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Full Length Research Paper

Effect of consumer background on sensory scores of microwaved Angus loins

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The objective of the study was to evaluate the effect of consumer background on the sensory evaluation of microwaved Angus loins. The steaks were prepared using a microwave. Only salt was added to taste. Sensory evaluation was done by an untrained panel of 70 participants of different ages, tribes and gender. Pearson's correlation coefficients between sensory characteristics were determined. Age of consumer had no effect on all the sensory characteristics. Gender had an influence ($P < 0.05$) on sustained impression of juiciness. Tribe had an influence ($P < 0.05$) on the amount of connective tissue. Significant correlations ($P < 0.05$) occurred between initial impression of juiciness and first bite, as well as with sustained impression of juiciness ($P < 0.001$), muscle fibre and overall tenderness ($P < 0.001$). First bite correlated positively ($P < 0.001$) with sustained impression of juiciness, as well as with muscle fibre and overall intensity. Microwaved meat has reduced juiciness as well as fat content, thus production of tougher than tender meat. Male consumers preferred the microwaved loins compared to female consumers. Consumer background therefore had an effect on sensory scores of microwaved Angus loins.

Key words: Microwaved meat, sensory characteristics, consumer background, Angus breeds, correlations.

INTRODUCTION

It is important to consider the differences among consumers when carrying out a market study because consumers from different countries, as well as consumers from different regions within the same country, can have differences in meat preferences (Furnols et al., 2006; Dyubele et al., 2010; Xazela et al., 2011). Consumers' opinion is a good guide to the improvement of meat quality (Issanchou, 1996). Background and attitude of consumers influence how consumers perceive meat (Dyubele et al., 2010; Xazela et al., 2011; Ngambu et al., 2011). Consumers from one tribe may like a certain type of meat, while other consumers may dislike that meat (Field et al., 1983; Jamora and Rhee, 1998; Rubino et al., 1999). However, the use of consumers for assessing meat quality, especially with an untrained panel, may produce responses that are unreliable or invalid (Stone and Sidel, 1993) since consumers can only tell you what they like or dislike (Lawless and Heymann, 1999).

Generally, consumers prefer tender meat regardless of the differences in their background and perceptions (Hoffman et al., 1996; Bryhni et al., 2003; Norman et al., 2003). Furthermore, consumers have even shown willingness to pay a premium for a tender product (Boleman et al., 1997). However, young consumers' preference for meat was shown to relate to sensory quality (King et al., 2004). Consumers aged between 31 and 60 years placed more emphasis on tenderness than the younger consumers (Aaslyng et al., 2007). Consumers aged between 18 and 30 years appeared to prefer the crumbly meat texture, whereas the consumers aged between 31 and 50 years disliked fibrous meat (Aaslyng et al., 2007).

In addition, gender preferences for some food items, in particular males for red meat, are associated with the expression of identity, power and domination of women (Beardsworth and Bryman, 2004). Aaslyng et al. (2007) showed that colour was the only attribute that differed between male and female consumers. Female consumers

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preferred well-done meat with a light/grey colour, whereas male consumers were not influenced by the appearance (Aaslyng et al., 2007). Females generally prefer light/white meat such as chicken (Kubberod et al., 2002). It has been reported that females show greater appraisal for tender beef, confirmed by their willingness to pay more than males for guaranteed tender steak (Lusk et al., 2001).

Social influences on food preference could also result from cultures and traditions (Beardsworth and Bryman, 2004; Dyubele et al., 2010; Xazela et al., 2011). Several studies in other important beef-producing and consuming countries have shown that consumers perceive differences in meat tenderness (Miller et al., 2001; Wheeler et al., 2002, 2004). In other countries, it has been determined that younger people, smaller families and higher household income increase the probability to purchase high-quality meat (Quagrainie et al., 1998). Sensory variables, such as colour, taste, aroma, juiciness and tenderness are some of the most influential factors in the perception and acceptance of food and in eating behavior (Imram, 1999; Kok et al., 2003; Ngambu et al., 2011).

Meat from Angus cattle is one of the most consumed all over the world. It is prepared using different methods. The method of heat treatment influences sensory characteristics of meat (Dyubele et al., 2010). Microwaving of meat is one of the most common heat treatment methods used to prepare meat because it is convenient in terms of time, cheap, and consumes less energy than normal stoves. Meat processed by microwaves is lower in moisture and crude fat when compared to those prepared by other methods (Janicki and Appledorf, 1974). Although, there are reports on the effect of gender, age and sex on meat preferences (Furnols et al., 2006; Aaslyng et al., 2007; Dyubele et al., 2010), little has been done on the effects of consumer background on sensory scores of microwaved Angus loins. Determining the effects of consumer background in terms of age, gender, tribe and place of residence on sensory scores of microwaved Angus loins is necessary. The objective of the current study was therefore, to determine the effects of consumer gender, age, and tribe on consumer sensory scores of microwaved Angus loins. The null hypothesis tested was that consumer background has no effect on consumer sensory scores of microwaved Angus loins.

