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Kadam PJ

Department of Livestock
Products Technology,
Krantisinha Nana Patil College
of Veterinary Science
(MAFSU), Shirwal, Satara,
Maharashtra, India

Sakunde DT

Department of Livestock
Products Technology,
Krantisinha Nana Patil College
of Veterinary Science
(MAFSU), Shirwal, Satara,
Maharashtra, India

Kadam BR

Department of Livestock
Products Technology,
Krantisinha Nana Patil College
of Veterinary Science
(MAFSU), Shirwal, Satara,
Maharashtra, India

Barate AK

Department of Veterinary
Biochemistry, Krantisinha
Nana Patil College of
Veterinary Science (MAFSU),
Shirwal, Satara, Maharashtra,
India

Bhong CD

Department of Veterinary
Public Health and
Epidemiology, Krantisinha
Nana Patil College of
Veterinary Science (MAFSU),
Shirwal, Satara, Maharashtra,
India

Tumlam UM

Department of Veterinary
Microbiology, Krantisinha
Nana Patil College of
Veterinary Science (MAFSU),
Shirwal, Satara, Maharashtra,
India

Corresponding Author:**Sakunde DT**

Department of Livestock
Products Technology,
Krantisinha Nana Patil College
of Veterinary Science
(MAFSU), Shirwal, Satara,
Maharashtra, India

Optimization of level of guava (*Psidium guajava*) leaves extracts in chicken nuggets

**Kadam PJ, Sakunde DT, Kadam BR, Barate AK, Bhong CD and
Tumlam UM**

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Abstract

Aim: The present study was carried out to determine the optimum level of incorporation of aqueous and hydroethanolic guava (*Psidium guajava*) leaves extract in chicken nuggets.

Methods: Aqueous and hydroethanolic guava leaves extracts (GLE) were prepared by mixing dried guava leaves powder with water and 50% ethanol in a 1:10 (w/v) ratio, followed by heating, filtration, and drying. During the optimization process, chicken nuggets were formulated by adding aqueous GLE at levels of 0, 0.08, 0.1, and 0.12%, while hydroethanolic GLE was incorporated at 0, 0.01, 0.03, and 0.05%.

Results: The addition of both aqueous and hydroethanolic GLE significantly reduced the pH of the chicken nuggets, and cooking yield was also significantly affected by increasing levels of the extracts. Sensory evaluation indicated that higher concentrations of aqueous GLE significantly decreased flavour and overall acceptability, whereas texture improved and juiciness and appearance showed non-significant reductions compared to the control. Nuggets containing 0.08% aqueous GLE were found to be almost comparable to the control in overall quality. In the case of hydroethanolic GLE, appearance and texture improved, while juiciness decreased non-significantly; however, flavour and overall acceptability declined significantly with increasing extract levels. Nuggets incorporated with 0.03% hydroethanolic GLE showed sensory characteristics comparable to the control.

Conclusion: Nuggets containing 0.08% aqueous GLE and 0.03% hydroethanolic GLE were found to be almost comparable to the control in overall quality.

Keywords: *Psidium guajava*, guava, GLE, leaves extract, hydroethanolic, chicken nuggets

Introduction

Poultry production and consumption have increased significantly over the last 40-50 years and are expected to continue growing, especially in developing countries, potentially making chicken meat one of the most important protein sources for the rapidly increasing global population (Petracci *et al.*, 2019) [10]. This expansion is largely due to the absence of major cultural or religious restrictions associated with the consumption of chicken meat (Ghonaim *et al.*, 2020) [4]. In countries like India, factors such as industrialization, rapid urbanization, globalization, and the increasing involvement of women in the workforce have led to a growing demand for convenient and quick-to-prepare meat products because they are easy to prepare, save time, and possess desirable sensory qualities (Verma *et al.*, 2016; Nikmaram *et al.*, 2018) [15, 9]. Guava (*Psidium guajava*) leaves are known to be rich in nutrients and various bioactive compounds. They contain approximately 82.47% moisture, 3.64% ash, 0.62% fat, 18.53% protein, and 12.74% carbohydrates, along with 103 mg of ascorbic acid and 1717 mg gallic acid equivalents (GAE) per gram of total phenolics, carotenoids, flavonoids (Shabbir *et al.*, 2020) [12]. However, synthetic additives are often considered potential carcinogenic or neurotoxic agents, which has led to restrictions on their use. Therefore, considering the need of food producers, the present study was undertaken to optimize the incorporation of guava (*Psidium guajava*) leaves extract in chicken nuggets.

