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# Evaluation of chevon characteristics to assess xylazine and ascorbic acid efficacy in rendering welfare to bucks subjected to long road transportation and stocking stress

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**ABSTRACT:** Stress in transported bucks as food animals can cause generation of reactive oxygen species at the cellular level which compromises the quality of chevon and could be detrimental to consumer's health. This could also cause monetary losses which would affect that agro-economics. This prompted this study in which sixty apparently healthy Sahel bucks were investigated upon. There were two studies a therapeutic intervention study and a non intervention study respectively. All animals were subjected to long term transportation in the harmattan. The intervention study groups were pre-treated with xylazine, ascorbic acid, combination and control which had 6 animals each with each group having a sub-group that were stocked as and low and high stocking rates. While in the non- intervention study, 12 animals were separated to two groups of 6 each, stocked at high and low stocking with no pretreatment. Experimental animals were offloaded after undergoing a journey of 28 hours and were subsequently transported. They were later slaughtered by severing of the trachea, esophagus and all structures of the investing fascia of the neck. Chevon characteristics evaluated were shrinkage, water holding capacity, pH colour, cooking loss and for excitatory score at slaughter. The combination (xylazine-ascorbic acid) significantly ($p<0.05$) decreased in shrinkage percentage, and improved; empty body weight, ultimate pH and cooking loss percentage. There were significant ($p<0.05$) interactions between various treatment regimens and stocking rate on the following parameters: excitatory score at slaughter, water holding capacity, pH and colour in the intervention study. In non-intervention study, there were significant ($p<0.05$) differences in the following parameters excitatory score at slaughter, empty body weight and luminosity in the meat colour due difference in stocking. Conclusively, this study gives credence that therapeutic intervention had effect on chevon quality when pretreated for transportation stress attenuation.

**Keywords:** Ascorbic acid, chevon, stress, xylazine.

## INTRODUCTION

Goat is an important food animal in developing countries (Alhaji and Odetokun, 2013). They serve important source of financial security to local populations (Aina, 2012; Alhaji and Odetokun, 2013; Alhaji et al., 2015). About 16.62% of the goats slaughtered annually for consumption in Africa are contributed by Nigeria. As sources of food, goats produce high quality protein products in form of meat and milk (Aina, 2012). In this way, it helps to narrow the wide protein gap in nutrition in the developing countries. Goat meat contains all essential amino acids required for healthy living. In addition, goats offer a convenient meat production unit for slaughter and consumption without the

need for expensive preservation equipment. Chevon is preferred above mutton and beef in some parts of the world including Nigeria (Devendra and McLeroy, 1982).

The superior nutritional properties of chevon have been previously documented (Jibir et al., 2012). It is an ideal source of red meat with low fat (Kannan et al., 2002), an important factor in reducing the risk of cardiovascular diseases. Goat meat is a good source of desirable fatty acids, since goats deposit higher amount of poly unsaturated fatty acids than other ruminants (Kadim et al.,2002). Goat carcasses had higher Ca, K, Mg, Na and P level than sheep carcasses, significantly lower saturated to unsaturated fatty acid ratio and lower carcass cholesterol content (Jibir, 2008).

Animal transportation is a common practice in animal husbandry that is inevitable during production, marketing and slaughter of food animals. In Nigeria, despite high demand for chevon, producers are always faced with the challenge of maintaining quality of goat chevon. Most goat slaughtered in Nigeria are reared in the northern part of Nigeria and transported (poorly stocked on lorries) to the south for sale and slaughter while being exposed to long term transportation stress (Biobaku et al., 2016a). The animals when exposed to long term transported stress are usually subjected to physiological and psychological stress affecting animal welfare and meat quality (Fazio, 2003; Gregory, 2004; Ayo et al., 2006). Pharmacological agents are useful in alleviating stress due to transportation (Ali and Al-Qarawi, 2002; Ali et al., 2006). Food animals transported at high stocking densities have greater tendency to produce dark firm dry syndrome and muscle sores which would compromise quality of chevon (Minka and Ayo, 2010; Biobaku et al., 2016b).

Thus, this study was embarked upon to assess the effect of xylazine and ascorbic acid at different stocking rates during long term transportation of Sahel bucks on some characteristics.

## MATERIALS AND METHODS

### Study location and bio-meteorological monitoring

The study was carried out at the livestock farm unit of Faculty of Agriculture, Usmanu Danfodiyo University, Sokoto, Nigeria. It is located along latitude 13.1ºN and longitude 5º13ˈE and 350 m above sea level in the semi-arid zone of north-west Nigeria. The goats were transported during the harmattan season in the month of January. The experimental journey started in Sokoto and ended at the Federal University of Agriculture, Abeokuta, and Ogun State; which was located along latitude 71º 0'N, longitude 32$^{o'}$E at an altitude of 76 m above sea level. Abeokuta is located in the rain forest zone of south-western Nigeria. The distance travelled during the experimental journey is 996 km at a speed of 40 km/hr as previously adopted by Biobaku et al. (2016a,b). This distance gives insight of the journey covered by goat marketers when transporting food animals across the country. The ambient temperature and wind speed was measured using wet bulb and dry bulb thermometer and digital anemometer (N492203, China), while the relative humidity was extrapolated using a chart.

