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Effect of Cooking Time and Potash Concentration on Organoleptic Properties of Red and White Meat

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Abstract: The current study was conducted to evaluate the effect of holding time and potash concentration on organoleptic properties of cooked red and white meat. Four classes each of red and white meat was used in the study and includes chicken, duck, turkey and rabbit for white meat and beef, chevon, mutton and camel for red meat. The meat was cut into nine different portions and each portion was cooked separately at 60°C and for 5, 10 and 20 min with 0, 5 and 10 g L^{-1} potash (KCl). The experiment was conducted using 2×3×3 factorial arrangement of completely randomized design. The results show significant difference ($p<0.05$) in tenderness, flavour, juiciness and overall acceptability between red and white meat. No significant difference ($p>0.05$) was reorded in meat tenderness and overall acceptability due to coking time. The concentration of potassium used significantly affected ($p<0.05$) the overall acceptability of cooked meat. It was concluded that cooking meat at 60°C for 20 min with 5 g L^{-1} potash increased tenderness and overall acceptabilty of meat. Treated mutton was the most preferred meat type by the respondents.

Key words: Camel, cooking, meat, mutton, time, Nigeria

INTRODUCTION

Meat is define as an animal flesh used for food, most often referring to skeletal muscle and associated fat. The term meat is also used to describe other edible tissues and organs such as liver, kidney, lung and skin (Lawrie and Ledward, 2006). Meat is usually surrounded by layer (s) of connective tissues, consisting of protein especially collagen. There are two types of meat identified based on colour perception. The red and white meat. Red meat refers to meat type rich in myoglobin such as beef, mutton and lamb. The more the myoglobin concentration the redder the meat. The white meat on the other hand is made up of muscle fibres, used by the animals for quick bursts activities such as in the case of poultry. The myoglobin content of white meat is low (Othman, 2011).

Meat and meat products are high in nutritive value. However, dressed carcass and fresh meat can only remain fresh for a short time before spoilage. In order to enhance its shelf-life, meats are processed into different products. The commonly used processing method is cooking which affect meat quality posively and sometime negatively (Omojola, 2008). The concept of meat quality is very difficult to define due to the subjective nature of its attributes that are of commercial importance such as colour, texture, juiciness and flavour. This is further complicated by the intrinsic heterogeneity of meat, even from the same source. The consumer considers quality to include a series of characteristics which make the cooked meat edible, attractive, appetising and nutritious assessed by the use of sensory organs (Beriain *et al*., 2000). Organoleptic qualities of meat are determined by sensory characteristics relating to colour, texture, aroma, flavour and juiciness and these are influenced by a number of factors including pre-slaughter handling, muscle composition, post slaughter biochemical reactions and technological factors. The meat colour is one of the most important criteria in initial selection of meat and it relates to the concentration of myoglobin pigments, the chemical state of the myoglobin structure and physical state of muscle proteins and the proportion of intermuscular fat. Tenderness on the other hand is an integrated textural property composed of mechanical, particulate and chemical components (Brewer and Novakofski, 2008). The mechanical characteristics include hardness, cohesiveness and elasticity. Other characteristics are grittiness and fibrousness. The chemical characteristics of meat include juiciness and oiliness (Brewer and Novakofski, 2008).

Meat tenderness is considered the most important palatability attribute of meat (Cross *et al*., 1986) and it is a critical eating quality which determines whether consumers are repeat buyers (Koohmaraie *et al*., 1989). Several post-mortem methods of improving meat tenderness have been reported. The involvement of ionic strength as tenderizer was reported by Wu and Smith

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(1987), the use of calcium chloride in reducing toughness in beef and lamb carcasses were also reported (Geesink, 1993; Wheeler *et al*., 1991; Morgan *et al*., 1991) and has gained prominence. However, it was reported that some of the organoleptic properties such as colour and flavour can be altered by the use of calcium salt ($CaCl_2$) among other type of salts and that such alteration is concentration dependent (Wheeler *et al*., 1991; Lansdell *et al*., 1995; Perez *et al*., 1998). Likewise, meat marination with calcium chloride longer than 24 h was found to result in bitter flavour, undesirable texture and colour changes (Gonzalez *et al*., 2001).

