THE EFFECT OF THE FARM AND THE ABATTOIR ENVIRONMENTS ON CATTLE BEHAVIOUR, BLOOD HORMONES AND METABOLITES AS STRESS INDICATORS

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Abstract-The objective of the study was to assess cattle behaviour, blood hormones and metabolites as stress indicators, influenced by the farm and the abattoir activities. Thirty, 12 months old castrates were observed for behaviour response at the farm feedlot and holding pens/crush; and at the abattoir lairage, race. Two sets of blood samples were obtained from each animal, both at the farm (live animals-from the tail) and the abattoir (exsanguination). Glucose, cortisol and lactate levels were analysed from the blood samples. Results showed that the cattle spent most of their time in the feedlot eating and resting. Removal from the feedlot to the holding pens resulted in agitation and trying to escape, frequent urination and loose excreta; which were associated with stress. At the abattoir, the cattle spent all the time standing until the slaughter time; looking around curiously and sniffing on animals in other pens (from different farms). Blood hormones and metabolites concentration registered at the farm did not show differences from that determined at the abattoir. It can be concluded that the abattoir environment and breed type have a different effect on cattle response behaviour compared to the farm. However these two environments had no effect on blood hormones and metabolites.

I. INTRODUCTION

Slaughter animals are subjected to at least three different environments in their lifetime before they are slaughtered and converted to meat. These include the farm where they are reared, which is characterised by minimal activities; the unstable and moving transportation vehicle; and the eventful, loud abattoir/slaughter house. It has been reported that these conditions could induce pre-slaughter stress on animals (1; 2; 3). This may be a great challenge as pre-slaughter stress is associated with reduced meat quality.

Bourguet *et al.* (4) reported that exercise and psychological stress just before slaughter increases muscle metabolic activity, which may continue after death, resulting in faster post-mortem pH decline. This can furthermore be linked to decreased meat quality (1). Knowledge of the response behaviour and physiological response of the animal can be used to minimise any losses or reduction in productivity that may be posed by stress. Moreover; this would result to known animal health status (5); ensure good animal social status and an effective and economical production enterprise (6).

Slaughter animals were reported to be unaware of what would happen to them at slaughter; they perceive the pre-slaughter distractions and changes as those of the farm during managerial procedures like vaccinations and dipping (7). This then results to similar behaviours in both environments. However; in addition to the behaviour response, blood hormones and metabolites have been used further as indicators of stress determinants. Ferguson and Warner (8) reported that disturbance in the environment activates the hypothalamic-pituitary-adrenal activity due to fear; resulting in the release of catecholamines and cortisol (9) which furthermore elevates blood lactate and glucose. Therefore the objective of this study was to assess the relationship between cattle response-behaviour, blood hormones and metabolites as stress indicators influenced by the farm and the abattoir activities.

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 data was collected from two study sites, the farm and the abattoir situated at around 120 km east of Alice Town. These two sites are about 30 km away from each other and are privately owned by the same group of people for business purposes.

Site one (farm): is situated in Berlin, King William's Town and its geographical coordinates are 32˚53'0" South and 27˚35'0" East. The average midday temperatures ranges between 20˚C (July) to 27˚C (February) with an annual rainfall of about 502 mm occurring mostly in summer. The vegetation around this area is comprised of Acacia Karroo bushes and the grasses involve species like *Themeda triandra*, *Eragrostis capensis*, *Heteropogon contortus* and others in a dense and sour-like form.

Site two (East London abattoir): is situated in Cambridge, East London. Its geographical coordinated are 32˚58'0" South and 27˚53'0" East. Average midday temperatures in East London range between 20˚C (July) to 26˚C (February) with an annual rainfall of about 593 mm mostly occurring during the summer months.

The abattoir operates under typical commercial conditions and is equipped with modern technology to enhance production. It operates according to standard laws and regulations governing abattoirs such as "The Meat Act, 2000, the Animal Protection Act, 1962 and 1935 for animal welfare maintenance" to ensure public health safety. According to the description report on different abattoirs by the RMAA (10), the current one is a high throughput abattoir.

Animal Transportation and resting periods

Animals were transported by truck for an hour from the farm to the abattoir and they were slaughtered on the same morning they arrived. They were allowed to rest at the abattoir holding pens (5.3 m × 5.3 m) with 7-9 cattle per pen, and had access to water for about 3 hours before slaughter. There was minimal animal-human interaction as the animals directions were led by the narrow crush connecting the holding pens and restraining or stunning areas.

Animal Description and Data Collection

A group of 30 twelve months old castrates were randomly picked from the farm herd and were used for the current study. These were 7 Angus, 14 Brahman and 9 Brangus breeds. Ear tagging was used to mark and identify.

The cattle were observed for response behaviour as a group at the farm feedlot and holding pens/crush; and at the abattoir lairage and race. The technique used was the direct observation of spontaneous behaviour with 3 assessors taking part. Behaviour assessment looked at the comfortability and the emotional state of the animals by looking at the animal's body language (11). This determined whether the animals were free and happy around each other and in the environment as a whole. Factors described in Table 1 below were noted; where group 1 represented positive behaviour and group 2 being the negative behaviour.

Table 1 Animals emotional state observation at farm

Group 1 (positive behaviour)	Group 2 (negative behaviour)
Active, Relaxed, Calm Content, Friendly, Playful Positively occupied, Lively Inquisitive, Happy.	Fearful, Agitated, Indifferent Frustrated, Bored, Irritable Uneasy, Apathetic, Distress.

Modified from Mounier (11)

Two sets of blood samples were obtained from each animal both at the farm and the abattoir for glucose, cortisol and lactate analysis (blood stress hormones and metabolites). This was done to measure the effect of both on cattle's stress levels.

