Fractionation and identification of lipids of processed rabbit meat

M. KAMAL E. YOUSSEF, S.H. ABOU-EL-HAWA, M.N. EL-RIFY and A.H. KHALIFA

Food Science & Technology Department, Faculty of Agriculture, Assiut University, Assiut, A.R. Egypt.

SUMMARY: Total lipids extracted from fore limb, loin and Hind limb of California and New Zealand white rabbit meat (both sexes of a marketable age 2 and 3 months) were used for fractionation and identification of lipid components. Meanwhile, the influence of certain processing methods, namely: pressure cooking, roasting and smoking on the lipids composition was assessed as well. Using thin-layer chromatographic technique lipids were fractionated to seven identified fractions. Females had slight higher pospholipids level than that of males, while an opposite trend in other lipid classes was recorded. Rather slight differences were observed between studied ages. Fore limb recorded the least phospholipids content, while the triglycerides rated the highest levels. In general processing methods reduced phospholipids and triglycerides contents, while monoglycerides, diglycerides, cholesterol and free fatty acids levels were increased. Hydrocarbons content decreased after pressure cooking and roasting processes, while it was increased after smoking process. However, an extra unknown lipid fraction was detected in roasted rabbit meat.

INTRODUCTION: The rabbit meat has several advantages over other meats. It is produced under controlled farm conditions, is healthy and availble all the year around and the carcass is of popular size for the moderate family (Netherway, 1977). The two main African producer of rabbits are Ghana and Egypt (Lebas et al., 1986). Intramuscular lipid composition of rabbit was approximately 50% triglycerides, 45% phospholipids, 5% cholesterol, less than 0.5% free fatty acids and no cholesteryl esters were detectable. (Romans et al., 1974). Total cholesterol content in rabbit meat was similar to other meats, but the content of esterified cholesterol was higher in rabbit meat (Lee and Ahn, 1977a). Cholesterol content of uncooked rabbit meat (total ground lean tissue) was 163.6±3.1 mg/100g. dry matter cited in the lower range of values for popular red meats and poultry (Lukefahr et al., 1989). Available information on rabbit meat caracteristics is very limited in contrast to that for other meat types (Holmes et al., 1984 and Lukefahr et al., 1989). Therefore the present investigation was performed in an attempt to study lipids fractionation and identification of rabbit meat as well as to assess the influence of processing methods on the lipid composition of rabbit meat.

MATERIAL and METHODS:

Sampling: Sixty four California and Newzealand White rabbits (equal number of both sexes) of a marketable age (2 and 3 months) were procured from AL Barari Investment Company Farm at Ismailia Governorate; Egypt were used in the present study. The rabbits were slaughtered and the carcasses were skinned, eviscerated, washed and split along the backbone into two halves. One half of each carcass was packaged in polyethylene bag and kept frozen at -20°C until withdrawn for treatment.

Treatments: The investigated rabbit carcasses were divided into four specified groups treated as follows: a) The first group was analyzed fresh and served as control. b) The second frozen at -20°C group was thawed at 4°C for 8-10 hours, then cooked in pressure cooker pan applying the sterilization regime $\frac{10\text{-}15\text{-}10}{110°C}$ as recommended by Ball and Olson (1957) and Helwan Engineering Industries catalogue (Anon, 1988) for pressure cooked rabbit meat. The pressure used in the pressure cooker pan was about 1,991 mm mercury. c) The third frozen at -20°C group was thawed, wrapped with aluminum fail and roasted in an electric oven at 167 (±2)°C to an internal temperature of 95°C according to the method of Greenhouse et al., (1984). d) The fourth frozen at -20°C group

was thawed, hot cured at 50°C in a brine solution consisting of 15% salt, 3% sucrose and 1.5 ppm sodium nitrite for 20 hours, then cold smoked for 3 hours within the temperature range of 30-35°C in the smoke chamber according to the method of Owen et al. (1979).

Preparation of samples: Fore limb, loin and hind limb cuts were withdrawn from fresh and treated carcasses according to Deltro and Lopez (1985). Each cut was deboned and finely minced rapidly through a mechanical meat chopper, then all determinations began promptly without any delay.

