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Effect of Different Levels of Beef and Duck Meat on the Properties of Sausage

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Abstract: This study was conducted in the meat laboratory of the Department of Animal Resources in the College of Agriculture at the University of Basrah during the period 20/2/2012 to 20/5/2012. Different levels of beef meat and duck meat were used in the production of Sausage according to the fallowing treatments. Treatment A (100% beef meat), B (75% beef meat+5% duck meat), C (50% beef meat+50% duck meat), D (25% beef meat+5% duck meat) and treatment E (100% duck meat). Components used in production of this Sausage include lean beef meat, deboned duck meat, animal fat, crushed ice, salt, wheat flour, garlic powder and green pepper. Chemical, physical and organoleptic properties and pH were determined for the sausage. Percentages of moisture (67.90%) percentages and protein (20.05%) and pH value (5.62) in the treatment A were significantly ($p = 0.05$) higher than that of other treatments. Some physical and organoleptic properties particularly cooking loss, flavor, tenderness, juiciness and overall acceptance were significantly higher for treatment A too. On the other hand, treatment E was significantly ($p = 0.05$) higher in the Percentages of fat (19.40%) and ash (2.07%) and in the amount of lost liquids, peroxide number and color. No significant differences were obtained for the content of free fatty acids between treatments.

Key words: Beef meat, duck meat, sausage

INTRODUCTION

Sausage is a meat product produced from seasoned ground meat, generally of cylindrical shape. It is one of the oldest foods manufactured by man. Since old time sausage manufacture depends mainly on the meat of beef and sheep but during the last two decades of the 20th century poultry meat was used in manufacture of sausage. Duck is one of poultry kinds consumed for its, meat since it raised all over the world especially in Asia. Reports pointed out that world average meat production of ducks for the year 2007 is 3583809 tons (FAO, 2009). Ducks meat may add some different properties to sausage because it is differ from other poultry in its chemical and physical properties (Ali *et al*., 2008).

This study aimed to investigate its chemical, physical and organoleptic properties of sausage manufactured from duck meat in combination with beef meat.

MATERIALS AND METHODS

Sausage preparation: Different combination of beef meat and duck meat were used in 5 treatments A, B, C, D and E as shown in Table 1. Ingredients include lean beef meat, deboned duck meat, tallow, wheat flour, salt, garlic powder, green pepper and crushed ice.

Meat grinding: meat was minced twice in a meat grinder of 6mm mesh while fat was minced through a 4mm plate.

Mixing: Meat mixture was mixed by a meat mixer for thorough homogenization.

Table 1: Combination and ingredients of sausage

	Treatments				
Ingredients %	A	B	C	D	E
Beef meat	72	54	36	18	0
Duck meat	0	18	36	18	72
crushed ice	10	10	10	10	10
Tallow	10	10	10	10	10
wheat flour	3.5	3.5	3.5	3.5	3.5
salt	1.5	1.5	1.5	1.5	1.5
Garlic powder and green pepper	3	3	3	3	3

Treatments = A (100% beef meat), B (75% beef meat+25% duck meat), C (50% beef meat+50% duck meat), D (25% beef meat+75% duck meat) and E (100% duck meat)

Stuffing: Sausage mixture was stuffed into clean sheep small intestine.

Proximate analysis: Procedures of AOAC (1990) were followed for the determination of moisture, ash, protein (kieldhal) and fat (Soxhlet method), while pH meter was used for determination of pH.

Determination of sausage properties

Drib loss: Sausage samples were tied through cotton threads and put in the refrigerator in small nylon bags at 4°C for 48 hours, then dried by filter paper and weighed according to Eart *et al.* (1996).

The following equation was applied for the calculation of drip loos:

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$$\text{Drib loss 0 (\%)} = \frac{\text{weight of sample-weight of sample after 48 hours}}{\text{Weight of sample}} \times 100$$

Cooking loss: sausage samples were weighed and cooked in an oven of 177°C for 20 minutes, then cooled for room temperature and weighed again. Loss during cooking was calculated according to the following equation of Eart *et al.* (1996):

$$\text{Cooking loss (\%)} = \frac{\text{uncooked weight-cooked weight}}{\text{uncooked weight}} \times 100$$

Free Fatty Acids (FFA): percentage of FFA as oleic acid was calculated according to the following equation of Pearson (1970).

$$\text{FFA0 (\%)} = \frac{\text{titrated KOH (A-B)} \times N \times 282 \times 100}{1000 \times \text{weight of sample (gm)}}$$

Where:

A = Volume of KOH (ml) titrated against fat sample
B = Volume of KOH titrated against blank
282 = Molecular weight of oleic acid
N = Normality of KOH solution

Peroxide value: The procedure of Pearson (1970) was used to determine the Peroxide value (number) and calculated by the following equation:

$$\text{Peroxide value} = \frac{\text{Na2S2O3 (ml)} \times N \times 1000}{\text{weight of sample (g)}}$$

Sensory evaluation: Thirty panelists from the staff of Animal Resources Department were chosen randomly as judges to evaluate color, flavor, taste, texture and overall acceptance of the sausages sample.

The samples were coded using a three-digit random number. Samples were presented randomly. Seven point hedonic scales were used for the sensory evaluation of the sausages, on which a score of one equals "extremely like", while a score of seven is "extremely like" (Meilgaard *et al.*, 1999).

