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## Assessment of physico-chemical and microbial parameters in the chicken nuggets incorporated with groundnut stored at refrigerated temperature

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**Abstract**

The groundnut (peanuts) is a source of vegetable protein and dietary fiber (lack in meat) which can be incorporated into comminuted chicken meat products. Groundnut has good emulsifying activity, emulsifying stability, foaming capacity, excellent water retention and high solubility have been observed for peanut proteins and can also provide a good protein ingredient in product formulation in the food industry. The present study was conducted to assess the quality of chicken nuggets embodied with mesh groundnut and powdered groundnut stored at refrigerated temperature. Firstly, chicken nuggets were prepared as per formulation decided. The effects of mesh groundnut and powdered groundnut on the quality of chicken nuggets were assessed based on pH, thiobarbituric acid, tyrosine value, and microbiological quality on Day 0, 5, 7, and 10. There is a significant increase in both pH and thiobarbituric acid of chicken nuggets incorporated with mesh groundnut and powdered groundnut from Day 0 to 10 and no significant change in the tyrosine value. There is a significant increase in total plate count from Day 0 to Day 10, but no *E. coli*, *Salmonella* spp. and *Staphylococcus aureus* were detected in the chicken nuggets.

**Keywords:** Chicken nuggets, Groundnut, pH, thiobarbituric acid, tyrosine value, total plate count, *E. coli*, *Salmonella* spp. and *Staphylococcus aureus*

**Introduction**

Chicken meat is considered an easily available source of high-quality protein and other nutrients that are necessary for proper body functioning. To meet the consumers' growing demands for high-quality protein and a low portion of saturated fat. Several studies have been conducted in many countries in the world on how to increase the per capita consumption of poultry meat. The development of value-added products, such as chicken nuggets has been identified as the best way to increase poultry meat consumption. These pre-processed products are ready-to-fry and serve, and are gaining importance in the consumer market. Improvement of such product quality widens the marketability of chicken products. The quality of nuggets is significantly affected by processing, raw material, and ingredient factors either from the nutritional value or overall acceptability by consumers. Only those nuggets with high nutritional value, low cholesterol, good textural properties, nice flavor, and taste profile will become the favorite choice of consumers as flavor and texture, particularly juiciness and tenderness, have a clear relationship to meat palatability<sup>[4, 10]</sup>.

Groundnut in preparation of chicken nuggets is a good source of plant origin protein, dietary fiber, and oil which otherwise lacks in meat<sup>[25]</sup>. The true protein digestibility of peanuts was compared with animal protein by Singh and Singh<sup>[21]</sup> and observed that the components in peanuts are highly digestible. Peanuts (*Arachis hypogaea*) are rich in protein, oil, and fibers and are technically considered as pea belonging to the family (Fabaceae) of bean/legume. The peanuts contain over 50% monounsaturated fats, which are easily digested due to a single unsaturated hydrogen bond and can be broken easily as described by Feldman<sup>[7]</sup> and also the fibers in peanuts are mainly insoluble, with lower amounts of soluble fibers as mentioned in the study by Higgs<sup>[11]</sup>. Importance of fiber in diet Dietary fibers acts as anticarcinogenic & antitumorigenic by reducing the production of carcinogenic substances in the colon<sup>[12, 19]</sup>. And as per a report by Colmenero<sup>[5]</sup>, dietary fiber also has other properties like water retention,

lubrication, and provides a neutral flavor to meat products. According to AOAC [3], dietary fiber is the remnant of the edible part of plants that escaped digestion and absorption in the small intestine and are made up of cellulose, hemicelluloses, resistant starches (RS), lignin, and pectin. Lefebvre and Thebaudin [17] reported that the fiber can bind a large amount of water and can increase stool weight. Increased stool bulk reduces the colonic transit time which helps to prevent constipation and production of carcinogenic and genotoxic compounds [9]. Dietary fiber plays a significant role in the prevention of several diseases and maintenance of health like, Type-2 diabetes mellitus is inversely correlated with intake of high fiber content diets [20], prevention of cardiovascular diseases [16].

## Materials and Methods

### Different ingredients of formulations

Live broiler birds (of age 7-8 weeks) were purchased from a college farm and oil, spices, eggs, STPP, ginger, onion, garlic, and groundnut were purchased from the local market of Aizawl. The Chicken was slaughtered by the "Halal" method hygienically. The dressed carcasses were stored at 4°C till further use.



