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DETECTION OF LARD ADULTERATION IN SOME IMPORTED MEAT PRODUCTS

(With 4 Tables)

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الكشف عن دهن الخنزير في بعض منتجات اللحوم المستورده

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أجريت الدراسه على بعض منتجات اللحوم المستورده والتى اشتملت على ١١ نوع من المعلبات، ٩ منها لانشون هولندى ماركة جروت، عينه لانشون هولندى ماركة برستول، عينة كورندبيف بهدف كشف وتحديد نسبة دهن الخنزير فى هذه المنتجات.

أوضحت النتائج المتحصل عليها بإستخدام التحليل الكروماتوجرافى الغازى للأحماض الدهنيه فى كل من الجلسريدات الثلاثيه فى ٢- أحادى الجلسريد أن معامل التدعيم بحامض البالمتيك كان مرتفع نسبياً فى جميع العينات تحت الدراسه.

وطبقاً للنتائج يمكن القول بأن عينات اللانشون المستورده تحتوى على ٩ ٪ دهن خنزير أو أكثر ، بينما عينات الكورندبيف تحتوى على ٣ ٪ دهن خنزير أو أكثر.

وبصفه عامه يمكن التوصيه بإستخدام كل من معامل التدعيم بحامض البالمتيك، نسبة عدم التشبع، نسبة الاحماض الدهنيه الكليه ك ١٦ / ك ١٨ ، بالاضافه إلى نسبة الاحماض الدهنيه المشبعه / الأحماض الدهنيه غير المشبعه كعوامل مساعده ذات قيمة فى الكشف عن دهن الخنزير فى منتجات اللحوم.

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SUMMARY

Studies on detection of lard adulteration in some imported meat products were carried out. Distribution of fatty acids within B-monoglycerides and triglycerides of imported meat product was studied using Gas Liquid Chromatographic technique. The obtained data showed that the palmitic acid enrichment factor was relatively high in both types of canned luncheon meat (Groot and Bristol). Accordingly this would indicate the presence of lard at 9% or more. Moreover, corned beef was shown to contain about 3% lard or more. Generally, the palmitic acid enrichment factor, unsaturation ratio, total C_{16}/total C_{18} fatty acids and saturated/unsaturated fatty acids ratios could be recommended as a criteria for lard detection in meat products.

INTRODUCTION

RASHWAN (1986) analysed meat products for the presence of lard. The data indicated that the palmitic acid enrichment factor (% Palmitic acid in B-monoglycerides divided by % palmitic acid in triglycerides) could be used detecting lard in meat products as it increased markedly as percentage of lard increased in canned beef and sausages.

YOUNES and SOLIMAN (1986) mentioned that the major fatty acids composition of tallow triglycerides and 2-monoglycerides resulting from lipolytic action were as follows: 1.04% and 3.06% myristic, 31.2% and 32.95% palmitic, 18.77% and 8.23% stearic, 45.06% and 53.76% oleic, and 3.93% and 2.0% linoleic, respectively.

EL-KHALAFY et al. *(1987)* analysed the fatty acid composition of beef fat and porcine fat using the Gas Chromatography. Results showed that $C_{16:0}/C_{18:1}$, $C_{16:0}/C_{18:2}$ ratio could be used as a guide for adulteration levels.

YOUSSEF et al. *(1988)* reported that canned pure beef luncheon meat, canned corned beef and canned Frankfurter-type sausage in brine imported into Egypt from Denmark, Brazil and the Netherland's, respectively were examined for the presence of lard. The analytical techniques used include: fat extraction, preparation of triglycerides, B-monoglycerides and methyl esters of fatty acids, GLC of methyl esters of fatty acids. The data obtained indicated that the palmitic acid enrichment factor (% palmitic acid in B-monoglycerides divided by % palmitic in triglycerides) could be used for detecting lard in

meat-products, as it increased markedly as % lard increased imported luncheon meat, corned beef and sausages contained lard > 7, > 3, > 13%, respectively.

MATERIAL and METHODS

Material:

Imported products:

11 types of imported canned meat were purchased from the Assiut local market, these products were:

(1) 9 pure beef luncheon meat (Groot) Holand.
(2) 1 pure beef luncheon meat (Bristol) Holand.
(3) 1 corned beef, France.