Extraction of lipids: The lipids was extracted from tissue samples by chloroform: methanol mixture (2:1, v/v) according to the method described by Folch et al. (1957).

Fractionation and identification of total lipid classes by thin layer chromatographic technique: The lipid extract was dissolved in pure chloroform. Silica gel G plates (13x18 cm) were used for qualitative and quantitative determinations of total lipid fractions. Plates were developed in mixture of petroleum ether : diethyl ether : glacial acetic acid (80:20:1, v/v/v). Visualization was carried out by iodine vapours. The isolated fractions were identified and estimated according to Stahl (1965).

RESULTS and DISCUSSION: The results of California and New Zealand white lipids composition as affected by sexes, ages and cuts are presented in table 1. Triglycerides constituted the highest percentages among lipid classes (49.08 and 47.04% of total lipids), while cholesterol recorded 4.61% and 5.48% in the two strains; respectively. Such results are in agreement with those reported by Romans et al., 1974. Phospholipids recorded 29.67 and 31.38% of total lipids. Similar results were reported by Hassan and Foad (1977) who reported that phospholipids constituted about 30% of total lipids in Baladi rabbit meat. The hydrocarbons recorded the lowest percentage (2.55%) in California lipids, while other fractions were 4.29% monoglycerides, 3.46% diglycerides and

Table (1): Influence of sex, age and cut on lipid composition of California and New Zealand white rabbit meat (as % of total lipids).

Sex	Age	Cut	Phospholipids		Monoglycerides		Cholesterol		Diglycerides		Free fatty acids		Triglycerides		Hydrocarbons	
			I	II	I	II	I	II	I	II	I	II	I	II	I	II
Male	2 Months	A	24.37	25.95	4.15	5.75	4.27	6.59	2.30	3.88	6.75	7.43	55.72	47.57	2.44	2.83
		B	31.97	29.93	4.56	5.63	5.10	6.31	3.99	3.32	6.96	5.72	44.92	45.19	2.50	3.90
		C	32.70	32.60	4.31	5.61	4.55	6.24	4.00	3.75	6.93	6.73	44.80	42.45	2.71	2.62
		mean	29.68	29.49	4.34	5.66	4.64	6.38	3.43	3.65	6.88	6.63	48.48	45.07	2.55	3.12
	3 Months	A	22.59	24.36	3.92	3.10	4.54	4.74	2.90	2.74	6.90	6.20	56.70	56.32	2.45	2.54
		B	32.47	31.80	4.88	3.46	5.34	5.90	4.85	2.23	5.38	6.50	43.84	46.41	2.64	3.70
		C	31.37	31.82	4.04	3.57	4.36	5.40	4.18	3.26	6.37	6.40	46.94	44.75	2.64	4.80
		mean	28.81	29.33	4.28	3.38	4.75	5.35	3.98	2.74	6.42	6.37	49.16	49.16	2.58	3.68
	Mean		29.25	29.41	4.31	4.52	4.70	5.87	3.71	3.20	6.65	6.50	48.82	47.12	2.57	3.40
Female	2 Months	A	25.40	26.67	3.15	5.32	3.35	6.55	2.45	3.55	5.42	5.78	57.35	49.65	2.88	2.48
		B	31.18	35.42	4.22	4.68	4.30	5.70	2.27	2.01	5.32	6.72	50.10	42.79	2.61	2.68
		C	33.19	36.19	4.53	3.40	5.78	5.37	4.15	3.51	6.86	5.95	42.88	43.54	2.60	2.04
		mean	29.92	32.76	3.97	4.47	4.48	5.87	2.96	3.02	5.87	6.15	50.11	45.33	2.70	2.40
	3 Months	A	23.72	26.93	4.35	2.45	3.43	3.15	2.89	2.50	6.17	4.59	57.71	58.19	1.73	2.19
		B	31.87	37.18	4.62	2.43	5.31	4.86	3.61	1.94	5.48	6.02	46.26	43.69	2.85	3.88
		C	35.20	37.71	4.75	2.94	4.99	4.89	3.92	2.82	6.86	5.36	41.71	43.90	2.57	2.38
		mean	30.26	33.94	4.57	2.61	4.58	4.30	3.47	2.42	6.17	5.32	48.56	48.59	2.38	2.82
	Mean		30.09	33.35	4.27	3.54	4.53	5.09	3.22	2.72	6.02	5.74	49.34	46.96	2.54	2.61
Over all mean			29.67	31.38	4.29	4.03	4.61	5.48	3.46	2.96	6.34	6.12	49.08	47.04	2.55	3.01

