EVALUATION OF KOFTA PROCESSED FROM EDIBLE MEAT BY-PRODUCTS

FARAG, MANAR M.A.

Meat and Fish Technology Research Department, Food Technology Research Institute, ARC, Giza, Egypt

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Abstract

Protein malnutrition and iron deficiency remain unsolved problems for developing countries. The nutrition of low income families in developing countries is based on cereals and legumes. Lysine is the first limiting amino acid in cereals and sulphure amino acids are limiting in legumes. Edible meat by-products, such as liver, spleen, lung and tongue are good sources of protein and of the essential amino acid lysine. Bovine spleen and liver are very rich sources of iron.

Six kofta blends were innovated from boiled edible meat by-products (liver, spleen, lung and / or tongue) and other components including egg, chickpea, burghal, onion, garlic, celery, salt and black pepper. Organolyptic evaluations revealed that tested blends were acceptable. It was noticed that the lung improved taste whereas tongue improved texture and appearance. Blends number (3) and (6) having both lung and tongue had the highest score. According to the sensory evaluation and costs, blend number (6) was selected as most convenient and chosen for further study.

Moisture, protein, fat, ash and carbohydrates content of the chosen blend before and after frying were 60.72 and 53.25, 16.83 and 19.32, 4.94 and 8.58, 1.48 and 1.35, and 16 and 16.9 %, respectively. The blend was relatively rich in Na, K, Ca, Mg and evidently rich in Fe and Zn. The nutritional value of selected kofta products prepared from edible meat by-products was rich in essential amino acids which reached about 39.77% of total amino acids. A portion of 220.3g of raw kofta will cover daily requirements of adult man in all essential amino acids. Chemical score ranged from 36.3 for leucine to 156.5 for methionine + cystine while the protein efficiency ratio ranged from 1.48 for PER_2 to 2.04% for PER_3 .

Key words: Edible meat by-products, kofta blends, sensory evaluation, costs, chemical composition, minerals and nutritive value.

INTRODUCTION

Moustafa (1997) found that edible meat by-products are rich sources of protein. Their protein contents varied from 55.82 for tongue to 77.73% for lung. Ether extract ranged from 15.09 for lung to 36.08% for tongue. Ash content varied from 3.45 to 4.81% on dry weight basis. Meat by-products are rich in minerals such as, phosphorus, iron, zinc, magnesium, copper, sodium and potassium but poor in calcium. He added that the edible meat by-products are of high nutritional quality. Their content of amino acids reach to 18 amino acids and the protein efficiency ratio (PER) ranged from 1.37 for stomach to 1.91 for tail.

The use of bovine lung and chickpea mixtures to develop snack product could provide an acceptable ready-to-eat product that would contain high quality protein, iron and vitamins. (Cardoso-Santiago and Areas, 2001).

Subba (2002) showed that the addition of meat by-products such as bovine lung, liver, spleen and bone to cereal and root tuber, such as cassava, improved their nutritional quality in terms of protein, lysine, iron and calcium content, and sensory acceptability for human consumption.

Moustafa (2004) reported that buffalo boiled spleen was incorporated in chicken sausage formulation to improve color, iron contents and texture of samples.

The aim of the present study was to develop kofta blends containing boiled bovine liver, spleen, lung and / or tongue with different percentages, and to evaluate the acceptability and nutritional value of the products.

MATERIALS AND METHODS

Liver, spleen, lung, tongue, egg, chickpea, burghal, onion, garlic, parsley, salt and black pepper were obtained from the local market at Giza, Egypt.

