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Effect of Concentrations of Basil Seed Gum on the Sensory Properties of Chicken Sausage

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Abstract: Chicken meat is a low-fat, high-protein food that is increasingly growing in popularity around the world. Therefore, various food ingredients have been added to improve the characteristics of the chicken sausage. Among them, Basil seed gum (BSG) was extracted, and the effect of adding it in percentages of 0.5, 1.0, 1.5, and 2.0 % was studied as- a partial replacement- for animal fat in processed sausages and its effect on the proximate composition, sensory and quality characteristics of chicken sausages. The yield of gum extract was 17.5% on a dry-weight basis. Moreover, the results of analyzing the proximate composition of prepared sausage showed an increase in the moisture, protein, and ash percentage. However, the percentage of fat, carbohydrates, and caloric value in them decreased. The results also showed increased water holding capacity, emulsion stability, and cooking yield in the prepared sausages. In contrast, the percentage of cooking loss and loss of thaw loss decreased. It was also noted that the peroxide value, free fatty acids, and cholesterol decreased by increasing the concentration of gum added, up to 2%. Besides that, the addition of gum concentrations resulted in a clear improvement in the sensory characteristics and acceptability of the assessor, especially colour, tenderness, juiciness, and overall acceptability. It can be concluded from this research that the possibility of using BSG as a fat replacer to manufacture low-fat chicken sausages, which contributes to reducing the cost of sausage mixtures and giving a healthy, low-calorie product.

Keywords: Chicken sausage, Functional properties, Plant gum, Sensory evaluation.

Introduction

Meat is a good source of protein due to its nutritional properties and its desirable taste and flavor. The highest consumption of white meat, including poultry meat, has increased in demand worldwide. Besides, its popularity has increased due to its cheap prices and nutritional properties and being for consumers in developed countries, an excellent source of animals (Saengphol & Pirak, 2018). The sources of meat used in processing differ in different countries and the sources of their livestock. Climatic conditions, food traditions, religious beliefs, economic level, and technical development play the main role in this variation (Capita *et al.*, 2006). For thousands of years, the sausage industry has relied on red meat. However, during the last two decades of the twentieth century, thinking began about introducing poultry meat into the sausage industry (Carballo, 2021).

The consumption of meat products such as sausages, whether chicken or beef sausages, is increasing due to the lifestyle development, but these traditional products lack dietary fibre, unsaturated fatty acids, essential fatty acids, antioxidants, and phenolic compounds (Pateiro *et al.,* 2018). Consumers prefer new types of products with good nutritional, health, and sensory characteristics. Ghafouri-Oskuei *et al.* (2019) prepared healthy beef sausages fortified with flaxseed and tomato powder.

Chicken meat has a high protein content and a low fat content, with a high proportion of unsaturated fatty acids and a low carbohydrate content. Also, chicken meat contains less saturated fat and cholesterol than beef and pork, which faces religious determinants for its consumption (Jo *et al.,* 2018). Thus, chicken meat is considered healthy for the consumer, and chicken meat and its products occupy a permanent place in the human diet due to the high quality of protein and its content of essential amino acids as well as being an excellent source of vitamin B, minerals and nutrients (Jung *et al.,* 2015).

The production of sausage from chicken meat only in Britain constitutes between 8-15% of the total production. Most of these products belong to the processed meat coated with high moisture and economic return and short shelf life such as mortadella and tinned hot dog sausages. Recently the emulsion system can be used to manufacture of healthy meat products that contain beneficial fatty ingredients such as unsaturated fatty acids such as EPA and DHA (Carballo, 2021).