### Experimental animal and design

Sixty apparently healthy Sahel bucks were used in this investigation. There were two studies: a therapeutic intervention and non-intervention studies. All animals were subjected to long term transportation during the harmattan season. In the intervention study groups, pre-treated with xylazine, ascorbic acid, combination (of xylazine and ascorbic acid) and control, all had six goats each. Each group had a sub-group that were stocked at low and high stocking rates. In the non- intervention study, 12 animals were separated to two groups of six each; stocked at high and low rates with no pre-treatment. The age range of the animals were between 18 to 24 months all with the same body condition score of 3 and were within the weight range of 9 to 15 kg. The animals were purchased from livestock markets in Tangaza, Gada, Kware and Achida of Sokoto state, Nigeria. The animals were stabilized for two weeks during which they were treated prophylactically with albendazole (Bamizole®, Nigeria) and Penicillin and streptomycin combination (Kepro®, Holland) and maintained on cowpea husk, wheat bran (Crown®, Nigeria) and water was provided *ad libitum.* All experimental procedure was in accordance with Usmanu Danfodiyo University approved thesis ethics approval number 08311804001 for research in animals as well as international approved standards. In the international standards, the space for an animal at road transportation depends on its weight .Twenty kilogram (20 kg) would require a space area of 0.19 m$^2$; for 21 to 25 kg animals, the space is 0.20 m$^2$; 26 to 30 kg not less than 0.23 m$^2$ and above 30 kg animals require 0.28 m$^2$ per animal. The loading ramp should be at least 0.75 m in width with 0.75 m high walls (Singh, 2007).

### Drug administration

The choices of these drugs with dosages were as previously reported (Biobaku et al., 2016a, b). Drugs were administered at pre-loading point. Xylazine (XYL-M2®, Belgium) was administered intramuscularly at a dose of 0.015 mg/kg. The ascorbic acid (Ascormed®, Nigeria) tablets were administered orally (dose: 300 mg/kg). The co-administered combination had doses of xylazine at 0.015 mg/kg and ascorbic acid at 300 mg/kg

### Ethics, loading of animals and experimental journey

Prior to transportation, a health certificate was obtained from the Veterinary Unit, Ministry of Forestry and Animal

Health, Sokoto State, Nigeria as stipulated by the Animal Disease Act (1988) of the Federal Republic of Nigeria. This is done to ensure strict adherence to guidelines governing animal transportation welfare by road as previously adopted by Minka and Ayo (2010). The bucks used in the experiment were acclimatized and not predisposed to stress prior to the experimental journey. The Sahel bucks were handled with care and loaded onto the transporting truck. Between the hours of 09:00 to 10:00 am.

The truck had a floor length, breadth and area of 6.45 m, 2.48 m and 16.00 $m^2$ respectively. The ratio of the stocking density per floor area was 2:1. This calculation was based on the standard as recommended (Animal Diseases Control Act, 1988) in comparison to the stocking rate used routinely by marketers. Therefore, an approximation of 10.70 $m^2$ and 5.30 $m^2$ floor areas for low and high density stocking were considered, while the dimensions were specifically 4.02 m × 2.01 m (low density stocking) and 2.84 m x 1.40 m (high density) as previously adopted (Biobaku et al., 2016a, b). The truck's floor was cushioned using sand and sorghum leaves which would absorb urine to prevent the animals from sliding from soft faeces that could predispose to injury during transportation.

**Carcass preparation and chevon quality assessment**

Prior to slaughter, the transported goats were rested for one day. This was done to ensure strict adherence to international regulations pertaining to animal welfare and to allow drug residues reach the daily acceptable concentration and since goats are faster metabolisers of drug, it would be safe since very low doses were administered. The halal method of slaughter was adopted (Jibir, 2008). The goat hairs were removed as previously described (Biobaku et al., 2016b). The head was decapitated at the atlanto-occipital joint and the fore and hind feet were removed at the carpal and tarsal joints as standard procedures for evacuating goat carcass (Colomer-Rocher et al., 1987). After evisceration of the internal offals, the carcass bearing the skin in this study was considered the dressed carcass (Tamir and Awuk, 2015; Biobaku et al., 2016b). The carcass weight without the internal organs was considered the empty body weight (Biobaku et al., 2016b). The dressing percentage was obtained by dividing the carcass weight by the live weight multiplied by one hundred (Tamir and Awuk, 2015). Cooking loss test was also conducted using a chop as a sample obtained from the *semi membranosus* muscle. It was measured to be 5 cm in length and width and 1 cm thickness with a weight of 4 gram (MIRINZ, 1996; Kannan et al., 2002; Jibir et al., 2012). The percentage loss in weight after boiling was assessed by extrapolating from the difference in values of final weight after boiling, from the initial weight multiplied by a hundred (Biobaku et al., 2016b). Meat ultimate pH was determined by taking a chop as a sample from the *semi membranosus* muscle as previously carried out (Pethick et al., 2005). Water holding capacity of the *semi membranosus* muscle was evaluated by the filter paper method (Wierbicki and Deatherage, 1958). Meat colour assessment of *rectus abdominis* muscle was as conducted by Jibir et al. (2012) and Biobaku et al. (2016b).

