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Proximate Composition and Sensory Evaluation of Mutton of West African Dwarf Sheep Fed Garlic Powder Supplemented Diets

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Abstract **Original Research Article**

Chemical and sensory characteristics of West African Dwarf (WAD) rams fed diets supplemented with garlic powder at varying levels were evaluated in this study. Raw and cooked meats from primal-cuts of the experimental animals were sampled to determine their chemical composition. Untrained panelists were used to evaluate the meat samples for sensory attributes such as: flavour, aroma, texture, juiciness, tenderness and overall acceptability of cooked primal-cut samples using nine-point scoring scale. Results from the chemical composition of the raw meat samples indicated that an increase in the level of inclusion of garlic powder influenced significantly ($p<0.05$) crude protein content of round and loin cuts. The highest raw and cooked values for crude protein contents were recorded in the loin cut, of treatment 5(8% garlic powder) and shoulder cut of treatment 4 respectively. There was no significant difference ($p>0.05$) among the treatment groups for chemical constituents of raw rib and shoulder cuts, while crude protein and moisture contents of the cooked round, rib, loin and shoulder cuts were mostly influenced by the dietary treatments in the study. Significant differences ($p<0.05$) were observed among the treatment groups for flavour and tenderness. The study concluded that the chemical constituents and overall acceptability of cooked meat products from WAD fed garlic powder supplemented diets were enhanced irrespective of their cut parts.

Keywords: chemical composition, sensory properties, garlic powder, West African Dwarf ram and primal-cuts.

INTRODUCTION

Lamb meat is an important source of protein, fat and trace elements [1, 2]. Nutritional factors have significant effects on biochemical, structural and metabolic characteristics of muscles, nutritive values, organoleptic properties and acceptability of meat from ruminants [3, 4]. Meat quality attributes are function of both sensory and chemical attributes [5] such as flavour, appearance, nutritional composition and microbiological safety of the finished product [6] of which tenderness and juiciness are part of the measures of overall meat eating quality [7]. Consumers usually assess meat qualities on the basis of sensorial properties such as appearance (colour), juiciness, aroma, tenderness and flavour of meat [8]. These sensory attributes with the combination of chemical composition of meat sometimes influence consumer to make purchasing decision [9]. There is need to enhance nutritive and eating values of lamb meat through dietary supplementation of spices and herbal plants which are of high bio-active properties. Garlic (*Allium sativum*) is well known as a spice and herbal medicine [10].

Tekeli A, Kutlu HR, Celik L *et al*. [11, 12] have reported positive effects of herbal supplements on production performance and carcass quality. The study is aimed at investigating the impact of feeding garlic powder supplementation on nutritional values and sensory properties of mutton of WAD rams.

MATERIALS AND METHOD

Location of Experimental Site

The experiment was conducted at the small ruminant unit of Teaching and Research Farm, of the Faculty of Agricultural Sciences, Ekiti State University, Ado-Ekiti. Analytical procedures and sensory assessments were conducted at laboratory section of Animal Science Department, Ekiti State University, Ado-Ekiti.

Experimental Animals and their Management

Forty yearling West African Dwarf rams of an average weight of 15kg were used for this study. Each animal was kept in a partitioned pen. The animals were allowed to acclimatize for a period of three weeks during which they were quarantined; water, *Panicum maximum* and dried cassava were provided *ad-libitum*.

The feeding lasted for 90 days and the animals were raised under intensive system.

Experimental Design

The experimental rams were grouped into five treatments consisting of four duplicates with two animals per duplicate in a complete randomized design. Treatment one (T1) were rams fed 0 % garlic, Treatment two (T2) fed with 2 % garlic powder, Treatment three (T_3) fed 4% garlic powder, Treatment four (T_4) fed with 6% garlic powder and Treatment five (T_5) fed 8% garlic powder supplementation.

