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การวิเคราะห์กรดไขมันบางชนิดในตัวอย่างน้ำมันบริโภค
Analysis of some fatty acids in edible oil samples

วรรณา กาญจนมยูร, สุชาติ ดาเดช*
Wanna Kanchanamayoon, Suchart Dadech*

Department of Chemistry and Center of Excellence for Innovation in Chemistry(PERCH-CIC), Faculty of Science, Mahasarakham University, Maha-Sarakham, 44150 Thailand

** Corresponding author: Wanna Kanchanamayoon, e-mail:wanna.s@msu.ac.th*

บทคัดย่อ

การศึกษานี้เป็นการวิเคราะห์หาปริมาณกรดไขมันบางชนิดได้แก่ กรดปาล์มมิติก กรดโอเลอิก (โอเมกา-9) กรดลิโนเลอิก (โอเมกา-6) และกรดลิโนเลนิก (โอเมกา-3) ในน้ำมันสำหรับบริโภค เช่น น้ำมันมะกอก น้ำมันดอกทานตะวัน น้ำมันรำข้าว น้ำมันถั่วเหลือง น้ำมันมะพร้าว น้ำมันงา น้ำมันปาล์มและน้ำมันข้าวโพด จากการนำตัวอย่างน้ำมันมาทำปฏิกิริยากับสารละลายของเมธาโนลิกไฮโดรคลอริกเพื่อเปลี่ยนให้อยู่ในรูปของเมธิลเอสเทอร์และสกัดด้วยโทลูอีน และวิเคราะห์ด้วยเครื่องแก๊สโครมาโทกราฟีโดยใช้คอลัมน์ DB-wax พบว่าปริมาณกรดไขมันที่พบขึ้นอยู่กับชนิดของน้ำมัน โดยน้ำมันที่เป็นแหล่งสำคัญในการให้ปริมาณกรดลิโนเลนิก (โอเมกา-3) สูงคือ น้ำมันมะกอก (1.36 มิลลิกรัม/กรัม) น้ำมันงา (3.27 มิลลิกรัม/กรัม) น้ำมันดอกทานตะวัน (2.84 มิลลิกรัม/กรัม) และน้ำมันถั่วเหลือง (2.70 มิลลิกรัม/กรัม)

คำสำคัญ: โอเมกา-3 โอเมกา-6 แก๊สโครมาโทกราฟี กรดไขมันจำเป็น น้ำมันพืช

Abstract

Some fatty acids; palmitic acid, oleic acid (omega-9), linoleic acid (omega-6) and linolenic acid (omega-3) in edible oils such as olive oil, sunflower oil, rice bran oil, soybean oil, coconut oil, sesame oil, palm oil and corn oil were determined. The oil samples were methylated to methylester by methanolic hydrochloric and extracted by toluene. The fatty acids were analyzed by gas chromatography with a DB-wax column. The fatty acid contents depend on the kind of edible oil. Olive oil (1.36 mg/g), sesame oil (3.27 mg/g), sunflower oil (2.84 mg/g) and soybean oil (2.70 mg/g) were found to be the potential sources of linolenic acid (omega-3).

Keywords: omega-3, omega-6, gas chromatography**,** essential fatty acid, vegetable oil.

1. Introduction

Fatty acids are carboxylic acids with long aliphatic tails, divided into saturated and unsaturated acids depending on the presence of an unsaturated double bond in the fatty acid chain (1). Essential fatty acids are polyunsaturated fatty acids such as a-linolenic acid (C18:3) or omega-3 (w-3), linoleic acid (C18:2) or omega-6 (w-6) and oleic acid (C18:1) or omega-9 (w-9), which could not be synthesized by human body. These essential fatty acids are very important for the human immune system and to help the blood pressure regulation. The w-3 and w-6 fatty acids are found in some food, fish, shellfish, flaxseed, soya oil, canola oil, hemp oil, pumpkin seed, sunflower seed, cotton seed oil and walnut The significance of fatty acid analysis has gained much attention because of the nutritional and health implications. The most common procedure for the analysis is the conversion of the fatty acid components to methylester in order to improve their volatility. There has been much research focusing on the analysis of fatty acids in plant seeds and edible oils such as Tamaridus indica L. (2-3), china chestnut (Sterculia monosperma vertenat) (4), rapeseed (5), Colodendrum capense thumb(6), Australian purlane (Portulaca oleracea) (7), flaxseed (Linum usitatissimum L.) (8), sand eel oil, tuna oil and soybean oil (9), grape seed oil (10), olive oils (11), edible oils (12-13), Thai Durian aril (Durio zibetbinus Murr.) (14), avocado oil, camellia oil, soybean, sesame oil, pumpkin seed and oil (15), Kenaf seed (Hibiscus cannabinus L.) (16), the seed of Sorghum bicolor L. (17), red pitaya seed (Hylocereus polyrhizus) and white pitaya seed (Hylocereus undatus) or dragon fruit (18), Maclura pomifera (Rafin) seed (19), local Thai plant seeds; Perilla frutescens(linn) Britt., Hibiscus canabinus, Hibiscus sabdariffa L., Corchorus olitorius L., Tamarindus indica Linn., Irvingia malayana Oliv. ex A.W. Benn (20). beer wort (21) and milk (22). Therefore, the objective of this research is to analyze the amounts of palmitic acid, stearic acid, oleic acid, linoleic acid and a-linolenic acid in some edible oils.

