

The Quality of Beef and Chevon During Harmattan Season in Makurdi, Nigeria

¹A. Y. Adenkola, ²I.I. Luga, ²O.O. Agbede and ¹J. Okpe

¹Department of Veterinary Physiology, Pharmacology and Biochemistry,

²Department of Public Health and Preventive Medicine, College of Veterinary Medicine,
University of Agriculture, Makurdi, Benue State, Nigeria

Abstract: The study was conducted with the aim of assessing the impact of harmattan season on the quality of beef and chevon Makurdi, Benue State, Nigeria. About 88 samples consisting of 44 beef samples and 44 chevon samples were obtained between December 2010 and January 2011 which was considered the peak period of harmattan in Makurdi. Approximately 50 g of the meat sample was taken from each animal post slaughter into a sterile container where 10 g each from the meat sample was processed for determination of the pH values, total coliform count and anaerobic plate count. Approximately 5 mL of blood sample was also collected from each animal whose meat sample was collected. This was done during slaughtering and the blood was collected into a sample bottle containing 2 mg mL⁻¹ of sodium salt of Ethylene Diaminetetra Acetic acid (NaEDTA) as an anticoagulant. The pH values of the beef samples ranged from 4.6-6.24 and the pH values of the chevon samples ranged from 5.0-6.5. The pH values of the beef samples were lower than that of the chevon samples. The total coliform plate count and anaerobic plate counts for the beef samples were higher than those of the chevon samples, indicating a higher contamination of the beef samples. The obtained PCV value of 33.78±0.83% in cattle was significantly ($p<0.05$) >27.24±0.89% recorded in goat while the haemoglobin concentration recorded in the goat was significantly ($p<0.05$) lower than the obtained value in cattle. Total erythrocyte count recorded in the goat was significantly ($p<0.05$) lower than that obtained in cattle. In conclusion harmattan season stressfully affects cattle and goat hence the quality of beef and chevon was compromised indicating that the goats were more stressed than the cattle during this season. It is therefore, recommended that minimal stress should be imposed on the animals intended to be slaughtered during this season in order to maintain the good and keeping quality of beef and chevon sample.

Key words: Beef, chevon, harmattan season, pH values, quality, Nigeria

INTRODUCTION

Livestock production in many African countries contributes 20-30% of Agricultural and 12.7% of the Gross Domestic Product (GDP) and meat which is derived from livestock is an important edible postmortem component originating from the live animals is used as food by human (Arain *et al.*, 2010).

The productivity and health of these animals are being affected by adverse meteorological conditions (Adenkola *et al.*, 2011) prevailing in the tropical and subtropical countries which make animals often subjected to environmental stress predisposing them to heat or cold stress (Adenkola *et al.*, 2011).

Environmental stress factors have been shown to cause oxidative stress and impair the activity of antioxidant *in vivo* (Sahin *et al.*, 2001). During stress stage, there is an increase in generation of Reactive

Oxygen Species (ROS), elevated to a level that overwhelms tissue antioxidant defense system (Adenkola and Ayo, 2010). The most important climatological thermal conditions are heat stress during the hot season and the wind chill factor during the cold season of the year (Broucek *et al.*, 2007).

Extremes in temperature are associated with stress in animals and this stress causes metabolic changes that can in turn adversely affect meat quality (Ashmore *et al.*, 1972; Apple *et al.*, 1995). When accurate quality is not achieved, the processor as well as the producer suffers economic losses (Chan *et al.*, 2002).

There is paucity of information on the quality of meat in relation to the adverse harsh harmattan season that the livestock are subjected to before being slaughtered. Therefore, the aim of this present study was to assess the quality of beef and chevon in Makurdi, Nigeria during the harmattan season.

MATERIALS AND METHODS

Experimental site: This study was conducted during the harmattan season in Makurdi (07°N, 08°37'E), Benue state, Nigeria. The town is located along River Benue, with daily temperature ranging from 26.5-42°C. The area has an annual temperature of 1,317-1,323 mm which spans between 6-7 months (Adenkola *et al.*, 2010).

Meteorological data: The meteorological data of Ambient Temperature (AT), Relative Humidity (RH), rainfall, sunshine hour per day, wind speed and direction were collected for the period of December and January (study period) from the Nigerian Meteorological Agency (NIMET) Makurdi.

Experimental design

Sample collection and sample preparation: A total number of 88 meat samples were used for the study, comprising 44 beef and 44 chevon samples. The samples were collected from the four major abattoirs (Wurukum, Modern market, North bank and Wadata) in Makurdi. This was done to get a representative sample of meat from animals slaughtered in Makurdi metropolis.

