Utilization of Sugar Beet Pulp in Meatballs Preparation
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INTRODUCTION
Several efforts have been done in order to get better the stability and quality of meat products such as minced meat, hamburgers, finger, and so on. The socio-economic changes factors (like the increment in the number of working women) have caused an increment in the preference of consumer for fast foods or ready to eat (Reddy and Vani, 2017). Fat considered as an important part of grind meat products and contributes to the flavour and structure. The main trouble in the acceptance of low-fat meat products is reducing the acceptance as a function for fat reduction (Gois et al., 2017; Khursheed et al., 2017). Various investigations have been done on fat replacer for improving the quality properties of low-fat ground meat products (Hashem and Jahan, 2016).

The beet pulp is a sugarless and high fibrous substance which is generated after extraction of sugar from sugar beet (Beta vulgaris L.). Pulp is a good feed for livestock and provides minerals, carbohydrates, and proteins. Sugar beet pulp is about 4 - 6% beetroots (Chen et al., 2015). Dietary fiber daily intake is recommended to be 25-35 grams. It is difficult to obtain this dietary fiber content by eating foods containing fiber. In this case, the beet pulp additive is a very good solution (Li et al., 2014), There are a different in sugar beet fiber structures in comparison with grain fibers, they do not have phytic acid and hence there is no inhibition in the absorption of minerals also, having a high water holding capacity (WHC) (Wang et al., 2016).

Sugar beet pulp contains a high levels of bioactive compounds such as dietary fibers, minerals (i.e., zinc, magnesium, phosphorus) and polyphenols (Ferulic and p-cumaric acid) (Aarabi et al., 2015). Meatball (koefte) is mainly made of minced meat (lamb and beef), fats, different spices mixture and wet bread (Yılmaz, 2004). Rusk and wet bread are the main binder and filler types usually used in preparation of meatballs (koefte) formula. This study was carried out to utilize beet pulp with different ratios (3, 10%) as fat replacer in preparation of meatballs. The quality attributes of the produced meatballs were studied.

MATERIALS AND METHODS

1. Materials:
Sugar beet pulp was obtained from Delta sugar factory. The sugar beet pulp was dried, powdered and sieved. Beef meat and other components used for burger preparation were obtained from local market at Kafr El-Sheikh city, Egypt.

2. Meatballs preparation
The beef burger was formulated to contain the following ingredients 65% red minced beef meat, 20% kidney fat, 10% (w/w) water (ice), 7.5% starch, 1.5% (w/w) salt and , 2.5% spices mixture according to Kobus-Cisowska et al. (2014). The aforementioned ingredients were used to prepare the control sample while 25 and 50% of control fat content were replaced by sugar beet pulp powder to prepare meat balls supplemented with sugar beet pulp powder as a fat replacer.

3. Proximate chemical composition
Chemical composition of sugar beet pulp powder and meatballs samples (moisture, crude protein, ether extract and ash) was estimated using A.O.A.C. (2010) methods, where total carbohydrates were determined by difference (Petersson et al., 2014).

4. Water holding capacity and fat holding capacity of raw materials
Oil binding capacity (OBC) and water holding capacity (WHC) of sugar beet pulp powder was measured using a modified method of Turgut et al. (2016).

5. Sensory evaluation:
The cooked meatballs were evaluated for its color, taste, texture, aroma and overall acceptability on a 1 to 10 hedonic scale as described by Badr and El-Waseif (2017).

6. Quality properties of cooked meat balls:
Cooking loss (%), cooking yield(%), Water Holding Capacity (WHC) and pH values of cooked meatballs were determined using the methods described by Kobus-Cisowska et al. (2014).

3. Statistical analysis
Statistical analysis was carried out using one – way analyses of variance, ANOVA Steel et al. (1980).
RESULTS AND DISCUSSION

1. Chemical composition, OBC and WHC of sugar beet pulp powder

The data given by the chemical analysis of sugar beet pulp powder showed that moisture, ash, protein, crude fiber, fat, total dietary fiber and carbohydrates were 6.30, 4.80, 9.86, 21.98, 0.66, 53.64 and 62.70%, respectively (Table 1). These results are in agreement with those reported by Yapo et al. (2007) and Mohdaly et al. (2010). They stated that ash, protein, crude fiber, fat, and carbohydrates were (2.80 - 5.63%), (8.40 - 10.20%), (16.24 - 23.80%), (0.50 - 1.32%) and (55.18 – 64.22%), in this order.

