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COMPARISON OF RABBIT, BEEF AND BUFFALO MEATS FOR FUNCTIONAL PROPERTIES AND EATING QUALITY

Abdel Aziz,Hanaa A. *, Hallabo, S.A.S. and El-Wakeil, F.A.****
* Meat and Fish Technology Research Department, Food Technology Research Institute, Agriculture Research Center, Giza, Egypt.
** Food Science and Technology Department, Faculty of Agriculture, Cairo Univ., Egypt

ABSTRACT: Chemical composition, chemical and physical properties, concentrations of amino acids and evaluation of protein were determined for rabbit, beef and buffalo meats to study the functional properties and eating quality. From the results, it could be noticed that rabbit meat had higher quality and functional properties than other meats, since, rabbit meat had the highest levels of moisture, protein, TSN, EC, WHC and plasticity, while it had the lowest levels of fat, ash, TBA, TVN and color. It was found relatively differences in concentrations of amino acids when rabbit meat compared with beef and buffalo meats. It could be concluded that the three types of meat under investigation contained considerable concentrations of amino acids, particularly the essential ones which usually lack in many cereals and legumes proteins. It was observed that meats protein had higher amino acid scores than the FAO reference protein for the three investigated meats.

INTRODUCTION

Meat quality has been traditionally determined by sensory aspects, as their appearance, texture, aroma and flavor as well as its nutritional value gained great importance among the factors that determine meat quality. The nutritional role of meat is controversial because consumers generally consider that high ingestion of meat contributes to excess fat, cholesterol and saturated fatty acids, which are strongly linked to obesity and cardiovascular problems. The close relationship between diet and health has lead to changes in consumer habits, demanding products that meet their dietary and nutritional preferences. Rabbit meat is highly valued for its nutritional and dietary properties; it is a lean meat with a low-fat content and less saturated fatty acids and cholesterol than other meats **(Lombardi-Boccia, et al., 2005; Hernández and Gondret 2006; Pla, et al., 2007; Hernández, 2008).**

Rabbit meat has a higher protein (20-21%), low calories (1749 Kcal/Kg), low fat content (10-11%), low cholesterol value (169 mg/100 g of dry matter basis) and low sodium content when compared with meat from most livestock species **(Janieri, 1987)**

Combes,(2004) studied the nutritional value of rabbit meat and he found that for rabbits at commercial slaughtering age and weight, protein (21.0 $\pm$ 1.5 % of fresh meat), water (72.5 $\pm$ 2.5 % of fresh meat) and total mineral (1.2 $\pm$ 0.1 % of fresh meat) Main variations in the lipid contents (5.0 $\pm$ 3.3 % of fresh meat) mainly originate from anatomical area and diet. Cholesterol content of 59 mg/100 g and a ratio omega 6/omega 3 of 5.9 make rabbit meat attractive for health purposes.

The main components of meat, excluding water, are proteins and lipids. Rabbit meat is a lean meat rich in proteins of a high biological value and it is characterized by high levels of essential amino acids **(Dalle Zotte, 2004)**. Furthermore, meat is also an important source of highly available micronutrients, such as vitamins and minerals. Also, rabbit meat does not contain uric acid and has a low content of purines **(Skřivanová, et al., 2002; Pla, et al., 2004; Hernández, 2007).**

Rabbit meat is characterized by its lower energetic value compared with red meats **(Dalle Zotte, 2004)** due to its low fat content. Fat content varies widely depending of the carcass portion from 0.6 to 14.4% (fat from edible meat with intramuscular and intermuscular fat content) with an average value of 6.8% with the loin being the leanest part of the carcass (1.2% of lipids). Fatty acid composition of rabbit meat is characterized by high polyunsaturated fatty acid content **(Hernández and Gondret, 2006).**

Buffalo meat is getting recognition world wide, due to its edge over other meats with the unique flavour and characteristics of lower intramuscular fat, cholesterol and calories, higher units of essential amino acids, biological value and iron content **(Anjaneyulu et al., 1990)**. Buffalo meat has good functional properties for processing into variety of meat products such as sausages **(Sachindra *et al.*, 2005)**, patties **(Suman and Sharma, 2003)**, and burgers **(Modi *et al.*, 2003)**. India is producing more than 46% of the total world's buffalo meat. The low price of buffalo meat and its convenience in processing enhanced demand for it in domestic and international markets **(FAO, 2005)**.

