Effect of gels on estimating the chemical and physical content of raw and boiled chicken leg meat (drumstick)

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ABSTRACT

Background: Meat, including poultry, have important nutritional value due to the characteristics they possess. Additionally, preparation methods and additives play a crucial role in determining its nutritional value, which is reflected in the consumer preferences.

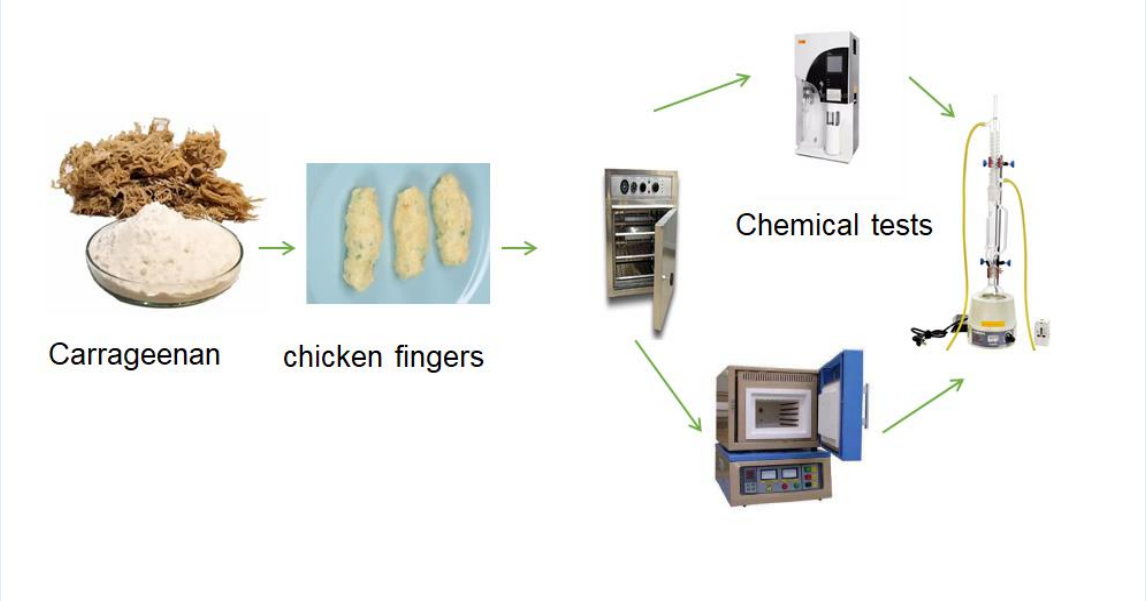
Objective: This study was conducted to determine the effect of carrageenan in the boiling process, and its effect on the physicochemical properties of chicken fingers made from chicken leg meat.

Materials and Methods: The total protein percentage was estimated by the Kjeldahl method. The percentage of fat was determined by the Soxhlet method using a volatile organic solvent, such as hexane. Moisture was determined by drying the samples in an oven at 105°C until a constant weight was achieved. The ash percentage was estimated by incineration at a temperature of 50-600°C until weight was stable. Carbohydrates were estimated using the constant weight with the remaining components. The acidity was also estimated. Physical tests determined the separated water by calculating the difference of weight before and after pressing. The loss in boiling was estimated by calculating the weight difference before and after boiling.

Results: Adding carrageenan at a rate of 2.5% reduced fat, protein, and moisture and increased the percentage of ash in the samples before the boiled process. The addition of carrageenan also led to a decrease in water loss during the boiling process. By increasing the product's ability to bind water and carrageenan, it improves consumers' acceptance of the final product.

Conclusion: The results showed a slight but significant increase in the percentage of ash, fat, and salt in the boiled and processed samples after adding carrageenan. Additionally, there was a decrease in the protein and acidity percentage for both the raw and boiled samples.

Keywords: carrageenan, chicken fingers, chicken leg (drumstick), chemical properties, physical properties.



INTRODUCTION

The increase in animal protein consumption, especially in developing countries, has actually led to a decrease in the per capita share of red meat [1].

Meat is one of the main products humans rely on for nutrition in order to obtain protein in their diets. The technological progress in meat preservation and transportation speed has contributed to the prosperity of the meat industry and international trade. This progress makes it possible to slaughter animals in one country and consume it in others [2].

