Effect of Flaxseed Flour on Physio-chemical and Sensory Acceptability of Chicken Nuggets

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ABSTRACT

The present study was taken up to enrich the fiber and healthy fatty acid content in chicken nuggets with addition of flaxseed flour. The chicken emulsion is prepared with fortification of flaxseed at different level viz., 1.0, 2.5, 5.0 and 10.0 percent respectively. The products were subjected for proximate analyses, physio-chemical and sensory analysis. The samples were analyzed as raw emulsion batter and cooked chicken nuggets. On analysis of proximate composition of nuggets the moisture retention, fiber, ash and fat content has significantly (p<0.05) increased. The pH and TBARS values represent stability and found to be low in flaxseed fortified chicken nuggets. The sensory acceptability with 2.5 percent addition of flaxseed had higher acceptance compared to others. The present study concludes that 2.5 percent addition of flaxseed has increased the nutritive value of chicken nuggets without much affecting the sensory acceptability of the product and increased level leads to sensory rejection.

Keywords: Chicken nuggets, Fiber rich, Functional food, Nutritive value, Proximate composition.

The consumption of meat provides the essential vital nutrients for growth, development and fulfill requirement of human body. It contains high quality bioavailable protein, essential amino acids and many vital nutrients (Barretto et al., 2015). The presence of high animal fat, saturated fatty acids, cholesterol and other unhealthy ingredients in meat are often associated with cardiovascular diseases, some types of cancer and obesity (Fernandez-Gines et al., 2005; Hygreeva et al., 2014). The concept of healthier and safe meat along with meat products are gaining importance and can be achieved by addition of health beneficial ingredients and/or removal of undesired component (Arihara, 2006). The addition of healthier ingredients includes vegetable oil, fish oil and natural extract of plants origin (Valencia et al., 2008) in meat and meat products to improve the nutritional and sensory acceptability of the products. The addition of fiber and good quality fat will improve the functional property of meat products (Bilek and Thuran, 2009; Schmiele et al., 2015; Yogesh et al., 2015).

The dietary fiber content of meat is low concentration and it can be added in meat products in order to improve the nutritive value and functional properties of meat. They also provide various health benefits such as reduced intestinal retention time, control of type-2 diabetes and cardiovascular disease (Talukder, 2015). The addition of fiber provides the functional property to meat products. The fat involved in sensory attribute and major factor influencing palatability, acceptability and shelf life of meat products (Akoh, 1998). The synthetic additives such as butylated hydroxyl anisole (BHA), butylated hydroxyl toluene (BHT) and other chemicals used to improve the quality and reduce the food spoilage. The consumers are concerned on ill effects of chemicals in food. Hence, the use of natural additive is preferred over synthetic as they provide various functionality such as antioxidants, antimicrobials, colorants, flavorings, and thickener agents to the products (Ayala-Zavala and González-Aguilar, 2011; White and McFadden, 2008).
Flaxseed is a rich source of dietary fiber, potential source of energy, protein and oil (Bhatty, 1995). It is the richest source of linolenic acid (18:3n-3) of terrestrial origin. In recent times, the preference over natural additives and food ingredients search found attention over flaxseed (Hall et al., 2006). It is a food and a medicine because of important constituents in it such as lignans and high omega-3 fatty acid content. Health benefits recognized with flaxseed are potential to reduce the risk of cardiovascular diseases and hormone dependent cancers such as prostate and breast cancer (Siger et al., 2008). Flaxseed is a rich source of different types of phenolic compounds such as phenolic acids, flavonoids, phenyl propanoids and tannins (Kasote, 2013). With the above statements it was evident that addition of dietary fiber rich constituents in meat will increase the functional property of the meat products. Hence, the present study taken up with an objective of finding the percentage of addition of flaxseed in meat emulsion without affecting the sensory attributes and acceptability of the flaxseed enriched chicken nuggets by the consumers.

MATERIALS AND METHODS

Materials
Freshly processed chicken meat cuts (without skin and visible fat) were obtained from local poultry processing plant (Farm Fresh Poultries, Hassan, Karnataka, India) and chilled overnight under refrigeration temperature (4±1°C). The chilled meat was first coarsely ground through a 13 mm plate followed by 8 mm plate of a meat mincer (SCHARFEN, Model X70, 58413 Witten, West Germany). Other ingredients (flaxseed, spices, condiments mix) required for preparation of emulsion were procured from local supermarket. All other chemicals used in the study were of reagent grade and greater purity.

Preparation of chicken nuggets
Chicken emulsion was prepared using minced chicken (70.0%), vegetable oil (10.0%), ice flakes (10.0%), egg albumin (2.0%), salt (1.5%), binder (3.0%) and spices mix (3.5%) according to our laboratory standard procedures. The flaxseed flour added to the meat emulsion at different levels in treatment groups (1.0% flaxseed; 2.5% flaxseed; 5.0% flaxseed and 10.0% flaxseed) and control. The experiment was repeated 3 times. The emulsion is packed in nugget carrier tightly and cooked in steam at 90-100 °C for 30-45 min or till the core temperature reaches 75 °C. The internal temperature was measured using probe thermometer.

