PRELIMINARY STUDY OF MEAT QUALITY CHARACTERISTICS OF YOUNG N'DAMA AND MUTURU BULLS

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ABSTRACT

In order to obtain information on the quality characteristics and acceptability of meat from N'dama (YN) and Muturu (YM) breeds of cattle, the young bulls were slaughtered at about 11 months of age and their *Longissimus dorsi* (LD) and *Psoars major* (PM) muscles subjected to chemical evaluation of the raw meat as well as eating quality characteristics of the meat cooked for 10, 15 and 20 min. These were compared to meat from mature Sokoto Gudali (SG). Results showed that meat from YM and YN had similar moisture contents but differed significantly ($P < 0.05$) in fat contents. Meat from YM and YN bulls had higher moisture but lower fat contents compared to meat from SG bulls. The LD muscles had higher % fat in the three experimental groups than the PM muscles. Total protein and ash contents were similar for all samples but protein solubility was higher ($P < 0.05$) in YN young bulls compared to mature bulls. YN and YM had similar ultimate pH but these young bulls had lower ultimate pH than mature bulls ($P < 0.05$). Total pigment contents varied ($P < 0.05$) between breeds, maturity and muscles types with YM having higher myoglobin than YN, PM higher than LD and mature bulls more than young bulls. Sensory colour and odour of meat varied ($P < 0.05$) between samples with meat from mature SG bulls being rated lower than those from YM and YN bulls. After cooking for 10 and 15 min, all samples were acceptable but their tenderness varied between samples, with the young bulls meat being rated as ($P < 0.05$) more tender than mature bulls but on cooking for 20 min, judges could detect significant differences in juiciness, flavour, tenderness and general acceptability of samples.

Generally, meat from young bulls were adjudged more acceptable than meat from mature bulls.

Key Words: Muturu, N'dama, Age, *Psoars*, *Longissimus*, Sokoto Gudali

INTRODUCTION

The relationship between breed, age and muscle type with meat quality characteristics is neither appreciated nor utilized by the meat trader in Nigeria. As a result, little or no effort is made to appropriately inform the meat consumer with regard to eating quality characteristics of meat animals. Experience from many developed countries suggest that rising personal incomes and expanding urban markets promote changes in marketing systems and consumer demands, making it imperative and profitable for the meat industry to cater for those extra requirements. In response, consumers show greater appreciation of quality and variety in meat and meat products. In relation to market changes and consumer demands, livestock farmers in many countries in recent years have tended to produce younger animals because of greater turnover, quick return on investment and the fact that younger animals produce leaner carcasses which are appreciated by present day consumers. Such a shift in consumer preference is obviously not being exploited by livestock producers in Nigeria with the result that juvenile animals are sold for slaughter only in emergency situations.

Two breeds of cattle - Muturu (*Bos brachycerus*) and N'dama (*Bos taurus*) - were used in a larger research directed at assessing their total breeding and production potentials. These cattle breeds exist in greater numbers along West African coast where they have developed a high degree of tolerance to trypanosomiasis which is endemic in this

region. Although these breeds are rarely slaughtered in public abattoirs for meat, the Muturu in particular is widely used for socio-cultural activities in the South Eastern State of Nigeria. The present study was therefore aimed at assessing the acceptability of meat from their young bulls when compared to meat from mature and more widely consumed trade cattle in Nigeria - Sokoto Gudali (*Bos indicus*).

MATERIALS AND METHODS

Samples Collection and Processing:

Twelve young Muturu (YM) and 5 young N'dama (YN) bulls were reared at the Department of Animal Science, University of Nigeria farm and 5 bulls from each group slaughtered at the Department slaughter house at an average age of eleven (11) months. Meat from 5 mature Sokoto Gudali (SG) bulls of about 3 years of age were collected from Nsukka market abattoir and used for comparison. It was not possible to use meat from mature N'dama and Muturu bulls for comparison because of lack of availability. Besides, these breeds are not usually slaughtered in public abattoir for commercial purposes.

Longissimus dorsi (LD) and *Psoas major* (PM) muscles were collected from each animal immediately after slaughter, trimmed of excess connective tissues and fat and stored frozen until required for analysis. Each muscle was divided into two halves. One half was used for chemical analysis of the raw meat and the remainder was cut into 2cm³ pieces, sealed in polythene bags and cooked for 10, 15 and 20min. respectively at boiling temperature. The sensory evaluation of the cooked meat was essential to fully comprehend those factors which affect eating quality because objective assessment of the raw meat does not reliably predict eating quality during organoleptic quality evaluation.

