SELECTION OF SUITABLE LEVELS OF FLAX SEED AND ESSENTIAL OILS FOR DEVELOPMENT OF SPENT HEN CHICKEN NUGGETS

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ABSTRACT

The present study was conducted to select the suitable level of flax seed along with essential oils for development of chicken meat nuggets by utilizing spent hen meat. Selection was done on the basis of sensory evaluation. Flaxseed flour (FF) at 2, 4 and 6% was tried and 4% level was selected for incorporation in chicken nuggets. Selected level of FF (4%) was further incorporated with different levels of rosemary (0.01, 0.05, 0.10, 0.15 and 0.20%), thyme (0.10, 0.15 and 0.20%) and oregano (0.10, 0.15, 0.20 and 0.25%) essential oils separately and in different combinations. It is concluded that organoleptically acceptable spent hen chicken nuggets can be prepared by incorporating flaxseed flour (4%) along with rosemary oil (0.01%), thyme (0.10%), oregano (0.10%) individually, and finally the combination of FF (4%), rosemary (0.01%), thyme (0.05%) and oregano (0.05%) were selected for incorporation in chicken meat nuggets.

Keywords: Flax seed, Oregano oil, Rosemary, Spent hen, Thyme

Spent hen meat is tough, rubbery and has poor functional properties, due to more collagen content and inter-molecular cross linkages and thus is not well accepted by the consumers. With increasing consumer awareness, the emphasis today is shifting towards development of functional foods and incorporation of functional ingredients during processing of meat is one of the strategies for developing such foods (Jimenez-Colmenero et al., 2001). Flax (Linum usitatissimum) is an oilseed crop and its seeds are known to contain many bio active compounds. It contains an average of 41% fat, about 39-40% of dietary fibre (Berglund, 2002). Flax seeds are rich source of PUFA (ω -3 fatty acid: α -linolenic acid), soluble and insoluble fibres, phytoestrogenic lignins, proteins and many antioxidants (Singh et al., 2011). Its growing popularity is due to several health imparting benefits like reducing cardiovascular diseases, risk of cancer, osteoporosis etc. (Goyal et al., 2014).

Meat and meat products are highly perishable due to microbial spoilage and oxidative rancidity. Synthetic antioxidants have been successfully used to prevent such oxidation but they are targeted to be potential carcinogens (Chen *et al.*, 1992). So, demand for all natural products has rapidly increased (Jayasena and Jo, 2014). An essential oil is hydrophobic liquid containing volatile aroma compounds from the plant. These oils consist of several constituents like terpenes, alcohols, acetones, phenols, acids, aldehydes and esters. Various studies have been undertaken to utilize essential oils from oregano, rosemary, thyme, sage, basil, turmeric, ginger, garlic, nutmeg, clove, mace etc. for extending shelf life and improving sensory quality of meat and meat products (Jayasena and Jo, 2014). Present study was undertaken to select suitable levels of flaxseed and essential oils (rosemary, thyme and oregano) for incorporation in spent hen chicken nuggets.

MATERIALS AND METHODS

Preparation of spent hen meat nuggets: Healthy spent hen of 18 months of age reared under similar feeding and management conditions were procured from the Animal Farm of department of Livestock Production Management of College of Veterinary Sciences, LUVAS, Hisar and were slaughtered and dressed as per the standard procedure. Flax seeds were procured from the local market of Hisar. Rosemary, Thyme and Oregano oil were procured from the reputed firm of Allin exporters. Flax seeds were roasted in conventional oven preheated at 180 °C for 5 minutes and ground to fine flour in an electric mixer. Deboned spent hen meat was minced in meat mincer (3mm plate, Mado Primus Meat Mincer, MEW-613; Dr. Froeb India Pvt. Ltd.). For preparation of control nuggets, 100 g minced meat was added with sodium chloride (2%), sodium tripolyphosphate (0.5%), sodium nitrite (140 ppm), spice mix (2%), garlic + ginger paste (3%), sunflower oil (4%), egg white (5%) and semolina (4%) and a stable emulsion was prepared in bowl chopper adding 8% ice cubes.

