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Determination of Some Changes in Chemical, Physical and Sensory Properties of Kebab when admixed with Chicken Breast Meat

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Abstract

The objective of this research was to determine chemical composition, physiochemical and sensory traits of kababafter adding chicken breast meat with different concentrations. The standard mixture of kebab considered as control treatment (20% beef, 5% sheep fat tail and 75% meat of sheep flank) was treated with addition of different concentrations of chicken breast meat (the concentration of meat from sheep flank area was changed by lowering from 75% to 45%) as T1, T2, T3, T4, T5 in rate of 10%, 15%, 20%, 25%, 30%, respectively. After preparing the samples, sensory evaluation was conducted for all of the kebab treatments. This wasfollowed by chemical analysis measurements for the raw and grilled samples, which comprised of the several parameters including the percentage of moisture, protein, fat and ash contents. Studying of the changes in the organoleptic features laterwas represented by measuring pH, peroxide value; free fatty acid (Acid Value), beside cholesterol content and water holding capacity. Overall, moisture content, similar to protein, increased when chicken meat was added. Whereas fat and water holding capacity (W.H.C) decreased. However, no significant difference was observed in changes of ash content among treatments. As regard meat fat parameters which includes peroxide value, free fatty acid and cholesterol, their values decreased significantly in samples where chicken meat was added. For the sensory evaluation, in general, significant lower values were obtained for treatments contained the highest concentration of chicken breast meat.

Introduction

Meat and meat products represent an important and large component of human food, and their quality is of concern to the consumers, the regulatory authorities, the processors and the retailers. Among those kebab is very popular meat product consumed by many people all over the world especially in Kurdistan region of Iraq; It is prepared from ground red meat, particularly beef and sheep. The demand for kebab is increasing mainly due to changing lifestyle. Moreover, kebab is also catered as a fast food option for a large number of domestic and foreign tourists.

Although kebab has a high nutritional value, higher consumption level of meat products associate with a negative health image *[1].*It gradually increases the risks of attracting chronic diseases such as obesity, cancer, cardiovascular disease and stroke, due to its "high" fat content, saturated fatty acid, cholesterol and salt especially in the case of red meat*[2].* Hence, efforts to find acceptable ways to maintain good quality and safety meat products are of great importance. The use of poultry meat in the formulation of kebab in the food industry has started from the Sixtieth of the last century, when there was a strong tendency to replace red meat with healthier, white meat in industrialized countries were the lower price of the latter compared to the other kinds of meat was one of the reasons to be sprouted in the food industry *[3].* Indeed poultry consumption has been increasingly accepted due to its relatively lower saturated fat and cholesterol content

than mammalian meats. Hence, we aimed to verify the influence of the addition of chicken meat on the chemical and sensory properties of kebab, hoping by this the new product could have less negative contribution to people's health when consumed.

Material and Methods

A. Preparation of Kebab Samples

In preparing mixture of meat for kebab sample, beef meat, meat of sheep flank and chicken breast meat were purchased in local market. Kebab is made from ground muscles of beef meat, meat of sheep flank and chicken breast with ground sheep fat tail, added %0.6 g salt, %1.6 g flour and %6.6 g tomato. Prepared mixture of meat and fixed on metal skewers and grilled on charcoal for max 3-5 min on each side. Kebab meat samples were analyzed before and after the grilling process. The percentage of Beef meat was %20 and sheep tail fat was %5, they were fixed amount, but the percentage of sheep and chicken was changed according to the kind of treatments as follow:

Control treatment: contain %20 beef, %5 sheep tail fat and %75 meat of sheep flank area.

Treatment 1: It was contain %20 beef, %5 sheep tail fat, %65 meat of sheep flank area and %10 chicken breast meat.

Treatment 2: It was contain %20 beef, %5 sheep tail fat, %60 meat of sheep flank area and % 15 chicken breast meats.

Treatment 3: It was contain %20 beef, %5 sheep tail fat, %55 meat of sheep flank area and % 20 chicken breast meats.

Treatment 4: It was contain %20 beef, %5 sheep tail fat, %50 meat of sheep flank area and %25 chicken breast meat.

Treatment 5: It was contain %20 beef, %5 sheep tail fat, %45 meat of sheep flank area and % 30 chicken breast meats.

The samples were kept in a special container at -20°C for further analysis.

B. Analyses and Measurements

Moisture Contents Determination

Moisture content was determined in raw and grilled samples according to AOAC (2000) *[4]*.

Total Fat Determination

Total fat was extracted from raw and grilled samples according to AOAC (2000) *[4]*.

Protein Content Determination

Protein percent (Kjeldahl N x 6.25), total nitrogen was determined according to AOAC (2000) *[4]*.

