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Effect of Incorporation of Soluble Dietary Fibre on the Physico-Chemical and Sensory Properties of Chicken Nuggets

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Studies were conducted to select a suitable soluble dietary fibre among lupin flour and oats bran for incorporating in functional chicken nuggets enriched with omega-3 eggs (OE). The lupin flour (T_1) and oats bran (T_2) at 4 % level were used separately, as sources of soluble fibre in the formulation. The chicken nuggets added with dietary soluble fiber were evaluated for various physico-chemical characteristics, proximate composition and sensory properties and compared with control C_1 (without any functional ingredients) and C_2 (enriched with 7.5 % OE). The enriched chicken nuggets differed significantly ($P<0.05$) from the unfortified chicken nuggets with respect to emulsion pH, product pH, cooking yield, moisture, protein and fat content. The lightness and yellowness values were significantly ($P<0.05$) higher for the chicken nuggets enriched with soluble dietary fibres than control (C_1) but redness value was significantly lower than control (C_1). Lupin flour at 4.0 % level adversely affected the appearance, colour, flavour and overall acceptability. Consumer preferred functional chicken nuggets can be made by incorporating 7.5 % OE and 4.0 % oats bran without deteriorating the nutritive and sensory qualities.

Key words: Functional chicken nuggets, Omega-3 eggs, Lupin flour, Oats bran

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. The recommended amount of dietary fibre by Food and Drug Administration is 20-30 g daily. However, due to changes in the food habits, lack of moderation and variety in the food consumed many people never get required levels of dietary fibre. Various reports revealed that intake of dietary fibre decrease intestinal disorders, cholesterol level and blood sugar level. Incorporation of dietary fibre from plant sources in meat products would help to reduce the bad effects of meat consumption, enhance their nutritional composition and desirability. With this background the present study was undertaken to develop a functional chicken nuggets incorporating soluble dietary fibre. The study was conducted to select a suitable soluble dietary fibre among lupin flour and oats bran for incorporating in functional chicken nuggets enriched with omega-3 eggs (OE).

Material and Methods

Chicken nugget preparation

Chilled deboned broiler chicken was minced through a 9 mm grinder plate in a meat mincer (MADO, Germany). The ground chicken was pre-blended with curing ingredients and kept under refrigeration for about 12 hours. The emulsion was prepared in a bowl chopper (MADO GARANT, Germany) by chopping the pre-blended chicken for 3-5 min. with simultaneous addition of ice flakes. Then omega-3 eggs were added and chopped further for 1-2 min., followed by the addition of pre-chilled refined sunflower oil till it was evenly dispersed in the batter during chopping. Then binders' corn flour and refined wheat flour @ 1.5% each, along with condiments and spices mix as per formulary were added. Fibre supplement was added with the mix and chopped till uniformly dispersed with desired consistency of the batter. Six hundred gram of the batter was taken and manually filled in stainless steel mould under hygienic condition. The mould was covered with lid and steam cooked for 40 min. to get properly cooked blocks. Chicken blocks so obtained were cooled and kept under refrigeration for 12-15 hours. These blocks were sliced into nuggets of 1.5 cm^3 size.

Analytical methods

The finished products were evaluated for different physicochemical properties. The pH was recorded according to the procedure explained by Trout *et al*. (1992). Emulsion Stability was determined by the method of Baliga and Madaiah (1970). The weight of meat loaves before and after cooking was recorded and the product yield was expressed in percentage.

Organoleptic evaluation

Sensory attributes of the chicken nuggets were assessed organoleptically (AMSA, 1983) using 8 point Hedonic scale, where 8= excellent; 1= extremely poor. The sensory panel consisted of seven trained taste panelists drawn from the Department of

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Livestock Products Technology, Mannuthy, Thrissur. The nuggets were shallow fried in sunflower oil and served warm to the panelists with code numbers to the samples. The average of the individual scores was taken as the score for the particular attribute.

The experiment was replicated four times and the data obtained for physico-chemical and sensory evaluation of different products were statistically analyzed as per Snedecor and Cochran (1994) by repeated measure ANOVA, one-way ANOVA and Kruskal-Wallis test using SPSS software version 21.

Results and Discussion

Physico-chemical properties

The chicken nuggets were enriched with soluble dietary fibres *viz*., lupin flour and oats bran at 4.0 per cent level for each of the fibre tested. The effects of addition of soluble dietary fibre in omega-3 chicken nuggets and unfortified chicken nuggets, which served as control are presented in Table 1. The enriched chicken nuggets differed significantly (P<0.05) from the unfortified ones with respect to emulsion pH, product pH, emulsion stability and cooking yield. Emulsion pH of treatments were significantly (P<0.05) higher when compared to control (C_1) and non significant with C_2. This result could be due to higher pH of added OE (pH 7.3) and might not be due to lupin flour and oats bran, since these plant fibres are considered neutral in action and similar results were noticed by Yilmaz *et al.* (2003) in low fat meat balls to which rye bran had been added. The pH value of cooked product of the treatments and control (C_1) ranged between 6.40-6.50, with no significant difference between the treatment samples. These results are consistent with Garcia *et al.* (2002); Kumar and Sharma (2006) indicating that, the addition of lupin flour or oats bran did not influence the pH of cooked chicken nuggets. There was an improvement in the emulsion stability and cooking yield due to the addition of lupin flour and oats bran. Cooking yield of treatments was significantly (P<0.05) higher than control (C_2). This shows the synergistic positive effect of OE and soluble dietary fibre towards cooking yield of the samples. Santhi and Kalikannan. (2014) also observed significant (P<0.05) increase in cooking yield in chicken nuggets added with oats flour.

