ON-FARM HANDLING BEHAVIOUR, BLOOD GLUCOSE, LACTATE AND CORTISOL LEVELS OF NGUNI AND NON-DESCRIPT BEEF STEERS REARED ON NATURAL PASTURES

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Abstract – The study was conducted to assess the on-farm handling behaviour in relation to the blood glucose, lactate and cortisol levels of Nguni (NG) and non-descript (ND) beef steers reared on natural pastures. Forty castrates of 20 NG and 20 ND were observed monthly for behaviour, recorded as Race Score (RC), Entry Score (ES), Weighing Box Score (WBS), Stepping Score (SS), and Exit Speed Score (ESS). Blood samples were obtained from each animal's caudal vein for glucose, lactate and cortisol analysis. Monthly weights of the animals were recorded. Cortisol did not differ (P>0.05) between genotypes, month and body weight. The NG steers had the highest glucose levels (4.7±0.7) compared to the ND (4.4±0.5). Higher lactate values were recorded in February (5.5±2.5) compared to March (4.2±2.3). There were no associations (P>0.05) between month and all the behaviour observation scores. Genotype was only associated (P<0.05) with the race score behaviour. The NG (21%) showed more confidence to walk through the race without stopping compared to ND steers (14%). Most ND's were reluctant to move forward (stopping) in the race compared to NG's (19%). NG responded better to handling and thus used up less glucose compared to ND. Lactate levels dropped with time of sampling.

Key Words – Genotype, Response behaviour, Stress hormones & metabolites.

I. INTRODUCTION

Cattle farming has greatly contributed towards the success of the red meat industry. There is a vast number of beef breeds reared in South Africa. Amongst them is the hardy indigenous Nguni breed which has functional characteristics which allows it to survive and reproduce in any given environment (1). The ND, also known as cross bred is also contributing greatly to the South African beef industry. Scholtz *et al*. (2) reported a 35% record of ND bulls found in the emerging sector.

Beef producing cattle are normally reared extensively during their early stages of life and are sometimes transferred to intensive systems during the fattening and finishing stages (3). Normal farm operations that require close human-animal interactions include time to time managerial activities and/or routines such as castration, dipping, branding, and vaccination, among others. Cattle destined for beef production are normally weaned and castrated at 7-10 months of age. Raussi (4) and Probst *et al*. (3) reported these events to be unpleasant for animals, to the extent that fear towards humans (who carry out these routines) might develop. In order to deal with certain situations at the farm, animals may respond and even develop certain behaviours or strategies (5) (i) towards each other during resting and feeding in the kraals/feedlots and, (ii) during management routines, when humans are involved through feeding or any other activity that seems to be interfering with their space.

On-farm behaviour and animal-human interaction assessments, regarding welfare and productivity, have mostly been conducted on dairy cows (6; 7) compared to beef cattle. A report by "A Farm Sanctuary Report" from a farmer's point of view stated that, unlike dairy cows, beef cattle are less accustomed to being handled and are thus a little less experienced with human interactions. Ultimately, the underlying factor that has much influence to ensure good quality product from farm animals is to maximize good management in favour of animal welfare at the farm.

In the presence of potential stressors, animals do not only change in behaviour, but also some physiological changes occur. Animal handling, transport and slaughter were noted to be stressors that produced significant changes in blood-hormonal levels in cattle. Disturbance in the environment activates the hypothalamic-pituitary-adrenal activity due to fear (8), thus leading to the release of catecholamines and cortisol (9) and further elevate blood lactate and glucose. Blood, urine and saliva have been used to extract hormones and metabolites such as catecholamines, cortisol, blood lactate and glucose and others for this determination. The current study then seeks to assess the on-farm

handling behaviour in relation to the blood glucose, lactate and cortisol of Nguni (NG) and non-descript (ND) beef steers reared on natural pastures.

II. MATERIALS AND METHODS

Ethical clearance

All procedures conducted on animals for the purpose of this research were done meeting the worldwide ethical principles considerations. Consent to carry out the study was approved and issued by the University of Fort Hare Ethical Clearance committee (Reference Number: MUC03S1NJI01).

Study site

The study was conducted at the University of Fort Hare's Honeydale Research Farm. It is situated 120 km inland from the coastline, in the False Thornveld of the Eastern Cape of South Africa. It is located at 32.78° S and 26.85° E, at an altitude of 520 m above sea level. The topography of the area is generally flat with few slopes. The mean annual temperature of the farm is 18.7°C. The hot-wet season is characterized by hot sunny weather and thunderstorms with average temperature range of 17 °C to 28 °C. The area receives low annual rainfall of approximately 480 mm per annum both between and within seasons. The vegetation is a mixture of several trees, shrubs and grass species. Plant species, such as *Acacia karroo, Themeda triandra, Panicum maximum, Digitaria eriantha, Eragrostis sp., Cynodon dactylon and Pennisetum clandestinum* are the predominant species.

Animal Description

From an ongoing study, forty 12-18 month-old Nguni and Non-descript cattle breeds sourced from 3 farms and kept and at the Fort Hare Honeydale farm were used for this study. The bulls were castrated, vaccinated, drenched, dipped, tagged and allowed 3 weeks of acclimatizing before the trial began. The initial weights of these animals ranged between 120-250 kg and they were grazing on natural pastures with access to water points.

