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Full Length Research Paper

Behavioural responses of four goat genotypes to successive handling at the farm

Saymore Petros Ndou[1], Voster Muchenje[1]* and Michael Chimonyo[2]

[1]Department of Livestock and Pasture Science, University of Fort Hare, P. Bag X1314 Alice 5700, South Africa.
[2]Discipline of Animal and Poultry Science, University of Kwa-Zulu Natal, P. Bag X01 Scottsville 3209, South Africa.

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The objective of the current study is to compare the behavioural responses of Xhosa lob-eared, Nguni and Boer goats and their crosses to blood collection and rectal palpation. A total of 48, six- month old castrated male indigenous goats of the Xhosa lob-eared, Nguni and Boer goats and their crosses were kept at the University of Fort Hare Farm, South Africa for eight weeks. The goats were randomly assigned to four pen groups with each pen having three goats of the same breed among the 12 goats in each pen. Immediately after blood and faecal collection, behavioural measurements through vocalization scoring (VS), pen scoring (PS), crush scoring (CS), flight speed (FS) and flight time (FT) were recorded for each goat every forth-night for 8 weeks. The Nguni was the most temperamental ($p < 0.05$) and the Boer goats were the most calm. There were significant increases in the behavioural scores of the four breeds during the successive weeks of handling. It can be concluded that the Boer goats had the calmest temperament, followed by the crossbreds, and lastly the Xhosa the Nguni were the most combative.

Key words: Indigenous goats, crush score, flight speed, pen score, temperament, welfare.

INTRODUCTION

Most resource-poor farmers in developing countries rear goats (*Capra hircus*) and use them as savings to accumulate wealth, provide security against crop failure and currencies fluctuations, provide a source of protein (milk and meat) and cash to buy other household goods (Lehloenya et al., 2005). In South Africa, indigenous goats are reared by most communal farmers under smallholder production systems. Common indigenous goat genotypes in South Africa include the Nguni, Boer goat and theirs crosses. The Nguni goat is a small-framed breed that has been reported to be hardy and can thrive under local environmental conditions, utilising available feed resources much more efficiently (Dziba et al., 2003; Nyamukanza and Scogings, 2008). The Xhosa lob-eared is a large-framed goat breed well known for its attractive coat pattern of various colours. The numbers of the Xhosa lob-eared, (one of the genotypes which were upgraded to produce the modern fast-growing Boer goat), is dwindling. As such, its value on the local market has increased markedly. Indiscriminate crossing with synthetic and exotic breeds also occur, resulting in changes in some morphological traits in goats, such as stature (Masika and Mafu, 2004). This resultant crosses have been reported to dominate most communal areas (Cardellino, 2009).

Despite their importance, goat welfare status has received low priority in developing countries, particularly in subsistence farms but influence post mortem meat quality and consumer acceptability (Schaefer et al., 2001; Muchenje et al., 2009a). Prior to slaughter, under smallholder production systems, goats are inevitably exposed to a variety of physical and psychological stressors through human-animal interactions, animal-animal interactions and animal-environmental interactions (Kadim et al., 2006; Gregory, 2008; Muchenje et al., 2009b). Smallholder production systems are characterized by less benign conditions, poor handling facilities, inexperienced stockman, poor records and lack animal

*Corresponding author. E-mail: vmuchenje@ufh.ac.za, vmuchenje@hotmail.com. Tel: +27 40 602 2059. Fax: +27 86 628 2967.

Abbreviations: VS, Vocalization scoring; **PS,** pen scoring; **CS,** crush scoring; **FS,** flight speed; **FT,** flight time.

identification techniques. Responsiveness to stress can be assessed through changes in behavioural reactions (Campo et al., 2008). Stress responsiveness is influenced by genotype, previous experience and specific features at the time of handling (Muchenje et al., 2008, 2009b).

Differences in stress responsiveness within and between genotypes opens an opportunity for farmers to select genotypes and lines that are tame so that economic losses associated with temperaments are reduced during handling. Due to the gradual increasing rate of consumer concerns (Muchenje et al., 2009a) and traceability of welfare conditions used in rearing the animals, assessment of welfare status will also enable stockman to identify areas where welfare is aversive (Smith et al., 2008).

