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EFFECT OF TURMERIC (*Curcuma longa*) EXTRACT ON THE TENDERIZATION OF SPENT LAYERS MEAT

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Abstract

The study investigated the impact of turmeric extract on the tenderness and overall acceptability of spent layer hen meat. Twenty hens were used, and their meat was marinated with different levels of turmeric extract (0%, 5%, 10%, and 15%). The higher the inclusion level of turmeric extract, the greater the improvement in meat tenderness. Specifically, the meat marinated with 15% turmeric extract exhibited the best tenderness and overall acceptability. The research also assessed other quality parameters, including cooking loss, water holding capacity, pH, temperature, oxidative rancidity, flavor, juiciness, texture, and color. The results showed significant differences among the treatments. For instance, the meat from 15% turmeric extract had the lowest cooking loss and highest water holding capacity. Furthermore, sensory evaluation by the panelists indicated that meat marinated with 15% turmeric extract scored highest in terms of flavor, juiciness, texture, tenderness, and overall acceptability. In conclusion, the study highlights the potential of turmeric extract as a natural meat tenderizer, providing valuable insights for improving the quality of spent layer hen meat for consumers. From the results obtained in this research, it was observed that greater tenderness and overall acceptability were achieved with 15% turmeric extract.

Keywords: Turmeric extract, spent layer, tenderization, sensory evaluation, meat quality and shear force

INTRODUCTION

The demand for high-quality meat, particularly white meat, has increased (Mullena *et al*., 2017). The sensory enjoyment of meat is influenced by three main attributes: flavor, juiciness, and tenderness (Aaslyng & Meinert, 2017). Tenderness, in particular, plays the most significant role in consumer purchasing decisions (Mennecke, Townsend, Hayes, & Lonergan, 2007). The tenderness of meat is influenced by several factors, which can be considered sequentially.

Spent layers are raised for egg-laying, and when their productivity declines, their meat becomes tough. Many attempts have been made to tenderize and improve the quality of meat from spent layers. The growth of the poultry industry has led to an increased availability of layers for meat at the end of their productive life, but their meat tends to be tough, dry, and sinewy (Mediratta *et al*., 2004). Finding ways to utilize this class of poultry with tough meat, such as developing further processed products from spent hen meat, would be profitable. Restructured meats, which involve designating and particle size reduction followed by forming into steaks, roasts, or patties, offer advantages like value enhancement, portion control, uniform quality, and consumer convenience (Hedrick *et al*., 1994).

Various methods have been used to physically tenderize meat, including pressure treatments, electrical stimulation, and the use of proteolytic enzymes derived from plants such as papain, bromelain, and ficin (Wada *et al*., 2002). Turmeric contains proteolytic plant enzymes, making it a potential meat tenderizer.

Curcuma longa rhizome, known as turmeric, is a spice used in food preparations for its flavor, color, and antioxidant properties, mainly due to the presence of curcumin, a curcuminoid and a major component of turmeric. Curcumin exhibits primary antioxidant effects against oxygen free radicals, breaking the oxidant chain reaction with its conjugated structure (Naganuma *et al*., 2006, Puangsombat *et al*., 2011; Sharma *et al*., 2012).

The aim of this study is to investigate the effect of the endogenous enzyme level of turmeric as a meat tenderizer on spent layer meat.

Materials and methods

Experimental site

This experiment was carried out at Animal Products and Processing Lab and Post-Graduate Laboratory, Department of Chemistry, Faculty of Natural Science, University of Jos, Jos Plateau state. On latitude 9.9181ºN and longitude 8.8804ºE

Methodology

An experiment was carried out on 20 spent layers' hen. The birds were slaughtered following standard procedure, dressed hygienically and manually deboned. The fresh turmeric was purchased at Fari gada market, washed and blended with distilled water and the deboned spent hen meat was cut into primal cut. The breast, thigh and drumstick were mainly used. The marinated carcass was kept in the refrigerator at the temperature of 4^0C overnight to ensure easy mincing and marinated in 0%, 5%, 10%and 15% inclusion levels respectively.

On the basis of this experiment, the following meat quality and tenderness parameters were evaluated.

Shear Force Value

The objective evaluation of tenderness was performed using the modified Warner Bratzler shear force procedure (Bouton and Haris, 1978). Meat samples were wrapped in aluminum foil and cooked to an internal temperature of 75°C as measured using Fluke type K temperature probe attached to Fluke 52 m. Three cores of 1.0 cm2 were removed from each sample using an electrical coring machine. Each core was shared at three locations parallel to the orientation of muscle fibre, using a Warner Bratzler shear force instrument.

