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Research Paper

Development of Functional Chicken Chips using Flaxseed and Oats Powder

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ABSTRACT

Consumption of unhealthy snack foods with high fat content, added chemical preservatives and low nutritive value is one of the predisposing factors for most of the lifestyle diseases. So, there is need for development of ready-to-eat shelf stable functional meat chips. This study was undertaken to standardize the recipe and procedure for preparation of chicken chips. Chicken chips recipe and procedure were standardized and three cooking methods viz. deep fat frying, microwave cooking and hot air oven cooking were compared. Sensory scores for appearance, flavour, texture, crispiness and acceptability were significantly ($p<0.05$) higher for the product prepared by microwave cooking. Hence, microwave cooking was selected for the preparation of chicken chips. To develop functional chicken chips different levels (2, 4 and 6%) of flaxseed powder (FSP) and (3, 6 and 9%) oats powder (OP) were added in to the standardized recipe. Chicken chips containing 4% FSP and 6% OP had scores of 6.37 and 6.47 for appearance; 6.70 and 6.70 for flavour; 6.70 and 6.50 for texture; 7.0 and 6.83 for crispiness; 6.83 and 6.60 for acceptance, respectively on 8 point hedonic scale. Based on sensory quality FSP level of 4% and OP 6% were selected for incorporation into chicken chips recipe for the development of functional chicken chips (FCC).

Keywords : *Functional chicken chips, Flaxseed powder, Oats powder, Sensory quality*

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INTRODUCTION

In the recent years, there has been a considerable increase in the consumption of snacks mainly due to changing lifestyle of the people. In India snack food market has reached a value of Rs. 1530 crores and is expected to grow at 9 to 12% during the tenth five-year plan (Singh *et al*. 2013). The snacks available in the market are mainly from cereal grains, which are sometime supplemented with vegetable protein but these snack are low in nutrient density, high in calories and lack essential amino acids such as threonine, tryptophan and lysine (Jean *et al*. 1996). Incorporation of meat into snacks can enhance its nutritional value especially with respect to the amino acids, omega-3 fatty acids, flavour and taste (Sobana *et al*. 2013; Tejasvi *et al*. 2013). Chips, a well known snack food are one of the most unique and universal fast food items. Its beneficial properties are enhanced when prepared with meat, having high biological quality. Improvement in sensory quality of chips by adding meat was reported by many workers (Singh *et al*. 2002).

A food can be regarded as "functional" if it affects beneficially one or more target functions in the body, beyond providing basic nutrition, in a way that improves health and well being or reduces risks of disease (Gibson and Williams 2000). Awareness of health and nutrition has led to the development of "functional foods" which is a new approach to achieve healthier status thus reducing the risk of diseases (Swapna *et al*. 2012). The functional meat products can be produced by the addition of selective ingredients which have some special health promoting properties like flaxseed for enriching omega 3 fatty acids and oats for enriching fibre content.

Flaxseed contains 32% carbohydrates, 19.3% protein and 35% of its mass as oil, of which 55% is alpha-linolenic acid (ALA) which is good for health (Ramcharitar *et al*. 2005; Prasad 2009; Rubilar *et al*. 2010). Nutritionally important omega-3 fatty acids include alpha-linolenic acid, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) which are polyunsaturated. The phenolic compound of interest that are accumulated in flaxseed include ferulic and vanilic acid (Siger *et al*. 2008). The flaxseed have potential health benefits such as reduction of cardiovascular disease, atherosclerosis, diabetes, cancer, arthritis, osteoporosis, autoimmune and neurological disorders (Ander *et al.* 2004; Morris 2008; Mueller *et al*. 2010; Mani *et al*. 2011).