Changes in animal behaviour are the most obvious indicators that the animal is having challenges in coping with the welfare procedures and in most cases some aspect of the situation is aversive (Broom, 2000). Animals perceive specific features through previous experience and learning (Moberg, 2001; Gregory, 2007) and will subsequently react through appropriate behavioural responses. The commonly used behavioural measurement methods include temperament (crush and pen scores), flight speeds (times), and vocalizing scoring (Warris et al., 1994; Campo et al., 2008). Compilation of these measurements is easy and cheap such that resource-poor farmers, if trained properly, can produce accurate on-farm welfare audits.

Limited information is available on social behaviour and physiological response of indigenous goats raised in communal areas prior to slaughter. The objective of the current study was to compare crush scores, pen scores, flight speeds, flight times and vocalization responses to blood collection and rectal palpation of the Xhosa lob-eared, Nguni and Boer goat and their crosses over time.

MATERIALS AND METHODS

Description of study site

The study was conducted at the Honeydale Research Farm, University of Fort Hare, situated in the False Thornveld of the Eastern Cape, 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. The area receives low annual rainfall of approximately 480 mm per annum both between and within seasons. The mean annual temperature of the farm is 18.7°C. 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.

Animals

Forty-eight 6- month old castrated male indigenous goats weighing between 15 and 20 kg were used. The genotypes used were Xhosa lob-eared, Nguni and the Boar goat and their crosses. From birth up to the time of weaning at six months of age, the male kids were kept on the pastures with their mothers. One month prior to the commencement of the experiment, the animals were dipped, vaccinated and dewormed. The kids were weaned and housed in large, partially sheltered open pens that comply with the local welfare standards. The weaned kids had free access to a basal diet of 500 g/head/day of *Medicago sativa* hay covering their needs for maintenance and growth (80 g/day CP; 5.69MJ/day ME). Water was provided at *ad libitum* in drinking containers. The goats from each genotype was randomly assigned to four pen groups such that there were 12 goats per pen group and each pen had three goats of the same genotype. The pens were arranged in such a way that animal inspection started with goats in Pen 1, followed by those in Pen 2, then Pen 3 and lastly Pen 4. The experiment was conducted during the months of July to August.

Measurements

Goats were subjected to blood collection and rectal palpation for faecal collection. About 10 ml of blood was collected from the jugular vein of each goat. Following these procedures, behavioural measurements through vocalization scorings (VS), pen scoring (PS), crush score (CS), flight speed (FS) and flight time (FT) were recorded for every animal (Broom, 2000; Campo et al., 2008). Vocalization scorings were compiled through a yes/no scoring for each goat. The goat's pen and crush scores were compiled using a four-point scale (1 = Very quiet, no resistance; 2 = has to be forced to move; 3-refuses to move, sprawls and 4 = similar to 3, but very excited) when the goats were forced to move from their pen and into the weighing box.

Flight speed was generalized through a ranking scale such as 1 = Walked, 2 = trotted, and 3 = ran (Campo et al., 2008). Flight time was measured using a stop watch by determination of the time period it takes an animal to cover a fixed distance (5 m) after release from the weighing box (Campo et al., 2008). The experiment was conducted over nine weeks after which goats were sent to a small-holder abattoir for slaughter.

Statistical analysis

The Shapiro-Wilk test (SAS, 2003) was used to test normality for all the measured variables. Analyses of variance were carried out using the general linear model (GLM) (SAS, 2003) to determine the effect of genotype, pen group and time of handling on the VS, PS, CS, FS and FT. Comparison of the means was performed using the probability of difference (PDIFF) procedure (SAS, 2003). Differences detected at the 0.05 level or less was considered statistically significant.

RESULTS

Effect of genotype and week of handling on behavioural measurements

The effects of genotype on the pen scores of the goats are presented in Table 1. The pen scores of the Nguni goats were the highest ($p < 0.05$), followed by those of the Xhosa lob-eared goats, then the Crosses and lastly the Boer goats. Table 2 shows the effect of the week of handling on pen of goats. The pen scores of the four genotypes significantly ($p < 0.05$) increased from week 4 up to week 8.

Figure 1 shows that the flight speeds for the Nguni goats

Table 1. Least square means ± standard error of pen scores of Xhosa lob-eared, Nguni, Boer goats and their crosses.

Genotype	n	Pen score
Boer	12	1.21 ± 0.09^{a}
Cross	12	2.27 ± 0.09^{b}
Xhosa lob-eared	12	3.08 ± 0.09^{c}
Nguni	12	3.29 ± 0.09^{c}
Level of significance		**

[abc] Mean values in the same column with different subscripts are significantly different at $p < 0.001$.