2. Materials and methods

2.1 Plant seed and edible oil samples

The edible oil samples, olive oil, sunflower oil, rice barn oil, soybean oil, coconut oil palm oil and corn oil were purchased from a market in Mahasarakham Province, Thailand.

2.2 Chemicals

Standard fatty acids (GC grade) were obtained from Fluka.

Methanolic hydrochloric acid in methanol (5:95 v/v) was prepared by stirring at a constant speed.

2.3 Gas chromatography conditions

Gas chromatography was performed on Shimadzu 17 A with a DB-wax fused silica capillary column (30m x 0.25 mm id., 0.25 mm film thickness). The injector temperature and flame ionization detector were maintained at 250 ^{o}C. The column temperature program was started at 150 ^{o}C and held for 1 min, then ramped to 180 ^{o}C with a heating rate of 25 ^{o}C/min and a final temperature was increased to 200 ^{o}C at a rate of 2 ^{o}C/min and held for 10 min. The pressure of the nitrogen carrier gas was 100 kPa.

2.4 Fatty acid extraction and methylation

A 1.0 g of each oil was weighted into screw-tap glass bottles then 5 mL of toluene and 5 mL of fresh methonolic hydrochloric solution were added[18]. The bottles were closed and placed in a water bath at 70 ^{o}C for 2 h, then 5 mL of 6% potassium carbonate solution and 1 mL of toluene were added and thoroughly vortexed for 1 min. The organic phase was separated using centrifugation at 1100 rpm for 5 min, and dried with sodium sulfate anhydrous and filtered by a Millipore 0.45 mm. A 1 mL aliquot was injected into the gas chromatograph.

3. Results and discussion

Table 1 shows the analysis parameters for the fatty acid by gas chromatography with DB-wax capillary column (30 m, 0.25 mm.id.). The calibration ranges were 0-50 mg/mL with a correlation coefficient of 0.9931-0.9987. The detection limits were in the range of 0.008-0.054 mg/mL.

Figure 1 shows the chromatogram of standard fatty acids and fatty acids extracted from rice bran oil, olive oil and soy bean oil. The essential fatty acids were found in all the edible oil samples. Sesame oil showed α-linolenic acid (w-3) the highest amount of 3.27 mg/g, follow by sunflower oil (2.84 mg/g), soybean oil No 1 (2.70 mg/g) and olive oil (1.36 mg/g), respectively. Corn oil possessed the highest amount of linoleic acid (w-6) at 30.51 mg/g. The amount of oleic acid (w-9) was highest in olive oil (extra virgin) 100.79 mg/g and palmitic acid was in the range of 1.45 -25.19 mg/g. Stearic acid was found only in coconut oil (3.75 mg/g), as shown in Table 2.

Table 1 Analysis parameters for fatty acids by gas chromatography with DB-wax capillary column (30 m x 0.25 mm id.)

Fatty acid	Calibration range (mg/ml)	Linear equation	R^2	Detection limit (mg/ml)
Palmitic acid (C16:0)	0-50	y = 306607x + 253066	0.9987	0.054
Stearic acid (C18:0)	0-20	y = 197783x – 234010	0.9883	0.023
Oleic acid (C18:1)	0-20	y = 91168x + 352879	0.931	0.026
Linoleic acid (C18:2)	0-50	y = 153572x + 39892	0.9967	0.015
α- Linolenic aicd (C18:3)	0-50	y = 173558x + 6187	0.9987	0.008

Table 2 Fatty acid contents in edible oils.

Edible oil	Fatty acid content (mg/g) ± RSD (n=3)				
	Palmitic acid	Stearic acid	Oleic acid (ω-9)	Linoleic acid (ω-6)	Linolenic acid (ω-3)
Olive oil (extra virgin)	2.75±0.03	nd	100.79±0.02	0.99±0.05	1.36±0.01
Olive oil (100% pure)	2.95±0.01	nd	57.17±0.01	9.21±0.03	0.94±0.04
Sunflower oil	1.45±0.01	nd	23.64±0.01	29.47±0.01	2.84±0.01
Rice bran oil	4.73±0.01	nd	30.60±0.02	18.69±0.01	0.30±0.01
Soybean oil No. 1	2.83±0.09	nd	15.12±0.02	26.02±0.01	2.70±0.02
Soybean oil No. 2	1.97±0.03	nd	12.84±0.03	20.59±0.00	1.79±0.04
Coconut oil	7.14±0.02	3.75±0.01	16.04±0.01	4.37±0.01	0.76±0.01
Sesame oil	25.19±0.05	nd	20.65±0.03	25.49±0.01	3.27±0.01
Palm oil No 1	11.98±0.02	nd	1.18±0.04	9.41±0.01	0.21±0.01
Palm oil No 2	9.94±0.01	nd	38.35±0.01	8.83±0.01	0.16±0.01
Corn oil	1.87±0.04	nd	16.00±0.05	30.51±0.03	0.91±0.01

