



A Study on the Development of Functionally Improved Low Fat Spent Broiler Breeder Hen Chicken Sausages Added with Ground Poppy Seed

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Abstract

Spent broiler breeder hen meat was utilized for development of low-fat functional chicken sausages fortified with ground poppy seed at three different levels (5, 7.5 and 10%) as partial chicken fat replacer to select optimum level of incorporation based on physico-chemical, proximate, fatty acid composition and sensory evaluation. Low fat chicken sausages incorporated with ground poppy seed at 10 % level were found to have significantly ($P < 0.05$) higher pH, cooking yield, emulsion stability, hardness, crude protein, crude fiber, total ash, PUFA /SFA ratio, mono and poly unsaturated fatty acids and significantly lower moisture, crude fat, cholesterol and saturated fatty acids when compared to the control and rest of the poppy seed fortified sausages with no significant difference was observed in sensory scores.

Keywords: Chicken Sausages, Fat Replacer, Functional, Ground Poppy Seed, Low Fat

Introduction

The present study was undertaken by keeping in view the necessity for proper utilization of less expensive meat from spent broiler breeder hens to produce cheaper and economically viable low-fat sausages by substituting animal fat with ground poppy seed (GPS). In recent years, due to the growing consumer demand for healthy products, the fat content of meat formulations has been decreasing in order to develop meat products with beneficial nutritional value (Yang *et al.*, 2016), because fat, particularly animal fat, often contains high levels of saturated fatty acids and cholesterol, which have been associated with obesity, hypertension, cardiovascular and coronary heart disease (Chernukha *et al.*, 2015). For this reason, nutritionists generally recommend a change in composition of the fat associated with meat products by substituting monounsaturated fatty acids (MUFA) for saturated fatty acids (SFA) (Zanardi *et al.*, 2000). Poppy seed *Papaver somniferum* is rich in protein, fiber and linoleic acid (Ankita Sharma *et al.*, 2015).

Material and Method

Preparation of Raw Materials

Spent boiler breeder birds (females) of 72 weeks of age were purchased from Chandragiri local market, transported and slaughtered at the Department of Livestock Products Technology, College of Veterinary Science, Tirupati. All subcutaneous fat and inter muscular fat was removed from the meat and used as the fat source. Poppy seeds were purchased from local super market and were separately cleaned thoroughly, dry roasted in a pan and made in to paste. The paste was prepared freshly on the day of incorporation. The spice ingredients purchased from local market were cleaned thoroughly and dried in a hot air oven at 50°C per 60 minutes and were ground separately in a blender and sieved through a fine mesh.

Table 1: Formulations of low-fat chicken sausages fortified with ground poppy seed (GPS) as fat replacer at different levels

Ingredient	Control	Low Fat Sausages Incorporated with Ground Poppy Seed		
		T1	T2	T3
Chicken meat (%)	85	85	85	85
Chicken fat (%)	15	10	7.5	5
Ground poppy seed (%)	0	5	7.5	10
Salt (%)	1.8	1.8	1.8	1.8
Sugar (%)	1	1	1	1
Polyphosphate (STPP) (%)	0.3	0.3	0.3	0.3
Ice (%)	10	10	10	10
Dry Spice mix (%)	2	2	2	2
Wet Condiment mix* (%)	3	3	3	3
Binder (Maida) (%)	3	3	3	3

Onion: Garlic paste (3:1)

Low fat chicken sausages were prepared by replacing the chicken fat with GPS in three different levels along with control as per the formulation given in Table 2.