In Nigeria, the use of potash in traditional meat processing is common. The term potash was originally applied to potassium carbonate-potassium hydroxide recovered in iron pots from washings of wood ashes. According to Searls, the term potash is commonly used in connection with a variety of water soluble compounds, all containing the element potassium. Potash can be potassium chloride (KCl or muriate of potash or MOP), potassium sulfate (K_2SO_4 or sulfate of potash or SOP), potassium-magnesium sulfate ($K_2SO_4.MgSO_4$ or sulfate of potash magnesia), potassium nitrate (KNO_3 or saltpeter) or mixed sodium-potassium nitrate (Chilean saltpeter).

Studies on potash and its related chemical influence on organoleptic properties of cooked meat products in Nigeria are scanty. Therefore, the current study was designed to evaluate the effect of holding time and potash concentration on organoleptic properties of cooked red and white meat.

MATERIALS AND METHODS

Study area: The study was conducted at the Department of Animal Science, Bayero University, Kano. The white meat used for the study was obtained by slaughter of one each of chicken, duck, turkey and rabbit. The red meat used was obtained from longissimus muscle of hindlegs of a bull, camel, ram and buck slaughtered at the Kano metropolitan abattoir. Each of the meat of eight species used (white meat: chicken, duck, turkey, rabbit and red meat: buck, bull, camel and ram) was cut into nine portions of approximately equal weight. The two meat types (red and white) were cooked immersed in water at 60°C and the cooking temperature was held at different times of 5, 10 and 20 min. Each of the meat type was cooked with addition of potash (KCl) at two different concentrations of 5 and 10 g L^{-1} with no potash treatment as control. The cooked meat was drained (for 10 min) and served immediately to an organoleptic taste panel for assessment.

Organoleptic assessment: A seven member sensory evaluation panel was requested to evaluate the different meat types, processed by cooking at 60°C for different periods with addition of different concentration of potash on a 9 point hedonic scale of 1-liked extremely; 2-liked very much; 3-liked moderately; 4-liked slightly; 5-neither like nor dislike; 6-disliked slightly; 7-disliked moderately; 8-disliked very much and 9-disliked extremely as described by Mahendraker *et al*. (1988).

Experimental design and statistical analysis: The experiment was laid in a 2×3×3 factorial arrangement (2-meat types: white and red; 3-cooking holding times of 5, 10 and 20 min and 3-potash concentrations of 0, 5 and 10 g L^{-1}) in a Completely Randomised Design (CRD). The data on organoleptic assessment was Analyzed for Variance (ANOVA) and means were separated using LSD. The sensory properties of white and red meat were compared using the student t-test.

RESULTS AND DISCUSSION

Table 1 shows the effect of type on sensory properties of cooked meat. No significant difference was recorded ($p>0.05$) on red meat and white meat on tenderness (2.90 vs. 2.95) and colour (3.22 vs. 3.12). However, the flavour of red meat was liked very much rated 2.94 significantly higher ($p<0.05$) than white meat rated between like moderately (3.00) to liked slightly (4.00). Also the juiciness in red meat was liked moderately (3.14) significantly higher ($p<0.05$) than white meat rated 3.45 by the panellists.

