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# Effect of sodium chloride replacement and apple pulp inclusion on the physico-chemical, textural and sensory properties of low fat chicken nuggets

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ABSTRACT

The effect of 40 percent sodium chloride replacement with salt substitute blend (potassium chloride, citric acid, tartaric acid and sucrose) and incorporation of apple pulp, at the levels of 8 (Treatment I), 10 (Treatment II) and 12 (Treatment III) g/100 g of formulation, on the various quality characteristics of low fat chicken nuggets was investigated. Emulsion and product pH values were significantly higher ($P < 0.01$) for the control when compared to treatments. Salt replacement and apple pulp addition resulted in significantly lower ($P < 0.05$) emulsion stability and cooking yield. Among low salt and low fat nuggets, the product with 12 g/100 g apple pulp had the highest moisture percent. Protein and ash contents were significantly lower ($P < 0.01$) in treatment products, whereas moisture protein ratio was higher. Incorporation of apple pulp significantly increased ($P < 0.01$) dietary fibre content, redness, yellowness and chroma index of the product. Textural properties of the products significantly decreased ($P < 0.01$) with substitution of common salt and addition of apple pulp. Sensory evaluation showed significant reduction ($P < 0.01$) in texture and overall acceptability scores of treatment products; however, scores were in the range of very good.



## 1. Introduction

Diet is one of the important factors that affects the well being and health of human beings. Nowadays, there is a mounting concern among meat consumers over nutritional diseases of affluence and correlation between food habits and health. Consumption of saturated fat, excess salt and calories has been correlated with the incidence of coronary heart diseases, hypertension, cancer, high blood cholesterol and obesity (Garcia, Dominguez, Galvez, Casas, & Selgas, 2002; Jimenez-Colmenero, Carballo, & Cofrades, 2001; Law, Frost, & Wald, 1991a, 1991b). In this regard, various low fat meat products such as sausages (Grigelmo-Miguel, Abadias-Seras, & Martin-Belloso, 1999; Hughes, Mullen, & Troy, 1998; Murguerza, Fista, Ansorena, Astiasaran, & Bloukas, 2002), low fat pork patties (Kumar & Sharma, 2004), and meatballs (Serdaroglu, Yildiz-Turp, & Abrodimov, 2005; Yilmaz, 2004) have been previously attempted.

Meat has a relatively low concentration of sodium, containing only 50–90 mg of sodium per 100 g (Romans, Costello, Carlson, Greaser, & Jones, 1994). But, processed meat products contribute a significant amount of salt in the diet and depending upon eating habits approximately 20–30% of common salt intake comes from meat and meat derivatives in western countries (Wirth, 1991). It has been established that the consumption of more than 6 g NaCl/day/person is associated with an age-increase in blood pressure and it had been recommended that the total amount of dietary salt be maintained at about 5–6 g/day (Aho et al., 1980; WHO, 1990). Thus, there is a rising demand of low salt meat products by health conscious consumers. Simple reduction of common salt has a negative effects on flavour (Gillette, 1985), water as well as fat binding capacity and ultimate gel texture upon cooking (Terrell, 1983) and product shelf-life (Sofos & Busta, 1980). Some work has been carried out in the past to reduce salt content in meat products like, bologna-type sausages (Ruusunen, Sarkka-Tirkkonen, & Puolanne, 1999); ground meat patties (Ruusunen et al., 2005) and pork sausages (Khate, 2007).

Meat and meat products are very poor sources of dietary fibre and their regular consumption is being associated with various health disorders such as colon cancer, obesity and cardiovascular diseases (Larsson & Wolk, 2006; Tarrant, 1998; Voskuil et al., 1997). Various reports have revealed that intake of fibre reduces the risk of such diseases (Eastwood, 1992; Johnson & Southgate, 1994; NCI, 1984). Hence, incorporation of dietary fibre from different sources in meat products would help to enhance their nutritional composition and desirability as well. Traditional fruits have many health

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benefits and especially apple pulp is a typical source of dietary fibre (Goñi, Torre, & Saura-Calixto, 1989), but the use of apple pulp as a source of dietary fibre in meat products is yet to be reported. The present study was undertaken to develop low salt, low fat and high fibre functional chicken nuggets through replacement of sodium chloride and apple pulp inclusion in the low fat chicken nuggets and observe their effect on the physico-chemical, textural and sensory properties of product.

## 2. Materials and methods

### 2.1. Raw materials

Dressed chickens were procured from Central Avian Research Institute, Izatnagar Bareilly. These were packed in clean low density polyethylene (LDPE) bags and quickly brought to the laboratory of Livestock Products Technology Division. After careful deboning, meat was packaged in polyethylene bags and stored overnight at $4 \pm 1$ °C in a refrigerator and then stored frozen at −18 °C till further use. Other additives used were sodium chloride, salt substitute blend composed of potassium chloride (0.2 g/100 g), citric acid (0.03 g/100 g), tartaric acid (0.03 g/100 g) and sucrose (1.0 g/100 g), sodium hexametaphosphate, sodium nitrite, liquid egg white, refined sunflower oil, carrageenan, sodium alginate, apple pulp, condiments (onion and garlic paste), refined wheat flour and spice mix (Table 1). Fresh apple pulp (pH-4.65, moisture-85.45 g/100 g, fat-0.003 g/100 g, protein-0.25 g/100 g, dietary fibre-1.86 g/100 g) used in the study was washed with the chilled distilled water for 10 min to remove its sweetness and then ground to the consistency of paste.