A= Fore limb B= Loin C= Hind limb I= California II= New Zealand White

6.34% free fatty acids. On the other hand, the lowest value of lipid fractions was diglycerides (2.96%) in New Zealand white rabbit lipids, while other fractions recorded 4.03, 6.12 and 3.01% of total lipids for monoglycerides, free fatty acids and hydrocarbons; respectively. Data given in table (1) showed that females had rather slight higher phospholipids content than males. Slight differences were observed the two studied ages, but between studied cuts its could be noticed that fore limb cut had lower percentage of phospholipids and higher percentage of triglycerides than the other two studied cuts.

Effect of pressure cooking on lipid composition: The results given in table (2) indicated the influence of pressure cooking process on lipid composition of rabbit meat. The data revealed that there was a noticeable decrease in phospholipids content as well as slight reduction of triglycerides and hydrocarbons. On the opposite trne there was a rather slight increase in the other fractions contents. Such results are in agreement with those reported by Youssef et al. (1983) for chiken meat who indicated that phospholipids and triglycerides contents were decreased, while monoglycerides, cholesterol, diglycerides and free fatty acids contents were increased by cooking. On the other hand Abd El-Wahed (1986) reported that cooking of either fresh or frozen chicken meat increased sterols and reduced hydrocarbons. The changes in the composition of lipid classes could be mainly due to heat destruction of lipids during cooking as previously reported by Aman and Shehata (1978a).

Effect of roasting process on lipid composition: Data given in table (3) showed the influence of roasting process on lipid composition of rabbit meat. The data revealed the detection of extra unknown fraction among the total identified lipid classes. The percentages of this unknown fraction were 2.10 and 3.14% of total lipids in California and New Zealand white rabbit lipid, respectively. Results in table (3) indicated that the roasting process caused a marked decrease in phospholipids and triglycerides contents and slight increase of

Table (2): Effect of pressure cooking on lipid composition of rabbit meat (as % of total lipids).

Strain	Treatment	Phospho-lipids	Monogly-cerides	Cholesterol	Diglyce-rides	Free fatty acids	Triglyce-rides	Hydro-carbons
California	raw	29.67	4.29	4.61	3.46	6.34	49.08	2.55
	pressure cooked	27.39	4.78	5.78	4.29	8.52	47.61	2.00
New Zealand white	raw	31.38	4.03	5.48	2.96	6.12	47.04	3.01
	pressure cooked	38.64	4.63	6.99	3.66	7.65	45.95	2.49

Table (3): Influence of roasting on lipid composition of rabbit meat (as % of total lipids).

Strain	Treatment	Phospho-lipids	Monogly-cerides	unknown	Cholesterol	Diglyce-rides	Free fatty acids	Trigly-cerides	Hydro-carbons
California	raw	29.67	4.29	--	4.61	3.46	6.34	49.08	2.55
	roasted	27.94	4.90	2.10	5.62	4.31	6.86	46.39	1.89
New Zealand white	raw	31.38	4.03	--	5.48	2.96	6.12	47.04	3.01
	roasted	29.17	4.82	3.14	6.58	3.92	6.21	44.27	1.86

Table (4): Effect of smoking on lipid composition of rabbit meat (as % of total lipid).

Strain	Treatment	Phospho-lipids	Monogly-cerides	Cholesterol	Diglyce-rides	Free fatty acids	Triglyce-rides	Hydro-carbons
California	raw	29.67	4.29	4.61	3.46	6.34	49.08	2.55
	smoked	25.72	5.16	5.91	4.15	8.57	47.06	3.60
New Zealand wite	raw	31.38	4.03	5.48	2.96	6.12	47.04	3.01
	smoked	26.80	4.87	6.85	3.96	8.60	44.90	4.04

monoglycerides; diglycerides, cholesterol and free fatty acid contents, while hydrocarbons recorded a rather slight decrease. Abd El-Wahed (1986) reported the decrease of hydrocarbons content in roasted chicken meat.

