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EFFECT OF INCORPORATION OF DRUMSTICK (*Moringa oleifera*) LEAVES EXTRACT ON THE QUALITYOF GROUND CHICKEN NUGGETS

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ABSTRACT

The present study was conducted to optimize the level of incorporation of aqueous drumstick (*Moringa oleifera*) leaves extract in ground chicken nuggets. The aqueous MoLE was prepared by taking dried mature *Moringa olifera* leaves powder and diluted in water at 1: 10 ratio, then kept at 55°C for 3 hours and finally filtered with the help of filter paper. During optimization, ground chicken nuggets were prepared by incorporating 0, 2.5, 5, and 7.5% MoLE in the nugget mix. The quality and acceptability of the MoLE added nuggets were evaluated based on proximate composition, physico-chemical, and sensory analysis. Moisture and fat showed a non-significant difference, while protein and ash significantly increased in 5% MoLE incorporated product. pH decreases while cooking yield& emulsion stability increased non-significantly with increase in the level of MoLE. Sensory scores of flavour, texture, juiciness and overall acceptability were comparable in the 2.5 % MoLE, while appearance was affected non significantly by the increased level of MoLE. The result of the study shows that nuggets incorporated with a 2.5% level of MoLE were comparable to the control in all quality parameters, along with improved nutritional properties.

Keyword: *Moringa oleifera*, drumstick, leaves extract, ground chicken nuggets, MoLE

INTRODUCTION

The poultry business is one of India's fastest-growing industries, contributing to the country's GDP and employing millions of people (BAHS 2020). Poultry farming is an integral part of the Indian meat industry. It has undergone significant shifts and transformations in the last three decades, from unstructured family businesses to highly organized entrepreneurial activity. Industrialization, rapid urbanization, globalization, and the increasing number of working women in India all contribute to a rapidly growing need for ready-to-eat and convenient meat products (Verma *et al*., 2013). *Moringa oleifera* is commonly known as a drumstick and is traditionally used for dietary

purposes as a vegetable. It is native to India, Africa, Arabia, Southeast Asia, and South America (Sengupta and Gupta, 1970). *Moringa oleifera* leaves are good source of minerals like calcium, potassium, zinc, magnesium, iron and copper (Kasolo *et al*., 2010). They also contain vitamins A, B, C, D and E (Mbikay, 2012). Importantly, they are also rich in different phytochemicals, reducing sugar and anti-cancerous agents (Berkovich *et al*., 2013). In addition to contributing to the taste and aroma of foods, it also contains a variety of bioactive substances, which are helpful considerably in extending the shelf life of food. Chicken nugget is one of the most popular products among meat items and is generally used as a snack or mixed with gravy. Nevertheless, the literature about using *Moringa oleifera* leaves extract in meat products is limited. Thus, the study was undertaken to optimize the level of incorporation of drumstick (*Moringa oleifera*) leaves extract in the ground chicken nuggets based on different quality attributes.

MATERIALS AND METHODS

Preparation of *Moringa oleifera* leaves extract (MoLE): Fresh *Moringa oleifera* leaves were collected from the Khandala tehsil of Satara district of western Maharashtra. The leaves were washed with the help of tap water, followed by distilled water to remove the dirt and dust or any other foreign material on its surface. After washing, leaves were dried in the hot air oven at 50°C till constant weight was obtained. Dried leaves were then powdered using a heavy-duty mixer grinder (BAJAJ FX 1000) and sieved. The dried powder was packaged in LDPE pouches and stored at refrigeration for further use. The stored powder was used to prepare the extract (MoLE) by the method suggested by Muthukumar *et al.* (2012) with slight modifications. The extract was prepared by dissolving 10 g of powder in 100 mL distilled water as a solvent with intermittent stirring in a water bath at 55°C for 3 hours. The mixture was first strained through muslin cloth and then filtered with the help of filter paper. The freshly produced extract was used for each trial.

Preparation of ground chicken nuggets: Ground chicken nuggets were prepared according to the method of Naveena *et. al* (2013) and Chauhan *et. al* (2021) with slight modifications. Deboned chicken meat of layer birds and all other ingredients were obtained from the local market of Shirwal. Fine powdered spice ingredients were prepared firstly by removing foreign material from the selected spices, then drying in a hot air oven at 50°C for 2 hours followed by grinding and sieving through a fine mesh. Appropriate proportions of powdered ingredients were used to prepare a spice mix (Sakunde, 2004, with slight modifications).