Data in the same table cleared that OBC and WHC of sugar beet pulp powder were 1.69 and 3.2 g/g, respectively. From the same table it could be noticed that, water holding capacity value of sugar beet pulp powder was higher than oil bending value capacity. These results were in the same line with Wang et al. (2016).

2. Sensory evaluation of prepared meatballs

The results about sensory scores of meatballs integrated with sugar beet pulp powder were tabulated in Table 2. Those data stated that adding sugar beet pulp powder decreased the sensory properties of meatballs. With the increment of adding levels of sugar beet pulp the decrement in sensory attributes was increased. Generally all tested samples were accepted from the point of view of consumers.

Table 1. Gross chemical composition, OBC and WHC of sugar beet pulp powder.

<table>
<thead>
<tr>
<th>Chemical Composition</th>
<th>Sugar beet pulp powder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture (%)</td>
<td>6.3</td>
</tr>
<tr>
<td>Ash (%)</td>
<td>4.8</td>
</tr>
<tr>
<td>Crude protein (%)</td>
<td>9.86</td>
</tr>
<tr>
<td>Crude fiber (%)</td>
<td>21.98</td>
</tr>
<tr>
<td>Fat (%)</td>
<td>0.66</td>
</tr>
<tr>
<td>Dietary Fiber (%)</td>
<td>53.64</td>
</tr>
<tr>
<td>*Total carbohydrate (%)</td>
<td>62.70</td>
</tr>
</tbody>
</table>

Physical properties

| OBC (g/g) | 1.69 |
| WHC (g/g) | 3.2  |

*Total carbohydrates were calculated by difference

Total carbohydrates = 100 – (protein+ ether extract + Ash + crude fiber)

Table 2. Sensory evaluation of meatballs samples integrated with different levels of sugar beet pulp.

<table>
<thead>
<tr>
<th>Meatball samples</th>
<th>Taste</th>
<th>Color</th>
<th>Odor</th>
<th>Texture</th>
<th>Appearance</th>
<th>Overall acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>9.0a</td>
<td>9.0b</td>
<td>8.6a</td>
<td>8.6b</td>
<td>8.7b</td>
<td>8.8b</td>
</tr>
<tr>
<td>Meatballs with 5% sugar beet pulp</td>
<td>7.9b</td>
<td>7.5b</td>
<td>6.5b</td>
<td>8.1b</td>
<td>7.9b</td>
<td>7.6b</td>
</tr>
<tr>
<td>Meatballs with 7.5% sugar beet pulp</td>
<td>7.1b</td>
<td>7.0b</td>
<td>6.3b</td>
<td>8.1b</td>
<td>7.4b</td>
<td>7.2b</td>
</tr>
</tbody>
</table>

Mean followed by different letters in the same column differs significantly (P ≤ 0.05).

3. Quality attributes of cooked meatballs:

Cooking loss and cooking yield of differently prepared meatball samples contained sugar beet pulp powder as fat replacer with the ratio of 25 and 50% of animal fat used were presented in Table (3).

Table 3. Cooking quality of meatball sample integrated with different levels of sugar beet pulp

<table>
<thead>
<tr>
<th>Meatball samples</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cooking yield (%)</td>
</tr>
<tr>
<td>Control</td>
<td>81.07</td>
</tr>
<tr>
<td>Meatballs with 5% sugar beet pulp</td>
<td>84.35b</td>
</tr>
<tr>
<td>Meatballs with 7.5 % sugar beet pulp</td>
<td>86.01a</td>
</tr>
</tbody>
</table>

Where, WHC is water holding capacity

Values followed by the same letter in the same column are not significantly different at P ≤ 0.05.

It could be noticed that cooking loss and cooking yield of prepared samples were significantly different (p ≤ 0.05) and in the same time there was a decrement in cooking loss and increment in cooking yield as the level of sugar beet pulp powder was increased. Lowest cooking loss (highest cooking yield) was noticed for made meat ball samples by substituting animal fat with 25 and 50% of sugar beet pulp powder, as their values of cooking yield were 94.35 and 86.01%, respectively, this may be due to sugar beet pulp powder was able to hold excess water (Huang et al., 2005).