MATERIALS AND METHODS

Description of study site

The sensory evaluation was conducted at the University of Fort Hare, Alice Campus, and Eastern Cape Province of South Africa. The University population is made up of academic and non-academic staff and students from various ethnic backgrounds. The meat used was sourced from Melmar Butchery, Adelaide. The butcher owner slaughters his cattle at Adelaide Municipal abattoir a small throughput abattoir situated 60 km South East of the University of Fort Hare.

Description of the meat samples and preparation method

The meat samples tested were steaks from the *longissimus dorsi* muscle (loin, also known as the fillet) from 18 months old, Angus steer. The meat came from beef that have gone through storage in a chilled state at least for 14 days at a temperature of between 0 and plus 2°C. The ultimate pH of the beef was measured. The steaks were prepared using a microwave. The steaks were cut into small pieces measuring about 5 × 5 cm before cooking. Water and cooking oil were not added to the beef, but salt was added to taste. The cooking temperature was recorded and a roasting time of 20 min was used. Microwaving was done in the meat science laboratory. It was then allowed to cool for a few minutes at room temperature before evaluation was done.

Sensory evaluation

The evaluators were untrained panel of students and workers at the University of Fort Hare. Tasting samples were randomly circulated around the participants, with each participant having a scoring sheet to record the individual sensory scores. The consumers were invited using e-mails and were of different ages (≤ 20, 21 to 25, 26 to 30 and ≥ 30), gender (female and male) and tribes (Xhosa, Shona and Zulu). The characteristics to test were the juiciness, tenderness, aroma intensity, flavour intensity, overall acceptably, as well as the off-flavour indicators. The scores ranged from 1 to 8, with the higher the scores the acceptable it is, except for off-flavour where lower scores indicate better scores. The sensory characteristics were aroma intensity (1 = extremely bland to 8 = extremely intense), initial impression of juiciness (1 = extremely dry to 8 = extremely juicy), first bite (1 = extremely tough to 8 = extremely tender), sustained impression of juiciness (1 = extremely dry to 8 = extremely juicy), muscle fibre and overall tenderness (1 = extremely tough, to 8 = extremely tender), amount of connective tissue (1 = extremely abundant to 8 = none), overall flavour intensity (1 = extremely bland to 8 = extremely intense), a-typical flavour intensity (1 = none to 8 = extremely intense). The off-flavour indicators were livery/bloody, cooked vegetable, pasture/grassy, animal like/kraal (manure), metallic, sour and unpleasant. The terms in the questionnaire were explained to the participants in simple terms as well as in the questionnaire itself. Participants were also given an opportunity to ask for clarifications where the terms were not clear.

Statistical analysis

The General Linear Model (GLM) procedure of SAS (SAS, 2000, Version 6, SAS Institute, Cary, NC, USA) was used to analyse the effects of gender, age and tribe of the participants on sensory characteristics of Angus loin quality. Least Square Difference was used to compare means. Pearson's correlation coefficient of SAS (2000) was used to measure the relationships between sensory characteristics. All statements of significance are based on the 5% level of probability. The linear model used was:

$$Y_{ijkl} = \mu + A_i + G_j + T_k + E_{ijkl}$$

Where, Y_{ijkl} is the response variable (aroma intensity, initial impression of juiciness, first bite, sustained impression of juiciness, fibre and overall tenderness, amount of connective tissue, overall flavour intensity and relevant a-typical flavour); μ is the overall

Table 1. Least square means and standard errors of means (S.E) for sensory characteristics of Angus loins by age of consumers.

Age	1	2	3	4
Aroma intensity	4.71 ± 0.802[a]	4.37 ± 0.450[a]	3.49 ± 0.739[a]	3.99 ± 0.643[a]
Initial impression of juiciness	3.80 ± 0.709[a]	4.78 ± 0.397[a]	3.86 ± 0.653[a]	4.76 ± 0.568[a]
First bite	5.67 ± 0.702[a]	5.42 ± 0.393[a]	4.89 ± 0.646[a]	5.57 ± 0.563[a]
Sustained impression of juiciness	3.72 ± 0.532[a]	5.08 ± 0.298[a]	4.19 ± 0.490[a]	4.64 ± 0.427[a]
Muscle fibre and overall tenderness	4.12 ± 0.692[a]	4.81 ± 0.428[a]	4.72 ± 0.643[a]	5.56 ± 0.570[a]
Amount of connective tissue	4.57 ± 0.577[a]	4.66 ± 0.357[a]	5.12 ± 0.536[a]	5.18 ± 0.475[a]
Overall flavour intensity	5.09 ± 0.781[a]	5.11 ± 0.483[a]	4.54 ± 0.726[a]	4.65 ± 0.644[a]
A-Typical flavour intensity	3.53 ± 2.208[a]	4.74 ± 1.365[a]	2.99 ± 2.052[a]	5.15 ± 1.818[a]

Means in the same row with different superscripts are significantly different at P < 0.05. Age groups: 1 = ≤20, 2 = 21 to 25, 3 = 26 to 30, 4 = ≥30.