**Organoleptic test**

The meat samples of test animals were subjected to sensory evaluation. The muscle used was the longissimus dorsi muscle, which was previously used for the lean colour evaluation. The meat samples were cut into cubes of nearly equal dimensions and were roasted using locally made oven with charcoal as source of heat. The temperature was maintained using a thermometer from time to ensure uniformity of source of heat. All meat pieces were placed at once to ensure constant supply of heat and consistent turning of pieces of meat from time to time until, when the meat was seen to be roasted by pressing the consistency. Neither curing material nor any form of flavouring was added in order to ensure that the meat to be assessed has its original flavour, juiciness and tenderness. A trained panelist of fifteen, non-smokers, males whose ages ranged between 23 to 29 years assessed the meat on a scale as previously adopted by Jibir (2008).

**Statistical analysis**

One-way analysis of variance was used to compare means of various chevon parameters among treatment groups in the intervention group, while T test was used in the study to compare means of high and low stocking (without therapeutic intervention). SPSS statistical package was used for all analyses and $p<0.05$ was considered significant.

**RESULTS**

The effect of treatment on various meat characteristics at high and low stocking rates and interaction between the two factors of drug and stocking rate are presented in Table 1. The control group had a significantly higher ($p<0.05$) shrinkage when compared with treated groups. However, the group administered with the drug combination had a significantly ($p<0.05$) lower shrinkage percentage, while the shrinkage is higher in the high density rate.

Table 2 shows significant ($p<0.05$) differences in the excitatory score at slaughter, empty body weight and colour. There was a significant ($p<0.05$) decrease in the excitatory score and empty body weight was observed in the low stocking rate. Also, a significantly ($p<0.05$) higher

**Table 1.** Effect of xylazine (0.015mg/kg) and ascorbic acid (300mg/kg) on excitatory score and meat characteristics of Sahel bucks exposed to long term transportation stress.

| Factor | Treatment | Meat characteristics | | | | | |
|---|---|---|---|---|---|---|---|
| | | Excitatory Score | Shrinkage (%) | Water Holding Capacity (%) | pH | Colour | Cooking Loss (%) |
| Drug | Xylazine (0.015mg/Kg) | 3.67 | 18.17$^{b}$ | 44.28$^{b}$ | 6.17$^{a}$ | 94.44 | 43.77$^{a}$ |
| | Asc. Acid (300mg/Kg) | 3.67 | 18.22$^{b}$ | 46.60$^{b}$ | 6.03$^{a}$ | 88.89$^{a}$ | 44.08$^{a}$ |
| | Combination | 3.83 | 17.03$^{c}$ | 44.91$^{b}$ | 5.83$^{a}$ | 82.22$^{a}$ | 43.83$^{a}$ |
| | Control | 3.67 | 19.52$^{a}$ | 69.00$^{a}$ | 5.87$^{a}$ | 106.67$^{a}$ | 41.07$^{a}$ |
| SE | | | 2.25 | 1.7 | 0.11 | 6.29 | 1.05 |
| Stocking | High | 3.75 | 19.62 | 48.72 | 6.06 | 86.11 | 42.34 |
| | Low | 3.64 | 16.83 | 53.69 | 5.88 | 100.00 | 44.21 |
| SE | | 0.11 | 1.91 | 1.47 | 0.08 | 5.45 | 0.92 |

p<0.05 is considered significant; SE, Standard error; and Asc. Acid, Ascorbic Acid.

**Table 2.** Effect of stocking on chevon characteristics Mean±SD of Sahel bucks exposed to long term transportation stress.

| Meat characteristics | Stocking | |
|---|---|---|
| | High stocking | Low stocking |
| Shrinkage (%) | 19.55 ± 4.65 | 19.37 ± 1.45 |
| Dress (%) | 70.83 ± 10.89 | 76.54 ± 6.04 |
| Excitatory score | 4.00 ± 0.00$^{a}$ | 3.33 ± 0.58$^{b}$ |
| Empty body weight (kg) | 8.60 ± 0.10$^{a}$ | 7.30 ± 0.52$^{b}$ |
| WHC (%) | 58.40 ± 18.97 | 79.67 ± 6.2 |
| pH | 6.30 ± 0.53 | 5.43 ± 0.12 |
| Colour (luminosity) | 93.33 ± 23.09$^{b}$ | 120.00 ± 0.00$^{a}$ |
| Cooking loss (%) | 39.15 ± 3.97 | 43.66 ± 1.62 |

p<0.05 is considered significant. Means bearing different superscripts along the same row differ significantly (p<0.05). Higher values of meat colour in luminosity of meat colour indicate lighter (pink) lower values indicate daker (congested) colour. WHC: water holding capacity.

