Introduction

Various public health and regulatory authorities have recommended reduced intake of dietary sodium chloride due to possible correlation between consumption of excess common salt and the incidence of hypertension (Law et al., 1991a, 1991b; Tuomilehto et al., 2001). Although, meat as such is relatively poor in sodium, meat products contribute significant amount of common salt in the diet. Similarly, the relationship between dietary fat and development of cardiovascular disease and hypertension has also prompted consumers to be aware of and concerned about the amount and characteristics of fat in their diet. So meat consumers are looking towards meat products that are healthier in context of sodium and added fat. As common salt and fat play beneficial role in the development of various quality attributes of meat products, it is vital to maintain these properties while developing low salt and low fat meat products.

The fat reduction can significantly affect the acceptability of a product (Giese, 1996) including an increase in the toughness of meat products (Mendoza et al., 2001). Approaches have been made to reduce salt (Gelabert et al., 2003; Ruusunen et al., 2005; Jimenez-Colmenero et al., 2005; Khate, 2007), and alter the quantity as well as quality of added fat through use of different animal fat substitutes like olive oil, walnut oil, interesterified oil and palm oil (Severini et al., 2003; Vural et al., 2004; Tan et al., 2006; Ozvural and Vural, 2008) in the meat products. Sunflower

Efficacy of Sunflower Oil Levels on the Physico-Chemical and Sensory Properties of Low Salt Functional Chicken Nuggets

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ABSTRACT

A study was conducted to standardize the optimum incorporation level of refined sunflower oil in the low salt chicken nuggets on the basis of physico-chemical and sensory properties. The refined sunflower oil was incorporated at 6%, 7% and 8% levels. Emulsion and product pH values did not differ significantly among treatments. There was gradual increase in the emulsion stability as the oil levels increased. The cooking yield increased significantly (P<0.01) with the increasing oil levels. Moisture per cent decreased significantly (P<0.01) with the increasing levels of sunflower oil, while fat per cent followed a reverse trend. Sensory evaluation revealed that incorporation of sunflower oil at higher levels resulted in non-significant increase (P>0.05) in various attributes. Although, the product with 8% added oil had better qualities, but owing to its higher fat content, 7% refined sunflower oil was adjudged as optimum for the low salt, low fat functional chicken nuggets.

Keywords: Chicken nuggets, physico-chemical properties, sensory qualities, sunflower oil

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oil can also be an alternative to animal fat in the
meat products, which is free of cholesterol. It is a
predominant source of linoleic acid (48-74%) in
triglyceride form (British Pharmacopia, 2005) and
has higher ratio of unsaturated to saturated fatty
acids, lecithin, tocopherols, carotenoids and
waxes. In this view, present study was undertaken
to determine optimum incorporation level of
sunflower oil for the development of low fat
chicken nuggets with low salt, and observe its
effects on the physico-chemical and sensory
characteristics of the product.

Materials and Methods

Dressed chicken procured from Central
Avian Research Institute, Izatnagar, Bareilly was
manually deboned. The meat was packaged in
polyethylene bags and kept overnight at 4±1°C
followed by frozen storage at -18°C till further
use. Other additives used were sodium chloride,
salt substitute blend (consisting of potassium
chloride, citric acid, tartaric acid and sucrose),
sodium hexametaphosphate, sodium nitrite, egg
white, refined sunflower oil, condiments (onion
and garlic paste), carrageenan, sodium alginate,
spice mix and refined wheat flour.

In the present study, sunflower oil at three
different levels i.e. 6% (T1), 7% (T2) and 8% (T3)
was incorporated in the pre-standardized (Table
1) low salt chicken nuggets recipe to select its
optimum level for the development of low fat,
low fat functional chicken nuggets. Meat
emulsion or batter was prepared for producing
chicken nuggets. It was obtained by chopping
the minced meat along with salt blend,
hexametaphosphate, sodium nitrite with
simultaneous addition of iceflakes. After adding
egg white, refined sunflower oil was slowly
incorporated while chopping till it was completely
dispersed in the batter. Finally, condiment mix,
carrageenan, sodium alginate, dry spice mix and
refined wheat flour were added and chopped until
uniform dispersion and desired consistency of
emulsion was achieved. Weighed quantity of
emulsion was taken and filled in stainless steel
mould. Mould was covered with lid and tied with
thread and steam cooked (without pressure) for
35 min. Chicken meat blocks so obtained were
sliced and cut into pieces to get nuggets. Quality
of nuggets with following parameter was
evaluated.

The pH of emulsion and cooked products
was determined by blending 10 g of sample with
50 ml of distilled water using an Ultra Turrax T 25
tissue homogenizer at 8000 rpm for 1 min. The
pH of the suspension was recorded by dipping
combined glass electrode of Elico digital pH meter.
Emulsion stability (ES) was determined as per
method of Townsend et al. (1968) with some
modifications. Product yield was determined by
measuring weight of emulsion and cooked meat
block and expressed as a percentage. Proximate
composition of the product was determined
following the standard procedure of AOAC (1995).
Standard sensory evaluation method using an 8-
point descriptive scale (Keeton, 1983) was
followed, where 1 denoted extremely disliked and
8 extremely liked. Data from the three trials were
compiled and analyzed for ANOVA and critical
difference using statistical software following the
standard procedure (Snedecor and Cochran,
1995).

