Journal of Animal Research: v.8 n.1, p. 67-72. February 2018

DOI: 10.30954/2277-940X.2018.00150.11

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

**Deepak, S.J.[1*], Chandre Gowda, C.T.[2], Ravikumar, P.[1] and Roopa, K.[3]**

*[1]Department of Veterinary Public Health and Epidemiology, Veterinary College, KVAFSU, Hassan, Karnataka, INDIA*
*[2]Department of Livestock Products and Technology, Veterinary College, KVAFSU, Hassan Karnataka, INDIA*
*[3]Department of Livestock production and Management, Veterinary College, KVAFSU, Hassan. Karnataka, INDIA*

**Corresponding author: Deepak SJ., E-Mail: disjdeepak@gmail.com*

**Received:** 25 Sept., 2017 **Revised:** 23 Nov., 2017 **Accepted:** 28 Nov., 2017

**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 conent 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 butlylated hydroxyl anisole (BHA), butlylated 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 super market. 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 temprature was measured using probe thermometer.

### Analysis of samples

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

### Proxiamate 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 100º 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 (16.34%). 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).

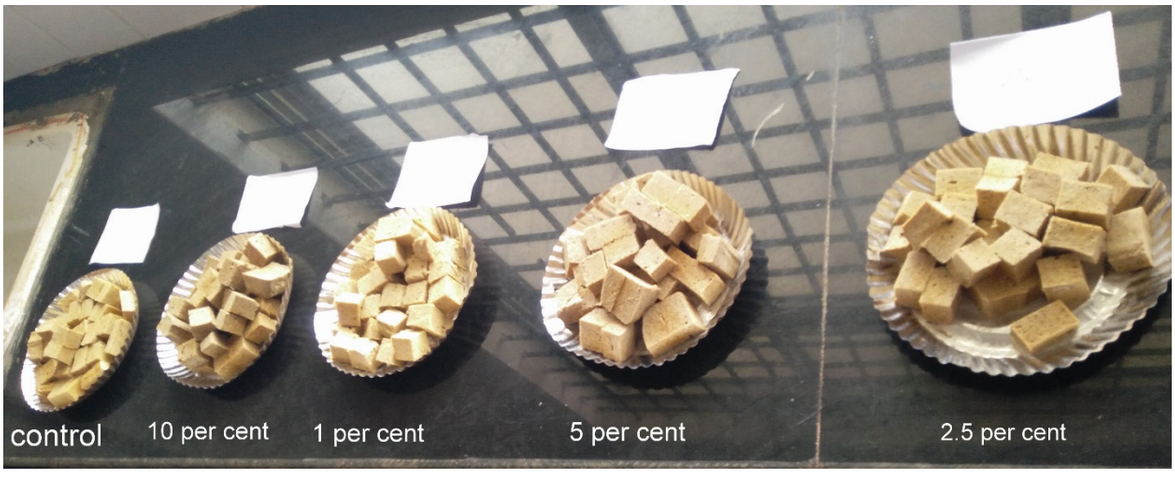


**Fig. 1:** The pictorial representation of cooked chicken nuggets

**Table 1:** Proximate analysis, pH and TBARS values for raw emuslsion and cooked chicken nuggets

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

Footnote: * indicates level of significance at (<0.05)., ** indicates level of significance at (<0.01)

