Effect of substituting oats and soybeans on the physicochemical composition of burgers and obtaining functional foods

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ABSTRACT

Background: Plant foods, as functional foods, provide not only the essential nutrients needed to sustain life but also low-energy foods for health promotion and disease prevention, the burger, made of several types of meat, contains soy and oats in varying proportions to enhance its chemical and physical properties, as well as to test the efficacy of soy and oat flour as fat alternatives.

Objective: The goal of this study was to conduct chemical and physical analyses to Calculation of proportions to determine whether use this type of hamburger Fast food energy reduction might be used for the manufacturing of low-fat beef burgers, the treatment of obesity and autism,

Materials and Methods: For both oats and soybeans, there were three burger treatments made of beef, chicken, and lamb, with a ratio of 5, 10, and 15% of each utilized to construct the model items. The meat fillers and fine fat were blended in a grinder. The Burger sample weight was 75 g and kept chilled on 4^0C for 24 hours.

Results: The burger fillers which contain 10% oats and 10% soy and 5%, 15% ratios, respectively, made improvement in the chemical qualities notably with beef and lamb, respectively, while improving physical properties especially with beef and lamb.

Conclusion: Low fat and high fiber kofta meat can be made using oat flour with an 8.0% oat flour and 0.5% carrageenan, with little negative impact on its physicochemical and sensory properties.

Keywords: Meat, chemical, physical, Burgers, Oats, Soybean, functional foods.
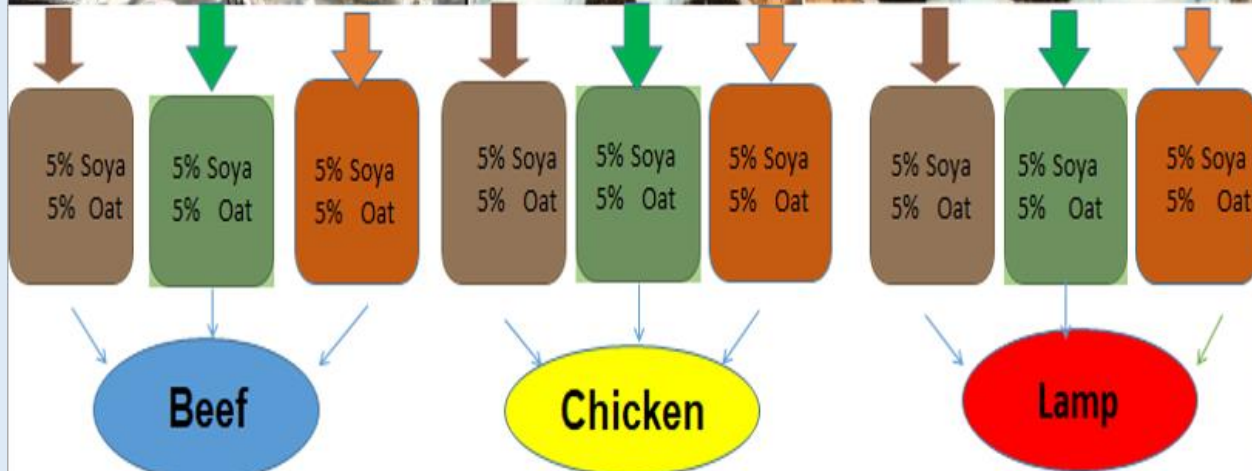
INTRODUCTION :

As a consequence of customer demand or severe rivalry, the meat business is the most significant in the world. As a result, research into new products is continuous.[1] In the case of functional meats, the goal of introducing functional ingredients is to provide meat with specific traits and modify its image in today's health-conscious society [2]. Recently, meal processors have made tremendous efforts to develop pioneering ready-to-eat (RTE) goods with fresh-like characteristics in response to the modern urban quality of life when the time for food preparation is limited [3]. Nowadays, consumer opinions of food consumption are mostly centered on preserving good health [4]. However, it is not always feasible for everyone to maintain a healthy and balanced diet for various practical reasons [4]. All the nutrients required for human health, such as carbs, protein, fat, water, minerals, and vitamins, are present in a burger [5].

Due to the significance of fat in meat products, there are several technological challenges associated with producing low-fat meat [6]. The fat content in a dish is crucial, as it affects the texture, juiciness, and overall flavor of the food. The taste and flavor of beef products with fat portions removed are impacted by changes in the sorts of aromatic flavor compounds [7]. There are several uses for oat flour [6], oat and buckwheat grains in the literature, and applications in meat products. According to current theories, most items contain whole grains, which is crucial to a person's diet [8]. Oats and buckwheat are two examples of cereal grains rich in a few nutrients that are ideal for an organism [9]. Grain provides vital proteins, lipids, and a variety of minerals

(Ca: calcium, Mg: Magnesium, K: potassium, P: Phosphorous, Na: Sodium, Fe: Iron), in addition to its major components: starch, B-group vitamins (thiamin, niacin, riboflavin, pantothenic acid) and vitamin E [10-11]. Additionally, it should be mentioned that the oil from oat grains includes a sizable amount of healthy unsaturated fatty acids [12].