Preparation of samples: The edible meat by-products were washed, boiled in water for 30 min and cut into slices. The decorticated chickpea and burghal were soaked for 6 hours in water, then were ground with a mixture of sliced boiled edible meat by-products, onion, garlic and celery, using meat-mixing machine to prepare the kofta. The mixture of kofta was combined with egg, salt and spices. Kofta blends are presented in Table (1). Chemical composition of the blends, i.e., moisture, protein, fat and ash were determined according to the methods outlined in A.O.A.C. (1995), while total carbohydrates were calculated by difference. Minerals including Na, K, Ca, Mg, Fe and Zn were determined according to the method of Dalton and Malanoski (1969) using the Perkin – Elmer 3300 Atomic Absorption Spectrometer (Germany). The amino acids composition of selected blend was determined using HPLC-Pico-Tag method according to Millipore Cooperative (1987) as described by Cohen et al. (1989). Chemical scores of the amino acids were determined according to FAO/WHO/UNU (1985) and protein efficiency ratio (PER) was described by Alsmeyer et al. (1974). Organolyptic evaluation of the different formulated kofta blends was carried out sensory by ten panelist for color, taste, odor, texture and appearance according to Nottèr et al., (1959) and values statistically analyzed according to the method described by Gomez and Gomez (1984). Cost of chosen kofta blends under study was calculated. Some physical properties such as, water holding capacity (WHC), plasticity and bound water % were measured according to Ham and Detheragee, (1966), while protein water coefficient (PWC) and protein water fat coefficient (PWFC) were calculated by the methods described by Tsoladze (1972).

RESULTS AND DISCUSSION

The chemical composition of raw and boiled edible meat by-products and other raw components are presented in Table (2). It could be noticed that the raw lung had the highest moisture content reaching 78.71% compared with lowest level in raw tongue which had 67.70% moisture. All boiled samples had lower moisture content than raw, that might be attributed to the loss of water holding capacity due to the protein denaturation during cooking process. The protein content increased after boiling from 19.6 to 22.3, 18.9 to 21.65, 17.7 to 20.27 and 16.8 to 19.24% in liver, spleen, lung and tongue, receptively. These results agree with these of Moussa (1981), who reported the increase in the protein content of each organ was due to the losses in other meat constituents such as moisture and fat as a result of boiling and stewing process. The previous report may explain the observed increase in ash content of all samples after boiling. It can be arranged in the following descending order, (1.46 to 2.3) > (1.38 to 2.15) > (1.16 to 1.82) > (o.88 to 1.37) for raw and boiled liver, spleen, lung and tongue, respectively. Meanwhile, the raw tongue contained the highest percentage of fat reaching 13.9%. The raw lung had the lowest fat percentage (1.8%). Generally, fat content of all samples decreased after boiling. This may be due to the melting of some fat escaped with drip away in soup. The previous results agree with those of Elmoudy (1979) who observed that the chemical composition of raw beef lung and spleen were 78.95 and 77.24%, 20.12 and 21.52% , 2.3 and 2.6% and 1.32 and 1.5% for moisture, protein, fat and ash, respectively.

The minerals content of boiled edible meat by-products which were used for processing kofta are presented in Table (3). Results revealed that spleen was characterized by the highest content of elements. Iron reached 25.75mg/100g spleen on wet weight followed by lung and then tongue. Spleen was also a rich source of Na and K reaching 554.55 and 601.17 mg/100g, respectively. The lung had the highest Mg and Ca percentages reaching to 61.49 and 36.47mg/100g sample on wet weight basis, respectively.

The formulated kofta blends presented in Table (1) were sensory evaluated for color, odor, taste, texture, appearance and overall acceptability average scores and the results are shown in Table (4). Odor and color had high score with and no significant differences between blender number (1) and (4), (3) and (6), and (2) and

(5). Meanwhile, the blends contained lung had improved taste like both blends number (1) and (4). They recorded highly significant differences ($P< 0.05$) with other blends. The presence of tongue in formulated blends improved the texture and possibly appearance. Blends number (2) (highest score) and (4) (lowest score) recorded highly significant differences with other blends for texture. It could be concluded that the variation of total score between divided by 5 blends depended upon the ingredients of the formula. The highest mean score of 8.84 was for blends (3) and (6). Other blends had more or less the same score (8.48 - 8.68).

According to the previous sensory evaluation, blends numbers (3) and (6) were selected to calculate their cost. Total cost of the these blends are presented in Table (5). It is observed that, total cost of blend (3) was more than that of blend (6). Blend (6) contained liver which price is equal or more than that of red meat. Therefore, blend (6) was finally selected and subjected to further studies.

