



International Journal of Veterinary Sciences and Animal Husbandry



ISSN: 2456-2912

NAAS Rating (2026): 4.61

VET 2026; 11(2): 468-471

© 2026 VET

www.veterinarypaper.com

Received: 03-11-2025

Accepted: 18-12-2025

Chidanandaiah

Professor, Department of
Livestock Products Technology,
Veterinary College, KVAFSU
(B), Hebbal, Bengaluru,
Karnataka, India

Pavan M

Assistant Professor, Department
of Livestock Products
Technology, Veterinary College,
KVAFSU (B), Hebbal,
Bengaluru, Karnataka, India

Prashanth Bagalkot

Assistant Professor, Department
of Veterinary Public Health,
Veterinary College Shivamogga,
Karnataka, India

Asif M Hebbal

Ph.D. Scholar, Department of
Veterinary Public Health,
College of Veterinary and Animal
Sciences, Mannuthy, Kerala,
India

Sudarshan S

Assistant Professor, Department
of Livestock Products
Technology, Veterinary College,
KVAFSU (B), Hebbal,
Bengaluru, Karnataka, India

Corresponding Author:

Chidanandaiah

Professor, Department of
Livestock Products Technology,
Veterinary College, KVAFSU
(B), Hebbal, Bengaluru,
Karnataka, India

Standardization and optimization of natural tenderizers on mutton chunks meant for preparation of mutton curry

**Chidanandaiah, Pavan M, Prashanth Bagalkot, Asif M Hebbal and
Sudarshan S**

DOI: <https://www.doi.org/10.22271/veterinary.2026.v11.i2e.3052>

Abstract

Mutton offers essential amino acids and trace elements for better human health with a culinary delight. Meat is not only delicious but also a nutritious choice. High-quality sheep breeds and lamb quality are in the spotlight as the market for sheep meat grows. Though mutton is preferred as the delicious meat, it is less tender meat compared to other meats. Some of the natural tenderizers viz. Lemon, Tamarind paste, Ginger paste and Curd can be used to improve the tenderness of the mutton during marination. The paper discusses the effect of natural tenderizers such as Lemon, Tamarind paste, Ginger paste and Curd in mutton chunks at different levels. Among the three levels of each tenderizers lemon at 3%, Tamarind paste at 4%, Ginger at 10% and Curd at 30% had better tenderization effect on mutton chunks.

Keywords: Lemon, tamarind paste, ginger paste, curd, mutton, marination

Introduction

The consumption of meat is increasing in India and agriculture is considered as the backbone of a majority of people. Live-stock plays a significant role, wherein meat and dairy are the major sectors contributing to economic development. The majority of meats consumed in India are fish, bovine, mutton, goat, pig, and poultry origin. In Indian context, culture, traditions, customs, and taboos influence meat consumption to a great extent (Devi *et al.*, 2014) [5]. Mutton and Chevon have become main part of the human diet with growing population and wealth. Mutton is rich in polyunsaturated fatty acids, vitamin B12, vitamin B2 (riboflavin), calcium, magnesium, and potassium. Additionally, the mutton digestibility by humans is as high as 90%. Mutton is a high-quality source of protein, containing essential amino acids and trace elements that are crucial for human health (Chikwanha *et al.*, 2018) [4]. Consumers increasingly favor its tender texture, rich nutritional value, unique flavor, and health benefits such as enhancing physical strength. Compared to other meats, mutton has high marbling, delicate and juicy texture, making it a delicious and nutritious choice. Improvement in economic standards and better understanding of mutton's nutritional value, the demand for high-quality mutton continues to grow (Ding *et al.*, 2024) [6]. The tenderness and quality of meat is very concerning for meat consumers. Meat tenderness relies on connective tissue and muscle proteolytic activity. The use of various chemical tenderizers is the subject of the majority of research studies on the meat tenderness. However, there are certain drawbacks of these chemical tenderizers on one or the other sensory characteristics of meat. Few natural tenderizers may be used to counteract these adverse effects of chemical tenderizers. Natural tenderizers are certain vegetables and fruits containing proteolytic enzymes that are responsible for tough meat tenderization (Ikram *et al.*, 2021) [8]. Natural tenderizers refer to those fruits and vegetables, which contain proteolytic enzymes, responsible for tenderization of tough meat. Therefore, the current study is focused on finding out effective commonly available natural tenderizer for household purpose in preparation of mutton curry. In the current study natural tenderizers used are Lemon, Tamarind paste, Ginger paste and Curd.