During the heating process, the protein in meat must form a stable compound and deform for the emulsion stability and capacity to hold water in the low-fat meat system. This may be accomplished by combining isolated soy protein, alginate, and carrageenan [13]. Separated soy protein's main objectives are to increase thickness, water holding capacity, and stabilize emulsions. This study examines the physicochemical properties of meat products (burgers) produced with different percentages of filler material substitution utilizing oat or soya mixes 5, 10, and 15% coupled with the ground meat of beef, chicken, and lamb.

MATERIALS AND METHODS:

The substance was made up of comminuted items with the following general composition: Burgers were made using varying percentages 5, 10, and 15 % of oat or soy blended with 75g of minced meats (beef, chicken, and lamb), as well as 20g fat, 5g of "summon powder", 1.5g sodium chloride and 0.5g of spices. The spices mixture was composed from black pepper, Kebaba, Nutmeg, Cloves, and Cinnamon. The meat fillers and fine fat were blended in a grinder. The Burger sample weight was 75 g and kept chilled on 4^0C for 24 hours.

Table 1: Ingredients (%) of formulated Three blends of (beef, chicken, lamb) burgers.

Ingredients	standard	Beef			Chicken			Lamb		
Flour	5	0			0			0		
Oat	0	5			5			5		
	0	10			10			10		
	0	15			15			15		
Soya	0	5			5			5		
	0	10			10			10		
	0	15			15			15		
Meat	75.0	70.0	65.0	60.0	70.0	65.0	60.0	70.0	65.0	60.0
Fat	10.0	20			20			20		
Summon powder	5	0			0			0		
Cold water	15.4	15.4			15.4			15.4		
Salt	1.5	1.5			1.5			1.5		
Spices	0.5	0.5			0.5			0.5		

Instruction in Processing Burger: After the components are added, the mixture is stirred for 4 minutes. The mixture's temperature was regularly checked to make sure it stayed between ten to fifteen ^{0}C while the tastes and spices are blended. For samples T1, T2, and T3, oat or soybean powder has been finely ground and added to the mixture. After that, the mixture was hit for a further two minutes. Each hamburger is then given a 75gr weight. They are packaged individually and kept cold for examination after being formed and cooled for one to two hours at a temperature of -18^{0}C.

Analysis: Samples were taken and analyzed for moisture, ash, protein, fat, and fiber according to [14]. The carbohydrates were calculated by subtracting the previous components from 100C [15]. Then the oil was extracted by n-hexan according to the method [16] using the Soxhlet apparatus.

Statistical analysis: For every experiment, three replicates were employed. Statistical differences for treatment groups means (quantitative variables) were analyzed by using One-way ANOVA, followed by several pairwise comparisons (Turkey's test, 0.05). For statistical evaluations and visualizations, Graph Pad Prism and SPSS version 20.0 were both employed. The three disparities from one another replicates considered a significant effect ($p<0.05$). The data were reported to the results that given as mean + SD, and replicates were deemed a significant effect ($p< 0.05$) reported to mean of SD.

RESULTS: Regarding Ash, outcomes showed that all treatments had statistical significance at $p< 0.01$. For

Oats, it was observed that the substituted (Chicken) of T1 Oats were 5%, the substituted (Beef) T3 Oats 15%, and the substituted (lamb) of T2 and T3 Oats 15%, which

recorded statistical significance compared with sub (Chicken) of T3 Soya 15%, which recorded the least significant at (0.55).
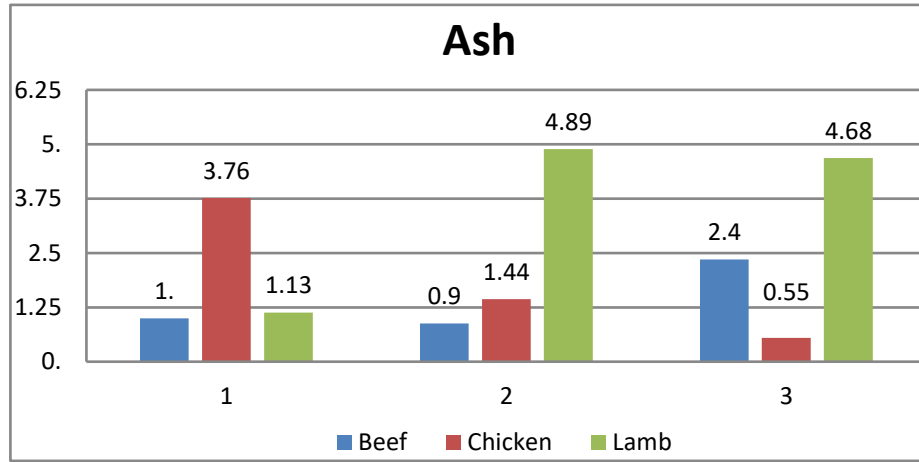

Figure 1: Ash concentration in the substituted burger with oat.