The purpose of this investigation was to make a comparison of Rabbit, Beef and Buffalo meats for functional properties and eating quality.

MATERIALS AND METHODS

Materials:

Male rabbits, Giza sp (Lepus Cuniculus) 10 weeks old and about 2 kgs in weight, were obtained from the Ministry of Agriculture. These rabbits were slaughtered by a sharp knife, left for bleeding. The head, skin and internal organs were removed, then the carcasses were rapidly washed with tap water. After the excess water drained, the meat of the whole carcasses was separated, minced by a home mincer and then used directly for analysis of fresh meat. Fresh beef and fresh buffalo meats (of the hind quarter) were purchased from a private shop at government of Giza.

Methods :

Physical analysis :

Emulsifying capacity of meats was determined according to the method described by **Webb et al., (1970)**. Water holding capacity (WHC) and plasticity of meats were measured using the method of **Soloviuskaia and Merkodlovia,(1958)**. The Warrer- Bratzler shear force apparatus was used to measure the tenderness of meats, whereas, low shear values indicated high tenderness as reported by Herring, (1976). The color of meats was colorimetrically measured according to the method recommended by **Husaini, et al., (1950).**

Chemical analysis :

Moisture, protein, fat and ash contents of meats were determined by the standard methods as reported in the **A.O.A.C (2005)**. Amino acids of tested samples were determined by using a LKB 4151 Alpha plus Amino Acid Analyzer according to the method described by **Pellet and Young, (1980)**, Tryptophan was colorimetrically determined according to the method of **Blauth et al.,(1963)**. Total soluble nitrogen (TSN) was determined according to the method described by **Soloviev,(1966)**. Thiobarbituric acid (TBA) value was determined as described by **Egan, et al., (1981)** and total volatile nitrogen (TVN) as indicator of the quality was determined according to the method published by **Winton and Winton (1958)**.

RESULTS AND DISCUSSION

Data given in Table (1) shows the chemical composition of rabbit meat in comparison with beef and buffalo meats. From the results, it could be observed that rabbit meat had the highest moisture content (73.15 %), while the lowest moisture content was found in case of buffalo meat (69.87 %) ; the moisture content of beef lied in between the other two meats (70.45 %). Protein content (on dry weight basis) in rabbit meat was higher (81.49 %) than for buffalo meat (71.16 %) ; but beef meat had slightly lower protein (66.59 %). The ash content (on dry weight basis) of rabbit meat was slightly high (3.58 %) than that of buffalo meat (3.42 %) and beef meat (3.45 %). The amount of crude fat (on dry weight basis) was rather low for rabbit meat (14.93 %) than for buffalo meat (25.42 %) and beef (29.95 %).Therefore, the main characteristics of rabbit meat were of highest protein and lowest fat contents when compared with buffalo and beef meats as reported by **(Hernández, 2008).** It might be also concluded that differences between buffalo and beef meats were not markedly pronounced. Such results coincide with those reported by the **USDA (1963)** and **Serdaroulu and Turp,(2005),** who found that chemical composition of beef was 63.4 % moisture, 14.7 % protein, 9.6 % fat, 0.7 % ash. The information available on chemical composition of rabbit meat is extremely variable, especially regarding fat content, depending on the part of the carcass studied **(Pla *et al.*, 2004)** and also on the different productive factors **(Dalle Zotte, 2002),** especially feeding factors having a strong influence on the chemical composition of rabbit meat, in particular, on its lipid composition.

Table 1: Chemical composition of fresh meats

Constituents (%)	Meats					
	Rabbit		Beef		Buffalo	
	W.W	D.W	W.W	D.W	W.W	D.W
Moisture	73.15	--	70.45	--	69.87	--
Protein	21.88	81.49	19.68	66.59	21.44	71.16
Fat	4.01	14.93	8.85	29.95	7.66	25.42
Ash	0.96	3.58	1.02	3.45	1.03	3.42