Table 2 shows the effect of cooking time (min) on organoleptic properties of meat. No significant difference

Table 1: The sensory evaluation rate of white and red meat

	Meat type		
Parameters	Red (mean±SE)	White (meant±SE)	t-value
Tenderness	2.90±0.112	2.95±0.130	0.301^{NS}
Flavour	2.94±0.104	3.25±0.121	1.939*
Colour	3.22±0.115	3.12±0.098	0.709^{NS}
Juiceness	3.14±0.109	3.45±0.111	1.987*
Overall acceptability	3.05±0.131	3.08±0.132	0.192^{NS}

NS: Not Significant, *p<0.05

Table 2: Effect of holding time on organoleptic properties of meat products

	Cooking time (min)				
Parameters	5	10	20	LS	LSD
Tenderness	2.99	2.98	2.81	NS	-
Flavour	3.30	3.15	2.83	*	0.390
Colour	3.19	3.23	3.09	NS	-
Juiceness	3.35	3.31.	3.23	NS	-
Overall acceptability	2.88	3.08	3.24	NS	-

NS: Not Significant, *p<0.05, LS: Level of Significant

(p>0.05) was recorded due to holding time on tenderness, colour and juiciness. However, a significant difference (p<0.05) was recorded in flavour of meat cooked for 20 min rated liked extremely (2.83) by the respondents compared to that cooked for 5 and 10 min rated between like moderately and liked slightly.

The effect of potash concentration on organoleptic properties of meat types is shown on Table 3. No significant difference (p>0.05) was recorded on tenderness of cooked meat. The tenderness of meat cooked with addition of potash at 5 g L^{-1} was rated the highest (2.77) and that with 10 g L^{-1} rated the lowest (3.07). The same trend was recorded on flavour, colour and juiciness. However, the overall acceptability rating was significantly higher (p<0.05) in meat cooked with addition of 5 g L^{-1} potash (2.75).

Table 4 shows the organoleptic properties of different meat type (red and white). A significant difference (p<0.05) was obtained on tenderness between the different species used in the study. Mutton rated 2.65 (liked very much) was the highest while turkey meat was rated liked moderately (3.48) and the least. Similar trend was obtained on flavour of the different meat species. No significant difference (p>0.05) was recorded on meat colour due to different species used. However, the colour ratings ranged between (liked very much to like moderately) in rabbit meat (2.89) and liked moderately in duck meat (3.37). A significance difference was obtained (p<0.05) in juiciness of beef rated 2.92 (like moderately to like slightly) and chicken had the least rating value (3.73) on juiciness. No significance difference (p>0.05) was recorded on meat texture due to species. The overall acceptability showed significant difference (p<0.05) due to species and duck meat was rated 2.86 significantly more acceptable than turkey meat rated liked moderately (3.63).

Table 3: Effect of concentration of Potash (RAM per litre on organoleptic properties of meat products)

	Potash concentration (g L^{-1})				
Parameters	0	5	10	LS	LSD
Tenderness	2.93	2.77	3.07	NS	-
Flavour	3.14	2.99	3.15	NS	-
Colour	3.21	3.03	3.27	NS	-
Juiceness	3.35	3.20	3.33	NS	-
Overall acceptability	3.20	2.75	3.24	*	0.19

NS: Not Significant, *p<0.05, LS: Level of Significance

The consumer perception was that mutton was more tender than the others meat types (beef, chevon and camel). Mutton is a highly marbled meat and is characterised with short fibre muscle compared to beef and camel meat (Beriain *et al*., 2000). Tenderness being a complex trait depends on sarcomere length, muscle/ connective tissue proteins and proteolytic degradation. These might have accounted for most variation in tenderness of meat (Koohmaraie *et al*., 2002). Thu (2006) opined that meat tenderness is influenced by collagens of the muscle. The meat of turkey was less tender compared to other white meat types and could be attributed to level of bird's maturity at the point of slaughter. Kristensen *et al*. (2004) reported that younger animal species muscles in which the connective tissues are under developed are mostly tender. Meat tenderness decreases with age (Ouali, 1991), a result of an increase in the number of thermo-resistant linkages between collagen fibres.

The levels of potash used in the study had no effect on tenderness possibly due to synergic effect that exists between K^{2+} and Ca^{2+} ions. Earlier, Okubanjo *et al*. (2011) injected calcium chloride on breast of spent layers at different time prior to cooking and recorded variation in tenderness due to increase time of calcium injection. Similarly, holding time had no effect on tenderness and could be attributable to degree of doneness which is increases with potash concentration. The current result is contrary to reports of Omojola (2008) who used different part of beef in preparing suya and roasted it for 20 min and obtained a significant difference in tenderness which was attributed it to the different cuts. Generally, the tenderness of red meat and white meat obtained in the current studies were similar and could be due to the relative age of the different species at time of slaughter.

