



ISSN Print: 2664-844X
ISSN Online: 2664-8458
NAAS Rating (2025): 4.97
IJAFS 2025; 7(11): xx-xx
www.agriculturaljournals.com
Received: 12-10-2025
Accepted: 16-11-2025

Martina A Gamit
Department of Livestock
Products Technology, College
of Veterinary Science and
Animal Husbandry,
Kamdhenu University, Anand,
Gujarat, India

Bhupendra C Parmar
College of Veterinary Science
and Animal Husbandry,
Kamdhenu University, Anand,
Gujarat, India

Corresponding Author:
Martina A Gamit
Department of Livestock
Products Technology, College
of Veterinary Science and
Animal Husbandry,
Kamdhenu University, Anand,
Gujarat, India

Standardization and Quality Evaluation of Chicken Cutlets Prepared with *Moringa Oleifera* Flowers

Martina A Gamit and Bhupendra C Parmar

DOI: <https://www.doi.org/10.33545/2664844X.2025.v7.i11d.969>

Abstract

Rising health awareness has boosted demand for nutritious food options. In this trend, meat and meat-based products are especially important because they provide high-quality protein that supports appetite control and helps manage body weight. *Moringa oleifera*, widely known as the drumstick tree or horseradish tree, is recognized for its nutritional value. The pods, leaves, and flowers of this plant are excellent sources of protein, dietary fiber, minerals, and they possess a well-balanced amino acid profile. The objective of this study was to standardize the incorporation levels of *Moringa oleifera* flowers in the formulation of chicken cutlets. Four formulations were prepared with varying inclusion levels: 0% (T1), 3% (T2), 6% (T3), and 9% (T4). These formulations were evaluated for their physicochemical properties, sensory attributes, and microbiological quality. Results indicated that the optimal level of *Moringa oleifera* flower incorporation was 3% (T2) for the preparation of chicken cutlets. Furthermore, the study demonstrated that chicken cutlets prepared with the standardized formulation could be safely stored in low-density polyethylene (LDPE) bags under refrigerated conditions (4°C) for up to six days without significant compromise in quality.

Keywords: *Moringa oleifera* flowers, Chicken cutlets, Physico-chemical attributes, Sensory attributes

Introduction

Growing awareness of health and nutrition has boosted consumer interest in healthier food choices. Meat and meat-based products are especially noteworthy for appetite control and weight management due to their high protein content. (Jakobsen *et al.*, 2014) ^[5]. *Moringa oleifera*, commonly known as horse radish tree or drumstick tree. The pods, leaves and flowers are good source of protein, dietary fiber and ash with an adequate profile of amino acids. (Gopalakrishnan *et al.*, 2016). Madane *et al.* (2019) ^[4, 7] investigated that the efficacy of *Moringa* flower (MF) extract to develop a functional chicken product. Three groups of cooked chicken nuggets—control (C), T1 (with 1% MF) and T2 (2% MF)—were elaborated and their physico chemical, nutritional, storage stability and sensory attributes were assessed during refrigerated storage at 4°C upto 20 days.

The heightened awareness of health and nutrition has significantly influenced consumer preferences toward food products that provide both nutritional benefits and convenience in preparation. As a result, ready-to-eat (RTE) and ready-to-prepare (RTP) products have emerged as preferred options for individuals adapting to modern, fast-paced living conditions (Singh *et al.*, 2014) ^[8]. Among these, meat cutlets are a prominent example of RTE products, commonly consumed as breakfast items in various regions. They are generally composed of minced meat combined with flour, pulses, nuts, potatoes, condiments, and spices, and are coated with rusk crumbs to improve their texture and sensory characteristics. Additionally, the rapid growth of the fast-food sector, driven by urbanization and shifting dietary behaviours, has further contributed to the widespread popularity and consumption of these convenient meat-based products.

Materials and Methods

Source of Raw Materials: Broiler deboned chicken meat, *Moringa oleifera* flowers, spices, table salt (Tata Chemicals Ltd., Mumbai), sugar, condiments (onion, ginger, and garlic), vegetable oil (sunflower oil from Adani Wilmar Ltd.), and low-density polyethylene (200-gauge) bags were sourced from the local market in Anand.