Materials and Methods**Preparation of guava (*Psidium guajava*) leaves extract**

Fresh guava (*Psidium guajava*) leaves of Sardar variety were washed, rinsed with distilled water, and dried in a hot-air oven.

The dried leaves were ground into a fine powder, sieved, and stored in LDPE pouches under refrigeration. The dried powder was used to prepare aqueous and hydroethanolic (50% ethanol) extracts according to method described by Chauhan *et al.* (2021) ^[3], with slight modifications. The d resulting dried aqueous and hydroethanolic guava leaves extracts (GLE) were subsequently used for further analysis.

Preparation of chicken nuggets

Chicken nuggets were prepared following the method described by Gomkale *et al.* (2023) ^[5], with slight modifications. Deboned chicken meat and chicken skin were procured from a local meat market in Shirwal. Spice powder was prepared by first removing extraneous materials from the ingredients. The cleaned ingredients were dried in a hot-air oven at 50 °C for 3 hours, ground, and then sieved through a fine mesh. The spice mix was formulated by combining the ingredients in suitable proportions according to Sakunde (2004) ^[4], with minor modifications.

Table 1: Formulation of chicken nuggets

S. No.	Particular	Quantity (% by weight)
1	Deboned meat	65.70
2	Chicken Skin	10.00
3	Vegetable oil	05.00
4	Common salt	01.40
5	STPP	0.40
6	Ice water	10.00
7	Maida	2.80
8	Spice mix	1.60
9	Condiments	3.00
10	Sodium nitrite	100ppm
	Total	100

Chilled deboned meat and chicken skin were cut into small pieces and minced using a meat mincer. The minced meat and skin were transferred to a heavy-duty mixer (BAJAJ FX 1000) and blended with salt, sodium nitrite, and sodium tripolyphosphate for 1-2 minutes. Ice water and vegetable oil were then added, and mixing was continued for another 1-2 minutes. Subsequently, the remaining ingredients listed in Table 1 were incorporated, and the mixture was blended for an additional 2-3 minutes to obtain a uniform and homogeneous batter. The prepared emulsion was filled into a mould measuring 17 × 10 × 4 cm to obtain the desired shape, and the lid was tightly secured to ensure an airtight seal. The moulds containing the emulsion were placed in a steam cooker and cooked for 20 minutes. After cooking, the product was removed, allowed to cool, and then packaged in LDPE pouches.

Optimization of the level of incorporation of GLE in the chicken nuggets: Chicken nuggets were prepared by

incorporating varying levels of GLE into the standardized nugget formulation. The extracts were added to the product by dissolving them in the ice-water, and the resulting products were evaluated based on physicochemical parameters such as pH, cooking yield and sensory attributes. Aqueous GLE was incorporated at 0%, 0.08%, 0.1%, and 0.12%, whereas hydroethanolic GLE was incorporated at 0%, 0.01%, 0.03%, and 0.05%. All treatments were replicated three times.

Physiochemical analysis: The following physiochemical parameters of the samples were analyzed.

pH: The pH of the cooked chicken nuggets was determined following the AOAC (2012) ^[1] method.

Cooking yield: The weight of the chicken nugget was taken before and after cooking and expressed in percentage.

$$\text{Cooking yield} = \frac{\text{Weight of cooked nugget}}{\text{Weight of uncooked nugget}} \times 100$$

Sensory Analysis: Sensory evaluation of the meat samples was conducted by a semi-trained panel. The samples were presented to the panelists for the assessment of sensory attributes, including appearance, flavour, juiciness, texture and overall acceptability, using an 8-point hedonic scale as described by Keeton *et al.* (1983) ^[7].

Statistical analysis: The experiment was conducted in triplicate, and the data obtained were analyzed using one-way ANOVA to evaluate day-wise and treatment-wise variations. Duncan's Multiple Range Test was applied for mean comparison using the SPSS software package (version 20.0), following the standard procedures described by Snedecor and Cochran (1994) ^[13].

Results and Discussion

The pH of chicken nuggets decreased significantly ($p < 0.05$) with increasing levels of aqueous and hydroethanolic GLE (Table 2 and 3). The observed reduction in pH may be attributed to the acidic nature of *Psidium guajava* leaves extract, with 5.82 pH in hydroethanolic extract and pH 6 in aqueous extract. A significant ($p < 0.05$) effect on cooking yield was observed with increasing levels of GLE. These findings correlated with Nascimento *et al.*, (2024) ^[8] in beef steak with pectin incorporated with guava leaf extract and Kabir *et al.*, (2025) ^[6] in chicken sausage batter incorporated with moringa leaf extract. Likewise, Biswas *et al.*, (2023) ^[2] in fish nuggets incorporated with guava peel powder.

