Research Article

Process Optimization for the Development of Value Added Chicken Meat Sausages

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Abstract

Different trials were conducted to incorporate the appropriate binder at right percentage for the development of value added chicken meat sausages. Three different binders viz. sorghum, oat and barley flours each at three different levels viz., 3, 6 and 9 percentages were added to prepare the value added chicken meat sausages to select a binder at its optimum desirable level. Among different treatments chicken meat sausages incorporated with Oat flour at 9 % level had recorded significantly ($p<0.01$) higher yield, emulsion stability, higher water holding capacity, penetration values and better organoleptic traits than the rest of the formulations. Hence incorporation of oat flour at 9 % level in chicken meat sausages was considered to be optimum with all the desired qualities of value added chicken meat sausages.

Keywords: Chicken meat sausages, Sorghum, Oat and Barley flours, value addition

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Introduction

Poultry meat places a major role in human diet and suited for processing due to its specific nutritional characteristics and bland flavor, which can be enhanced by condiments. Now a days, the consumption of poultry meat has raised drastically. In recent years, cereals and their ingredients have been accepted as functional foods, primarily due to constant promotion of dietary fiber, protein, energy, minerals, vitamins, and antioxidants required for human health. It has been reported that carbohydrate-based fat substitutes from plant polysaccharides such as fiber and starch can retain moisture and provide textural qualities that are usually provided by fat. Value added meat products are the processed products with easy convenience to consumer through decreasing preparation time, minimizing preparation steps, allowing use of specific parts and increasing value of the product. Generally meat products are prepared by reformulation of meat by incorporating health producing ingredients like different fibers, proteins and antioxidants etc. Incorporation of non meat binders such as sorghum, oat, barley flour, soy flour, Bengal gram, corn flour, whole egg liquid, etc in meat products improves their nutritional and organoleptic quality as well as reduced the cost of production. Hence in the current research, an attempt was made to standardize the procedure for the preparation of chicken meat sausages with three different binders at three different levels and to arrive at a suitable formulation.

Materials and Methods

Initially six trials were conducted to determine the optimum level of inclusion of non meat binders. The optimum level of inclusion of Sorghum flour, Oat flour and Barley flour were determined by preparing six batches of chicken meat sausages incorporating three different levels viz., 3, 6 and 9 percentages of each flour and subjected them to quality analysis i.e. physico-chemical characteristics like cooking loss, emulsion stability, water holding capacity, hardness and organoleptic evaluation. Cooking loss was estimated by recording difference between the pre and post cooking weight of chicken meat sausages and is expressed in percentage. Emulsion stability, Water holding capacity, Hardness of the product were determined as per the procedures of Townsend *et al.*, [1], Weirbicki *et al.*, [2] and

Dixon and Parekh [3] respectively. Sensory evaluation of the product was carried out on a 9 point hedonic scale by a semi trained five members taste panel. The proximate analysis was conducted as per the procedures outlined by AOAC [4]. The data thus obtained was subjected to statistical analysis using SPSS MAC, version 20.0, SPSS Chicago (US).

Results and Discussion

Cooking loss

Chicken meat sausages prepared with sorghum, oat and barley flours each at 9 % recorded significantly (P<0.01) lower cooking loss than the same flours at 3 and 6 % levels. Lower cooking loss might be due to optimum absorption of moisture from the emulsion by the extenders thus lowering the loss of moisture during cooking and also due to the water binding capacity of the respective flours [5]. Among the flours chicken meat sausages incorporated with oat flour at 9 % had registered significantly (P<0.01) lower cooking loss compared to the rest of the formulations. Higher cooking yield was probably due to ability of oat hydrocolloidal fiber to create a tridimensional matrix, holding water and avoiding losses of water during cooking [6]. The lower cooking loss with addition of extenders recorded in the present study corroborated well with the reports of Hughes *et al.,* [7] in frankfurters, Morin *et al.,* [8] in reduced-fat breakfast sausages, Modi *et al.,* [9] in cooked and fried meat kofta, Prasad *et al.,* [10] in chicken kofta, Devatkal *et al*., [11] in gluten-free chicken nuggets, Obula reddy [12] in chicken meat patties, Santhi and Kalaikanna [13] in low fat chicken nuggets and Reddy *et al*., [14] in mutton nuggets.