Oats contains 10.7% moisture, 13.6% protein, 7.6% fat, 1.8% minerals, 3.5% fibre, 62.8% carbohydrate, 50 mg calcium, 380 mg phosphorus, 3.8 mg iron, 374 Kcal energy/100 g. It is a rich source of protein and contains a number of important minerals, lipids, beta glucans which is well known as a prebiotic and anticancer activity. In addition oats contain large amounts of antioxidants such as vitamin E, various phenolic compounds

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and avenanthramides which also have health benifits (Peterson *et al*. 2002). Oats possesses a wide spectrum of biological activities like anti-inflammatory, wound healing, immunomodulatory, antidiabetic, hypocholesterolemic and antioxidant properties indicating its health benefits (Butt *et al*. 2008). This study was undertaken to standardize the recipe and procedure for preparation of chicken chips and to develop functional chicken chips by incorporating a suitable level of flaxseed powder and oats powder in the standardized recipe.

MATERIALS AND METHODS

Preparation of chicken chips: Chickens were procured from Instructional Livestock Farm Complex, Rajiv Gandhi Institute of Veterinary Education and Research (RIVER) and slaughtered under hygienic condition in the semi-automatic poultry dressing unit in the Department of Livestock Products Technology (LPT), RIVER. All the carcasses were deboned manually and cut into small chunks. Then packed in LDPE bags and stored in freezer a -18±1°C till further use.

Several preliminary trials were conducted to select different ingredients and the level of inclusion of selected ingredients like whole egg liquid, sodium bicarbonate, rice flour, dry spice mix, green condiments mix. Based on the sensory evaluation, the best level of inclusion of various ingredients were selected and used for the preparation of chicken chips. The standardized recipe of the chicken chips is presented in Table 1. The thawed meat and fat were minced separately by passing through 8mm plate in a meat mincer (Mado shop Mincer Junior, Germany). The batter was prepared in bowl chopper by mixing salt, sugar, phosphate, sodium bicarbonate, chilled water for 1minute, then whole egg liquid and minced fat was mixed for 30 seconds to get an emulsion. Then green condiments, rice flour and dry spices mix were mixed for 1 min to get the batter.

Partial cooking to get chicken block: The batter was filled into stainless steel mould and were cooked partially in water at 80^{0}C for 30 minutes followed by cooling under tap water. After cooling for an hour in refrigerator the moulds were opened to get the chicken block. Then the blocks were sliced to 3mm thickness using meat slicer (Sirmon SPA, Italy).

Making chips: Each slices were cut into small square shaped pieces and was subjected to three different methods of cooking viz. deep fat frying (130±2^{0}C for 3 min), microwave cooking (first 2 min then turned and another 2 min) in power level 100, using IFB microwave oven and hot air oven cooking (1 hour 15 min at 140^{0}C). The chicken chips prepared by three methods of cooking were subjected to sensory evaluation. Based on sensory scores best method of cooking for preparation of chicken chips was selected.

Table 1: Standardized recipe of chicken chips

Ingredients	Proportion (%)
Meat	80
Chicken fat	5
Whole egg liquid	5
Green condiments	2.5
Rice flour	2
Dry spice	2
Salt	1.7
Sugar	1
Sodium bicarbonate	0.5
Alkaline phosphate	0.3
Total	100
Chilled water	10

Preparation of functional chicken chips: Several preliminary trials were conducted to select the suitable levels of flaxseed powder (FSP) and oats powder (OP) for incorporation in chicken chips to make it a functional chicken chips.

Preparation of flax seed and oats powder: Flaxseeds and Oats (Quaker's oats) were purchased from local market in Puducherry and were dried in hot air oven at 50^{0}C for 2 hours. The dried flaxseeds and oats were ground mechanically by home mixer grinder (Sumeet Machines Ltd, Mumbai) and stored in food grade plastic containers till further use.

Incorporation of flax seed and oats powder: Flaxseed powder (FSP) and oats powder (OP) were incorporated at the level of 2, 4, 6 % and 3, 6, 9%, respectively in the standardized recipe of chicken chips. Product prepared without the incorporation of flaxseed and oats powder was used as control. Then the products were subjected to sensory evaluation. Based on the results of sensory evaluation the best level of inclusion of flax seed powder and oats powder was selected for the preparation of functional chicken chips.