Chemical Evaluation:

Proximate composition: The chemical proximate composition of the raw meat was determined by AOAC (1990) methods. The pH was determined on dispersion of 5g sample

in 50 ml of distilled water using combined glass electrode, after standardizing the pH meter with PH 4 and 7 buffer solutions.

Nitrogen solubility: Nitrogen solubility study was carried out by homogenising 1.0g of the raw meat in 10 ml of 0.1M potassium chloride, stirred intermittently for 30 min at room temperature and filtered using whatman no. 1 filter paper. The filtrate contained soluble proteins and non-protein nitrogen while the residue contained insoluble proteins. To the filtrate was added 10ml of 2% trichloroacetic acid (TCA), stirred intermittently for 30 min. at room temperature and filtered again. The filtrate contained non-protein nitrogen while the residue contained soluble proteins. All three fractions were subjected to micro-kjeldahl digestion and distillation methods and the percent soluble, insoluble and non - protein nitrogen were calculated.

Total pigment: Total (as acid haematin) pigments were determined according to the method of Hornsey (1956). The optical density of the filtrate was determined at 640 nm and total pigment calculated as: Total Pigment (ppm) = absorbance (at 640nm) x 680

Sensory Evaluation

Twenty five persons were ranked according to their ability to make correct judgements using triangular tests with cooked meat samples as test materials. Twenty judges were finally selected from those scoring 60% and above correct judgements in about 10 trials. During evaluation, about 80 pieces of cooked meat measuring about 2cm³ or less were placed on flat white enamel plate. 18 such plates were used to correspond to the 3 cooking regimes for the 3 breeds and 2 muscle types. The plates were placed at the sensory evaluation booths and labelled in such a way as to prevent disclosing the identity of the samples. Judges moved to the samples one at a time. Each judge evaluated the samples on a seven-point rating of Excellent (7), Very good (6), Good (5), Medium (4), Poor (3), Very poor (2) and unacceptable (1). Parameters evaluated were colour, texture, juiciness, flavour, tenderness and general acceptability.

Statistical Analysis:

Data were analysed by analysis of variance using a split-plot model (Gomez and Gomez, 1984) and when differences were significant, Duncan's new multiple range test (Duncan, 1975) was used to separate means.

RESULTS AND DISCUSSION

Variations Due to Chemical Composition:

Data on Table 1 show that no significant difference ($P > 0.05$) in moisture content could be observed between YM and YN bulls or between LD and PM muscles of these breeds. However, meat from YM bulls contained significantly ($P < 0.05$) lower fat ($1.74 \pm 0.28\%$) compared to YN ($2.48 \pm 0.43\%$) while LD muscles contained higher fat ($3.04 \pm 0.13\%$) compared to PM muscles ($1.17 \pm 0.22\%$). Since both breeds were of the same age range and were managed similarly in the same farm, this result suggests that YN bulls accumulate intramuscular fat (marbling) faster than YM bulls. Callow (1962) reported similar variation in intramuscular fat of Herford and Friesian breeds of cattle and between their LD and PM muscles. When compared to the meat from more mature SG bulls, it is seen that the mature bulls contained lower amount of water ($69.96 \pm 0.53\%$) but higher amount of intramuscular fat ($10.23 \pm 0.31\%$) compared to YN and YM bulls. The LD muscles of the mature bulls also contained lower proportions of water but higher percent fat compared to PM muscles. These results support the long known inverse relationship between fat and water in tissues of meat animals and that fat content increases while water content decreases as animals grow older (Lawrie, 1961, Berg and Butterfield, 1976).

Although variations in total ash and nitrogen contents were not significantly different ($P > 0.05$) between LD and PM muscles, or between YM and YN or between the mature and young bulls, it is however observable that ash and total nitrogen contents of mature bulls were lower than those of YM and YN bulls - suggesting age differences. When nitrogen was partitioned into insoluble, soluble and non-protein nitrogen, it appeared

that YM contained lower insoluble proteins ($11.54 \pm 0.50\%$) and consequently higher soluble protein ($76.48 \pm 0.42\%$) compared to YN ($17.57 \pm 0.1\%$ and $70.56 \pm 0.09\%$ respectively). However, muscle differences were not the same for the two breeds with respect to protein solubility. While LD and PM muscles of YM were similar, the LD was significantly different ($P < 0.05$) from PM in YN (Table 1). Meat from mature bulls also contained higher insoluble proteins and non-protein nitrogen than those from YM and YN bulls. Variations in protein solubility are known to depend on the quantities and nature of connective tissue proteins present. These change with age - becoming more reticularized and polymerised as the animal grows older (Boccard *et al.*, 1979).