Ash Determination

Ash was determined according to AOAC (2000) *[4]*.

Physiochemical traits of Kebab

pH Measurement

The pH was measured according to Culler et al., (1978) *[5]*.

Peroxide Value (PV) Determination

Pv determined according to Aksu (2007) *[6]*.

Acid Value (A.V)

Acid value measured as procedure describe by Okpuzor et al., (2009) *[7]*.

Cholesterol Determination

For detection of cholesterol value in the lipid samples, UV-visible spectrophotometer was used according to Liebermann-Burchard method *[8]*.Liberman-burchard reagent was prepared by 0.5 ml of sulfuric acid (%99.9) dissolved in 10 ml of acetic anhydride covered and kept in ice bucket *[9]*.

Preparation of Samples and Standards

One gm of fat samples was extract from each meat samples, and dissolved in 10 ml of chloroform. Then 1 ml of the diluted sample was further diluted 10-folds to give a final dilution of 100 fold in chloroform. Standard were prepared as show in *(Table: 1)*.

Table-1: Volume of stock Cholesterol Standard and Chloroform used in the Preparation Cholesterol Standards

Reagent	***S1***	***S2***	***S3***	***S4***	***S5***	***S6***	***S7***
5Standard cholesterol (mg)	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*	*0.7*	*0*
Chloroform (ml)	*2.5*	*2.25*	*2*	*1.75*	*1.5*	*1.25*	*2.5*

Then Cholesterol content was estimated by adding one ml of Liberman-Burchanrd reagent to 2.5 ml of sample /standard cholesterol and the tube was covered and kept in a dark place for 15 minutes. The absorbance of the samples and the standards were read at 620nm. Then the cholesterol concentration was calculated from comparison with a constructed standard curve, *Figure: 1.*

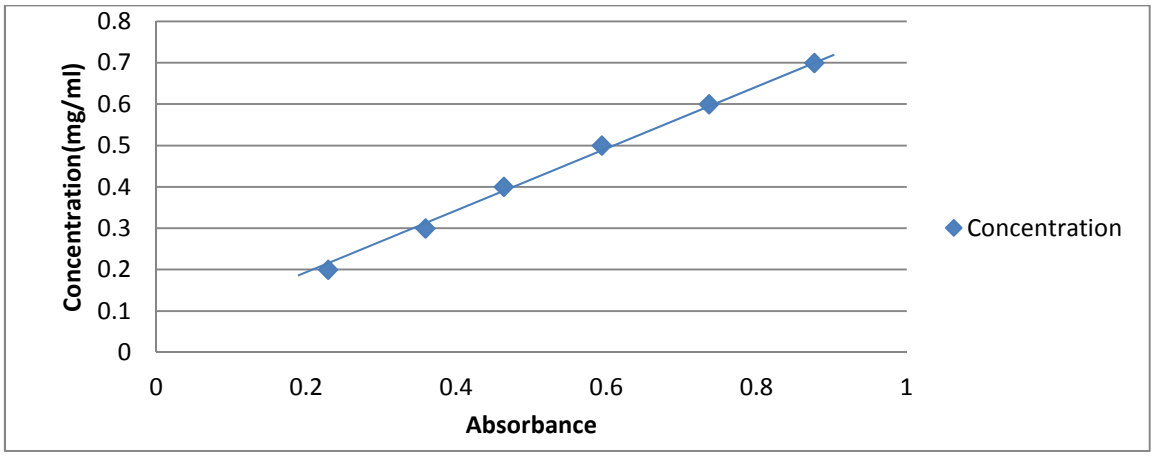

Figure-1: Calibration Curve Using for Cholesterol Standard.

Water Holding Capacity (WHC)

WHC was measured according to***[10].***

Sensory Evaluation

Sensory evaluation was carried out by an eight member semi-expert panelist who was involved to evaluate the treatments. The panel members were academic staff of food science and animal science Departments' at Sulaimani University-College of Agricultural Sciences and all were experienced in sensory evaluation of various food products. Members were asked to evaluate the samples of each treatment for color, taste, flavor, odour, texture and tenderness. The panel evaluated a piece of kebab from each one of the six treatment samples at the same time, the evaluation was done at exactly 11 am for the break time interval with water drunk between the evaluations sessions ***[11]***.

Table-2: Sensory Evaluation Table Format

Treatments	***Color***	***Odour***	***Taste***	***Flavour***	***Texture***	***Tenderness***	***Overall acceptable Sum***
Control							
T1							
T2							
T3							
T4							
T5							

*All the scores were recorded on a scale of 1-5 where:

1- Very unacceptable, 2-Un acceptable, 3- Slightly acceptable, 4- Acceptable, 5- Very acceptable

Statistical Analysis

Data collected for all parameters were analyzed in a completely randomized design (CRD).

