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Quality Evaluation of Beef Sausage Formulated with Different Levels of Dried Pumpkin Powder

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Abstract

The present study aim at investigating the quality properties of beef sausage formulated with dried pumpkin powder. Sausages prepared with recommended raw materials. Three levels of dried pumpkin powder (10%, 20%, and 30%) incorporated, while control sample left free (0%).Proximate composition, pH value, water holding capacity, microbiological aspects and sensory properties of beef sausages were carried out. Incorporation of dried pumpkin powder had significant impact, where decreasing pattern of moisture content observed as the level of dried pumpkin powder increased. The sample formulated with 30% dried pumpkin powder recorded the lowest moisture content (64.22%) compared with (72.43%) for the control sample. Significance increase ($p< 0.05$) of fat and protein content recorded, where the sample formulated with 30% dried pumpkin powder recorded the highest content (9.30%) and (20.55%), respectively. Moreover, increase of dried pumpkin powder levels decreased pH value and increased water holding capacity. Produced sausage samples had total viable bacterial count ranged between 2.89 log_{10} cfu/g and 1.70 log_{10} cfu/g. Interestingly, the findings obtained mirrored that all samples free of salmonella. Positive effect on improvement of color observed where, the sample formulated with 30% recorded the highest score rating (5.38) compared with the control sample (4.90).

Keywords: *Pumpkin powder, beef sausage, proximate composition, microbiological aspects, sensory evaluation.*

1. Introduction

Pumpkin belongs to the family of *Cucurbitaceae*. It is widely grown throughout the world [1]. Pumpkins are sweet when fully mature with yellow or orange flesh rich in carotene, vitamins, minerals and dietary fibre [2]. Carotenoids are a primary source of vitamin A for most of the people living in developing countries [3] where, vitamin A deficiency is still common [4]. One way to increase vitamin A intake of infants is to incorporate high carotenoids food in their diet [5].β-carotene present in pumpkin is converted to vitamin A in the body and plays a crucial role in the prevention of chronic diseases during adult life due to their antioxidant abilities [6].

Sudan is vast multitudes of domestic animals represent a large proportion of all African livestock. It is ranks first to third among all African countries in the number of cattle, sheep, goats and camels, third in the number of poultry and fifth in the number of donkeys [7].

Nutritionally, meat is very good source of essential amino acid, to lesser extent of certain mineral, vitamins, fats and limited quantities of carbohydrates [8]. Sausage is the most meat products popular and admirable for its easily prepared and stored, its exclusive taste and flavor make it widely accepted usually as snacks and the factor which makes sausage spread all over is the fact that is saves a lot of time and more efforts. As well as, it is more feasible for consumers compared with all other meat products [9].

There is strong evidence that high consumption of processed meat products is directly related to cardiovascular diseases, type-2 diabetes, obesity and some cancer types [10]. Moreover, recently WHO International Agency for Research on Cancer has classified the consumption of red meat as carcinogenic to humans [11]. As consumers have become increasingly more health conscious, foods including meat products with decreased levels of fat, salt, cholesterol as well as enriched with dietary fiber has become more and more popular [12]. Enhancement of meat and meat products with vegetables, fruits and their fibers could reduce production costs and improve the technological and nutritional quality of the products. As well as, the relevance of fruits and vegetables in the processing of meat products relates to their functional properties such

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as water binding, fat emulsification, and improves cook yield, textural and sensory properties. There fore, this work aim at production beef sausage formulated with cheap and nutritious filler (dried pumpkin powder) and to evaluate its effects on the quality characteristics of beef sausage.

2. Materials and Methods

2.1 Food Materials

Pumpkin fruits (*Cucurbita moschata*) (*Baldi*) Varity were obtained from the farm of National Food Research Centre (27 km north Khartoum).Natural casing, addition fat; skim milk, spices, salt and sugar were obtained from local market at Omdurman city, Sudan. Fresh meat loins were obtained from the Veterinary Research Center at Khartoum North city and transferred immediately to the National Food Research Center, where it kept frozen at -11±1ºC.

2.2 Chemicals and Reagents

Chemicals and reagents used were obtained from stores of National Food Research Center (NFRC). All chemicals used in this experiment were of analytical grade.

