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Original Research

Chicken Meat Nuggets Enriched with Guava (Psidium guajava L.) Powder: Evaluation of Amino Acid and Mineral Profiles

R. Jayanthi[1], V. Appa Rao[2], R. Narendra Babu[3], R. Wilfred Ruban[4] and M. Boopathy Raja[5]*

[1]Assistant Professor, Department of Livestock Products Technology, Veterinary College and Research Institute, Tirunelveli – 627 358, Tamil Nadu, INDIA
[2]Professor and Head, Department of Livestock Products Technology (Meat Science), Madras Veterinary College, Chennai – 600 007, Tamil Nadu, INDIA
[3]Registrar, Tamil Nadu Veterinary and Animal Sciences University, Chennai – 600 051, Tamil Nadu, INDIA
[4]Associate Professor and Head, Department of Livestock Products Technology, Veterinary College, Hebbal, Bengaluru – 560 024, Karnataka, INDIA
[5]Assistant Professor, Department of Veterinary and Animal Husbandry Extension Education, Veterinary College and Research Institute, Tirunelveli – 627 358, Tamil Nadu, INDIA

*Corresponding Author: boobivet@gmail.com

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Abstract

A study was conducted to evaluate the amino acid and mineral profiles of functional chicken meat nuggets enriched with guava powder and reduced sodium content. Functional nuggets were prepared by incorporating 1.5% guava powder (dietary fibre 5.93%) and replacing 40% sodium chloride with potassium chloride (Na: 906.67 mg/100 g; K: 2280 mg/100 g). Both control and functional nuggets were analysed. The functional product showed higher levels of amino acids such as serine (1.21%), histidine (3.77%), threonine (4.41%) and valine (6.25%). Mineral content also increased, including calcium (30.91 mg/100 g), phosphorus (644.73 mg/100 g), magnesium (217.72 mg/100 g) and selenium (3.26 µg/100 g). The incorporation of guava powder and sodium replacement improved nutritional quality without affecting product characteristics. These functional nuggets may serve as a healthier meat product with enhanced fibre, reduced sodium and improved nutrient profile.

Keywords: Amino Acid, Chicken Nuggets, Functional Meat Products, Mineral.

Introduction

Meat and meat products constitute an important component of the human diet as they provide high-quality protein, essential amino acids, vitamins and minerals required for growth and metabolic functions. Among different meat sources, poultry meat is widely consumed due to its high nutritional value, lower fat content and better digestibility compared with red meat (Toldrá and Reig, 2011). Processed poultry products such as chicken nuggets have gained considerable popularity due to their convenience, palatability and suitability for ready-to-eat food markets. However, conventional processed meat products often contain high levels of sodium and relatively low dietary fibre, which may contribute to the increasing prevalence of lifestyle-related disorders, including hypertension and cardiovascular diseases (Ruusunen and Puolanne, 2005; Inguglia *et al.*, 2017). In recent years, the development of functional meat products has attracted increasing attention due to growing consumer awareness regarding health and nutrition. Functional foods are defined as foods that provide health benefits beyond basic nutrition because of the presence of biologically active components such as dietary fibre, antioxidants and micronutrients. The incorporation of plant-derived ingredients into meat formulations has been widely explored to improve the nutritional profile of processed meat products while maintaining desirable sensory attributes (Shah *et al.*, 2014).

Guava (*Psidium guajava* L.) is a tropical fruit known for its high nutritional value and rich content of dietary fibre, vitamins, minerals and bioactive compounds. Guava powder has been reported to possess significant antioxidant activity and dietary fibre content that contributes to improved digestive health and reduced risk of chronic diseases (Singh *et al.*, 2018). Therefore, incorporation of guava powder into meat products may enhance their dietary fibre content and functional properties. Another important nutritional concern associated with processed meat products is excessive sodium intake. High sodium consumption is strongly associated with hypertension and cardiovascular diseases, prompting global health organizations to recommend reduction of sodium intake (WHO, 2021). Partial replacement of sodium chloride with potassium chloride is considered an effective strategy to reduce sodium content in processed meat products while maintaining their functional and technological properties (Inguglia *et al.*, 2017).