All chemicals used in the experiment were obtained from reputable suppliers (HiMedia). The condiment mixture was prepared by peeling onion, ginger, and garlic, cutting them into small pieces, and blending them in a household mixer. The *Moringa oleifera* flowers were thoroughly cleaned and subsequently dried in a hot air oven.

Methodology for Preparation of Chicken Cutlets

Boneless broiler chicken meat was chopped into small pieces, minced twice using a 6 mm plate, and then utilized for preparing the cutlets.

Chicken cutlets were prepared using a slightly modified procedure based on Singh et al. (2014) [8]. *Moringa oleifera* flowers were incorporated at 3, 6, and 9% levels by replacing an equivalent amount of lean meat in the formulation. Salt, sodium nitrite, and sugar were mixed with the minced chicken and sautéed for 3 minutes in 2.5% (w/w) refined sunflower oil. Separately, the condiment mixture was fried until it turned light golden brown. The cooked chicken, condiments, and spices were then combined and blended to achieve a uniform mixture. The batter was shaped into cutlets using round metal moulds and deep-fried in sunflower oil for 3 minutes until golden brown. The internal temperature was checked with a thermometer to ensure it reached 80°C, and any excess surface oil was removed using tissue paper.

(1) pH

The pH of the chicken cutlets was measured following the procedure described by Trout et al. (1992) [10].

(2) Product yield

The product yield was calculated as:

$$\text{Product yield (\%)} = \frac{\text{Weight of cooked chicken cutlet}}{\text{Weight of whole cutlet dough}} \times 100$$

(3) Proximate composition

The moisture, crude protein, crude fat, crude fiber, and ash contents of the chicken cutlets were analyzed using the standard methods outlined by the Association of Official Analytical Chemists (AOAC, 1995).

(4) Microbiological analysis

Standard plate counts, psychrophilic counts, coliform counts, and yeast and mold counts were assessed using the procedures recommended by the American Public Health Association (APHA, 2001)

(5) Sensory evaluation

A sensory evaluation was conducted with a panel of seven members from the College of Veterinary Science and Animal Husbandry, Anand. The chicken cutlets were assessed for appearance, flavour, juiciness, texture, and overall acceptability following the method of Keeton (1983) [6], using an 8-point descriptive scale in which 8 indicated extremely desirable qualities and 1 indicated extremely undesirable qualities. The panelists evaluated the samples in a quiet, odor-free, well-lit room, and plain water was provided for rinsing between evaluations.

(6) Statistical analysis

Each experiment was conducted five times. The resulting data were statistically analyzed using analysis of variance

(ANOVA) and Duncan's multiple range test, following the procedures outlined by Snedecor and Cochran.

Results & Discussions

Physico-chemical attributes

Table 1 presents the mean values of the physicochemical properties of chicken cutlets formulated with varying levels of *Moringa oleifera* flower.

Table 1: Effect of different levels *Moringa oleifera* flowers on physico-chemical attributes of chicken cutlets

Parameters	T1	T2	T3	T4
Product yield (%)	70.00 ± 0.38 ^a	75.33 ± 0.57 ^b	81.00 ± 1.33 ^c	86.89 ± 0.22 ^d
pH	6.24 ± 0.013 ^a	6.14 ± 0.011 ^b	6.02 ± 0.005 ^c	5.94 ± 0.004 ^d
Moisture (%)	46.46 ± 1.10	44.89 ± 1.08	44.71 ± 0.85	42.07 ± 1.38
Protein (%)	24.35 ± 0.51 ^a	23.02 ± 0.28 ^b	21.74 ± 0.52 ^c	20.43 ± 0.25 ^d
Fat (%)	13.04 ± 0.14 ^a	13.61 ± 0.10 ^b	13.99 ± 0.05 ^c	14.62 ± 0.04 ^d
Ash (%)	3.78 ± 0.13 ^a	3.49 ± 0.10 ^b	3.26 ± 0.07 ^b	2.67 ± 0.05 ^c

Mean ± S.E. with difference superscripts in a row differ significantly ($P < 0.05$)