The cooking properties of meat products could be affected by the functional characteristics of nonmeat ingredients (WHC and OBC) and their effects in the water holding capacity of the final product. Therefore, the WHC of differently prepared meatball samples was evaluated and the results were shown in Table (3). It could be noticed the positive effect of sugar beet pulp powder used as fat replacer with the ratio of 25 and 50% of animal fat. The WHC of meatball samples contained sugar beet pulp powder was significantly higher (p ≤ 0.05) (2.80 and 3.20g/g, respectively) than the WHC value of control meatball samples (100% animal fat) (1.49 g/g). Data in the same table stated that pH values of cooked meatballs were not influenced by the levels of substitutions. In all meatballs, the values of pH were within the range of the optimal values (5.5 to 6.7) according to Serdaroglu and DeÎ¿irmencioÎ¿lu (2004). The changes in these attributes may be due to the addition of sugar beet pulp which caused an increment in cooking yield and water holding capacity.

4. Chemical composition of prepared meatballs:

The chemical composition of prepared meatballs regarding moisture, crude protein, crude fat, and ash are displayed in Table 4. The results in Table 4 appeared a gradually increasing in meatball content of moisture, protein, crude fibre and ash as a function for levels of sugar beet pulp powder increment until reach to 50%. The moisture, protein, crude fibre and ash contents of meatballs were gradually increased from 62.30 to 65.38%, from 18.53 to 19.34%, from 1.28 to 3.20 % and from 2.30 to 2.35% respectively, as a function for increasing the amounts of sugar beet pulp powder. Also, data in the same table cleared that substitution of 25% and 50% fat with sugar beet pulp powder reduced gradually fat content of the prepared meatballs from 19.46 % to 11.16%. These results agreed with those of Martinez-Cervera et al. (2012).
Table 4. Proximate chemical composition of meatball sample integrated with different levels of sugar beet pulp (g/100 g on dry weight basis)

<table>
<thead>
<tr>
<th>Meat ball samples</th>
<th>Moisture</th>
<th>Crude protein</th>
<th>Ether extract</th>
<th>Ash</th>
<th>Crude fiber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>62.30a</td>
<td>18.53a</td>
<td>19.46b</td>
<td>2.30ab</td>
<td>1.28ab</td>
</tr>
<tr>
<td>Meatballs with 5% sugar beet pulp</td>
<td>64.25a</td>
<td>19.08a</td>
<td>13.39a</td>
<td>2.75ab</td>
<td>2.60ab</td>
</tr>
<tr>
<td>Meatballs with 7.5% sugar beet pulp</td>
<td>65.58a</td>
<td>19.34a</td>
<td>11.16a</td>
<td>2.90b</td>
<td>3.20b</td>
</tr>
</tbody>
</table>

Values followed by the same letter in the same row are not significantly different at P ≤ 0.05

CONCLUSION

Finally, it could be concluded that using of sugar beet pulp powder have proved to be effective as a fat replacer in producing low fat meat balls samples. The application of different aforementioned fat replacer improved the physical (WHC) and cooking characteristics (cooking yield and cooking loss) of prepared meat ball samples without any negative effects on the sensory characteristics.

REFERENCES


Serdaroğlu, M., and Değirmencioglu, Ö. (2004). Effects of fat level (5%, 10%, 20%) and corn flour (0%, 2%, 4%) on some properties of Turkish type meatballs (kofte). *Meat science* 68, 291-296.


الاستفادة من مسحوق ب بنتج السكر في إنتاج كرات لحم منخفض السعرات الحرارية

رويدا يونس عيسى و ساهر مامون أبراهيم مصطفى

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"ництпокт.ан, нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйшткпс нпйش يتكپس.

تم إجراء هذا البحث لتقييم كفاءة استخدام مسحوق ب بنتج السكر كجزء من الدهون على كفاءة لحوم البرتقال المخصصة للدهون. حيث تم استعمال مسحوق ب بنتج السكر كجزء من الدهون على 50% من الدهون الجوفية المستخدمة بعد طهي البرتقال. تم إجراء تحليلات كيميائية وتقنية على 샾ك إل ب كي وinating ابتج (WBC) في مسحوق ب بنتج السكر. والمسحوق مع طبقات البرتقال. وقد أظهرت النتائج أ قد حدث زيادة في معامل الطبع النهائية لراتنجات الحوم عن 9.55 إلى 9.81٪. ورغم ذلك، لم يتم فحص النتائج أيضًا لأنه لا يوجد فرق معين في التراكيب المرتبطة بين بنجات النورة الباهتة في البرتقال والبرتقال. كما أصبحت النتائج أيضًا أنه يمكن استخدام مسحوق ب بنتج السكر كجزء من الدهون في حضور النورة الباهتة في البرتقال لتنقيح النتائج دون أي تأثير سلبي على التراكيب المرتبطة بين بنجات النورة الباهتة في البرتقال. 119