Table-1.0: Composition of experimental diets (%)

	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Level of garlic inclusion	0%	2%	4%	6%	8%
Ingredients					
Soybean meal	10.0	10.0	10.0	10.0	10.0
Maize	35.0	35.0	35.0	35.0	35.0
Rice bran	15.0	15.0	15.0	15.0	15.0
Brewer's dry grain	37.5	37.5	37.5	37.5	37.5
Bone meal	1.0	1.0	1.0	1.0	1.0
Salt	1.0	1.0	1.0	1.0	1.0
Vitamin/mineral	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100
Calculated protein (%)	16.07	16.07	16.07	16.07	16.07
Calculated Energy(kcal/kg)	2605.7	2605.7	2605.7	2605.7	2605.7

Slaughtering process and dissection of retail cuts

At the end of 90 days feeding trial, the three rams between average weights of 20 to 25 kg were randomly selected from treatment group, severed at the jugular veins and carotid arteries of the neck region after feed withdrawal of 12 hrs [13]. Animals were thorough bled, skinned and eviscerated. The carcasses were split into two halves longitudinally along the median plane of the vertebrae using a sharp knife [14]. The half carcasses from the left side were jointed into five retail cuts (wholesale primal cuts) according to [15] namely ribs, loin, round (leg) and shoulder. All primal cuts were weighed and wrapped in a polythene bags thereafter kept chilled at 4ºC overnight prior analysis.

Determination of chemical compositions of samples

The contents of moisture, protein, fat and ash of meat samples were determined according to the procedures of [16]

Sensory evaluation

Meat samples of each primal cut from each treatment were collected after dissecting the lean (flesh) from the bone were chopped into an average of 50g and labeled for identification. Meat samples of each primal cut were wrapped in labeled polythene bags, cooked in water bath at a temperature of 75ºC for 25 minutes [17]. Ten untrained panelists were used in the assessment procedure. The panelist scored for, flavour, aroma, texture, juiciness and tenderness. Water and unsalted biscuits were served to the panelists between samples to clear and rinse their palate after each chew. The panelists scored each sample on a nine – point hedonic scale (9 = like extremely, 8 = like very much, 7 = like moderately, 6 = like slightly, 5 = neither like nor dislike, 4 = dislike slightly, 3 = dislike moderately, 2 = dislike very much and 1 = dislike extremely) [18]. Overall acceptability was scored on a three- point scale (1= least acceptable, 2 = more acceptable and 3 = most acceptable) [19].

STATISTICAL ANALYSIS

All data collected were analyzed using analysis of variance with the general linear model of [20].

RESULTS AND DISCUSSIONS

Proximate composition of primal cuts

The result of the proximate composition of the raw primal cuts is shown on table 2. The results of the proximate composition of raw primal cuts shows that crude protein of round and loin cuts were significantly influenced ($p<0.05$) by the dietary treatment, rib cut ranged from 22.38% (treatment 3) to 22.28 %(treatment 4), loin crude protein ranged from 21.91% (treatment 4) to 23.11% (treatment 5) and shoulder crude protein ranged from 21.64% (treatment 4) to 22.46% (treatment 1); fat content of round cut ranged from 5.08% (treatment 4) to 5.35% (treatment 1), fat content of rib ranged from 5.07% (treatment 2) to 5.75% (treatment 4); fat content of raw loin cut was influenced significantly ($p<0.05$) by treatment diets while raw shoulder fat content ranged from 5.05 % (treatment 3) to 5.60% (treatment 1). There were no significant differences ($p>0.05$) in the moisture contents of various raw cuts obtained from rams fed treatment diets. Results of the cooked cuts are revealed on table 3. The dietary treatments significantly influenced ($p<0.05$) crude protein, fat and moisture contents of cooked round and loin cuts; crude protein, ash and moisture contents significantly ($p<0.05$) differ in cooked rib cuts of rams, while dietary treatment influenced significantly($p<0.05$) crude protein and moisture contents in the cooked shoulder cuts of WAD rams fed treatment diets.