Emulsion Stability

Chicken meat sausages extended with 9% sorghum, oat and barley flours recorded significantly (P<0.01) higher emulsion stability as compared to other two formulations of the respective flours which might be due to high functional properties of added flours and the ability of emulsion to hold liquid. Chicken meat sausages extended with oat flour at 9 % recorded higher emulsion stability than the rest of formulations. The results obtained in the study are in agreement with the reports of Hughes *et al.,* [7] in frankfurters, Govind *et al*., [15] in emu meat sausages, Obula reddy [12] in chicken meat patties and Reddy *et al*., [14] in mutton nuggets.

Water-holding Capacity

Chicken meat sausages extended with sorghum flour, oat flour and barley flour each at 9 % had significantly (P<0.01) higher water-holding capacity as compared to 3 and 6 % levels of respective flour formulations. This might be due to the fact that higher level of flour retains more water, thereby increasing the water-holding capacity [16].Chicken meat sausages extended with oat flour at 9 % had significantly (P<0.01) higher water-holding capacity than the sausages extended with sorghum and barley flours each at 9 %. This might be due to the formation of more stable meat-protein-matrix which leads to a smaller release of water and fat thus improving binding properties. Irrespective of type of flour formulations, increased level of extender had significantly (P<0.01) increased the water-holding capacity. The results obtained in the study are in accordance with Hughes *et al.,* [7] in frankfurters, Morin *et al.,* [8] in reduced-fat breakfast sausages, Modi *et al.,* [9] in meat kofta, Govind *et al*., [15] in emu meat sausages, Obula reddy [12] in chicken meat patties, Reddy *et al*., [14] in mutton nuggets.

Hardness

Chicken meat sausages extended with sorghum flour, oat flour and barley flour each at 9 % had significantly (P<0.01) higher penetration value as compared to 3 and 6 % of respective flour formulations. This might be due to the fact that higher level of flour retains more water, thereby increasing the penetration value [16] Softness was observed when cereal flours were added to the product and primarily due to higher water absorption capacity of the flours when heated. More water binding sites become available to dissociated protein subunits upon heat treatment.Chicken meat sausages extended with oat flour at 9 % had significantly (P<0.01) higher penetration values than the other flours Irrespective of type of flour formulations, increased level of extender had significantly (P<0.01) increased the penetration values. The results obtained in the study are in accordance with Modi *et al.,* [9] in cooked meat kofta, Devatkal *et al*., [11] in gluten-free chicken nuggets, Reddy *et al*., [14] in mutton nuggets.

Table 1 Effect of incorporation of different levels of Sorghum flour on the physico-chemical and organoleptic properties of chicken meat sausages (Mean ±S.E)

Parameters	Control	Chicken meat sausages incorporated with Sorghum flour		
		3 per cent	6 per cent	9per cent
Cooking loss %	12.78±0.13^{d}	10.32±0.27^{c}	8.01±0.17^{b}	6.09±0.46^{a}
Emulsion stability %	67.49±0.94^{a}	80.17±0.20^{b}	87.93±0.13^{c}	95.49±0.20^{d}
Water holding capacity %	55.95±0.17^{a}	58.43±0.10^{b}	64.52±0.15^{c}	66.56±0.12^{d}
Hardness (penetration value)	109.33±3.44^{a}	125.00±1.83^{b}	145.67±1.89^{c}	157.83±2.59^{d}
Colour	7.00±0.24^{a}	7.00±0.24^{a}	7.12± 0.17^{a}	7.33±0.28^{a}
Flavour	6.67±0.39^{a}	6.67±0.39^{a}	6.83±0.16^{a}	6.97±0.12^{a}
Juiciness	6.00±0.24^{a}	6.67±0.39^{ab}	7.33±0.39^{b}	7.58±0.80^{b}
Tenderness	5.67±0.20^{a}	6.67±0.20^{b}	7.35±0.29^{bc}	7.58±0.35^{c}
Over all acceptability	6.42±0.35^{a}	6.58±0.19^{a}	7.42±0.30^{b}	7.76±0.16^{b}

(P<0.05); Means bearing at least one common superscript in the same row do not differ significantly.