The degree of intra- and inter-muscular crosslinkages between the polypeptide chains in collagen has also been found to increase with increasing animal age (Lawrie, 1991) and this is associated with decreasing solubility (Sharp, 1963). The lower proportion of non-protein nitrogen in the muscles of the young bulls compared ($P > 0.05$) to the mature bulls suggest that these are rapidly utilized in muscle synthesis in the young bulls. As Lawrie (1961) explained, non-protein nitrogen attains its characteristic adult value from 12 months of age. The young bulls used in this study were slaughtered at an average age of 11 months.

Total colour pigments varied significantly ($P < 0.05$) between YM and YN breeds as well as between LD and PM muscles of these breeds. YM meat contained higher total pigments (138.36 ± 0.52 ppm) than YN meat (123.42 ± 0.30 ppm) while LD muscles of both breeds had lower total pigment compared to PM muscles. These differences in myoglobin contents are assumed to be due to differences in levels of activity of different muscles. Those muscles or breeds which are more exercised have higher muscle pigments (Lawrie, 1991). It is also seen from Table 1 that mature bulls contained higher muscle pigments than YN or YM bulls supporting the conclusion of Boccard *et al* (1979) who observed increase in colour pigments with increase in chronological

TABLE 1: CHEMICAL CHARACTERISTICS OF THE MUSCLES

Parameter	Maturu			N'dama			Mature Sokoto Gudali		
	LD	PM	X $\pm$ SD	LD	PM	X $\pm$ SD	LD	PM	X $\pm$ SD
Moisture (%)	72.42 $\pm$ 0.96 ^{ad}	73.76 $\pm$ 0.32 ^{abd}	73.10 $\pm$ 0.64	75.20 $\pm$ 0.57 ^{ab}	76.20 $\pm$ 0.38 ^b	75.7 $\pm$ 0.43	68.40 $\pm$ 0.53 ^c	71.52 $\pm$ 0.53 ^d	69.96 $\pm$ 0.53
Fat (%)	2.33 $\pm$ 0.19 ^a	1.14 $\pm$ 0.36 ^b	1.74 $\pm$ 0.28	3.75 $\pm$ 0.70 ^c	1.20 $\pm$ 0.07 ^d	2.48 $\pm$ 0.07	11.85 $\pm$ 0.33 ^c	8.60 $\pm$ 0.28 ^f	10.23 $\pm$ 0.31
Ash (%)	1.52 $\pm$ 0.27 ^a	1.46 $\pm$ 0.01 ^a	1.49 $\pm$ 0.14	1.64 $\pm$ 0.16 ^a	1.43 $\pm$ 0.01 ^a	1.54 $\pm$ 0.09	1.04 $\pm$ 0.04 ^a	0.98 $\pm$ 0.03 ^a	0.99 $\pm$ 0.04
Protein(%)	22.53 $\pm$ 1.36 ^a	21.98 $\pm$ 0.39 ^a	22.26 $\pm$ 0.88	22.02 $\pm$ 0.10 ^a	21.98 $\pm$ 0.09 ^a	22.0 $\pm$ 0.05	19.7 $\pm$ 0.27 ^a	18.90 $\pm$ 0.37 ^a	19.30 $\pm$ 0.32
Insoluble Protein (%)	11.63 $\pm$ 0.56 ^a	11.45 $\pm$ 0.44 ^a	11.54 $\pm$ 0.50	18.87 $\pm$ 0.30 ^a	16.26 $\pm$ 0.17 ^b	17.57 $\pm$ 0.24	22.14 $\pm$ 0.16 ^c	20.17 $\pm$ 0.59 ^c	21.14 $\pm$ 0.38
Soluble Protein (%)	77.23 $\pm$ 0.41 ^a	75.73 $\pm$ 0.43 ^a	76.48 $\pm$ 0.42	68.99 $\pm$ 0.10 ^b	72.12 $\pm$ 0.17 ^c	70.56 $\pm$ 0.14	65.31 $\pm$ 0.32 ^d	69.10 $\pm$ 0.02 ^b	67.21 $\pm$ 0.17
Non-Protein nitrogen (%)	11.14 $\pm$ 0.01 ^a	12.82 $\pm$ 0.19 ^c	11.98 $\pm$ 0.10	12.16 $\pm$ 0.14 ^{bc}	11.56 $\pm$ 1.38 ^{ab}	11.89 $\pm$ 0.76	12.40 $\pm$ 0.15 ^{bc}	11.73 $\pm$ 0.44 ^{ab}	12.16 $\pm$ 0.30
Total Pigments (PPM)	125.08 $\pm$	151.64 $\pm$	138.36 $\pm$	110.16 $\pm$	136.68 $\pm$	123.42 $\pm$	179.86 $\pm$	188.7 $\pm$	184.28 $\pm$
	0.61 ^a 5.6 $\pm$ 0.001 ^a	0.43 ^b 5.60 $\pm$ 0.001 ^a	0.52 5.60 $\pm$ 0.001	0.30 ^c 5.57 $\pm$ 0.02 ^a	0.30 ^d 5.64 $\pm$ 0.10 ^a	0.30 5.61 $\pm$ 0.02	0.26 ^a 5.69 $\pm$ 0.01 ^c	0.60 ^f 5.69 $\pm$ 0.01 ^c	0.43 5.69 $\pm$ 0.01