Results and Discussions

Chemical Composition of Raw and Grilled Kebab

Moisture Percentage

The moisture value of several Kebab treatments of two main sample types; raw and grilled showed in table 1, he results revealed that there were significant differences in the moisture values between raw and grilled treatments, it was higher in raw kebab with average of 56.85% than of grilled Kebab with average of 48.27%, there was at least 6.8% moisture differences between grilled and raw kebabs, close result for moisture mean value was reported by Mustafa (2013) *[12]*which was 68.73 % for raw beef meat that reduce to 64.62% in grilled beef meat, and 58.14%. For raw mutton Meat that reduces to 56.14% in grilled mutton meat, this is due to evaporation of water and volatile agents during grilling which cause the reduction in moisture content. In comparison between the treatments, the value reached as high as 57.74% in treatment (5) of raw samples where 30% of chicken meat added. This value is slightly higher than that of the control of raw samples which was 55.87%., after grilling, the highest content of the moisture content was also recorded in treatment (5)(50.94%) which is far higher than that of the control of grilled samples (%44.39) but lower if compared with its correspondent of the raw samples, this means that the more added of chicken meat, the highest value recorded for each treatment. These results are in consistent with the study of Fabiane *et al., (2003)[13]*who found that the moisture content of sausage was increased from the control treatment (with no chicken) which was 59.86% to reach a value of 63.98% by adding 20% of chicken meat. The reason behind the rise in moisture content in kebab samples with the added of chicken meat can be attributed to the fact that chicken meat is moister than sheep and beef meat*[14; 15]*which in turn cause increase in the moisture content of the samples when added by chicken meat.

Table-3: Moisture percentage of the five kebab treatments (Raw and Grilled) consist of mixed beef and sheep meat (control) treated by adding different percentages of chicken meat.

	Moisture Percentage (%)	
Treatments	***Raw Samples***	***Grilled Samples***
Control	*55.87 ± 0.008 c*	*44.39 ± 0.477 d*
	A	*D*
T1	*56.46 ± 0.971 bc*	*47.19 ± 0.336 c*
	A	*C*
T2	*57.18 ± 0.679 ab*	*47.66 ± 0.313 bc*
	A	*C*
T3	*56.54 ± 0.133 abc*	*49.72 ± 1.915 ab*
	A	*B*
T4	*57.35 ± 0.619 ab*	*49.73 ± 0.436 ab*
	A	*B*
T5	*57.74 ± 0.184 a*	*50.94 ± 0.410 a*
	A	*B*
Average	*56.85*	*48.27*

*Control (beef and sheep flank meat), T1 (10% chicken breast meat), T2 (15% chicken breast meat), T3 (20%chicken breast meat), T4 (25% chicken breast meat), T5 (30% chicken breast meat).

* Small letters represent changes among the five different treatments within same category (raw or grill) column but capital letters represent changes between the two categories (raw and grill).

* Means having the same letter are not significantly different at $p>0.05$.

Fat Percentage

The fat percentages of all kebab treatments with a significant difference ($p<0.05$) between raw and grilled samples (table 2),. The former samples column shows that the fat valued 21.51% in the control, with the addition of chicken meat, the value of all the five treatment reduced gradually to record a minimum of 9.62% at treatment (5), where 30% of chicken meat added. Likewise, after grilling the Fat percentages of all the treatments decreased from that of the control (31.20%) to reach a minimum of 16.09% in treatment (5) which is nearly half of the control value. Generally, it is observed that the raising in the percentage of added chicken meat for each treatment had reduced the fat content in both raw and grilled meat. Similar effect can be obtained from the study of Fabiane et al., (2003) *[13]*who recorded 19.89% of fat value in sausage of control treatment, this value reduced to 16.89% when the researcher added 20% chicken meat to the control. The question of the reduction in fat value after addition of various percentages of chicken meat can be answered by the fact that chicken meat contains less amount of fat as Kang et al., (2007) *[14]*reported 1.05% of fat in raw breast chicken meat while 0.57% was reported by Pizato et al., (2014) *[15]*,therefore the higher amount added, the more reduction in fat values of samples were noticed. In comparison raw and grilled samples, it is obvious that the fat values increased by grilling as opposed to the raw Samples, the raw sample of control treatment had 21.51% while its value has increased to 31.20 % when grilled. The average of mean for both samples categories (raw and grilled) also confirms that fat content became higher after grilling (15.47% and 23.36% respectively). Nemati et al., (2008) *[16]*also showed that the fat content in kebab product was 14.05% when samples where raw and became 18.58% after grilling. Increased values after grilling can be attributed to the dehydration that occurs by this process which led it increase the percentage of fat.