Analysis

Physico-chemical Parameters

The pH of the samples was determined as per the procedure of Jay (1964). Percent Cooking yield was estimated by recording the difference between the pre- and post-cooking weights of meat sausages and expressed in percentage. The Percent Emulsion stability of the sample was determined as per the method Baliga and Madaiah (1970). The hardness of the product was measured in terms of penetration value (penetration value \times 10⁻¹ mm) with the help of cone penetrometer as described by Dixon and Parekh (1979). Proximate composition of sausages was estimated as

per the procedures outlined by AOAC (1994). Cholesterol was estimated as per the method described by Wybenga *et al.*, (1970) as modified by Rajkumar *et al.*, (2004). Fatty acid composition was estimated by Folch *et al.* (1957) and Lepage and Roy (1986). The results of fatty acid composition were expressed as area percentage. Functional chicken meat sausages were subjected to sensory evaluation on a 9-point hedonic scale by semi-trained panalists.

Results and Discussion

Physico-chemical Properties

The pH significantly ($P \leq 0.05$) differed between low fat formulation and control (Table 2). The low-fat chicken sausages incorporated with 10% ground poppy seed (GPS) recorded higher values than the rest of the formulations. This might be due to high pH of GPS. These findings are correlated with Ruben *et al.* (2017) in frankfurter type sausages. The percent cooking yield and percent emulsion stability of low-fat chicken sausages were significantly ($P < 0.05$) affected by addition of GPS. Percent cooking yield and emulsion stability was increased with increased addition of GPS. The formulation of low-fat chicken sausages added with GPS at 10% level recorded significantly lower losses than rest of the formulations and control. This increase in cooking yield and emulsion stability might be due to better moisture retention and emulsifying property of GPS (Gok *et al.* 2011 and Purnima *et al.* 2007). Findings of the present study are in agreement with Choi *et al.* (2016) in chicken sausages, Selani *et al.* (2016) in low fat beef burger and Saniya *et al.* (2016) in fish nuggets.

All the formulations of low-fat chicken sausages recorded significantly ($P < 0.05$) lower penetration values (Higher penetration value corresponds to lower hardness of the sausages) compared to the control. Mean penetration values of low-fat formulations decreased with increased level of addition of GPS. Low fat sausages replaced with 10% GPS (T3) had significantly ($P \leq 0.05$) lower penetration values than rest of treatments and control. This increase in hardness of poppy seed fortified sausages might be due to reduced fat and moisture percent. These results were in accordance with Gok (2015) in Turkish sucuks.

Table 2: Effect of partial replacement of chicken fat with ground poppy seed on physico-chemical properties of low-fat chicken sausages

Parameter	Control	T1	T2	T3
pH	6.23±0.02 ^a	6.27±0.005 ^b	6.29±0.004 ^b	6.30±0.004 ^b
% Cooking yield	87.19±0.02 ^a	90.06±0.07 ^b	91.33±0.07 ^c	92.54±0.13 ^d
% Emulsion stability	87.09±0.15 ^a	88.7±0.03 ^b	90.69±0.07 ^c	92.04±0.05 ^d
Hardness (mm)	26.06±0.18 ^a	22.85±0.19 ^b	21.78±0.08 ^c	20.81±0.14 ^d

Control - 15 % Chicken fat (CF); T1 - 10 % CF + 5% GPS; T2 - 7.5% CF + 7.5% GPS; T3 - 5% CF + 10% GPS; Mean values bearing at least one common superscript do not differ significantly

Proximate Composition

Ground poppy seed (GPS) addition significantly affected ($p < 0.05$) the protein content of the sausages with the highest protein content determined in low fat sausages having 10% GPS than rest of treatments and control (Table-3). This might be due to relatively high protein content. Fat content of treated sausages was significantly ($P < 0.05$) reduced. These results are correlated with Saniya *et al.* (2016) in GPS fortified fish nuggets and Anna Anandh and Annal Villi (2018) in chicken Meat Cutlets. Low fat sausages replaced with 10% GPS (T3) had significantly ($P < 0.05$) higher percent total ash and crude fiber than rest of treatments and control. This might be attributed to the higher total ash (6%) and fiber (25%) contents of poppy seed. Similar trend was reported by Choi *et al.* (2016) in chicken sausages and Elbakheet *et al.* (2017) in beef sausages.