**Table 3.** Effects of xylazine and ascorbic acid on organoleptic properties of chevon in Sahel bucks.

| Organoleptic property | Drug treatments | | | | |
|---|---|---|---|---|---|
| | Xylazine (0.015mg/kg | Ascorbic acid (300mg/kg) | Xylazine (0.015 mg/kg) & ascorbic acid (300 mg/kg) | Control | S E M |
| Tenderness | 3.82 | 3.63 | 3.07 | 3.13 | 0.25 |
| Juiciness | 3.23 | 2.70 | 2.60 | 2.37 | 0.28 |
| Flavour | 3.00 | 3.17 | 2.90 | 2.40 | 0.29 |

luminosity in the meat colour was observed in this same group.

Table 3 shows mean values of the effect of xylazine, ascorbic acid and their combination on organoleptic of chevon of Sahel bucks. The result indicated that there were no significant effects of the treatments on organoleptic properties of chevon namely: tenderness, juiciness, and flavor from Sahel bucks.

A moderately significant (p<0.05) interaction between the effect of drug and stocking rate on the excitatory score at slaughter, on water holding capacity, and pH. There was a highly significant (p<0.05) interaction between drug effect and stocking density on colour of the meat. The empty body weight was significantly (p<0.05) higher in the xylazine group (Figures 1 to 3).

There was an interaction of treatment on water holding capacity (Figure 1), which significantly increased mean values at the low stocking rate in the combination of

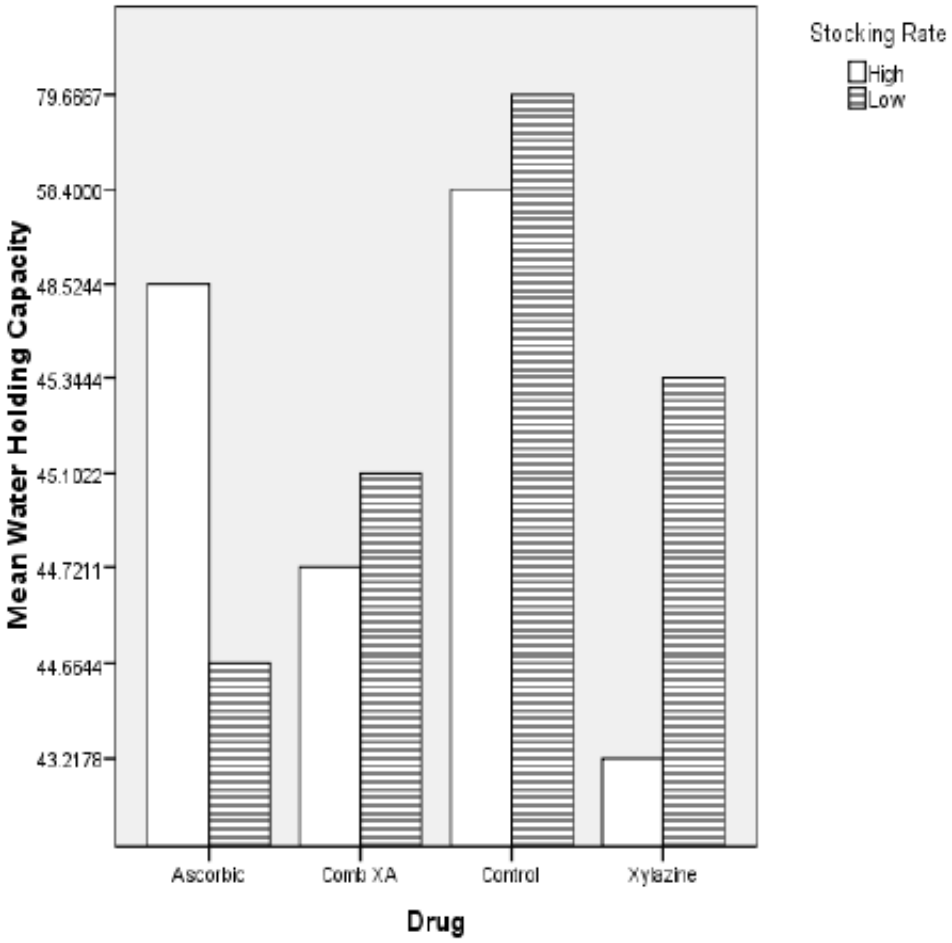


**Figure 1.** Interaction of drug and stocking rate on water holding capacity. Ascorbic: Ascorbic acid (300mg/kg), Comb XA: combination of xylazine (0.015mg/kg) and ascorbic acid (300mg/kg) and Xylazine: xylazine (0.015mg/kg).

xylazine (0.015 mg/kg) and ascorbic acid (300 mg/kg), xylazine (0.015 mg/kg) and the control. The ascorbic acid (300 mg/kg) had the mean water holding capacity significantly increasing at high stocking rate and decreased at low stocking.