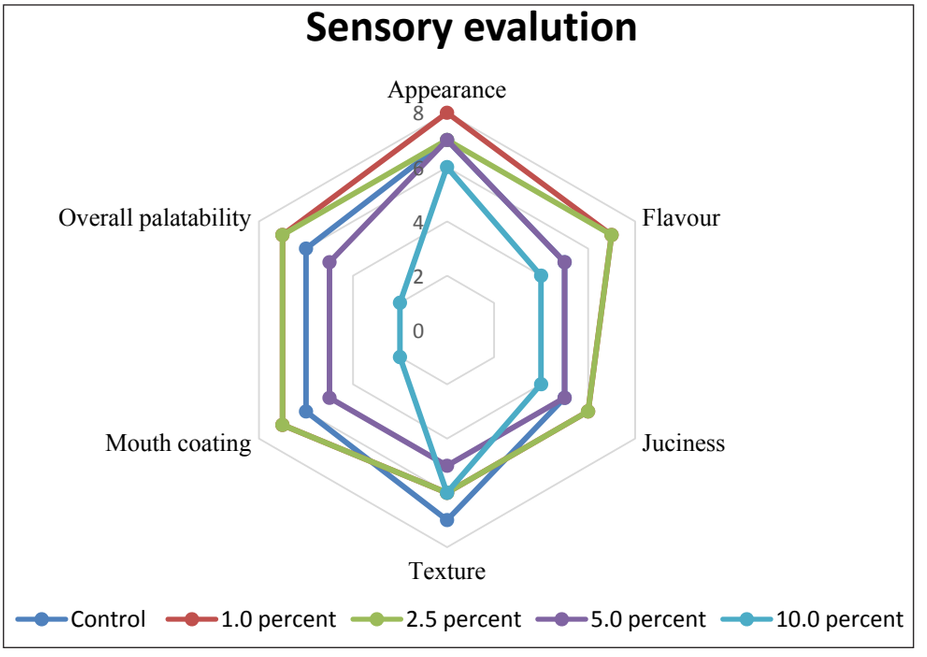


**Fig. 2:** The sensory report of chicken nuggets based on sensory evaluation

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

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 (Kayaard 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.

## ACKNOWLEDGEMENTS

The authors wish to thank for assistance of Dean, Veterinary College, Hassan. Karnataka Veterinary Animal and Fisheries Sciences University, Bidar, Karnataka, India supported this work under university-funded project (DR/KVAFSU/SRP/PreandParaclinical. 13/2016-17).

## REFERENCES

Akoh, C. C. 1998. Fat replacers. *Food. Technology.*, **52**(3): 47-53.

AOAC. 2005. Official Methods of Analysis, 18th edn. Washington, DC: Association of Official Analytical Chemists.

Arihara, K. 2006. Strategies for designing novel functional meat products. *Meat. Sci.,* **74:** 219–229.

Ayala-Zavala, J.F. and González-Aguilar, G.A. 2011. Use of additives to preserve the quality of fresh-cut fruits and vegetables. In O. Martín-Belloso, & R. Soliva-Fortuny (Eds.), Advances in fresh-cut fruits and vegetables processing Boca Raton, FL, USA: CRC Press. pp. 231−254).

Barretto, A.C.D.S., Pacheco, M.T.B. and Pollonio, M.A.R. 2015. Effect of the addition of wheat fiber and partial pork back fat on the chemical composition, texture and sensory property of low-fat bologna sausage containing inulin and oat fiber. *Food. Sci. Technol.,* **35**(1): 100-107.

Bhatty, R.S. 1995.Nutrient composition of whole flaxseed and flaxseed meal. S.C. Cunnane, L.U. Thompson (Eds.), Flaxseed in human nutrition, AOCS Press, Champaign, IL, pp. 22–42

Bilek, A.E. and Turhan, S. 2009. Enhancement of the nutritional status of beef patties by adding flaxseed flour. *Meat. Sci.*, **82:** 472–477.

Choi, Y.S., Choi, J.H., Han, D.J., Kim, H.Y., Lee, M.A., Jeong, J.Y., Chung, H.J. and Kim, C.J. 2010. Effects of replacing pork back fat with vegetable oils and rice bran fiber on the quality of reduced-fat frankfurters. *Meat Sci.,* **84**(3): 557–563.

Claus, J.R., Hunt, M.C. and Kastner, C.L. 1990. Effects of substituting added water for fat on texture, sensory and processing characteristics of bologna. *J. Muscle. Foods.*, **1**(1): 1-21.