nd = non detected, less than detection limit

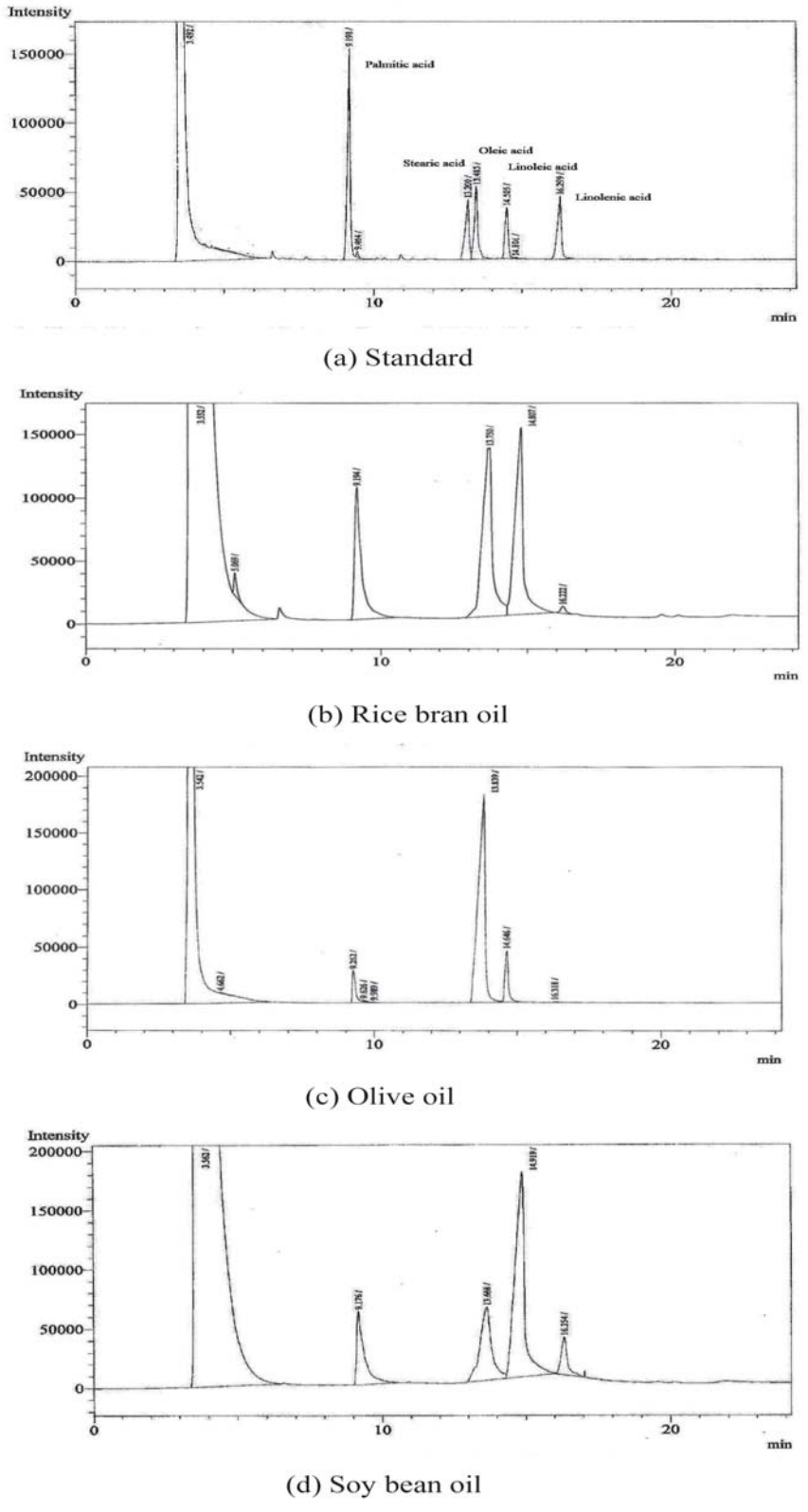

Figure 1 Chromatogram of standard fatty acids (a) and fatty acids extracted from rice bran oil (b), olive oil(c) and soy bean oil(d) using DB-wax fused silica capillary column (30m x 0.25 mm id., 0.25 mm film thickness).

4. Conclusion

Most of edible oil contain unsaturated fatty acid. Fatty acid content depends on the kind of edible oil. Sesame oil is a rich source of linolenic acid (ω-3), sunflower oil and soybean oil are also found to be the potential sources of ω-3 and ω-6 for human health. α-inolenic acid (ω-3) and linoleic acid (ω-6) are essential fatty acids for human health.

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