The shortage of animal protein has called research centers to work on introducing new and inexpensive materials, such as carbohydrates, into the meat industry. This aims to increase productivity and obtain cheap products with high standards from a chemical, sensory, and physical standpoint. Examples include carrageenan, starch, and others.

Meat is composed by a group of muscle, connective, and fatty tissue. This is in addition to some glands and internal organs such as the liver, heart, spleen, tongue, kidney, brain, and others. Meat is taken from edible animal carcasses, provided they are free of pests and diseases. Meat is composed of protein content ranging from 18-22%. Meat also contains essential amino acids and fat soluble vitamins, such as A, D, E, and K, as well as the B and C group of vitamins. In processed meat products, the content of mineral salts ranges between

0.8-1.2% with the most important being potassium, phosphorus, and iron [3]. The prosperity of poultry meat is due to the establishment of large specialized farms. Processed meat is one of the most important products, in which the quality of fresh meat is shaped through the use of various manufacturing methods, such as chopping, crushing, emulsifying, salting, adding flavors, heat treatment, smoking, and fermentation. Burger products, meatballs, sausages, and fingers have recently become popular. These products are considered a favorite among children because of their good flavor and low nutritional content.

Carrageenan, a natural extract from many marine red algae, is used as a thickener agent that aids the formation of jelly [4].The main objectives of this experiment were to evaluate the effects of carrageenan on the chemical composition and physical properties of chicken meat fingers, with a particular focus on the effect of the boiling process on their chemical content.

MATERIAL AND METHODS

Experiment design: I took a chicken drumstick with 10% fat content and stripped the meat from it, which was then grounded using a meat grinding machine with 3 mm holes. Salt was added, and then the mixture was refrigerated for 12 hours at 4°C to complete the salting process. Next the meat was divided into two equal parts, and two mixtures were prepared from these portions.

The first mixture, control A, only had spices added to it. The second mixture, control B, was prepared with the same ingredients as control A along with the addition of 2.5% carrageenan based on the total weight.

After mixing the ingredients, they were left in the refrigerator for a period of time until the consistency stabilized. Afterwards, they were prepared in the form of fingers weighing 20-25 grams, and then boiled at 90°C for 30 minutes.

Chemical and physical tests: The percentage of total protein was estimated using the Kjeldahl method by digesting the samples with concentrated sulfuric acid with heating. The distillation process was performed, and the distillate was received in a volumetric flask containing 3% boric acid, after which was titrated in the presence of the reagent [5]. The Soxhlet method was used to estimate lipids using a volatile organic solvent [6]. Moisture was determined by drying the samples in an oven at 105°C until the weight was constant [7]. The ash percentage was estimated by incineration at a temperature of 50-600°C until the weight was stable [8].

Carbohydrates were estimated by determining the constant weight of the remaining components. The acidity was estimated by titration with 0.1 M sodium hydroxide, using the phenolphthalein index according to the total acidity based on lactic acid [9].

Physical tests measured the separated water by calculating the weight difference between before and after pressing the 1 kg sample for 10 minutes [10]. The loss in boiling was estimated by calculating the weight difference between before and after boiling [11-12].

Sensory tests: This included color, taste, smell, and texture [13].

Statistical analysis: Statistical analysis was conducted by calculating the value of the least significant difference (L.S.D.) at a significant level of 0.05 using the Anova program [14].

Result and discussion: The results logged in Table 1 show that the percentage of protein is 19.8%, fat is 4.01%, moisture is 74.1%, and ash is 1.3%. The percentages are close [15]. The slight difference between the components of the meat from one sample to another can be due to age, nutrition, gender, and other factors affecting the chemical composition of the meat [16].

Table 1: Chemical content of broiler leg meat used in manufacturing

Number	Ingredients	Percentage
1	Protein	19.8
2	Fat	4.01
3	Moisture	74.1
4	Ash	1.3

Our results in Table 2 show a significant decrease in acidity at $p<0.05$ in the sample with carrageenan prepared hot under strong conditions [17]. The humidity in the control sample reached 62.11%, while it was 59.90% in the sample to which carrageenan was added. Therefore, the decrease in humidity in the sample that carrageenan was added to is due to addition of a dry carbohydrate, which led to a decrease in the moisture content in the samples based on the total weight [18].