The incorporation of *Moringa oleifera* flowers significantly influenced the physico-chemical parameters of chicken cutlets. The mean value of products yield indicates a progressive and significant ($P < 0.05$) increase in yield was observed with higher levels of *Moringa oleifera* flower addition. The yield ranged from 70.00 ± 0.38% in T1 to 86.89 ± 0.22% in T4, indicating improved water-binding capacity and cooking stability with increasing flower content. These findings are similar to Madane et al. (2019) [7]. The mean value of pH of the cutlets showed a gradual and significant ($P < 0.05$) decline from 6.24 in T1 to 5.94 in T4. The decrease in pH might be attributed to the slightly acidic nature of *Moringa oleifera* flowers and their organic constituents. The mean value for the moisture percentage showed a decreasing trend with higher flower incorporation, the differences were not statistically significant. This reduction could be associated with the increased binding of moisture by dietary fiber present in *Moringa oleifera* flowers. The mean value of protein levels decreased significantly ($P < 0.05$) with increasing inclusion of *Moringa oleifera* flowers, ranging from 24.35 ± 0.51% (T1) to 20.43 ± 0.25% (T4). This reduction may result from the partial replacement of meat protein with the lower-protein plant material. The mean value for fat percentage increased significantly ($P < 0.05$) with higher flower incorporation, possibly due to the inherent lipid content of *Moringa oleifera* flowers and the improved retention of fat during cooking. The mean value of ash content decreased significantly from 3.78 ± 0.13% in T1 to 2.67 ± 0.05% in T4, indicating a dilution effect of mineral concentration with higher plant inclusion levels.

Sensory evaluation

According to the criteria of sensory evaluation, parameters such as general appearance, flavour, texture, juiciness, and overall acceptability were assessed. The selection of the best product was determined by the sensory evaluation panelists using the 8-point Hedonic Scale. Mean values of the sensory attributes of chicken cutlets of chicken cutlets incorporated with different levels of *Moringa oleifera* flower are presented in Table-2.

Table 2: Effect of different levels of *Moringa oleifera* flowers on sensory attributes of chicken cutlets

Sensory Attributes	T1	T2	T3	T4
General appearance	7.54±0.10 ^a	7.17±0.11 ^a	6.50±0.19 ^b	5.92±0.19 ^c
Flavour	7.58±0.10 ^a	7.08±0.15 ^a	6.38±0.20 ^b	6.04±0.24 ^b
Texture	7.17±0.13 ^a	7.13±0.17 ^a	6.58±0.20 ^b	6.25±0.22 ^b
Juiciness	7.13±0.17 ^a	6.75±0.18 ^{ab}	6.38±0.23 ^{bc}	5.83±0.21 ^c
Overall acceptability	7.38±0.13 ^a	7.33±0.17 ^a	6.58±0.14 ^b	6.04±0.17 ^c

Mean±S.E. with difference superscripts in a row differ significantly ($P < 0.05$)

The inclusion of *Moringa oleifera* flowers at different levels had a significant effect on the sensory attributes of chicken cutlets. General appearance and flavour scores decreased progressively from T1 to T4, with T1 and T2 showing no significant difference ($p > 0.05$), but both scoring significantly higher than T3 and T4 ($P < 0.05$). Texture and juiciness also followed a similar declining trend, with T1 and T2 rated higher by the panelists. Overall acceptability was highest for T1 (7.38 ± 0.13) and T2 (7.33 ± 0.17), while T4 (6.04 ± 0.17) received the lowest score. The finding similar to Gamit *et al.* (2020)^[7].

These results indicate that moderate incorporation of *Moringa oleifera* flowers (3% level) maintains desirable sensory characteristics, while higher levels may negatively affect product acceptability. The average sensory scores of the chicken cutlets prepared using the optimized level of *Moringa oleifera* flower powder, along with the control, during refrigerated storage are presented in Table 3.