Results and Discussion

There were no significant differences
(P>0.05) in the emulsion or product pH values
among treatments (Table 2). This was in
agreement with the results obtained by Bloukas
and Paneras (1993) in frankfurters and ground
beef patties prepared with different fat levels
(Troudt et al., 1992). The emulsion stability of
various treatments also did not differ significantly
(P>0.05). However, with the increasing oil levels,
emulsion stability slightly increased. This was in
consonance with the findings of Marquez et al.
(1989) who reported increase in emulsion stability
as final fat content in the frankfurter was
increased. Cooking yield of the products increased
### Table 1: Chicken nuggets formulation containing different levels of refined sunflower oil

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>$T_1$ (6%)</th>
<th>$T_2$ (7%)</th>
<th>$T_3$ (8%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lean meat (%)</td>
<td>75.69</td>
<td>74.69</td>
<td>73.69</td>
</tr>
<tr>
<td>Sodium chloride (%)</td>
<td>1.2</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td>Sod. hexametaphosphate (%)</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Sodium nitrite (ppm)</td>
<td>150</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Salt substitute blend (%)</td>
<td>1.26</td>
<td>1.26</td>
<td>1.26</td>
</tr>
<tr>
<td>Ice flakes (%)</td>
<td>6.5</td>
<td>6.5</td>
<td>6.5</td>
</tr>
<tr>
<td>Egg white (%)</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Refined sunflower oil (%)</td>
<td>6.0</td>
<td>7.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Condiment mix (%)</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Carrageenan (%)</td>
<td>0.75</td>
<td>0.75</td>
<td>0.75</td>
</tr>
<tr>
<td>Sodium alginate (%)</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Spice mix (%)</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Refined wheat flour (%)</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

$T_1$: Chicken nuggets with 6% refined sunflower oil; $T_2$: Chicken nuggets with 7% refined sunflower oil; $T_3$: Chicken nuggets with 8% refined sunflower oil

### Table 2: Effect of different levels of sunflower oil on the physico-chemical properties of low salt chicken nuggets

<table>
<thead>
<tr>
<th>Parameters</th>
<th>$T_1$ (6%)</th>
<th>$T_2$ (7%)</th>
<th>$T_3$ (8%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emulsion pH</td>
<td>5.65±0.03</td>
<td>5.67±0.02</td>
<td>5.64±0.02</td>
</tr>
<tr>
<td>Product pH</td>
<td>5.75±0.04</td>
<td>5.78±0.04</td>
<td>5.78±0.04</td>
</tr>
<tr>
<td>Emulsion stability* (%)</td>
<td>92.04±0.35</td>
<td>92.45±0.50</td>
<td>92.66±0.23</td>
</tr>
<tr>
<td>Cooking yield (%)</td>
<td>94.24±0.21</td>
<td>95.07±0.18</td>
<td>95.72±0.14</td>
</tr>
<tr>
<td>Moisture (%)</td>
<td>65.09±0.19</td>
<td>63.99±0.20</td>
<td>62.49±0.11</td>
</tr>
<tr>
<td>Protein (%)</td>
<td>18.83±0.53</td>
<td>18.37±0.29</td>
<td>18.05±0.23</td>
</tr>
<tr>
<td>Moisture: Protein ratio</td>
<td>3.47±0.10</td>
<td>3.49±0.05</td>
<td>3.46±0.05</td>
</tr>
<tr>
<td>Fat (%)</td>
<td>8.22±0.17</td>
<td>9.16±0.07</td>
<td>10.47±0.15</td>
</tr>
<tr>
<td>Ash (%)</td>
<td>2.74±0.10</td>
<td>2.77±0.07</td>
<td>2.67±0.19</td>
</tr>
</tbody>
</table>

$n=6$; *$n=8$; *n-values with different superscripts in the same row differ significantly ($P<0.05$).

Moisture per cent of products decreased significantly ($P<0.01$) with the increasing levels of refined sunflower oil. The cooking yield of ground beef patties increased up to 10% fat level (Berry, 1992) and that of low fat ground pork patties containing 3%, 4% and 5% pork back fat (Kumar, 2001).
increasing fat levels was also observed by Troutt et al. (1992), Marquez et al. (1989) and Papadima and Bloukas (1999) in ground beef, beef frankfurters and traditional Greek sausages, respectively. The protein percentage and moisture:protein ratio among treatments did not differ significantly (P>0.05). As expected, fat percentage of low salt chicken nuggets increased significantly (P<0.01) as the levels of refined sunflower oil increased. It could be due to better emulsifying capacity which resulted in higher fat binding. Kumar (2001) also reported similar findings in low fat pork patties using 3%, 4% and 5% pork back fat. The differences in the ash percent among treatments were non-significant (P>0.05).

The organoleptic evaluation of products revealed no significant differences (P>0.05) in the various sensory attributes of low salt chicken nuggets with different levels of refined sunflower oil (Table 3). However, general appearance, flavour, juiciness and overall acceptability scores slightly increased with the higher levels of refined sunflower oil. Marginal increase in juiciness and flavour scores with increasing levels of fat was reported by Kumar (2001) in low fat ground pork patties. An increase in intensity of certain flavour attributes such as saltiness, spiciness and smokiness have also been reported in low fat meat products (Chevance and Farmer, 1998).

On the basis of above results, it is concluded that emulsion stability, cooking yield, fat per cent and sensory attributes increased with the increasing levels of refined sunflower oil and the product with 8% refined sunflower oil had better quality. However, it had significantly higher fat per cent (10.5%) than the recommended level of 10% for the low fat meat products. Therefore, 7% refined sunflower oil was adjudged as optimum for the development of low salt, low fat functional chicken nuggets.

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References


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