Statistical analysis: Data was statistically analyzed according to the program SPSS (2009).

RESULTS AND DISCUSSION

Table 2 shows the effect of source of meat on the proximate analysis of sausage. Moisture percentages of sausage in the treatments A (67.90%), B (67.47%) and C (67.39%) were significantly ($p<0.05$) higher than that of treatments D (65.69%) or E (62.89%), on the other hand, treatments A, B and C contained low percentages of fat (10.53,11.50 and 13.40%, respectively) in comparison with treatments D (16.37%) and E (19.40%). Treatments A, B and C contains higher percentages of beef meat (100,75 and 50%, respectively) compared with treatments D and E which contain high percentages of duck meat (100 and 75%, respectively) since duck meat contain higher percentages of fat (USDA, 2008). Andre's *et al.* (2004) also pointed out that increase of fat content in the sausage decreases of moisture content. The increase of ash content of treatment E (100% duck meat) compared with treatment A (100% beef meat) probably due to the damage occur to bones of duck and complained with the meat of sausage since duck bones are easy to damage during deboning compared with beef (Serdaroglu and Degirmencioglu, 2004). Significantly ($p<0.05$) high value of pH (5.62) of treatment A which contained the higher percentages of beef meat compared with other treatment probably due to the effects of age, weight and type of muscle on pH of meat (Okruszek *et al.*, 2008).

Table 3 shows that percentage of lost liquids in sausage of treatment E (100% duck meat) was significantly higher ($p<0.05$) than other treatments. The reason for this may be low content of duck meat of protein and low pH value which cause decrease in water holding capacity of meat. Peroxide value in treatment E was also significantly higher compared with other treatments. This is may be due to high contest of fat (Table 2) in duck meat (treatment E) (Tahir, 1990). The highest ($p<0.05$) percentage of liquids lost during cooking was in treatment A (100% beef meat). Muscle thickness of beef meat is greater than duck meat. Baeza *et al.* (2002) stated that liquids lost during cooking increase with the increase of muscle thickness of meat. No significant differences were noticed in free fatty acid percentages between treatments.

Treatment A (100% beef meat) was significantly higher ($p<0.05$) in flavor (8.17), tenderness (7.67), juiciness (7.67) and overall acceptably rating (8.17) in comparison with treatments containing 25-100% duck meat (Table 4). Color of sausage of treatment E (100% duck meat) evaluated the highest (8.17) compared with treatments A (6.33), B (6.50), C (6.67) and D (7.70). Presences of fat between muscles reduce the effect of connective tissues on tenderness in addition to the marbling of meat which add a flavor and stimulate the secretion of saliva in mouth leading to feeling with high juiciness (AL-Aswad, 2000). Differences in these parameters may be related to the effect of pigments myoglobin and hemoglobin and their concentration in the muscle, in addition to the vascular system in muscle which increase the concentration metabolism of hem pigment. Also pH of muscle and its content of marbling fat have a big effect on variation in color

Table 2: Effect of beef or duck meat percentage on the chemical composition and pH of sausage±Standard error

Treatments	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	pH
A	67.90a±0.20	20.05a±0.90	10.53e±0.60	1.63c±0.15	5.62a±0.04
B	67.47a±0.71	18.37b±0.93	11.50d±0.35	1.90b±0.10	5.54b±0.08
C	67.39a±0.36	17.50c±0.52	13.40c±0.32	1.80b±0.20	5.43c±0.04
D	65.69b±0.33	15.40d±0.40	16.37b±0.29	1.83b±0.05	5.09d±0.05
E	62.89c±0.69	14.97e±0.46	19.40a±0.26	2.07a±0.11	4.90e±0.01

*Means with different letter differ in each column significantly at 5%

Table 3: physical properties of sausage as affected by levels of beef and duck meat ±SE

Treatments	Lost liquids%	Liquids lost during cooking%	Peroxide value	Free fatty acid%
A	5.77e±0.43	54.99a±0.59	2.06c±0.24	1.20±0.15
B	6.44d±0.17	52.48b±0.26	2.09c±0.04	1.13±0.10
C	7.24c±0.38	51.64c±1.27	2.00c±0.06	1.10±0.20
D	8.01b±0.30	47.62d±1.11	2.43b±0.04	1.10±0.05
E	8.41a±0.23	40.37e±0.24	3.12a±0.15	1.23±0.11

*Means with different letter differ in each column significantly at 5%

Table 4: Effect of level of beef meat and duck meat on the sensory evaluation of sausage±SE

Treatments	Color	Flavor	Tenderness	Juiciness	Overall acceptably
A	6.33c±0.55	8.17a±0.35	7.67a±0.61	7.67a±0.15	8.17a±0.30
B	6.50c±0.56	7.83a±0.30	7.83a±0.16	7.00b±0.10	7.50b±0.22
C	6.67c±0.80	6.33b±0.71	6.50b±0.71	6.83b±0.20	7.17b±0.40
D	7.70b±0.42	6.17b±0.65	6.33b±0.66	6.83b±0.05	6.17c±0.47
E	8.17a±0.30	6.50b±0.76	6.30b±0.61	6.50c±0.11	6.00c±0.25

*Means with different letter differ in each column significantly at 5%

between muscles of meat (Fletcher *et al*., 2002). In conclusion, partially replacements of beef meat with duck meat in sausage manufacture significantly reduce cooking loss, improve color and did not significantly affect flavor and tenderness.

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