Table 2. Least square means ± standard error of pen scores due to effect of week of handling.

Date (week)	n	Pen scores
2	12	2.42 ± 0.09^{b}
4	12	2.06 ± 0.09^{a}
6	12	2.67 ± 0.09^{c}
8	12	2.71 ± 0.09^{c}
Level of significance		***

[abc] Mean values in the same column with different subscripts are significantly different at $p < 0.001$.

were the highest ($p < 0.05$) followed by those of the Xhosa lob-eared goats, then the crosses and those of the Boer goats were the lowest ($p < 0.05$). As shown in Figure 1, flight speeds for all genotypes generally increased ($p < 0.05$) during the experiment. As illustrated in Figure 2, the vocal scores of the Xhosa lob-eared and Nguni goats were the highest ($p < 0.05$), followed by those of the crosses, and the Boer goats had the lowest ($p < 0.05$) vocalization scorings. There were significant increases in the vocalizations of the Boer, Crosses, Xhosa lob-eared and Nguni goats during the experiment, especially during the last weeks of handling (Figure 2).

For every successive week of handling, the crush scores of the Nguni goats were the highest ($p < 0.05$) followed by the Xhosa lob-eared goats, then the crosses and the Boer goats had the lowest crush scores ($p < 0.05$). There were significant ($p < 0.05$) increases in the crush scores of all the goats on every successive week of handling (Figure 3). Figure 4 shows that the flight times for the Boer goats were the highest ($p < 0.05$) followed by those of the crosses, then those of the Xhosa lob-eared and the Nguni goats had the lowest ($p < 0.05$). The flight times of the Nguni, Boer goats and the crosses decreased ($p < 0.05$) with every week of successive handling.

Effect of pen group on goat behaviour

The effect of pen group on the flight speeds, vocalization scores, pen scores, crush scores and flight time of the goats are shown in Table 3. The flight speeds of goats in pen group 4 were the highest ($p < 0.05$), followed by those in pen group 3, then pen group 2 and goats in pen group 1 had the lowest ($p < 0.05$) flight speeds. Although the flight speeds of goats in pen group 3 and pen group 4 were similar ($p < 0.05$), there were no significant differences in the flight speeds of goats in pen group 1, pen group 2 and pen group 3. The pen scores of goats in pen group 4 were the highest ($p < 0.05$), followed by those in pen group 3 and pen group 1 and goats in pen group 2 had the lowest ($p < 0.05$) pen scores. However, there were no significant differences in the pen scores of all the groups except for the pen scores in group 2 which were different ($p < 0.05$) from all the other pen groups.

The crush scores of goats in pen group 4 were the highest ($p < 0.05$) followed by those of goats in pen group 3, then pen group 1 and pen group 2 had the lowest ($p < 0.05$). There were, however, no significant differences in the crush scores of goats in pen group 1, pen group 3 and pen group 4 but these were different to pen group 2 and were also different ($p < 0.05$) from the other groups. The flight times of goats in pen group 1 were the highest ($p < 0.05$), followed by pen group 3 with pen group 2 having the least ($p < 0.05$).

DISCUSSION

The higher negative behavioural ratings for Nguni and Xhosa lob-eared goats than for Boer goats can be ascribed to the fact that the later had been solely developed for meat production of which tameness is greatly selected for in developing meat animals (Simela and Merkel, 2008). Furthermore, genotype differences in behavioural measurements can be due to the fact that different animals respond differently to the same stressor (Hall et al., 1998; O' Neill et al., 2009). The observation that the behavioural ratings of crossbreds were intermediate between that of the Xhosa lob-eared and the Boer suggest that temperament can be improved through crossbreeding; implying that farmers can cross the Boer and some other indigenous goats so that offspring produced can be tame.

The finding that crossbreds had calmer temperament than the pure Xhosa ear-lobed and Nguni indigenous genotypes implies that their handling will be easier, takes less time, does not frustrate the handler, and reduces injuries both to the handler or themselves, thus resulting in more economic benefits. These implications contradict the claim by Ayalew et al. (2003) that crossbreeds do not generate more net benefits than indigenous goats raised under Ethiopian smallholdings. However, there is need for characterizing, investigating and analyzing behavioural, physiological and biochemical response of indigenous goat genotypes raised under local environments.