2.3 Raw Materials Preparation

2.3.1 Preparation of Pumpkin Powder

Pumpkin fruits were washed with filter tap water to remove any adhering soil and weighed. The rind, fibrous matter and seeds were removed. The clean flesh peeled using sharp stainless steel knives. Peels were cut in to approximately 1 inch cubes using (Electronic Dicer). The pumpkin cubes were then immediately dipped into (0, 15%) Ascorbic acid solution and were spread on dehydration trays (62.5×45.5 cm^2) under moving fans for 3 days to a moisture content of 10-12% at ambient temperature . The dried cubes of pumpkin were milled into fine flour using a hammer mill (Serial NO. 88123, mesh size 80- 120). The powder was packed in polyethylene pouches and then stored at -18 ºC till used. Three levels of pumpkin powder were used (10%, 20% and 30%) besides the control sample (0%).

2.3.2 Beef Meat Preparation

Stored beef meat was allowed to thaw and then sliced through 0.75 inch plate. The beef meat was ground using a meat grinder. The ground beef meat was stored refrigerated at 4 ±1ºC for about 20 hours; sample was taken from the ground meat and analyzed for moisture content, protein, fat and ash according to A.O.A.C [13].

2.3.3 Casings

Natural casing from sheep intestines were cleaned, salted and kept in a refrigerator.

2.3.4 Sausage Preparation

Four different beef sausages were formulated with 0%, 10%, 20% and 30% of dried pumpkin powder .All ingredients were added to each treatment. The sausage mix was reground. The sausage mix was stuffed in sheep casings using piston stuffer then the sausage was linked and frozen in a lab freezer about -18 ºC.

2.4 Analytical Methods

Moisture content, protein content, fat, ash, pH and water holding capacity were achieved according to A.O.A.C [13].Titratable acidity was determined using the method suggested by Rangana [14]. Proximate analyses were performed in triplicate. Sensory evaluation was carried out according to Ihekoroney and Ngoddy [15], where 15 of semi trained panelists were participated. Microbial analyses were carried out according to Harrigan and McCance [16].

2.5 Statistical Analysis

The statistical analysis from the different treatment was subjected to analysis of variance and whenever appropriate the mean separation procedure of Duncan Multiple Range Test (DMLT) was employed according to Steel and Torrie [17], SAS program (Ver. 1988) was used to perform the general linear model (GLM) analysis.

3. Results and Discussions

3.1 Proximate Composition

As shown in Table1 there were significant differences ($p< 0.05$) among the treatments for moisture content. Control sample had the highest moisture content followed by 10%, 20% and 30% pumpkin powder, respectively. These differences could be attributed to the fact that the samples containing pumpkin powder had better water binding capacity when compared to the control sample (0%); in addition, it could be due to the increase in solid materials content. Prominently, moisture content decreases with the increase in the level of pumpkin powder, whereas the sample formulated with 30% pumpkin powder recorded lowest moisture content (64.22%). Similar observation was reported by Serdaroğlu *et al.,* [18] who found significant decrease in moisture content of beef patties formulated with dried pumpkin pulp and seed. López-Vargas *et al.,* [19] reported that, the moisture content fell with the addition of passion fruit albedo in raw and cooked burgers.

In terms of the fat content, the results revealed that there was no significant difference among the treatments ($p> 0.05$). It is noticeable, that fat content increased with the increase in the level of pumpkin powder, whereas the sample formulated with 30% pumpkin powder recorded highest fat content (9.30%), while the sample formulated with 0% pumpkin powder recorded lowest fat content (7.79 %).

Table 1: Proximate composition of beef sausage formulated with different levels of dried pumpkin powder

Parameters	Levels of dried pumpkin powder			
	Control 0%	10%	20%	30%
Moisture (%)	72.43 ±1.22^{a}	70.77 ±2.51^{ab}	65.43 ±5.48^{bc}	64.22 ±6.74^{c}
Fat (%)	7.79 ±2.36^{a}	8.60 ±2.53^{a}	8.91 ±2.76^{a}	9.30 ±2.26^{a}
Protein (%)	17.55 ±2.20^{b}	19.00 ±1.05^{ab}	19.46 ±0.38^{a}	20.55 ±0.66^{a}
Ash (%)	2.02 ±0.33^{a}	2.10 ±0.33^{a}	2.20 ±0.31^{a}	2.30 ±0.40^{a}

