EFFECT OF OAT FLOUR ON PHYSCICO-CHEMICAL CHARACTERISTICS OF MUTTON NUGGETS
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Abstract: Repeated trials were conducted for incorporating the oat flour at right percentage in the mutton nuggets and its effect on physico-chemical and organoleptic qualities of mutton nuggets were evaluated. Mutton nuggets were prepared with 3%, 6% and 9% with oat flour to select an optimum desirable level. Among different treatments, oat flour at 9% produced significantly (p<0.05) higher cooking yield, emulsion stability, water holding capacity, penetration values and better organoleptic traits than the rest of the formulations. The proximate analysis of the product with 9% oat flour was superior in terms of moisture and fibre and recorded low fat than rest of the formulations. Hence incorporation of oat flour at 9 percent level was considered to be optimum with all the desired qualities in mutton nuggets.

Keywords: Mutton nuggets, Oat flour, value addition, Physico-chemical properties and sensory evaluation.

Introduction

Cereals have been considered as functional foods as they are rich in dietary fiber, protein, energy, minerals, vitamins, and antioxidants required for human health. Due to change in socio economic lifestyle and urbanization, everyone is aware about the risk associated with food and demanding foods with health promoting properties like high-fiber and low-fat meat products which place a greater attention in meat industry for health aspect. Though mutton has more intra muscular fat and least fiber content, it has more demand in the Indian market due to its high biological protein, vitamins and minerals. Daily intake of dietary fiber is essential for human health. Fortifying mutton which is low in fiber content with fiber rich foods like cereals will enhance the quality of mutton. Hence, the objective of present study was to optimize the inclusion of oat flour which is rich in dietary fiber, at different levels to fortify the mutton nuggets rich in fiber.

Materials and methods

Six trials were conducted initially to know the optimum levels of inclusion of oat flour. After desired levels were identified, six batches of mutton nuggets incorporated with

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three levels viz., 3, 6 and 9 percentages were subjected to quality analysis i.e. physico-chemical characteristics viz., cooking loss, emulsion stability, water holding capacity, hardness, proximate analysis and organoleptic evaluation.

Cooking loss was estimated by recording difference between the pre and post cooking weight of mutton nuggets and is expressed in percentage. Emulsion stability, Water holding capacity, Hardness of the product were determined as per the procedures of Townsend et al., (1968), Weirbicki et al., (1962) and Dixon and Parekh (1979) 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 (1994). The data obtained in the present study were analyzed statistically as per the methods outlined by Snedecor and Cochran (1994).

Results and Discussion

The effect of incorporation of different levels of oat flour on various physico-chemical and organoleptic properties of mutton nuggets were presented in Table 1.

Cooking loss

Mutton nuggets at 9% oat flour showed significantly (P<0.05) lower cooking loss than the at 3% and 6 % which might be due to water binding capacity of the added flour that absorbs moisture from the emulsion lowering the loss of moisture during cooking (Reddy and Rao, 1996 and Serdaroglu 2006). The results of the present study were in accordance with reports of Dawkins et al., (1999) in chevon patties, Modi et al., (2008) in cooked and fried meat kofta, Alvarez and Barbut (2013) in cooked meat batters and Santhi and Kalaikanna (2014) in low fat chicken nuggets.

Emulsion Stability

Mutton nuggets extended with 9% oat flour recorded significantly (P<0.05) higher emulsion stability as compared to other two formulations which might be due to high functional properties of added flour to hold the moisture in the emulsion. The results obtained in the study are in agreement with the reports of Hughes et al., (1997) in frankfurters using oat fibre and Govind et al., (2013) in emu meat sausages prepared with oat flour.

Water-holding Capacity

Mutton nuggets at 9% oat flour has significantly (P<0.05) higher water-holding capacity than at 3% and 6% which might be due to the fact that higher level of flour retains more water, thereby increasing the water-holding capacity (Reddy et al., 1999) and also due to the formation of more stable meat-protein-matrix which leads to a smaller release of water

**Hardness**

The penetration value was significantly (P<0.05) higher in mutton nuggets extended with 9% oat flour which was due to fact that flour at 9% retains more water thus increasing the penetration value (Reddy et al., 1999). More water binding sites become available to dissociated protein subunits upon heat treatment. The results obtained were on par with studies of Yang et al., (2007, 2009) in pork and duck meat sausages respectively, Modi et al., (2008, 2009) in chicken and mutton kofta respectively.