All values are in Mean $\pm$ SDValue with different superscripts in the same row are significantly different ($P < 0.05$).

TABLE 2: SENSORY CHARACTERISTICS OF MEAT COOKED FOR 10 & 15 MINUTES

Parameter	Young Mutura			Young N'dama			Mature Sokoto Gudali		
	LD	PM	$\pm$ SD X-	LD	PM	$\pm$ SD X-	LD	PM	$\pm$ SD X-
Colour	5.23 $\pm$ 0.67 ^a	5.17 $\pm$ 1.11 ^a	5.21 $\pm$ 0.89	4.70 $\pm$ 1.25 ^a	4.60 $\pm$ 0.94 ^a	4.65 $\pm$ 1.10	4.68 $\pm$ 0.70 ^a	4.25 $\pm$ 0.80 ^a	4.47 $\pm$ 0.77
Texture	5.04 $\pm$ 0.93 ^a	4.81 $\pm$ 1.16 ^a	4.92 $\pm$ 1.05	4.15 $\pm$ 1.93 ^a	3.60 $\pm$ 1.43 ^a	3.88 $\pm$ 1.70	4.15 $\pm$ 1.19 ^a	4.29 $\pm$ 0.93 ^a	4.22 $\pm$ 1.06
Juiciness	4.39 $\pm$ 1.04 ^a	4.09 $\pm$ 0.96 ^a	4.24 $\pm$ 1.01	5.50 $\pm$ 1.47 ^b	4.65 $\pm$ 1.23 ^{ab}	5.08 $\pm$ 1.40	4.84 $\pm$ 0.90 ^{ab}	4.31 $\pm$ 0.71 ^a	4.57 $\pm$ 0.84
Flavour	5.44 $\pm$ 1.12 ^a	5.14 $\pm$ 1.26 ^a	5.28 $\pm$ 1.19	5.30 $\pm$ 1.49 ^a	5.35 $\pm$ 1.35 ^a	5.33 $\pm$ 1.40	4.83 $\pm$ 0.86 ^a	5.04 $\pm$ 0.68 ^a	4.93 $\pm$ 0.77
Tenderness	5.30 $\pm$ 0.68 ^a	5.36 $\pm$ 0.81 ^a	5.13 $\pm$ 0.78	5.20 $\pm$ 1.23 ^a	5.25 $\pm$ 1.48 ^a	5.23 $\pm$ 1.35	3.64 $\pm$ 0.72 ^b	4.19 $\pm$ 0.83 ^b	4.01 $\pm$ 0.79
General Acceptability	5.43 $\pm$ 0.74 ^{ab}	5.81 $\pm$ 0.64 ^a	5.62 $\pm$ 0.71	5.80 $\pm$ 1.44 ^a	5.50 $\pm$ 1.12 ^a	5.65 $\pm$ 1.27	4.60 $\pm$ 0.80 ^b	4.66 $\pm$ 0.90 ^b	4.63 $\pm$ 0.84

All values are mean $\pm$ SD; Values with different superscripts in the same row are significantly different ($P < 0.05$).