Materials and Methods

A two year old sheep was slaughtered at local slaughter hall and fore shank cut was purchased. The fore shank cut is later cut into uniform sized ($\approx 3 \times 3$ cm) mutton chunks. Different levels of natural tenderizers viz. Lemon juice, Ginger paste, Curd and Tamarind paste were used. Fresh lemon juice is collected by squeezing out of lemon by hands with strict hygiene. Ginger paste is prepared using fresh Ginger. The Ginger skin was peeled and cleaned. The cleaned Ginger is cut into small pieces and ground in mixer (Make: Preethi, India). The Curd (fat-3% and SNF 8.5% from pasteurized toned milk) of "Nandini" brand of Karnataka Milk federation was used. Tamarind was purchased from local groceries shop and was immersed in warm water (50 ml) for 20mins, Tamarind extract was collected by squeezing the soaked Tamarind.

The mutton chunks were categorized into four major groups. Each group was mixed with 0.5% salt and with any one of the tenderizer at different levels. The salted mutton chunks are mixed with natural tenderizers viz. Lemon juice, Ginger paste, Curd and Tamarind paste. The process of tenderization was carried out at room temperature. The muttons chunks are kept in marination along with tenderizers for 30 min. Several trials were conducted using the natural tenderizers to optimize the range of natural tenderizers. The Lemon juice was used at 0%, 1%, 2% and 3%, Tamarind paste was used at 0%, 2%, 4% and 6%, Ginger paste was used at 0%, 6%, 8% and 10%, and Curd was used at 0%, 10%, 20% and 30% respectively. Each treatment was pressure cooked at 120 °C for 10 min. and sensory evaluation was conducted. Sensory scores were given based on 8 point hedonic scale sensory evaluation chart. Sensory evaluation was carried out by trained students and staff panelists on how to distinguish between tenderness and toughness of the meat. Seven panelists were asked to evaluate the mutton chunks on 8-point scale; 8 being very tender, 6 moderately tough and 1 very tough. (Keeton, 2006) [9]. Samples of meat portion from each treatment were presented in 3-digit number coded plates and served to the panelists individually in a randomized order for sensory evaluation. The panelists were provided with water to rinse their mouths before and in-between tasting. The data obtained from the study were analyzed using the statistical software package SPSS (Version 26.0). Results are expressed as Mean $\pm$ Standard Error (SE). (Snedecor and Cochran, 1994) [14]. Data regarding the standardization of tenderizers concentrations and cooking methods were analyzed using one-way Analysis of Variance (ANOVA) to assess significant differences between treatments.

Results and Discussion

The mutton chunks were mixed with 0.5% salt and tenderizers at different levels. The process of marination was carried out at room temperature for 30 minutes. Treatments were pressure cooked at 120°C for 10 min. and sensory evaluation was conducted. Sensory scores were given based on 8 point hedonic scale of sensory evaluation chart.

Among the three levels of lemon as tenderizer viz. 1%, 2% and 3%, lemon at 3% had better tenderness as well as sensory appeal than the other treatments. A control group was marinated only with salt at 0.5%. The statistically evaluated sensory scores are given in the table 1. Juice of lemon (*Citrus limon*) is commonly used for culinary purposes around the world and is used as a food preservative and often used for marinating meat to improve the juiciness and tenderness of meat (Kumar *et al.*, 2017) [10]. Lemon juice contains citric acid, L-ascorbic acid, sugars, proteins, and fibres, as well as