Figure 1 illustrates substituted Ash concentration in the different types of burger meat with oat at a concentration of 5,10, and 15%. Regarded with Soya, sub (Beef) of T2 Soya 10%, sub (Chicken) of T2 Oats 10% and sub (lamb) of T1 Oats 5% recorded statistically significant,

compared to the sub (Beef) of T1Soya 5%, sub (Beef) of T1Soya 5% and sub (lamb) of T2Soya 10%, which were recorded lowest significant at 0.92, 1.79 and 2.12, respectively.
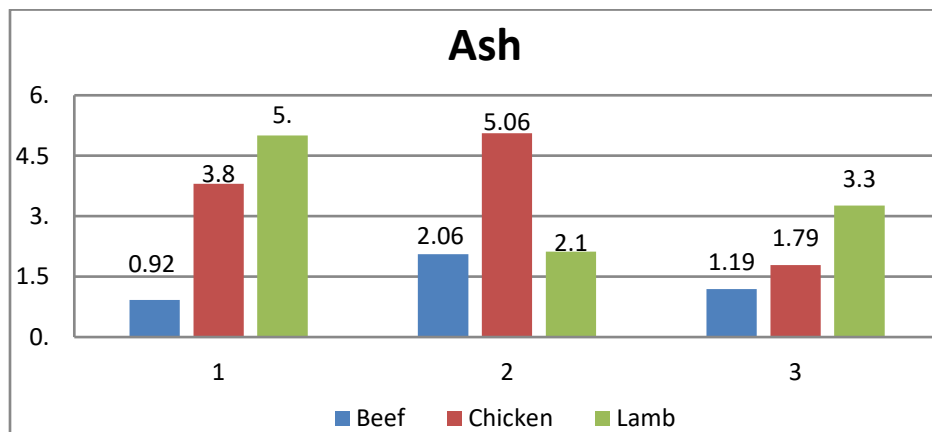

Figure 2: Ash concentration in the substituted burger with soya.

Figure 2 illustrates the Ash concentration for the different types of burger meat with soya at a concentration 5,10 and 15%.: All the results showed that all treatments were statistically significant at p< 0.01. Sub

(Beef) of T1 Oats 5%, sub (Chicken) of T3 Oats 15% and sub (lamb) for T1 and T2 Oats5, 10% recorded a statistically significant than the remaining treatment which recorded lowest significant for Oats.
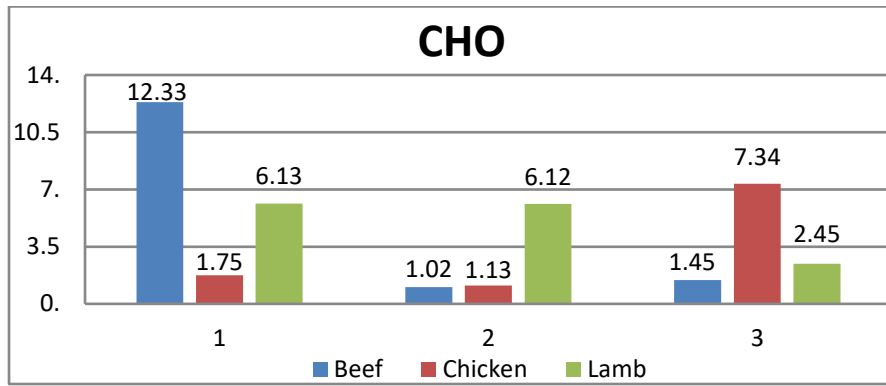
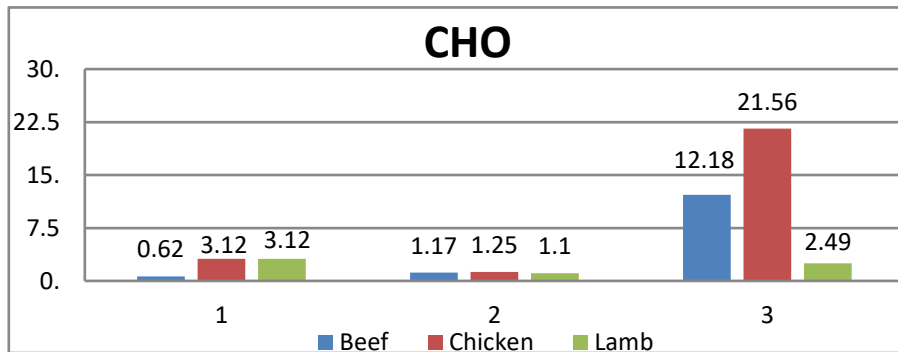**Figure 3:** CHO concentration in the substituted burger with oat

Figure 4: CHO concentration in the substituted burger with Soya.