Analysis of samples
The samples were taken from raw emulsion batter and cooked chicken nuggets separately and were analyzed.

Proximate analysis and pH
Moisture, protein, fiber, ash and fat content were determined according to procedure of AOAC (AOAC, 2005). The pH was determined by lending 10 g sample with 50 ml distilled water for 60 s in a homogenized using mortar and pestle. The pH values were measured using a standardized electrode attached to a digital pH meter (Fisher Scientific, Model: 1.5-078-201, India).

Sensory evaluation
The 10 member’s panellist consisting of teaching staff (professors) and students were asked to evaluate the appearance, colour, texture, juiciness, flavour, mouth coating and overall palatability on an 8-point hedonic scale. An eight-point descriptive scale (Keeton, 1983) was used, where 8-extremely palatable, 7-very palatable, 6-moderately palatable, 5-slightly palatable, 4-slightly unpalatable 3-moderately unpalatable, 2-very unpalatable and 1-extremely unpalatable. The panellists were required to cleanse their platates with water between samples.

Thiobarbituric acid reactive substances (TBARS)
The thiobarbituric acid reactive substances (TBARS) of cooked sausages were determined (Witte et al., 1970) by blending 4 g sample with 20mL of 20% trichloroacetic acid solution followed by centrifugation and mixing 2.0mL of supernatant with equal volume of 0.1% thiobarbituric acid in glass test tubes and heated in water bath at 100° C for 30 min. The absorbance of the mixture was measured at 532 nm using UV-VIS spectrophotometer (Model: UV-1700 Pharma Spec, SHIMADZU, Japan), and the TBARS values were calculated using a TBA standard curve and expressed in mg malonaldehyde/kg.
Statistical analysis

The overall experiment was replicated on three separate occasions and duplicate samples used for all the parameters were averaged for statistical analysis. The experimental design was a randomized complete block design. Statistical analysis was performed with the analysis of variance using SPSS (SPSS version 13.0 for windows; SPSS, Chicago, IL, USA) and differences among mean values were obtained by Duncan’s multiple range test. Significance was defined at a level of $p<0.05$ and $p<0.01$. The results were expressed as the least square mean values of three independent replications.

RESULTS AND DISCUSSION

Proximate and physico-chemical analysis of raw emulsion and nuggets

The proximate analysis of the plain flaxseed flour revealed moisture (6.71%), ash (3.55%), crude fat (41.3%), crude protein (25.3%), crude fibre (6.8%) and carbohydrate (16.3%). The proximate composition of chicken nuggets fortified with different levels of flaxseed flour are given in Table 1 for cooked chicken nuggets and raw emulsion batter. The pictorial representation of the cooked chicken nuggets depicted in Fig. 1. The raw emulsion batter and cooked chicken nuggets moisture level did not alter much but decreased with higher level of flaxseed addition when compared to control. The dry matter (DM) has increased with increase in flaxseed when compared with control. The present results are in agreement with decreased moisture level of flaxseed enriched cooked meat batter (Yogesh et al., 2015) and supported with argument of Claus et al., (1990) that substitution of fat by plant origin leads to loss of water and quality of meat products. The ash content represents the mineral content of the product, which was not much affected with addition of flaxseed. The increased ash percent can be attributed to the increased mineral content of the flaxseed enriched food products been studied previously by (Turhan et al., 2005, Turhan et al., 2007). The fat content of the product has significantly increased ($P <0.05$) in all treatment groups when compared with control. Similar results been observed with increased fat content of beef patties enriched with flaxseed (Bilek and Turhan, 2009), flaxseed enriched cooked chicken meat batter by Yogesh et al., 2015 and restructured mutton chops enriched with flaxseed by Sharma et al., 2014. The fiber increase was significant ($P <0.01$) in all treatment groups when compared with control. To encounter in human variety of food with fiber particular dietary/soluble fiber are advised for weight management and cardiovascular disease (Kristensen and Jensen, 2011). The protein content of product was found to in significantly ($P <0.05$) decreasing trend line. The proteins content and structure in food system affects the hydration mechanisms for solubility and water or oil retention capacity, rheological characteristics for viscosity and gelation, and their interfacial properties for emulsions and foams (Moure et al., 2006).