Table 2: Effect of different levels of aqueous GLE on physicochemical and sensory attributes of chicken nuggets

Parameter	Control	Aqueous extract (GLE)			F value
		0.08%	0.1%	0.12%	
Physicochemical properties					
pH	6.48±0.02 ^b	6.45±0.01 ^{ab}	6.44±0.01 ^{ab}	6.41±0.01 ^a	3.958
Cooking Yield	97.02±0.03 ^a	97.44±0.01 ^b	97.48±0.01 ^b	97.78±0.01 ^c	292.14
Sensory attributes					
Appearance	7.7±0.09	7.69±0.06	7.66±0.07	7.64±0.12	0.108
Flavour	7.79±0.12 ^b	7.68±0.12 ^b	6.58±0.17 ^a	6.52±0.15 ^a	25.419
Texture	7.57±0.14	7.61±0.13	7.69±0.11	7.77±0.09	0.567
Juiciness	7.83±0.08	7.79±0.10	7.69±0.09	7.60±0.14	0.954
Overall Acceptability	7.82±0.08 ^b	7.70±0.10 ^b	6.88±0.23 ^a	6.75±0.20 ^a	11.008

n = 6, Means ± S.E. bearing different superscript (a, b, c, d) differ significantly ($p < 0.05$), T₀: control, T₁: 0.08% aqueous GLE, T₂: 0.1% aqueous GLE, T₃: 0.12% aqueous GLE

Table 3: Effect of different levels of hydroethanolic GLE on physicochemical and sensory attributes of chicken nuggets

Parameter	Control	Hydroethanolic extract (GLE)			F value
		0.01%	0.03%	0.05%	
Physicochemical properties					
pH	6.48±0.02 ^c	6.37±0.01 ^b	6.35±0.01 ^b	6.31±0.01 ^a	32.036
Cooking Yield	97.02±0.03 ^a	97.14±0.02 ^b	97.22±0.03 ^c	97.32±0.01 ^d	28.127
Sensory attributes					
Appearance	7.69±0.11	7.77±0.09	7.80±0.09	7.87±0.05	0.622
Flavour	7.79±0.1 ^b	7.81±0.07 ^b	7.83±0.08 ^b	7.29±0.12 ^a	6.612
Texture	7.75±0.09	7.78±0.13	7.82±0.08	7.86±0.08	0.229
Juiciness	7.92±0.05	7.88±0.05	7.83±0.08	7.79±0.08	0.617
Overall Acceptability	7.71±0.10 ^b	7.80±0.07 ^b	7.82±0.08 ^b	7.20±0.10 ^a	10.556

n = 6, Means ± S.E., bearing different superscript (a, b, c, d) differ significantly ($p < 0.05$), T₀: control, T₄: 0.01% hydroethanolic GLE, T₅: 0.03% hydroethanolic GLE, T₆: 0.05% hydroethanolic GLE

Sensory attributes

With increasing levels of aqueous GLE, the sensory scores for flavour and overall acceptability of chicken nuggets decreased significantly, except in T₁ where the change was non-significant. Whereas, texture improves and juiciness, appearance reduced non significantly in all treatment to that of control. Notably, nuggets containing 0.08% aqueous GLE were nearly comparable to the control. As the amount of extract was increased, the flavour of lean meat was masked and in hydroethanolic GLE, the sensory scores of treated chicken nuggets for parameters such as appearance and texture improved while juiciness reduced non significantly than control, whereas flavour and overall acceptability reduced significantly with increased hydroethanolic GLE. Notably, chicken nuggets containing 0.03% levels of hydroethanolic GLE were almost comparable and improved in overall sensory attributes compared to the control. Similar observations were reported by Velasco-Arango *et al.*, (2021) ^[14] in frankfurters incorporated with guava epicarp extract and Verma *et al.*, (2013) ^[16] found in meat nuggets incorporated with guava powder.

Based on the experimental results, it was concluded that the incorporation of aqueous GLE at 0.08% and hydroethanolic GLE at 0.03% in chicken nuggets resulted increased cooking yield and comparable to improved sensory attributes than the control. Hence, the levels of 0.08% aqueous GLE and 0.03% hydroethanolic GLE were selected for further evaluation.

Conclusion

Chicken nuggets incorporated with 0.08% aqueous GLE and 0.03% hydroethanolic GLE showed optimum cooking yield and quality attributes comparable to the control.

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