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Full Length Research Paper

Effects of some medicinal plants on consumer sensory characteristics of village chicken meat

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The objective of the current study was to determine the correlations between the sensory characteristics of village chickens that were treated with medicinal plants. A total of 42 mature village chickens were kept at Fort Cox College of Forestry and Agriculture for 14 days until slaughter. The chickens were randomly allocated to five groups: Group 1 was for the negative control (treated with distilled water against gastro-intestinal parasites), group 2 was for the positive control (treated with Mebendazole), group 3 were treated with Aloe ferox, group 4 were treated with Agave sisalana and group 5 were treated with Gunera perpensa. Yellow maize mixed with wheat bran was given to the chickens at 600 g per group per day. The mean live weight of the chickens was 1.36 ± 0.667 (± standard error). There were significant treatment effects on aroma intensity, initial impression of juiciness for chickens treated with A. ferox, distilled water and mebendazole polymorph. Consumers gave higher scores for aroma intensity and connective tissue (P < 0.01) for birds treated with distilled water, mebendazole and A. ferox than that of G. perpensa. There were also positive significant correlations among first bite and amount of connective tissue of village chicken meat. Village chicken meat treated with A. ferox, A. sisalana and distilled water was tender, juicier and had a good flavour when compared to other medicinal treatments. It can be recommended that A. ferox and A. sisalana can be used in treating village chickens for it does not affect meat quality characteristics for human consumption.

Keywords: Flavour, juiciness, meat quality, medicinal plants, tenderness.

INTRODUCTION

In South Africa, a pool of indigenous and exotic breeds of chickens was reared by both rural and commercial farmers. These chickens are a source of protein to the ever increasing population in the country (Dyubele et al., 2010). To the rural farmers, indigenous chickens are the most preferred for they are not capital intensive (Muchadeyi, 2007; FAO, 2010). The chickens have little/no religious or social constraints affecting their production (Swatson, 2001). Indigenous chickens have, however, poor growth rate, low feed conversion efficiency, and their weight is 2.5 times less when compared with exotic breeds of chickens (broilers) (Jaturasitha et al., 2008). Indigenous chickens have an advantage of responding positively to treatment of gastro-intestinal parasites with herbal medicine (Mwale et al., 2005).

According to Mwale and Masika (2009), medicinal plants are easy to use, cheap, readily available and easily accessible to the communal farmers. Medicinal plants such as Aloe ferox, Agave sisalana and Gunnera perpensa are used to control gastro-intestinal parasites in village chickens in the communal areas of the Eastern Cape Province in South Africa (Mwale and Masika, 2009). A. ferox is a commercially important plant due to the fact that it has succulent, fleshy, tapering leaves as a source of bitter-tasting flavour used in medicine (Peaks Enterprises, 2010).

In addition, among the medicinal plants, Aloe species can be used as coccidiostats and for treating a wide

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Table 1. Treatments used for controlling gastro-intestinal parasites.

Treatment group	Treatment	Measurements
Negative control	Distilled water (0 ml)	1 ml /chicken/day for 4 consecutive days
Positive control	Mebendazole polymorph C (1 ml/ kg dose)	1 ml/chicken for one day
Group 3	*A. ferox* (Ikhala) at 200 mg/kg dose	1 ml /chicken/day for 4 consecutive days
Group 4	*A. sisalana* (Iralibhomu) at 200 mg/kg dose	1 ml /chicken/day for 4 consecutive days
Group 5	*G. perpensa* (Gangasane /Iphuzi lomumlambo) at 200 mg/kg dose	1 ml /chicken/day for 4 consecutive days

range of diseases both in humans and livestock species (Mwale et al., 2005). G. perpensa is a perennial plant which is best known for easing the pain during calving in cows. It is found in many parts of South Africa especially KwaZulu Natal (Khan et al., 2004). These medicinal plants may have an effect on chicken meat quality attributes by changing the texture and nutritional value of meat (Waskar et al., 2009).

