Comparative study on quality evaluation of buffalo meat slices incorporated with finger millet, oats and chickpea

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ABSTRACT
Studies were conducted on the development of buffalo meat slices incorporated separately with chickpea, finger millet and oats. Levels of these ingredients were kept at 4%. The control was prepared using meat only. The slices were cooked in steam and the samples were packed in polyethylene bags and stored at -5°C for storage study. The physicochemical qualities like moisture, protein, fat, carbohydrate, ash, cholesterol content, pH and microbiological qualities like total plate count (TPC), and yeast & mold (Y&M) count were studied in fresh and refrigerated storage (-5°C) conditions after every 20 days of interval. It was found that incorporation of the chickpea, finger millet and oats resulted in a decrease in the moisture content and an increase in pH. The highest protein content was found in chickpea incorporated samples while control sample had the highest value of moisture content. During storage, it was found that chickpea incorporated samples had the highest TPC values while Y&M was found to be the highest in control sample. The samples were in edible condition even after 120 days of storage.

Keywords: Buffalo meat; Finger millets; Oats; Chickpeas; and Meat slices.

INTRODUCTION
A buffalo meat is a major and cheapest source of protein in India, especially for those consuming a non-vegetarian diet. It is also a major source of healthy iron in the Indian diet. Research and the launch of new meat products is designed to providing healthy alternatives to promote meat industry and wipe unfortunate image drives mainly from the high fat content, saturated fatty acids, and cholesterol and their association with cardiovascular diseases, some types of cancer, obesity, and so forth [1].

Regarding meat products, efforts are mainly directed toward their reformulation by modifying the lipid and fatty acid content, and/or by adding a series of functional ingredients (fiber, vegetal proteins, monounsaturated or polyunsaturated fatty acids, vitamins, calcium, phytochemicals, and so forth) [2]. Meat and meat products are essential for a balanced diet, although it must also be remembered that they are susceptible to modifications to give them a “healthier” appearance. Other non meat additives used as fillers/binders include wheat flour in chicken nuggets [3], texturized soy protein in chicken kebab [4], cowpea and peanut flour in chicken nuggets [5], Bengal gram flour and maida in chicken patties [6], and green and black gram flours in buffalo meat burger [7].

Ragi or finger millet (Eleusine coracana) is a low-cost cereal and is a rich source of calcium, iron and phosphorous. It contains a good balance of amino acids [8]. Chickpeas are high in protein and a helpful source of zinc and folate. It is also very high in dietary fibers and hence a healthy source of carbohydrates for persons with insulin sensitivity or diabetes. Chickpeas are low in fat and most of this is polyunsaturated. Recent studies by government agencies have also shown that they can assist in lowering of cholesterol in the bloodstream. Oats (Avena sativa L.) is a typical cereal containing β-glucans, which have an effect on blood cholesterol levels and control of lipoprotein metabolism [9,10,11]. The object of this paper is to evaluate the effect of adding functional ingredients such as chickpea, finger millet and oats on the physicochemical, microbiological and sensory characteristics of buffalo meat slices.

MATERIALS & METHODS
The preparation of buffalo meat slices incorporated with chickpea, finger millet and oats are the same and the composition selection of all the ingredients are mentioned in Table 1 on the basis of preliminary organoleptic trails. These ingredients were weighed and mixed properly, wet-ground and prepared in the form of dough, which was filled in stainless steel brick shaped moulds.
Table 1: Ingredients of buffalo meat slices incorporated with chickpea, finger millet and oats

<table>
<thead>
<tr>
<th>S.No</th>
<th>Ingredients</th>
<th>Control</th>
<th>Chickpeas based</th>
<th>Finger millet</th>
<th>Oats based</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Buffalo lean meat</td>
<td>540g</td>
<td>540g</td>
<td>540g</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Chickpea</td>
<td>400g</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>3</td>
<td>Finger millet</td>
<td>--</td>
<td>400g</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Oats</td>
<td>--</td>
<td>--</td>
<td>400g</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Big cardamom</td>
<td>4g</td>
<td>4g</td>
<td>4g</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Cinnamon</td>
<td>3g</td>
<td>3g</td>
<td>3g</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Black pepper</td>
<td>3g</td>
<td>3g</td>
<td>3g</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Garlic paste</td>
<td>5g</td>
<td>5g</td>
<td>5g</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Ginger paste</td>
<td>5g</td>
<td>5g</td>
<td>5g</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Turmeric powder</td>
<td>6g</td>
<td>6g</td>
<td>6g</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Red chilly powder</td>
<td>14g</td>
<td>14g</td>
<td>14g</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Table salt</td>
<td>20g</td>
<td>20g</td>
<td>20g</td>
<td></td>
</tr>
</tbody>
</table>

Note: not added (--)  

Physico-chemical analysis

pH measurement  
For pH measurement of meat sample, 10g of minced meat was homogenized in 50ml distilled water in a waring blender (Yorco, India). The homogenate was transferred to a clean beaker and the pH of the suspension was measured using digital pH meter (Thermo Orion, USA).

TBA number was measured according to the method of Strange et al. [12]. Moisture ash and fat contents were estimated following the AOAC, 1995 method [13] and protein content was determined by the standard method of Raganna [14].

For total cholesterol and HDL cholesterol the reagents used were Sulfuric acid, ethyl acetate, ferric perchlorate and cholesterol reagent. The total cholesterol and HDL cholesterol were estimated according to Wybenga et al. [15].