Long-chain hydrophilic polymers with a high molecular weight are known as hydrocolloids, and are not surfactant compared to proteins that have strong hydrophilic and hydrophobic regions (Huang *et al.,* 2001). However, several protein-forming units were observed in the hydrophilic region of hydrocolloids. The most important hydrocolloids are sulfated galactans, such as agar (AG) and κ -carrageenan (κ -Car). In addition, uronic acid-based polymers like high methoxylated pectin (HMP), alginate (ALG), cellulosic-based gums like carboxymethylcellulose (CMC), xanthan (XG), galactomannans like guar (GG), and cress seed gum (CSG). Then there is sage seed gum (SSG), glucomannans like basil seed gum (BSG), and xanthan gum (XAG). CMC, GG, and XG are distinguished by providing stability and thickness, while AG, κ-Car, ALG, and HMP are gelling in food and pharmaceutical applications (Alghooneh *et al*., 2019). Carob gum was rich in bioactive compounds, in addition, it has antioxidant activity (Al-Ameri & Nasser, 2021).

BSG is a negatively charged anionic glucomannan consisting of two large molecules of different molecular weight PER-BSG (6000) and super-BSG (1045kDa) and consisting of D-glucose, D-galactose, D-mannose, L-arabinose, D-xylose, and L-rhamnose in approximate ratios 5:15:15:10: 25:25 (Naji-Tabasi & Razavi, 2017b).

Hydrocolloids are one of the main replacements in low-fat processed meat products. The ability of these compounds to alter the rheological and functional properties of food products makes them very preferred in the food industry. Many hydrocolloids have been introduced into meat products as fat reducing agents, for example, κ-Car and GG as fat replacers in meatballs (Ulu, 2006). Yousefi *et al.* (2018) prepared a low-fat burger by adding quince seed gum.

Basil is grown in warm regions such as Africa, Asia (India, and Iran), and Central and South America, while its leaves are used as a flavoring agent to give flavor to food. BSG is extracted from the *Ocimum basilicum* L. seeds and takes the form of random coil conformation. The gum exhibits functional properties such as emulsification, thickening, stabilizing, fat replacer, ice crystals growth-inhibiting, encapsulating properties, binding, and a surface-active material (Osano *et al.*, 2014; Naji-Tabasi & Razavi, 2017a). BSG consists of two main parts: the first is acid-stable glucomannan with a ratio of 43%, where the ratio of glucose to mannose is 2:10. The second part is (1-4) -linked xylan at a rate of 24.2%, and also has acid side chains at carbon atom C-2 and C 3 of poly xylose in the acid dissolved fraction, as well as containing a small amount of glucan at 2.31% (Mirhosseini & Amid, 2012).

Sweet BSG is used in many foods, industrial, and pharmaceutical applications as a thickening and binding agent. Its importance is evident in the food industries as a thickening or stabilizing substance and in improving the texture of the food product, as it was used in the manufacture of jelly, salad flavors, and sweets (Hosseini-Parvar *et al.*, 2010). Along with possesses several therapeutic and biological activities such as antiulcer and antioxidant activity (Zeynali *et al.*, 2019).

Basil seeds are a source of gel, which makes up about 20% (w/w) (Naji-Tabasi & Razavi, 2017a). Gel-layer forms around the basil seeds when soaked in water. The swelling index of the seeds is 34-35 ml, and according to the high mucilage content in basil seeds, it can be used as a new source of edible colloids in the food industry. Recently, researchers have been interested in adding BSG as one of the commercial colloids in the food industry due to the ease of extracting it (Zeynali *et al.*, 2019). Several studies have indicated the possibility of successfully using BSG as a replacer for fat in the manufacture of yogurt, mayonnaise, ice cream, and pistachio butter, as BSG creates a network that traps the droplets of fat and impedes its movement (Naji-Tabasi & Razavi, 2017b).

In recent years, there has been an increase in demand for ready-made meals, which are cold and exposed to a minimum of conventional treatments. The marketing of these products increased in developed countries and less developed countries alike, due to the increase in consumption of chicken meat and its manufactured products globally (OECD /FAO, 2017). Therefore, the availability of basil seeds in Iraq, the cheapness of their price, and the ease of extracting gum from them, the study aims is to replace animal fat with BSG with different concentrations when preparing chicken sausages and to study the effect of that on the physical, chemical, and sensory and texture properties of the product.