Figure 2 shows the interaction of treatment on the pH of meat. The xylazine (0.015 mg/kg), ascorbic acid (300 mg/kg) and the drug combination groups had lower values of meat pH at high stocking rate than at low stocking rate. In contrast with the control, the combination group had higher meat pH values at higher stocking rate than at low stocking rates.

Figure 3 shows an Increase in colour luminosity of chevon at low stocking rate in the xylazine (0.015mg/kg) administered group and a decrease in high stocking rate (Figure 3). Ascorbic acid group had a reversed trend with the high stocking rate group having increased colour luminosity of chevon and decrease luminosity at low stocking rate.

Figure 4 and 5 shows the ambient temperature and wind speed at various locations along the experimental journey.

## DISCUSSION

The treatment improved the chevon characteristics by decreasing significantly the shrinkage, excitatory score at slaughter, empty body weight and water holding capacity at different stocking. It is evident that the treatment had various extents of interactions on the chevon characteristics which would have been influenced by stocking.

In this study, the changes shrinkage observed could be due to the physical and psychological stress coupled with the change in the dynamics of the neurotransmitters. This could explain further that changes in electrolytes at stress must have affected the muscle mass. These findings were in agreement with previous studies (Minka and Ayo, 2010; Adenkola et al., 2009). The attributed anti-stress effect of the ascorbic acid was as previously reported (Ayo et al., 2006; Adenkola et al., 2009; Biobaku et al., 2017b). The combination of xylazine and ascorbic acid, reflected on minimal shrinkage in the treated group. The vitamin C ameliorated the oxidative stress by improving the anti-

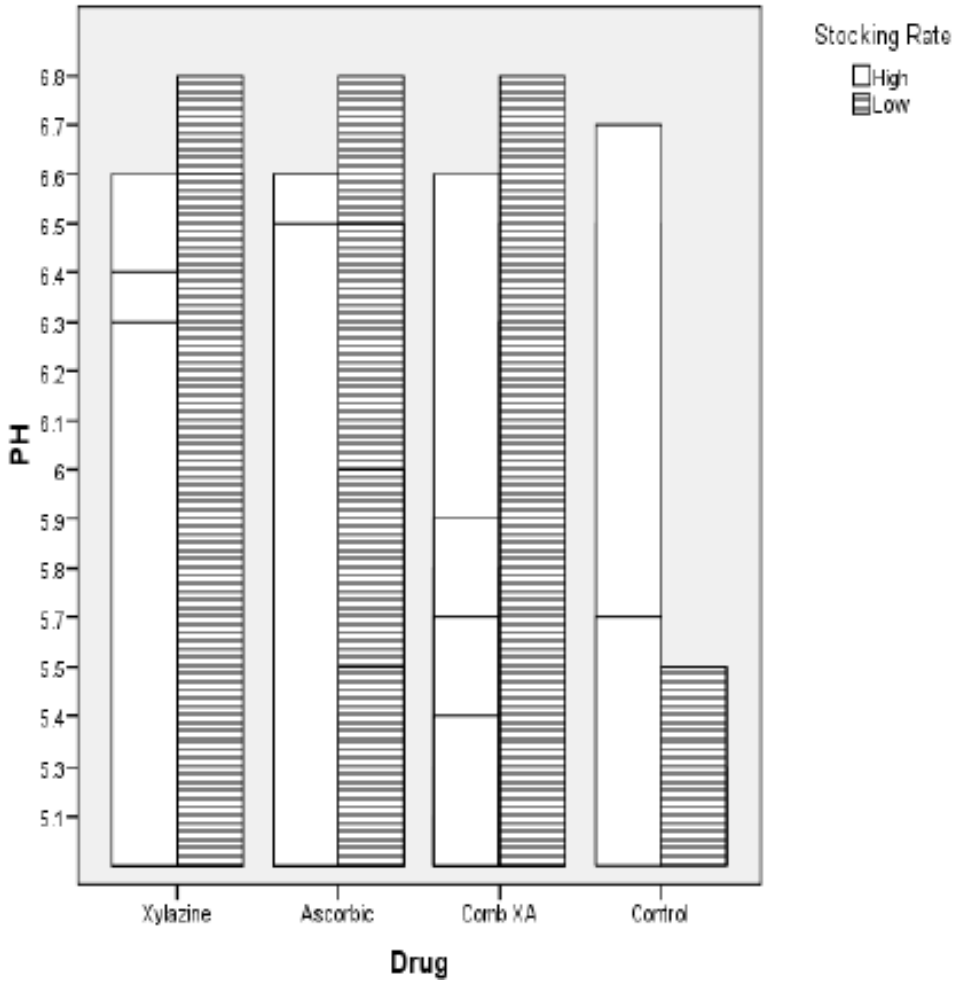


**Figure 2.** Interaction of Drug and stocking rate on pH of chevon. Xylazine: xylazine (0.015mg/kg), Ascorbic: ascorbic acid (300mg/kg), Comb XA: combination of xylazine (0.015mg/kg) and ascorbic acid (300mg/kg).

