American Journal of Food Technology

ISSN 1557-4571

Academic Journals Inc.

www.academicjournals.com

American Journal of Food Technology 6 (1): 80-86, 2011
ISSN 1557-4571 / DOI: 10.3923/ajft.2011.80.86

Effect of Natural Tenderizers on Physico-Chemical Properties of Chicken Gizzard and Goat Heart

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ABSTRACT

An investigation was conducted to evaluate the physico-chemical properties of chicken gizzard and goat heart treated with kachri (*Cucumis trigonus* Roxb.) and ginger (*Zingiber officinale roscoe*) as natural tenderizers. Both the byproducts were marinated at 4±2°C for 48 h with 10% (w/w) paste of natural tenderizers alone and in combination (ginger+kachri, 75:25) followed with cooking in boiling water. Chicken gizzard had significantly higher shear press value, Water Holding Capacity (WHC), cooking loss, moisture and protein content and significantly lower fat content than goat heart in control as well as treatments. Moisture content and shear press value significantly reduced and protein, fat, ash content and pH increased on cooking, in both the byproducts. Kachri paste lowered the pH and Water Holding Capacity (WHC) but combination of ginger with kachri was effective in improving the pH and WHC up to the level of control. Combination of ginger+kachri treatment increased the cooking loss but reduced the shear press value in both the byproducts significantly for further utilization of these byproducts.

Key words: Tenderizers, ginger, kachri, physico-chemical property, gizzard, goat heart

INTRODUCTION

The demand for foods with lower level of harmful chemicals have made food processors to focus on exploring natural food additives to improve the shelf life and other functional properties of foods (Sunilson *et al*., 2009). Herbs like ginger have been used in foods since ancient times, not only as folk medicine, but also as to improve the quality parameters (Culter, 1995). Abulude *et al*. (2007) also studied the composition and physical characters of *Cucumis sativa* and reported that the samples had no Pb level which is known to be toxic, but contained valuable enzymes having high protein digestibility. Natural tenderizers refer to those fruits and vegetables, which contain proteolytic enzymes, responsible for tenderization of tough meat. Zingibain in ginger (Greenberg and Winnick, 1940) and cucumin in kachri (Hujjatullah and Baloch, 1970) have been used as common meat tenderizers.

In developing countries like India with rapid strides being made in urbanization, food habits and consumer preference are changing, thereby increasing the demand of providing processed, ready to eat convenient food including meat and meat byproducts (Rajesh Kumar *et al*., 2007). Animal byproducts include everything of economic value other than the carcass obtained from an animal during slaughter and processing. Edible offals that are available from these slaughtered animals are of great value. Efficiant utilization of these edible byproducts is essential to support an

economical viable meat system (Selvan *et al.*, 2007). Unprocessed edible byproducts like chicken gizzard and goat heart are comparatively harder, fetch considerably low price and not preferred by consumer. However, from nutritional point of view these are highly proteinous and rich in essential amino acids. Heart muscles contain a large surplus of threonine, leucine, lysine and tryptophan (Gaudy and Landis, 1973). Proximate composition and amino acid profile of gizzard is nearly the same as that of chicken meat (Arafa, 1977). Hence, these byproducts can be efficiently utilized after tenderization for preparation of palatable, nutritious and shelf stable meat food products and can increase monetary returns to the processors. Therefore, this study was carried out to evaluate the effect of natural tenderizers (kachri and ginger) on phyco-chemical properties of these commonly unused byproducts for utilization into a well-accepted one.

MATERIALS AND METHODS

The study was conducted in the Department of Animal Products Technology, College of Animal Sciences, CCS Haryana Agricultural University, Hisar (India) as a M.V.Sc. Student research project under the guidance of Dr. S. S. Ahlawat as major advisor during the year 2006-07. Chicken gizzards and goat hearts obtained from local meat market were transported to the laboratory in polyethylene bags under chilled conditions in an insulated icebox. They were trimmed of incoming and outgoing ducts, adhering fat and properly washed. Each gizzard was divided longitudinally and inner linings along with stored feed were removed manually. Hearts were divided in to two halves in such a way that each half contained one atrium and one ventricle and they were washed to remove clotted blood. Ginger and kachri were obtained from local market of Hisar.