Figures 3 and 4 illustrate the CHO concentration in the different types of burger meat with oat and soya at concentrations 5,10, and 15%. For Soya, the results we obtained displayed statistical significance to sub (Beef, Chicken) of T3 Soya 15% and the sub (lamb) of T1 Oats 5% than any other treatment. In regard to protein, the findings showed that all treatments were statistically significant at p< 0.01. For oats, all treatments showed statistically significant differences from the remaining treatment of sub beef in T1 oats 5% and sub sheep in T1 oats 5%.
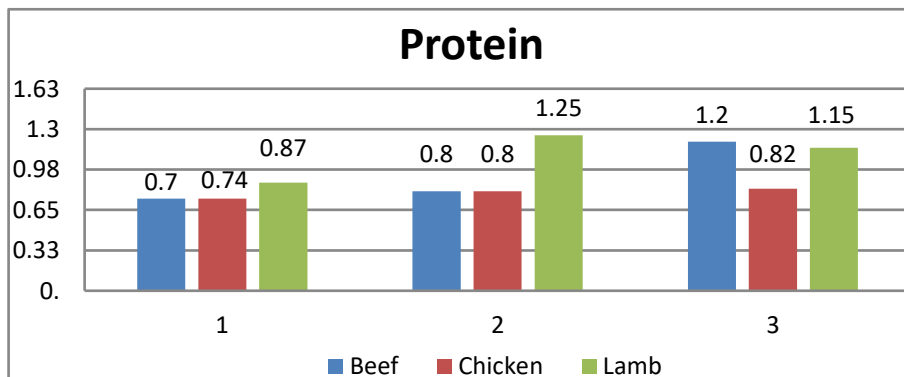

Figure 5: Protein concentration in the substituted burger with oat.

Figures 5 and 6 illustrates Protein concentration in the different types of burger meat with oat and soya at a concentration 5,10 and 15%. While with Soya, the sub Beef of T2 (10% Soya), sub Chicken of T2, T3 (15% Soya) and sub lamb of T2 (10%Soya) recorded statistical significance, compared to treatments that gave the least

significant (p < 0.01) for the substituted beef in T3 soya 15%, the substituted chicken in T1 (5%soya), and the substituted lamb in T1 (5 %Soya).
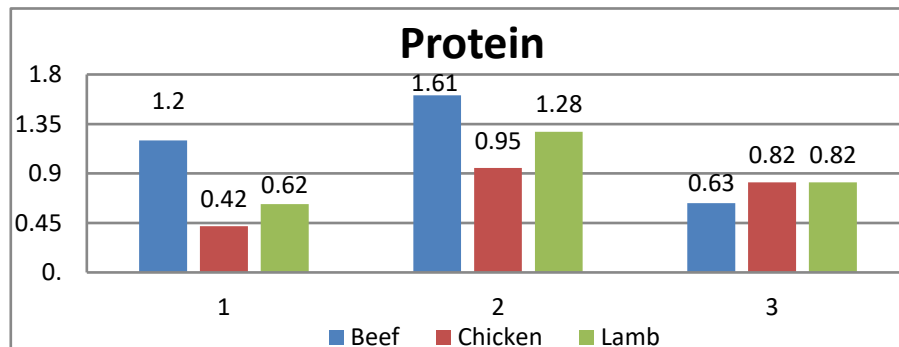

Figure 6: Protein concentration in the substituted burger with soya.

Regarding DM, the data showed that all treatments had gave statistical significance at p< 0.01. For Oats, sub Beef of T3 (15%), sub Chicken of T1 and sub lamb of T2 (10%) recorded statistically significant than the remaining treatments.
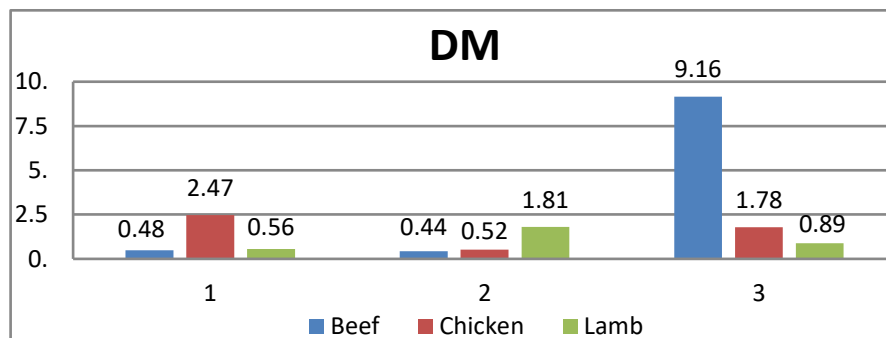

Figure 7: DM concentration in the substituted burger with oat.