oxidative pro-anti oxidative ratio at the cellular level thus, minimizes the stress due to transportation. The anti-oxidative effect of ascorbic acid could have synergistic effect with xylazine acting in tandem on the detrimental outflow of neurotransmitters triggered by long term transportation induced stress (Biobaku et al., 2017a). Xylazine's sedative effect would minimize psychological stress by modulating the excitatory neurotransmitters. This would bring about calmness in animals which must have probably being the reason for the improved effect (Ayo et al., 2006; Adenkola et al., 2009; Biobaku et al., 2017a). Similarly, Ali and Al- Qarawi (2002) advocate the use of the combination of xylazine and a supplement to bring about calmness in transported animals subjected to transportation stress. The shrinkage also is due to the general adaptive syndrome brought about by the physiology of the animal to bring about changes in the myofibrils of the muscle mass, reflecting on weight and size of the individual muscle resulting in shrinkage (Singh, 2007).

The ultimate pH was improved upon by the drugs because the modulating effect of the ascorbic acid and xylazine at different extents improved the catecholamine surge, resulting in a counteracting effect of the sympatho-adrenal conversion of glycogen to glucose and interfering with pyruvic acid present in the muscle (Buncic, 2006). The colour and cooking loss percentage is dependent on the myoglobin and water holding capacity. In stress conditions, there are changes in pigmentation of the muscle, this with the haematological changes coupled with other physiological could be responsible for the observation (Kannan et al., 2002). Furthermore, xylazine possess myo- relaxing effect and sedation that would have brought about physiological compensatory effect of calmness after alarm reaction and thus improving the quality of chevon (Biobaku et al., 2017a). On the other hand, the drug was suggested to decrease food intake (Van Miert et al., 1994), this minimized the demand for food that might be detrimental to the compensatory metabolic process accompanying long term transportation.

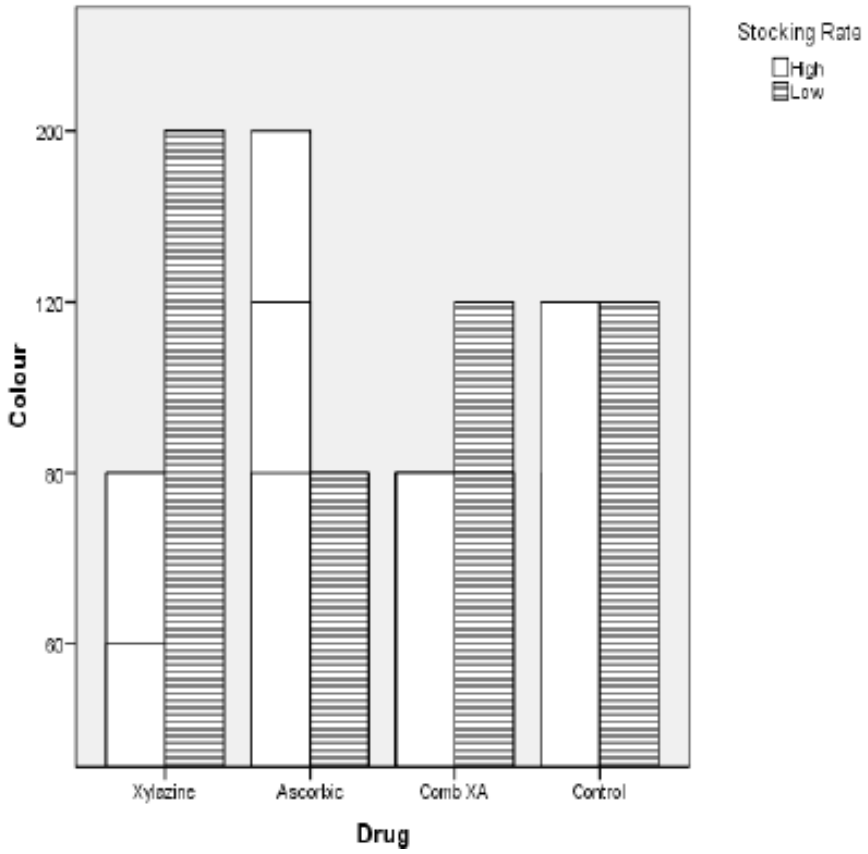


**Figure 3.** Interaction of drug and stocking rate on meat colour. Higher values (luminosity) of colour indicate lighter and lower values indicates darker colour. Xylazine: Xylazine (0.015mg/kg), Comb XA: Combination of xylazine (0.015mg/kg) and ascorbic acid (300mg/kg) and Ascorbic: ascorbic acid (300mg/kg).