Considering that village chickens provide resource-limited farmers with the much needed protein (FAO, 2003, 2010), it is crucial to determine the effect of medicinal plants on meat quality of village chickens. Most studies tend to concentrate on production trends of village chickens without considering meat quality such as flavour, aroma and off-flavour descriptors (Dyubele et al., 2010). Consumers need to know the factors that affect meat flavour as these factors contribute to lower off-take of village chicken (Jaturasitha, 2004). Little has been done on the factors such as age, breed, sex, medication used for treatment of internal parasites and type of feed in relation to meat quality of village chickens. In addition, off-flavour descriptors are rarely considered when evaluating sensory characteristics (Cameron et al., 2000), whereas, they negatively affect consumer's decision of purchasing meat (Muchenje et al., 2009). Therefore, the objective of the study was to determine the relationship between sensory characteristics for village chicken meat and the effect of medicinal plants on chicken sensory quality.

MATERIALS AND METHODS

Study site

The chickens were raised at Fort Cox College of Forestry and Agriculture, while sensory evaluation was done at the University of Fort Hare, both in the Eastern Cape Province of South Africa. University of Fort Hare (UFH) is situated in Alice town at latitudes 32° 46` S and longitudes 26° 52` E and 520m above sea level in the False Thornveld of Eastern Cape in South Africa. The Fort Cox College is approximately 580 m above the sea level at latitudes 27° 03` N and 32° 45` E of longitudes. The college receives 550 mm of rainfall per year of which much of it is in summer. A total of 42 village chickens were purchased from Zixenene in Amathole Basin. Amathole basin is situated in latitudes 32° 29` 65`` S and longitudes 28° 17` 80``E and 476 m above sea level. The place receives 700 - 1000 of rainfall per annum of which most of it comes in spring and summer (October - March).

Management of chickens, handling and slaughter procedure

Forty two village chickens with the mean (± standard error) live weight of 1.36 ± 0.667 were kept for 14 days at Fort Cox College until they were slaughtered. They were in a house where temperatures and ventilation were not artificially controlled. The floor was covered with dry wood shavings bought in Alice town. The chickens were identified by wool threads of different colours in each group depending on the type of treatment given to them. The wool threads were tied on their legs, they were all given 600 g of yellow maize mixed with wheat bran at a ratio of 3:1 per treatment per day as shown in Table 1. In the day of slaughter, feed was withdrawn from the chickens and they were taken to the slaughterhouse. During slaughtering, the chickens were allowed to bleed for 5 min to enhance meat tenderness. Boiled water was used for easy plucking of feathers, after which the chickens were eviscerated. The carcasses were weighed warm an hour after slaughter and as cold after 24 h. After slaughter, the chicken meat was kept in a refrigerator at 2°C for 7 days. Thereafter, the meat was separated into five samples according to how the chickens were treated. The meat was prepared by cutting small pieces of the breast muscle using the same method of cooking in all the five samples.

Consumer sensory evaluation

Meat preparation

The meat was cooked on an ordinary kitchen stove and salt was added to enhance taste. The pieces were cooked at a temperature of 70°C. Each sample was cooked separately as they were given different treatments. At the end of cooking, every piece was allowed to cool to 50°C. Samples of the breast muscle were put in a big bowl and were randomly allocated to the participants at the same time ensuring that each participant tasted meat from all the samples.

Consumer acceptability scores

Sixty four panellists were trained for sensory evaluation of village chicken meat. These participants composed of different students and staff members from the University of Fort Hare. The gender, age and tribe of the panellists were different in order to establish any differences in the tasting of meat using a sensory evaluation form. Gender was categorised into male and female, age was categorised into ≤20 years, 21 - 25 years, 26 - 30 years and ≥30 years and the tribal groups were Xhosa, Zulu, Shona, Ndebele and the others (small group of other tribes). The participants were

Table 2. Least square means and standard errors of means (S.E.) of treatment effects on sensory characteristics of chickens.

Sensory characteristic	*Agave sisalana* (200 mg/kg dose)	*Aloe ferox* (200 mg/kg dose)	Distilled water (0 level)	*Gunnera perpensa* (200 mg/kg dose)	Mebendazole (1 ml/kg dose)	P-value
Aroma intensity	5.5 ± 0.32 [a, b]	5.8 ± 0.32 [b]	6.1 ± 0.32 [b]	5.0 ± 0.32 [a]	6.0 ± 0.32 [b]	**
Initial Impression	4.8 ± 0.27 [a]	5.5 ± 0.27 [b]	5.7 ± 2.27 [b]	5.0 ± 0.27 [a]	5.4 ± 0.27 [b]	**
Connective Tissue	4.1 ± 0.26 [a]	4.7 ± 0.25 [b, c]	4.8 ± 0.25 [b, c]	4.4 ± 0.26 [a, b]	5.0 ± 0.26 [c]	**
Off-flavour	3.6 ± 0.32	3.6 ± 0.32	3.8 ± 0.32	3.8 ± 0.32	3.9 ± 0.32	NS

[a, b, c] Means with the same superscript in the same row are not significantly different. Significant difference **P < 0.01, NS = no significant difference.