Each half of both the byproducts was pierced with the tines of a 4-tined fork, three times per side. Natural tenderizers were ground to a pasty consistency and applied on the byproducts (10%, w/w) alone and in combination of ginger+kachri (75:25) thoroughly. Control (marinated in water) and treated gizzard and heart were kept at 4±2°C for 48 h followed by cooking for 10 min in boiling water. Shear press value was estimated by employing Warner Bratzler shear press (Salter model No. 235 6S). Force needed to shear one cm^3 of meat was expressed in kg cm^{-3}. Cooking loss was determined by measuring the difference in the sample weight before and after cooking and was calculated with slight modifications according to Serdaroğlu (2006). Method of Trout *et al.* (1992) was followed for determining the pH and WHC was estimated by following the press technique used by Whiting and Jenkins (1981). Moisture, crude protein, ether extract and total ash content of raw, marinated and cooked gizzard and heart were determined by following standard methods (AOAC, 1995). Data were subjected to multiple range tests for finding out the significant difference if any.

RESULTS AND DISCUSSION

Physico-chemical properties

Shear press value: The shear press value of chicken gizzard (19.21 kg cm^{-3}) was significantly higher (Table 1) than that of goat heart (3.74 kg cm^{-3}) in raw samples. Chen and Stinson (1983) also reported the texture of chicken gizzard is tough and rubbery due to its characteristic muscular construction. The similar trend of higher shear press value in chicken gizzard than goat heart was observed irrespective of treated and cooked samples (Table 1).

Ginger and kachri alone and in combination (75:25) significantly reduced the shear press value of marinated as well as cooked chicken gizzard and goat heart. Kachri showed highest tenderizing effect in marinated chicken gizzard and goat heart (8.45 and 0.88 kg cm^{-3}) followed by

Table 1: Effect of natural tenderizers on physico–chemical properties of chicken gizzard and goat heart (n = 6, Mean±SE)

	Shear press value (kg cm^{-3})			
	Gizzard		Heart	
Treatments	Marinated	Cooked	Marinated	Cooked
Control	15.20±0.22^{dD}	4.15±0.10^{cC}	2.84±0.08^{cB}	1.95±0.03^{bA}
Kachri treated	8.45±0.15^{aC}	0.95±0.03^{aB}	0.88±0.02^{aB}	0.55±0.02^{aA}
Ginger treated	9.90±0.12^{cC}	1.50±0.07^{bB}	1.30±0.07^{bB}	0.75±0.01^{aA}
G+K treated	9.44±0.13^{bD}	1.33±0.04^{bC}	1.17±0.03^{bB}	0.70±0.02^{aA}
Raw	19.21±0.61^{eD}	5.57±0.49^{dC}	3.74±0.23^{dB}	2.71±0.11^{cA}
pH				
Control	6.11±0.08^{abA}	6.39±0.07^{abBC}	6.22±0.08^{bAB}	6.59±0.09^{bC}
Kachri treated	5.87±0.06^{aA}	6.25±0.05^{aB}	5.92±0.06^{aA}	6.38±0.03^{aB}
Ginger treated	6.15±0.11^{bA}	6.45±0.03^{bB}	6.28±0.08^{bAB}	6.67±0.05^{bC}
G+K treated	5.92±0.09^{abA}	6.31±0.06^{abBC}	6.12±0.06^{abAB}	6.50±0.06^{abC}
Raw	6.60±0.12^{cA}	----	6.72±0.09^{cA}	-----
	WHC (%)		Cooking loss (%)	
Treatments	Gizzard	Heart	Gizzard	Heart
Control	31.45±0.21^{cdA}	29.19±0.08^{cdB}	45.44 ±0.19^{aA}	44.19±0.29^{aB}
Kachri treated	29.62±0.18^{bA}	27.95±0.24^{bB}	47.82±0.15^{eA}	46.18±0.04^{eB}
Ginger treated	31.90±0.07^{dA}	29.56±0.34^{dB}	44.87±0.27^{aA}	43.74±0.07^{aB}
G+K treated	31.16 ±0.11^{cA}	28.62±0.09^{cB}	46.52±0.24^{bA}	45.05±0.03^{bB}
Raw	24.10 ±0.09^{aB}	22.72±0.12^{aA}	-----	-----

G+K: Ginger+Kachri. Means with different small superscripts in column and capital superscripts in row differ significantly ($p \leq 0.05$)

ginger+kachri treatment (9.44 and 1.30 kg cm^{-3}) as compared to their controls (15.20 and 2.84 kg cm^{-3}), respectively. Hydrolyzing effect of cucumin on myofibrillar and connective tissue is well documented (Kumar and Berwal, 1998; Mendiratta *et al.*, 2003; Naveena *et al.*, 2004). Thompson *et al.* (1973) also indicated that proteolytic activity of ginger protease on collagen and actomyosin protein complex resulted in more tender meat. These findings are in accordance with Lee *et al.* (1986) and Naveena *et al.* (2004).