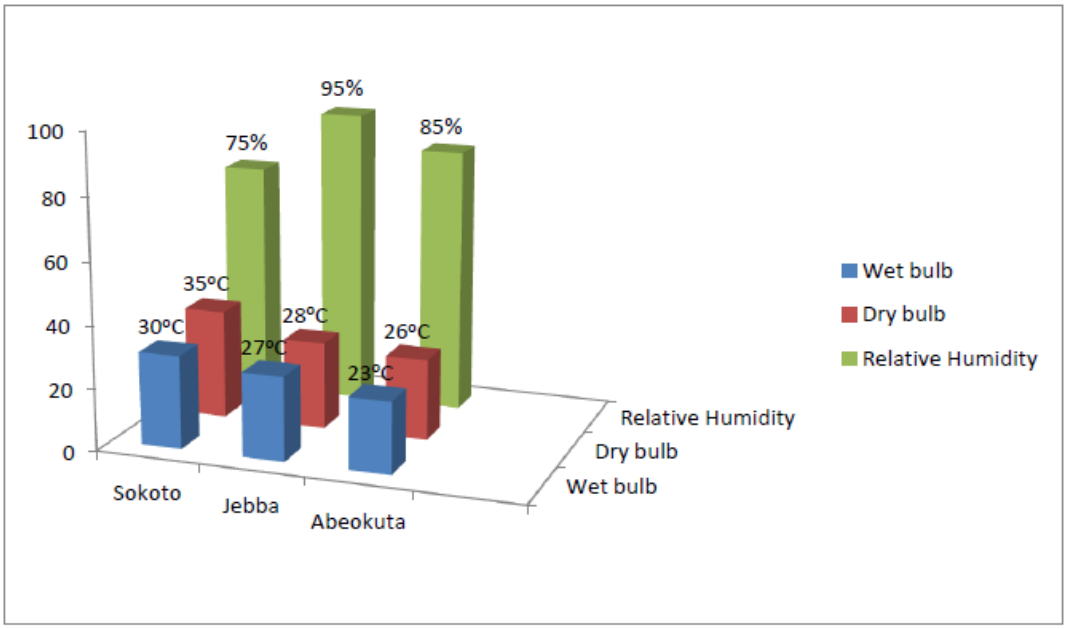


**Figure 4.** Shows wet bulb, dry bulb temperatures and relative humidity at different locations at the experimental journey at assessment of xylazine, ascorbic acid and their combinations in Sahel bucks.

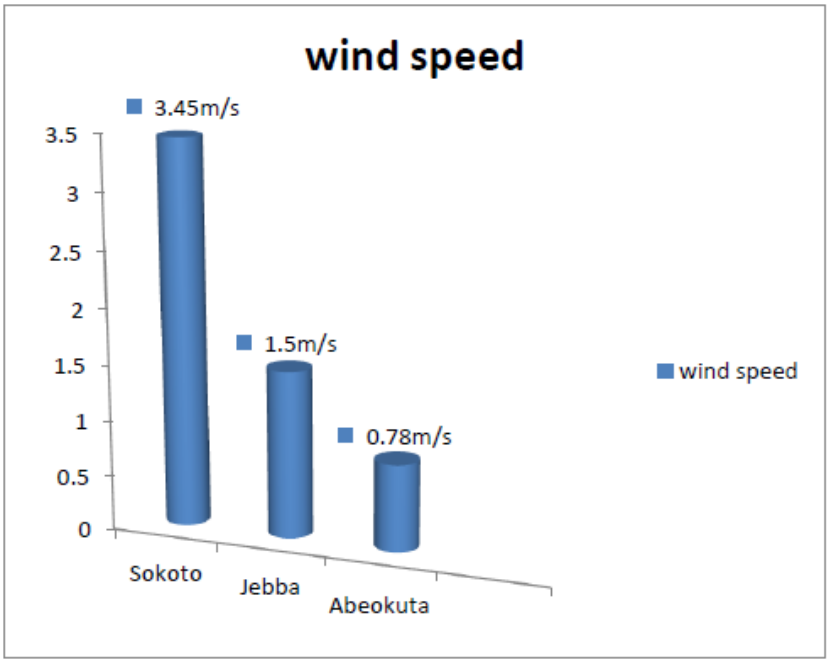


**Figure 5.** Shows means wind speed (m/s) at different locations at the experimental journey. To assessment of xylazine, ascorbic acid and their combinations in Sahel bucks.

The animal's calmness during transportation could affect muscle and the quality of chevon. The calmness of the animals coupled with the muscle relaxing effect of xylazine might be an advantage to the conservation of muscle glycogen that would help prevent deterioration of meat. Stress at pre-slaughter would further cause the depletion of muscular glycogen and would result to higher pH values of meat (Kannan et al., 2002). The ameliorative effect of xylazine with low stocking enhanced better psychological wellbeing of the animals and would prevent an expenditure of energy utilization by the skeletal muscles.