The behavioural ratings of the goats increased with every week of successive handling. Farm animals regularly learn about specific traits and characters in their environ-

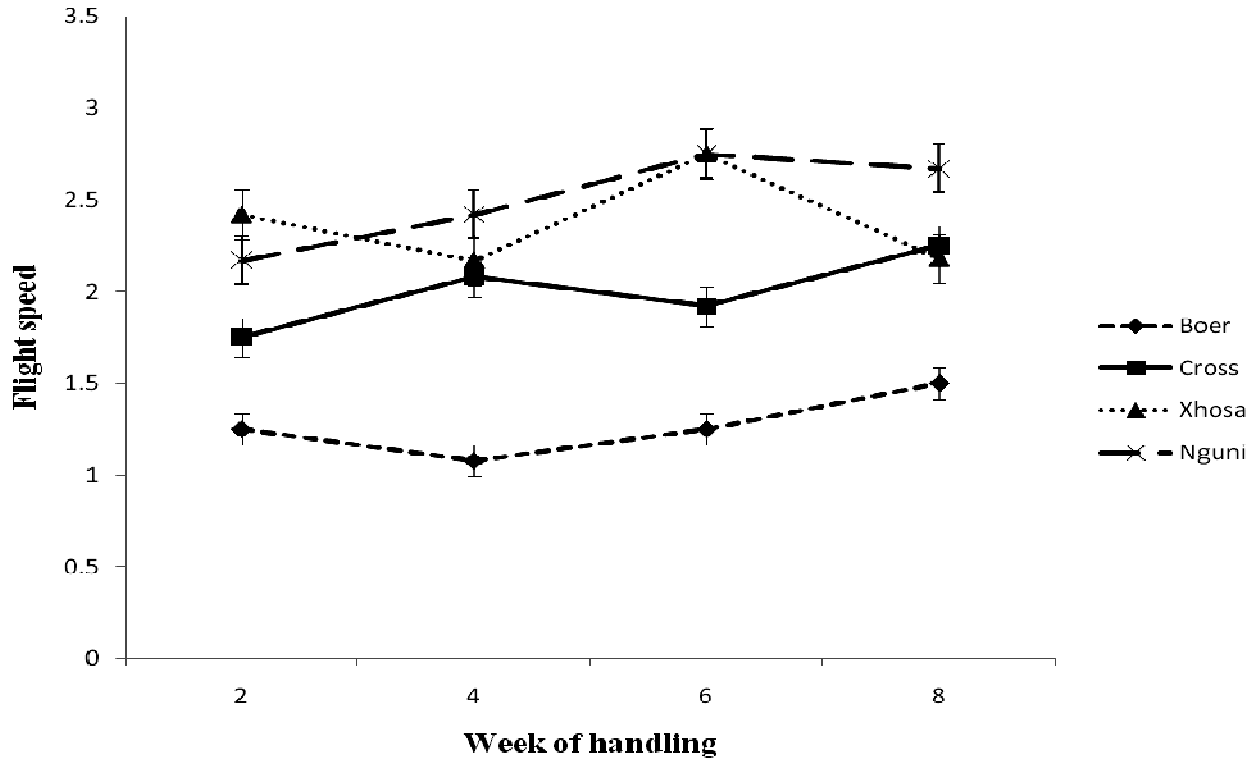

Figure 1. Least square means of flight speeds by week handling of the Nguni, Xhosa lob-eared, Boer goats and their crosses.