Table 2. Least square means and standard errors of means (S.E) for sensory characteristics of Angus loins by gender of consumers.

Gender	M	F
Aroma intensity	4.23 ± 0.496[a]	4.05 ± 0.466[a]
Initial impression of juiciness	4.31 ± 0.438[a]	4.29 ± 0.412[a]
First bite	5.59 ± 0.434[a]	5.18 ± 0.408[a]
Sustained impression of juiciness	4.37 ± 0.329[a]	4.08 ± 0.309[b]
Muscle fibre and overall tenderness	4.87 ± 0.461[a]	4.74 ± 0.440[a]
Amount of connective tissue	4.88 ± 0.384[a]	4.89 ± 0.366[a]
Overall flavour intensity	4.86 ± 0.521[a]	4.83 ± 0.497[a]
A-Typical flavour intensity	3.63 ± 1.471[a]	4.58 ± 1.403[a]

Means in the same row with different superscripts are significantly different at P < 0.05. M = male, F = female.

mean; A_i is the effect of age on sensory scores; G_j is the effect of gender on sensory scores; T_k is the effect of tribe on sensory scores; E_{ijkl} is the random error term, assumed to be normally and independently distributed with mean 0 and variance equal to δ^2.

RESULTS

Effect of consumer background on sensory characteristics

The effects of age, gender and tribe on the sensory attributes of microwaved Angus loins are shown in Tables 1, 2 and 3, respectively. Age had no effect on all the sensory characteristics (Table 1). Gender had an influence (P < 0.05) on sustained impression of juiciness but had no effect on other sensory scores (Table 2). While tribe had an influence (P < 0.05) on the amount of connective tissue, but no effect on other sensory scores (Table 3).

Relationships among sensory characteristics

As shown in Table 4, there was a positive correlation (P < 0.05) between aroma intensity and sustained impression of juiciness as well as muscle fibre and overall tenderness. A stronger correlation (P < 0.001) existed between aroma intensity and overall flavour intensity. Also, correlation (P < 0.05) occurred between initial impression of juiciness and first bite, as well as with sustained impression of juiciness (P < 0.001) and muscle fibre and overall tenderness (P < 0.001). First bite correlated positively (P < 0.001) with sustained impression of juiciness as well as with muscle fibre and overall intensity. There was also a positive correlation (P < 0.05) between first bite and overall flavour intensity. In addition, a positive correlation (P < 0.001) occurred between sustained impression of juiciness and muscle fibre and overall intensity, as well as with overall flavour intensity. Muscle fibre and overall tenderness correlated positively (P < 0.05) with amount of connective tissue and as well as with overall flavour intensity.

DISCUSSION

In the current study, consumer background did not have effect on aroma intensity. This is however, in contrast with the findings by Chulayo et al. (2011) who reported that scores for aroma intensity and initial impression of

Table 3. Least square means and standard errors of means (S.E) for sensory characteristics of Angus loins by tribe of consumers.

Tribe	N	O	S	X	Z
Aroma intensity	4.88 ± 0.970[a]	4.75 ± 0.798[a]	3.73 ± 0.542[a]	4.17 ± 0.398[a]	3.18 ± 1.403[a]
Initial impression of juiciness	4.76 ± 0.857[a]	4.82 ± 0.705[a]	4.72 ± 0.479[a]	4.20 ± 0.352[a]	3.01 ± 1.240[a]
First bite	5.42 ± 0.849[a]	5.90 ± 0.698[a]	5.14 ± 0.474[a]	4.71 ± 0.348[a]	5.76 ± 1.228[a]
Sustained impression of juiciness	4.82 ± 0.644[a]	5.01 ± 0.530[a]	4.55 ± 0.360[a]	4.65 ± 0.264[a]	3.00 ± 0.932[a]
Muscle fibre and overall tenderness	4.36 ± 0.794[a]	5.55 ± 0.654[a]	4.39 ± 0.444[a]	4.80 ± 0.326[a]	4.93 ± 1.584[a]
Amount of connective tissue	4.72 ± 0.662[ab]	3.75 ± 0.545[b]	4.53 ± 0.370[a]	4.18 ± 0.272[b]	7.23 ± 1.320[a]
Overall flavour intensity	5.25 ± 0.897[a]	5.44 ± 0.738[a]	4.29 ± 0.501[a]	4.53 ± 0.368[a]	4.37 ± 1.789[a]
A-Typical flavour intensity	3.46 ± 2.534[a]	4.55 ± 2.085[a]	3.57 ± 1.416[a]	4.09 ± 1.040[a]	4.84 ± 5.054[a]

Means in the same row with different superscripts are significantly different at P < 0.05. N = Ndebele, O = Others, S = Shona, X = Xhosa, Z = Zulu.