In addition to control, flaxseed flour was incorporated at 2, 4 and 6% levels and the product was selected on the bases of sensory evaluation. Rosemary oil (R) at 0.01, 0.05, 0.10, 0.15 and 0.20% levels; Thyme oil (T) at 0.10, 0.15 and 0.20% levels; and Oregano oil (O) at 0.10, 0.15, 0.20 and 0.25% levels were added in addition to selected flaxseed flour level. One level from each essential oil incorporated nuggets was selected on the basis of sensory evaluation.

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The combinations of oils (C1=Rosemary 0.01% + Thyme 0.10% + Oregano 0.10%) and (C2= Rosemary 0.01% + Thyme 0.05% + Oregano 0.05%) were also tried for incorporation in chicken nuggets and one combination level was finally selected on the basis of sensory evaluation. All the ingredients were mixed in a bowel chopper to prepare a stable emulsion. Preparation of nuggets was done by steam cooking for which the prepared emulsion was stuffed in autoclavable beakers uniformly. The beakers were covered with aluminium foil and pressure cooked for 30 minutes at low gas flame till core temperature reached 80 °C. Cooked emulsion was taken out, cooled to room temperature and cut into pieces of uniform size (2 cm^3) to form nuggets.

Sensory evaluation: A four member experienced panel of judges consisting of faculty members of the Department evaluated the samples for the sensory attributes of colour and appearance, flavour, texture, tenderness, juiciness and overall acceptability (OAA) using 8-point descriptive scale, where 8= excellent and 1= extremely poor (Meilgaard *et al.*, 1991). The test samples were presented to the panelists after assigning suitable codes. The samples were warmed in a microwave oven for 20 seconds before serving to the sensory panelists. Water was served for rinsing the mouth between the samples.

Statistical analysis: Data were analyzed statistically on 'SPSS-16.0' (SPSS Inc., Chicago, II USA) software package as per standard methods (Snedecor and Cochran, 1994). Statistical significance was estimated at 5% level ($p\leq0.05$) and evaluated with Duncan's Multiple Range Test.

RESULTS AND DISCUSSION

Selection of suitable level of flaxseed flour (FF)

With increase in incorporation level of FF, a decrease in colour scores of nuggets was observed which was significant at 6% level (Table 1). It might be due to masking effect of brown colour of FF resulting in darker product with reduced redness. This was supported by the findings of Deepak *et al.* (2017) who observed chicken meat nuggets getting darker with reduced colour scores as the level of FF incorporation increased. With increase in FF incorporation at 6% level, flavour score also decreased significantly in comparison to all other treatments. Reduction in flavour score might be due to dilution of meaty flavour (Sharma et al., 2014). Texture, tenderness and juiciness scores of FF treated nuggets were comparable to control. OAA scores of 2% and 4% FF treated nuggets were comparable to control. At 6% level, scores decreased significantly which might be due to a significant decrease in colour and appearance and flavour scores which affected overall acceptability. Kasthuri et al. (2016) also selected 4% flaxseed powder on basis of sensory parameters to develop functional chicken chips. Overall acceptability score of 4% FF treated nuggets was comparable to control and significantly better than 6% FF treated nuggets, hence 4% FF level was selected.

Selection of suitable levels of essential oils

Colour and appearance scores of nuggets treated with different levels of rosemary (Table 2), thyme (Table 3), oregano oil (Table 4) and combination of all three oils (Table 5) were comparable to control. Significantly lower, objectionable and unacceptable flavour scores were observed at 0.10%, 0.15% and 0.20% level of rosemary oil incorporation in the treated nuggets (Table 2). So rosemary oil level in nuggets was further reduced to obtain desirable flavour scores. Flavour score at 0.05% was also significantly lower than control but was fair and acceptable. Flavour score at 0.01% was very good and comparable to control. Similar findings in case of rosemary essential oil incorporation were indicated by Viuda-Martos et al. (2010) who revealed that 0.02% level didn't affect sensorial properties significantly in mortadella. Both thyme (Table 3) and oregano oil (Table 4) treated nuggets showed comparable flavour scores to control at 0.10% level of their incorporation and as the level increased, scores decreased significantly. Results are in consonance with Karabagias et al. (2011) whose findings showed that thyme and oregano essential oil incorporation at concentration 0.1% in fresh lamb meat