Table-4: Fat percentages of the five kebab treatments (Raw and Grilled) consist of mixing beef and sheep meat (control) treated by adding different percentages of chicken meat

	Fat Percentage (%)	
Treatments	***Raw samples***	***Grilled samples***
Control	*21.51 ± 0.317 a*	*31.20 ± 0.715 a*
	C	*A*
T1	*19.14 ± 1.435 b*	*26.01 ± 0.045 b*
	D	*B*
T2	*15.62 ± 0.600 c*	*23.31 ± 0.147 c*
	E	*C*
T3	*14.57 ± 0.138 c*	*19.18 ± 1.830 d*
	E	*D*
T4	*12.38 ± 0.632 d*	*18.42 ± 0.596 de*
	F	*D*
T5	*9.62 ± 0.894 e*	*16.09 ± 0.224 e*
	G	*E*

*Control (beef and sheep flank meat), T1 (10% chicken breast meat), T2 (15% chicken breast meat), T3 (20% chicken breast meat), T4 (25% chicken breast meat), T5 (30% chicken breast meat).

* Small letters represent changes among the five different treatments within same category (raw or grill) column but capital letters represent changes between the two categories (raw and grill).

* Means having the same letter are not significantly different at $p>0.05$

Protein Percentage

The protein content of kebab samples is illustrated in Table3,The results reveal that protein mean was significantly ($p <0.05$) increased with the addition of chicken breast meat in all the treatments for raw and grilled samples. It is obvious that the lowest level of protein content(19.96%) was recorded for the control of raw sample while the highest level for such samples (29.53%) was in treatment(5) (where 30% of chicken

breast meat added). These values increased after grilling to show 21.46% for the control mixture and 30.21% for treatment (5)(30% of the breast chicken meat added). It means that the protein content gradually increased by adding chicken breast meat . This is due to the fact that, raw chicken breast meat contain a higher protein percentage compared with beef and sheep *[8;17]*which cause increasing the protein content of the kebab treatments when added to them .

In comparison between raw and grilled samples it was found that the means percentage of protein for grilled samples (26.50%) was higher than that of raw samples (24.89%) by 1.61. The raising in protein content of the grilled samples compared to raw samples was also reported by Mustafa (2013) *[12]*who found that the deference between grilled and raw kebabs were 7.10% and 4.03% using beef meat and mutton meat respectively. Also Nemati et al., (2008) *[16]*studied the deference between the protein content in raw kebab and grilled one, which was 5.19%, and the same result reported before by *[18]*on donar kebab. Increasing amount of protein after grilling is attributed to the effect of decreased water (moisture) from the grilled samples result in increasing of other components including protein *[16]*.

Table-5: Protein percentages of the five kebab treatments (Raw and Grilled) consist of mixing beef and sheep meat (control) treated by adding different percentages of chicken meat

	Protein Percentage (%)	
Treatments	***Raw samples***	***Grilled samples***
Control	*19.96 ± 0.284 f J*	*21.46 ± 0.225 f I*
T1	*21.66 ± 0.488 e I*	*23.86 ± 0.295 e H*
T2	*24.46 ± 0.137 d G*	*26.31 ± 0.194 d F*
T3	*26.23 ± 0.138 c F*	*28.22 ± 0.117 c D*
T4	*27.50 ± 0.138 b E*	*28.97 ± 0.117 b C*
T5	*29.53 ± 0.278 a B*	*30.21 ± 0.059 a A*

*Control (beef and sheep flank meat), T1 (10% chicken breast meat), T2 (15% chicken breast meat), T3 (20% chicken breast meat), T4 (25% chicken breast meat), T5 (30% chicken breast meat).

* Small letters represent changes among the five different treatments within same category (raw or grill) column but capital letters represent changes between the two categories (raw and grill).

* Means having the same letter are not significantly different at $p>0.05$.

Ash Percentage

The ash percentages of raw and grilled kebab treatments are showed in table 4. The results show that there were no significant difference($p>0.05$) in ash percentages neither between the five treatments of both two sample types, or between the two controls. However the mean value of the ash content of grilled kebab (%1.51) was higher than that of raw kebab (%1.21), same were reported by Mustafa (2013) *[12]*who found that the ash content of kebab were 1.10% and 1.19% in grilled beef and mutton respectively, also Nemati et al., (2008) *[16]*found increase in the ash content of cooked Bonab kebab samples in comparison with raw sample. The deference be Significant or not between the treatments in ash contents, attributed to the fact that both raw and grilled samples of kebab were expose to extreme heating to remain the mineral content (ash content) which are not destroyed by references.