Table 3. Least square means and standard errors of means (S.E.) of sensory scores of chicken due to the effect of age of consumers.

Sensory characteristic	≤20 years	21 - 25 years	26 - 30 years	>30 years	P-value
Aroma intensity	6.2 ± 0.44 [b]	5.4 ± 0.24 [a, b]	5.2 ± 0.35 [a]	6.6 ± 0.35 [b]	*
Initial Impression	5.0 ± 0.37 [a]	5.1 ± 0.20 [a]	5.1 ± 0.29 [a]	5.9 ± 0.30 [b]	*
Off-flavour	3.4 ± 0.44 [b]	4.0 ± 0.23 [b, c]	3.2 ± 0.35 [a]	4.4 ± 0.35 [b]	**
Overall flavour	6.4 ± 0.37 [a]	5.7 ± 0.20 [b]	4.6 ± 0.30 [c]	5.9 ± 0.30 [a, b]	***

[a, b, c] Means with the same superscript in the same row are not significantly different. Significant difference *P < 0.05, **P < 0.01 and ***P < 0.001.

trained on how to complete the form. A structured category scaling, with verbal descriptors was used to evaluate samples for aroma intensity, initial impression of juiciness, first bite, sustained impression of juiciness, muscle fibre and overall tenderness, amount of connective tissue, overall flavour intensity and off-flavour intensity and off-flavour descriptors according to ISO 8586-1, 1993.

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 village chicken 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.

RESULTS

There were significant treatment effects on the sensory characteristics (Table 2) of the village chicken meat. Aroma and initial impression of juiciness scores were highest (P < 0.01) for chickens treated with A. ferox, distilled water and Mebendazole than for those treated with A. sisalana and G. perpensa. As for the impression on first bite, all the treatments were not (P > 0.01) different except for the amount of connective tissue scores that were lower (P < 0.05) for chickens treated with A. sisalana, A. ferox and G. perpensa.

The scores given by consumers for the sensory characteristics by age are presented in Table 3. Consumers older than 30 years of age gave higher (P < 0.05) scores for aroma intensity and initial impression of juiciness. There were significant differences (P < 0.001) in the scores given by the consumers for overall flavour intensity. The age group <30 years also gave higher scores (P < 0.05) for aroma intensity and for overall flavour (P < 0.001). The lowest scores (5.2 ± 0.35) were given by the age group between 26 - 30 years. Table 4 shows that there were significant tribe effects on the sensory characteristics of chicken meat, such as aroma intensity, initial impression of juiciness, off-flavour and overall flavour intensity. Other tribes (small different group of people) gave higher scores for aroma, initial impression of juiciness and overall flavour. The tribe that gave lower (5.0 ± 26) scores for aroma intensity and overall flavour (4.9 ± 22) were the Xhosa's. The gender effects on sensory characteristics were significant as indicated on Table 5. Females gave higher (P < 0.01) scores for aroma intensity, initial impression of juiciness (P < 0.05) and for overall flavour (P < 0.01).

There were significant correlations between sensory characteristics of village chickens on Table 6. The correlation between aroma, overall flavour and off flavour intensity scores were not accepted although the other sensory characteristics were positively correlated (P < 0.001). There was an association between initial impres-sion of juiciness and first bite (r = 0.58), initial impression and sustained impression of juiciness (r = 0.69), initial impression of juiciness and amount of connection tissue (r = +0.32) and initial impression of juiciness and muscle fibre (r = +0.45). In addition, association between sustained impression of juiciness and first bite (r = +0.54), sustained impression of

Table 4. Least square means and standard errors of means (S.E) for sensory characteristics of chicken by tribe of consumers.

