily performance is low compared to Zebu cattle. This is an indication that crossbreeding can indeed improve productive traits of the WAD cattles populations.

Calf birth weight is considered as a crucial factor that leads to survival and for improving growth performances. It is the first trait that provides data on the future development of an animal (Wiener and Rouvier, 2009). The average birth weights of phenotypically taurine breed reported in this study were similar to the findings reported by Alkoiret *et al.* (2016) of 18.7 ± 1.8 Kg in the Borgou breed in Benin. Yet, the birth weight of humpless crossbred cattle reported in this survey was higher than the average value (12 ± 3 Kg) recorded on Somba cattle in their breeding zone in the northeast of Togo (Adanléhoussi, 2003). The CG measured on calves can be used to identify those which have the highest genetic potential for production (Frizzas *et al.*, 2008). A positive and significant correlation between BW and CG was observed in the current survey, suggesting the possibility to improve the BW by selecting animals on CG.

In our survey, male calves had higher birth weight than females. Birth weight was affected by calf gender (Hess *et al.*, 2016). These findings were similar to other survey conducted by Alkoiret *et al.* (2016) in Borgou cattle population in Benin and in Sanga cattle population in Ghana (Obese *et al.*, 2008). Both surveys showed higher birth weights of male calves. In addition, our survey showed a better survival fitness of crossbred calves, with a better birth weight compared to the Somba pure breed. In the crossbreeding between West-African taurine and Zebu, it is expected crossbred cattle with high production traits from Zebu bull and the high adaptive traits (trypanotolerance, resistance to tick infestation and tick-borne diseases, other adaptive response to environmental fluctuations, from the taurine cattle.

In the current study, BW was affected by the calving season. This effect can be explained by the microclimatic (temperature fluctuations over the year and the season) and nutritional conditions. This may influence the accessibility and availability of quality grazing feeds in both dry and rainy seasons in the survey area. Similar effects were previously reported (Lecomte *et al.* 1996). In the study, contrary to the birth BW, the CG was not influenced by the season. Therefore, CG is more suitable than BW for the selection or the monitoring of the calf's growth performance purposes.

Our results show that crossbred cattle performed better, 0.68 ± 0.27 L of milk / day than the Dwarf taurine breed (0.46 ± 0.15 L per day). This supports the findings reported by Kassa *et al.* (2016) indicating that Somba taurine breed is a poor dairy cow with really low average daily milk yield of 0.48 L. The performance recorded in the crossbred cows falls within the range (0,48 L) of performances reported in the Borgou breed in extensive breeding system and in Somba breeding area in Benin (Kassa *et al.*, 2016). In Burkina Faso, Zakpa and Kamuanga (2002) recorded a production of 0.7 L of milk per day in the traditional humpless short-horned cattle breeding system. Even so, it is important to note that the quantity of milk daily recorded in our survey

corresponds to the quantities of milk for only one time of the day (in the morning) without taking into account the quantity taken by the calves to stimulate the flow of milk.

The average mortality rates recorded in our survey were similar for the three cattle populations. In Benin, Chabi Toko *et al.* (2016) recorded almost a similar mortality rate of 10% in Banikoara, Malanville and Kalalé. Our results show a mortality rate of the crossbred cattle slightly lower than those obtained in Somba taurine and zebu breeds. This is in accord with the findings reported by Santoze and Gicheha, (2019) and can be explained by better adaptation to the local environment, which is highly infested by animal trypanosomiasis (Talaki *et al.,* 2014).

The search for improving local cattle production is the goal of traditional crossbreeding, and will continue to be the main approach driving the resilience in the traditional cattle production forward (Berghof *et al.*, 2019). Yet, the challenge of crossbreeding as a breeding strategy is the risk of introgression of pure Somba and Laguna populations well adapted to their environment (Koudandé *et al*., 2009). The phenotypes resulting of crossbreeding, generally, cannot be distinguished with the parental Somba and Laguna breed. However, increased community awareness and improved refuge areas will contribute to safeguarding the holding areas where controlled movement can subsequently be organized together with small holder farmers.

Conclusion

A significant difference between Somba taurine breed, crossbred cattle (Dwarf taurine × Zebu) and Zebu phenotypes was observed for birth weight and milk yield traits in the current study. Optimized crossbreeding programs for productive traits would generate more income for livestock breeders. Dwarf taurine breed performed poorly compared to humpless crossbred cattle and Zebus phenotypes in terms for birth weight and milk yield. Our results suggest that crossbreeding could be an approach to improve the traditional production system. However, the prerequisite is to have more information on the genetics status of the cattle population through a good characterization of the different populations using phenotypic and molecular tools.

Authors' contributions

Dr Dayo Guiguigbaza-Kossigan and Dr Yao Lombo, have been involved in the data collection protocol, analysis and interpretation of the result, revising content of the article. They approved the final version to be published. Dr Djagba Atouga Yembliman, Dr Seme. Kpassi, Mr Assota Kossaoga, Mr N'Féidé Toï and Dr Mollong Eyabana, have been involved in the field data collection, analysis of the result and revising content of the article. They approved the final version to be published. Dr Nuto Yaovi and Dr Omasaki Simon Kipkemboi have been involved in the analysis and interpretation of the result, revising the scientific content and language style of the article. They approved the final version to be published.

Conflict of Interest

The corresponding author has received PhD research grants from PPAAO-Togo (IDA N°5955-TG). The authors declare that they have no conflict of interest.

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