Cooking yield

The weight of meat was recorded before and after cooking and the yield was expressed as percentage.

$$\text{Cooking yield} = \frac{\text{Weight of cooked meat}}{\text{Weight of raw meat}} \times 100$$

Water holding capacity

Water Holding Capacity (WHC) was determined according to Wardlaw, Maccaskill, and Acton (1973). Minced meat (20 g) was placed in a centrifuge tube containing 30 ml of 0.6 M NaCl and was stirred with glass rod for 1 min. The tube was then kept at 4 ± 1 °C for 15 min, stirred again and centrifuged at 3000g (R-24, Remi Instruments, India) for 25 min. The supernatant was measured and WHC was expressed in percentage.

Determination of extract release volume (ERV)

The technique was first described in Jay, 1964, has been shown to be a value in determining incipient spoilage in meat as well as in predicting refrigerator shelf life.

Requirements: Beaker, distilled water, Whatman No. 1 filter paper, pestle and mortal, graduated cylinder.

Procedure

a) Take 25 g meat sample in 100 ml distilled water

b) Bend it with in pestle and mortal

c) Filter through What man No. 1 filter paper, folded thrice so as to make eight sections.

d) Allow the homogenate to seep between the folds

e) Collect the extract in 100 ml graduated cylinder for 15 min.

f) Record extracts release volume and interprets results

Interpretation:

ERV (ml) Meat quality

> 25 ml Good quality

> 20 ml Incipient spoilage

< 20 ml Spoiled meat

pH

The pH value of raw and cooked meat samples will be determined by weighing 10 grams of sample into a blender with 90ml of distilled water and homogenized until smooth slurry was formed. The digital pH meter was placed in a buffer solution in order to allow equilibrium for two minutes before placing it into prepared slurry. An average of three readings taken gave the pH value according to method described by AOAC (2000).

Temperature

The was determined using a probe meter as described by AOAC (2000).

Oxidative rancidity

Thiobarbituric acid value (TBA) was estimated by modified methods of Buege and Aust (1978). Three mls each of glacial acid and 1% TBA solution were added to test tubes appropriately labelled blank and tests. 0.6ml of distilled water was added to the blank, while 0.6ml of the homogenised sample was added to each of the test-tubes. These were thoroughly mixed, incubated in a boiling water bath for 15 minutes, then allowed to cool, after which they were centrifuged and their supernatants collected. The supernatant from the blank was used to zero the spectrophotometer (preset at 532nm) before reading the absorbance of the supernatant from the test solutions.

The amount of TBARS was expressed as milligrams of malondialdehyde per gram of sample.

$$TBA = \frac{O.D \times V \times 1000}{A \times v \times I \times Y}$$

Where:

O.D = Absorbance of test at 532nm.

V= Total volume of the reaction mixture = 6.6mL

A= Molar extinction coefficient of the product, and according Buege and Aust (1978) is equal to 1.56×10^5

I= Length of light path =1cm.

Y= mg of tissue in the volume of the sample used.

v= volume of tissue extract used =0.6ml

Sensory evaluation

A total of 20 trained individuals aged between 20 and 40 years were used to assess two replicates of the prepared sausage. The samples were evaluated using a 9-point hedonic scale for flavor, colour, juiciness, tenderness, and overall acceptability The scale had a maximum score of 9 while the lowest score of 1 was assigned to the poorest condition (Mahendraker *et al.*, 1988).

Experimental Design and layout

Completely randomized design was used for this experiment.

Data analysis

The data obtained was statistically analyzed with the SPSS program for Windows (SPSS version 11.5, SPSS Inc., Chicago, IL, USA). Duncan's multiple-range test was used to compare the different between the means.

RESULTS

Figure 1: Shows the shear force of spent layers' meat tendered with turmeric extract. The results obtained show a consistent pattern. As the levels of inclusions increased, the shear force value decreases. 15% of turmeric extract had the lowest shear force value while control without turmeric extract had the highest shear force values.