Fig. 1: The pictorial representation of cooked chicken nuggets
The cooked chicken nuggets were evaluated of physico-chemical analysis by various parameters such as consistency, pH and thiobarbituric acid reactive substances (TBARS) value predilection. The nuggets had good uniform consistency and did not break on boiling test. The pH and TBARS value is been depicted in Table 1 for cooked chicken nuggets and raw emulsion batter. The pH value was evident to be decreased with increase in addition of flaxseed. This statement is in agreement with Yogesh et al., 2015 with cooked meat batter incorporated with flaxseed powder. The TBARS value was in limit stating the product is safe and fit for consumption and low

<table>
<thead>
<tr>
<th>Sample</th>
<th>Dry matter</th>
<th>Ash</th>
<th>Fat</th>
<th>Protein</th>
<th>Fiber</th>
<th>Moisture</th>
<th>pH</th>
<th>TBARS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control raw</td>
<td>31.67</td>
<td>1.71</td>
<td>20.95*</td>
<td>27.7*</td>
<td>0.64**</td>
<td>68.33*</td>
<td>6.00</td>
<td>0.16</td>
</tr>
<tr>
<td>Control cooked</td>
<td>33.75</td>
<td>1.66</td>
<td>13.64*</td>
<td>30.1*</td>
<td>0.52**</td>
<td>66.25</td>
<td>6.00</td>
<td>0.16</td>
</tr>
<tr>
<td>1% raw</td>
<td>31.94</td>
<td>1.72</td>
<td>21.94*</td>
<td>28.66*</td>
<td>1.21**</td>
<td>68.06*</td>
<td>5.90</td>
<td>0.15</td>
</tr>
<tr>
<td>1% cooked</td>
<td>34.99</td>
<td>1.69</td>
<td>13.49*</td>
<td>31.74*</td>
<td>0.98**</td>
<td>65.01</td>
<td>6.00</td>
<td>0.14</td>
</tr>
<tr>
<td>2.5% raw</td>
<td>33.11</td>
<td>1.72</td>
<td>21.46*</td>
<td>25.56*</td>
<td>3.58**</td>
<td>66.89*</td>
<td>5.80</td>
<td>0.15</td>
</tr>
<tr>
<td>2.5% cooked</td>
<td>33.98</td>
<td>1.70</td>
<td>15.43*</td>
<td>27.19*</td>
<td>1.26**</td>
<td>66.02</td>
<td>5.90</td>
<td>0.15</td>
</tr>
<tr>
<td>5% raw</td>
<td>34.06</td>
<td>1.70</td>
<td>23.87*</td>
<td>25.31*</td>
<td>4.95**</td>
<td>65.96*</td>
<td>5.80</td>
<td>0.15</td>
</tr>
<tr>
<td>5% cooked</td>
<td>34.96</td>
<td>1.63</td>
<td>19.93*</td>
<td>26.93*</td>
<td>5.91**</td>
<td>65.04</td>
<td>5.90</td>
<td>0.14</td>
</tr>
<tr>
<td>10% raw</td>
<td>37.24</td>
<td>1.82</td>
<td>23.42*</td>
<td>25.85*</td>
<td>6.84**</td>
<td>62.76*</td>
<td>5.80</td>
<td>0.14</td>
</tr>
<tr>
<td>10% cooked</td>
<td>36.60</td>
<td>1.89</td>
<td>18.84*</td>
<td>25.71*</td>
<td>6.45**</td>
<td>63.4</td>
<td>5.90</td>
<td>0.14</td>
</tr>
</tbody>
</table>

Footnote: * indicates level of significance at (<0.05), ** indicates level of significance at (<0.01)
rancidity. TBARS values are attributed to endogenous lipid oxidation and fatty acid degradation of chicken. The reports said that olive and other vegetables used for the manufacture of muscle foods enhance the oxidative instability of the final product (Kayaa and Gök, 2004; Choi et al., 2010). The pH value showed decreased order with increase in flaxseed concentration. The TBARS value was in limit and low rancidity was expected.

Sensory analysis

The chicken nuggets are compared between the control and treatment groups of incorporation of flaxseed flour. The sensory report findings are coded in Fig. 2. The flavor, juiciness, mouth counting and overall acceptability of higher level of incorporation flaxseed has significantly decreased. The visual score for 5.0 and 10.0 percent flaxseed enriched emulsion and nuggets were darker, low scored and on consistency found harder when compared to control. The harder and colour changes are in agreement with Sharma et al., 2014. The appearance and texture did not alter much but some reported that higher the level of enrichment more the thicken course texture and the darker is the color appearance. Similarly, Sharma et al., 2014 has reported that 1 percent level of flaxseed flour incorporation in restructured mutton chops are preferred much. The 2.5 percent level of incorporation of flaxseed in most preferred and appreciated product.

CONCLUSION

The incorporation of flaxseed flour in chicken nuggets has shown a promising results with evidence of significant increase in fat (p<0.05) and fiber (p<0.01) content. The pH and TBARS values were in low trend with addition of flaxseed flour. The sensory acceptability decreased with increased level of addition of flaxseed flour. The present study concludes that the addition of flaxseed flour at 2.5 per level has shown the high fat and fibre content which is suggestive to be best formulation in commercial food industry.

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