In comparison between the treatments, the control of raw samples recorded the lowest ash content (1.14%) while the highest value was detected in the control of grilled samples (1.63%), mean that replacing of beef and sheep meat with breast chicken have little deference on the ash content of the treatments because the ash content in chicken breast meat was not always high (1.7%) *[14]*. Hence it is obvious that nearly the same ash content existed in all types of meat (sheep, beef and chicken). However determination of ash content of any food including kebab still important, because quality of many foods depends on the concentration and type of minerals they contain, including their taste, appearance, texture and stability*[7]*.

Table-6: Ash percentage of the five kebab treatments (Raw and Grilled) consist of mixing beef and sheep meat (control) treated by adding different percentages of chicken meat.

	Ash Percentage (%)	
Treatments	***Raw samples***	***Grilled samples***
Control	*1.14 ± 0.024 a D*	*1.63 ± 0.011 a A*
T1	*1.17 ± 0.026 a D*	*1.59 ± 0.020 a AB*
T2	*1.21 ± 0.027 a D*	*1.37 ± 0.095 a BCD*
T3	*1.22 ± 0.047 a D*	*1.46 ± 0.160 a ABC*
T4	*1.26 ± 0.028 a CD*	*1.60 ± 0.054 a AB*
T5	*1.27 ± 0.055 a CD*	*1.46 ± 0.317 a ABC*

*Control (beef and sheep flank meat), T1 (10% chicken breast meat), T2 (15% chicken breast meat), T3 (20% chicken breast meat), T4 (25% chicken breast meat), T5 (30% chicken breast meat).

* Small letters represent changes among the five different treatments within same category (raw or grill) column but capital letters represent changes between the two categories (raw and grill).

* Means having the same letter are not significantly different at $p>0.05$

Physiochemical Traits of Kebab

pH Value

The pH value of kebab samples ranged between 5.61-5.82 for raw sample and between 6.00-6.06 for grilled sample Table(5)were significant differences (P<0.05) among them. The pH values of raw samples were increased after grilling in all the treatments, the mean value of pH of raw and grilled samples were 5.72 and 6.03respectively, this is agree with Nemati et al., (2008) *[16]*who reported 5.99 and 6.45 values for raw and grilled kebab Respectively, the reason behind that due to that most meats sold or processed after 24 hr. from slaughtering process, which caused to lower the pH value below 6.5 after the rigor mortis occurred*[17]*. In comparison between the treatments, pH values reached the highest level (6.06) in treatment (5) in grilled samples (30% chicken meat) while the lowest value (5.61) was recorded in control mixture of raw samples. This mean that addition of chicken breast meat to kebab product resulted in a higher pH values for raw and grilled samples, due to the fact that the pH value of chicken meat is slightly higher than that of beef and sheep, some studies reported a value of 6.88 for chicken breast meat *[17]*and a value of 6.29 was recorded by Pizato et al., (2014) *[15]*for grilled chicken breast meat, which cause of increasing the pH values for raw and grilled samples after adding breast chicken meat to them.

Table-7: pH value of the five kebab treatments (Raw and Grilled) consist of mixing beef and sheep meat (control) treated by adding different percentages of chicken meat.

Treatments	*Raw samples*	*Grilled samples*
Control	*5.61 ± 0.015 e*	*6.00 ± 0.000 c*
	F	*AB*
T1	*5.68 ± 0.004 d*	*6.02 ± 0.009 bc*
	G	*A*
T2	*5.70 ± 0.004 c*	*6.04 ± 0.004 ab*
	E	*C*
T3	*5.72 ± 0.000 b*	*6.04 ± 0.009 ab*
	D	*A*
T4	*5.82 ± 0.004 a*	*6.06 ± 0.014 a*
	E	*BC*
T5	*5.82 ± 0.004 a*	*6.06 ± 0.028 a*
	D	*A*

*Control (beef and sheep flank meat), T1 (10% chicken breast meat), T2 (15% chicken breast meat), T3 (20% chicken breast meat), T4 (25% chicken breast meat), T5 (30% chicken breast meat).

* Small letters represent changes among the five different treatments within same category (raw or grill) column but capital letters represent changes between the two categories (raw and grill).