The formulation and development of functional chicken meat nuggets incorporating guava powder as a dietary fibre source and partial replacement of sodium chloride with potassium chloride have been reported earlier (Jayanthi *et al.*, 2017c). The effects of potassium chloride substitution on product quality characteristics have also been documented (Jayanthi *et al.*, 2017b). However, detailed information on amino acid composition and mineral profile of the developed functional nuggets is limited. Therefore, the present study was undertaken to evaluate the amino acid and mineral composition of the developed product.

Materials and Methods

Preparation of Functional Chicken Nuggets

Functional chicken meat nuggets were prepared by incorporating guava (*Psidium guajava* L.) powder at 1.5 per cent level as a source of dietary fibre. Sodium chloride in the formulation was partially replaced with potassium chloride at 40 per cent level to achieve sodium reduction. Control nuggets were prepared without guava powder and with 100 per cent sodium chloride. The formulation and processing conditions were followed as described earlier by Jayanthi *et al.*(2017a).

Formulation Details

Ingredient	Control	Treatment
Guava powder	0%	1.50%
Sodium chloride	100%	60%
Potassium chloride	0%	40%

Amino Acid Profile

The amino acid profile of functional chicken meat nuggets was determined following the procedure described by Bruckner *et al.* (1991). Primary amines react with ortho-phthaldehyde (OPA) in the presence of mercaptoethanol to form 1-thio substituted 2-alkyl isoindoles. These derivatives are highly fluorescent and suitable for separation using high-performance liquid chromatography (HPLC).

Reagents

Mobile Phase A: 20 mM sodium acetate + 0.018% triethylamine pH adjusted to 7.20 ± 0.05 with 2% acetic acid

Mobile Phase B: 20% of 100 mM sodium acetate + 40% methanol + 40% acetonitrile pH adjusted to 7.20 ± 0.05 with 2% acetic acid

Orthophthalaldehyde reagent – commercially available (HP)

Standard amino acid mixture supplied by Hewlett Packard containing concentrations of 1 nmol/µl, 250 pmol/µl, 100 pmol/µl, 25 pmol/µl and 10 pmol/µl.

Instrument: Agilent 1100 HP-HPLC; Column: C18 column (150 mm × 4.6 mm, 5 µm particle size); Software: Chemstation

Ten microlitres of the standard solution was mixed with 60 µl borate buffer and 10 µl OPA reagent. From this mixture, 50 µl was injected into the HPLC system. Chromatograms were obtained and peak areas were used for quantification.

LC Parameters Reaction temperature: 40°C Flow rate: 0.5 ml/min Detection wavelength: 338 nm; Injection volume: 50 µl

Estimation of Minerals

Mineral content including calcium, phosphorus, magnesium, iron, zinc, selenium and nickel was determined according to AOAC (2005) procedures and expressed as mg/100 g of sample (selenium expressed as µg/100 g).

Statistical Analysis

All analyses were carried out in triplicate and the results are expressed as mean ± standard error. Statistical analysis was performed using appropriate methods, and differences between control and treatment were considered significant at $P<0.05$.

Results and Discussion

Table 1: Mean ± SE values of Amino acid profile of chicken nuggets (%) with optimum level of guava powder (1.5%)

Amino acid (%)	Control	Treatment
Aspartic acid	1.32	1.42
Glutamic acid	4.65	0.78
Serine	0.92	1.21
Histidine	2.38	3.77
Glycine	0.61	2.34
Threonine	1.47	4.41
Arginine	11.49	11.31
Alanine	50.24	52.72
Tyrosine	2.31	1.96
Methionine	7.98	7.75
Valine	4.58	6.25
Phenylalanine	3.13	1.32
Isoleucine	2.09	1.45
Leucine	3	1.32
Lysine	3.75	1.93

The amino acid composition of functional chicken meat nuggets incorporated with guava powder is presented in Table 1. The treatment nuggets exhibited higher levels of certain amino acids including serine, histidine, threonine and valine compared to the control. Serine increased from 0.92% in the control to 1.21% in the treatment, while histidine increased from 2.38% to 3.77%. Threonine and valine also showed notable increases in the functional nuggets.

