Turkey (Meleagris gallopavo) occupies an important position next to chicken, duck, Guinea fowl and quail in contributing to the most evolving sector, which is playing a significant role in augmenting the economic and nutritional status of varied population. They form almost two percent of the total poultry population. They are reared for meat only and its meat is the leanest among other domestic avian species. Turkey (Meleagris gallopavo) meat is one of the white meat choice and famous for its leanness and delicacy and it contains minimal total fat and saturated fat and rich source of protein, iron, zinc, potassium and phosphorus. Regular Skinless turkey (Meleagris gallopavo) meat consumption can help in lower the cholesterol levels. Since it is low in cholesterol it is accepted by all age group. It also has better meat to bone ratio. Hence the turkey (Meleagris gallopavo) meat is used for emulsion product preparation. High fibre tends to reduce the risk of colon cancer, obesity, cardiovascular disease and other several diseases. In meat products, fibre is now being used as most common functional ingredients as fat replacer, volume enhancer, binder and stabilizer. Oats contain more soluble fiber than any other grain, resulting in slower digestion, a feeling of satiety and suppression of appetite. One type of soluble fiber, beta-glucans, has been proven to lower cholesterol. Oat fibre contains antioxidant which reduces the risk of coronary heart disease and LDL cholesterol level. Hence in this study oats was used as a wheat flour replacer in turkey (Meleagris gallopavo) emulsion based meat balls preparation.

MATERIAL AND METHODS
Six Turkey (Meleagris gallopavo) birds above one year of age were purchased from Poultry Farm Complex and slaughtered as per the standard procedure and the carcass was hygienically deboned and trimmed off all visible adipose and connective tissues. The deboned meat was minced through an 8-mm plate using a meat mincer. The oats and wheat flour were purchased from the local super market and the oats were used to incorporate to turkey (Meleagris gallopavo) meat balls at different levels.

Preparation of turkey (Meleagris gallopavo) meat ball: For the experiment trial the following basic formulation was used. The non-meat ingredients were added one and above the per cent of meat.

Physico-chemical quality parameters:
Emulsion pH: For measuring emulsion pH of the emulsion and product1, 5 g of sample was homogenized with 45 ml of distilled water by using tissue homogenizer (Polytron PT 3100, Switzerland) for about 1 minute. The pH of the homogenate was recorded by immersing combined glass electrode and temperature probe of the digital pH meter (Model 361, Systronics, India).

Emulsion stability For the estimation of Emulsion stability2-3, 15 g of turkey (Meleagris gallopavo) meat sample was weighed, packed in polyethylene bags and heated by placing in water
at 80°C for 20 minutes over a temperature controlled induction stove. Then, the fluid released was drained and meat sample was weighed. The ES calculated by the formula

\[ \text{Emulsion stability (\%)} = \frac{\text{Weight after heating}}{\text{Raw emulsion weight}} \times 100 \]

**Cooking yield:** Weights of turkey (*Meleagris gallopavo*) meat balls before and after cooking were recorded. The product yield was calculated as below

\[ \text{Cooking Yield (\%)} = \frac{\text{Weight of chicken meat balls after cooking}}{\text{Raw emulsion weight}} \times 100 \]

**RESULTS AND DISCUSSION**

The mean (± S.E.) values of physico-chemical properties of turkey (*Meleagris gallopavo*) meat balls with wheat flour (3 per cent) and oats flour at 4, 7 and 10 per cent level were presented in Table-2.

The emulsion pH was 5.72, 5.53, 5.74 and 5.72 in control, T1, T2 and T3, respectively (Table-2 and Fig.-2) and high significant (P<0.01) difference was found between the treatments and control. The emulsion pH was high in meat balls with 40% oat flour compared to other treatments. The similar pH value for meat ball incorporated with wheat bran 4. The emulsion pH was at 4 per cent level significantly higher with control. This variation in pH between treatments could be due to difference in the oats fiber level inclusion and interaction with emulsion.

The Emulsion stability was 99.0 ± 1.95, 93.27 ± 0.43, 99.35 ± 0.35 and 96.95 ± 0.43 for control T1, T2, and T3 (Table-2 and Fig.-3), respectively. A high significant (P<0.01) difference was found between the treatments. The emulsion stability was low in treatments compared to control. The emulsion stability was highest in OF at 10 per cent level and significantly (P<0.01) lower in 4, 7 per cent level. This might be due to improved water binding and water absorption by insoluble fibres 5. The cooking yield was significantly (P<0.01) higher when wheat flour was replaced by oats flour at 7 percent level.