Table 2 Effect of incorporation of different levels of barley flour on the physico-chemical and organoleptic properties of chicken meat sausages (Mean ±S.E)

Parameters	Control	Chicken meat sausages incorporated with barley flour		
		3 per cent	6 per cent	9per cent
Cooking loss %	12.78±0.13^{d}	8.55±0.13^{c}	7.21±0.14^{b}	5.77±0.50^{a}
Emulsion stability %	67.49±0.94^{a}	87.43±0.49^{b}	91.33±0.67^{c}	95.41±0.17^{d}
Water holding capacity %	55.95±0.17^{a}	59.45±0.11^{b}	64.62±0.12^{c}	67.54±0.16^{d}
Hardness (penetration value)	109.33±3.44^{a}	142.17±3.66^{b}	144.00±4.86^{b}	163.83±3.17^{c}
Colour	7.00±0.21^{a}	7.06±0.39^{a}	7.09±0.25^{a}	7.17±0.25^{a}
Flavour	6.17±0.40^{a}	7.67±0.71^{a}	7.75±0.63^{a}	7.83±0.48^{a}
Juiciness	6.75±0.31^{a}	7.67±0.56^{ab}	7.79±0.45^{ab}	8.27±0.31^{c}
Tenderness	6.83±0.17^{a}	7.83±0.17^{b}	7.77±0.25^{b}	8.33±0.33^{c}
Over all acceptability	6.25±0.44^{a}	7.92±0.33^{b}	8.00±0.22^{b}	8.32±0.06^{c}

(P<0.05); Means bearing at least one common superscript in the same row do not differ significantly.

Table 3 Effect of incorporation of different levels of oat flour on the physico chemical and organoleptic properties of chicken meat sausages (Mean±S.E)

Attributes / Parameters	Control	Chicken meat sausages incorporated with oat flour		
		3 per cent	6 per cent	9 per cent
Cooking loss %	12.78±0.13^{d}	7.38±0.14^{c}	6.93±0.05^{b}	4.94±0.07^{a}
Emulsion stability %	67.49±0.94^{a}	81.21±0.40^{b}	87.59±1.07^{c}	96.59±0.17^{d}
WHC %	55.95±0.17^{a}	60.62±0.47^{b}	65.06±0.23^{c}	71.42±1.04^{d}
Hardness (penetration values)	109.33±3.44^{a}	125.50±3.69^{b}	144.00±4.86^{c}	168.17±1.70^{d}
Colour	7.08±0.33^{a}	7.33±0.36^{a}	7.42±0.27^{a}	7.42±0.37^{a}
Flavour	6.67±0.21^{a}	7.25±0.31^{ab}	7.50±0.43^{ab}	8.00±0.26^{b}
Juiciness	6.33±0.49^{a}	7.18±0.40^{ab}	7.23±0.40^{b}	8.33±0.33^{c}
Tenderness	6.75±0.40^{a}	7.38±0.45^{ab}	7.52±0.58^{ab}	8.58±0.20^{c}
Over all acceptability	6.42±0.33^{a}	7.67±0.40^{b}	7.72±0.58^{b}	8.50±0.26^{c}

(P<0.05); Means bearing at least one common superscript in the same row do not differ significantly.