Parameter	Tribe					P-value
	Xhosa	Zulu	Shona	Ndebele	Others	
Aroma intensity	5.0 ± 0.26 [a]	5.7 ± 0.87 [ab]	5.1 ± 0.21 [a]	5.2 ± 0.39 [a]	7.3 ± 0.45 [b]	***
Initial impression	5.4 ± 0.22 [b, c]	5.2 ± 0.74 [a, b, c]	4.6 ± 0.18 [a]	4.9 ± 0.33 [a, b]	6.2 ± 0.39 [c]	**
First bite	5.4 ± 0.23 [b]	6.1 ± 0.78 [b]	4.7 ± 0.19 [a, b]	5.5 ± 0.35 [b]	5.6 ± 0.40 [b]	*
Off- flavour	3.7 ± 0.26 [b]	1.8 ± 0.88 [a]	4.3 ± 0.21 [b]	3.4 ± 0.40 [a, b]	5.6 ± 0.46 [c]	***
Overall flavour	4.9 ± 0.22 [a]	6.4 ± 0.75 [b, c]	5.5 ± 0.18 [b]	5.0 ± 0.34 [a, b]	6.4 ± 0.39 [c]	***

[a, b, c] Means with different superscripts in the same row are significantly different. Significance difference *P <0.05, **P < 0.01 and ***P < 0.001.

Table 5. Least square means and standard errors of means (S.E.) of gender of consumers` effects on sensory characteristics of village chicken.

Sensory characteristics	Male	Female	P-value
Aroma intensity	5.3 ± 0.25 [a]	6.1 ± 0.30 [b]	**
Initial Impression	5.0 ± 0.21 [a]	5.5 ± 0.26 [b]	*
First Bite	5.3 ± 0.22	5.6 ± 0.27	NS
Off-flavour	3.7 ± 0.25	3.9 ± 0.30	NS
Overall flavour	5.3 ± 0.22 [a]	6.0 ± 0.26 [b]	**

[a, b, c] Means with different superscripts in the same row are significantly different. Significantly correlated at * P < 0.05, ** P < 0.01 and *** P < 0.001.

Table 6. Correlations among sensory characteristic of village chicken meat. Significantly correlated at ** P < 0.05, *** P < 0.001.

Sensory Characteristic	Aroma intensity	Initial impression of juiciness	First bite	Sustained impression of juiciness	Muscle fibre	Connective tissue	Overall flavour	Off-flavour
Aroma intensity	-	0.442***	0.367***	0.379***	0.325***	0.24***	0.55***	0.247***
Initial impression	-	-	0.584***	0.687***	0.450***	0.324***	0.297***	0.286***
First bite	-	-	-	0.539***	0.571***	0.437***	0.222***	0.122**
Sustained impression	-	-	-	-	0.419***	0.252***	0.297***	0.271***
Muscle fibre	-	-	-	-	-	0.541***	0.333***	0.221***
Connective tissue	-	-	-	-	-	-	0.347***	0.175***
Overall flavour intensity	-	-	-	-	-	-	-	0.384***
A-typical flavour intensity	-	-	-	-	-	-	-	-

juiciness and connective tissue (r = +0.25), sustained impression of juiciness and muscle fibre (r = +0.42) was significant (P < 0.001). There was a positive association between muscle fibre and connective tissue (r = +0.54) (P < 0.001).

DISCUSSION

Consumers preferred meat treated with Mebendazole, A. ferox and distilled water more than any other meat because of its tenderness as indicated by the sensory evaluation. Village chicken meat is tender than broilers, this is in agreement with findings by Fanatico et al. (2007). Meat tenderness has been described to be the most determining factor to meat acceptability (Strydom et al., 2000). This is due to the amount of connective tissue present as the amount of connective tissue is the contributing factor on sensory characteristics (Muchenje et al., 2008a). Although the chickens were cooked using ordinary stove than those cooked using a microwave (Waskar et al., 2009), the quality of meat was not affected by the medicinal plants used in terms of aroma, initial impression of juiciness and connective tissue. Tenderness of meat also depends on the type of muscle (Muchenje et al., 2010) and the tender the meat the higher it is acceptable to consumers (Waskar et al., 2009).

Higher scores for sensory characteristics means that medicinal plants (A. ferox and A. sisalana) destroyed the impact of intestinal parasites hence meat quality was improved (Mwale and Masika, 2010). This gives a clear understanding that chickens even if they are treated at the age of less than 6 months, their meat quality does not change (de Almeida and Zuber, 2009). Off-flavour is undesirable and must be taken into account when determining causes of acceptability of chicken meat by consumers (Kishowar et al., 2006).