TABLE 3: EATING QUALITY CHARACTERISTICS OF MEAT COOKED FOR 20 MINUTES

Parameter	Young Mutura Bull			Young N'dama Bull			Matured Sokoto Gudali		
	LD	PM	$\pm$ SD X-	LD	PM	$\pm$ SD X-	LD	PM	$\pm$ SD X-
Colour	4.26 $\pm$ 1.05 ^{ab}	4.34 $\pm$ 1.81 ^{ab}	4.31 $\pm$ 1.43	5.20 $\pm$ 0.63 ^a	3.00 $\pm$ 0.94 ^c	4.10 $\pm$ 0.79	4.10 $\pm$ 1.10 ^{ab}	3.81 $\pm$ 1.00 ^{bc}	4.11 $\pm$ 1.00
Texture	5.19 $\pm$ 1.16 ^a	5.04 $\pm$ 1.40 ^a	5.12 $\pm$ 1.28	3.80 $\pm$ 1.53 ^{bc}	3.00 $\pm$ 0.82 ^c	3.40 $\pm$ 1.19	4.60 $\pm$ 1.30 ^{ab}	4.14 $\pm$ 1.20 ^{abc}	4.37 $\pm$ 1.30
Juiciness	5.50 $\pm$ 1.20 ^a	4.12 $\pm$ 1.04 ^a	4.46 $\pm$ 1.12	5.20 $\pm$ 1.62 ^{ab}	5.80 $\pm$ 1.03 ^b	5.50 $\pm$ 1.33	4.26 $\pm$ 0.90 ^a	4.84 $\pm$ 0.70 ^{ab}	4.56 $\pm$ 0.80
Flavour	5.60 $\pm$ 1.14 ^a	5.44 $\pm$ 1.12 ^a	5.52 $\pm$ 1.13	4.70 $\pm$ 0.82 ^a	3.30 $\pm$ 1.34 ^b	4.01 $\pm$ 1.08	5.31 $\pm$ 0.77 ^a	5.0 $\pm$ 0.85 ^a	5.16 $\pm$ 0.81
General Acceptability	5.43 $\pm$ 0.61 ^{ab}	5.66 $\pm$ 0.89 ^{ab}	5.55 $\pm$ 0.75	5.90 $\pm$ 1.29 ^b	5.60 $\pm$ 0.97 ^{ab}	5.75 $\pm$ 1.13	4.56 $\pm$ 0.74 ^a	5.20 $\pm$ 0.90 ^{ab}	4.88 $\pm$ 0.82

All values are in Mean $\pm$ SD; Values with different superscripts in the same row are significantly different ($P < 0.05$).

age of Afrikaner and Fresland breeds of cattle. pH of the sample also varied with maturity and probably influenced total pigment contents ($r = 0.91$) such that muscles with high ultimate pH had higher pigment contents. Bouten *et al* (1978) observed similar effect of age on pH while Scaife (1955) reported positive relationship of pH to total pigment contents of muscles.

Sensory Characteristics of The Cooked Meat

Table 2 summarises the sensory characteristics of the meat cooked for 10 and 15 min. It was found that there were differences ($P > 0.05$) between samples cooked for 10 min and 15 min in all parameters evaluated, thus in Table 2 these two results were combined. It is readily seen that all samples were acceptable but significant difference in colour, texture and flavour were not observed ($P > 0.05$) between breeds or muscles of maturity after 10 and 15 min cooking. Apparently, the length of cooking time was not sufficient to reveal significant difference in these parameters (Locker *et al.*, 1977; Davey and Niederer, 1977). But differences were observed in tenderness after 10 and 15 min cooking and it is shown that mature bulls were significantly less tender (4.01 ± 0.79) compared to YM (5.13 ± 0.78) and YN (5.23 ± 1.35) bulls. The observed differences in tenderness appeared to be sufficient to enable panelists detect significant differences in general acceptability. YM and YN bulls were more acceptable than mature bulls after 10 and 15 min. cooking. After cooking for 20 min. (Table 3.), judges could show that significant differences ($P < 0.05$) exist between meat samples in colour, texture, flavour, juiciness, tenderness and general acceptability. It is probable that juiciness, flavour and tenderness influence eating quality of the cooked meat product because those muscles which scored high in these parameters also scored high in general acceptability.

The results show that cooked meat from young (11 months) Muturu and N'dama can be of acceptable eating quality. Similar conclusions on other breeds of cattle have

been reached by various workers (Field, 1971, Hunsley *et al.*, 1971; Ntunde *et al.*, 1977; Riley *et al.*, 1986). After cooking for 20 min meat from YM cattle possessed more desirable flavour and tenderness than YN which was better in juiciness presumably due to higher moisture content of YN muscles (74.7 ± 0.43 vs 73.1 ± 0.64).

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