Fig 1: Groundnut

### Composition of formulation of different treatment

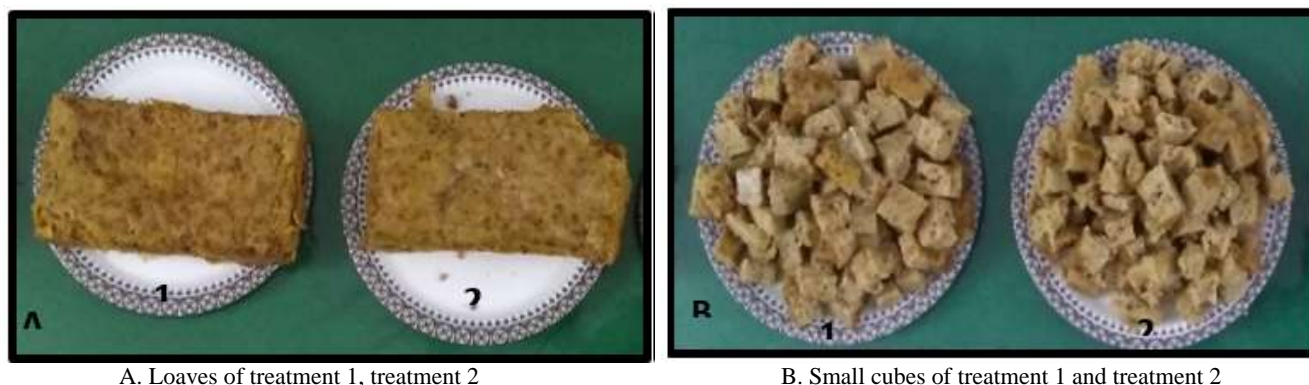
The chicken nuggets were formulated with chicken meat, fat, spice mix, salt, condiment mix, egg white, groundnut powder, sodium tripolyphosphate, and groundnut mesh/granules. Treatment 1 was treated with Groundnut powder and treatment 2 was treated with groundnut mesh. The detail of each formulation is given in table 1.

Table 1: Formulation of Chicken Meat Nuggets

| Ingredients (%)                | Treatment 1 | Treatment 2 |
|--------------------------------|-------------|-------------|
| Meat                           | 64          | 64          |
| Fat                            | 8           | 8           |
| Ground nut Powder/ Granules    | 10          | 10          |
| Salt                           | 1.5         | 1.5         |
| Condiment Mix                  | 3           | 3           |
| Spice                          | 1.5         | 1.5         |
| Water                          | 10          | 10          |
| Egg white                      | 1.8         | 1.8         |
| Sodium tripolyphosphate (STPP) | 0.2         | 0.2         |

### Preparation of chicken nuggets

The deboned chilled lean meat was cut into small pieces/chunks and minced in a meat mincer (Sirman, Italy). Meat, fat, salt, groundnut powder, ground nut mesh/cracks/granules, spice mix, condiments mix, sodium tri poly phosphate, water and whole egg liquid were weighed according to formulation given in table 1. All ingredients were measured on the basis nuggets formulation. About 800 gm emulsion was used for each treatment Meat emulsion for chicken nuggets were prepared in bowl chopper (MADO Garant). Minced meat was blended with salt, sodium tri poly phosphate for 1minute. water was added and blending was continued for 1mintue. this was followed refined oil (dhara oil) and blending for 1-2 minute. This was followed by addition of ground nut add powder/ground nut mesh/cracks/granules and blended for 1.5-2 minute. This was followed by addition of spice mix and condiments mix and blended was continued for 1-2 minute. This was followed by addition of whole egg and blended for 1-2minute. Then after all ingredients mix .The blending was carried for further for 1.5-2 minute to get the desired emulsion. The emulsion was stuffed in reweighed moulds (18cm x 10cm x 5.5cm) so as to get proper shape. The lid was then fixed on it so as to make air tight. The filled mould weight for each treatment was recorded. The moulds containing emulsion was kept in a steam cooker and cooked for 35 min without pressure. The internal temperature of loaves was maintained as 80 °C±2 °C. Cooked loaf was cooled at room temperature and weight was recorded and the loaves were then cut into nuggets of size 4x1.5x1.5 cm which were subsequently packaged in polyethylene pouches. The samples were aerobically packed and sealed in LDPE and kept under refrigeration temperature (4±1°C) were analyzed for different Physico-chemical, microbiological and sensory parameters at intervals of 0, 5, 7, and 10 days for refrigerated storage.