Cooking significantly reduced the shear press value of both the marinated byproducts in control as well as treated samples. Moist heat induced changes in connective tissues resulted in tenderization. Boiling in water and pressure cooking of gizzard has been reported to increase the tenderness significantly (Sharma *et al.*, 1986; Pangas *et al.*, 1998; Grover *et al.*, 2005).

pH: Raw gizzard and heart had a pH value of 6.60 and 6.72, respectively. The pH of controlled samples declined to 6.11 (gizzard) and 6.22 (heart) (Table 1). This decline of pH from raw samples could be attributed to postmortem glycolysis and resultant accumulation of lactic acid. These pH values were within the range as reported by Sharma *et al.* (1986).

Cooking significantly increased the pH value of gizzard and heart irrespective of treatments. Increase in pH of meat on cooking has also been reported by Bouton *et al.* (1971), Fogg and Harrison (1975) and Nath *et al.* (1996). Babu *et al.* (1994) attributed the increase in pH on cooking to change in net charge of protein due to denaturation.

Treatment with kachri reduced and ginger increased the pH of chicken gizzard and goat heart. The pH of ginger treated gizzard and heart was significantly higher than that of kachri treated samples. The pH value of (G+K) treated samples in both the byproducts did not differ significantly from control. The marked reduction in pH of kachri treated samples as compared to ginger treatment could be due to low pH of kachri as compared to ginger (Naveena *et al.*, 2004).

WHC: The WHC (Table 1) of heart (22.72%) was significantly lower than that of gizzard (24.10%). This might be due to lower total protein content and higher content of fat (Table 2) in goat heart (Savchenko *et al.*, 1981) as compared to gizzard. Water holding capacity of control gizzard and heart as estimated by percent loose water was higher (31.45 and 29.19) than raw (24.10 and 22.72%), respectively. There was a significant reduction of WHC in kachri treated samples but ginger treatment slightly increased the WHC in both the byproducts as compared to their controls. However, WHC of control and G+K treated gizzard and heart did not differ significantly. The reduction in WHC of kachri treated samples might be due to lower pH (Table 1) and this drop in pH may be responsible for an overall reduction in reactive groups of proteins available for water holding (Hedrick *et al.*, 1993). The increase in WHC of ginger treated samples was due to increase in pH (Table 1).

Cooking loss: The cooking loss of goat heart (44.19%) was significantly lower than that of chicken gizzard (45.44%) (Table 1). The higher cooking loss of gizzard could be due to its higher WHC. These findings are also in line with the observations of Prasad and Sahoo (1989). The lowest cooking loss was observed in ginger treated gizzard (44.87%) and heart (43.74%) samples and kachri treated samples showed highest cooking loss i.e., 47.82 (gizzard) and 46.18% (heart) followed by G+K treated gizzard (46.52%) and heart (45.05%). Similar effect of kachri and ginger on cooking loss in buffalo meat was also reported by Naveena *et al.* (2004).

Proximate composition

Moisture: The moisture content of raw gizzard (76.80%) was significantly higher (Table 2) than that of goat heart (71.22%). These values were in the range reported by Arafa (1977) and Pereira *et al.* (2002). Moisture content of control and treated chicken gizzard and goat heart drastically reduced on cooking. No significant difference in moisture content was observed between control and treated samples. Naveena *et al.* (2004) also reported that moisture content did not differ significantly in control, kachri and ginger treated samples.

Protein: The percent protein content of raw (19.86) chicken gizzard was significantly higher than that of goat heart (10.70) (Table 2). This might be due to proportionately much higher fat content in goat heart as compared to gizzard. Similar observations were also presented by Pereira *et al.* (2002). Cooking significantly increased the protein content in chicken gizzard and goat heart as compared to raw irrespective of treatments. This apparent quantitative increase in protein content resulted due to loss of moisture content (Posati, 1979; Keetan, 1983) during cooking. Control and treated samples did not differ significantly in protein content in both the marinated and cooked samples. Naveena *et al.* (2004) also reported that kachri and ginger when used individually had no significant effect on protein content as compared to control.