B-group vitamins, beta-carotene, macro- and micronutrients, and biologically active ingredients, such as essential oils (mainly limonene), bioflavonoids, phytoncides, and pectins. (Lebiedzińska *et al.*, 2012) [11]. Divakar *et al.*, (2019) [7] had applied 20% lemon juice on beef had less tenderizing effect than Curd. Among the three levels of Tamarind paste as tenderizer viz. 2%, 4% and 6%. There was significant difference in treatments compared to control (0%). The statistically evaluated sensory scores are given in the table 2. Among the three levels of Tamarind paste as tenderizer both at 4% and 6% showed improvement in tenderness but the effect was non significant among the treatments. Tamarind paste at 6% had better tenderness in mutton chunks, but was sourer in taste. Hence, Tamarind paste at 4% can be considered best level to improve the tenderness on mutton chunks meant for curry preparation. Contrarily Cheok and Chin (2012) [3] found that the Tamarind juice alone do not give much positive effects on water enhancing and meat tenderizing probably due to the electron-withdrawing inductive effect of hydroxyl groups existing as tartaric acid in Tamarind juice. He also quoted that the Tamarind is a spice that is used only to enhance the sweet sour taste to local culinary, but does not improve the juiciness and tenderness of meat. Similarly in the current study Tamarind paste had very less tenderizing effect than any other tenderizers. The unique sweet sour taste of Tamarind is contributed by tartaric acid, a naturally occurring dicarboxylic acid, which consists of about 13% of the total composition (Vollhardt and Schore 2007) [15]. Ginger is being used as tenderizing agent in many of the researches. In the current study the three levels of Ginger paste was used as tenderizer viz. 6%, 8% and 10%. There was significant difference in treatments compared to control (0%). The statistically evaluated sensory scores are given in the table 3. Among the three levels of Ginger paste as tenderizer on mutton chunks, 8% and 10% incorporation showed better tenderness than 6%. There was significantly $p \leq 0.05$ higher tenderness, flavour and juiciness values at 10% of Ginger paste incorporation. Similar results are being observed by An and Kim (2024) where 7% Ginger extract powder was used on Korean black goat biceps femoris was softened, and was judged that Ginger will have a positive effect on the texture of commercial Korean black goat meat. Naveena *et al.* (2004) [12] mentioned that increase in the moisture with increasing concentration of Ginger extract indicates improvement in hydrophilic properties by the enzyme treatment. Abdeldaiem *et al.*, (2014) [1] concluded his work stating 30% (v/w) Ginger rhizome extract can be effectively utilized to tenderize camel meat without adversely affecting other meat quality parameters.

Curd was used at three levels 10%, 20% and 30%. There was significant ($p \leq 0.05$) difference in treatments compared to control. Among the three levels of Curd as tenderizer, Curd at 20% and 30% showed better tenderness. There were significantly ($p \leq 0.05$) higher texture, tenderness and juiciness values at 30% of Curd incorporation in mutton chunks. Lactic acid is the major component in Curd that contributes to tenderness of meat. Lemon (*Citrus limon*), a common and popular fruit in India is a rich source of citric acid and lemon juice is also used in tenderization of meat. Curd and lemon juice, two naturally occurring sources of weak acids are commonly used in Indian kitchens for meat marination as well as ingredients in day-to-day cooking. In contrast to these Divakar *et al.*, 2019 [7] found less tenderizing effect from Curd on Kara beef. But Simitzis *et al.*, (2021) [13] reported significant increase in tenderness values, when the beef was marinated in yoghurt acid whey.

Table 1: Sensory scores for mutton chunks marinated with lemon juice

Lemon	Appearance and colour	Juiciness	Texture	Tenderness	Flavour	Overall Acceptability
0%	6.62 ± 0.15 ^a	6.67 ± 0.08 ^a	6.67 ± 0.18 ^a	6.88 ± 0.08 ^a	6.75 ± 0.11 ^a	6.83 ± 0.10 ^a
1%	6.71 ± 0.16 ^a	6.96 ± 0.10 ^{ab}	7.21 ± 0.10 ^b	7.29 ± 0.07 ^b	7.21 ± 0.10 ^b	7.17 ± 0.08 ^a
2%	6.96 ± 0.15 ^a	7.21 ± 0.10 ^b	6.96 ± 0.15 ^{ab}	7.21 ± 0.10 ^{ab}	6.96 ± 0.15 ^{ab}	7.17 ± 0.08 ^a
3%	6.96 ± 0.15 ^a	6.96 ± 0.15 ^{ab}	7.13 ± 0.08 ^{ab}	7.25 ± 0.09 ^b	7.21 ± 0.07 ^b	7.17 ± 0.08 ^a
F-Value	1.232	3.951	3.180	4.597	3.844	3.478
p-Value	0.324	0.023	0.046	0.013	0.025	0.035