Water holding capacity was improved upon by the attenuation of stress with the drugs. The control (non treated group) had detrimental effect on the water holding capacity; this could be due to the effect of stress on myocytes of the muscles in the chevon. The metabolic process might have been improved upon by one or more of the drugs used in this study and this would have reflected on the water holding capacity, the ultimate pH of the meat and other parameters. Xylazine (0.015mg/kg) at low stocking density increased the water holding capacity when compare to other treatments, this could be due to the effect on the muscles cells, contractility of the muscle unit and fatigue in the animals. The ascorbic acid however had a non pronounced effect on the water holding capacity.

The combination treatment (xylazine 0.015 mg/kg and ascorbic acid at 300 mg/kg) also had a positive effect on the water holding capacity since xylazine relaxes the muscles. It is suggested that this preserves the expenditure of energy that would have been used up by contraction of myocytes, and decreases the detrimental effect of catecholamines at the myoneural junction. Ascorbic acid possesses antioxidative and cytoprotective effects (Adenkola et al. 2009), this potential plays an important role in improving intermediary metabolic pathways as stress improved animal welfare and reflected on the values of the water holding capacity.

The ultimate pH of meat was another parameter that was influenced by drugs and stocking rate. High stocking rate could cause various injuries and extravasations of fluid from the muscle cells, the tissue interstitial space and increased utilization of muscular glycogen conversion to glucose. This could predispose to increase of pH that could be detrimental to the quality of the meat. The xylazine and the combination group at low density stocking (standard stocking) improved the welfare of the animals and metabolism which mitigated the detrimental effect of adverse alarm and general adaptive syndrome of the animals. This prevented dark firm dry condition of the meat which could be due to muscle sore sequel to transportation stress. This reflected on the meat ultimate pH by making it tend acidic, which could improve the shelf life. It could be suggested that therapeutic attenuation of stress coupled with adherence to standard stocking at low stocking improved meat quality. On the other hand, animals that were calm due to the use of xylazine, ascorbic acid and their combination were less predisposed to bulling and injuries associated with transportation and this could also decrease the surge of cortisol and stress that could affect metabolism and predispose the animal to metabolic

syndrome that may distort the electrolytic balance resulting to detrimental acidosis or alkalosis (Biobaku et al., 2016a).

The wind speed also contributes to the cause of shrinkage of the animals which was improved upon by the ascorbic acid and the combination of xylazine and ascorbic acid. Ascorbic acid possesses stress mitigation effect, while xylazine synergistically has muscle relaxing and analgesic activity which would interfere with over contraction of the muscles at anxiety and inhibit the effect of progeneration of autocoids and proinflamatory cytokines (Biobaku et al., 2017a). There is dearth of information on the use of (xylazine and ascorbic acid) combination but speculations based on the antistress effect of ascorbic effect of ascorbic acid and xylazine $\alpha_2$-adrenergic effect. The observation that chevon of animals transported at lower stocking rate had higher luminosity value than those in high stocking may be speculated to be due to improved ability of oxygenation of the myoglobin to form oxymyoglobin. This assumption is as suggested by the previous study of Biobaku et al. (2016b) and Biobaku et al. (2017a). The animals when calm would be predisposed to less internal haemorrhage, clots of blood, inflammation of muscle tissue and tendons due compromise the capillaries, myocitis and other factors that might affect the appearance of the muscles and the meat colour. The ascorbic acid and combination of xylazine and ascorbic acid would have also prevented cortisol and catecholamine surge that would have been detrimental to the chevon product. Ascorbic acid mitigates meat deterioration due to the pro-inflammatory cytokines produced due to the stress of transportation (Biobaku, 2015; Biobaku et al., 2016b). In the same vein, the interplay of the sympathetic and parasympathetic system coupled with the responsiveness of the *amgdalastria terminalis* of the brain would make the physiology to adjust. This would improve the welfare of animals at transportation and would enhance the meat product (Adenkola et al., 2009; Biobaku et al., 2017a)

This study indicates that chevon colour of the animals transported using standard stocking were lighter and had higher luminosity than animals that were transported using high stocking density. Animals subjected to more body contact are easily predisposed to bullying causing gored injuries that will compromise the vasculature and colour of meat. The decrease in haemoglobin concentration might also reflect on the myoglobin and blood perfusion affecting chevon's colour, shelf life, quality and acceptability.

## Conclusion

Conclusively, ascorbic acid, xylazine and their combination at low stocking rate improved dressing percentage, water holding capacity, ultimate pH of meat and colour of chevon. Adherence to the standard regulations of animal welfare could improve the wholesomeness of meat for consumption. Professional use of pharmacological agents should be ensured in mitigating stress in food animals and strict adherence to withdrawal period is also paramount in rational use of drugs in rendering animal welfare. More research is needed to explain the patterns of neurotransmitters and hormonal kinetics when using pharmacologic agents as they influence meat and other products from food animals.

## CONFLICT OF INTEREST

Authors declare that they have no conflict of interest.

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