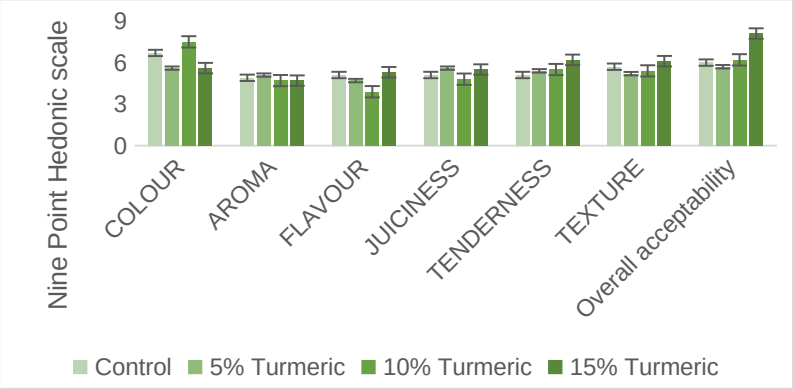


Figure 1: Shear force of the spent layer's meat tendered with turmeric extract

The cooking loss of meat from spent layer tendered with turmeric extract is shown in Table 1. There were significantly differences in cooking loss of meat from breast, drumstick and thigh muscle. Control treatment had the highest cooking loss for breast meat while meat from 15% turmeric extract had the lowest cooking loss of (24.75%).

Table 1: Cooking loss of spent layers meat tender with turmeric extract

Parameters	Control	5% Turmeric	10% Turmeric	15% Turmeric	SEM
Cooking loss of Breast meat	35.90^{a}	30.50^{b}	29.43^{b}	24.75^{c}	1.31
Cooking loss of Drumstick meat	22.73^{c}	41.42^{a}	21.11^{c}	31.01^{b}	2.50

Cooking loss of thigh meat	40.83[a]	28.95[c]	34.86[b]	32.03[b]	1.49

[abc] Means on the same row with different superscripts are significantly different ($p<0.05$)

SEM= Standard Error mean

The water holding capacity and extract released volume of meat from spent layer tendered with turmeric extract results was showed in Table 2. A consistent value was observed for water holding capacity. As the inclusion level increased, the water holding capacity increases. More so, the extract released volume result shows that the control had the lowest value of (17.50%) without turmeric extract while spent layer meat tendered with turmeric extract at 5% had the highest value of (43.75%).

Table 2: Physical evaluation of spent layers meat tender with turmeric extract

Parameters	Control	5% Turmeric	10% Turmeric	15% Turmeric	SEM
Water holding capacity	33.33[c]	68.33[b]	70.00[b]	85.83[a]	5.80
Extract released volume	17.50[c]	43.75[a]	23.75[b]	28.75[b]	3.28

[abc] Means on the same row with different superscripts are significantly different ($p<0.05$)

SEM= Standard Error mean

All the chemical evaluation parameters were represented in Table 3. There were significant differences in all the parameters measured. The mean pH value was higher in meat from 15% turmeric extract while the control meat had the lowest pH value. Control without the extract had the temperature value of 24.05 ^{o}C, with the lowest in 10% and 15% inclusion level of the extract of 23.50 ^{o}C. Spent layer meat oxidative rancidity was higher in control with 0% inclusion level with lowest in meat from 15% turmeric extract.

Table 3: Chemical evaluation of spent layers' meat tender with turmeric extract

Parameters	Control	5% Turmeric	10% Turmeric	15% Turmeric	SEM
pH	6.55[b]	6.65[ab]	6.65[ab]	6.70[a]	0.02
Temperature ^{o}C	24.05[a]	23.55[b]	23.60[b]	23.50[b]	0.07
Oxidative rancidity	3.63[a]	2.93[b]	2.46[b]	2.33[b]	0.14

[abc] Means on the same row with different superscripts are significantly different ($p<0.05$)

SEM= Standard Error mean

Data on the sensory evaluation of meat containing various levels of turmeric extract as natural tenderizer are presented in Figure 2. 10% turmeric extract had the highest colour while meat from 15% turmeric extract had the highest flavor, juiciness, texture, tenderness and overall acceptability.