Table 1. Effect of lupin flour and oats bran on the physico-chemical characteristics of chicken nuggets

Parameters	C_1	C_2	T_1	T_2
Emulsion pH	6.23 ±0.02^a	6.30 ±0.02^b	6.32 ±0.01^b	6.31 ±0.02^b
Product pH	6.42 ±0.03^a	6.50 ±0.01^b	6.42 ±0.01^a	6.40 ±0.01^a
Emulsion stability(%)	91.52±0.36^a	94.63±0.51^b	94.96 ±0.36^b	95.49±0.35^b
Cooking yield (%)	93.78±0.25^a	95.36±0.55^b	96.69±0.30^c	97.14 ±0.13^c

Mean ± SE with same superscripts in a row does not differ significantly (P<0.05). C_1 - Control - 1 (without OE, DF), C_2 - Control - 2 (with 7.5% OE +0% DF), T_1 – Treatment- 1 (with 7.5% OE+ 4% Lupin flour), T_2 – Treatment- 2 (with 7.5% OE+ 4% oat bran),OE-Omega- 3 eggs, DF-Dietary fibre.

Table 2. Effect of lupin flour and oats bran on the sensory attributes of chicken nuggets

Parameters	C_1	C_2	T_1	T_2
Appearance &colour	6.73 ±0.14a	6.61±0.11ab	6.32±0.17b	6.95 ±0.11a
Flavour	6.80 ±0.11a	6.70 ±0.13a	5.80±0.22b	6.75 ±0.18a
Juiciness	6.50 ±0.16ab	6.59 ±0.17b	6.09±0.17a	6.77 ±0.15b
Texture	6.77 ±0.11a	6.75 ±0.13 a	6.32 ±0.21b	7.07 ±0.10 a
Saltiness	6.45 ±0.18	6.61 ±0.14	6.64 ±0.18	6.68 ±0.17
Mouth coating	6.64 ±0.17	6.64 ±0.14	6.41 ±0.19	6.91 ±0.15
Overall acceptability	6.73 ±0.15a	6.91±0.13ab	6.07±0.13c	7.15 ±0.12b

*Based on 8-point Hedonic scale (1=extremely undesirable; 8 = extremely desirable) Mean ± SE with same superscripts in a row does not differ significantly (P<0.05). C_1 - Control - 1 (without OE, DF), C_2 - Control - 2 (with 7.5% OE +0% DF)T_1 – Treatment- 1 (with 7.5% OE+ 4% Lupin flour), T_2 – Treatment- 2 (with 7.5% OE+ 4% oat bran) OE-Omega- 3 eggs, DF-Dietary fibre.

Sensory characteristics

The scores obtained for various sensory attributes are shown in Table 2. Chicken nuggets containing lupin flour had significantly (P<0.05) lower score for appearance and colour which might be attributed to decrease in intensity of meat colour with increase in yellowness contributed by yellow colour of lupin flour. Appearance and colour score of chicken nuggets incorporated with oats bran did not differ significantly with controls. The flavour scores of chicken nuggets incorporated with lupin flour was significantly (P<0.05) lower among all. It might be due to dilution of meaty flavour with lupin flour, which imparted distinct bland taste to the product. Chicken nuggets enriched with oats bran (T_2) did not significantly differ with control. Whereas, Santhi and Kalaikannan (2014) reported that addition of oats flour decreased the sensory scores for flavour. Chicken nuggets incorporated

with 4.0 per cent oats bran (T_2) had significantly ($P<0.05$) the highest juiciness score. This could be attributed to the increased moisture retention of the product during cooking. Desmond *et al.* (1998) also reported similar benefits in different meat products. No significant difference was noted for saltiness and mouth coating between treatments and control(s). The overall acceptability scores ranged from 6.07 to 7.15, with the maximum acceptability obtained for chicken nuggets incorporated with oats bran and significantly ($P<0.05$) lower score for chicken nuggets with lupin flour. The above results show that lupin flour at 4.0 per cent level could adversely affect the appearance, colour, flavour and overall acceptability. However, acceptable functional chicken nuggets can be made by incorporating 7.5 per cent OE and 4.0 per cent oats bran without deteriorating the nutritive and sensory qualities of the product.

Conclusion

The addition of plant source dietary soluble fibre improved the emulsion stability and cooking yield in the omega-3 enriched functional chicken nuggets. Lupin flour at 4 per cent level adversely affected the colour and appearance, flavour, texture and also overall acceptability. The oat bran at 4 per cent level improved all sensory qualities. and it was found to be comparable with control(s).

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