Sensory Evaluation

Table 4 shows the result of the sensory evaluation of the meat of WAD rams fed garlic powder supplemented diets. This study revealed that the dietary treatments did not significantly influence ($p>0.05$) the sensory properties such as aroma, juiciness, texture and overall acceptance. Significant difference ($p<0.05$) were observed in flavour and tenderness in meat of treatment group as measured by Panelists. Treatment 5 recorded significantly ($p<0.05$) highest values in aroma, flavor, tenderness, juiciness, texture and overall acceptability of the meat samples.

DISCUSSIONS

Proximate composition

The percentage moisture content was similar among dietary treatments in all primal cuts (round, rib, loin and shoulder). Generally; moisture content was high as observed in all raw cut parts. The values of moisture content obtained from various raw cuts parts were comparable with 74.55% from fresh camel and 72.69% fresh beef by [21] and 72.7% reported for raw mutton by [22]. The moisture values obtained by [23] in lamb were higher than those obtained in the study [24] found 75.23% moisture in lamb meat. Moisture content contributes immensely towards meat juiciness, texture, marbling and water activity in meat products. The crude protein obtained from various raw cuts parts were comparable to 21.96% in fresh camel and 18.96% fresh beef by [21] and 19% in mutton reported by [22]. The crude protein as obtained from all raw cuts of WAD rams fed garlic supplementation in the study were lesser than those reported by [14] in Yankasa rams; but similar to the range of 20.06 to 20.80% reported by [23] in lamb. The crude protein value obtained in raw loin cuts were very close to value of 21.00% reported by [25] in lamb loin chops. The ether extracts values obtained for all raw cuts (rib, round, loin and shoulder) fell within the range of 1.5 and 13.0% reported by [27, 23] reported lower fat content than those obtained in the study. Ether extracts obtained in the study from all raw cut parts of treatment groups were higher than the value of 1.86% reported by [26] for raw beef whereas [14] reported higher in Yankasa rams. Ash content of the raw rib, round, loin and shoulder cuts of WAD rams fed dietary treatments were lower than the values of 8.29% observed by [27] for raw beef but comparable to the value of 1.1% reported for mutton by [22] but were within the values reported by [14] in Yankasa rams and [23] in lamb. According to [28] chemical composition of raw meat may serve as a useful tool for the evaluation of the effect of husbandry practices, production and marketing on the nutrient composition of the muscles. All values obtained for chemical composition of raw primal cuts for moisture, protein, ash and fat fell within the standard composition for normal adult mammalian muscle of 75% moisture, 19% protein, 2.5% fat and 0.65% minerals (ash)[29].

The results of the cooked cuts were comparable to 59.4% and 28.2% for moisture and crude protein reported by [22] in cooked mutton [30] reported higher range value of 63.71% to 65.89% in mutton nugget. Protein found in cooked primal cuts was incomparable with 69.8 % reported by [31] in roast cooked pork loin. The results obtained for ether extracts were comparable with the findings of [26] in cooked meat product. The ash content obtained in the study varied numerically among WAD rams fed experimental diets for all cooked primal cuts. The nutritional value of cooked meat is more useful than raw as the cooked meat show actually consumed meat [32], it is also useful for determination of palatability and safety of final products [33]. Therefore, determinations of proximate composition of both cooked and raw meat were very important for the assessment of nutritive value of meat [22].