A quantity of about 50 g of both beef and chevron samples were collected directly from each of the carcass and immediately put in a separate sterile container which was transferred in ice pack to Public Health Laboratory in the Department of Public Health and Preventive Medicine for analysis. The meat samples were processed for bacteriological analysis to assess the selected microbial attributes such as total plate count and anaerobic plate count by using Nutrient and MacConkey agar as well as determining the pH of the meat samples. Individual samples of 10 g were cut into bits using a sterile scissors into a sterile blender (E824BK Lloytron Plc., UK in 2009) while 90 mL of distilled water was poured into the blender and a homogenized suspension was made. Thus, a 1:10 dilution of each sample was obtained. This was done for all the 88 meat samples. Approximately 5 mL of blood sample was also collected from each animal whose meat sample was collected. This was done during slaughtering and the blood was collected into a sample bottle containing 2 mg mL⁻¹ of sodium salt of Ethylene Diaminetetra Acetic acid (NaEDTA) as an anticoagulant (Adenkola and Ayo, 2009). After collection the samples were transferred immediately to Physiology Laboratory in the Department of Physiology, Pharmacology and Biochemistry where the blood were analyzed for Packed Cell Volume (PCV), Haemoglobin Concentration (Hb), Total Erythrocyte Count (TEC), Total Leukocyte Count (TLC) as described by Schalm *et al.* (1975).

Determination of pH: The already homogenized meat suspension was poured into sterile containers. A portable pH meter (Hanna Instruments HI 9024, Microcomputer pH meter) was used to determine the pH of each meat samples by inserting the electrodes into the homogenized meat suspension. Prior to the measurement of the pH, the meter was calibrated using pH buffer solutions made from pH buffer tablets 4.0 and 7.0 (Labtech® Chemicals Avishkar).

The pH solutions were kept in the fridge after each day and were warmed in a water bath before making use of it. This calibration was done daily on each day of the experiment prior to usage and after each calibration the electrode was rinsed with distilled water and also after every sample measurement the electrode of the pH meter was rinsed with distilled water before using it on other sample.

Microbiological analysis: Using sterile pipettes serial dilutions ranging from 10⁻²-10⁻⁹ were prepared according to the recommendation of International Organization for Standardization (ISO) in 1995. The beef and chevon samples were cultured on both nutrient and MacConkey agar, 0.1 mL of dilution 10⁻² of the samples was plated on MacConkey agar using sterile pipette and the plate turned slightly to ensure proper spreading of the suspension. The same procedure was repeated for nutrient agar but a serial dilution of 10⁻⁴ of each sample was used. The plate was then kept in the incubator at 37°C for 24 h. Following incubation, plates on which growth occurred was observed and read. This was repeatedly done for all the beef and chevon samples.

RESULTS

The maximum temperature recorded in January (34.26±0.49) was not significantly (p>0.05) different from 34.80±0.21 obtained in December. The minimum temperature recorded during the same period was not significantly (p>0.05) different. No rainfall was recorded during the study period and the wind direction fluctuates from North to East in December to predominantly eastern but occasionally South eastern direction was recorded, this was accompanied with moderate breeze with maximum dust characteristic of the season (Table 1). The obtained PCV value of 33.78±0.83% in cattle was significantly (p<0.05) >27.24±0.89% recorded in goat while the haemoglobin concentration recorded in the goat was significantly (p<0.05) lower than the obtained value in cattle. Total erythrocyte count recorded in the goat was significantly (p<0.05) lower than that obtained in cattle while the leukocyte count was not significantly (p>0.05)

Table 1: Meteorological parameters during the study period

Meteorological parameters	December	January
Ambient temperature maximum	34.80±0.21	34.26±0.49
Ambient temperature minimum	16.13±0.47	16.51±0.38
Rainfall (mm)	0.00	0.00
Relative humidity high (%)	54.00	38.00
Relative humidity low (%)	26.00	19.00
Sunshine (h day ⁻¹)	9.17±0.30	7.70±0.38
Wind speed (m sec ⁻¹)	68.00	16.00
Wind direction	North East	East

Table 2: Haematological parameters of cattle and goat during the study period

Haematological parameters	Cattle	Goat
Packed cell volume (%)	33.78±0.83*	27.24±0.89*
Haemoglobin concentration (g%)	11.26±0.28*	9.08±0.30*
Total erythrocyte count (×10 ⁶ μL ⁻¹)	5.37±0.21*	8.90±0.30*
Total leucocyte count (×10 ³ μL ⁻¹)	14.25±0.65	15.94±0.69
Mean corpuscular volume (fl)	66.99±2.59*	31.92±1.21*
Mean corpuscular haemoglobin (pg)	22.32±0.86*	10.64±0.40*
Mean corpuscular haemoglobin concentration (g dL ⁻¹)	33.33±0.00	33.33±0.00