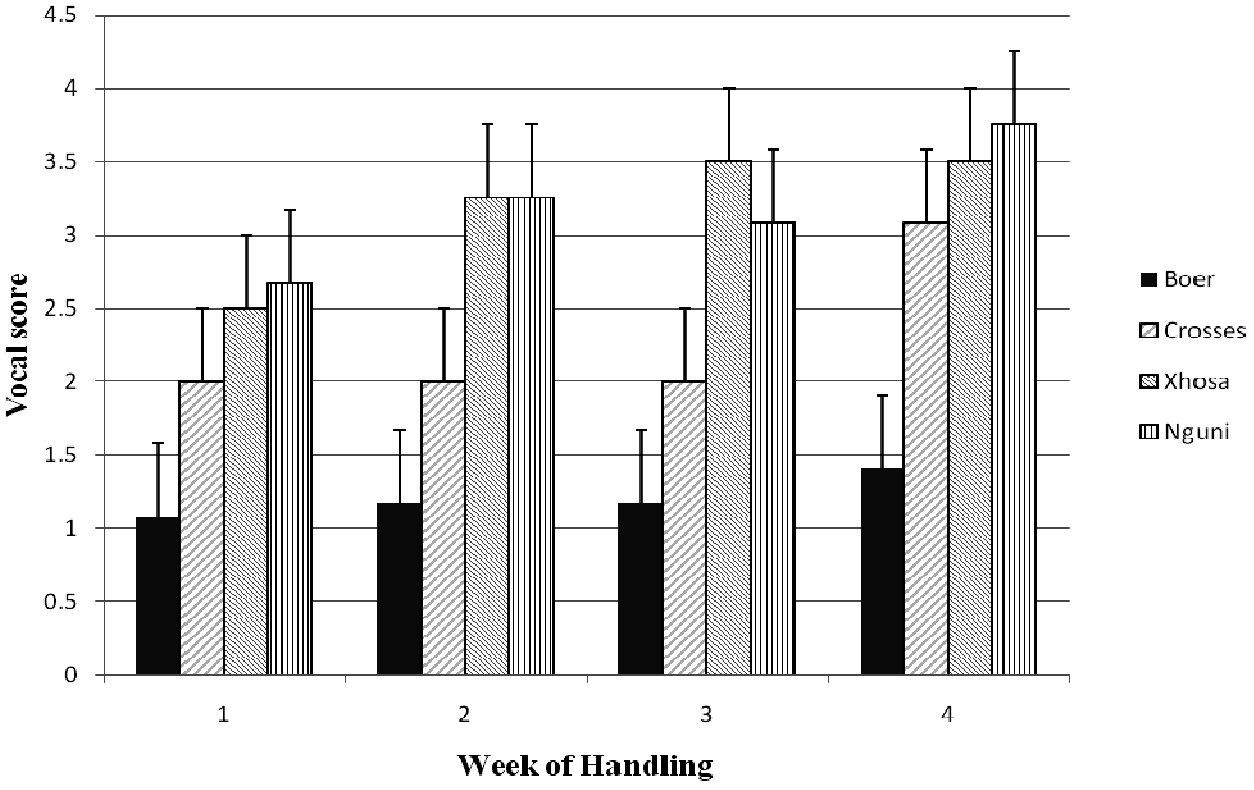

Figure 2. Least square means of vocalization scores by week of handling of the Nguni, Xhosa lob-eared, Boer goats and their crosses.