Chemical composition of selected blend before and after frying is presented in Table (6). It was observed that, the moisture content decreased from 60.72 to 53.25%, and ash content slightly decreased from 1.48 to 1.35% after frying. The protein and fat increased from 16.83 to 19.32 and 4.94 to 8.58%, respectively.

Minerals content of the selected blend (No.6) before and after frying are shown in Table (7). The selected blend contained high amount of elements, specially the iron because of containing spleen. After frying, the minerals slightly decreased with percentages ranged from 5 -10% for Na and K, respectively. Slight minerals decrease may be observed which may be due to increasing fat content of blend after frying,

Moussa (1981) studied the effect of cooking of beef meat organs (heart, lung and spleen) on the mineral contents, and noticed that, stewing of beef heart and boiling of beef lung caused a marked decrease in P, Ca, Fe, Mg, Na, K and Cu. The percent retention were (89.4 and 89.2), (94.1 and 91%), (92.5 and 87.5%), (92,6 and 91.8%), (75.2 and 74.1%), (90.0 and 87.9%) and (86.7 and 93.3 %), respectively, meanwhile boiling of raw spleen showed a good retention ranged 97.9% for Mg to 100 % for P.

Results in Table (8) show the amino acids composition, chemical score of selected blend and the daily requirements of adult man in (g) according to FAO/WHO/UNU, (1985). The results revealed that this blend which was prepared with edible meat by-products was rich essential amino acids like, lysine which reached 7.22g/100g protein, followed by, methionine + cyctine which reached 6.57g/100 protein and phenylalanine + tyrosine which were 5.5g/100g protein. Non-essential amino acids reached to 15.31g/100g protein glutamic, Then both aspartic and alanine came which were 9.6g/100g protein. The highest chemical scores were 156.5, 137, 112 and 109 % for methionine+cyctine, histidine, thrionine and lysine, respectively. Both leucine and tryptophan were limiting amino acids (36.3 and 43.5%, respectively) to cover the daily requirements of adult man in essential amino acids of blend should be consumed biased on tryptophan (limiting amino acid), therefore 220g of kofta will cover all the requirements. The nutritional value of kofta prepared from edible meat by-products thereby was high, in essential amino acids reaching about 39.77% from total amino acids. The protein efficiency ratio of the samples ranged from 1.49 of PER_2 to 2.04% of PER_3.

Data presented in Table (9) show the physical properties of selected blend before and after frying including, water holding capacity, plasticity, bound water %, protein water coefficient and protein water fat coefficient. From the results, it could be noticed that, the ability of blend for binding water decreased from 91.70 to 72.66% after frying, because of losing some water and absorbing an amount of oil during the frying. This result might be due to denaturation of protein during heat treatment, followed by decreasing of plasticity from 3.3 to 2.4 $cm^2/0.3g_{sa,}$ after frying. The more the WHC, the more bound water % and the more the plasticity and vice versa. Also, data given in Table (9) show the texture indices including protein water coefficient (PWC) and protein water fat coefficient (PWFC), it could be noticed that, both PWC and PWFC increased from 0.277 to 0.363 and 0.256 to 0.312, respectively after frying. According to Tsoladze (1972), the less the value of texture indices (PWC and PWFC), the more the tenderness of meat and vice versa.

The above mentioned data are in agreement with that of Hamm and Detheragee, (1966) who found that most of changes occurred during heating were ascribed to temperature.

CONCLUSION

Edible meat by-products expressed rich source of gross chemical composition, minerals, specially, iron (in spleen) and high nutritive value considering high essential amino acids level reached to about 40% of total amino acids, revealing high chemical score and protein efficiency ratio.

Table 1. Composition of kofta blends ($g/100g_{wet\ wt.}$).

Ingredients	Blends					
	(1)	(2)	(3)	(4)	(5)	(6)
Liver	30	30	20	-	-	-
Spleen	-	-	-	30	30	20
Lung	30	-	20	30	-	20
Tongue	-	30	20	-	30	20
Other components	15% Egg, 5% chickpea, 5% burghal, 6% onion, 3% garlic, 1% parsley, 3% salt and 2%black pepper.					