A. Loaves of treatment 1, treatment 2

B. Small cubes of treatment 1 and treatment 2

Fig 2: Chicken nuggets

### Measurement of quality of chicken nuggets

After the preparation of Chicken nugget, quality assessment was done by measuring physicochemical and microbiological parameters.

#### Physicochemical parameters

In physicochemical parameters, pH, thiobarbituric acid (TBA), and tyrosine value was measured.

#### pH

pH was measured for all the samples by using a digital pH meter (Cyberscan 1000 Euteoh instruments) described by AOAC [3] on the 0<sup>th</sup>, 5<sup>th</sup>, 7<sup>th</sup>, and 10<sup>th</sup> day of refrigeration storage

#### Thiobarbituric acid number

The thiobarbituric acid number of all the samples was determined by the following method described by Wilson [24] on the 0<sup>th</sup>, 5<sup>th</sup>, 7<sup>th</sup>, and 10<sup>th</sup> day of refrigeration storage

#### Tyrosine value

The Tyrosine value of all the samples was determined by the following method described by Strange [23] on the 0<sup>th</sup>, 5<sup>th</sup>, 7<sup>th</sup>, and 10<sup>th</sup> day of refrigeration storage

#### Microbiological parameters

##### Total plate count

Enumeration of the organisms was done by following the techniques outlined by American Public Health Association [2,6] for all the samples on the 0<sup>th</sup>, 5<sup>th</sup>, 7<sup>th</sup>, and 10<sup>th</sup> day of refrigeration storage.

##### Detection of *E. coli*, *Salmonella* spp. and *Staphylococcus aureus*

Detection of *E. coli*, *Salmonella* spp. and *Staphylococcus aureus* was done by using a standard protocol [13-15] on 0<sup>th</sup>, 5<sup>th</sup>, 7<sup>th</sup> and 10<sup>th</sup> day of refrigeration storage.

#### Statistical analysis

The data obtained from the experiments were analyzed statistically as per the method outlined by Snedecor and Cochran [22] using the SPSS version 20. Firstly, to normalize the data arcsine transformation has been used for proportional data. General Linear Model of one way and two way ANOVA based on Fisher's Least Significant Difference method was used to check the significant difference. The significant values in the ANOVA were further tested through the Duncan multiple range test. Results are depicted as Mean±S.D. and when  $p < 0.05$ ,  $p < 0.01$ , and  $p = 0.00$  then the differences were considered significant.

### Results and Discussion

#### pH

The change in pH of meat is the indicator of spoilage of meat. The pH value of 6.11 to 6.25 is considered as the optimal pH

of chicken meat. In the study, the pH of chicken nuggets incorporated with groundnut powder (treatment 1) and groundnut mesh/ granules (treatment 2) have shown significant increase over the period from day 0 to day 10 stored at 4 °C (Table 2), but the pH values of chicken nuggets in the present experiment was in optimal range. This indicates that the quality of proposed products was maintained up to day 10 under refrigerated temperature. As such, there are no reports available showing preservative effect of groundnut. However, scientific reports showing preservative effects of ginger and spices (used in the experiment) are available [18]. So, in the present study, ginger and spices may be responsible to prevent the spoilage. Till date, no study is available which showed the effect of groundnut on the pH of chicken nuggets. Further study can be conducted to check the effect of groundnut on pH.

#### Thiobarbituric acid number

The TBA of chicken nuggets incorporated with groundnut powder (treatment 1) and groundnut mesh/ granules (treatment 2) have shown significant increasing trend over the period from day 0 to day 10 stored at 4°C (Table 2), but were below the acceptable threshold level of 1 mg/ kg of the sample. The non-air tight packaging of chicken nuggets may be the reason for significantly increasing trend of TBA value.

#### Tyrosine value

The tyrosine value indicate autolysis and proteolysis of protein by bacterial enzyme. In this study, it was found that the tyrosine value of treatment 1 (incorporated with groundnut granules) and treatment 2 (incorporated with mesh groundnut) was found to be non-significantly ( $p > 0.05$ ) increasing over the period of storage from day 0 to day 10 at 4°C as shown in the table 2. This indicate that chicken nuggets prepared from treatment 1 and treatment 2 were able to withstand the autolysis and proteolysis up to day 10 at storage temperature of 4 °C.