Mean ± standard deviation (n = 3). Mean values within a raw followed by a different letter are significantly different ($P < 0.05$)

The higher fat content of the sample formulated with 30% could be refer to the percent of oil in the dried pumpkin powder. According to Omotoso [20] fats are essential in diets as they increase the palatability of foods by absorbing and retaining their flavors and help in the transport of nutritionally essential fat-soluble vitamins .For the protein content, the 30% treatment had the highest protein content (20.55%) and the least value (17.55%) was reported for the control (0%). The differences of protein content among all treated samples could be attributed to the incorporated levels of dried pumpkin powder. Contrarily, Ali *et al.,* [21] found that fish burger formulated with mashed pumpkin and mashed potato showed higher moisture and lower protein, fat and ash contents than control groups. The ash content of all treated samples were similar to each other, however, there is no significant differences ($p< 0.05$) reported among the treatments.

3.2 pH and Water Holding Capacity (WHC)

According to Table2, pH values of beef sausage were 60.22, 6.20, 6.17 and 6.15 for the samples formulated with 0%, 10%, 20% and 30% of dried pumpkin powder, respectively. Incorporation of dried pumpkin powder significantly ($p< 0.05$) affects the pH value of beef sausage samples, where the pH value decreased by the increase of dried pumpkin powder. The same trend was reported by López-Vargas *et al*., [19] who found that passion fruit albedo addition decreased pH value compared to control samples in raw burgers which could be attributed to the acid nature of the ingredient. Contrarily, Serdaroğlu *et al.,* [18] reported that the incorporation of dried pumpkin pulp and seed mixture increased the pH value of both uncooked and cooked patties compared to control group.

Table 2: pH value and water holding capacity of beef sausages formulated with different levels of dried pumpkin powder on

Parameters	Levels of dried pumpkin powder			
	Control 0%	10%	20%	30%
pH	6.22 ± 0.22^{a}	6.20 ± 0.35^{a}	6.17 ± 0.12^{ab}	6.15 ± 0.15^{b}
Water Holding Capacity	96.80 ± 0.10^{a}	73.60 ± 0.20^{d}	79.10 ± 0.10^{c}	79.80 ± 0.10^{b}

Mean ± standard deviation (n = 3). Mean values within a raw followed by a different letter are significantly different ($P < 0.05$).

Water holding capacity was presented in Table2. WHC of beef sausage were 96.80, 73.60, 79.10 and 79.80 for the samples formulated with 0%, 10%, 20% and 30% of dried pumpkin powder, respectively. Clearly, significant differences were found among treatments ($p<0.05$). The increase of WHC of formulated samples could be explained by the fact that pumpkin considered one of the richest sources of dietary fiber. Minarovičova *et al*., [22] stated that pumpkin flour contains 27.4% total dietary fiber. According to Ammar *et al*., [23] 1 g of pumpkin flour has the ability to hold 7.01 g of water that it could be used as a thickening agent in formulation of many foods. In addition, they found that water holding capacity of meatball samples contained pumpkin flour were significantly higher than meatball samples contained date seed powder or wheat germ.

3.3 Microbiological Aspects

3.3.1Total Viable Bacterial Count (TVBC)

The results obtained in Table 3, revealed that there was significant (*P≤0.05*) difference in total viable bacteria count of beef sausage samples formulated with dried pumpkin powder. Highest TVBC was recorded for control sample (2.89 $\log_{10}$ cfu/g), while, lowest TVBC was recorded for sausage sample formulated with 30% (1.70 $\log_{10}$ cfu/g).Clearly, the TVBC decreased as the level of dried pumpkin powder increased. Contrarily, Ibtsam *et al.,* [24] reported that, TVBC of sausage significantly ($P\leq0.05$) increased in chickpea incorporated sausage. FAO [25] reported that, the TVBC in beef products indicated the contamination from skin, mouth and nose of employees. According to Judge *et al.,* [8] TVBC is a major indicator of microbiological contamination.