Table 2. Gross chemical composition of raw and boiled ingredients (g/100g $_{wet\ wt.}$)

Ingredients	Moisture		Protein		Ash		Fat		Fiber	Carbohydrates*	
	Raw	Boiled	Raw	Boiled	Raw	Boiled	Raw	Boiled	Raw	Raw	Boiled
Liver	71.50	66.21	19.6	22.3	1.46	2.30	4.10	3.10	0	3.34	6.09
Spleen	75.60	69.79	18.9	21.65	1.38	2.15	2.40	1.80	0	1.72	4.61
Lung	78.71	72.66	17.7	20.27	1.16	1.82	1.80	1.35	0	0.63	3.90
Tongue	67.70	62.51	16.8	19.24	0.88	1.37	13.9	10.5	0	0.72	6.38
Egg	72.50	-	13.8	-	0.93	-	12.25	-	0	0.52	-
Chickpea	12.40	-	24.2	-	2.45	-	1.98	-	2.18	56.7	-
Burghal	12.03	-	12.4	-	1.16	-	1.28	-	1.53	71.6	-
Onion	85.88	-	1.42	-	0.61	-	0.22	-	0.81	11.0	-
Garlic	61.95	-	5.72	-	1.31	-	0.16	-	1.34	29.2	-
Celery	88.20	-	4.34	-	2.30	-	0.81	-	1.73	2.62	-

*Carbohydrates were calculated by difference.

Table 3. Minerals content of boiled ingredients (mg/100g $_{wet\ wt.}$).

Ingredients	Minerals					
	Na	K	Ca	Mg	Fe	Zn
Spleen	554.55	601.17	20.58	44.92	25.75	4.98
Lung	258.33	304.71	36.47	61.49	4.92	4.39
Tongue	378.55	422.87	27.15	44.50	2.93	2.93

Table 4. Sensory evaluation of the formulated kota blends.

Bends	Color (10)	Taste (10)	Odor (10)	Texture (10)	Appearance (10)	Overall Average score
(1)	8.8b	9.1a	9.2a	7.5c	7.9c	8.50b
(2)	9.0a	8.4b	8.5c	9.2a	8.2b	8.66ab
(3)	8.8b	8.9a	8.8bc	8.9ab	8.8a	8.84a
(4)	8.8b	9.0a	9.1ab	7.4c	8.1c	8.48b
(5)	9.1a	8.3b	8.5c	9.1a	8.4b	8.62ab
(6)	8.8b	8.9a	8.8bc	8.9ab	8.8a	8.84a
LSD (0.05)	0.231	0.338	0.290	0.358	0.228	0.224

Mean values in the same colum with the same latter are not significantly different (at 0.05 level).
* High significant difference (at 0.01 level).

Table 5. Cost of the formulated kofta blends (100g) compared with red meat kofta**(Egyptian pound).

Blends	Ingredients					Other components*	Processing	Total
	Liver	Spleen	Lung	Tongue	Egg			
(3)	8.5	-	2.88	4.99	1.5	1.0	5.66	24.5
(6)	-	3.35	2.88	4.99	1.5	1.0	4.12	17.8

*Other components: 15% Egg, 5% chickpea, 5% burghal, 6% onion, 3% garlic, 1% parsley, 3% salt and 2%blackpepper.
** Red meat kofta from local market equal 20 – 28 Egyptian pound.

Table 6. Chemical composition (g/100g $_{wet\ wt.}$) of the selected kofta blend (No.6) before and after frying.

Treatment	Moisture	Protein	Ash	Fat	Carbohydrates*
Before frying	60.72	16.83	1.48	4.94	16.03
After frying	53.25	19.32	1.35	8.58	16.90

*Carbohydrates were calculated by difference.

Table 7. Minerals content of the selected kofta blend (No.6) before and after frying (mg/100g $_{wet\ wt.}$).

Treatment	Minerals					
	Na	K	Ca	Mg	Fe	Zn
Before frying	227.6	253.6	15.96	29.29	6.26	2.11
After frying	216.3	228.3	15.12	27.24	5.95	1.92

Table 8. Amino acids and chemical score estimated for kofta protein.

