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Production and fertility performance of Barka cattle breed in the different agro-ecological zones of Eritrea

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ABSTRACT
This study was carried out to determine the milk yield (MY), growth (Gp) and fertility (Fp) performances of Barka cattle breed reared in the two major agro-ecological zones (AEZs) in Eritrea. The breed which is indigenous to Eritrea is mainly kept in crop-livestock system in both zones implying similarity in production management. We thus hypothesized that the effect of agro-ecological zone would significantly impact on the production and reproduction performances of the Barka breed. Herds of 15 cows each were established and maintained at Halhale and Shambuko research stations from which MY, Gp and Fp data were obtained. The two sites are managed by the National Agricultural Research Institute (NARI) of Eritrea and represented the highland and lowland AEZs, respectively. General linear model (GLM) was used in the analysis with the age of a cow and calf sex being fitted as fixed effects in determination of MY, Gp and Fp performances over two lactations periods. The mean MY of cows for the two lactations period at Halhale and Shambuko were 3.93±0.17 kg and 2.80±0.13 kg, respectively. There was no significant difference in the average birth weight (BW) between the herds with male calves ranging between 22.19 kg in the first lactation and 23.03 kg in second lactation. There was no significant difference in weaning weight as well and the average weight irrespective of age of the dam which averaged 66.05±11.75 kg. The services per conception (SPC) averaged 1.2±0.43 while the average days open or post-partum anoestrus was 168±87 days. The findings from this study provide valuable information useful in Barka breed utilization and conservation efforts.

Keywords: Age, Barka, cattle breed, Eritrea, lactation, reproduction, weaning

RÉSUMÉ
Cette étude a été réalisée pour déterminer les performances en rendement laitier (RLp), en croissance (Cp) et en fertilité (Fp) des bovins Barka élevés dans les deux principales zones agro-écologiques (ZAE) en Erythrée. La race indigène de l'Érythrée est principalement conservée dans le système de culture-élevage dans les deux zones, ce qui implique une similitude dans la gestion de la production. Nous avons donc émis l'hypothèse que l'effet de la zone agro-écologique aurait un impact significatif sur les performances de production et de reproduction de la race Barka. Des troupeaux de 15 vaches chacun ont été établis et maintenus aux stations de recherche de Halhale et de Shambuko à partir desquelles des

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données de RLp, Cp et Fp ont été obtenues. Les deux sites sont gérés par l'Institut national de recherche agricole d'Érythrée et représentaient respectivement les ZAE des hauts et bas terrains. Le modèle linéaire général (GLM) a été utilisé dans l'analyse avec l'âge dela vache et le sexe du veau ajusté facteurs fixes dans la détermination des performances RLp, Cp et Fp sur deux périodes de lactation. La RLp moyenne des vaches pour les deux lactations à Halhale et Shambuko était respectivement de 3,93 ± 0,17 kg et 2,80 ± 0,13 kg. Il n'y avait pas de différence significative du poids moyen à la naissance entre les troupeaux de veaux mâles compris entre 22,19 kg en première lactation et 23,03 kg en deuxième lactation. Il n'y avait pas non plus de différence significative du poids au sevrage et du poids moyen indépendamment de l'âge de la mère qui était en moyenne de 66,05 ± 11,75 kg. Les services par conception étaient en moyenne de 1,2 ± 0,43 tandis que le nombre moyen de jours favorables ou d'anesthésie post-partum était de 168 ± 87 jours. Les résultats de cette étude fournissent des informations précieuses utiles dans l'utilisation de la race Barka et les efforts de conservation.

Mots-clés: Age, Barka, race bovine, Erythrée, lactation, reproduction, sevrage

INTRODUCTION

Livestock production plays important social and economic roles at national and household levels in Eritrea by providing both tangible and intangible benefits to the rural and urban households (Goitom *et al.,* 2016). According to MOA (2013), the livestock population in Eritrea stands at 2.2 million head of cattle, 2.1 million sheep, 2.5 million poultry and 0.1 million camels. The Eritrean government has identified livestock farming as the priority industry as it employs approximately 80% of human population living in the rural areas. Most of the country's livestock and crop production is dominated by the smallholder production systems segmenting into either pastoral or agro-pastoral systems (MOA, 2012). Much of the production is practiced to satisfy nutritional needs and as sources of cash for the livelihood of the farmers. Cattle production in Eritrea is mostly practiced in arid and semi-arid areas (ASALs), and the main cattle breeds in these areas are indigenous. The animals are therefore well adapted to the nutritional and environmental constraints which are common problems in the ASALs region.