The panellist's flavour perception of mutton was liked very much and for turkey liked moderately to like slightly. Turkey meat is associated with some off-flavour linked to pre-slaughter handling practice and which might have been percieved by the respondents as a degree of rancidity (Rousset-Akrim *et al*., 1997). According to Thu (2006) different flavour was perceived for beef, chicken, turkey and lamb due to the different fatty components of the meats. The fatty tissues give each a specific flavour profile. The characteristic flavour of meat of a particular

Table 4: Effect species on organoleptic properties of white meat and red meat

	White meat				Red meat				
Parameters	Duck	Turkey	Chicken	Rabbit	Beef	Camel	Chevon	Mutton	SEM
Tenderness	2.78	3.48	2.75	2.81	3.14	2.76	3.05	2.65	0.237*
Flavour	3.27	3.60	3.14	2.98	2.89	2.92	3.14	2.86	0.236*
Colour	3.37	3.16	3.05	2.89	2.95	3.16	3.35	3.43	NS
Juiceness	3.37	3.44	3.73	3.25	2.92	3.05	3.33	3.25	0.260*
Overall acceptability	2.86	3.63	2.90	2.94	3.08	3.03	3.13	2.95	0.242*

NS: Not Significant, *p<0.05

species is determined by the amount of unsaturated fatty acids which are more susceptible to oxidation into volatile compounds of low molecular weight such as aldehydes, ketones hydrocarbons and alcohols that contributes to meat aroma (Young *et al*., 1997).

Cooked meats held for 20 min were more tender and flavourant. This could be due to the effect of time on release of various components of fatty acids. Omojola (2008) reported no difference in flavour of different beef part used in making suya. However, Lansdell *et al.* (1995) and Perez *et al.* (1998) showed that organoleptic properties of meat such as colour and flavour are altered by the use of salts (Calcium chloride) and that such alteration is concentration and time dependent. Red meat flavour was rated higher than white meat and could be due to higher amount of intramuscular fat that is deposited within the muscles in loose network of perimysial connective tissues and between muscle bundles (Thu, 2006).

Meat colour is of the most important criteria in initial selection of food by the consumer. It is related to the chemical state of myoglobin on the surface of the meat. The structure and physical state of muscle proteins and the proportion of intermuscular fat contributes to meat colour (Beriain *et al*., 2000). The panellist liked rabbit meat colour very much and that of mutton moderately. This was in agreement to the reports of Horcada. Meat colour depends on species differences and in distribution of myoglobin pigment on meat surface.

The colour rating of red and white meat were similar and could be due to the meat preparation method used similar to the reports of Beriain *et al.* (2000). Juiciness of meat is made up of two similar effects, the impression of moisture released during chewing and salivation produced by flavour factors (Omojola *et al*., 2003). Beef juiciness perceived by panellist was liked very much for beef and liked slightly for chicken, this could be due to marbling and type of protein which are major sources of variation in meat types (Thu, 2006). Egena and Ocheme (2008) reported that increase in temperature during cooking causes shrinkage of meat tissue leading to the release of juices. Likewise, the effect of potash on juiciness was not significant and could be due to the low concentration and penetration of potash into meat (Okubanjo *et al*., 2011).

Beriain *et al.* (2000), opined that colour is the most important criteria in meat assessment. The choice of mutton as most favoured was aided by its high tenderness and flavour and which are low in turkeys meat as judged by the panellist.

CONCLUSION

It was concluded that tenderness and flavour of red and white meat treated with potash were similar. Cooking meat at 60°C with 5 g L^{-1} potash indicated higher trend for more accepable product. Mutton processed with addition of potash held for 20 min is the most preferred meat type with more acceptable tenderness and flavour.

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