Methods:

Analytical methods:

1. Fat extraction: Fat extracted from fatty tissues using the method described by *FOLCH* et al. *(1957)* as modified by *WAYS and HANAHAN (1964)* using chloroform: Methanol (2:1).
2. Preparation of triglycerides: The triglycerides were separated from total fat by adopting the method of *DISTER and BAUR (1965),* using column chromatography with silica gel (Merk 100-200 mesh) as adsorbent material and benzene eluting solvent.
3. Preparation of B-monotriglycerides: Enzymatic preparation of B-monoglycerides from triglycerides by pancreatic lipase was performed as described by *ROSSELL* et al. *(1978).*
4. Preparation of methyl esters of fatty acids: The methyl esters of fatty acids were prepared from aliquots of total lipids, triglycerides and B-monoglycerides using 5 ml 3% H_2SO_4 in absolute methanol and 2 ml benzene as mentioned by *ROSSELL* et al. *(1963).* The contents were sealed in special combustion tubes under nitrogen and heated for methanolysis at 90°C for 90 min. After cooling, phase separation was performed by addition of 5 ml water and methyl esters were extracted with 2 aliquots of 5 ml hexane each. The organic phase was discarded, filtered through anhydrous sodium sulfate to remove traces of water and concentrated by using rotary evaporator.
5. Gas Liquid Chromatography of methyl esters of fatty acids: The methyl esters of fatty acids were separated using a PYE unicam (GCD) Gas Liquid Chromatography apparatus with S8 autosampler. The separation was performed with a glass column, 6 ft. long and 2 mm O.D., packed with SP-2330 on 100-120 mesh chromosorb WAW. The chromatographic analysis was carried out under the following condition: Column temp. program, 135°C and increased to 230°C by 16°C/min., and final hold for 8 min., injector temp. 240°C, detector temp. 260°C (FID) detector, carrier gas: nitrogen 20 ml/min. The quantitative determination

of the different acids was performed by measuring the peak areas with an Hewlett packard integrator 3390A.

Factors Calculation:

The palmitic acid enrichment factor, the unsaturation ratio and other ratios based on the fatty acids composition of triglycerides were calculated by the method used by *ABDEL-FATTAH (19774); EL-DASHLOUTY (1978) and BAYOUMY (1982).*

The following equations were used respectively:

1- Palmitic acid enrichment factor = $\frac{\text{\% of palmitic acid in B-Mg}}{\text{\% of palmitic acid in T.G.}}$

2- Unsaturation ratio= $\frac{\text{\% of unsaturated fatty acid in B-MG}}{\text{\% of unsaturated fatty acid in T.G.}}$

3- (a) $\frac{\text{\% of total C16 fatty acid in B-MG}}{\text{\% of total C18 fatty acid in B-MG}}$

(b) $\frac{\text{\% of saturated fatty acids in B-MG}}{\text{\% of unsaturated fatty acids in B-MG}}$

RESULTS

The obtained results were revealed in Tables (1,2,3 & 4).

DISCUSSION

Distribution of fatty acids within B-monoglycerides and triglycerides of canned luncheon meat:

In this part two kinds of luncheon meat were investigated, namely type A (pure beef luncheon meat, Groot, Holand) and type B (canned luncheon Bristol, Holand).

Table (1) represent the data of fatty acid composition of triglycerides and B-monoglycerides of fat extracted from imported canned luncheon meat. Such data revealed that palmitic acid content was relatively high in B-monoglycerides than in triglycerides of both two studied samples. On the contrary, oleic acid ($C_{18:1}$) content of triglycerides was rather high than that of B-monoglycerides.

Palmitic acid enrichment factor:

Table (2) illustrated the data of palmitic acid enrichment factor of fat extracted from imported canned luncheon meat. Such data indicated that palmitic acid enrichment factor was 1.32 and 1.38 in type A and type B of canned luncheon meat, respectively. It is evident from such data that the palmitic acid enrichment factor was relatively high in both types of products than that of beef tallow.