Blood Sampling

Central circulatory blood was collected from the caudal vein through a puncture using a needle connected to the vaccutainer tube and its holder. The samples were kept in ice until separation of serum through centrifuging at 21^{o}C for 5 min at 3000 rpm before analysis.

Behaviour Scoring

The Race Scores (RC) were recorded as not-stopping (1) or stopping (2) while in the race; Entry Score (ES) was measured by no encouragement required to move the animal (1), slight encouragement (2), some encouragement (3), Force the animal to move (4); Weighing Box Score (WBS) was whether the animal was calm (1) or agitated (2) in the box; Stepping Score (SS) was determined by no kicking (1), light kick (2) and aggressive kick (3); and Exit Speed Score (ESS) was scored as walked (1), trotted (2) and ran (3).

Statistical analysis

The association between month, breed and the behaviour observation scores (RS, ES, WBS, SS, ESS) was analysed using Chi-square of SAS (10) statistical package. The effect of breed and month and their interaction (month and breed) on cortisol, glucose and lactate was analysed by ANOVA using PROC GLM with weight considered as a covariate. Differences between means were evaluated using tukey's test. The model used was: $Y_{ijk} = \mu + \alpha_i + \lambda_j + (\alpha\lambda)_{ij} + \beta_1 X_1 + e_{ij}$

III. RESULTS AND DISCUSSION

Table 1 shows that there were no associations ($P > 0.05$) between month and all the behaviour observation scores. Breed was only associated ($P < 0.05$) with the race behaviour scores. It was reported that cattle often perceive an encounter with humans as predatory (11) such that they develop certain behaviours or strategies, trying to cope (5). However, the NG steers (21%) showed more confidence (Figure 1) in walking through the race without stopping compared to the ND steers (14%). Most ND steers were reluctant to move forward (stopping) through the race compared to Nguni steers (19%), their avoidance instinct kicked in and hence encouragement was required to move them further.

Table 1: The association between month, breed and handling behaviour observation scores

Variables	*RS*	*ES*	*WBS*	*SS*	*ESS*
Breed	P <0.05	NS	NS	NS	NS
Month	NS	NS	NS	NS	NS

NS-Not Significant, significant difference at P<0.05, Race Scores (RC), Entry Score (ES), Weighing Box

Score (WBS), Stepping Score (SS), and Exit Speed Score (ESS)

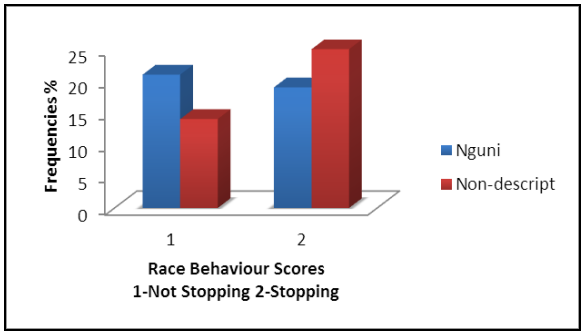

Figure 1: The frequencies of Nguni and Non-descript behaviour scores in the race during handling

Table 2 shows that glucose differed ($P < 0.05$) with breed. The NG steers had the highest glucose levels (4.7 ± 0.7) compared to the ND (4.4 ± 0.5). Lactate also differed ($P < 0.05$) with month. The steers recorded higher lactate levels (5.5 ± 2.5) in the beginning of the trial in the month of February compared to March (4.2 ± 2.3). Gruber *et al*. (12) associated raised lactate concentrations with more stress-indicating behaviour. Therefore, the current results show an improvement trend with progressing months. It could be attributed to the steers getting used to handling. Cortisol did not differ ($P > 0.05$) with breed, month and weight. The weight of the animals had no effect ($P > 0.05$) on glucose, lactate and cortisol levels.

Table 2: The effect of breed, month and weight on cortisol, lactate and glucose levels

Variables	Breed		Month	
	NG	**ND**	**Feb**	**Mar**
Glucose	$4.7^{a} \pm 0.7$	$4.4^{b} \pm 0.5$	NS	NS
Lactate	NS	NS	$5.5^{a} \pm 2.5$	$4.2^{b} \pm 2.3$

Means in the same row with different superscripts are significantly different at $P<0.05$, NS-Not Significant, NG-Nguni, ND-Non-descript.

Generally, the NG breed is known for being hardy and able to cope in harsh conditions. Muchenje *et al*. (13) reported in a study on three beef breeds that the NG steers had the lowest ($P < 0.05$) catecholamine concentrations in response to pre-slaughter encounters compared to the Bonsmara and Angus breeds; making them less susceptible to pre-slaughter stress. Moreover, the low glucose levels recorded for ND steers can be related to their reluctance to move through the race and thus more energy utilized, through high muscle activity, while trying to avoid handling and moving forward. Increased physical stress can result to glucose levels decreasing. In contrast, glucose was reported to increase more with handling and transportation on temperamental cattle than on calm ones (14; 15).

IV. CONCLUSION

The obtained results conclude that the NG steers were less susceptible to stress and thus had higher glucose levels in the blood, compared to the ND steers. The lactate levels for the group dropped with time of sampling.

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