Despite the superior ability of the indigenous livestock species to produce and reproduce in the dry areas, there has been a notable decline in productivity among the indigenous cattle (Breuil *et al.,* 2014). Understanding the production and reproduction performance of the livestock species reared in Eritrea in relation to the production environment in which they are kept would be important as it would form the first step in designing efficient indigenous cattle genetic improvement programme. A mismatch between the breed and production resources (dictated by the biophysical environment) would result is sub-optimal utilization of the livestock production resources including species genetic potential.

This study was aimed at determining the milk yield, growth rate and fertility performance of Barka breed in two agro-ecological zones in Eritrea. The breed accounts for 47.6% of the indigenous cattle population (MOA, 2007) and is mainly reared in crop-livestock production systems in Eritrea. Morphologically, Barka breed is well known for its huge body appearance as compared to other indigenous cattle types of Eritrea. Morphometrically, the breed has average dewlap width (21.3±0.5), body weight (320±5.2 kg), body length

(126.1±16 cm), height at wither 130±14 and chest girth (166.4±23) (Mulugeta and Berhan, 2015; Tewelde *et al.,* 2017). The breed is also native to Ethiopia. Million and Tadelle (2003) showed that Barka produced 9.1% more milk than the Boran cattle types in smallholder farm systems in Ethiopia.

MATERIALS AND METHODS

Study area. This study was carried out at Halhale and Shambuko research stations of the National Agricultural Research Institute (NARI) of Eritrea. Halhale is located at 15º 07' 59'' N - 38º 81' 17'' E at an elevation of 1950 meters above sea level (highland) while Shambuko is located 14º 97' 22'' N - 37º 71' 66'' E at an elevation of 886 meters above sea level (western lowland). Average temperatures in the lowlands where Shambuko Research Station is located ranges between 30° C to 40° C with an average annual humidity of about 40%. Over 90 percent of the total area receives less than 450 mm and only 1 percent receives more than 650 mm of annual rainfall. Average temperatures in the highlands (Halhale Research Station) range from 15° C to 30° C with the night temperature falling to between 0° C to 7° C during December and January period. The highlands receive more rains and are therefore characterized by high and diverse supply of pastures. Crop production is also higher in the highlands resulting to better supply of crop residues which are used to supplement grazed animals feed resources.

The data for milk yield, growth rate and fertility performance were obtained from the two Barka herds reared at the two stations that represents the two predominant agro-ecological zones in Eritrea.

Feeding management. The animals were mainly grazed on natural pastures at respective research stations. Water and mineral supplements were provided *ad libitum*. Besides, the cows were provided with sorghum stover (Shambuko station) or barley/wheat straw (Halhale station).

Data collection. Milk performance data were obtained from 15 lactating purebred Barka cows at each of the research stations. Daily milk production record for each cow was obtained from the sum of milk from the two milking (morning and evening) per day. The sum of the daily milk productions was used in estimation of the lactation yield per cow. The lactation length was considered to be 365 days. Fertility data included the number of services per conception and the number of days open or post-partum anestrus which was determined by the number of days required to come to heat after parturition. Birth weight and sex data were obtained immediately after birth for each successful parturition. The weaning weight was obtained at four months of age when calves were considered to consume enough solid diets necessary to supply them with their nutrients needs.

Data analysis. General linear model (GLM) was used to analyze the data for milk yield, growth and fertility performances us-ing Genstat software (Genestat, 2014). Location, age and sex of a calf were fitted as the fixed effects, and age was nested on location. The analyses considered two locations and three age categories. The class interval among age groups was taken to be two years. The calf sex effect was considered when analyzing the birth and weaning weights. The Least Significant Difference (LSD) approach was used for means separation. The statistical model used for the analysis is described by Rutherford (2001) as:

$$y_{ijk} = \mu + \alpha_i + \beta_{ij} + \gamma_k + \varepsilon_{ijk}$$

where y_{ijk} is an observation of the k^{th} cow on milk yield, lactation length, SPC, DO, or on calf birth or weaning weight, μ is the overall mean, α_i is fixed effect of i^{th} location (i = 1 and 2), β_{ij} is j^{th} age group of a cow (j = 1, 2 and 3), k^{th} sex of a calf (k = male and female) and ε_{ijk} = random error where, ii DN (0, σ^2).