Accordingly this would indicate the presence of lard at 9% level or more as previously outlined. This is due to the fact that B-monoglycerides of lard are specifically occupied with saturated fatty acids mainly palmitic acid. In conclusion on the basis of the obtained data palmitic acid enrichment factor could be helpful in detecting lard in canned luncheon meat, which is in close agreement with *BAYOUMY (1982); RASHWAN (1986) and EL-ZEINI (1991)* findings.

The unsaturation ratio:

Data presented in Table (2) show the unsaturation ratio of fat extracted from imported canned luncheon meat.

The results revealed that the unsaturation ratio of both type A and type B of luncheon meat was 0.96 and 0.92, respectively. These values were relatively lower than that of beef tallow (1.09). This may be attributed to low content of unsaturated fatty acids in B-monoglycerides of such products.

Due to the fact that unsaturation ratio decreased as lard percentage was increased, it could be concluded that these products contained a rather high percentage of lard reaching about 9% or more.

Table (1): The percentage of fatty acids content of B-monoglycerides and triglycerides of fat extracted from imported Canned Luncheon meat.

Type of fat	% of fatty acid content*							
	$C_{14:0}$	$C_{14:1}$	$C_{16:0}$	$C_{16:1}$	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$	C_{183}
Type A*								
Triglycerides	0.98	0.31	22.58	2.32	13.71	49.61	4.72	5.93
B-monogly-cerides	3.45	8.76	29.81	4.09	6.33	42.26	3.45	1.88
Type B**:								
Triglycerides	1.01	0.23	22.78	3.12	12.69	48.63	5.14	6.44
B-monogly-cerides	4.20	9.67	31.34	4.62	5.98	37.81	4.22	2.31

* : Pure beef Luncheon meat. "Groot" Holand.
**: Canned Luncheon "Bristol" Holand.

Total C_{16}/total C_{18} fatty acids and saturated/unsaturated fatty acids ratios:

Table (2) represents the data of total C_{16}/total C_{18} fatty acids and saturated/unsaturated fatty acids ratios in B-monoglycerides for fat extracted from imported canned luncheon meat. The data showed that the first ratio was higher in type B (0.71) than that of type A (0.63). This may be due to high content of C_{16} fatty acids in B-monoglycerides and low content of C_{18} fatty acids in type B, while, the other type recorded an opposite trend.

Regarding to saturated/unsaturted fatty acids ratio the data revealed that type B recorded the highest value (0.71) followed by type A (0.66). This may be due to high content of saturated fatty acids in B-monoglycerides of type B, and vice versa in type A.

In general, it could be concluded that such ratios may allow to detect about 9% or more lard in canned luncheon meat.

Table 2: Some calculated ratios from fatty acids of B-monoglycerides and triglycerides of fat extracted from imported from imported Canned Luncheon meat.

Type of sample	Palmitic acid enrichment factor	Unsaturation	Total C_{16} in B-MG / Total C_{18} in B-MG	% S.F.A. in B-MC / % U.F.A. in B-MG
Type A*	1.32	0.96	0.63	0.66
Type B**	1.38	0.92	0.71	0.71

* : Pure beef Luncheon meat "Groot" Holand.
**: Canned Luncheon "Bristol" Holand.

Distribution of fatty acids within B-monoglycerides and triglycerides of corned beef:

Fatty acids composition of B-monoglycerides and tryiglycerides of fat extracted from imported corned beef are illustrated in Table (3).

Table 3: The percentage of fatty acids content of B-monoglycerides and triglycerides of extracted from imported Corned beef.

Type of	% of fatty acid content*							
	$C_{14:0}$	$C_{14:1}$	$C_{16:0}$	$C_{16:1}$	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$
B-monoglycerides	4.32	6.98	20.73	4.56	9.03	42.56	6.81	5.07
Triglycerides	1.98	1.41	22.96	1.56	12.80	46.46	6.42	6.50

The data showed that palmitic acid ($C_{16:0}$) was higher in triglycerides than that in B-monoglycerides. The same trend was observed in oleic acid ($C_{18:1}$) content, as it was 46.46% and 42.56% in triglycerides and B-monoglycerides, respectively.