Figures 7 and 8 illustrates DM concentrations in the different types of burger meat with oat and soya at a concentration of 5,10 and 15%. The findings showed that all treatments recorded statistical significance when compared to other treatments, and that there was a statistically significant difference for DM with Soya at p< 0.01 between treatments.
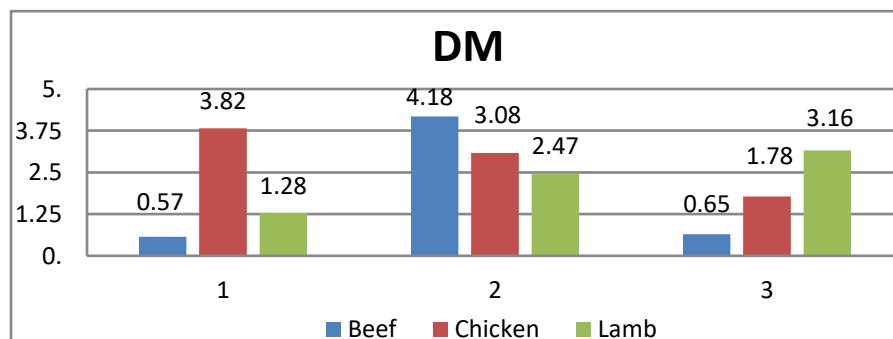

Figure 8: DM concentration in the substituted burger with Soya.

Figures 9 and 10 illustrates concentration of nitrogen for different types of burger meat with oat and soya at concentrations of 5,10 and 15%. In regard to nitrogen, the findings showed a significant effect between treatments at p < 0.01, compared to treatments that gave lowest significantly at (p < 0.01) for sub lamb of T1. All treatments for oats (5%) recorded a statistical significance.
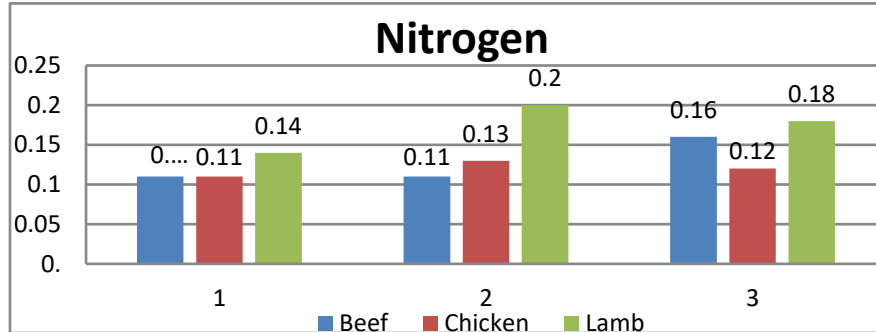

Figure 9: Nitrogen concentration in the substituted burger with oat.

While sub Beef of T1 (5% Soya), sub chicken of T1, T2 (Soya 5, 10%) and sub lamb of T2 (10% Oats) recorded statistically significant for DM regarding with Soya than another treatment.
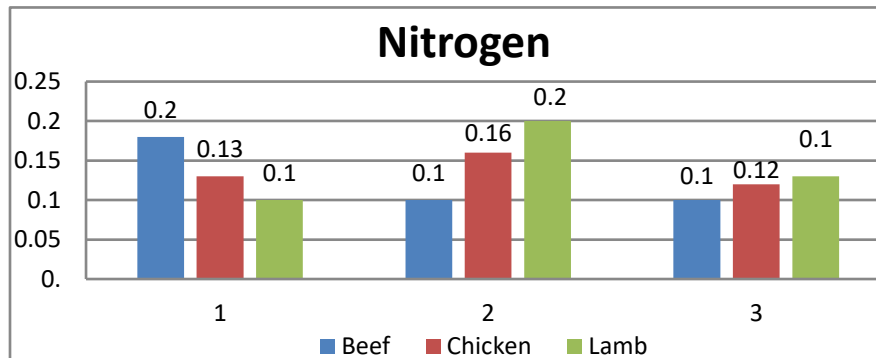
Figure 10 : Nitrogen concentration in the substituted burger with Soya.

