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# Comparision of fiber rich flours on value added chicken meat balls

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**Abstract**
In the present study sorghum, oat and barley flours each at 5, 10 and 15 percentages were selected to prepare value added chicken meat balls. Among different treatments, chicken meat balls with 15% oat flour produced significantly ($p<0.05$) higher cooking yield, emulsion stability, water holding capacity, penetration values, % crude fiber, moisture % with low crude fat % and better organoleptic traits than the rest of the formulations. Hence incorporation of oat flour at 15% level was considered to be optimum with all the desired qualities of value added chicken meat balls.

**Keywords:** Chicken meat balls, Sorghum, Oat and Barley flours, fiber rich value addition, Physico-chemical properties

## Introduction
Recently the attention of the nutritional experts, meat technologists and food industrialists is focussed especially on fibre rich cereals like oats, barley, sorghum etc as a value addition. Incorporation of non meat binders like sorghum, oat, barley, soy, bengal gram, corn flours, tapioca starch, whole egg liquid, etc in comminuted poultry meat products, results in improvement of their nutritional and organoleptic quality as well as reduction in the cost of production. Besides their accessibility, these cereals are interesting due to their relatively high contents of soluble non-starch polysaccharides (fibrous material). One of the food ingredients greatly used when developing nutritionally designed foods that promote health is the dietary fiber. Fiber is suitable in meat products and frequently used in meat emulsion products because it has diverse functional properties such as moisture holding capacity, gel forming ability, viscosity, solubility, provide structural integrity, volume, adhesiveness and shelf stability and has a neutral flavour with no or fewer changes in textural parameters by enhancing water binding capabilities and carries great economical advantages for both the consumers and processors. Poultry meat places a major role in human diet and suited for processing due to its specific nutritional characteristics and bland flavor and its value can be enhanced by adding fiber rich flours. Keeping in view the above facts the present study was undertaken to develop high fiber value added chicken meat balls with fiber rich flours and to evaluate the influence of these flours on the physico-chemical and sensory properties of the meat balls to arrive a suitable formulation.

## Materials and methods
The optimum level of inclusion of Sorghum flour, Oat flour and Barley flour were determined by preparing six batches of chicken meat balls incorporating three different levels viz., 5, 10 and 15 percentages of each flour and subjected them to quality analysis i.e. physico-chemical characteristics viz., cooking loss, emulsion stability, water holding capacity, hardness, proximate analysis and organoleptic evaluation. Formulation of chicken meat balls incorporated with various levels of binders were depicted in Table no 1**.**
Cooking loss was estimated by recording difference between the pre and post cooking weight of meat balls and expressed in percentage. Emulsion stability, Water holding capacity, Hardness of the product were determined as per the procedures of Townsend *et al*., (1968) [14], Weirbicki *et al.,* (1962) [15], Dixon and Parekh (1979) [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 per cent moisture, crude protein, crude fat and crude fibre were estimated as per the procedures outlined by AOAC (1994) [1]. The data thus obtained was subjected to statistical analysis using SPSS MAC, version 20.0, SPSS Chicago (US).

**Table 1:** Formulations of chicken meat balls incorporated with various levels of binders

| Ingredients (gm per cent) | Control | Chicken meat balls incorporated with | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Sorghum flour | | | Oat flour | | | Barley flour | | |
| | | 5 % | 10 % | 15% | 5 % | 10 % | 15% | 5 % | 10 % | 15% |
| Chicken meat | 77 | 72 | 67 | 62 | 72 | 67 | 62 | 72 | 67 | 62 |
| Sorghum flour | - | 5 | 10 | 15 | - | - | - | - | - | - |
| Oat flour | - | - | - | - | 5 | 10 | 15 | - | - | - |
| Barley flour | - | - | - | - | - | - | - | 5 | 10 | 15 |
| Poly-phosphates | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Sugar | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Salt | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| Spice mix | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Condiment mix | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Vegetable oil | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| Chilled water | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

**Results and discussion:** The results obtained in the current study were mentioned in the tables 2, 3, 4 and 5.

**Cooking Yield**

Chicken meat balls prepared with sorghum, oat and barley flours each at 15 % level recorded significantly (P<0.05) higher cooking yield than the same flours at 5 and 10 % levels which 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 (Reddy and Rao, 1996) [12]. Among the flours meat balls with 15 % oat flour had registered significantly (P<0.05) higher cooking yield compared to the rest of the formulations which was probably due to ability of oat hydrocolloidal fiber to create a tridimensional matrix, holding water, avoiding losses of water during cooking (Geese, 1992) [4]. The lower cooking loss with addition of extenders recorded in the present study corroborated well with the reports of Modi *et al.*, (2008) [8] in cooked and fried meat kofta, Devatkal *et al*., (2011) [2] in gluten-free chicken nuggets extended with sorghum flour, Santhi and Kalaikannan (2014) [13] in low fat chicken nuggets added with oat flour and Reddy *et al*., (2017) [9] in chicken meat sausages.

**Emulsion stability**

Chicken meat balls extended with 15 % of each flour recorded significantly (P<0.05) 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 balls extended with oat flour at 15 % level significantly (P<0.05) recorded higher emulsion stability than the other flours at 15% level. The results obtained in the study are in agreement with the reports of Govind *et al*., (2013) [5] in emu meat sausages and Reddy *et al*., (2017) [9] in chicken meat sausages.

