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Utilization of Sugar Beet Pulp in Meatballs Preparation

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ABSTRACT

This investigation was done to assess the quality attributes of reduced fat meatballs as influenced via sugar beet pulp powder addition. The prepared samples of meatball which contained sugar beet pulp powder as a fat replacer with the ratio of 25 and 50 % of animal fat utilized after cooking. Chemical composition, oil holding capacity, and water holding capacity (WHC) of raw materials was studied. The cooking attributes, WHC and sensory characteristics of the made meatball samples were estimated. The cooking yield of meatball samples was increased from 81.07 to 86.01%. While cooking loss of the meatball samples was decreased. No significant difference ($p \geq 0.05$) in sensory properties between control meatball sample and the prepared meatball samples. sugar beet pulp powder could be utilized as fat replacer within the different studied percentages in meatball samples preparation without any negative effects on the sensory attributes of the final product.

Keywords: Meatballs, Sugar beet pulp, Quality characteristics and Fiber

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., znic, 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 capacity value. 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 Table2. 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.

Chemical Composition	Sugar beet pulp powder
Moisture (%)	6.3
Ash (%)	4.8
Crude protein (%)	9.86
Crude fiber (%)	21.98
Fat (%)	0.66
Dietary Fiber (%)	53.64
*Total carbohydrate (%)	62.70
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 meat ballsamples integrated with different levels of sugar beet pulp.

Meatball samples	Sensory properties (0 - 10)					
	Taste	Color	Odor	Texture	Appearance	Overall acceptability
Control	9.0[a]	9.0[a]	8.6[a]	8.6[a]	8.7[a]	8.8[a]
Meatballs with 5% sugar beet pulp	7.9[b]	7.5[b]	6.5[b]	8.1[b]	7.9[b]	7.6[b]
Meatballs with 7.5% sugar beet pulp	7.1[b]	7.0[b]	6.3[b]	8.1[b]	7.4[b]	7.2[b]

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 meat ball sample integrated with different levels of sugar beet pulp

Meatball samples	Properties			
	Cooking yield (%)	Cooking loss (%)	WHC (g/g)	pH
Control	81.07[c]	18.93[a]	1.49[c]	5.93[a]
Meatballs with 5% sugar beet pulp	84.35[b]	15.65[b]	2.80[b]	6.02[a]
Meatballs with 7.5 % sugar beet pulp	86.01[a]	13.99[c]	3.20[a]	6.05[a]

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 ($p \leq 0.05$) 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 84.35 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 ($p \leq 0.05$) (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 Serdaroğlu and Değırmencioğlu (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 to19.34%, 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 meat balls 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)

Meat ball samples	Component%				
	Moisture	Crude protein	Ether extract	Ash	Crude fiber
Control	62.30^{c}	18.53^{b}	19.46^{a}	2.30^{b}	1.28^{c}
Meatballs with 5% sugar beet pulp	64.25^{b}	19.08^{a}	13.39^{b}	2.75^{ab}	2.60^{b}
Meatballs with 7.5 % sugar beet pulp	65.58^{a}	19.34^{a}	11.16^{c}	2.90^{a}	3.20^{a}

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 ball 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.

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الإستفادة من مسحوق لب بنجر السكر في إنتاج كرات لحم منخفض السعرات الحرارية

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تم إجراء هذا البحث لتقييم تأثير إستبدال مسحوق لب بنجر السكر بجزء من الدهن علي خصائص الجودة لكرات اللحم المخفضة الدهون. حيث تم إستبدال مسحوق لب بنجر السكر كبديل للدهون بنسبة ٢٥ و ٥٠٪ من الدهن الحيواني المستخدم بعد الطهي. تمت دراسة التركيب الكيميائي والقدرة على ربط الزيت والطاقة الاستيعابية للماء (WHC) لمسحوق لب بنجر السكر. وقدرت صفات الطبخ ، WHC والخصائص الحسية لعينات كرات اللحم المصنوعة. و قد أظهرت النتائج أه قد حدث زيادة في قيم ناتج الطبخ النهائي لكرات اللحم من ٨١.٠٧ إلى ٨٦.٠١٪. بينما انخفض فقدان الطهي لعينات كرات اللحم. كما أوضحت النتائج أيضا انه لا يوجد فرق معنوي في الخصائص الحسية بين عينة كرات اللحم الضابطة (الكنترول) وعينات كرات اللحم المحضرة. كما أوضحت النتائج أيضا أنه يمكن استخدام مسحوق لب البنجر السكري كبديل للدهون في حدود النسب المدروسة المختلفة في تحضير كرات اللحم بدون أي آثار سلبية على الخصائص الحسية للمنتج النهائي.