Figures 11 and 12 illustrates fat for the different types of burger meat with oat and soya at concentration 5,10 and 15%. In regard to fat, the outcomes showed that all treatments gave a significant effect at p<0.01. For oats, subs Beef, Chicken, and lamb of T1, T2, and T3 (Oats, 5, 10, and 15%) and sub sheep of T1 (Oats, 5 %) were recorded statistically significant compared to the other treatments, which yielded the lowest significance.
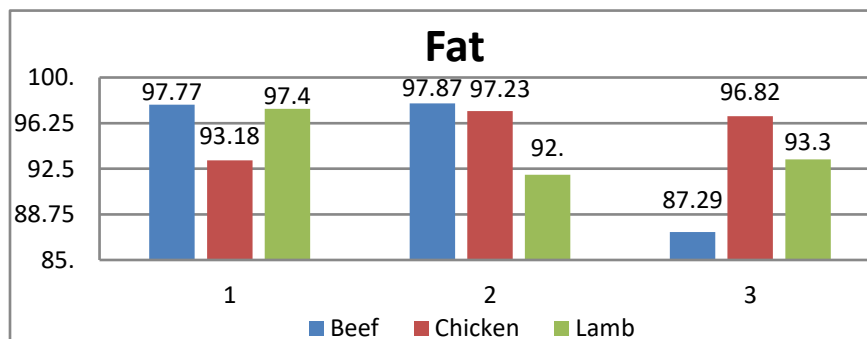

Figure 11 : Fat concentration in the substituted burger with oat

Whereas the results of DM regarding Soya, indicated that sub Beef of T1, T3 (5, 15% Soya), sub chicken of T2, T3 (10, 15% Soya) and the sub (lamb) of T1, T2 and T3 (5, 10 and 15% Oats) respectively, had recorded statistically significant compared with the remaining treatments that gave lowest significance.
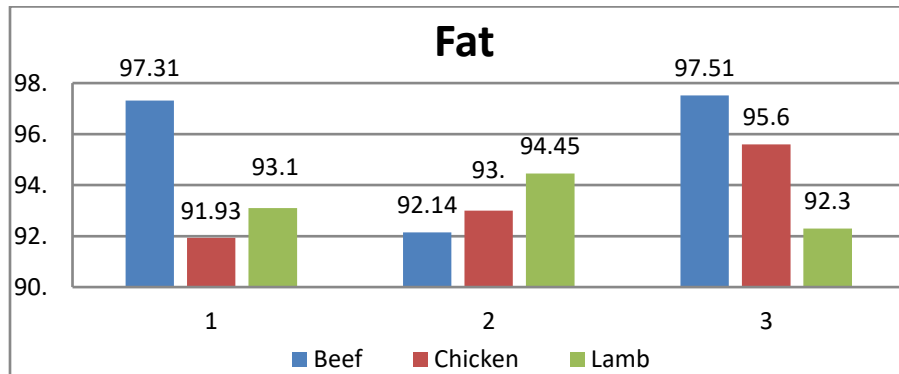

Figure 12 : Fat concentration in the substituted burger with Soya.

DISCUSSION: Although the focus of food has been geared towards the appearance of the healthiest ingredients in products, food can play a role in the treatment and prevention of diseases. The addition of non-meat ingredients to products not only improves the quality of meat products, but also reduces the cost, which is beneficial to consumers [17]. The addition of oat bran to food products increases its water-holding capacity and apparent viscosity, which improves the texture and quality of the food. It was reported that the beneficial health of β-glucan in oat bran is known to prevent coronary heart disease, by lowering cholesterol and glucose levels. Besides β-glucans, the phenols and other antioxidants found in oat bran have health benefits as well. Gluten-free proteins, such as soy and oats, are important for those with a gluten intolerance [18]. Amino acids, such as lysine and threonine, are also found in oats [19]. Soy protein is the most widely used vegetable protein for meat products. It is used in meat products because of its high biological factors and good functional properties, which result in an increased water-binding capacity. Thus, improving the texture and consumer response to the final product. However, it was found that soy food, or any food containing soy is prohibited for those with a specific genetic disorder.

In general, completed burgers include different types of meat and varying amounts of oat and soy fillers. Replacing fats with fiber contributes to lowering the calorie content of meat products [20], while also appealing to the recent growing consumer interest in healthy and low-fat nutrition, which helps in developing a large market for high-fiber foods [21-22]. Dietary fiber has an important physiological role in the human body and is taken into consideration before other nutrients to ensure proper nutrition. A lack of fiber in the diet is often associated with digestive system problems and/or diseases, including constipation and colon cancer, as well as an increased risk of cardiovascular disease, hypercholesterolemia, stroke, obesity, and diabetes [23].

It has been determined that burgers produced with different types of meat and various quantities of oats and soy display improvements in chemical properties, especially with beef and sheep meats, respectively, and improves the physical properties in both meats, respectively. Overall, diets high in fiber and low in fat are

popular, due to consumer awareness of the hazards associated with consuming fat-rich foods [24].