**Water-holding capacity**

Significantly (P<0.05) higher water-holding capacity was observed in chicken meat balls extended with added flours at 15 % when compared with 5 and 10 % 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 (Reddy *et al*., 1999) [11]. Among the flours, oat flour at 15 % had significantly (P<0.05) higher water-holding capacity than the other flours each at 15 % level which might be due to the formation of more stable meat-protein-matrix which leads to a smaller release of water thus improving binding properties. The results obtained in the study are in accordance with Yang *et al.,* (2007) in low fat sausages, Modi *et al.*, (2008) [8] in meat kofta, Govind *et al*., (2013) [5] in emu meat sausages and Reddy *et al*., (2017) [9] in chicken meat sausages.

**Hardness**

Chicken meat balls extended with added flours each at 15 % secured significantly (P<0.05) higher penetration values as compared to 5 and 10 % levels of respective flour formulations. This might be due to higher level of flour retains more water, thereby increasing the penetration value (Reddy *et al*., 1999) [11]. The decrease in hardness may be associated with the water-binding and water absorption capacity of the added flours. More water binding sites become available to dissociated protein subunits upon heat treatment. Chicken meat balls extended with oat flour at 15 % level had significantly (P<0.05) higher penetration values than the meat balls extended with other flours and control. The results obtained in the study are in accordance with Yang *et al.*, (2007, 2009) [17, 16] in pork and duck meat sausages respectively, Modi *et al.*, (2008) [8] in cooked and fried meat kofta and Devatkal *et al*., (2011) [2] in gluten-free chicken nuggets and Reddy *et al*., (2017) [9] in chicken meat sausages.

**Sensory Evaluation**

No significant (P>0.05) effect was brought about on the colour scores of chicken meat balls by incorporating sorghum, oat and barley flours at various levels. Similar findings were noted by Reddy *et al*., (2017) [9] in chicken meat sausages. Coming to flavor scores, chicken meat balls at 10 % oat flour secured significantly (P<0.05) higher flavour scores than the other flours. Addition of oat flour might have incorporated the flavour precursors like alcohols and esters during cooking which have appreciable odour and taste. On the contrary lower flavour scores of chicken meat balls 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 Yang *et al.,* (2007, 2009) [17, 16] in pork and duck meat sausages respectively and Reddy *et al*., (2017) [9] in chicken meat sausages whereas juiciness and tenderness scores were significantly (P<0.05) higher for meat balls incorporated with sorghum, oat and barley flours each at 15 %. 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 balls

incorporated with oat flour at 15 % level had registered the highest (P<0.05) juiciness and tenderness scores. This might be due to the fact that oat flour at 15 % 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 Yang *et al*., (2007) [17] in low fat sausages, Modi *et al*., (2008) [8] in cooked kofta, Devatkal *et al*., (2011) [2] in gluten-free chicken nuggets, Santhi and Kalaikannan (2014) [13] in low fat chicken nuggets and Reddy *et al*., (2017) [9] in chicken meat sausages.

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 balls at 15% oat flour level.

**Proximate analysis of the chicken meat balls**

Among different treatments chicken meat balls prepared with the flours each at 15 % had significantly (P<0.05) higher moisture % and crude fiber % whereas Crude Protein % and crude fat % were significantly (P<0.05) lower at 15% of each flour than the remaining treatments and control. Among the flours oat flour at 15 % significantly secured (P<0.05) higher moisture % and crude fiber %. The higher moisture % in the obtained in the product was due to water binding properties of added oat flour which retains more moisture during cooking. Higher percentage of crude fiber might be due to higher concentration of insoluble fiber in oats than in meat (Huang *et al*., 2011 [6] in sausages prepared with wheat, oat fibers and inulin) whereas the lower percentage of crude protein and crude fat in the product were due to lower moisture losses during processing at15 % level. Among the flours oat flour at 15 % significantly secured (P<0.05) lower crude fat % than rest of formulations and control. Kerr *et al.,* (2005) [7] observed a decrease in crude protein and fat levels with increase in the levels of oat flour which may be attributed to the contribution of carbohydrates from oat flour where the protein and fat content of oats is lower than that of meat. The results obtained in the present proximate investigation were similar with findings of Yang *et al.,* (2007, 2009) [17, 16] in pork and duck meat sausages respectively, Modi *et al.,* (2008) [8] in chicken kofta respectively, Devatkal *et al*., (2011) [2] in gluten-free chicken nuggets, Santhi and Kalaikannan (2014) [13] in chicken nuggets and Reddy *et al.,* (2017) [10] in mutton nuggets.

**Conclusion**

The results of this study revealed that chicken meat balls added with oat flour at 15% level had recorded significantly (P<0.05) higher percent cooking yield, emulsion stability, water-holding capacity, higher penetration values, higher per cent moisture, crude fiber and lower per cent fat and better organoleptic traits viz., flavour, juiciness, tenderness and overall acceptability compared to the incorporation of other two flours at different levels and control. Hence, incorporation of oat flour at 15 per cent level in chicken meat balls was considered to be optimum for all the desired qualities.

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