* Means having the same letter are not significantly different at $p>0.05$

Peroxide value

Table (6) shows the peroxide values (PV) of raw and grilled samples, which ranged from 2.03 - 2.24 meqO_2/Kg in raw samples but 2.81 - 3.37 meqO_2/Kg in grilled samples with significant difference between the two sample Categories, the grilled samples (with a mean value of 3.13 meqO_2/Kg), PVs increased as compared to the raw samples (with a mean value of 2.14 meqO_2/Kg) other study reported the PVs of 2.30 and 1.45 meqO_2/Kg for raw beef and sheep meat, respectively, which increased to 4.51 and 3.4 meqO_2/Kg in grilled beef and mutton meat *[12]*, PVs give an indication of the oxidation progress because it measures the amount of peroxides, which are the primary products of the initial stages of oxidation of lipids, and the major factor that leads to substantial lipid oxidation in the meat, is the exposure to the direct heat during the period of grilling, since the meat samples are exposed to elevated temperature (200 – 220°C) *[19]* therefore the PVs of grilled samples were higher than those of raw samples. Adding chicken breast meat to kebab treatments in this study reduce the PVs, the highest of 3.37 meqO_2/Kg value recorded in control mixture in grilled samples and the lowest value of 2.03 meqO_2/Kg was observed in treatment 5 (30% chicken meat) in raw samples, this mean that addition of chicken breast meat to the kebab mixture yielded lower PVs in all the treatments comparing to the controls. The highest of added chicken meat, the lower PV was recorded due to the lower values of PVs of raw and grilled breast chicken meat compared to raw and grilled beef and sheep *[20]*.

Table-8: PVs value of the five kebab treatments (Raw and Grilled) consist of mixing beef and sheep meat (control) treated by adding different percentages of chicken meat.

	Peroxide Value meqO2/kg	
Treatments	***Raw samples***	***Grilled samples***
Control	*2.24 ± 0.000 a*	*3.37 ± 0.025 a*
	F	*A*
T1	*2.24 ± 0.000 a*	*3.35 ± 0.004 a*
	F	*A*
T2	*2.18 ± 0.009 b*	*3.21 ± 0.009 b*
	G	*B*
T3	*2.14 ± 0.004 c*	*3.08 ± 0.009 c*
	H	*C*
T4	*2.06 ± 0.001 d*	*2.98 ± 0.004 d*
	I	*D*
T5	*2.03 ± 0.009 e*	*2.81 ± 0.023 e*
	J	*E*

*Control (beef and sheep flank meat), T1 (10% chicken breast meat), T2 (15% chicken breast meat), T3 (20% chicken breast meat), T4 (25% chicken breast meat), T5 (30% chicken breast meat).
* Small letters represent changes among the five different treatments within same category (raw or grill) column but capital letters represent changes between the two categories (raw and grill).
* Means having the same letter are not significantly different at $p>0.05$

Acid Value (A.V)

Acid values (A.V) among different kebab treatments both raw and grilled meat samples are shown in table (7). Overall it is obvious that there was significant difference ($p<0.05$) between the raw and grilled samples and between the treatments of each Raw and grilled meat as well. It is also clear that among the raw samples the control had the highest acid value 1.23 mg KOH/g.fat, steadily and with the addition of gradually-increased-in-the-concentration of chicken breast meat, the acid values declined to reach a minimum of 1.03 mg KOH/g.fat in treatment(5). Similarly, within grilled samples, the maximum acid value was detected in the control, but values fell afterwards to reach of as low as 2.25 mg KOH/g.fat in the Treatment (5). It is claimed that the reason for the reduction in acid values in both controls when treated with chicken breast meat could be due to the overall reduction in fat ratio of the mixture with outcome products of lower acid values. In comparison between raw and grilled samples of kebab treatments, results revealed that there were significant differences in the acid values between them, it was higher in grilled samples with an average of 2.27 mg KOH/g.fat than of raw samples with an average of KOH/g.fat. close results obtained by Mustafa (2013) *[12]* with acid values of 2.71 mg KOH/g.fat and 3.06 mg KOH/g.fat in grilled beef and mutton kebab, respectively which were higher than 1.78 mg KOH/gm.fat and 2.12 mg KOH/gm.fat which obtained when the samples were raw. Shater et al., (2012) *[21]*also reported acid values of 0.53 mg KOH/g.fat for raw chicken breast meat samples which increased to 1.1 mg KOH/g.fat in roasted chicken breast meat samples, the reason of that is due to that exposure to the direct heat during grilling had led to the degradation of the product with the final raise in acid values*[22].* Hence acid value is regarded as an important determinant of quality and fat rancidity in meat products including kebab.

Table-9:A.Vs of the five kebab treatments (Raw and Grilled) consist of mixing beef and sheep meat (control) treated by adding different percentages of chicken meat.