Sensory evaluation

The sensory results of flavour and tenderness aligned with the submission of others that nutritional factors have significant effects on organoleptic attributes and acceptability of meat from ruminants [4, 23]. No significance observed in aroma, juiciness, and texture as supported by [34] assertion that diet has little effect on sensorial properties of mutton. The study aligned with the view of others, that natural antioxidants have no effect on sensory characteristics such as aroma, juiciness and texture of meat [35]. Aroma was slightly perceptible in treatment groups, the result obtained supports the observation of [36] that as the fat of meat increases so does the flavour and is one of the main characteristics in evaluating the acceptability of mutton by consumer [23]. Safari E, Fogarty NM, Ferrier GR, Hopkins LD, Gilmour A [37] reported that the most important contributing sensory attribute to eating quality is tenderness and flavour while juiciness contributing to a lesser extent. The study showed that the flavor of treatment 5 cut was moderately liked as evidence that feeding garlic did not impact unpleasant odour on the product. Flavor is of primary importance among the attributes that make consumers buy and consume lamb [38]. Sample juiciness of all treatment groups and texture of treatments 4 and 5 were similar to those reported by [14] in ram. Juiciness of meat depends on the raw meat quality and on the cooking procedure [39] and is directly related to the intramuscular lipid and moisture content of the meat [40] Texture score was slightly fine in meat of WAD fed on treatment 5 (8% garlic inclusion) as compared with other test diets and agreed with the observation of [23] in lamb meat.

Table-2: Proximate composition of raw primal cuts of WAD rams fed garlic powder supplemented diets (%)

Muscle type	Parameters	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5
Round	CP	2086±0.27^{b}	21.71±0.13^{a}	22.25±0.73^{a}	22.01±0.78^{a}	22.74±0.26^{a}
	EE	5.35±0.13	5.14±0.05	5.08±0.14	5.08±0.14	5.17±0.12
	Ash	1.07±0.06	1.06±0.10	1.09±0.06	0.98±0.11	1.04±0.10
	MC	71.85±0.25	71.13±0.20	70.78±0.82	71.27±0.96	70.28±0.23
Rib	CP	22.03±0.30	21.69±0.55	21.38±0.00	22.28±0.70	21.46±0.17
	EE	5.28±013	5.07±0.06	5.10±0.00	5.75±0.05	5.27±0.21
	Ash	1.12±0.03	1.10±0.10	1.02±0.07	1.04±0.07	1.24±0.24
	MC	70.91±0.51	71.31±0.59	71.45±0.44	72.68±0.31	71.31±0.19
Loin	CP	22.37±0.47^{b}	22.37±0.43^{b}	22.29±0.76^{b}	21.91±0.55^{b}	23.11±0.61^{a}
	EE	5.60±0.10^{a}	5.17±0.06^{b}	5.06±0.16^{b}	5.04±0.23^{b}	4.69±0.18^{c}
	Ash	1.07±0.12	1.03±0.06	0.98±0.11	1.04±0.06	1.10±0.10
	MC	70.80±0.56	70.63±0.41	71.11±0.59	71.45±0.88	70.72±0.45
Shoulder	CP	22.46±0.41	22.23±0.24	22.29±0.85	21.64±0.31	22.12±0.67
	EE	5.60±0.35	5.14±0.06	5.05±0.05	5.23±0.15	5.23±0.06
	Ash	1.00±0.00	1.03±0.12	1.08±0.13	1.02±0.08	1.06±0.10
	MC	70.2±0.16	70.79±0.12	70.79±0.80	71.40±0.27	70.63±0.60

Mean ± standard deviation; a, b means of different superscripts on same row are significantly (P<0.05) different, Treatment 1- 0% garlic Treatment 2- 2% garlic, Treatment 3- 4% garlic, Treatment 4- 6% garlic, Treatment 5- 8% garlic; CP- crude protein, EE- ether extracts, MC- moisture content

Table-3: Proximate composition of cooked primal cuts of WAD rams fed garlic powder supplemented diets (%)