Table 4 showed some calculated ratios from fatty acids of B-monoglycerides and triglycerides of fat extracted from imported corned beef. According to the data outlined in this table, the palmitic acid enrichment factor was <1.0(0.9). Therefore, as it has been previously discused in Table 7, this type of products may contain about 3% lard or more.

The unsaturation ratio recorded 1.06 Table 4. This value indicates that more unsaturated fatty acids are found in B-monoglycerides than that in triglycerides. According to the data of the experimentally standard mixtures of this work, the unsaturation ratio could be considered as another proof that the corned beef might contain 3% lard or more. On the other hand, the total C_{16}/total C_{18} fatty acids in B-monoglycerides was 0.40, this value is another indication that this type of products may contain 3% lard or more. Moreover, the saturated/unsaturated fatty acid in B-monoglycerides was 0.52. This value when compared with that previously obtained we can say that corned beef might contain about 3% lard or more. These results are in good accordance with those previously reported by *ABOU-ARAB (1980); BAYOUMY (1982); RASHWAN (1986) and EL-ZIENI (1991).*

Generally, the palmitic acid enrichment factor; unsaturation ratio; total C_{16}/total C_{18} fatty acids and saturated/unsaturated fatty acids ratios could be recommended as a criteria for lard detection in meat products.

Table 4: Some caiculated ratios from fatty acids of B-monoglycerides and triglycerides of fat extracted from imported Corned beef.

Plamitic acid enrichment factor	Unsaturation	Total C_{16} in B-MG / Total C_{18} in B-MG	% S.F.A. in B-MG / % U.F.A. in B-MG
0.90	1.06	0.40	0.52

REFERENCES

Abdel-Fattah, E.L. (1974): Analysis study of some food and pharmaceutical lipids products. Ph.D. Thesis, Fac. of Pharmacy, Cairo Univ., Egypt.

Abou-Arab, A.A. (1980): Identification of the sort of fats and oils in different foods, M.Sc. Thesis, Food Science Dept., Fac. of Agric., Ain Shams Univ., Egypt.

Bayoumy, A.H. (1982): Studies on the detection of pork products in some foods. M.Sc. Thesis, food Sci. Dept. Fac. of Agric., Moshtohor, Zagazig University.

Dister, E. and Baue, F.J. (1965): The determination of mono, di and triglycerides concentrates by column chromatography. J. Assoc. Offic. Afric. Chemists 48, 2: 444-448.

El-Dashlouty, A.A. (1978): Studies on the quality of some meat products. Ph.D. Thesis, Faculty of Agric. Ain Shams University, Egypt.

El-Khalafy, H.M.; Fadel, H.M.; Soliman, M.M.A. and Osman, F. (1987): Adulterated beef fat: Fatty acid composition. Grasasy Aceites, 38(2): 85-86.

El-Zeini, S.A. (1991): Identification of the animal fat species in different meat products. Ph.D. Thesis, Dept. of Meat and Fish Hygiene, Faculty of Vet. Medicine, Cairo University, Egypt.

Folch, J.; Lees, M. and Stanley, G.H.S. (1957): J. Biol. Chem., 226, 497 (1957).

Rashwan, M.R.A. (1986): Studies on the detection and evaluation of lard in some food products. Ph.D. Thesis presented to Fac. of Agric. (Food Technology), Assiut University.

Rossell, J.B.; Russell, J. and Chidley, L.E. (1978): Glyceride analysis of commercial fats by lipase hydrolysis. J. American oil Chemists' Society, 55: 902-903.

Rossell, J.B.; King, B.J. and Downes, M.G. (1983): Detection of adulteration. J.. American oil Chemists' Society, 60: 333-339.

Ways, P. and Hanahan, D.J. (1964): J. Lipid Res., %:318.

Younes, N.A. and Soliman, M.M.A. (1986): Adulteration of butter fat with other sources of fat. Grasasy Aceited, 37(4): 200-203.

Youssef, M.K.E.; Omar, M.B.; Skulberge, A. and Rashwan, M. (1988): Detection and evaluation of lard in certain locally processed and imported meat products. Food Chemistry 30(3): 167-180.