Materials & Methods

Raw Materials

Basil seeds

Basil seeds were obtained from local herbal stores in Baghdad- Iraq, and diagnosed by the Public Authority for examining and certifying the seeds, Ministry of Agriculture. The seeds were cleaned by removing impurities and foreign materials before use and kept in sealed glass containers with a temperature 18 ℃ until used.

Chicken

Freshly slaughtered broilers chicken breast (clean, skinless), Muscularis (pectoralis major) was obtained from the local markets of Baghdad city of 5-week old chickens with a live weight of about 1.5-2 kg. Further, the breast piece was isolated and placed in polyethylene bags inside a cooled cork box and transferred to the laboratory. The meat was stored by freezing at a temperature of -18° C throughout experiments.

Sheep back fat

After obtaining the sheep back fat from the local markets of Baghdad, they were put in sealed plastic bags and freeze. Then the fat was cut into cubes of 2-3 cm^3 before manufacturing the sausage to facilitate the grinding process.

Methods

Extracting the basil seeds gum

Basil seed gum (BSG) was extracted according to the method mentioned by Fekri *et al.* (2008) with some modifications. Thus, the basil seeds were mixed with distilled water at a 1:20 (w/v) ratio for an hour at room temperature. The mixture was filtered through a cotton cloth, and the gum suspension was deposited by adding 95% ethyl alcohol at a ratio of 3:1 Alcohol/gum suspension (v/v). The gum suspension was separated by centrifugation at a speed of 6500xg for 15 minutes, then dried and milled in a laboratory mill. The powder was kept in sealed containers at a temperature of 4°C.

Calculating yield of gum (Y)

The percentage of gum yield was calculated according to Saengphol & Pirak (2019) from the following equation:

$$\text{Yield (\%)} = \left(\frac{\text{Weight of gum}}{\text{Weight of soaked seed}}\right) \times 100$$

Manufacture of chicken sausages

This study was conducted in the Meat Processing Laboratory, Department of Food Sciences, College of Agricultural Engineering Sciences, University of Baghdad, for the period from September 2020 to December 2020. Chicken breast and different concentrations of dried BSG were used as a replacer for the added fat, crushed ice, garlic powder, and onions were also used, which were obtained from the local markets of Baghdad city, and the treatments were prepared as shown in the table (1).

Table (1): Treatments of chicken sausages.

Ingredient (g)	Treatments				
	C	T1	T2	T3	T4
Chicken Breast meat	70	70	70	70	70
Sheep back fat	10	9.5	9	8.5	8
Basil seed gum	0	0.5	1	1.5	2
Crushed Ice	10	10	10	10	10
Salt	1.5	1.5	1.5	1.5	1.5
Garlic powder	4	4	4	4	4
Onion powder	1.5	1.5	1.5	1.5	1.5

Meat grinding was minced by a grinder machine containing a 6 mm hole grinder plate twice, while the fat was minced with the same grinding machine using the Grinder plate with holes of 4 mm diameter. A mixer machine mixed the meat mixture. The mixture was stuffing and filled with transparent plastic covers with a diameter of 2 cm and a length of 15 cm. as described by Al-Zaidi & Ahmed (2020). Then, the sausages were preserved in refrigerate until the research's qualitative and sensory tests are conducted.

The sausage samples were cooked by heating them in a cooking pot with boiling water until the temperature of the sample center reached 75 °C, and it was cooled at room temperature of 22 °C. Then the samples were cut into square pieces with dimensions (height × diameter, 3 × 2.5), with a total weight of 10 g, and were used for sensory and loss evaluation at cooking (Park *et al.,* 2012).

Proximate composition

The proximate composition (moisture, fat, protein and ash) of dried BSG and chicken sausage was analyzed according to the standard methods mentioned in AOAO (2010) with three replications, carbohydrates were calculated by subtraction.

Caloric content

Total calories (kcal) were calculated per 100 g of chicken meat sausage according to Ghafouri-Oskuei *et al.* (2019) using values for fat (9 kcal.g^{-1}), carbohydrates (3.87 kcal. g-^{1}), and protein (4.02 kcal.g-^{1}).