Effect of smoking process on lipid composition of rabbit meat: Results given in table (4) indicated the influence of smoking process on lipid composition of rabbit meat. The data indicated a marked decrease of phospholipids and triglycerides levels as well as a marked increase of free fatty acids content, while monoglycerides, diglycerides, cholesterol and hydrocarbons contents recorded a rather slight increase. In general the increase in sterols taking place in all studied processing methods might be attributed to the denaturation of lipoprotein complex (El-Bastwisy and Simrnova, 1970). On the other hand, Aman and Shehata (1978a) indicated that the decrease in triglycerides levels was observed with a parallel increase in monoglycerides and diglycerides levels.

REFERENCES

ABD EL-WAHED, W.Z.M. (1986): Effect of preparation and cooking methods on the constituents and characteristics of poultry meat. Ph.D. Thesis, Food Sci. & Tech. Depart., Facu. of Agric., Cairo University.

AMAN, M.E.B. and SHEHATA, A.A.Y. (1978a): Effect of prolonged frozen storage and after-heat treatment on lipid changes in the muscles of sheat fish. Alex. J. Agric. Res., 26 (1) 137-144.

ANON, (1988): Pressure cooker pan. Helwan Engineering Industries Catalogue, Helwan, Cairo.

BALL, C.O. and OLSON, F.C.W. (1957): Sterilization in Food Technology. First Edition, Mc Graw-Hill Book Company, Inc. New York. Toronto. London.

DELTORO, J. and LOPEZ, A.M. (1985): Allometric changes during growth in rabbits. J. Agric. Sci., Camb.,105, 339-346.

EL-BASTAWISY, M.A. and SMIRNOVA, G.A. (1970): Studies on pike muscle by aid of thin layer chromatography. Fish Industry, 46: 65-67. (In Russian).

FOLCH, I., LEES, M. and SLOANESTANLEY, G.H. (1957): A simple method for the isolation and purification of total lipids from animal tissues. J. Biological Chemistry 226, 497-509.

GREENHOUSE, P., KIRMANI, Z. and STIGGER, F. (1984): Sensory panel rates domestic rabbit meat. Arkansas Farm Research 33 (3) 6.

HASSAN, K.A. and FOAD, A.A. (1977): Effect of age and sex on total phospholipids in certain tissues of rabbits. The first Arab Biologists Congress, 26-30 October, Alexandria, Egypt.

HOLMES, Z.A., WEI, S.F., HARRIS, D.J., CHEEKE, P.R. and PATTON, N.M. (1984): Proximate composition and sensory characteristics of meat from rabbits fed three levels of alfalfa meal. J. Anim. Sci., Vol. 58. No. 1, 62-67.

LEBAS, F., COUDERT, P., POUVIER, P., and DE ROCHOMBEAU, H. (1986): The rabbit husbandry, health and production. FAO Animal Production and Health Series No. 21.

LUKEFAHR, S.D., NWOSU, C.V. and RAO, D.R. (1989): Cholesterol level of rabbit meat and trait relationships among growth, carcass and lean yield performances. J. Anim. Sci., 67: 2009-2017.

NETHERWAY MARJORIE EP., (1977): A manual of rabbit farming. Fur & Feuther. Idle, Bradford and London.

OWEN, J.E., ISON, R.W. NICOLAIDES, L., REILLY, A. and SILVERSIDE, D. (1979): Curing and smoking of rabbit meat. Tropical Sci., 21 (1) 11-31.

ROMANS, J.R., PALMER, I.S., WENGER D.R., COSTELLO, W.J. TUMA, H.J. and WAHLSTROM, R.C. (1974): Prestaughter treatment affecting intramuscular and plasma lipid 1. Effect of ACTH in rabbits. J. Anim. Sci., 38(1) 32-37.

STAHL, E. (1965): Thin layer chromatography. A laboratory Hand book, New York, N.Y.

YOUSSEF, K.E., ABOU EL-HAWA, S.H. and EL-RIFY, M.N. (1983): Changes in lipid fractions of chicken broiler tissues and their fatty acid composition during chilling, freezing and cooking. First African Conference of Food Science and Technology, 14-17 November, Cairo, Egypt.