The functional properties of meats are very important for the final characteristics of their finally processed products **(Whiting and Jenkins, 1981).** Therefore, total soluble nitrogen (TSN) , total volatile nitrogen (TVN), thiobarbituric acid value (TBA), emulsifying capacity (EC), water holding capacity (WHC), tenderness (measured as shear force and as plasticity) and color were determined for different meats used in this investigation and the obtained results are illustrated in Table (2). Results in Table (2) indicate that TSN values were nearly the same for beef (2.46 %) and buffalo meat (2.35 %) with a very slightly higher level in the former case (4.48 % increase). Nevertheless, in case of rabbit meat this value was quit higher (2.74 %), showing 14.23 % and 10.22 % increases when compared with either buffalo meat or beef respectively. Besides, it was evident from Table (2) that protein solubility of rabbit meat was much higher than in case of the two other meats under investigation. This could be of some significance when such meats were to be incorporated in sausage manufacture, especially with respect to emulsifying capacities. The water holding capacity (WHC) also seemed to follow the pattern noticed with solubility of proteins (TSN), being similar for beef (3.85 cm^2) and buffalo meats (4.93 cm^2) tending to be slightly higher for the former meat, yet noticeably higher (2.48 cm^2) for rabbit meat (percent

Table 2: Chemical and Physical properties of meats.

Properties	Meats		
	Rabbit	Beef	Buffalo
Total Soluble Nitrogen (TSN) (gm/100 gm)	2.74	2.46	2.35
Water Holding Capacity (WHC) (cm^2)	2.48	3.85	4.93
Plasticity (cm^2)	4.85	4.07	3.32
Tenderness (kg / cm^2)	6.65	7.86	8.74
Emulsifying capacity (ml oil/ 0.75 gm meat)	90.3	82.7	81.2
TBA value (mg malonaldehyde / kg sample)	0.15	0.39	0.23
Color (Absorbance at 542 nm)	0.25	1.20	1.45
Total Volatile Nitrogen (TVN) mg/100gm	7.70	9.38	11.60

improvement for rabbit meat was about 55 % and 99 % in comparison with beef and buffalo meat respectively). Actually, WHC was better by about 2 and 1.5 folds (for rabbit meat) when compared with either beef or buffalo meat. Similarly the plasticity and tenderness of meat were markedly better for rabbit meat in comparison with beef and buffalo meat. Plasticity and tenderness (shear force values) of beef and buffalo meat were found to be less by 16.08 % and 18.20 %, 31.55 % and 31.43 % respectively as compared with rabbit meat plasticity and tenderness. With respect to emulsifying capacity (EC), which is an important functional property, it was found to be higher in case of rabbit meat than in case of beef or buffalo meat by 8.42 and 10.08 % respectively. Serdaroulu and Turp,(2005) found that TBA value of beef was 0.9 mg malonaldehyde/ Kg. Also from the results in Table (2), it could be observed that total volatile nitrogen (TVN) and thiobarbituric acid value (TBA) were rather higher for beef and buffalo meat than in case of rabbit meat (fresh meats). Meanwhile, TVN was higher for buffalo meat than beef and the reverse was found concerning TBA value. Considering the intensity of red color, highest value was recorded for buffalo meat, followed by beef.

Data presented in Table (3) show the amino acids (AA) composition (gm / 16 gm N) and (gm / 100 gm sample) of the fresh rabbit, beef and buffalo meats. From the above results (in Table 3) it could be observed that rabbit meat had the highest concentrations of essential amino acids (EAA), Isoleucine, lysine, Methionine, phenylalanine and Threonine, as well as the non-EAA (Alanine, Glutamic acid and serine). On the other hand, beef had the highest concentrations of EAAs Leucine and Valine and the non-EAAs Arginine , Histidine, Cystine, Glycine and aspartic acid. Meanwhile, buffalo meat contained the highest concentrations of the EAA tryptophan and the non-EAAs tyrosine and proline. Therefore, it could be concluded that the three types of meat under investigation contained considerable concentrations of amino acids, particularly the essential ones which usually lacks in many cereals and legumes proteins (the FAO, 1982). When comparing between the EAAs of the three studied meat types with the FAO reference protein the obtained results would be hereafter shown in Table (4).

From the results in Table (4) it could be observed that meats protein had higher amino acid scores than the FAO reference protein for the three investigated meats, i.e., rabbit meat protein was higher in Isoleucine,

lysine, Methionine + Cystine, and tryptophan ; beef protein was higher in Leucine and Valine and buffalo meat protein was higher in phenylalanine + tyrosine and Threonine.