Sensory properties

pH

The pH was measured according to the method reported by Saengphol & Pirak (2018) using a pH meter (Mettler, Switzerland).

Water holding capacity (WHC)

The ability of chicken sausages to hold water was measured according to the method reported by (Saengphol & Pirak, 2019).

Emulsion stability (total expressible fluid)

The stability of the emulsion was determined according to the Ali *et al.* (2011). The stability of the emulsion was calculated from the following equation:

$$\mathrm{TEF} = (\text{Weight of centrifuge tube and sample} - \text{Weight of centrifuge tube and pellet})$$

$$\%\ \mathrm{TEF} = \left(\frac{\mathrm{TEF}}{\text{sample}}\right) \times 100$$

Thaw loss

Thaw loss was calculated according to the method mentioned by (Al-Zaidi & Ahmed, 2020).

Cooking loss

Loss during cooking was calculated according to the method described by Saengphol & Pirak (2019) by calculating the difference in weight before and after cooking from the following equation:

$$\text{Cooking loss (\%)} = \left(\frac{\mathrm{Wr} - \mathrm{Wc}}{\mathrm{Wr}}\right) \times 100$$

Where Wr = weight of the uncooked sample (g)

Wc= weight of the cooked sample (g)

Cooking yield

The Cooking yield was calculated according to the method mentioned by Mousavi *et al.* (2019) by measuring the weight of the samples for each treatment before and after cooking using the following equation:

$$\text{Cooking yield (\%)} = \left(\frac{\text{cooked weight}}{\text{Raw weight}}\right) \times 100$$

Free Fatty Acids (FFA)

Free fatty acids were estimated based on of oleic acid according to the method mentioned in AOAC (2016) using the following equation:

$$\text{Free fatty acids (\%)} = \frac{\text{volume of of KOH(ml)} \times \text{N} \times 282 \times 100}{1000 \times \text{Sample weight (g)}}$$

Peroxide value (PV)

The PV was estimated according to the method mentioned in Shabeeb & Nassir (2019) using the following equation:

$$\text{Peroxide value (meq. kg} - 1 \text{ of sausage sample)} = \frac{(\text{S} \times \text{N}) \times 1000}{W}$$

Where: S is the volume of titration (ml), *N* is the normality of sodium thiosulfate solution ($N = 0.01$), and *W* is the sample weight (g).

Cholesterol estimation

Total cholesterol concentration was measured using the method mentioned in the diagnostic (Kit) manufactured by the Spanish company Linear Chemicals and read in a spectrophotometer at a wavelength of 500 nm.

Sensory evaluation

The sensory evaluation of chicken sausage was conducted by 11 of the experienced experts in the Department of Food Sciences, College of Agricultural Engineering Sciences, University of Baghdad, in terms of colour, flavor, tenderness, juiciness, and overall acceptance, using a 10-point descriptive scale and represents 1 = extremely undesirable, 10 = extremely desirable (Park *et al.*, 2012).

Statistical Analysis

The Statistical Analysis System- SAS (2012) program was used to detect the effect of different factors in study parameters. The least significant difference –LSD test (Analysis of Variation-ANOVA) was used to compare between means in this study significantly.

Results & Discussions

The results in table (2) refer to the chemical content of the chicken breast, as it was noticed that the moisture content was 71.7% and protein was 23.9%. These results were close to what (Modi *et al.*, 2005) pointed out, that chicken meat contains a high percentage of high-quality protein that increases in the chicken breast and a low percentage of fat, as the percentage of fat and ash reached (1.9, and 1.6 %), respectively.

Table (2): Proximate composition of chicken breast meat (wet basis).