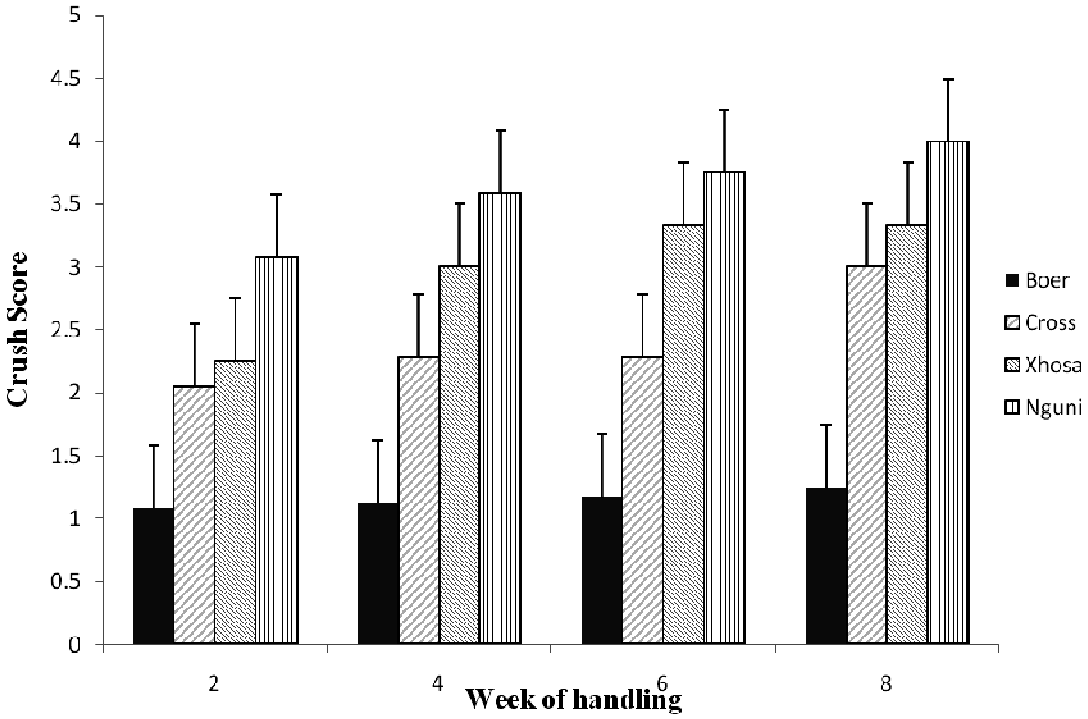

Figure 3. Least square means crush score by week of handling of the Nguni, Xhosa lob-eared, Boer and their crosses.

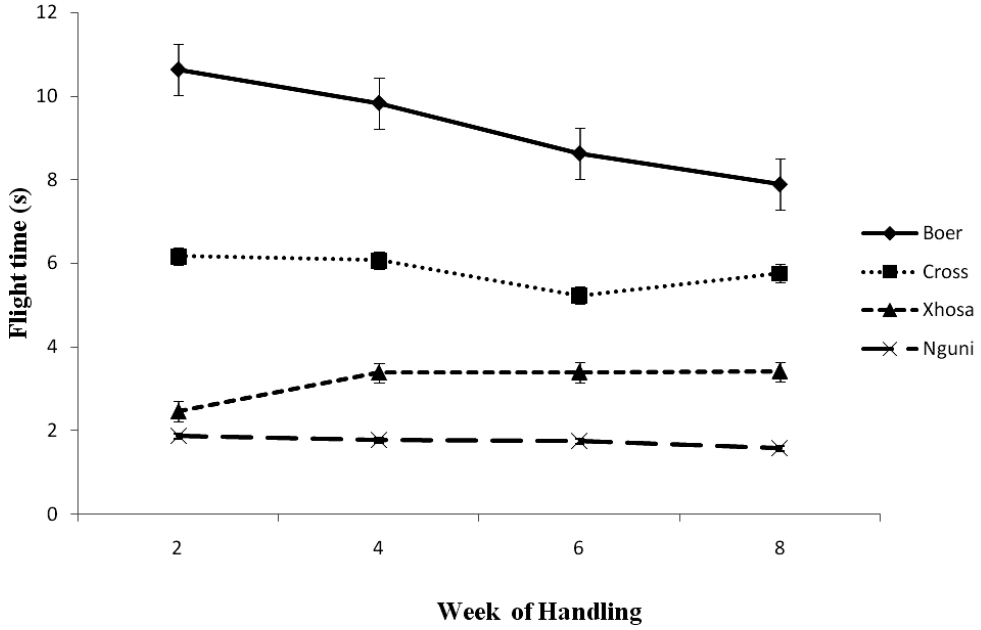

Figure 4. Least square means flight time by week of handling of the Nguni, Xhosa lob-eared, Boer and their crosses.

ment (Wechsler and Lea, 2007), thus, behavioural ratings are largely influenced by how the animals perceive specific features, previous handling and learning (Moberg, 2001; Gregory, 2007). The overall increase in the behavioural ratings during the experiment indicates that the way the goats were handled was stressful or aversive and were increasingly becoming more flighty. These observations agree with the claim by Lensink et al. (2000)

Table 3. Least square means ± standard error of behavioural measurements due to effect of pen group.

Treatment group	n	Flight speeds	Vocalization scoring	Pen scores	Crush scores	Flight time (s)
Pen 1	12	1.90 ± 0.08^{a}	0.56 ± 0.08	2.56 ± 0.08^{b}	2.60 ± 0.08^{b}	5.76 ± 0.13^{c}
Pen 2	12	1.90 ± 0.08^{a}	0.52 ± 0.08	2.15 ± 0.09^{a}	2.35 ± 0.08^{a}	4.82 ± 0.13^{a}
Pen 3	12	2.10 ± 0.08^{ab}	0.56 ± 0.08	2.56 ± 0.08^{b}	2.58 ± 0.08^{b}	5.69 ± 0.13^{c}
Pen 4	12	2.25 ± 0.08^{b}	0.54 ± 0.08	2.58 ± 0.08^{b}	2.67 ± 0.08^{b}	5.18 ± 0.13^{b}
Level of significance		*	NS	***	*	***

[abcd] Mean values in the same column with different subscripts are significantly different at *p < 0.05; ***p<0.001; NS = not significant (p > 0.05).

that in various species of livestock, gentled animals show more approaches towards, and less avoidance of, people regardless of their familiarity.