The off-flavour scores given by consumers contradict with the report of Muchenje et al. (2010), as flavour and aroma scores are high, off-flavour scores must be low. This shows that chickens were not affected by the treatments given although off-flavour scores were also high as flavour and aroma scores. Meat from chickens treated with A. ferox and distilled water was juicer although they had lower connective tissue. Muchenje et al. (2010) reported that higher amount of connective tissue increases the ability of the muscle to hold water hence initial impression of juiciness.

The consumer gave different scores for aroma because the results for group of panellists over 30 years were different from those given by panellists between 26 – 30 years. The study agrees with what was reported by Dyubele et al. (2010), the perception of chicken meat is determined by the background of the consumer. Panellists above 30 years old gave the highest scores for aroma intensity and initial impression of juiciness because of their experience. The Xhosa tribe gave lower scores for aroma intensity and overall flavour than the other tribe and the Shona tribe. This is in agreement with the report by Dyubele et al. (2010). Consumers believe that meat from village chickens is tastier than meat from broilers. This agrees with finding by Jahan et al. (2005) and Jaturasitha et al. (2008) that village chicken meat has unique characteristics such as low fat which makes it more ideal for the health status of communal farmers but this is in contrast with findings by Dyubele et al. (2010).

There were tribe effects on off-flavour scores given by the Zulu's hence these may be due to the volatile compounds that develop in meat during cooking (Alian and Farmer, 2006). According to Muchenje et al. (2008b), undesirable flavours that develop in meat are due to nutrition, type of muscle and method of cooking. Consumer's report agrees with the findings by Dyubele et al. (2010), that there were no significant gender effects on chicken meat.

The positive correlation between aroma and flavour scores was expected because flavour is a very complex attribute of meat palatability (Calkins and Hodgen, 2007; Muchenje et al., 2010; Dyubele et al., 2010), as aroma intensifies, so is the flavour. In addition, flavour is the combination of aroma and taste. Simela (2005) defined flavour as a result of sensory volatile substances by the nasal cavities; therefore as the smell increases, flavour is likely to be acceptable to the consumers. According to Fanatico et al. (2007), flavour and aroma come from the materials present in fat which become volatile when heated. In addition, in poultry meat there are 450 compounds that result in flavour (Parker et al., 2006). Many studies (Parker et al., 2006) have identified that natural components such as A. ferox have little aroma in meat until during cooking; complex processes such as lipid oxidation, thermal degradation of thiamine and Millard reactions react to enhance chicken flavour (Aliani and Farmer 2006; Dyubele et al., 2010). The composition and amount of fat also determine the intensity of flavour in meat (Muchenje et al., 2010) and these give a challenge that fat composition should be observed in village chickens as it was not done in the current study.

Waskar et al. (2009) indicated that addition of herbal product improves collagen and myofibrillar solubility and hence flavour. Aroma and off-flavour, overall flavour intensity and off-flavour are positively correlated and this indicates that panellists were not familiar with the terms used for sensory characteristics even though they were trained (Fanatico et al., 2007). Despite the fact that the panellists were trained before sensory evaluation was done, they were unable to differentiate flavour and off-flavours together with aroma and off-flavours. The negative correlation between flavour and off-flavour scores was due to natural degradation of nitrogen containing compound during aging of meat. There are few studies that have been done on sensory evaluation of indigenous meat, (Muchenje et al., 2010). Off-flavour scores and flavour scores maybe independent of each other because of the complex nature of flavour.

The positive correlation among the amount of connective tissue, muscle fibre and overall tenderness was also reported by Muchenje et al. (2008b). According to Fanatico et al. (2007), the diameter of the muscle fibre is positively related to the tenderness of meat. The size of the muscle fibre and sarcomere length can influence the tenderness of meat. Sarcomere is the basic unit of cross striated myofibril that are assembled together. The longer the sarcomere the more tender the meat hence tenderness is important because it increases consumer acceptability, helps in product development, increases shelf life of meat and meat product and it also assists in quality control (Strydom et al., 2000).

Conclusion

Chicken meat from village chickens treated with medicinal plants especially A. ferox, Mebendazole, A. sisalana and distilled water had a good flavour, tender and also the meat was juicier. It can therefore be recommended that A. ferox and A. sisalana can be used in treating village chickens for it does not affect meat quality characteristics for human consumption.

Studies can be done to determine the perception of consumers on off-flavours that develop in village chicken meat. Furthermore, fat levels and the amount of unsaturated fatty acids in village chicken meat can also be evaluated due to sensitivity of chicken meat to oxidative processes.

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