Parameter	Percentage (%)
Moisture	71.7 ± 4.63
Protein	23.9 ± 1.47
Fat	1.9 ± 0.07
Ash	1.6 ± 0.5

The results in table (3) indicated the chemical content of BSG, as the moisture content reached 4.9% and protein was 9.2%. A small amount of protein in gum is important in improving emulsifying properties, fat binding, and some other functional characteristics. The percentage of ash and fat was (1.1, and 0.05%), consistent with (Fekri *et al.*, 2008; Abd El-Aziz *et al.*, 2016) results. The total carbohydrate content in the gum powder was 84.75%, which depends on the amount of protein and fat remaining after extracted the gum. Osano *et al.* (2014) reported that BSG consists of 1.32% protein, 4.38% fat, 79.63% total carbohydrates, and 9.1% moisture. Likewise, (Naji-Tabasi & Razavi, 2017b) indicated that the percentages of moisture, ash, protein, and total sugars in the gum itself were (5.92, 5.36, 2.37, and 92.44%), respectively.

Table (3): Proximate composition of BSG powder.

Parameter	Percentage (%)
Moisture	4.9 ± 0.12
Protein	9.2 ± 0.37
Fat	0.05 ± 0.01
Ash	1.1 ± 0.02
Total carbohydrate	84.75 ± 5.17

The yield of gum extracted was 17.5% on a dry weight basis. Table (4) showed the chemical content of sausage samples made from the chicken breast meat and BSG powder added to it in different percentages to replace animal fat. It was noticed that the moisture content of the prepared sausage increased insignificantly ($P \leq 0.05$) by increasing the percentage of adding gum powder. Besides, the highest increase at 2% amounted to 66.96%, compared with standard sausages, which was 64.32%, and reached (66.91, 66.73, and 66.14%), at a concentration of (0.5, 1.0, and 1.5%) of the added gum powder. The percentage of protein and ash also increased significantly ($P \leq 0.05$) in direct proportion to the increase in the concentrations of the added gum, which is more obvious up to 2%, which does not differ significantly from its percentage in 1% and 1.5%. On the other hand, it differed significantly from its percentage with concentrations of 0 and 0.5%. However, the decrease in fat percentage was recorded with significant differences with the increase of the concentration used, as it decreased from 2.40% in the standard sample to 0.11% when adding 2% of gum, and these results are agreed with what (Lee & Chin, 2017) found.

Table (4): Proximate composition of chicken sausage with BSG powder.

Treatments	Moisture (%)	Protein (%)	Ash (%)	Fat (%)	Total carbohydrate (%)	Caloric content (kcal. g^{-1})	Cholesterol (mg.$100g^{-1}$)
C	64.32 ±2.45 a	17.06 ±0.58 b	1.33 ±0.04 b	2.40 ±0.08 a	14.89 ±0.79 a	147.80 ±5.21 a	150.66 ±6.41 a
T1	66.14 ±3.05 a	17.88 ±0.61 ab	1.51 ±0.09 b	1.83 ±0.04 a	12.64 ±0.73 b	137.26 ±6.07 b	144.93 ±5.38 a
T2	66.73 ±2.72 a	18.60 ±0.74 a	1.82 ±0.06 ab	1.12 ±0.04 b	11.73 ±0.61 b	130.24 ±5.44 bc	140.33 ±5.95 a
T3	66.91 ±2.55 a	18.65 ±0.71 a	1.89 ±0.11 ab	0.65 ±0.07 bc	11.90 ±0.55 b	126.87 ±5.37 c	139.00 ±4.68 a
T4	66.96 ±2.61 a	18.83 ±0.74 a	2.00 ±0.08 a	0.11 ±0.01 c	12.10 ±0.63 b	123.51 ±4.92 c	139.00 ±4.68 a
LSD: 0.05	3.27 NS	1.094 *	0.466 *	0.682 *	1.85 *	8.423 *	17.53 NS

The different letters in the same column differed significantly
* *($P \leq 0.05$)*
Basil seed gum powder: 0%(C), 0.5%(T1), 1%(T2), 1.5%(T3), 2%(T4)

Similarly, the total carbohydrate percentage decreased significantly at a concentration of 0.5%, which in turn did not record a significant decrease with the other gum concentrations used, as it reached (12.64, 11.73, 11.90, and 12.10%) at concentrations of (0.5, 1.0, 1.5, and 2 %). Whereas, the caloric value decreased significantly with the increase of the added gum powder concentrations, as it reached (147.80, 137.26, 130.24, 126.87, and 123.51 kcal.$100g^{-1}$) when adding gum at concentrations of (0, 0.5, 1.0, 1.5, and 2%), respectively. So, it was noticed that the highest value of caloric value was in the control treatment, which differed significantly from the concentrations of (0.5, 1.0, 1.5, and 2%). At the same time, the difference was not significant in the concentrations of (0.5, and 1.0%) and at (1.0, and 1.5%) of percentage gum.