### 2.2. Detailed study

In the present study 40 percent of total common salt of pre-standardized low fat chicken nuggets was replaced by 1.26 g/100 g salt substitute blend consisting of potassium chloride, tartaric acid, citric acid and sucrose. In the resultant formulation, apple pulp was incorporated as a source of dietary fibre at three different levels i.e. 8 (Treatment I), 10 (Treatment II) and 12 g/100 g (Treatment III), by replacing lean meat. The products so developed were compared for various physico-chemical, textural and sensory properties against pre-standardized low fat chicken nuggets prepared with 2 g/100 g common salt (Control). Formulations of control and different treatments are presented in Table 2.

### 2.3. Product preparation

Chicken meat was partially thawed for 12 h, cut into small cubes and double minced in an Electrolux mincer (Model- 9152). Meat emulsion was prepared in a bowl chopper (Seydelmann K20, Ras, Germany). In a pre-weighed quantity of minced chicken meat, salt/salt blends, sodium hexametaphosphate, and sodium nitrite were added and chopped for 2–3 min with simultaneous addition of ice flakes. After adding egg white and chopping again for 1 min, refined sunflower oil was slowly incorporated while chopping till it was completely dispersed in the batter. Condiment paste, carrageenan, sodium alginate, apple pulp, dry spice mix and refined wheat flour were added. Chopping continued till uniform dispersion of all the ingredients and desired consistency of the emulsion was achieved. Weighed quantity (360 g) of emulsion was taken and filled in stainless steel mould. Mould was covered with lid and tied with thread and steam cooked for 35 min to achieve an internal temperature of about 85 °C. Chicken meat blocks so obtained were sliced and cut into pieces to get nuggets ($\sim$15 mm$^3$).

**Table 1**
Composition of spice mix.

| Ingredients | Percentage |
|---|---|
| Cumin (Zeera) | 15 |
| Coriander (Dhania) | 20 |
| Aniseed (Soanf) | 10 |
| Black pepper (Kalimirch) | 07 |
| Caraway (Ajwain) | 10 |
| Capsicum (Mirch powder) | 12 |
| Cardamom (badi Elaichi) | 05 |
| Dried ginger (Saundh) | 05 |
| Cinnamon (Dalchini) | 05 |
| Clove (Laung) | 02 |
| Bay leave (Tej pat) | 03 |
| Nutmeg (Jaifal) | 03 |
| Mace (Javitri) | 03 |

**Table 2**
General formulation for the control and treatment nuggets.

| Ingredients | Control | T-I | T-II | T-III |
|---|---|---|---|---|
| Lean meat (g/100 g) | 75.14 | 66.68 | 64.68 | 62.68 |
| Sodium chloride (g/100 g) | 2.00 | 1.20 | 1.20 | 1.20 |
| Sod. hexametaphosphate (g/100 g) | 0.50 | 0.50 | 0.50 | 0.50 |
| Sodium nitrite (mg/Kg) | 150 | 150 | 150 | 150 |
| Salt substitute blend (g/100 g) | – | 1.26 | 1.26 | 1.26 |
| Ice flakes (g/100 g) | 6.50 | 6.50 | 6.50 | 6.50 |
| Egg white (g/100 g) | 1.50 | 1.50 | 1.50 | 1.50 |
| Refined sunflower oil (g/100 g) | 7.00 | 7.00 | 7.00 | 7.00 |
| Condiment mix (g/100 g) | 3.00 | 3.00 | 3.00 | 3.00 |
| Carrageenan (g/100 g) | 0.75 | 0.75 | 0.75 | 0.75 |
| Sodium alginate (g/100 g) | 0.10 | 0.10 | 0.10 | 0.10 |
| Apple pulp (g/100 g) | – | 8.00 | 10.00 | 12.00 |
| Spice mix (g/100 g) | 1.50 | 1.50 | 1.50 | 1.50 |
| Refined wheat flour (g/100 g) | 2.00 | 2.00 | 2.00 | 2.00 |

Control: low fat chicken nuggets.
T-I: low salt, low fat chicken nuggets with apple pulp 8 g/100 g formulation.
T-II: low salt, low fat chicken nuggets with apple pulp 10 g/100 g formulation.
T-III: low salt, low fat chicken nuggets with apple pulp 12 g/100 g formulation.

### 2.4. Product analysis

#### 2.4.1. Samples

Six samples (duplicate in three batches) for all four types of products (control and treatment I, II and III) were evaluated for various parameters such as pH, cooking yield, proximate composition, dietary fibre, and product colour as well as texture profile analysis. However, in case of sensory analysis 30 samples were analysed (ten samples in three batches) and for emulsion stability analysis of 8 samples (duplicate in four batches) was conducted.

#### 2.4.2. pH determination

The pH of emulsion and cooked products was determined by blending 10 g of sample with 50 ml of distilled water using an Ultra Turrax T 25 tissue homogenizer (Janke and Kunkel, IKA Labortechnik, Staufen, Germany) at 8000 rpm for 1 min. The pH of the suspension was recorded by dipping combined glass electrode of Elico digital pH meter, Model LI 127 (Elico Limited, Hyderabad, India).

#### 2.4.3. Emulsion stability and product yield

Emulsion stability (ES) was determined as per method of Townsend, Witnauer, Riloff, and Swift (1968) with some modifications. About 25 g emulsion samples were placed in polyethylene bags and heated at 80 °C in a thermostatically controlled water bath for 20 min. The stability was calculated from weight loss during cooking and expressed as percentage of the initial weight. The product yield was obtained by measuring weight of meat blocks for each treatment and calculating the ratio of cooked weight to raw weight and expressed as a percentage.