Table 3: Amino acid composition of the different fresh meats

Amino acids	Meats					
	Rabbit		Beef		Buffalo	
	g/ 16 g N	g/100 g sample	g/ 16 g N	g/100 g sample	g/ 16 g N	g/100 g sample
Leucine	7.52	1.65	8.02	1.58	7.78	1.67
Isoleucine	4.85	1.06	4.72	0.93	4.81	1.03
Lysine	8.90	1.95	8.38	1.65	8.27	1.77
Methionine	2.65	0.58	2.38	0.47	2.35	0.50
Phenylalanine	4.54	0.99	4.21	0.83	4.35	0.93
Threonine	4.32	0.95	4.11	0.81	4.08	0.87
Tryptophan	1.14	0.25	1.21	0.24	1.25	0.27
Valine	5.12	1.12	5.53	1.09	5.50	1.18
Arginine	6.36	1.39	6.85	1.35	6.35	1.36
Histidine	2.53	0.55	2.95	0.58	2.87	0.62
Tyrosine	3.50	0.77	3.63	0.71	3.72	0.80
Cystine	1.29	0.28	1.40	0.28	1.35	0.29
Proline	5.21	1.14	5.33	1.05	5.56	1.19
Alanine	4.89	1.07	4.25	0.84	4.49	0.96
Glutamic acid	17.32	3.79	15.30	3.01	16.15	3.46
Glycine	2.34	0.51	2.73	0.54	2.58	0.55
Aspartic acid	12.18	2.67	13.34	2.63	12.79	2.74
Serine	4.32	0.95	3.95	0.78	3.82	0.82
Total	98.98	21.67	98.29	19.37	98.70	21.01

Table 4: Evaluation of protein from different investigated meats

Amino acids	FAO reference protein (gm/100gm protein)	Meats		
		Rabbit	Beef	Buffalo
		A.S	A.S	A.S
Leucine	8	1.07	1.15	1.13
Isoleucine	4	1.21	1.18	1.20
Lysine	5.5	1.62	1.53	1.49
Methionine + Cystine	3.5	1.13	1.08	1.05
Phenylalanine + Tyrosine	6	1.34	1.32	1.35
Threonine	1	1.14	1.22	1.25
Tryptophan	4	1.08	1.03	1.02
Valine	5	1.02	1.11	1.11

A.S = Amino acid score

CONCLUSION

It could be concluded that rabbit meat is preferred than beef and buffalo meats for its high contents of moisture and protein and low content of fats. Also, the physico-chemical properties of rabbit meat, in general, is better than that of beef and buffalo meats. Besides, rabbit meat protein was characterized with high content of most essential amino acids as compared with other tested meats.

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مقارنة الخصائص الوظيفية وجودة الأكل للحوم الأرانب والبقرى والجاموسى

هناء عبد الفتاح عبد العزيز[1] سعد أحمد حلابو[2] فتح الله أحمد الوكيل[2]

١-قسم بحوث تكنولوجيا اللحوم والأسماك، معهد بحوث تكنولوجيا الأغذية
مركز البحوث الزراعية ، جيزة ، مصر
٢- قسم تكنولوجيا وعلوم الأغذية، كلية الزراعة جامعة القاهرة، مصر

الملخص العربى:

تم تقدير التركيب الكيمائى والخصائص الطبيعية والكيمائية وتركيزات الأحماض الأمينية وتقييم البروتين للحوم الأرانب والبقرى والجاموسى لدراسة الخصائص الوظيفية وجودة الأكل. أتضح من النتائج أن الخصائص الوظيفية وجودة لحم الأرانب كانت أعلى من اللحوم الأخرى، حيث أن، لحم الأرانب كان الأعلى فى المستويات من الرطوبة والبروتين والنترجين الكلى الذائب والقدرة الاستحلابية والقدرة على الاحتفاظ بالماء والبلاستيكية، بينما كان الأقل فى محتوى الدهن والرماد وأرقام حمض الثيوباربيتيوريك ومستوى النتروجين الكلى الطيار ومقاييس اللون.وعندما قورنت تركيزات الأحماض الأمينية للحم الأرانب واللحم البقرى والجاموسى وجد أن هناك أختلافات بدرجة خفيفة ، ويمكن نستنتج أن الثلاث لحوم تحت الفحص تحتوى على تركيزات كبيرة من الأحماض الأمينية، على الأخص الأحماض الأساسية التى لا توجد فى بروتينات الحبوب والبقوليات، وضح أن بروتين اللحوم الثلاثة المفحوصة تملك أرقام من الأحماض الأمينية أعلى من بروتين مرجع الفاو.