The cholesterol levels decreased in an insignificant matter by increasing the concentration of gum added to 2%. It was 150.66 mg.$100g^{-1}$ in the gum-free control treatment, while it was less when the gum powder was added at a concentration of 2%, which reached 139.00 mg.$100g^{-1}$.

Table (5) showed the functional properties of sausages made from chicken meat by adding different percentages from BSG powder.

It was noticed that the weight loss was not significant during cooking. The thaw loss also gradually decreased in an insignificant manner with the increase in the concentration of the added gum powder, as the weight loss during cooking was (38.60, 38.42, 38.04, 37.94 and 37.92%). However, the thaw loss was (2.11, 2.08, 2.02, 2.00, and 2.00%) when gum was added at concentrations of (0, 0.5, 1 and 1. 5 and 2%, respectively. Cooking loss is important to understand the effect of non-meat ingredients on product characteristics.

It is also noted from table (5) that the cooking yield levels increased and improved in an insignificant matter by increasing the concentrations of added gum. The results were agreed with (Lee & Chin, 2017) finding, that the addition of BSG at a concentration of 0.5% improved the cooking yield, while the addition of BSG at the same concentration with gelatin at 0.25 and 0.5% gave higher levels of cooking yield compared with the control treatment without it. The cooking yield improvement may be attributed to the role of BSG in trapping moisture and fat in the chicken sausage mixes.

WHC was significantly increased by increasing the concentrations used up to 1% of the added gum. Furthermore, water-holding capacity is one of the indicators of meat quality, as it affects the appearance of the product, the characteristics of cooking, juiciness and tenderness. (Darwish *et al.*, 2012; Al-Husseiny & Khrebish, 2019).

Table (5): Functional properties of chicken breast sausage with BSG powder.

Treatments	Cooking loss (%)	Thaw loss	WHC (%)	Emulsion stability (%)	Cooking yield (%)	pH
C	38.60 ± 1.52 a	2.11 ±0.07 a	42.04 ±2.46 a	4.32 ±0.76 c	61.40 ±2.54 a	6.5 ±0.33 a
T1	38.42 ±2.05 a	2.08 ±0.11 a	43.04 ±2.76 a	6.11 ±0.15 b	61.58 ±2.33 a	5.8 ±0.29 b
T2	38.04 ± 1.25 a	2.02 ±0.06 a	44.36 ±2.07 a	7.02 ±0.20 a	61.96 ±1.97 a	5.9 ±0.31 b
T3	37.94 ±1.08 a	2.00 ±0.07 a	44.30 ±1.67 a	7.15 ±0.17 a	61.02 ±183 a	6.2 ±0.37 ab
T4	37.92 ± 1.27 a	2.00 ±0.12 a	44.22 ±2.33 a	7.20 ±0.24 a	62.08 ±2.05 a	6.0 ±0.26 ab
LSD: 0.05	2.85 NS	0.168 NS	3.09 NS	0.882 *	3.265 NS	0.598 *

The different letters in the same column differed significantly
* *($P \le 0.05$)*
Basil seed gum powder: 0%(C), 0.5%(T1), 1%(T2), 1.5%(T3), 2%(T4)

It was observed that the product's ability to holding water was significantly increased by increasing the used concentrations of BSG, which were more obvious at concentrations of 0.5 and 1%, which amounted to 43.04% and 44.36%, respectively. Thus, there were directly proportional to the emulsion stability, which increased with increasing concentrations.