	Total Acidity *mg KOH/g.fat*	
Treatments	***Raw samples***	***Grilled samples***
Control	*1.23 ± 0.015 a*	*2.29 ± 0.000 a*
	E	*A*
T1	*1.21 ± 0.009 ab*	*2.28 ± 0.004 a*
	F	*AB*
T2	*1.21 ± 0.000 b*	*2.28 ± 0.004 ab*
	F	*AB*
T3	*1.16 ± 0.012 c*	*2.27 ± 0.004 b*
	G	*BC*
T4	*1.14 ± 0.004 d*	*2.26 ± 0.000 c*
	H	*CD*
T5	*1.13 ± 0.004 d*	*2.25 ± 0.004 c*
	H	*D*

*Control (beef and sheep flank meat), T1 (10% chicken breast meat), T2 (15% chicken breast meat), T3 (20% chicken breast meat), T4 (25% chicken breast meat), T5 (30% chicken breast meat).

* Small letters represent changes among the five different treatments within same category (raw or grill) column but capital letters represent changes between the two categories (raw and grill).

* Means having the same letter are not significantly different at $p>0.05$

Cholesterol

the cholesterol content in raw and grilled kebab samples (Table, 8)Results show that there were significant differences ($p<0.05$) among cholesterol values of the two sample categories. A value of 46.67 mg/100g was measured in the control of raw samples which decrease in the subsequent treatments to reach the lowest of 43.05mg/100g in treatment(5) (where 30% chicken breast meat added to the raw meat. The highest value of cholesterol content of grilled samples was also recorded in the control (81.38 mg/100g) and decrease gradually by adding chicken breast meat to reach the lowest (76.33 mg/100g) in the treatment(5). Hence the raising in the percentage of added chicken meat for each treatment had reduced the cholesterol content in both raw and grilled meat. Similar effect can be obtained from the study of Fabiane et al., (2003) *[13]* who recorded 19.89% as fat value of sausage control, this value reduced to 16.89% when the researcher treated the control with 20% chicken meat, the reason behind this is Due to the fact that chicken meat contains less amount of cholesterol and the higher concentration added, the more decrease in fat values of samples were noticed. Means average of cholesterol content for grilled meat (79.05 mg/100g) was higher than that of the raw ones measured such values and recorded the values of 50 and 60 mg/100g in raw beef and mutton which increase to 81 and 130 mg/100mg in cooked beef and mutton, respectively. Also Yasmine (2009) *[23]*measured cholesterol content of chicken breast meat and reported 50 and 69 mg/100g for raw and grilled chicken breast meat, respectively. Cholesterol content increased in grilled samples possibly because of lowering the moisture content which in turn resulted in relative increase in the fat and cholesterol among samples composition *[16]*.

Table-10: Cholesterol content of the five kebab treatments (Raw and Grilled) consist of mixing beef and sheep meat (control) treated by adding different percentagesof chicken meat.

Treatments	*Raw samples(mg/100g)*	*Grilled samples(mg/100g)*
Control	*46.67 ± 0.25 a*	*81.38 ± 0.25 a*
	D	*A*
T1	*46.27 ± 0.623 a*	*81.38 ± 0.623 a*
	D	*A*
T2	*44.16 ± 0.623 b*	*79.71 ± 0.623 b*
	E	*B*
T3	*43.60 ± 0.623 b*	*78.60 ± 0.623 b*
	E	*B*
T4	*43.38 ± 0.623 b*	*76.93 ± 0.623 c*
	E	*C*
T5	*43.05 ± 0.623 b*	*76.33 ± 0.623 c*
	E	*C*

*Control (beef and sheep flank meat), T1 (10% chicken breast meat), T2 (15% chicken breast meat), T3 (20% chicken breast meat), T4 (25% chicken breast meat), T5 (30% chicken breast meat).

* Small letters represent changes among the five different treatments within same category (raw or grill) column but capital letters represent changes between the two categories (raw and grill).

* Means having the same letter are not significantly different at $p>0.05$.

Water holding capacity (WHC)

(Table: 9) shows the water holding capacity WHC among various raw and grilled kebab samples with high significant difference ($p<0.05$) between them. The mean value of WHC of raw samples was 45.36 which decrease after grilling to 38.12% in all the treatments, which mean less water remained after grilling .Reduction in WHC after grilling was partially due to dehydration of the samples by the impact of heating but mainly due to the raise in pH value and the changes in protein structure after grilling. In the control of raw samples water retained at its highest level of 46.59% but this started to decrease among raw sample treatments to record 44.04% in the last treatment (where 30% of chicken breast meat added). The same decrease in WHC found after grilling, 40.01% of WHC recorded in control treatments which reduce to reach the lowest value of 35.77% in treatment (5). Since chicken breast meat is different in terms of the latter characteristics, for example different capacity to change during cooking, and less value of WHC compared to red meat, its addition to the samples with various concentrations had led to fall in WHC in those treated with it. It was studied that alterations in muscle proteins, especially myofibrils, play important roles in the capability of such organ to hold water *[22]*.