As for protein, there was a slight decrease in the manufactured sample to which carrageenan was added compared to the control sample. Fats increased in the control sample and decreased in the sample carrageenan was added to, that is due to the carbohydrates present in carrageenan. The table shows a significant increase in the ash percentage of the sample by 4.01%, This is because carrageenan is derived from marine algae treated with alkali in the form of salts of either sodium or calcium [19].

Table 2: General chemical content of the raw sample before boiling

Sample	Acidity	Moisture	Protein	Fat	Ash	CHO
Control	0.29a	62.11a	19.01a	17.90a	3.02	--
Sample with 2.5% carrageenan added	0.24b	59.90b	18.21b	17.30b	4.01a	1.45a

Similar letters indicate that there are no significant differences between the studied samples.

Table 3 shows the chemical composition of the samples after the boiling process. The decrease in the moisture percentage in the after boiling sample compared to before boiling is due to the percentage of carrageenan, which have the ability to retain water since they are thickeners and can absorb moisture [20-21]. The protein in the boiled samples was lower than in raw ones due to the loss of nitrogenous substances during boiling [22]. The percentage of ash in boiled samples was lower than in raw ones because some mineral elements were lost in the boiling water. However, for carrageenan, the loss was less than in the control sample because carrageenan binds to the mineral elements. This reduces the rate of loss in boiling water. Regarding fat, the loss in raw samples was greater than in boiled samples because carrageenan reduced fat loss by acting as an emulsifier, which gave relative stability to the emulsion [23]. The decrease in acidity in the boiled sample was due to the loss of organic acids in the boiling water.

Texture is a key sensory factor in meat quality, indicating its freshness, tenderness, juiciness, and its ability to bind water. Meat texture is considered to be one of the most important qualitative characteristics of meat and its products [24].

Table 3: Chemical content of boiled samples

No.	Treatment	Ash	Fat from relative weight	Fat	Protein from relative weight	Total protein	Moisture	Acidity
1	Control sample	1.82b	9.40b	12.42b	17.92a	24.40a	59.99b	0.21a
2	Sample with 2.5% carrageenan added	2.78a	10.99a	13.21a	17.58b	22.58b	60.28a	0.18b

Similar letters indicate that there are no significant differences between the studied samples.

Table 4 illustrate that carrageenan reduced the loss during the boiling process compared to the control sample. This happened because carrageenan has the ability to form gels at high temperatures, which contributes to binding the components of the final product and reducing the loss of various components during the boiling process. Carrageenan is considered a stable substance in alkaline and moderate solutions and is also thermally stable [25-26]. Moreover, carrageenan substance that binds strongly to water.

Table 4: Percentage of bound and lost water in boiling water.

Number	Treatment	Loss in blanching %	Percentage of bound water by total weight in raw samples
1	Control sample	32.98a	83.01b
2	Sample with 2.5% carrageenan added	25.88b	89.54a

Similar letters indicate that there are no significant differences between the studied samples.

Table 5 shows that chicken fingers with carrageenan added excelled in sensory characteristics like texture and taste. Additionally, it received the highest rating from tasters compared to the control sample with no additives [27-28].

Table 5: Taste profiles of chicken fingers

Number	Samples	Color	Juiciness	Favor	Taste
1	Control sample	4.88	3.35	4.32	2.96
2	Sample with 2.5% carrageenan added	4.80	3.36	4.68	3.32

Similar letters indicate that there are no significant differences between the studied samples

CONCLUSION

It was concluded that adding carrageenan affected the chemical content of raw and processed chicken meat fingers by increasing the percentage of mineral elements, which brought it closer to the control sample. The boiling process affected the chemical content of chicken meat fingers, leading to a loss of fat. Carrageenan increased the percentage of the product by binding with water, which reduced losses during the boiling process. It enhanced the product's ability to also bind to water and reduce water loss during the boiling process. This led to a positive effect on the consistency of the product and the stability of the emulsion, thus reducing the loss of fat and the improving sensory properties of the final product.

Abbreviations: mm: measuring unit, gm: gram, ml: millimeters, °C: Celsius degree.

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