As the ratios of one impact the other, the connection between DM, ash, protein, and fat is complimentary. While succulent or moisture has a somewhat soft relationship to fat, protein and ash have an inverse interaction with fat, increasing the ability of muscles or other components to retain water or the makeup of the fatty composition [25]. Most of the natural antioxidants are obtained from plant resources including culinary herbs, Spices, fruits, vegetables, and oilseed products [26-27], this was evident in Figures No. 11 and 12, where this relationship was represented at the highest level with beef.

We discovered that protein has an inverse association with fat and DM but contains a soft link with ash; this was evident in Figures No. 1 and 2 for Ash, where they represent the highest level in lamb meat. The enhanced ability of oat fiber to maintain moisture, as well

as stop cooked meats from drying out, is one of its many advantages in addition to its tongue-feel that resembles fat and its capacity to preserve the meat's unique flavors [28], this was evident in Figures No. 7 and 8 for DM, where they represent the highest level in beef, consistent with the fact that it retained fat. This was also significantly higher in Figures 11 and 12.

According to popular belief, oat fiber has a mouthfeel similar to fat and preserves the natural flavors of the product. In the same token, it adds additional fiber to the final product [24]. Additionally, the oat fiber helped retain moisture, resulting in a more appetizing product [29]. The findings for oats showed a significant difference in all treatments at p< 0.01, while [30-31] oat flour and carrageenan were added to the mixture, which increased yield and moisture retention while cooking and frying (P < 0.05). The findings for oats showed a significant difference in all treatments at p<0.01, compared to beef meat at 15% Oats treatments.

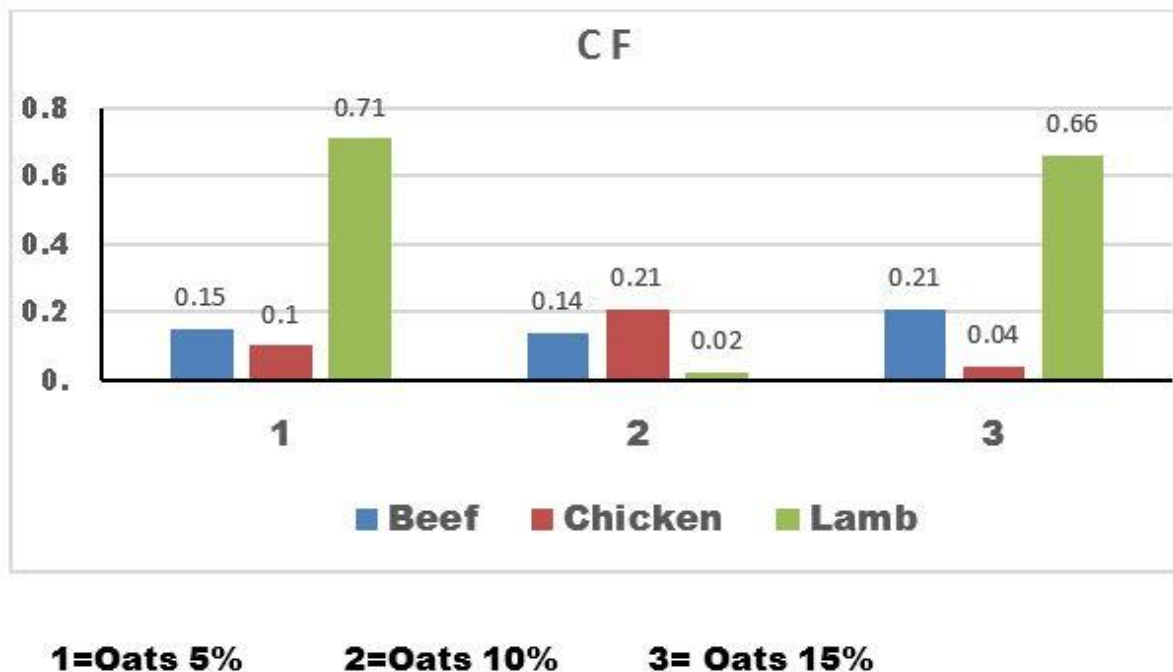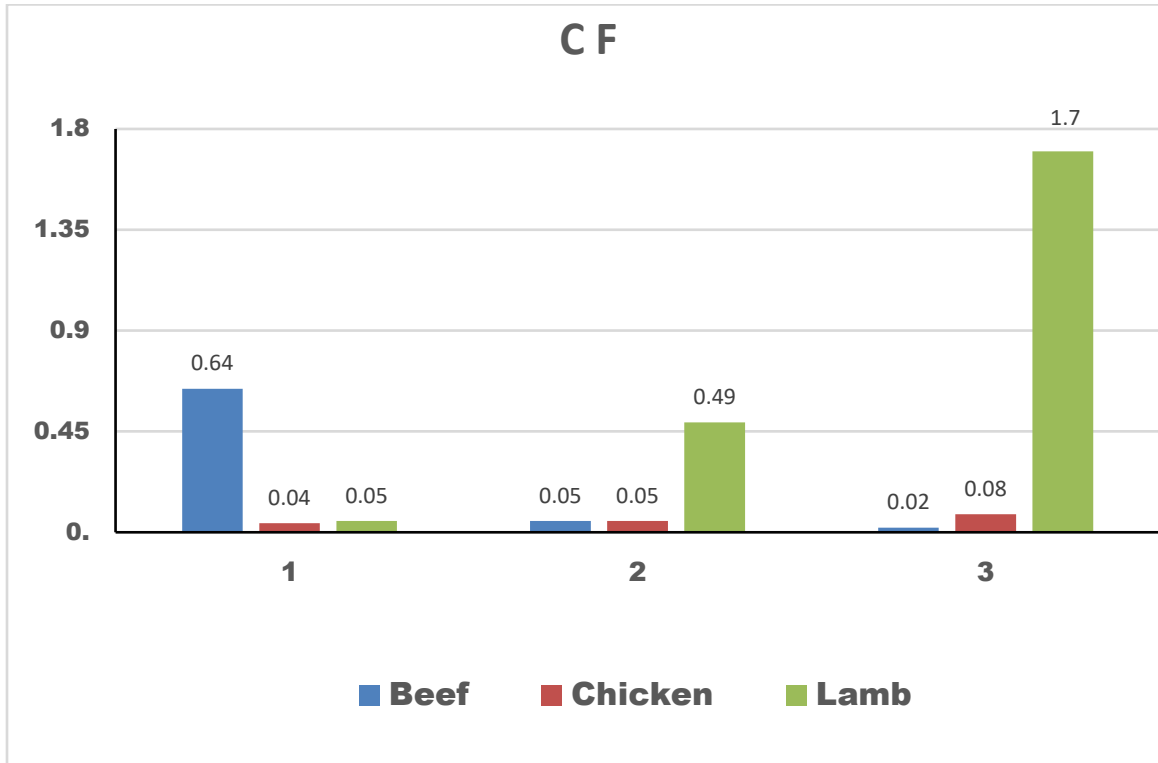**Figure 13 :** Fiber concentration in the substituted burger with Soya