Fernandez-Gines, J.M., Fernandez-Lopez, J., Sayas-Barbera, E. and Perez-Alvarez, J.A. 2005. Meat products as functional foods: A review. *J. Food. Sci.,***70:** 37–43.

Hall III, C., Tulbek, M.C. and Xu, Y. 2006. Flaxseed. In: Taylor, S. (Ed.), Advances in Food and Nutrition Research, 51: 1-97

Hygreeva, D., Pandey, M.C. and Radhakrishna, K. 2014. Potential applications of plant based derivatives as fat replacers, antioxidants and antimicrobials in fresh and processed meat products. *Meat Sci.*, ***98***(1): 47-57.

Kasote, D.M. 2013. Flaxseed phenolics as natural antioxidants: a review. *Int. Food. Res. J.,* **20:** 1797-1804.

Kayaard, S. and Gök, V. 2004. Effect of replacing beef fat with olive oil on quality characteristics of Turkish soudjouk (sucuk). *Meat Sci.,* **66(1):** 249–257.

Keeton, J.T. 1983. Effect of fat and sodium chloride phosphate levels on the chemical and sensory properties of pork patties. *J. of Food Sci.,* **36:** 261–276.

Kristensen and Jensen 2011. Dietary fibres in the regulation of appetite and food intake. Importance of viscosity. *Appetite.,* **56**(1): 6570.

Moure, A., Sineiro, J., Domınguez, H. and Parajo, J.C. 2006. Functionality of oilseed protein products: a review. *Food. Res. Int.,* **39:** 945–63.

Schmiele, M., Mascarenhas, M.C.C.N., Barretto, A.C.S. and Pollonio, M.A.R. 2015. Dietary fiber as fat substitute in emulsified and cooked meat model system. *LWT - Food Sci, Tech.*, **61**(1): 105-111.

Sharma, H., Sharma, B.D., Mendiratta, S.K., Talukder, S. and Ramasamy, G. 2014. Efficacy of Flaxseed Flour as Bind Enhancing Agent on the Quality of Extended Restructured Mutton Chops. *Asian Australas. J. Anim. Sci.*, **27**(2): 247-255.

Siger, A., Nogala-Kalucka, M. and Lampart-Szczapa, E. 2008. The content and antioxidant activity of phenolic compounds in cold-pressed plant oils. *J. Food. Lipids.*, **15**(2): 137–149.

Talukder, S. 2015. Effect of dietary fiber on properties and acceptance of meat products: a review. *Crit. Rev. Food Sci. Nutr.*, ***55***(7): 1005-1011.

Turhan, S., Temiz, H. and Sagir, I. 2007. Utilization of wet okara in low-fat beef patties. *J. Musc. Food.* **18:** 226–235.

Turhan, S., Sagir, I. and Ustun, N.S. 2005. Utilization of hazelnut pellicle in low-fat beef burgers. *Meat. Sci.,* **71:** 312–316.

Valencia, I., O'Grady, M.N., Ansorena, D., Astiasaran, I. and Kerry, J.P. 2008. Enhancement of the nutritional status and quality of fresh pork sausages following the addition of linseed oil, fish oil and natural antioxidants. *Meat. Sci.,* **80:** 1046–1054.

White, J.M.L. and McFadden, J.P. 2008. Contact allergens in food ingredients and additives: Atopy and the hapten-atopy hypothesis. *Contact. Dermatitis.,* **58**(4): 245−249.

Witte, V.C., Krause, G.F. and Bailey, M.E. 1970. A new extraction method for determining 2-thiobarbituric acid values of pork and beef during storage. *J. Food. Sci.,* **35**(5): 582–585.

Yogesh, K., Langoo, B.A., Sharma, S.K. and Yadav, D.N. 2015. Technological, physico-chemical and sensory properties of raw and cooked meat batter incorporated with various levels of cold milled flaxseed powder. *J. Food. Sci. Tech.,* **52**(3): 1610–1617.