Table 2: Effect of natural tenderizers on proximate composition (%) of chicken gizzard and goat heart (n = 6, Mean ±SE)

	Moisture			
	Gizzard		Heart	
Treatments	Marinated	Cooked	Marinated	Cooked
Control	76.80±0.71^{aC}	69.72±0.84^{aB}	71.00±0.39^{aB}	63.03±0.39^{aA}
Kachri treated	77.19±0.90^{aC}	70.20±0.90^{aB}	71.21±0.28^{aB}	63.70±0.35^{aA}
Ginger treated	78.16±0.86^{aC}	71.00±0.70^{aB}	71.70±0.33^{aB}	64.05±0.46^{aA}
G+K treated	77.90±0.74^{aC}	71.33±0.72^{aB}	71.55±0.32^{aB}	63.95±0.30^{aA}
Raw	76.91±0.25	69.95±0.58	71.22±0.28	63.34±0.51
Protein				
Control	19.50±0.40^{aC}	25.52±0.56^{aD}	10.85±0.12^{aA}	13.79±0.25^{aB}
Kachri treated	18.88±0.38^{aC}	24.86±0.49^{aD}	10.83±0.25^{aA}	13.66±0.30^{aB}
Ginger treated	18.30±0.47^{aC}	24.55±0.57^{aD}	10.61±0.14^{aA}	13.48±0.19^{aB}
G+K treated	18.58±0.35^{aC}	24.12±0.51^{aD}	10.67±0.13^{aA}	13.52±0.34^{aB}
Raw	19.86±0.48^{C}	25.85±0.38^{D}	10.70±0.15^{A}	13.71±0.29^{B}
Fat				
Control	1.93±0.12^{aA}	2.51±0.12^{aB}	17.02±0.10^{aC}	21.63±0.13^{aD}
Kachri treated	1.70±0.10^{aA}	2.23±0.15^{aB}	16.90±0.11^{aC}	21.35±0.15^{aD}
Ginger treated	1.97±0.09^{aA}	2.48±0.07^{aB}	16.70±0.15^{aC}	21.22±0.18^{aD}
G+K treated	1.87±0.15^{aA}	2.44±0.09^{aB}	16.75±0.08^{aC}	21.23±0.10^{aD}
Raw	2.02±0.07^{A}	2.63±0.11^{B}	16.89±0.12^{C}	21.52±0.15^{D}
Ash				
Control	0.98±0.02^{aA}	1.24±0.05^{aC}	0.87±0.04^{aA}	1.14±0.05^{aB}
Kachri treated	0.97±0.04^{aA}	1.22±0.07^{aC}	0.93±0.02^{aA}	1.18±0.04^{aB}
Ginger treated	1.01±0.07^{aA}	1.30±0.04^{aC}	0.95±0.06^{aA}	1.20±0.04^{aB}
G+K treated	1.05±0.04^{aA}	1.33±0.08^{aC}	0.94±0.06^{aA}	1.19±0.05^{aB}
Raw	0.94±0.05^{A}	1.20±0.07^{B}	0.81±0.08^{A}	1.05±0.09^{C}

G+K: Ginger+Kachri, Means with different small superscripts in column and capital superscripts in row differ significantly ($p \leq 0.05$)

Fat: Fat content of raw chicken gizzard and goat heart was 2.02 and 16.89%, respectively. Similar findings have been reported earlier also for gizzard (Grover *et al*., 2005) and goat heart (Pereira *et al*., 2002). On cooking, fat content increased significantly in chicken gizzard and goat heart as compared to raw samples due to drastic reduction of moisture content resulting in proportionate increase in the fat content. Ginger and kachri treatment did not change the fat content significantly in marinated gizzard and heart samples.

Ash: There was no significant difference of ash content between gizzard and heart. Cooking significantly increased the ash content of gizzard and heart as compared to raw due to the loss in moisture content during cooking. Similar increasing trend in ash content was also noticed in all the treated samples on cooking in both the byproducts. Effect of tenderizers on ash content in both marinated and cooked byproducts were statistically non significant. Grover *et al.* (2005) also observed no significant difference on ash content of gizzard treated with proteolytic enzyme as compared to control.

CONCLUSION

It is concluded from the findings that chicken gizzard and goat heart can be successfully tenderized with combination of ginger+kachri (75:25) using as natural tenderizers without much

affecting their physico chemical properties for further preparation of palatable, nutritious and shelf stable meat food products and can increase monetary returns to the processors.

ACKNOWLEDGMENTS

The authors are grateful to Dr. (Mrs.) N. Khanna, Prof. and Head, Dept. of A.P.T., CCS HAU, Hisar, for providing all the necessary facilities and to Dr. D. P. Sharma, Prof. (A.P.T.) for his technical help as co-major advisor of the student.

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