Table-11: WHC percentage of the five kebab treatments (Raw and Grilled) consist of mixing beef and sheep meat (control) treated by adding different percentages of chicken meat.

	WHC%	
Treatments	***Raw samples***	***Grilled samples***
Control	*46.59 ± 0.042 a*	*40.01 ± 0.455 a*
	A	*E*
T1	*45.95 ± 1.006 ab*	*39.27 ± 0.437 bc*
	AB	*E*
T2	*46.53 ± 0.849 a*	*39.23 ± 0.360 bc*
	A	*DE*
T3	*44.22 ± 0.232 c*	*37.43 ± 1.980 ab*
	B	*CD*
T4	*44.83 ± 0.670 bc*	*37.06 ± 0.460 ab*
	AB	*CD*
T5	*44.04 ± 0.383 c*	*35.77 ± 0.441 a*
	B	*C*

*Control (beef and sheep flank meat), T1 (10% chicken breast meat), T2 (15% chicken breast meat), T3 (20% chicken breast meat), T4 (25% chicken breast meat), T5 (30% chicken breast meat).

* Small letters represent changes among the five different treatments within same category (raw or grill) column but capital letters represent changes between the two categories (raw and grill).

* Means having the same letter are not significantly different at $p>0.05$

Sensory Evaluation:

The sensory evaluation of all kebab samples are shown in table (10), there were highly significant differences ($p<0.01$) in color and tenderness characteristics among samples of the product. for the color property, the control was 4.4 while treatment (1) gave the highest value of 4.8, even higher than the control. Treatment 5 recorded the least value of 3.3. Likewise, the values of both treatments (1 and 2) of tenderness property were higher than their control (4.1, 4.4 and 4, respectively). The panelist evaluated the(taste, flavor, odour and texture) and provided all their treatments with values which were lower than their correspondent controls. The overall acceptance column shows highly significant differences between the treatment 1 and 2 as compared to treatment 3-5 with a control value that was higher than any treated samples. Control samples of most of the sensory properties rated higher than individual treatments. This might be due to the fact that people are acquaint more with a kebab product made from pure sheep meat or beef than a product which was mixed with chicken breast meat. However, the rate of acceptance indicated that even this mixture had good preference than was expected to be refused by the panel members.

Table-12 : Sensory Evaluation of the five kebab treatments (Raw and Grilled) consist of mixing beef and sheep meat (control) treated by adding different percentages of chicken meat.

Treatments	*Color*	*Odour*	*Taste*	*Flavour*	*Texture*	*Tenderness*	*Overall acceptable Sum*
Control	*4.4*	*4.4*	*4.4*	*4.3*	*4.2*	*4*	*4.28*
T1	*4.8*	*3.9*	*4.2*	*4.2*	*4.1*	*4.1*	*4.21*
T2	*3.9*	*3.6*	*3.9*	*3.9*	*4.1*	*4.4*	*3.96*
T3	*3.9*	*3.8*	*3.7*	*3.9*	*3.9*	*4*	*3.86*
T4	*3.7*	*3*	*3.6*	*3.4*	*3.9*	*3.7*	*3.55*
T5	*3.3*	*3.4*	*3.6*	*3.5*	*3.7*	*3.5*	*3.5*
t (observed value)	*18.51***	*28.54***	*26.20***	*18.99***	*53.17***	*30.75***	*35.01***
t (critical value)	*2.57*	*2.57*	*2.57*	*2.57*	*2.57*	*2.57*	*2.57*

*Control (beef and sheep flank meat), T1 (10% chicken breast meat), T2 (15% chicken breast meat), T3 (20% chicken breast meat), T4 (25% chicken breast meat), T5 (30% chicken breast meat).

Conclusions

1. Adding chicken breast meat to kebab mixture cause decrease of fat and cholesterol content and increase protein content in kebab which is very important for health benefits.
2. There were significant differences ($P<0.05$) between raw and grilled samples of kebab for all constituents which were analyzed except the ash content.
3. The lower moisture content in the grilled samples of kebab caused a relative increase inprotein, fat, peroxide value, acid values and cholesterol content compared to the raw samples. It is concluded that adding chicken breast meat to kebab mixture caused lower fat and cholesterol but higher protein contents in kebab. This fact brings about many health benefits for the new product at the time of consumption.

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