*Significant difference (p<0.05)

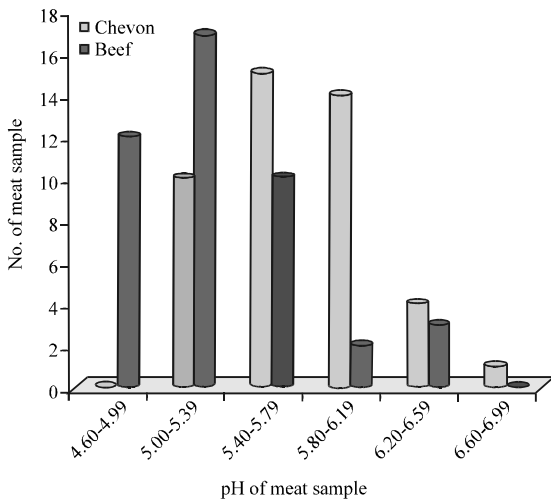


Fig. 1: The distribution of the pH values for beef and chevon

different. The MCV and MCHC recorded significant (p<0.05) higher values in cattle (Table 2). The mean of the total coliform counts for the beef samples was over 3.0×10⁵ CFU mL⁻¹ and the mean of the total coliform counts for the chevron samples was 1.487×10⁵ CFU mL⁻¹ from a range of 0.280×10⁵-2.560×10⁵ CFU mL⁻¹.

The mean of the anaerobic plate counts for the beef samples was over 3.0×10⁷ CFU mL⁻¹ and the mean of the anaerobic plate count for the chevron samples was 1.293×10⁷ CFU mL⁻¹ from a range of 0.440×10⁷-2.600×10⁷ CFU mL⁻¹. The pH values of the beef samples ranged from 4.6-6.24 and the pH values of the chevron samples ranged from 5.0-6.5. The distribution of the pH values for both beef and chevon is as shown in Fig. 1.

Statistical analysis: All data obtained were subjected to statistical analysis using Student's t-test. Data were expressed as Mean±Standard error of mean. Values of p<0.05 were considered significant.

DISCUSSION

The AT recorded during the period are predominantly outside the thermo-neutral zone of 25-30°C established for ruminants (Tarr, 2007) and this was not conducive for their normal thermoregulation which may impair homeostatic mechanisms resulting in pathological changes (Teeter *et al.*, 2005) as well as generation of free radicals which may impair homeostatic mechanisms (Adenkola and Ayo, 2009; Adenkola *et al.*, 2011). The fact that the high AT recorded in the 2 months of the study period was not significantly different is an indication that the AT during the months was the same. The meteorological results obtained during the present study as well as haematological parameters agree with the previous findings that the harmattan season is thermally stressful to livestock (Ayo *et al.*, 1999; Adenkola *et al.*, 2009).

The obtained pH values of the beef samples were lower compared to that of the chevon samples, though the values was higher than that observed elsewhere in the tropics (Arain *et al.*, 2010). In a well rested animal, the glycogen in the muscle is high and this is converted to lactic acid after the animal is slaughtered. The lactic acid is necessary to produce meat which is tasteful and of good keeping quality (Awonorin *et al.*, 1999; Adenkola and Ayo, 2010).

If the animal is stressed prior to slaughter, especially in this study where animals are already subjected to harmattan stress which act concomitantly on these animals to reduce the glycogen level there by causing less accumulation of lactic acid in the muscle hence a higher pH (Adenkola and Ayo, 2010) especially in goat sample. The lower pH in the cattle could be due to the fact that cattle responded to thermal stress better than goats (Adenkola and Agbendeh, 2010). The findings in this study revealed that the level of contamination in the meat was higher compared to that in developed countries (Arain *et al.*, 2010).

Though this is more in beef samples compared to chevon and this accounts for the higher values of the total coliform and anaerobic count in beef. However, the value obtained in this study is within the safety limit of coliforms in meat samples (Cohen *et al.*, 2007). This finding thus reflected the hygienic status of meat production in the developing world (Bhandare *et al.*, 2007) in addition to the fact that high nutritive value of meat makes it an ideal medium for bacterial growth and the

stressful harmattan season could have compromise the immune status of live animals. Windy and dusty harmattan condition could also increase the degree of contamination of meat on their way to the market as meat are normally transported to the markets either in open vans, taxi's, motorcycles and bicycles.

CONCLUSION

The study shows that the stressful harmattan season affects the quality of beef and chevon but chevon more indicating that the goats were more stressed than the cattle during this season.

RECOMMENDATIONS

It is recommended that minimal stress should be imposed on the animals intended to be slaughtered during this season in order to maintain the good and keeping quality of beef and chevon sample.

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