The ability of BSG to holding water may be attributed to the fact that the gum is composed of more than 80% carbohydrates and that the increase in the pH and the ionic strength increases the capacity of the existing protein to holding water and binding to it as it moves away from the isoelectric point or, the gum works to protect proteins from decomposition and prevent water from coming out and remaining bonded to the protein by protein-water bonds.

The stability of the emulsion was (4.32, 6.11, 7.02, 7.15 and 7.20%), as it was observed to be significantly increased by increasing the percentages of adding BSG with concentrations of (0, 0.5, 1, 1.5, and 2%), respectively. It was noticed that the highest stability of the emulsion was at a concentration of (1.0, 1.5, and 2%), which differed significantly from what it was from the concentration of 0.5% and the control treatment, as show in table (4). Relatedly, it is evident from the results that adding gum to chicken sausage led to a reduction in fluid loss compared to the control treatment. -This may be attributed to the increased ability to form chemical bonds, which reduces water loss (Ara´ujo *et al.*, 2018). These results are agreed with Lee & Chin (2017) findings.

Table (6) indicated the PV and FFA percentage for prepared chicken breast sausage by adding different concentrations of BSG. However, it was noted that the value of FFA decreased insignificantly at a concentration of 0.5% compared with the control treatment. In contrast, its decrease was significant with the concentrations (1.0, 1.5, and 2%). It was also observed that PV values decreased in an insignificant matter, as the PV value in the control treatment was 1.14 meq.kg^{-1}, compared with 0.93 meq.kg-^{1} when adding gum at a concentration of 2%. This may be attributed to the fact that the BSG is rich in phenolic compounds that can chelate metal ions and scavenging free radicals in sausages. These antioxidant properties can inhibit lipid oxidation in meat products. These results agree with (Al-Zaidi & Ahmed, 2020) that the PV does not exceed 1.4 meq.kg^{-1} of fat when preparing sausages by adding natural extracts of lemon and orange peels. Thus, these additives have a clear inhibitory effect in inhibiting lipid oxidation and reducing the PV (O'Brien, 2008; Kim & Chin, 2016) indicate the same results.

Table (6) Peroxide value and FFA of chicken breast sausage with BSG powder.

Treatments	Peroxide value (meq.kg^{-1})	(%) Free Fatty Acids
C	1.14 ±0.08 a	0.05 ±0.008 a
T1	1.10 ±0.19 a	0.04 ±0.005 ab
T2	0.99 ±0.11 a	0.02 ±0.002 b
T3	0.97 ±0.09 a	0.02 ±0.001 b
T4	0.93 ±0.15 a	0.02 ±0.001 b
LSD: 0.05	0.288 NS	0.022 *

Basil seed gum powder: 0%(C), 0.5%(T1), 1%(T2), 1.5%(T3), 2%(T4)

Many kinds of research have indicated the possibility of many gums such as flaxseed gum (Thakur *et al.,* 2009) and cress seed gum (Ul-Ridha *et al*., 2019) to reduce cholesterol due to these plant gums contain antioxidants. The PV did not show any perceptible differences with the increase in the concentrations used up to 1%.

Table (7) showed the sensory evaluation of the prepared chicken breast sausage by adding different concentrations of BSG. It was noticed that the sensory characteristics improved significantly by adding the gum concentrations, especially the colour, juiciness and overall acceptability. At the same time, its improvement was slight and insignificant for flavor and tenderness. This was evident especially at (0.5 and 1%), which was evident in tenderness, juiciness, and overall acceptability and then in colour and flavor respectively, making it more acceptable to the panelists

Table (7): Sensory evaluation of chicken breast sausage with BSG powder.