Table 4 Effect of selected levels of flours (sorghum flour at 9%, barley flour at 9% and oat flour at 9%) on the physico-chemical properties and sensory quality of chicken meat sausages (Mean ± S.E)

Attributes/ Parameters	Control	Chicken meat sausages incorporated with		
		Sorghum flour (9%)	Barley flour (9%)	Oat flour (9%)
Cooking loss %	12.78±0.13^{c}	6.09±0.46^{b}	5.77±0.50^{b}	4.94±0.07^{a}
Emulsion stability %	67.49±0.94^{a}	95.49±0.20^{b}	95.41±0.17^{b}	96.59±0.17^{b}
WHC %	55.95±0.17^{a}	66.56±0.12^{b}	67.54±0.16^{b}	71.42±1.04^{c}
Hardness (penetration values)	109.33±3.44^{a}	157.83±2.59^{b}	163.83±3.17^{bc}	168.17±1.70^{c}
Colour	6.58±0.42^{a}	7.08±0.35^{a}	7.67±0.40^{a}	7.42±0.37^{a}
Flavour	6.67±0.39^{a}	7.00±0.12^{a}	7.17±0.28^{a}	8.67±0.20^{b}
Juiciness	6.00±0.24^{a}	7.00±0.34^{a}	7.33±0.31^{b}	8.50±0.21^{c}
Tenderness	5.67±0.21^{a}	7.50±0.38^{b}	7.20±0.32^{b}	8.58±0.17^{c}
Over all acceptability	6.42±0.35^{a}	7.42±0.19^{b}	7.45±0.23^{b}	8.75±0.16^{c}

($P<0.05$); Means bearing at least one common superscript in the same row do not differ significantly

Sensory Evaluation

No significant ($P>0.05$) effect was brought about on the colour scores of chicken meat sausages by incorporating sorghum, oat and barley flours at various levels. Similar findings were noted by Hughes *et al*., [7] in frankfurters and Obula reddy [12] in chicken meat patties. Flavor scores of chicken meat sausages at 9 % oat flour secured significantly ($P<0.01$) higher values than the other flours. Addition of oat flour might have incorporated the flavour precursors into the product like alcohols and esters having appreciable odour and taste. On the contrary lower flavour scores of chicken meat sausages with sorghum and barley flours might be due to flours, which perhaps masked the meat flavour to a substantial extent. These results are in agreement with that of Obula reddy [12] in chicken meat patties and Reddy *et al*., [14] in mutton nuggets whereas juiciness and tenderness scores were significantly ($P<0.01$) higher for meat sausages incorporated with sorghum, oat and barley flours each at 9 %. Higher juiciness scores might be due to increased moisture retention of the product during cooking. Higher tenderness might be due to breakage of intra and inter molecular cross linkages between the poly peptide chains of collagen during mincing of meat. Among the flours, chicken meat sausages incorporated with oat flour at 9 % level had registered the highest ($P<0.01$) juiciness and tenderness scores. This might be due to the fact that oat flour at 9 % had bounded more water and increased moisture retention during cooking than the other flours thus makes the product more juicy and tender, besides, sorghum and barley flours had higher shrinkage during cooking resulting in some loss of juiciness. These results are in conformation with that of Devatkal *et al*., [11] in gluten-free chicken nuggets, Obula reddy [12] in chicken meat patties, Santhi and Kalaikannan [13] in low fat chicken nuggets and Reddy *et al*., [14] in mutton nuggets. Higher significant difference between different combinations of flours in the product for various parameters like flavour, juiciness and tenderness have influenced the panelists to rate high for the product and increases the overall acceptability meat sausages at 9% oat flour level.

Conclusion

The results of this study revealed that chicken meat sausages added with oat flour at 9 per cent level had recorded significantly ($P<0.01$) higher percent cooking yield, higher percent water-holding capacity, higher penetration values and better organoleptic traits viz., flavour, juiciness, tenderness and overall acceptability compared to the incorporation of other two flours and control. Hence, incorporation of oat flour at 9 per cent level in chicken meat sausages was considered to be optimum for all the desired qualities.

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