Sensory evaluation: A semi-trained panel consisting of ten faculty and post-graduate students of RIVER were selected for sensory evaluation of the products. The panellists were explained about the nature of experiment without disclosing the identity of the samples. They were requested to record their preference on 8 point hedonic scale (8=extremely desirable, 1=extremely undesirable) (Keeton 1983) for attributes viz. appearance, flavour, texture, crispiness and acceptability. Plain water was provided to each panellist to rinse the mouth in between the samples.

Statistical analysis: Each experiment was replicated thrice and each parameter was analyzed in duplicate. The data were analyzed using SPSS version 16.0 MSI (SPSS, Chicago, USA). One way analysis of variance (ANOVA) was used for sensory attributes of chicken chips. The level of significant effects was tested using the least significant difference (LSD) test (Snedecor and Cochran 1967).

RESULTS AND DISCUSSION

Effect of cooking methods on sensory quality of chicken chips: Results on the appearance scores (5.86 to 7.14) (Table 2) of chicken chips prepared by different methods of cooking revealed that appearance scores were significantly higher ($p<0.05$) for microwave cooking when compared to deep fat frying and hot air oven cooking. This was mainly due to the product prepared by microwave cooking with lighter colour and puffyness, whereas, the products prepared by other two methods were dark in colour and had no puffiness. Similar to this observation, Biswas and Beura (2014) has reported that poultry meat finger chips prepared by microwave cooking exhibited the highest appearance score when compared to deep fat frying and hot air oven cooking. Biswas *et al*. (2014); *et al*. (2013) and Singh *et al*. (2011) observed that chicken snacks prepared by microwave cooking method had very good appearance score.

The scores for flavour (5.04 to 7.04), texture (4.75 to 7.25) and crispiness (4.54 to 7.50) (Table 2) of chicken chips prepared by different methods of cooking were between slightly desirable to very desirable. The scores of chicken chips prepared by microwave cooking were significantly higher ($p<0.05$) followed by deep fat frying and hot air oven. The highest flavour score of microwave cooked product may be due to sudden rise of the temperature without substantial changes of quality attributes of products. Similarly, Biswas and Beura (2014) reported that poultry meat finger chips prepared by microwave cooking had the highest flavour score, when compared to deep fat frying and hot air oven cooking. Biswas *et al*. (2014) and Singh *et al*. (2011) also reported that chicken snacks prepared by microwave cooking had very good flavour score. Product prepared by microwave cooking was crispy and crunchy which might be due to the puffing effect while the hot air oven cooked product became hard and tough since there was no puffing.

The scores for acceptability of chicken chips prepared by different cooking methods were between slightly desirable to extremely desirable as per hedonic scale with the numerical score ranging from 4.86 to 7.64. The acceptability scores were significantly ($p<0.05$) higher for the product prepared by microwave cooking followed by deep fat frying and lowest for hot air oven cooking.

Sensory scores of all the attributes were significantly ($p<0.05$) higher for the product prepared by microwave cooking. Hence, microwave cooking was selected for the preparation of chicken chips.

Table 2: Effect of different methods of cooking on the sensory quality of chicken chips (Mean ± SE)

Parameters	Deep fat frying	Microwave cooking	Hot air oven
Appearance	6.07 ± 0.22^{a}	7.14 ± 0.16^{b}	5.86 ± 0.25^{a}
Flavour	6.04 ± 0.27^{b}	7.04 ± 0.15^{c}	5.04 ± 0.29^{a}
Texture	6.07 ± 0.21^{b}	7.25 ± 0.16^{c}	4.75 ± 0.29^{a}
Crispiness	5.96 ± 0.24^{b}	7.50 ± 0.12^{c}	4.54 ± 0.27^{a}
Acceptability	6.18 ± 0.23^{b}	7.64 ± 0.11^{c}	4.86 ± 0.27^{a}

Means with different superscripts in the same row differ significantly ($p<0.05$)