Treatments	Colour	Flavor	Tenderness	Juiciness	Overall acceptability
C	7.33 ±0.43 b	8.00 ±0.39 a	7.33 ±0.41 a	7.36 ±0.34 b	7.67 ±0.61 ab
T1	8.02 ±0.55 ab	8.25 ±0.42 a	7.65 ±0.48 a	7.96 ±0.50 a	8.35 ±0.56 a
T2	8.87 ±0.48 a	8.00 ±0.40 a	7.77 ±0.26 a	8.24 ±0.56 a	8.30 ±0.62 a
T3	8.85 ±0.61 a	7.77 ±0.35 a	7.32 ±0.37 a	8.15 ±0.42 a	7.93 ±0.49 ab
T4	8.74 ±0.67 a	7.50 ±0.51 a	7.32 ±0.37 a	7.99 ±0.48 a	7.40 ±0.50 b
LSD: 0.05	0.902 *	0.884 NS	0.498 NS	0.707 *	0.793 *

The different letters in the same column differed significantly
* *(P≤0.05)*
Basil seed gum powder: 0%(C), 0.5%(T1), 1%(T2), 1.5%(T3), 2%(T4)

The results showed that the addition of different concentrations of BSG improved in the colour of the processed sausages and was more obvious by increasing the concentrations of added gum. According to several research, adding dietary fibre to low-fat meat products diminishes hardness through disrupting the protein-protein or protein-water network (Han & Bertram, 2017). Because the diameter of the muscle fibre is big and the fat concentration is low, chicken breast muscle is mostly made up of quick glycolytic fibres (type11b fibres). As a result, the meat tissue is dry and firm (Choe, 2018).

Finally, adding dietary fibre to meat products gives a soft texture while reducing the fat content because its oil holding capacity. The researchers noted the importance of using tissue enhancing substances in meat products, which are often used as fat replacers, to reduce added fat and improve tissue properties (Wang *et al.,* 2018). Saengphol & Pirak (2018) showed the possibility of using hoary basil gum as a replacer for lard fat with more than 80% by adding 2% salt to manufacture meat products.

Conclusion

It can be concluded from the research the possibility of using BSG to prepare healthy and good-quality chicken sausages due to the improvement of water and fat binding qualities as well as the improvement of the cooking yield, flavor and, other sensory qualities. BSG can also be used as a partial replacement to fat for making chicken sausages, which reduces the cost of sausage mixes and gives a healthy, low-calorie product.

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تاثير تراكيز من صمغ بذور الريحان على الصفات النوعية لصوصج الدجاج

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المستخلص: يتميز لحم الدجاج بانه غذاء منخفض الدهن ومرتفع البروتين ويتزايد استهلاك لحم الدجاج بشكل مضطرد عالميا. وقد اضيفت مكونات غذائية مختلفة لتحسين خصائص الصوصج المصنعة من لحم الدجاج. وقد تم استخلاص صمغ بذور الريحان BSG ودراسة تاثير اضافته بنسب 2.0,1.5,1.0,0.5 % بديلاً عن الشحم الحيواني في النقانق المصنعة وأثر ذلك في التركيب الكيميائي والصفات الحسية والنوعية لصوصج الدجاج. كانت حصيلة الصمغ المستخلص 17.5% على أساس الوزن الجاف. أظهرت نتائج تحليل التركيب الكيميائي للنقانق المحضرة زيادة نسبة الرطوبة والبروتين والرماد في حين انخفضت نسبة الدهن والكاربوهيدرات والقيمة السعرية فيها. كما بينت النتائج زيادة في قابلية حمل الماء وثباتية المستحلب وحصيلة الطبخ في الصوصج المحضرة في حين انخفضت نسبة الفقدان عند الطبخ والفقدان بالسائل الناضح. كما لوحظ ان رقم البيروكسيد والاحماض الدهنية الحرة والكولسترول تنخفض بزيادة تراكيز الصمغ المضافة ولغاية 2%، وأدت اضافة تراكيز الصمغ تحسناً واضحاً في الخواص الحسية وتقبل المقيمين وخاصة اللون والطراوة والعصيرية والتقبل العام . نستنتج من البحث امكانية استخدام BSG بديلاً عن الدسم لتصنيع نقانق الدجاج منخفضة الدسم مما يساهم في تقليل كلف خلطات الصوصج واعطاء منتوج صحي قليل السعرات.

الكلمات المفتاحية : صوصج الدجاج، خصائص وظيفية، صمغ نباتي ، تقويم حسي.