Muscle type	Parameters	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5
Round	CP	27.90±0.21^{b}	29.27±0.93^{a}	28.60±0.49^{a}	27.83±0.53^{b}	27.97±0.82^{b}
	EE	8.03±0.57^{a}	7.61±0.92^{a}	7.48±1.14^{a}	8.17±0.40^{a}	6.96±0.12^{b}
	Ash	2.77±0.50	2.84±0.72	2.83±0.65	2.90±0.72	2.90±0.72
	MC	58.62±0.39^{a}	56.37±0.27^{b}	5791±0.48^{b}	58.20±0.15^{a}	59.47±0.27^{a}
Rib	CP	28.66±1.11^{a}	27.83±1.27^{b}	28.50±0.85^{a}	28.20±0.9^{b}	29.77±0.96^{a}
	EE	8.12±0.33	7.51±0.70	8.18±0.56	8.16±0.94	8.30±0.50
	Ash	2.80±0.50^{b}	2.80±0.50^{b}	2.87±0.86^{b}	3.00±0.7^{a}	2.97±0.57^{a}
	MC	57.04±0.37^{b}	58.44±0.85^{a}	57.41±1.72^{b}	57.36±1.42^{b}	55.85±1.16^{c}
Loin	CP	28.7± 0.39^{b}	29.9±1.41^{a}	28.6±0.27^{b}	28.4±0.91^{b}	27.3±1.85^{b}
	EE	6.97±0.82^{b}	8.05±0.62^{a}	7.57±1.23^{b}	8.13±0.60^{a}	8.88±0.35^{a}
	Ash	2.80±0.67	3.10±0.53	2.90±0.63	3.00±0.44	2.90±0.30
	MC	57.8±0.71^{a}	55.2±1.10^{b}	57.9±0.24^{a}	57.2±0.87^{a}	57.6±0.01^{a}
Shoulder	CP	28.64±0.55^{b}	27.33±1.50^{b}	28.9±0.44^{b}	30.4±0.82^{a}	28.87±1.03^{b}
	EE	8.07±0.83	7.0±1.26	7.2±1.50	8.30±0.59	8.0±0.37
	Ash	2.80±0.07	2.90±0.64	2.80±0.07	2.80±0.06	3.00±0.44
	MC	56.53±1.33^{b}	59.03±0.68^{a}	57.77±0.86^{b}	55.21±0.95^{c}	57.02±1.34^{b}

Mean ± standard deviation; a, b, c means of different superscripts on same row are significantly (P<0.05) different, Treatment 1- 0% garlic Treatment 2- 2% garlic, Treatment 3- 4% garlic, Treatment 4- 6% garlic, Treatment 5- 8% garlic; CP- crude protein, EE- ether extracts, MC- moisture content

Table-4: Sensory quality of cooked loin muscle of WAD rams fed garlic powder supplemented diets

Items	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5
Aroma	4.00±0.55	4.60±0.14	4.00±0.41	4.80±0.05	5.00±0.01
Flavour	3.40±0.30^{c}	3.40±0.34^{c}	4.20±0.30^{b}	5.00±0.73^{a}	5.20±0.48^{a}
Tenderness	5.00±0.41^{b}	6.40±0.52^{b}	5.60±0.52^{b}	5.60±0.89^{b}	7.40±0.14^{a}
Juiciness	6.40±0.82	6.20±0.64	6.60±0.89	6.2±00.30	7.60±0.14
Texture	5.20±0.79	5.60±0.82	5.80±0.10	6.00±0.01	6.80±0.30
Overall acceptability	2.10±0.01	2.00±0.00	3.00±0.00	3.00±0.01	3.00±0.00

Mean ± standard deviation; a, b means of different superscripts on same row are significantly (P<0.05) different, Treatment 1- 0% garlic
Treatment 2- 2% garlic, Treatment 3- 4% garlic, Treatment 4- 6% garlic, Treatment 5- 8% garlic

CONCLUSION

The results obtained from West African Dwarf rams showed that the proximate compositions of cooked primal cuts were highly influenced by the dietary treatments than those obtained in the raw cuts. The sensory properties of loin muscle investigated did not influenced attribute such as aroma, juiciness, texture and overall acceptability by treatment diets. The meat products of treatments 4 and 5 were mostly accepted by the panelist. Therefore, incorporation of garlic powder into sheep's diets up to 8% can enhance the proximate composition and sensory properties.

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