Sensory scores of Flaxseeu nour incorporated nuggets (Mean-15E, n=12)							
Treatment	Colour and Appearance	Flavour	Texture	Tenderness	Juiciness	Overall acceptability	
С	7.75 ^b ±0.62	7.67 ^b ±0.49	7.58±0.51	7.50 ± 0.80	7.67±0.89	7.83 ^b ±0.39	
FF 2%	$7.67^{b} \pm 0.65$	$7.75^{b}\pm0.45$	7.67 ± 0.49	7.50 ± 0.90	7.67±0.65	7.75 ^b ±0.62	
FF 4%	$7.58^{\text{b}} \pm 0.90$	7.83 ^b ±0.39	7.75 ± 0.45	7.58±0.51	7.67±0.49	7.92 ^b ±0.29	
FF 6%	$6.58^{a} \pm 0.67$	6.17 ^a ±0.39	7.83±0.39	7.67±0.89	7.75 ± 0.45	6.33 ^a ±0.65	

 Table 1

 Sensory scores of Flaxseed flour incorporated nuggets (Mean±SE, n=12)

C=Control, FF=Flaxseed flour.

Means with different small letter superscripts in a column differ significantly ($p \le 0.05$).

 Table 2

 Sensory scores of Rosemary oil incorporated spent chicken nuggets (Mean±SD, n=12)

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Treatment	Colour and Appearance	Flavour	Texture	Tenderness	Juiciness	Overall acceptability
С	7.58±0.90	7.83°±0.39	7.75±0.45	7.58±0.51	7.67±0.49	7.92±0.29
R-0.10%	7.58 ± 0.67	4.67°±0.49	7.75 ± 0.62	7.67 ± 0.49	7.67±0.65	4.75±0.75
R-0.15%	7.67 ± 0.49	$3.50^{b} \pm 0.52$	7.83 ± 0.58	7.75 ± 0.45	7.75±0.62	$3.83 {\pm} 0.58$
R-0.20%	7.67±0.65	2.75°±0.45	7.83 ± 0.39	7.83 ± 0.58	7.75±0.62	3.25±0.62
R-0.05%	7.58±0.67	$5.75^{d} \pm 0.45$	$7.67 {\pm} 0.65$	7.67 ± 0.65	7.67±0.49	5.83±0.39
R-0.01%	7.58±0.51	7.75°±0.45	7.75±0.45	7.67±0.49	7.67±0.65	7.75±0.45

C=Flaxseed flour (4%), R=Rosemary oil.

Means with different small letter superscripts in a column differ significantly ($p \le 0.05$).

Table 3 Sensory scores of Thyme oil incorporated spent chicken nuggets (Mean±SD, n=12)							
Treatment	Colour and Appearance	Flavour	Texture	Tenderness	Juiciness	Overall acceptability	
С	$7.58{\pm}0.90$	7.83°±0.39	7.75±0.45	7.58±0.51	7.67±0.49	7.92°±0.29	
T-0.10%	7.67±0.65	$7.75^{\circ}\pm0.62$	7.75 ± 0.87	7.75 ± 0.62	7.75±0.45	7.83°±0.39	
T-0.15%	7.75 ± 0.45	$6.58^{b} \pm 0.51$	7.83 ± 0.58	7.75 ± 0.45	7.75±0.39	$6.58^{b} \pm 0.51$	
T-0.20%	7.75±0.39	$5.58^{a} \pm 0.51$	7.83±0.39	7.83 ± 0.58	7.83±0.39	5.58 ^a ±0.51	

C = Flaxseed flour (4%), T = Thyme oil.

Means with different small letter superscripts in a column differ significantly ($p \le 0.05$).

Table 4 Sensory scores of Oregano oil incorporated spent chicken nuggets (Mean±SD, n=12)							
Treatment	Colour and Appearance	Flavour	Texture	Tenderness	Juiciness	Overall acceptability	
С	7.58±0.90	7.83 ^b ±0.39	7.75±0.45	7.58±0.51	7.67±0.49	7.92 ^b ±0.29	
O-0.10%	7.75±0.45	7.83 ^b ±0.58	7.75 ± 0.62	7.67 ± 0.78	7.75±0.45	7.83 ^b ±0.39	
O-0.15%	7.75±0.39	$6.75^{a}\pm0.45$	7.83 ± 0.39	7.83±0.39	7.75±0.39	6.83 ^a ±0.39	
O-0.20%	7.83±0.39	$6.67^{a}\pm0.49$	$7.83 {\pm} 0.58$	7.83 ± 0.58	7.83 ± 0.58	$6.67^{a}\pm0.49$	
O-0.25%	7.83 ± 0.58	6.42 ^a ±0.51	7.67±0.65	7.75±0.39	7.67±0.65	$6.50^{a} \pm 0.52$	

C=Flaxseed flour (4%), O=Oregano oil.