Table 4. Correlations among sensory characteristics of Angus loins.

Parameter	AI	IJ	FB	SJ	MFT	ACT	OFI
IJ	NS						
FB	NS	0.37*					
SJ	0.30*	0.55**	0.34**				
MFT	0.30*	0.34**	0.48**	0.46**			
ACT	NS	NS	NS	NS	0.27*		
OFI	0.41**	0.29*	0.37*	0.46**	0.34*	NS	
ATFI	NS	NS	NS	NS	NS	NS	NS

*P < 0.05, **P < 0.001. AI = aroma intensity, IJ = initial impression of juiciness, FB = first bite, SJ = sustained impression of juiciness, MFT = muscle fibre and overall tenderness, ACT = amount of connective tissue (residue), OFI = overall flavour intensity, NS = not significant.

juiciness increased with age (≥30 years) and could be ascribed to the experience or exposure time of older consumers to meat. The higher sustained juiciness scores given by female panellists than those given by male panellists on sustained impression of juiciness might be explained by the fact that females prefer soft and tender meat, and they are cautious about their teeth. It has been reported that more tender meat releases juices more rapidly and leaves less residual tissue after mastication (Tshabalala et al., 2003; Xazela et al., 2011). The fact that males recorded the highest scores for most variables compared to females could be due to the fact that meat is more regarded masculine than feminine (Fiddes, 1991). This is also in contrast with findings by Simela et al. (2008) where female consumers tend to give higher scores in most of the sensory attributes. A further perception in the food ideology with an influence on social interactions is that some food items, in particular red meat, are associated with the expression of male identity, male power and male domination of women (Beardsworth and Bryman, 2004).

Moreover, the finding that there was a positive correlation between aroma intensity and overall flavour intensity agrees with findings by Chulayo et al. (2011). This is so because flavour is a very complex attribute of meat palatability (Calkins and Hodgen, 2007; Muchenje et al., 2010; Dyubele et al., 2010). Therefore, as aroma intensifies so does the flavour, since flavour is combination of aroma and taste (Chulayo et al., 2011; Ngambu et al., 2011). Schonfeldt and Strydom (2011) reported that aroma intensity showed a low linear correlation with flavour intensity, suggesting independence of the two attributes. A positive correlation between aroma intensity and sustained impression of juiciness was also reported by Schonfeldt and Strydom (2011). Generally, juiciness of meat is directly related to the intramuscular lipids and moisture content of the meat (Muchenje et al., 2008a).

The fact that there was a positive correlation between initial impression of juiciness, and the first bite was expected and can be explained by the fact that the amount of pressure required to bite (tenderness) a piece of meat is determined by its juiciness. An increase in initial impression of juiciness is an increase in tenderness of the meat. A positive correlation between initial impression of juiciness and the sustained impression of juiciness was therefore expected. This is also similar to the findings of Schonfeldt and Strydom (2011), thus implying mutual independency (Cross et al., 1973a). A positive correlation was expected between initial impression of juiciness and muscle fibre and overall tenderness. Flavour, juiciness and succulence are along

with tenderness, important factors in meat palatability (Troy and Kerry, 2010). Juicy fluids exuded from meat give more flavour to the meat, hence consumer acceptability. Muchenje et al. (2010) found that the composition and amount of fat also determines the intensity of flavour in meat.

The positive correlation among the amount of connective tissue, muscle fibre and overall tenderness was also reported by Muchenje et al. (2008b). This study also agrees with findings by Chulayo et al. (2011). The size of the muscle fibre and sarcomere length, which is the basic unit of cross striated myofibril that are assembled together, can influence the tenderness of meat (Chulayo et al., 2011). First bite and sustained impression of juiciness were expected to correlate positively. Risvik (1994) reported that water/fat perceptions and structure perception (described as juiciness and tenderness) are orthogonal phenomena by which most of the other textural characteristics can be explained. The juicier samples exhibited a faster decline in amount of force required to chew (tenderness) than the less juicy sample in a study by Zimoch and Gullett (1997).

Conclusion

Consumer background had an effect on sensory scores of microwaved Angus loins. Male consumers gave higher sensory scores than female consumers for the microwaved loins. It was also observed that most of the consumer sensory variables tested were positively correlated.

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