Table 2: Sensory scores for mutton chunks marinated with Tamarind paste

Tamarind paste	Appearance and colour	Juiciness	Texture	Tenderness	Flavour	Overall Acceptability
0%	6.56 ± 0.15 ^a	6.25 ± 0.09 ^a	6.42 ± 0.08 ^a	6.37 ± 0.08 ^a	6.29 ± 0.08 ^a	6.25 ± 0.13 ^a
2%	6.92 ± 0.08 ^{ab}	7.12 ± 0.05 ^b	6.87 ± 0.10 ^b	6.87 ± 0.10 ^{bc}	7.08 ± 0.05 ^b	6.96 ± 0.15 ^b
4%	7.08 ± 0.05 ^b	7.16 ± 0.08 ^b	7.12 ± 0.10 ^b	6.79 ± 0.10 ^b	7.00 ± 0.09 ^b	7.08 ± 0.05 ^b
6%	7.17 ± 0.05 ^b	7.12 ± 0.11 ^b	7.04 ± 0.15 ^b	7.17 ± 0.08 ^c	7.37 ± 0.05 ^b	7.29 ± 0.10 ^b
F-Value	6.270	26.512	7.627	11.958	20.621	15.689
p-Value	0.004	0.000	0.001	0.000	0.000	0.000

Table 3: Sensory scores for mutton chunks marinated with Ginger paste

Ginger paste	Appearance and colour	Juiciness	Texture	Tenderness	Flavour	Overall Acceptability
0%	6.49 ± 0.15 ^a	6.75 ± 0.11 ^a	6.58 ± 0.15 ^a	6.75 ± 0.11 ^a	6.50 ± 0.18 ^a	6.58 ± 0.15 ^a
6%	6.92 ± 0.08 ^{ab}	6.83 ± 0.10 ^{ab}	7.00 ± 0.18 ^{ab}	6.92 ± 0.15 ^a	6.75 ± 0.11 ^{ab}	6.92 ± 0.15 ^{ab}
8%	7.25 ± 0.11 ^b	7.25 ± 0.11 ^{bc}	7.08 ± 0.15 ^{ab}	7.08 ± 0.15 ^{ab}	7.08 ± 0.15 ^{bc}	7.17 ± 0.10 ^b
10%	7.33 ± 0.10 ^b	7.37 ± 0.14 ^c	7.37 ± 0.05 ^b	7.45 ± 0.12 ^b	7.37 ± 0.11 ^c	7.29 ± 0.13 ^b
F-Value	7.760	6.739	5.111	4.969	7.232	5.090
p-Value	0.001	0.003	0.009	0.010	0.002	0.009

Table 4: Sensory scores for mutton chunks marinated with Curd

Curd	Appearance and colour	Juiciness	Texture	Tenderness	Flavour	Overall Acceptability
0%	6.59 ± 0.15 ^a	6.42 ± 0.20 ^a	6.50 ± 0.13 ^a	6.25 ± 0.11 ^a	6.58 ± 0.20 ^a	6.42 ± 0.15 ^a
10%	6.83 ± 0.17 ^{ab}	6.83 ± 0.10 ^{ab}	6.75 ± 0.17 ^{ab}	6.75 ± 0.11 ^b	6.75 ± 0.17 ^{ab}	6.83 ± 0.10 ^{ab}
20%	7.12 ± 0.08 ^{ab}	7.04 ± 0.04 ^{bc}	7.25 ± 0.11 ^{bc}	7.08 ± 0.08 ^{bc}	7.17 ± 0.10 ^{ab}	7.08 ± 0.08 ^{bc}
30%	7.29 ± 0.08 ^b	7.37 ± 0.08 ^c	7.33 ± 0.08 ^c	7.37 ± 0.05 ^c	7.29 ± 0.10 ^b	7.33 ± 0.08 ^c
F- Value	5.446	10.651	9.787	26.584	4.974	12.571
p-Value	0.007	0.000	0.000	0.000	0.010	0.000

Conclusion

All the natural tenderizers showed tenderization effect on mutton significantly. Among the three levels of each tenderizers lemon at 3%, Tamarind paste at 4%, Ginger at 10% and Curd at 30% had better tenderization effect on mutton chunks meant for curry preparation. Additional or reduced amount of natural tenderizers may not only have adverse effect on flavor but also alters the tenderness and overall acceptability of cooked mutton chunks.