RESULTS AND DISCUSSION

Table 1 presents the 1st and 2nd lactations milk performance records for the Barka breed reared at the two agro-ecological zones in Eritrea. The amounts ranged between 2.79±0.004 and 4.18±0.29 kg at Shambuko and Halhale research sites respectively. Generally, the breed performed better in the 2nd lactation and at higher altitude. The higher milk yield in Halhale was as anticipated as highlands receive more rains than the lowlands implying better supply of nutrients and subsequently cattle performance.

The mean milk yield for the Barka breed in Eritrea was 3.36±0.15 kg which contrasts the findings from research carried out in Northern Ethiopia by Mulugeta and Berhan (2015) in which the breed milk yield averaged 2.52 kg. The difference can be attributed to the environmental factors rather than the genetic makeup of the breed. The Barka breed performance records obtained from this study are comparable to those presented by Gebretnsae *et al.* (2017) for non-categorised indigenous cattle reared in similar conditions in Ethiopia which averaged 3.67±0.15 kg. Various studies have reported differing mean yield for different large East Africa Zebu (Rege *et al.,* 1999), which Barka breed falls into, however comparisons are limited due to differences in milk let down periods. The Barka breed cows dried off after 250 days of milk let down while the cattle populations studied by Lutfi *et al.* (2005), Mulugeta and Berhan (2015), Gebretnsae *et al.* (2017) and Kebede *et al.* (2017) dried off after 278, 278, 268 and 191 days, respectively.

Growth performances. Table 2 shows that mean birth and weaning weights of Barka cattle calves recorded at Shambuko and Halhale research stations did not differ significantly (P>0.05). The overall mean between the lactations was 22.23 kg. The value resonates well with other studies carried out in Africa as summarized in Gwaza and Momoh (2016). Male calves were generally heavier than their female contemporaries. Various studies have supported the sexual dimorphism in growth traits (Latorre *et al.,* 2003; Fairbairn, 2013; Pointer *et al.*, 2013). Age of the dams and the parity did not affect the birth and weaning weights. Possible explanation would be that the cattle are kept in suboptimal production conditions where they expend nutrients in search of feeds (grazing).

Fertility performances. The number of services required for a cow to conceive and the period between drying off and subsequent conception were used to determine the fertility performance. The Barka breed averaged 1.2±0.43 services per conception (SPC) and 168±87 days post-calving anoestrus. The current findings are in agreement with the 175 days' post-partum anoestrus reported by Gebretnsae *et al.* (2017) for Barka breed in Ethiopia and 185 days.

Table 1. Milk yield (kg) for two lactations and research sites (locations)

		1st lactation	2nd lactation	Location mean
Research site	N	Mean ±SE	Mean ±SE	Mean ±SE
Shambuko	15	2.79±0.00	2.80±0.22	2.80±0.13
Halhale	15	3.67±0.01	4.18±0.29	3.93±0.17
Lactation mean		3.23±0.05	3.49±0.25	3.36±0.15
Significance		p <0.05	p <0.05	

Table 2. Calves birth weights and weaning weights grouped in lactation, age group of the cow and calf sex

Lactation	Variable	Description	Birth weight	Weaning weight
1st	Sex	Male	22.19	-
		Female	21.89	-
	Age	Young		
		Medium	22.08	
			22.24	59.38
			56.13	
		Old	21.81	63.62
2nd	Sex	Male	23.03	-
		Female	21.79	-
	Age	Young		
		Medium	22.83	
			22.68	74.13
			76.82	
		Old	21.76	66.22

CONCLUSION

Based on the findings from this study, Barka cattle breed milk yield, growth and fertility performances is comparable to other indigenous cattle breeds implying that they can do well in the environment. However, the breed genetic potential is curtailed when reared in the lowland grazed systems characterized by harsh weather and limiting nutrients supply. Barka cattle breed has potential to satisfy the milk needs of pastoral and agro-pastoral producers considering that the findings presented here are based on purely grazed cattle.

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STATEMENT OF NO-CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in this paper.

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