Amino acids	FAO/WHO/UNU Pattern (1985) g A.A /100g protein	g A.A/100g sa.	gA.A/100protein	Chemical score	*Daily requirement of man(g)(reference)	GDR
Essential:						
Isoleucine	4.6	0.559	2.898	63.0	0.819	148.9
Leucine	9.3	0.652	3.375	36.3	1.197	183.5
Lysine	6.6	1.395	7.220	109.3	1.008	72.26
Methionine	4.2	0.639	3.309	156.5	1.071	84.33
Cystine		0.631	3.267			
Phenylalanine	7.2	0.123	0.636	76.56	1.197	112.4
Tyrosine		0.942	4.875			
Thrionine	4.3	0.933	4.827	112.3	0.567	60.77
Valine	5.5	0.982	5.083	92.42	0.819	83.40
Histidine	2.6	0.689	3.565	137.12	1.008	146.3
Tryptophan	1.7	0.143	0.740	43.53	0.315	220.3
Total		7.69	39.79			947.2
Non-Essential						
Aspartic		1.856	9.607			
Glutamic		2.939	15.309			
Serine		1.732	8.964			
Glycine		0.788	4.077			
Arginine		1.075	5.565			
Alanine		1.869	9.673			
Proline		1.366	7.071			
Total		11.63	60.21			
E.A.A / T.A.A%		39.75	39.79			
PER1		1.89				
PER2		1.49				
PER3		2.04				

* FAO / WHO / UNU (1985).

PER1 = 0.684 + 0.456 (Leucine%) – 0.047 (Proline%).

PER2 = 0.468 + 0.454 (Leucine%) – 0.105 (Tyrosine%).

PER3 = 1.816 + 0.435 (Methionine%) + 0.78 (Leucine%) + 0.211 (Histidine%) – 0.944 (Tyrosine%).

Table 9. Physical properties of the selected kofta blend.

Physical properties	Before frying	After frying
WHC* cm 2/ 0.3g sa.	1.8	5.2
Plasticity cm 2/ 0.3g sa.	3.3	2.4
Bound water%	91.70	72.66
PWC** %	0.277	0.363
PWFC*** %	0.256	0.312

* WHC: Water holding capacity. ***PWFC: protein water fat coefficient.

**PWC: protein water coefficient.

REFERENCES

1. Alsmeyer, R.H., A.E. Cunningham and M.L. Happich. 1974. Equations predict PER from amino acid analysis. Food Technology, 28(1): 34 – 40.
2. A.O.A.C. 1995. Official Methods of Analysis of the Association of Official Analytical Chemists, 15th ed., Washington.
3. Cardoso-Santiago, R.A. and J.A.G. Areas. 2001. Nutritional evaluation of snacks obtained from chickpea and bovine lung blends. Food Chemistry, 74: 35 - 40.
4. Cohen, S.A., M. Mewyesand, T.L. Travin. 1989. The Pico-Tag Method. In " A Manual of Advanced Techniques for Amino Acid Analysis", Millipore, USA.
5. Dalton, E.F., A.J. Malanoski. 1969. Atomic Absorption Analysis of Copper and Lead in Meat and Meat Products. In the Analytical Method for Atomic Absorption Spectroscopy (1994).
6. El-Moudy, R.A., 1979. Studies on chemical constituents of edible offals. M.Sc. (Meat Hygiene) Thesis, Faculty of Veterian Medicine., Cairo Univ.,.
7. FAO/WHO/UNU 1985. Energy and protein requirements. Report of joined FAO/WHO/UNU, Expert consolation World Health Organization technical Report, Ser. 724, WHO, Geneva.
8. Gomez, K.A. and A.A. Gomez.1984. Statistical Procedure for Agriculture Research. John Wiley and Sons. Inc. USA.
9. Hamm, R. and F.E. Detheragee. 1966. Changes in hydration and changes of muscles proteins during freeze dehydration of meat. J. Food Research, 25: 587.
10. Moussa, B.M. 1981. Chemical and biological evaluation of meat organs. Ph.D. Thesis, Faculty of Agriculture., Cairo University.
11. Moustafa, M.M.I. 1997. Technological and microbiological studies on some edible meat by-products. Ph.D. Thesis, Faculty of Agriculture., Minia University.
12. Moustafa, M.M.I., 2004. Quality changes occurring during frozen storage of chicken sausage containing buffalo spleen. Egypt. J. Agric. Res., 82 (3): 327-341.
13. Notter, G.K., D.H. Tayler and N.J. Dawnens. 1959. Orange juice powder factors affecting storage stability. Food Technology, 13: 113.
14. Subba, D. 2002. Acceptability and nutritive value of keropok-like snack containing meat offal. International, Journal of Food Science and Technology, 37: 681- 685.
15. Tsoladze, E.A. 1972. The releationship between the tenderness of fish meat and its protein-water and protein-water fat coefficients. Fish Industry, (7): 68-69.