Central circulatory blood was collected from the tail/caudal vein once at the farm through the palpation of animal's tail, vein identification, then a puncture using a needle connected to the vaccutainer tube and its holder. Blood was drawn and sucked into the vaccutainer tube. The second set of blood samples were collected during the process of exsanguination after the stunning processes. The samples were kept in ice until separation of serum through centrifuging at 21^{o}C for 5 min at 3000 rpm. Analysis of the samples was done in two laboratories; University of Pretoria Pathology lab (cortisol and lactate) and Victoria hospital laboratory (glucose).

Statistical analysis

The effect of environment and breed on behaviour was analysed using PROC FREQ of SAS (12) statistical package. The effect of the environment and animal characteristics on blood hormones and metabolite levels was analysed by means of Proc GLM for ANOVA.

III. RESULTS AND DISCUSSION

Overall observations on behaviour responses

The cattle in the current study showed positive behaviour at the feedlots (Table 1;

Figure 1). This is a normal scenario as reported by literature that cattle spend most of their time feeding and resting at the feedlots (13; 14; 15). Moreover; the animals were calm and content around one another, showing no signs of aggression or fighting. However when they were driven out of the feedlot to the holding pens/race and into the crush, a negative set of response behaviour was observed in some (Figure 1). This movement can be related with the invasion that normally happens when the management activities like vaccination are conducted at the farm. During blood sampling at the holding pens/crush, most of the animals (56.7%) were observed to show aggression (negative behaviour, Figure 1) involving attempt to kick, escape and vocalization. This set of behaviour was also observed when the castrates were moved from the lairage through the race to the stunning box. This could be attributed with the human interference with the animals. Broom and Fraser (6) reported that lack of control or destructions in the animal's environment may result to strange behaviours in response to trying to adjust. In addition, frequent urination and release of loose faeces were observed. This was thought to be related to the adrenalin hormone release due to the aggressive behaviour.

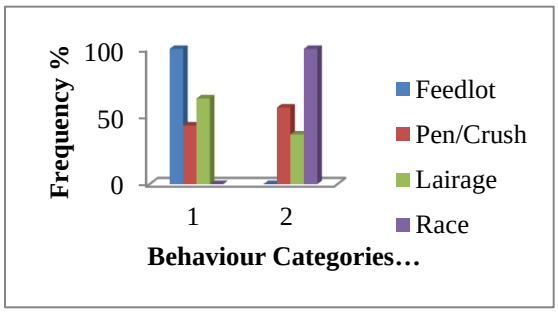

Figure 1. General Frequencies in behaviour scores at the feedlot, holding pen/crush, abattoir lairage and race

However this was not the case at the abattoir lairage. Animals were observed to possess more of the positive (63.3%) behaviour than the negative one (Table 1); they were calm and curious. This was contrary to the expected results that animals would respond better at the farm than the new environment which is the abattoir. Moreover; Grandin (5) reported that from her on-farm (feedlot) and abattoir observations on animal behaviour, she discovered that cattle behaved the same but went on to say that dangling chains and disturbances on their paths around abattoir races resulted to fear thus refusal to move. This could explain the other 36.67% that showed negative behaviour at the lairage. In addition, Bourguet *et al.* (4) also reported that presence of physical distractions like shiny objects, humans, and changes on light intensity from light to dark induce a sense of anxiety.

All breeds were calm at the feedlots and agitated at the abattoir race(Figure 1). Figure 2 shows that all Angus castrates (53.8%) possessed positive behaviour (calm-) at the farm holding pens and in the crush, and at the abattoir lairage; whereas the Brahman (82.4%) showed negative behaviour (aggression, kicking). This was expected because of the Brahman's notorious nature of being disobedient. On the other hand, the crosses between the two (Brangus) were mostly positive in both areas (Pen/Crush-46.2% and Lairage-31.6%). This could be a result of hybrid vigor, which generally allows offspring from two different breeds to perform better than its parents. Moreover; Lanier *et al.* (16) reported that different types of animals may have different physiological and behavioural responses to the same procedure.

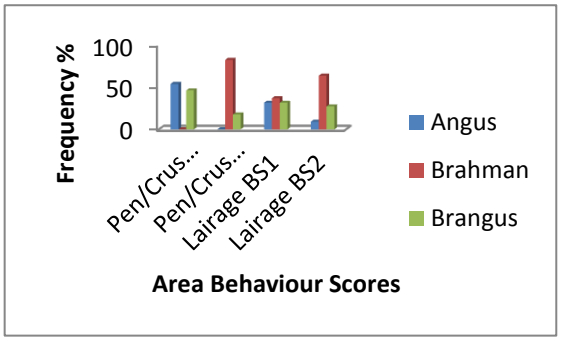

Figure 2. Frequencies across breeds in behaviour scores at the holding pen/crush and abattoir lairage

Blood analysis results

The animals' stress hormones and metabolites did not differ with either environment or animal characteristics. This may have been due to a smaller sample of 40 cattle used so far. Moreover; it could be related to that cattle perceive the transportation and slaughter process the same way they see the management activities (dipping, vaccination) that normally take place at the farm. The slaughter animals do not really know that they will die (5). Hence there is no elevated reaction than normal. It could also be linked to the fact that in both situations at the farm and abattoir, humans were present to influence the animal's response behaviour by moving the animals from one point to another before the sampling took place.

IV. CONCLUSION

It can be concluded that environment and breed differences have an effect on cattle response behaviour. However; the blood glucose, cortisol and lactate do not differ with environmental changes. Moreover; more data samples need to be obtained around the same matter to give room to variations.

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