Means with different small letter superscripts in a column differ significantly ($p \le 0.05$).

didn't reveal any objectionable odour and taste. Flavour score of combination 1(C+ R-0.01% + T-0.10% + O-0.10%) (C1) was slightly desirable and significantly lower in comparison to control. To improve flavour scores, levels of thyme and oregano were halved in combination 2 (C + R- 0.01\% + T-0.05\% + O-0.05\%) (C2). The scores of C2 were comparable with control as the cumulative effect of all 3 oils was no longer objectionable and as strong as that in C1.

Texture scores of rosemary, thyme, oregano and combination of all 3 oils treated nuggets were comparable to control. Tenderness scores in all the essential oil treated nuggets {rosemary oil (Table 2), thyme oil (Table 3), oregano oil (Table 4) and combination (Table 5)} were comparable to the control. Juiciness also followed similar trend indicating that incorporation of essential oils did not affect the tenderness and juiciness of chicken nuggets. Nuggets incorporated with rosemary oil at levels from 0.10% to 0.20% resulted in OAA scores below 5 meaning acceptability less than desirable. Incorporation of rosemary oil at 0.05% level resulted in moderately desirable acceptability scores. Further reduction of rosemary oil to 0.01% level resulted in OAA score comparable to control. This level was selected for incorporation in chicken nuggets.

OAA scores decreased significantly with increase in level of incorporation of thyme oil in nuggets (Table 3). Chicken nuggets incorporated with thyme oil at 0.10% level showed OAA score similar to control. Further increase in level of incorporation of thyme oil resulted in a significant decrease in OAA scores. As the OAA score of 0.10% thyme oil incorporated chicken nuggets was

Table 5	
Sensory scores of spent chicken nuggets with combinations of oil (Mean ± SD, n=12	2)

Treatment	Colour and Appearance	Flavour	Texture	Tenderness	Juiciness	Overall acceptability
С	7.58 ± 0.90	7.83 ^b ±0.39	7.75±0.45	7.58±0.51	7.67±0.49	7.92 ^b ±0.29
C1	7.67±0.65	5.33 ^a ±0.49	7.83 ± 0.58	7.83 ± 0.58	7.75±0.39	6.33 ^a ±0.89
C2	7.67 ± 0.49	$7.83^{\text{b}}\pm 0.58$	7.75 ± 0.62	7.83 ± 0.39	7.75±0.45	7.92 ^b ±0.29

C=Flaxseed flour (4%), C1=Combination 1(C+R-0.01%+T-0.10%+O-0.10%)

C2=Combination 2 (C+R-0.01%+T-0.05%+O-0.05%).

Means with different small letter superscripts in a column differ significantly ($p \le 0.05$).

comparable to control so this level was selected for incorporation in chicken nuggets. Similar trend was observed in nuggets treated with oregano oil (Table 4). Level of 0.10% was selected as its OAA score was similar to control. Karabagias et al. (2011) reported that thyme and oregano essential oils incorporation at 0.1% v/w concentration in fresh lamb meat didn't result in any deleterious effect on the sensory parameters. OAA score of combination 1 incorporated with 0.01% rosemary +0.10%thyme+0.10% oregano oil was around 6.0 and significantly lower than control. To improve the sensory scores of chicken nuggets, level of essential oils was decreased. OAA score of combination 2 incorporated with 0.01% rosemary + 0.05% thyme + 0.05% oregano oil was comparable to control, so combination 2 was selected (Table 5).

It is concluded that organoleptically acceptable spent hen chicken nuggets can be prepared by incorporating flaxseed flour alone (4%) along with rosemary oil (0.01%), thyme (0.10%), oregano (0.10%) and their combination (rosemary+thyme+oregano at 0.01%+0.05%+0.05% levels).

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