Effect of flaxseed powder and oats powder in chicken chips: Report on use of FSP in meat based chips could not be found in available literature. Therefore, results of this part are compared with the reports on use of FSP in other type of meat products. The scores for appearance of the chicken chips incorporated with different levels of FSP were moderately desirable with the numerical score ranging from 6.07 to 6.47 (Table 3). The appearance scores recorded for the chicken chips were significantly ($p<0.05$) lower for all the treatments when compared to the control. But there was no significant difference between 2% and 4% FSP containing product. No significant difference was observed between 4% and 6% FSP incorporated products. This decrease in the appearance score was probably due to the incorporation of FSP which has imparted slightly dark colour and little roughness on the surface of the product, and the FSP incorporated product didn't expand like control product rather it shrunk as the level of FSP increased. Similar to this observation, Yogesh *et al*. (2015) reported significant decrease in the appearance score of raw and cooked meat batter incorporated with higher levels of FSP. Singh *et al*. (2014) reported that chicken meat patties with 4% linseed flour had significantly ($p<0.05$) lower appearance score when compared to control.

The flavour scores of the chicken chips incorporated with different levels of FSP were between moderately desirable to very desirable with the numerical score from 6.23 to 6.97 (Table 3). The flavour scores were significantly ($p<0.05$) lower for the 6% FSP containing product and there was no significant

difference between control and 2% FSP incorporated product. No significant difference was found between 2% and 4% FSP containing products. Yogesh *et al*. (2015) has also reported significant decrease in the flavour scores of raw and cooked meat batter incorporated with higher levels of FSP. Singh *et al*. (2014) reported that chicken meat patties with 4% linseed flour had significantly ($p<0.05$) lower flavour score when compared to control.

The texture (6.27 to 6.80), crispiness (6.20 to 7.00) and acceptability (6.17 to 7.00) (Table 3) scores of the chicken chips incorporated with different levels of FSP were between moderately desirable to very desirable. The texture, crispiness and acceptability scores were significantly ($p<0.05$) lower for 6% FSP containing product compared to 2% and 4% FSP containing products. There was no significant difference between control, 2% and 4% FSP containing product. Such decrease in the texture, crispiness score of chicken chips treated with FSP might be due to the effect of less expansion of product incorporated with FSP and acceptability score due to the incorporation of FSP at higher level in the product which had negatively affected the other sensory attributes. Similarly, Yogesh *et al*. (2015) observed significant ($p<0.05$) decrease in the crispiness and acceptability scores of raw and cooked meat batter incorporated with higher level of FSP.

As there was no significant ($p<0.05$) difference in the sensory attributes of chicken chips incorporated with 2% and 4% FSP, chicken chips with 4% FSP were selected for the production of functional chicken chips (FCC) with the aim of increasing omega-3 fatty acid and fibre content.

Table 3: Effect of incorporation of flax seed powder (FSP) on the sensory quality of chicken chips (Mean ± SE)

Parameters	Control	2% FSP	4% FSP	6% FSP
Appearance	7.27 ± 0.12^{c}	6.47 ± 0.12^{b}	6.37 ± 0.13^{ab}	6.07 ± 0.14^{a}
Flavour	7.17 ± 0.16^{c}	6.97 ± 0.14^{bc}	6.70 ± 0.14^{b}	6.23 ± 0.13^{a}
Texture	7.13 ± 0.14^{b}	6.80 ± 0.18^{b}	6.70 ± 0.15^{ab}	6.27 ± 0.15^{a}
Crispiness	7.33 ± 0.15^{b}	7.00 ± 0.16^{b}	7.00 ± 0.15^{b}	6.20 ± 0.16^{a}
Acceptability	7.27 ± 0.14^{c}	7.00 ± 0.14^{bc}	6.83 ± 0.13^{b}	6.17 ± 0.11^{a}

Means with different superscripts in the same row differ significantly ($p<0.05$)

The scores for appearance of the chicken chips incorporated with different levels of OP were between moderately desirable to very desirable with the numerical score ranging between 6.47 to 7.03 (Table 4). The appearance scores were significantly ($p<0.05$) lower for 6% and 9% OP containing product compared to 3% OP containing product and control. There was no significant difference in the appearance scores for the chicken chips with 6% and 9% OP treated products. There was no significant difference between 3% OP treated product and control. This decrease in appearance score at higher level of inclusion of OP was probably due to less expansion and puffiness of the chips and dark in colour due to incorporation higher level of OP. Similar to this observations, Aswathi *et al*. (2013) reported that appearance score of functional poultry meat stick with 5% oats flour was significantly ($p<0.05$) higher, but showed decreasing trend as the level of oats flour incorporation increased further. Singh *et al*. (2015) reported that oats flour incorporation at 6% level in chevon cutlet decreased the appearance and colour score of the product, but it was not affected up to 4% OF incorporation. However, Santhi and Kalaikannan (2014) reported no significant difference in appearance scores of oat flour incorporated chicken nuggets.