Table 3: Effect of refrigerated storage on sensory attributes of chicken cutlets prepared with optimized level of *Moringa oleifera* flower

Treatments	Refrigerated storage period (Days)		
	0 days	3 days	6 days
General appearance			
T1	7.92 ± 0.05 ^a	7.54 ± 0.10 ^b	6.83 ± 0.07 ^c
T2	7.63 ± 0.11 ^a	6.88 ± 0.06 ^b	6.08 ± 0.05 ^c
	**	**	**
Flavour			
T1	7.46 ± 0.12 ^a	7.04 ± 0.11 ^b	6.38 ± 0.10 ^c
T2	7.25 ± 0.13 ^a	6.25 ± 0.09 ^b	5.29 ± 0.09 ^c
	**	**	**
Texture			
T1	7.00 ± 0.13	6.96 ± 0.04	6.46 ± 0.10
T2	7.00 ± 0.10	6.67 ± 0.09	5.92 ± 0.05
Juiciness			
T1	7.38 ± 0.17	6.96 ± 0.11	6.29 ± 0.09
T2	6.96 ± 0.19	6.21 ± 0.08	5.46 ± 0.10
Overall acceptability			
T1	7.67 ± 0.09	6.96 ± 0.07	6.50 ± 0.10
T2	7.00 ± 0.15	6.17 ± 0.07	5.63 ± 0.10

Mean±S.E. with difference superscripts in a row (small alphabet) and column (**) differ significantly ($P < 0.05$)

The mean sensory attributes of chicken cutlets prepared with the optimized level of *Moringa oleifera* flowers showed a gradual decline during refrigerated storage. The mean value of general appearance in both T1 and T2 treatments exhibited significant ($P < 0.05$) decreases in appearance scores with increasing storage time. The highest score was recorded at 0 days (7.92 ± 0.05 for T1), which gradually declined to 6.83 ± 0.07 after 6 days of storage. The mean

value of flavour was downward trend. At 0 days had the highest flavour scores, while the lowest values were recorded after 6 days (6.38 ± 0.10 for T1 and 5.29 ± 0.09 for T2). The reduction was statistically significant ($P < 0.05$). The mean values of texture and juiciness both parameters showed a gradual decline as the progression of during the storage period. However, the decline was more pronounced in T2 than in T1, indicating that *Moringa oleifera* incorporation at higher levels may slightly affect moisture retention and texture stability during storage. The mean value of overall acceptability followed the same decreasing trend as other attributes. At 0 day, prepared cutlets (T1: 7.67 ± 0.09) were rated highest, while those stored for 6 days had the lowest scores (T2: 5.63 ± 0.10). Overall, sensory scores for all attributes decreased significantly with storage period ($P < 0.05$), though the product remained acceptable up to 6 days under refrigerated conditions. These findings are accordance with the observations of Gamit *et al.* (2020)^[7],

Microbiological Quality

The mean values illustrating the impact of refrigerated storage on the microbiological quality of chicken cutlets formulated with the optimized level of *Moringa oleifera* flower powder are shown in Table 4.

Table 4: Impact of refrigerated storage on the microbiological profile of chicken cutlets prepared using the optimized level of *Moringa oleifera* flower

Treatments	Refrigerated storage period (Days)			
	0 days	3 days	6 days	9 days
Standard plate count (log₁₀ cfu/gm)				
T1	1.25 ± 0.01 ^a	2.62 ± 0.13 ^b	3.18 ± 0.01 ^c	4.73 ± 0.01 ^d
T2	1.18 ± 0.01 ^a	2.32 ± 0.20 ^b	3.08 ± 0.01 ^c	4.62 ± 0.02 ^d
	**	**	**	**
Psychrophilic counts (log₁₀ cfu/gm)				
T1	ND	ND	ND	2.22 ± 0.02
T2	ND	ND	ND	1.98 ± 0.02
				**
Coliform count (log₁₀ cfu/gm)				
T1	ND	ND	ND	ND
T2	ND	ND	ND	ND

Mean±S.E. with difference superscripts in a row (small alphabet) and column (**) differ significantly ($P < 0.05$)