The high pen scores suggest that animals are not comfortable with human presence and would try to free themselves through avoidance or escape behaviours. The finding by Jackson and Hackett (2007) that exposure of the animals to the handler lessens the fear of humans causing them to approach more quickly or escape slowly with less hesitation, stands only when the handler is gentle with the animals. Another explanation for the increase of the behavioural scores can be attributed to the fact that animals were also resisting separation from their flock especially when they are to be confined as individuals during crush scoring or body inspection (Cockram et al., 1993; Napolitano et al., 2008).

The higher flight speeds of the Nguni and the Xhosa goats than for the Boer can be attributed to the fact that the former were easily agitated and may impose negative economic implications as they will take a lot of time during handling or may end up frustrating the stockman. The higher flight time for the Boer than for the Nguni and Xhosa can be explained by the fact that the former responded slowly to the handling procedures whilst the latter can react so quickly thereby increasing the chances of injuries to themselves or the handler. These findings are in line with those reported by Campo et al. (2008), who found that animals that were easily agitated fled from the handler or the handling facilities faster than those that were calmer. The observed increase in vocalizations between the first and the last week of handling indicates that the goats did not habituate to routine handling procedures (Napolitano et al., 2008).

The observed decrease in flight times for all the goats throughout the experiment concurs with the increase of other behavioural ratings that animals were not gentled by the experimenter and thus, became more erratic. The decrease of flight time over a period of time also indicates that it will take time to familiarize animals to stockman or handling facilities, at the same time strengthening the claim that selection for calmness is more reliable than training animals. In cattle, flight time values indicate that meat from calmer animals is tender and develops a desirable colour than that from aggressive animals (Campo et al., 2008; Muchenje et al., 2009b). These results suggest that when working with more excitable animals such as Nguni and Xhosa lobed-ear genotypes, temperament of individual animals must be considered if quality chevon is to be produced. However, to our knowledge, the relationship between pre-slaughter behaviour and chevon quality at *post-mortem* is not known. Further work is needed to investigate the impact of animal welfare on the meat and milk quality and overall health of animals that are raised with regular human contacts or training under local conditions.

The differences in flight speeds of goats in different pens can be attributed to the fact that different social groups may perceive the presence of the stockman differently because animals in different pens may receive unique qualities of stockman caring as they are gentled during handling (Dwyer, 2009). These findings agree with Dwyer (2009) in sheep, Coleman et al. (2000) in pigs, Cransberg et al. (2000) in poultry, and Breuer et al. (2000), Hanna et al. (2009) and Bertenshaw and Rollinson (2009) in dairy cattle, who observed that stockperson attitude and behaviour towards the animals in their care can have a significant impact on fear, welfare and productivity. According to Jackson and Hackett (2007), gentling is defined as a form of positive physical attention that seeks to calm the animal and increases the affinity for a healthy animal–human bond. Gentling can also be influenced by how many times the handler is visiting the animals for individual inspection, the more the visits the most likely is the reduction of gentling during handling (Jackson and Hackett, 2007).

It is possible to assume that animals in pen 1 having the lowest behavioural measurements were tame and used to human handling or proximity (Campo et al., 2008). The other reason can also be ascribed to the fact that these were usually receiving quality or gentle handling because they were the first to be handled and the handler would pay great attention during human to animal interaction. In contrast, the observation that the pen scores and crushes scores of goats in pen 4 werehighest can be due to the fact that they were usually the last to be handled, thus the amount and quality of attention of the handler to each individual animal may have decreased due to the increase in the herd numbers to attend to (Le Neindre et al., 1996; Breuer et al., 2000). The differences in flight times for the goats in different pens which were adjacent further strengthens the suggestion by Fitzpatrick et al. (2006) that it is imperative

to take into account the welfare of individual animals within flocks. However, the observation that goats in pen 2 had the lowest flight times suggests that within species, the response of animals can also vary even when the animals are kept in the same environment (Ali et al., 2006).

Conclusion

The Boer goats were the calmest while the Xhosa and the Nguni were the most combative. Goats that are not gentled in the previous handling are aggressive during successive handling procedures. Different social groups of animals may perceive the presence of the stockman differently because animals in different pens may receive unique qualities of stockman caring as they are gentled during handling.

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