1=Soya 5%   **2=Soya 10%**   **3=Soya 15%**

Figure 14 : Fiber concentration in the substituted burger with Soya

CONCLUSION: Low fat and high fiber kofta meat can be made using oat flour with an 8.0% oat flour and 0.5% carrageenan, with little negative impact on its physicochemical and sensory properties. To boost yield, stabilize emulsified meat products and decrease processing costs and water loss, soy protein isolate is frequently utilized as a binder in processed meat products [32]. There was no discernible variation in the texture of the product. With higher levels of oat inclusion, the juiciness score rose, while the texture and taste scored average, which decreased consumer interest in the product. The proportion of crude protein and fat reduced as the amount of oats rise, while moisture, crude fiber and gross energy increased significantly. As a result, up to 10% more oats than chicken flesh can be used to create low-fat, dietary fiber-rich chicken nuggets that are acceptable [4].

Ultimately, increasing the amount of soybean waste will decrease cooking loss by a proportionate amount. In other words, the product that has the highest amount of soybean waste will produce higher amounts of juice and have a higher weight due to the waste's ability to store water and fat. In comparison to other samples, the sample generally provided the lowest hardness level. This might be according to the proximate analysis that was done, as there is a high proportion of fat present. The amount of fat in a sample heavily influences its hardness, and a large level will make the dish softer and juicier [19; 33-34].

A few studies have been conducted on quality and durability of meat products by additional fiber, such as burgers. The findings of this study suggested processing burgers by adding various plant sources (soybeans and oats) with varying Proportions of 5, 10, and 15% on the product's quality attributes. The findings suggested that fibers might be used as food additives in burger products, without producing unfavorable changes in the product's quality or attributes.

The purpose of this study was to evaluate the textural characteristics of low-fat meat products (burgers) when soybean and oats were added in 5, 10, and 15% proportions to the preparation of meat nuggets. The possibility of using additional vegetable fibers as a filler or supporting component in the production of meat products will become available in the future.

Abbreviations: Ca: Calcium, Mg: magnesium, P: potassium, Pb: phosphorous, Na: sodium, Fe: iron, B: vitamin B, E: vitamin E, CHO: carbohydrates, CF: Crude fiber, DM : Dry matter , RTE: Ready To eat.

Authors Contribution: Sara Thamer Hadi: Formal analysis; Methodology; Project administration; Funding acquisition; Validation; Writing-original draft. Firas Riyadh Jameel: Data curation; Formal analysis; Methodology; Project administration; Supervision; Resources; Validation; Mohammed Majed Hamid: Writing-review and editing.

Competing Interests: The authors declared no conflict of interest.

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