Table 1. Formulation of ground chicken nuggets

Sr. no.	Particular	Quantity (% by weight)
1	Deboned meat	72.00
2	Vegetable oil	08.50
3	Common salt	1.4
4	STPP	0.40
5	Ice water	10.00
6	Maida	3.00
7	Spice mix	1.60
8	Condiments	3.00
9	Sodium nitrite	100ppm

Chilled deboned chicken meat (from layer birds) was chopped into pieces and minced in a meat miner. Salt, sodium nitrite, and sodium tripolyphosphate were added to minced meat and blended in a blender (Tefal Masterchef Gourmet QB505D38) for 1-2 minutes. Then ice and vegetable oil were added and blended into the mix for approximately 1-2 minutes. After that, other ingredients shown in Table1 were mixed thoroughly in the blender (approx. 2-3 min) to obtain a homogenous mixture. The emulsion was stuffed in a mould (17cm x 10cm x 4cm) to get the proper shape. The lid was fixed to make it airtight. The mould containing emulsion was kept in a steam cooker and cooked for 20 minutes, which were subsequently packaged in LDPE pouches.

Optimization of the level of incorporation of MoLE in the ground chicken nuggets: Ground chicken nuggets were prepared by incorporating, varying levels of MoLE in the standardized formulation of nuggets. The ice water of the formulation was replaced with MoLE 0%,2.5%, 5%, and 7.5%. The product was assessed for quality based on physico-chemical properties such as pH, cooking yield, emulsion stability, proximate composition, and sensory evaluation. The experiment was replicated thrice.

Proximate composition: The moisture, fat, protein, and ash content of cooked ground chicken nuggets were determined by following the standard method of AOAC (1995).

Physio-chemical analysis: The following physico-chemical parameters of the samples were analyzed.

pH: The pH of cooked nuggets was determined by the method of AOAC (2012).

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

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

Emulsion stability: The Baliga and Madaiah (1970) method was used to test the emulsion stability of chicken emulsion.

$$\text{Emulsion stability (\%)} = \frac{\text{Weight of cooked mass}}{\text{Initial weight}} \times 100$$

Sensory Analysis: Sensory analysis of the meat samples was carried out by semi-trained panelists. The meat samples were served to the panelists to assess the sensory attributes, viz. colour & appearance, odour, and general acceptability, using 8 points hedonic scale (Keeton *et al.,* 1983).

Statistical Analysis: This study experiment was repeated three times and each time, investigation of all the parameters was done in duplicate. The data analysis was carried out using *SPSS* software (version 20.0) as per the standard methods described by Snedecor and Cochran (1994).

RESULT AND DISCUSSION

Moisture percentage in the MoLE-treated chicken nuggets was non-significantly reduced with an increment of the amount of extract in the product (Table 2). Madane *et al.* (2019) observed a similar trend in the moisture content of goat meat nuggets incorporated with *Moringa* flower extract. The protein percentage was found to increase numerically with an increased amount of MoLE in the final product. This increase in the protein percentage of MoLE-treated ground chicken nuggets is probably due to the protein content of *Moringa oleifera* leaves. Higher protein content (26.28%) in *Moringa oleifera* leaves powder was recorded by Olusanya *et al*. (2020). Mashau *et al.* (2021) recorded a similar trend in the cooked ground beef added with *Moringa oleifera* powder. Similarly, Madane *et al.* (2019) also noticed that the protein content of chicken nuggets increased with an increased percentage of *Moringa* flower extract.

It was observed that the incorporation of MoLE has a non-significant effect on the fat content of the chicken nuggets. Concordant findings were recorded by Hazra *et al.* (2012). Similarly, Madukwe *et al*. (2013) have documented that aqueous *M. oleifera* leaves extract contains low levels of fat. Similarly, Kadakadiyavar *et al.* (2017) reported that the fat percentage of chicken nuggets increased non-significantly with an increase in mango pulp powder extract.

The result indicates that the ash contents of ground chicken nuggets increased numerically with the increased amount of MoLE in the final product. The *Moringa oleifera* leaves have a higher amount of minerals (13.08%) (Olusanya *et al*., 2020). Hence, the ground chicken nuggets show higher ash content with an increased level of MoLE in the final product. These findings are similar to those of Mashau *et al.* (2021) in cooked ground beef added with *Moringa oleifera* leaves powder. Al- Juhaimi *et al*. (2016) also recorded that the ash content of raw patties increased as the percentage of *Moringa oleifera* seed flour was increased in cooked ground buffalo meat.