تقييم كفتة مصنعة من المنتجات الثانوية للحم البقرى

منار ممدوح أحمد فرج

قسم بحوث تكنولوجيا اللحوم والأسماك – معهد بحوث تكنولوجيا الأغذية – مركز البحوث الزراعية.

تعتبر مشاكل سوء التغذية و الأنيميا من أهم المشاكل التى تواجهة الدول النامية و لحل هذه المشاكل لابد من توفر كل من البروتين و الحديد وهذان العاملان لا يتوفران فى الحبوب و البقوليات حيث تفتقر الحبوب فى الحامض الأمينى الليسين فى حين تفتقرمعظم البقوليات للأحماض الأمينية الكبريتية و كل منهما يفتقر فى نسبة الحديد.

الهدف من البحث توفير البروتين الحيوانى و لكن من مصادر رخيصة الثمن حتى يسهل الحصول عليها و تناولها. إستخدمت فى المنتجات الثانوية للحم البقرى مثل الكبد و الطحال والرئة و اللسان بعمل ٦ خلطات مختلفة من الكفتة بنسبة ٦٠ % تحتوى أساسا فى تركيبها على هذه المنتجات الثانوية بعد إجراء معاملة السلق عليها و ذلك للحفاظ على المكونات الداخلية التى قد تفقد أثناء التقطيع أو الفرم مثل الطحال و هو مصدر غنى بالحديد.

أوضحت النتائج أن سلق المنتجات الثانوية للحم أدى إلى زيادة نسب كل من البروتين و الرماد وإ نخفاض نسبة الرطوبة و الدهن. تم الخلط مع باقى مكونات الكفتة الأخرى ثابتة فى جميع الخلطات وهى تتمثل فى بيض و حمص و برغل و بصل و ثوم وبقدونس و ملح و توابل و تمثل ٤٠ %.

وبإجراء الأختبارات الحسية على الخلطات السابقة أوضحت النتائج أن الرئة حسنت طعم الخلطة فى حين أن اللسان حسن طعم و مظهرالخلطات المحتوية عليه وقد سجلت الخلطتان (٣) و (٦) أعلى درجة كمتوسط لمجموع الدرجات.

بحساب تكلفة الخلطتان وأضافة نسبة التصنيع كان سعر الخلطة (٣) تعادل ١,٥ مرة سعر الخلطة (٦) وذلك لأحتواء الخلطة الأولى على كبد الذى يعادل فى ثمنه ثمن اللحم الأحمر لذلك تم أختيار الخلطة (٦) لأجراء باقى الأختبارات عليها .

تم تقدير التركيب الكيميائى و العناصر المعدنية للخلطة المختارة قبل و بعد التحمير حيث زادت نسبة البروتين والدهن بعد التحمير فى حين قل محتوى الخلطة من العناصر المعدنية قليلاً بنسبة تتراوح من ٥ – ١٠ %. ولمعرفة القيمة الغذائية للخلطة تم تقدير الأحماض الأمينية و كفاءة البروتين المستفاد التى تراوحت من ١,٥ – ٢ % و نسبة الأحماض الأمينية الأساسية تمثل حوالى٤٠% من إجمالى الأحماض الأمينية وتناول ٩٤٧جم يوميا من كفتة رقم ٦ يكفى بإحتياجات الشخص البالغ يوميا.