Cholesterol

Significant difference ($P < 0.05$) was observed between low fat treatments and control. Cholesterol content of low-fat treatments decreased with increased addition of GPS. Low fat sausages replaced with 10% GPS (T3) had significantly ($P < 0.05$) lower cholesterol than rest of treatments and control. This is might be due to replacement of chicken fat with GPS which is devoid of cholesterol. Similar trend was reported by Ruben *et al.* (2017) in reduced fat frankfurters.

Table 3: Effect of partial replacement of chicken fat with ground poppy seed (GPS) on proximate composition of low-fat chicken sausages

Parameter	Control	T1	T2	T3
% Moisture	67.11±0.14 ^a	66.04±0.07 ^b	64.30±0.06 ^c	63.27±0.04 ^d
% Crude protein	18.42±0.07 ^a	20.45±0.10 ^b	20.82±0.03 ^c	21.24±0.09 ^d
% Crude fat	10.65±0.06 ^a	9.94±0.03 ^b	10.12±0.03 ^c	10.31±0.02 ^d
% Total ash	1.53±0.05 ^a	2.10±0.01 ^b	2.23±0.02 ^c	2.43±0.02 ^d
% Crude fiber	0.68±0.03 ^a	1.46±0.03 ^b	2.01±0.03 ^c	2.47±0.03 ^d
Cholesterol (mg)	81.45±0.08 ^a	66.04±0.03 ^b	56.26±0.01 ^c	43.91±0.03 ^d

Control - 15 % Chicken fat (CF); T1 - 10 % CF + 5% GPS; T2 - 7.5% CF + 7.5% GPS; T3 - 5% CF + 10% GPS; Mean values bearing at least one common superscript do not differ significantly.

Fatty Acid Composition of Low-Fat Chicken Sausages

Addition of ground poppy seed (GPS) decreased ($P<0.05$) the saturated fatty acid (SFA) concentration and increased ($P<0.05$) the poly unsaturated fatty acid (PUFA) concentration and ratio of PUFA/SFA in sausages. Low fat sausages had significantly ($P<0.05$) lower percent of total SFA control sausages. Among the low-fat treatments T3 sausages had significantly ($P<0.05$) higher percent of total MUFA, PUFA and ratio of PUFA/SFA when compared to the other treatments and control. These results agree with those reported by Backes *et al.* (2017) in salami. GPS addition resulted in the increased linoleic acid and decreased myristic acid, palmitic acid, stearic acid, behenic acid and oleic acid contents in low fat sausages than control. Linoleic acid percent of low-fat chicken sausages was increased with increased level of addition of GPS and highest value recorded in T3 sausages. This might be due to high concentration of linoleic acid (73%) in poppy seed (Ozcan and Atalay 2006). The changes fatty acid composition of poppy seed added chicken sausages are in agreement with the reports of Gok *et al.* (2011) in beef burgers.

Table 4: Effect of partial replacement of chicken fat with ground poppy seed (GPS) on fatty acid composition of low-fat chicken sausages