Table 3: Effect of different levels of dried pumpkin powder on microbial counts (cfu/g) of beef sausage

Parameters	Levels of dried pumpkin powder			
	Control 0%	**10%**	**20%**	**30%**
(TVBC) (Cfu/g)	2.89 $\log_{10}$	2.76 $\log_{10}$	2.49 $\log_{10}$	1.70 $\log_{10}$
Salmonella	Nil	Nil	Nil	Nil

CFU: Colonies Forming Unit; TVBC: Total Viable Bacterial Count

Table 4: Sensory evaluation of beef sausage formulated with different levels of dried pumpkin powder

Parameters	Levels of dried pumpkin powder			
	Control 0%	**10%**	**20%**	**30%**
Aroma	5.30 ±0.56^{a}	4.81 ±0.50^{b}	4.77 ±0.43^{b}	4.75 ±0.59^{b}
Color	4.90 ±0.24^{bc}	5.14 ±0.47^{ab}	5.23 ±0.34^{ab}	5.38 ±0.38^{a}
Taste	5.11 ±0.40^{a}	4.87 ±0.55^{ab}	4.83 ±0.54^{ab}	4.54 ±0.43^{b}
Juiciness	4.66 ±0.42^{a}	4.63 ±0.22^{ab}	4.35 ±0.61^{bc}	4.24 ±0.34^{c}
Over all acceptability	5.23 ±0.36^{a}	4.77 ±0.50^{b}	4.73 ±0.31^{b}	4.54 ±0.32^{b}

Mean ± standard deviation (n = 3). Mean values within a raw followed by a different letter are significantly different ($P < 0.05$)

3.3.2 Salmonella

As shown in Table 3, there was no presence of *Salmonella* among sausage samples. These findings comply with the Sudanese standard (SSMO) [26] which is mentioned that meat suitable for human consumption must be *Salmonella* free. Similar observation was recorded by Eltom [27] who reported *Salmonella* free meat samples. Fung [28] reported that the presence of *Salmonella* in beef products is an indication that the system for controlling contamination is not working. According to the United States Department of Agriculture (USDA) [29] sausage makers should ensure that their products are not contaminated by pathogens such as *Listeria*, *E. coli* O157, *Salmonella*, *Trichinae* and *Staphylococcus* enterotoxin.

3.4 Sensory Evaluation

The results of sensory properties of produced sausages are given in Table 4.The results revealed that sensory scores of aroma, color, taste, juiciness and over all acceptability varied between 5.30-4.75, 4.90-5.38, 5.11-4.54, 4.66-4.24 and 5.23-4.54, respectively. Sensory panelists detected clear difference in the meaty aroma among beef sausage treatments. Control sample (0%) recorded the highest score in deviation from meat aroma which is could be attributed to the intensive flavor of dried pumpkin powder. According to Brown [30] aroma and flavor are probably the most important attributes that influence on the sensory properties. On the other hand, the sample formulated with 30% of dried pumpkin powder recorded the lowest score in taste, flavor and tenderness, while control sample (0%) was juicer than all sausage samples. Incorporation of non-meat ingredients in meat product formulations could lead undesired changes in sensory characteristics in case of excessive use or intensive aroma or color of the ingredient added. Therefore, it is important to evaluate the sensory properties of the product and perform necessary regulations in the formulations (Serdaroğlu *et al*.,) [18]. These results disagree with the conclusion reported by Ammar *et al.,* [23] where, stated that utilization of pumpkin flour had no considerable effect on sensory properties of meatballs. Also, Zargar *et al.,* [31] reported that no significant effect of pumpkin was observed on the appearance, color and flavor scores of the chicken sausages. Regarding the color, the control sample had the smallest change in color (4.90) among treatments while, the sample formulated with 30% recorded the highest score rating (5.38).This could be attributed to the yellow colour imparted by the carotenoids pigment naturally present in pumpkin and/or refer to the presence of the antioxidants and phenols which are prevent lipids oxidation. The results of this study confirm the recommendation reported by Serdaroğlu *et al.,* [18] who stated it should be noted that utilization of higher concentrations should be avoided to maintain sensory quality and consumer acceptability of the products.

Conclusion

Pumpkin is one such vegetable which is rich in nutrients and its utilization in Sudan is limited. In this study, incorporation of dried pumpkin powder in beef sausage formula improved the product quality. It reduced the moisture content which is consider most visible from economical point of view, besides increased protein and fat content. All samples were free of *salmonella*. Although the incorporation of dried pumpkin powder in beef sausage had significant impact on quality properties, it can be recommended that technological processes should be performed such as utilization of low concentrations to enhance the general acceptability of the finished product.

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