#### Total plate count (TPC)

The TPC for treatment 1 and treatment 2 was significantly increased from day 0 to day 10 as shown in table 2 which was less than as per recommended by "Prevention of Food Adulteration Rules, 1956". Also, *E. coli* and *Salmonella* spp. were absent in chicken nuggets prepared from treatment 1 and treatment 2. According to Prevention of Food Adulteration Rules (1956), the TPC for meat products should be less than 1000 cfu/g of meat sample and there should be not *E. coli* and *Salmonella* spp. per 25 gram of meat sample [8]. So, it can be said that the furnished chicken nuggets are safe for human consumption from microbial standards point of view. This may be due to groundnut as reported by Alakali *et al.* [1] reported for microbial quality of beef patties formulated with Bambara groundnut. This can be proved by further experimentation.

**Table 2:** Physico-chemical and microbial parameters of chicken nuggets incorporated with groundnut.

| Parameter                     | 0 <sup>th</sup>          | 5 <sup>th</sup>          | 7 <sup>th</sup>          | 10 <sup>th</sup>        |
|-------------------------------|--------------------------|--------------------------|--------------------------|-------------------------|
| pH                            |                          |                          |                          |                         |
| T1**                          | 6.05±0.03 <sup>aCD</sup> | 6.06±0.17 <sup>aB</sup>  | 6.08±0.02 <sup>aB</sup>  | 6.11±0.02 <sup>bB</sup> |
| T2*                           | 6.04±0.02 <sup>aC</sup>  | 6.06±0.03 <sup>abB</sup> | 6.08±0.05 <sup>abB</sup> | 6.10±0.01 <sup>bB</sup> |
| TBA number (mg/ kg of sample) |                          |                          |                          |                         |
| T1**                          | 0.26±0.08 <sup>aB</sup>  | 0.27±0.04 <sup>aA</sup>  | 0.28±0.08 <sup>aA</sup>  | 0.30±0.03 <sup>aA</sup> |
| T2**                          | 0.27±0.02 <sup>aB</sup>  | 0.29±0.07 <sup>aA</sup>  | 0.31±0.03 <sup>aA</sup>  | 0.67±0.14 <sup>bB</sup> |

| Tyrosine value ( $\mu\text{g}$ tyrosine/ml) |                                  |                                   |                                  |                                  |
|---|----------------------------------|-----------------------------------|----------------------------------|----------------------------------|
| T1 <sup>NS</sup>                            | 102.40 $\pm$ 15.57 <sup>aA</sup> | 112.67 $\pm$ 11.82 <sup>abA</sup> | 119.48 $\pm$ 4.8 <sup>ba</sup>   | 120.39 $\pm$ 3.7 <sup>ba</sup>   |
| T2 <sup>NS</sup>                            | 100.90 $\pm$ 14.41 <sup>aA</sup> | 106.66 $\pm$ 16.12 <sup>aA</sup>  | 108.50 $\pm$ 14.59 <sup>aA</sup> | 110.33 $\pm$ 20.64 <sup>aA</sup> |
| TPC (log <sub>10</sub> cfu/ml)              |                                  |                                   |                                  |                                  |
| T1 <sup>**</sup>                            | 1.23 $\pm$ 0.03 <sup>abA</sup>   | 3.42 $\pm$ 0.11 <sup>bcB</sup>    | 3.75 $\pm$ 0.12 <sup>bc</sup>    | 4.03 $\pm$ 0.12 <sup>bd</sup>    |
| T2 <sup>**</sup>                            | 1.20 $\pm$ 0.03 <sup>aA</sup>    | 3.58 $\pm$ 0.07 <sup>cdB</sup>    | 3.89 $\pm$ 0.06 <sup>bc</sup>    | 4.19 $\pm$ 0.08 <sup>cd</sup>    |

\* $p < 0.05$ -Significant at 5%, \*\* $p < 0.01$ -Significant at 1% (Highly significant),  $p > 0.05$  (NS)-Non-significant, single superscripts (small letter) column-wise differs significantly, double superscripts (small letter) column-wise do not differ. Single superscripts (capital letter) row-wise differs significantly, double superscripts (capital letter) row wise do not differ.

## Conclusion

From this study, it can be concluded that groundnut can be successfully incorporated in the form of powder and granules at a 10% level to develop low-cost chicken nuggets. The furnished chicken nuggets are physico-chemically and microbiologically acceptable for human use.

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