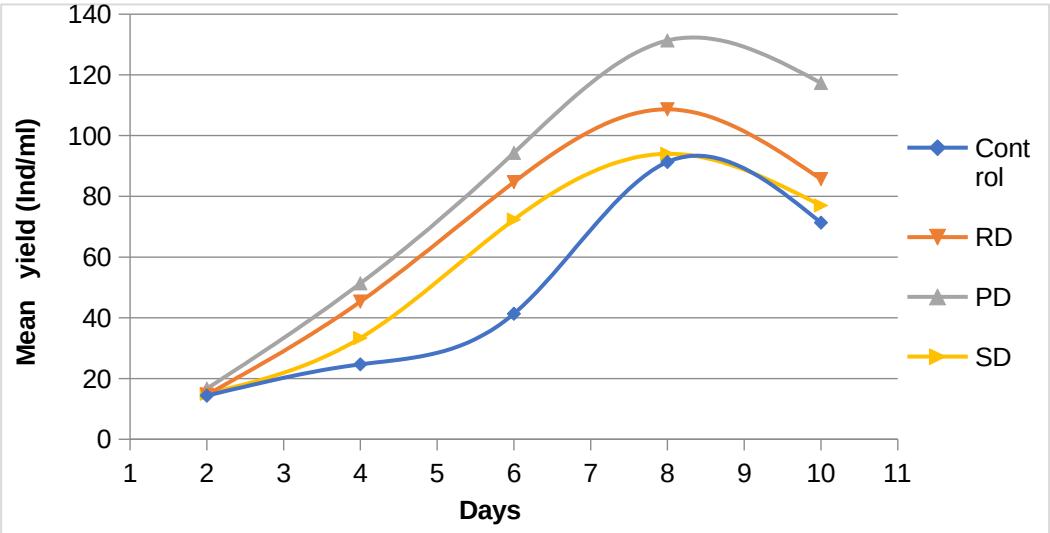


Figure 2: Sensory Evaluation of spent layers' meat tender with pawpaw leave extract

DISCUSSION

The objective evaluation of tenderness was perform using the modified Warner Bratzler shear force procedure (Bouton and Harris, 1978) compared to Mohammed (1998). The shear force values indicate tenderness of meat. When the value obtained is higher, it denotes that the meat will be tough but when the values obtained was lower, it shows that the meat will be tender. In this study a trend was observed in the shear force value of the meat. As the inclusion levels of turmeric extract increased, there was decrease in the shear forces. These results might be attributed to the effect of proteolytic enzyme found in the turmeric which may lead to more degradation and availability of dietary protein. Shear force values in our experiment are in agreement with Naveena *et al.,* 2004 reported significant reduction of shear force value in all enzyme treated samples compared to control. Similar result was also obtained in the work of Verma, *et al*. (2018).

The cooking loss of meat from spent layer tendered with turmeric extract is shown in Table 1. There were significantly differences in cooking loss of meat from breast, drumstick and thigh muscle. Control treatment had the highest cooking loss for breast meat while meat from 15% turmeric extract had the lowest cooking loss of (24.75%). The Reduction in the yield of turmeric treated samples may be due to lower pH, which in turn reduced the water holding capacity

The water holding capacity (WHC) is the ability of meat to hold water after external pressure was applied. Turmeric treated sample had higher WHC than control which are in agreement with Naveena and Mendiratta (2001). WHC of papain treated sample was in between the broiler and ginger treated samples. Khanna and Panda (2007) reported increased WHC of spent hen meat treated with papain and Naveena *et al.,* (2004) reported similar results in buffalo meat treated with ginger extract.

Extract released volume is a technique that is based on the volume of aqueous extract released by homogenate of meat when allow to pass through the filter paper for a given period of time, by this meat of good organoleptic and microbial quality release large volume of extract, whereas meat of poor-quality releases smaller volume or none. The result obtained shows that as the inclusion level increased the meat organoleptic and microbial quality was improved. This could be due to phytochemical substances present in the turmeric extract.

All the chemical evaluation parameters were represented in Table 3. There were significant differences in all the parameters measured. The mean pH value was higher in meat from 15% turmeric extract while the control meat had the lowest pH value.

Control without the extract had the temperature value of 24.05 ^{o}C, with the lowest in 10% and 15% inclusion level of the extract of 23.50 ^{o}C,

Spent layer meat oxidative rancidity was higher in control with 0% inclusion level with lowest in meat from 15% turmeric extract.

The sensory evaluation of spent layers' meat fed turmeric extract shown in Figure 2 reveals that meat from 15% turmeric extract had the highest flavor, juiciness, texture, tenderness and overall acceptability. The result obtained in this result was not in agreement with those who reported by (Black Shear *et al,* 1966).

CONCLUSION

This study demonstrated that marinating spent layer meat with turmeric extract overnight before cooking improved its flavour, juiciness, tenderness and water holding capacity. It also reduced the shear force of the meat thereby making it more tender and acceptable. From the result obtained from this research it is clear that turmeric extract has a tenderizing effect on spent layer meat and it was observed from the result obtained from the sensory panels that greater tenderness and overall acceptability was achieved at 15% turmeric extract.

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