**Sensory Evaluation**

No significant (P>0.05) effect was brought about on the colour scores of mutton nuggets by incorporating oat flour at various levels. Similar findings were noted by Hughes et al., (1997) in frankfurters and Serdaroglu and Degirmencioglu (2004) in Turkish beef meat sausages whereas flavor, juiciness and tenderness scores were significantly (P<0.05) higher for mutton nuggets at 9% oat flour. These results are in agreement with that of Garcia et al., (2002) in ground beef and low fat dry fermented sausages, Sedaroglu (2006) in beef patties, Yang et al., (2007, 2009) in pork and duck meat sausages respectively, Pinero et al., (2008) in low-fat beef patties, Modi et al., (2008, 2009) in chicken and mutton kofta and Santhi and Kalaikannan (2014) in low fat chicken nuggets. Addition of oat flour might have incorporated the flavour precursors like alcohols and esters during cooking which have appreciable odour and taste. Mutton nuggets with 9% oat flour increases moisture retention during cooking than the other treatments which enhances juiciness to product. The higher tenderness in the product is because of breakage of intra and inter molecular cross linkages between the polypeptide chains of collagen during mincing of meat. Higher significant difference between different combinations of oat flour 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 of mutton nuggets at 9% level.

**Proximate analysis of the mutton nuggets**

Among different treatments mutton nuggets prepared with oat flour at 9 per cent level had significantly (P<0.05) higher moisture % and crude fiber % whereas Crude Protein % and crude fat % were significantly (P<0.05) lower at 9% than the remaining treatments and control. The higher moisture % in the obtained in the product was due to water binding
properties of added flour which retains more moisture during cooking. Higher percentage of crude fiber was obtained in the present study which might be due to higher concentration of insoluble fiber in oats than in meat (Huang et al., 2011) 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 at higher concentration of oat flour. Kerr et al., (2005) 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 investigation were similar with findings of Yang et al., (2007, 2009) in pork and duck meat sausages respectively, Modi et al., (2008, 2009) in chicken and mutton kofta respectively and Santhi and Kalaikannan (2014) in chicken nuggets.

**Conclusion**

The results of this study revealed that mutton nuggets added with oat flour at 9 per cent level had recorded significantly (P<0.05) higher percent cooking yield, higher percent emulsion stability, higher percent water-holding capacity, higher penetration values, higher per cent moisture, crude fiber and lower per cent crude fat and better organoleptic traits viz., flavour, juiciness, tenderness and overall acceptability compared to other treatments and control. Hence, incorporation of oat flour at 9 per cent level in mutton nuggets was considered to be optimum for all the desired qualities.

**References**


**Table 1.** Effect of incorporation of different levels of oat flour on the physico-chemical and organoleptic properties of mutton nuggets (Mean ± S.E)

<table>
<thead>
<tr>
<th>Attributes / Parameters</th>
<th>Control</th>
<th>Mutton nuggets incorporated with oat flour</th>
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<tbody>
<tr>
<td></td>
<td>3 per cent</td>
<td>6 per cent</td>
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<tr>
<td>Cooking loss (%)</td>
<td>15.15±0.13&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.65±0.14&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>Emulsion stability (%)</td>
<td>85.01±0.94&lt;sup&gt;a&lt;/sup&gt;</td>
<td>89.86±0.40&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>WHC (%)</td>
<td>59.95±0.17&lt;sup&gt;a&lt;/sup&gt;</td>
<td>66.72±0.47&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>Hardness (penetration values)</td>
<td>100.73±3.44&lt;sup&gt;a&lt;/sup&gt;</td>
<td>129.90±3.69&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>Moisture (%)</td>
<td>62.76±0.27&lt;sup&gt;a&lt;/sup&gt;</td>
<td>64.52±0.31&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>Crude protein (%)</td>
<td>19.82±0.15&lt;sup&gt;a&lt;/sup&gt;</td>
<td>17.65±0.50&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>Crude fat (%)</td>
<td>14.52±0.11&lt;sup&gt;c&lt;/sup&gt;</td>
<td>12.16±0.11&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>Crude fiber (%)</td>
<td>0.75±0.01&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.20±0.15&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>Colour</td>
<td>7.48±0.33&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.43±0.36&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Flavour</td>
<td>6.69±0.71&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.45±0.35&lt;sup&gt;ab&lt;/sup&gt;</td>
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<tr>
<td>Juiciness</td>
<td>6.33±0.49&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.02±3.41&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Tenderness</td>
<td>6.75±0.40&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.18±0.45&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>Over all acceptability</td>
<td>6.42±0.33&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.67±0.40&lt;sup&gt;b&lt;/sup&gt;</td>
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(P<0.05); Means bearing at least one common superscript in the same row do not differ significantly.