Parameter	Control	T1	T2	T3
Myristic acid (C14)	0.64±0.004 ^a	0.51±0.004 ^b	0.51±0.006 ^c	0.49±0.005 ^d
Palmitic acid (C16)	21.4±0.06 ^a	17.78±0.027 ^b	17.73±0.04 ^c	16.38±0.029 ^d
Stearic acid (C18)	5.09±0.004 ^a	4.00±0.017 ^b	3.13±0.03 ^c	3.64±0.029 ^d
Behenic acid (C22)	0.42±0.005 ^a	0.35±0.005 ^b	0.29±0.004 ^c	0.27±0.007 ^d
Oleic acid (C18:1)	40.77±0.06 ^a	37.71±0.03 ^b	34.50±0.09 ^c	31.38±0.04 ^d
Palmitoleic acid (C16:1)	5.26±0.014 ^a	4.04±0.006 ^b	3.77±0.01 ^c	3.39±0.029 ^d
Linoleic acid (C18:2)	24.25±0.015 ^a	33.90±0.027 ^b	38.03±0.01 ^c	43.06±0.012 ^d
Linolenic acid(C18:3)	1.36±0.006 ^a	1.43±0.01 ^b	1.26±0.008 ^c	1.12±0.006 ^d
Arachidonic acid (C20:4)	0.16±0.004 ^a	0.10±0.005 ^b	0.13±0.002 ^c	0.12±0.002 ^d
Ecosapentaenoic acid (C20:5)	0.35±0.006 ^a	0.04±0.006 ^b	---	---
Docosahexaenoic acid (C22:6)	0.13±0.005 ^a	0.03±0.003 ^b	---	---
Others	0.12±0.001 ^a	0.07±0.005 ^b	---	---
SFA	27.55±0.07 ^a	22.63±0.02 ^b	22.26±0.01 ^c	20.88±0.15 ^d
MUFA	46.03±0.009 ^a	41.75±0.01 ^b	38.27±0.008 ^c	31.75±0.01 ^d
PUFA	26.23±0.01 ^a	35.55±0.03 ^b	39.47±0.01 ^c	47.37±0.01 ^d
PUFA/SFA	0.95±0.002 ^a	1.57±0.001 ^b	1.77±0.001 ^c	2.26±0.01 ^d

Control - 15 % Chicken fat (CF); T1 - 10 % CF + 5% GPS; T2 - 7.5% CF + 7.5% GPS; T3 - 5% CF + 10% GPS; Mean values bearing at least one common superscript do not differ significantly

Sensory Parameters Influenced by Fat Replacement with Ground Poppy Seed in Low Fat Chicken Sausages

Low fat sausages scored uniformly higher scores for all sensory parameters than control. Scores of all sensory parameters for three treatments of sausages were in the range of 7.47-7.79 which indicates acceptability of the low-fat chicken sausages. These results are in agreement with Ankita Sharma *et al.* (2015) in poppy seed oil incorporated recipes, Saldana *et al.* (2015) in mortadella type products and Pradeepa Roberts *et al.* (2019) in chicken sausages.

Table 5: Effect of partial replacement of chicken fat with ground poppy seed on sensory parameters of low-fat chicken sausages

Parameter	Control	T1	T2	T3
Appearance	7.65±0.12 ^a	7.66±0.12 ^a	7.68±0.15 ^a	7.69±0.15 ^a
Flavour	7.48±0.16 ^a	7.47±0.12 ^a	7.50±0.16 ^a	7.52±0.16 ^a
Juiciness	7.68±0.11 ^a	7.68±0.13 ^a	7.66±0.15 ^a	7.66±0.11 ^a
Tenderness	7.70±0.11 ^a	7.75±0.12 ^a	7.74±0.16 ^a	7.79±0.12 ^a
Overall acceptability	7.62±0.12 ^a	7.58±0.14 ^a	7.61±0.13 ^a	7.58±0.11 ^a

Control - 15 % Chicken fat (CF); T1 - 10 % CF + 5% GPS; T2 - 7.5% CF + 7.5% GPS; T3 - 5% CF + 10% GPS; Mean values bearing at least one common superscript do not differ significantly

Conclusion

Low fat chicken sausages incorporated with ground poppy seed (GPS) at 10 % level were found to have significantly ($P<0.05$) higher pH, cooking yield, emulsion stability, hardness, crude protein, crude fiber, total ash, PUFA /SFA ratio, mono and poly unsaturated fatty acids and significantly lower moisture, crude fat, cholesterol and saturated fatty acids when compared to the control and rest of the poppy seed fortified sausages but no significant difference was observed in sensory scores.

Conflict of Interests

There is no conflict of interest.

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