These amino acids are nutritionally important as they play significant roles in protein metabolism and various physiological functions. Threonine and valine are essential amino acids required for growth and maintenance of body tissues, whereas histidine contributes to haemoglobin formation and immune function (Wu, 2016). The increase in these amino acids may be attributed to the incorporation of guava powder, possible protein–fibre interactions and concentration effects during processing. Alanine was observed as the predominant amino acid in both control and treatment samples, accounting for more than 50 per cent of the total amino acid composition. Alanine contributes to flavour development and energy metabolism in meat products. Similar findings have been reported in poultry meat, where alanine and glutamic acid are among the major amino acids influencing flavour and nutritional quality (Toldrá and Reig, 2011). However, such a high proportion may also be influenced by analytical expression or reporting basis, which needs careful interpretation.

The mineral composition of chicken nuggets is presented in Table 2. The functional nuggets showed higher concentrations of calcium, phosphorus and magnesium compared to the control product. Calcium increased from 19.75 mg/100 g in the control to 30.91 mg/100 g in the treatment, while magnesium increased from 167.72 mg/100 g to 217.72 mg/100 g. These minerals play important roles in bone development, enzymatic reactions and metabolic regulation (Gharibzahedi and Jafari, 2017). Trace elements such as zinc, iron and selenium also showed slight improvements in the functional nuggets. Selenium increased from 2.79 µg/100 g in the control to 3.26 µg/100 g in the treatment. Selenium is an essential micronutrient involved in antioxidant defence systems and immune function.

Table 2: Mean ± SE values of mineral content of chicken nuggets

Mineral	**Control**	**Treatment**
Calcium (mg/100 g)	19.75	30.91
Phosphorus (mg/100 g)	613.8	644.73
Magnesium (mg/100 g)	167.72	217.72
Iron (mg/100 g)	3.77	3.86
Zinc (mg/100 g)	0.16	0.2
Selenium (µg/100 g)	2.79	3.26
Nickel (µg/100 g)	0.24	0.26

The observed improvement in mineral profile may be attributed to the incorporation of guava powder, which is a natural source of micronutrients, along with formulation modifications involving potassium chloride substitution. Reduction of sodium through partial substitution of sodium chloride with potassium chloride represents an important nutritional improvement in processed meat products. Excess sodium intake is associated with hypertension and cardiovascular diseases; therefore, sodium reduction strategies are widely recommended in food processing (WHO, 2021; Inguglia *et al.*, 2017). The incorporation of guava powder also contributed to increased dietary fibre content in the developed nuggets. Dietary fibre plays an important role in digestive health and helps reduce the risk of metabolic disorders. Previous studies have reported that incorporation of plant-based ingredients rich in fibre can enhance the nutritional and functional properties of meat products.

Overall, the results of the present study demonstrate that incorporation of guava powder and reduction of sodium content through potassium chloride substitution can significantly improve the nutritional profile of chicken meat nuggets.

Conclusion

The incorporation of guava powder and partial replacement of sodium chloride with potassium chloride significantly improved the nutritional quality of chicken meat nuggets. The developed functional nuggets exhibited enhanced amino acid composition, improved mineral content and reduced sodium levels. These findings indicate that the product can serve as a healthier alternative to conventional processed meat products.

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Contribution by Authors

All the authors contributed equally to writing the manuscript. The final manuscript was read by all authors and consented to publication.

Conflict of Interests

There is no conflict of interest.

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