Cooking yield was 90.28 ± 0.09, 96.49 ± 0.10, 95.97 ± 0.07 and 98.39 ± 0.06 for control T1, T2 and T3 respectively (Table-2 and Fig.-4). There was high significant (P<0.01) difference was found among the treatments and the cooking yield was high in T3 when compared to control and other treatments. As the per cent of oats increases the cooking yield was also increases. Cooking yield varied as fat percentage. The higher fiber group had a significantly higher cooking yield than other treatment groups. The lower cooking yield in control meatballs might be attributed to the excessive fat separation and water release during cooking. There is a possible connection between increasing cooking yield and higher fat retention. The addition of oat flour increased cooking yields of meatballs probably due to the ability of keep the moisture in the matrix. Keeping fat within the matrix of meat products during processing is necessary for ensuring sensory quality and acceptability. Product formulation and processing methodology are key determinants of fat loss and weight loss during cooking of products such as sausages and burgers 6. Fat retention increased with decreased fat level in meatballs.

The cooking yield has been lowered at 4 percent level this might be due to the fact that inclusion of oat fiber to turkey (*Meleagris gallopavo*) meat balls favors water binding property and fat absorption capacity by insoluble fibers present in the oats 7-10. Increasing the level of beta-glucan which is the insoluble fibres in oats 11, in cooked batters resulted in a significant reduction in cooking losses. The addition of wheat fibre to mutton nuggets at 2.5, 5.0 and 7.5 percent level improved cooking yield which might be due to the improved moisture and fat retention by the added wheat fibre as observed by them 12-13. In contrast the present findings observed no difference cooking loss between the treatments with oats.

**CONCLUSION**

The Emulsion pH, Emulsion stability and cooking yield were significantly affected by the addition of oat flour. The emulsion pH was high in T2 compared to other treatments. The Emulsion stability was low in treatments compared to control. The cooking yield was high in T3 when compared to control and other treatments. As the per cent of oats level increases, the cooking yield also increases. Based on the present findings, it is concluded that the addition of oats flour to turkey (*Meleagris gallopavo*) meat ball increased the emulsion stability and cooking yield, without any undesirable changes in the textural and sensory properties at 10 per cent level. So the final product obtained more than other treatment and economically viable. Hence this study infers that turkey (*Meleagris gallopavo*) meat
Table 1. Treatment details

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Control (g)</th>
<th>T1 (g)</th>
<th>T2 (g)</th>
<th>T3 (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lean Turkey (Meleagris gallopavo) meat</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>Vegetable oil</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Salt</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Ginger</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Garlic</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Onion</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Chicken meat-salt</td>
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<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Maida</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Wheat flour</td>
<td>30</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Oats flour</td>
<td>-</td>
<td>40</td>
<td>70</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 2. Mean (±S.E.) Physico-chemical characteristics of turkey (Meleagris gallopavo) meat balls incorporated with oats flour

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Control</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>5.72 ±0.01</td>
<td>5.53 ±0.02*</td>
<td>5.74 ±0.03</td>
<td>5.72 ±0.02*</td>
</tr>
<tr>
<td>Emulsion stability (%)</td>
<td>99.07 ±1.95</td>
<td>93.27 ±0.43*</td>
<td>99.00 ±0.35</td>
<td>96.91 ±0.43*</td>
</tr>
<tr>
<td>Cooking yield ( %)**</td>
<td>90.28 ±0.09</td>
<td>96.49 ±0.10</td>
<td>95.97 ±0.07</td>
<td>98.39 ±0.06</td>
</tr>
</tbody>
</table>

Means bearing different superscripts differ significantly

Fig.1: Flow Chart for the preparation of Turkey (Meleagris gallopavo) Meat Balls

- Minced Turkey (Meleagris gallopavo) lean meat (1000g) + 
- Salt (20g) + 
- Vegetable Oil (50g) + 
- Condiments (ginger 25g, garlic 25g and onion 25g) + 
- Spice mix (20g) + 
- Wheat flour (control = 30g) + 
- Oats flour (T1=40g, T2=70g, T3=100g) +

Emulsion, forming of meat balls.

Cooking in water (core temperature 82°C)

Fig.2. Emulsion pH

Fig.3. Emulsion Stability

Fig.4. Cooking Yield

ball can be enriched with oats flour with 10 per cent level and it can be recommended for turkey (Meleagris gallopavo) meatballs production to improve cooking properties filler especially in low fat formulations.

REFERENCES