ND=Not detected

The microbiological profile of chicken cutlets made with the optimized level of *Moringa oleifera* flowers were significantly influenced by refrigerated storage duration. The mean value of standard plate count increased progressively with storage period in both treatments. In T1, the count rose from $1.25 \pm 0.01 \log_{10}$ cfu/g on day 0 to $4.73 \pm 0.01 \log_{10}$ cfu/g on day 9, while in T2, a similar trend was observed with values increasing from 1.18 ± 0.01 to $4.62 \pm 0.02 \log_{10}$ cfu/g. The increase was statistically significant ($P < 0.05$). The comparatively lower counts in T2 indicate that *Moringa oleifera* flower incorporation exerted a mild antimicrobial effect, potentially extending the microbial stability of the product. The mean value of psychrophilic count were absent up to the 6th day of storage in either treatment. However, by the 9th day, low levels of psychrophilic bacteria appeared, recording $2.22 \pm 0.02 \log_{10}$ cfu/g for T1 and $1.98 \pm 0.02 \log_{10}$ cfu/g for T2. This late onset of psychrophilic growth further supports the inhibitory potential of *Moringa oleifera* constituents against cold-

tolerant spoilage microorganisms. The mean value of coliforms were not detected throughout the entire storage period (0-9 days) in both T1 and T2 samples, indicating effective hygienic processing, good handling practices, and absence of faecal contamination. Overall, microbial counts remained within acceptable limits for refrigerated meat products up to 6 days of storage, after which a sharp rise in total viable count and onset of psychrophilic growth indicated the beginning of spoilage. The inclusion of *Moringa oleifera* flowers appeared to slightly retard microbial proliferation compared to the control. These findings are in similar with the observations of Gamit *et al.* (2020)^[7], who observed a marked reduction in the microbial quality of chicken cutlets formulated with finger millet flour as storage progressed.

Conclusions

Based on the comprehensive evaluation of physicochemical, proximate, microbiological, and sensory parameters, the incorporation of *Moringa oleifera* flower powder at a 3% level was determined to be optimal for the formulation of chicken cutlets. Samples packaged in low-density polyethylene (LDPE) bags and stored under refrigerated conditions (4 ± 1 °C) maintained acceptable microbial quality for up to six days. Moreover, the cutlets containing *Moringa oleifera* flower powder (T2) demonstrated comparatively lower microbial counts than the control (T1), thereby indicating improved microbial stability and potential preservative effects associated with *Moringa oleifera* flower incorporation.

Acknowledgments

The authors gratefully acknowledge the administration of the College of Veterinary Science and Animal Husbandry, Kamdhenu University, Anand, for their generous financial assistance and for providing the necessary facilities that were instrumental in the successful execution of this research.

References

1. AOAC. *Official Method of Analysis*. 16th ed. Washington (DC): Association of Official Analytical Chemists; 1995.
2. APHA. *Compendium of methods for the microbiological examination of foods*. 4th ed. Washington (DC): American Public Health Association; 2001.
3. Gamit M, Gupta S, Savalia CV. Quality characteristics of chicken meat cutlets incorporated with finger millet (*Eleusine coracana*) flour. *J Anim Res*. 2020;10(1):111-6.
4. Gopalakrishnan L, Doriya K, Kumar DS. *Moringa oleifera*: A review on nutritive importance and its medicinal application. *Food Sci Hum Wellness*. 2016;5(2):49-56.
5. Jakobsen LM, Arildsen V, Vuholm S, Aaslyng MD, Kristensen M, Sørensen KV, et al. Sensory characteristics and consumer liking of sausages with 10% fat and added rye or wheat bran. *Food Sci Nutr*. 2014;2(5):534-46.
6. Keeton JT. Effects of fat and NaCl/phosphate levels on the chemical and sensory properties of pork patties. *J Food Sci*. 1983;48(3):878-81.
7. Madane P, Das AK, Pateiro M, Nanda PK, Bandyopadhyay S, Jagtap P, et al. Drumstick (*Moringa oleifera*) flower as an antioxidant dietary fibre in chicken meat nuggets. *Foods*. 2019;8(8):307.
8. Singh PK, Kumar S, Kumar P, Bhat ZF. Effect of mincing on the quality characteristics of chevon cutlets. *J Anim Res*. 2014;4(2):193-200.
9. Snedecor GW, Cochran WG. *Statistical Methods*. 8th ed. Ames (IA): Iowa State University Press; 1994.
10. Troutt ES, Hunt MC, Johnson DE, Claus JR, Kastner CL, Kropf DH. Characteristics of low-fat ground beef containing texture-modifying ingredients. *J Food Sci*. 1992;57(1):19-24.