Physico-chemical properties: The pH value of ground chicken nuggets decreases with increased amount of MoLE, although non-significantly (Table 3). The decrease in the pH of meat might be due to the acidic pH (5.9) of *Moringa oleifera* leaves extract. Madane *et al*. (2019) in chicken nuggets incorporated with *Moringa oleifera* flower extract, there is a non-significant effect of adding higher levels of MoLE on the emulsion stability and cooking yield in MoLE-treated nuggets. These findings corroborated with observations of Madane *et al*. (2019) in chicken nuggets incorporated with *Moringa oleifera* flower extracts, Das *et al*. (2015) in goat meat nuggets with the inclusion of various levels of bael pulp residue, and Malav *et al.* (2016) in mutton patties added with different levels of red kidney bean powder.

Sensory attributes: The sensory scores for the parameters like flavour, texture, and juiciness of the ground

Table 2: Effect of different levels of MoLE on proximate composition of ground chicken nuggets

Parameters	Control	*Moringa oleifera* leaves extract (MoLE)		
		2.5%	5%	7.5%
		Proximate composition		
Moisture (%)	65.80±1.09	65.59±1.06	65.29±0.42	64.60±0.31
Protein (%)	16.04±0.15^{a}	17.18±0.14^{b}	17.83±0.29^{c}	18.36±0.19^{c}
Fat (%)	18.38±0.12	18.45±0.68	19.70±0.64	19.87±1.19
Ash (%)	2.88±0.27^{a}	3.84±0.54^{a}	5.79±0.67^{b}	6.46±0.70^{b}

n=6, Means ± S.E., a,b,c mean values within rows with different superscripts significantly different (P<0.05). T0: control, T1: 2.5% MoLE, T2: 5% MoLE, T3: 7.5% MoLE.

Table 3: Effect of different levels of MoLE on physico-chemical properties of ground chicken nuggets

Parameters	Control	*Moringa oleifera* leaves extract (MoLE)		
		2.5%	5%	7.5%
Physico-chemical properties				
pH	6.33±0.44	6.31±0.26	6.27±0.34	6.25±0.11
Cooking Yield (%)	95.21±0.23	95.42±0.79	95.61±0.37	95.88±0.67
Emulsion stability (%)	92.88±1.54	93.76±1.33	94.01±1.20	94.46±0.52

n=6, Means ± S.E., a,b,c mean values within rows with different superscripts significantly different (P<0.05). T0: control, T1: 2.5% MoLE, T2: 5% MoLE, T3: 7.5% MoLE.

Table 4: Effect of different levels of MoLE on sensory attributes of ground chicken nuggets

Parameters	Control	*Moringa oleifera* leaves extract (MoLE)		
		2.5%	5%	7.5%
Sensory attributes				
Appearance	7.66±0.11	7.61±0.13	7.55±0.95	7.53±0.13
Flavour	8.00 ± 0.00^{c}	7.75 ± 0.17^{bc}	7.48 ± 0.13^{b}	6.91 ± 0.20^{a}
Texture	7.81 ± 0.16^{b}	7.66 ± 0.21^{b}	7.00 ± 0.22^{a}	6.50 ± 0.22^{a}
Juiciness	7.86 ± 0.13^{b}	7.25 ± 0.17^{b}	7.25 ± 0.30^{b}	6.70 ± 0.20^{a}
Overall Acceptability	7.83 ± 0.16^{b}	7.58 ± 0.20^{b}	7.41 ± 0.08^{b}	6.75 ± 0.25^{a}

n=6, Means ± S.E., a,b,c mean values within rows with different superscripts significantly different (P<0.05). T0: control, T1: 2.5% MoLE, T2: 5% MoLE, T3: 7.5% MoLE.

chicken nuggets differed significantly (P<0.05), whereas appearance differed non-significantly compared to the control (Table 4). A decreasing trend was observed for all the sensory parameters with increased MoLE incorporation. Notably, ground chicken nuggets with 2.5% MoLE were almost comparable with the control for all the sensory parameters. As the amount of extract increased, lean meat's flavour was masked. Moreover, ground chicken nuggets treated with 7.5% MoLE exhibited a sour taste. Similar findings were noted by Jayawardana *et al.* (2015) and Elhadi *et al.* (2017) for chicken sausages and chicken patties
incorporated with moringa (*Moringa oleifera*) leaf powder. Based on the data obtained in the experiment, it was concluded that incorporating MoLE at 2.5% level in the ground chicken nuggets resulted in optimum moisture, fat, emulsion stability, and cooking yield comparable to that of control while high in protein and ash. Similarly, the scores of sensory attributes were optimum for the product with a 2.5% level of MoLE.

CONCLUSION

Ground chicken nuggets incorporated with MoLE at a 2.5% level resulted in optimum moisture, fat, emulsion stability, and cooking yield while high in protein and ash contents compared to the control. Ground chicken nuggets incorporated with 2.5 % MoLE had comparable quality and acceptability as control nuggets.

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