Conflict of Interest

Not available

Financial Support

Not available

References

- Abdeldaiem MH, Hoda GA, Ali GM. Tenderization of camel meat by using fresh ginger (*Zingiber officinale*) extract. Food Sci Qual Manag. 2014;23:25-38.
- An JH, Kim HY. Effect of ginger extract on Korean black goat biceps femoris as a tenderizer. Heliyon. 2024;10(23):e40736.
- Cheok CY, Chin NL. Effect of tamarind juice and salt on physical and textural changes of traditionally marinated beef satay. Journal of Food Agriculture and Environment. 2012;10(1):43-48.
- Chikwanha OC, Vahmani P, Muchenje V, Dugan MER, Mapiye C. Nutritional enhancement of sheep meat fatty acid profile for human health and wellbeing. Food Res Int. 2018;104:25-38.
- Devi SM, Balachandar V, Lee SI, Kim IH. An outline of meat consumption in the Indian population: a pilot review. Korean J Food Sci Anim Resour. 2014;34(4):507-515.
- Ding W, Lu Y, Xu B, Chen P, Li A, Jian F, *et al.* Meat of sheep: insights into mutton evaluation, nutritive value, influential factors, and interventions. Agriculture. 2024;14(7):1060-1060.
- Divakar N, Nayar R, Chetan S, Khanapur K, Rajagopal S, Rajkumar R, *et al.* Quality and shelf life attributes of carabeef treated with curd, lemon juice and blade tenderization. Indian Journal of Natural Science. 2019;9(53):17089-17096.
- Ikram A, Ambreen S, Tahseen A, Azhar A, Tariq K, Liaquat T, *et al.* Meat tenderization through plant proteases: a mini review. Int J Biosci. 2021;18(1):102-112.
- Keeton JT, Leu R, Vanderzant C, Bohae JJ, Griffin DB, Savell JW, *et al.* Evaluation of fresh vacuum-packaged beef steaks coated with an acetylated monoglyceride. Journal of Food Sci. 2006;53(3):701-704.
- Kumar Y, Singh P, Pandey A, Tanwar VK, Kumar RR. Augmentation of meat quality attributes of spent hen breast muscle (pectoralis major) by marination with lemon juice vis-a-vis ginger extract. Journal of Animal Research. 2017;7(3):523-529.

11. Lebiedzińska A, Czaja J, Petrykowska K, Szefer P. Evaluation of vitamin C content in fruit juices and nectars. *Bromatol Chem Toksykol.* 2012;45(3):390-396.
12. Naveena BM, Mendiratta SK, Anjaneyulu ASR. Tenderization of buffalo meat using plant proteases from *Cucumis trigonus* Roxb (Kachri) and *Zingiber officinale* Roscoe (ginger rhizome). *Meat Sci.* 2004;68(3):363-369.
13. Simitzis P, Zikou F, Progoulakis D, Theodorou G, Politis I. A note on the effects of yoghurt acid whey marination on the tenderness and oxidative stability of different meat types. *Foods.* 2021;10(11):2557-2557.
14. Snedecor GW, Cochran WG. Statistical methods. 6th ed. Ames (IA): Iowa State University Press; 1994.
15. Vollhardt KPC, Schore NE. Organic chemistry: structure and function. USA: Freeman and Co.; 2007. p. 189, 201-203, 1120.

How to Cite This Article

Chidanandaiah, Pavan M, Bagalkot P, Hebbal AM, Sudarshan S. Standardization and optimization of natural tenderizers on mutton chunks meant for preparation of mutton curry. *International Journal of Veterinary Sciences and Animal Husbandry.* 2026;11(2):468-471.

Creative Commons (CC) License

This is an open-access journal, and articles are distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 International (CC BY-NC-SA 4.0) License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.