The flavour scores of the chicken chips incorporated with different levels of OP were between moderately desirable to very desirable with the numerical score ranging between 6.60 to 7.10. There was no significant difference between control 3% and 6% OP incorporated chicken chips. Santhi and Kalaikannan (2014) reported that flavour scores of chicken nuggets incorporated with oat flour (OF) decreased as the level of OF incorporation increased. Singh *et al*. (2015) also reported that flavour scores of chevon cutlets decreased significantly with the increase in the level of oats flour incorporation. Indumathi and Reddy (2015) reported that flavour score was maximum for the chicken popcorn enrobed with oats powder. Aswathi *et al*. (2013) reported that flavour score of functional poultry meat sticks with 5% oat flour exhibited no significant ($p<0.05$) difference when compared to control.

The texture (6.03 to 7.23), crispiness (6.73 to 7.47) and acceptability (6.57 to 7.37) (table 4) scores of the chicken chips incorporated with different levels of OP were between moderately desirable to very desirable. Scores showed decreasing trend as the level of incorporation of oats powder increased beyond 6%. Similarly Santhi and Kalaikannan

(2014) reported that texture and overall acceptability scores of chicken nuggets incorporated with oat flour (OF) decreased as the level of incorporation of OF increased. Singh *et al*. (2015) also reported that texture and overall acceptability scores of chevon cutlets decreased significantly ($p<0.05$) with the increase in the level of oats flour incorporation. Indumathi and Reddy (2015) reported that texture and overall acceptability scores was maximum for the chicken popcorn enrobed with oats powder. Aswathi *et al*. (2013) reported that texture, crispiness and overall acceptability score of functional poultry meat sticks with 5% oat flour exhibited no significant ($p<0.05$) difference when compared to control and decreased as the level of oat flour incorporation increased.

There was no significant difference in any of the sensory attributes of chicken chips incorporated with 3% OP and control. At the same time sensory score for all the products incorporated with different levels of OP were well above the acceptable limit. As there was no significant difference in the flavour score of chicken chips with 3% and 6% OP containing products, chicken chips with 6% OP were selected to prepare functional chicken chips (FCC).

Table 3: Effect of incorporation of flax seed powder (FSP) on the sensory quality of chicken chips (Mean ± SE)

Parameters	Control	3% OP	6% OP	9% OP
Appearance	7.23 ± 0.15^{b}	7.03 ± 0.11^{b}	6.47 ± 0.16^{a}	6.50 ± 0.13^{a}
Flavour	7.13 ± 0.14^{b}	7.10 ± 0.15^{b}	6.70 ± 0.15^{ab}	6.60 ± 0.18^{a}
Texture	7.33 ± 0.15^{b}	7.23 ± 0.13^{b}	6.50 ± 0.13^{a}	6.03 ± 0.18^{a}
Crispiness	7.60 ± 0.11^{b}	7.47 ± 0.12^{b}	6.83 ± 0.19^{a}	6.73 ± 0.17^{a}
Acceptability	7.40 ± 0.11^{b}	7.37 ± 0.12^{b}	6.57 ± 0.16^{a}	6.60 ± 0.14^{a}

Means with different superscripts in the same row differ significantly ($p<0.05$)

CONCLUSION

The recipe and procedure for preparation of chicken chips were standardized and microwave cooking was selected for the preparation of chicken chips. Based on the sensory quality FSP level of 4% and OP 6% were selected for incorporation into chicken chips recipe for the preparation of functional chicken chips by replacing meat.

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