Calculations

1. Total cholesterol insample mg / dl = \( \frac{O.D_{Test}}{O.D_{Std}} \times 200 \)

2. Total cholesterol insample mg / dl = \( \frac{O.D_{Test}}{O.D_{Std}} \times 50 \)

Microbiological Analysis

The bacterial and fungal counts were determined and presented as described by APHA [16].

RESULTS & DISCUSSION

Physicochemical properties of dog food samples

pH: Figure 1 shows the pH of buffalo meat slices samples developed by 4% finger millet, oats and chickpea incorporated meat slices. The physico-chemical parameters such as pH were examined and its impact on meat slices are presented in Figure 1. The pH of the control sample was 6.64 where as the pH of 4% finger millet, oats and chickpea incorporated buffalo meat slices samples were 6.4, 6.7 and 6.61 respectively. During the storage study of 120 days, pH value of control sample was increased, while finger millet, oats and chickpea incorporated buffalo meat slices samples were slightly increased with increasing storage period.

Moisture content: Figure 2 Shows the effect of finger millet, oats and chickpea incorporation on the moisture content of developed meat slices. It may be noted that moisture content of control sample was 59.72% where as that of finger millet, oats and chickpea developed meat slices were 51.88, 50.48 and 48.88...
respectively. The control sample had the highest value of moisture content. During 120 days storage, the moisture content increasing with increasing storage period.

**TBA values:** The TBA value of buffalo meat slices developed by incorporation of finger millet, oats and chickpea. It may be noted that TBA values of control sample on day one was 0.31 and after 120 days the value reached to 0.79. The marginal increase in value was obtained in order; the following finger millet, oats and chickpea respectively. During the shelf life study it was observed that up to 120 days of storage, the product was found in good condition. The result is presented in Figure 3. This increasing trend in TBA values indicated that all the samples may be less stable in atmosphere packaging system.

**Ash content:** Figure 4 shows the effect of finger millet, oats and chickpea incorporated buffalo meat slices on the ash content. It may be noted from the results that the ash content of control sample was 2.3% where as the corresponding values for finger millet, oats and chickpea were 4.4%, 3.9% and 3.4%. Finger millet shows higher ash content values as it has higher mineral contents than oats and chickpea respectively.

**Protein content:** Figure 5 shows the effect of incorporation of finger millet, oats and chickpea in varying quantities on the protein content of buffalo meat slices. It may be noted that protein content of control meat slices was 21.38% and during the storage period of 120 days it was marginally decreased to 21.32%. The initial value of protein content of finger millet, oats and chickpea incorporated of buffalo meat slices 18.41, 16.40 and 26.4 respectively. Chickpea incorporated of buffalo meat slices shows highest value of protein content.

**Fat content:** Figure 6 shows the effect of incorporation of finger millet, oats and chickpea in varying quantities on the fat content of buffalo meat slices. It may be noted that fat content of control meat slices was 16.35 and after 120 days storage it was reached to 16.23%. Oats incorporated of buffalo meat slices shows lowest value of fat content than finger millet and chickpea.

**Cholesterol content:** It was observed that the control meat slices showed the highest cholesterol value of 21.1 mg/dl on day 1 of storage. The finger millet, oats and chickpea fortified meat slices showed 5.6 mg/dl, 4.2 mg/dl and 7.1 mg/dl respectively. The oats showed the lowest cholesterol content in all the developed samples.

**Microbiological analysis**

**Total plate counts (TPC)**

The influence of buffalo meat slices control sample, finger millet, oats and chickpea samples on the total plate counts (TPC) was determined. The data presented in Figure 7 reveals that the cereal or millet addition and storage conditions exert an impact on the microbial quality of developed buffalo meat slices. After 120 days of storage, the TPC for the control samples was 3.82 x10^3 CFU/g. The chickpea incorporated buffalo meat slices showed higher total plate count than finger millet and oats respectively which increased on further storage.

**Yeast and mold counts:** In addition to bacterial counts, the yeast and molds have also been enumerated in stored finger millet, oats and chickpea incorporated buffalo meat slices. The data presented in Figure 8 indicate that storage of control and different flour incorporated buffalo meat slices under refrigerated condition favours the growth of yeasts and molds counts. The fungal population in control samples was 2.13 x 10^3 CFU/g and it increased with increasing storage period. The finger millet, oats and chickpea incorporated samples showed very low levels of contamination (Figure 8). The most frequent mycotic fungi growths occurred in control sample. Yeasts were not present in any sample. The highest Y&M was found in control meat slices. Some species of fungi is cold tolerant and heat tolerant which indicate that growth can occur at either low or high temperatures, but is not optimal. Thus, some mesophilic fungi may be able to grow or at least survive at either low or high temperatures, depending on the environmental and nutrition conditions.
CONCLUSION
Based on the above results, the following conclusions can be drawn:
A control buffalo meat slice which were prepared without fortification of any cereal or millet flour. The fortification with finger millet, oats and chickpea in the development of buffalo meat slices could impart multi-pronged beneficial attributes together with a host of beneficial physiological effects. Keeping in view the many promising health effects, such food adjuncts could be regarded as ‘neutraceuticals’, which makes the food healthier.
Thus, among the processed meat slices with fortification have the advantage of a longer shelf life (120 days) and low cost of processing. The longer shelf life of these products at refrigerated temperature and good nutritive/medicinal values may add great convenience to many meat consumers. Finger millet, oats and chickpea incorporated samples are lower in fat and higher in protein content and ash content, which indicates that the finger millet, oats and chickpea incorporated samples are rich in mineral source in comparison to control samples.

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REFERENCES