

# Oil content and fatty acid composition of eggs cooked in drying oven, microwave and pan

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**Abstract** In this study, the effect of heating on the oil yield and fatty acid composition of eggs cooked in drying oven, microwave oven, pan and boiled were determined, and compared. The highest oil content (15.22%) was observed for egg cooked in drying oven, while the lowest oil (5.195%) in egg cooked in pan. The cooking in microwave oven caused a decrease in oleic acid content (46.201%) and an increase in the amount of palmitic acid content (26.862%). In addition, the maximum oleic acid (65.837%) and minimum palmitic acid (14.015%) contents were observed in egg oil cooked in pan. Results showed that fatty acids were significantly affected by cooking method. This study confirms that the cooking processing influences the fatty acid composition of egg oils.

**Keywords** Egg · Heating · Cooking · Boiling · Oven · Microwave · Fatty acid · GC

## Introduction

Egg is a good source of high quality lipids which contained polyunsaturated fatty acids (PUFAs) for the human diet (Mazalli et al. 2004). Meat, milk and egg

play an important role in human nutrition (Newman et al. 2002; Basmacıoğlu et al. 2003). Consumers are increasingly interested in functional foods that can prevent or ameliorate disease (Patterson et al. 2001). Chicken eggs are popular foods due to their high nutritional value. Edible part of egg (100 g) contains approximately 11.2 g of fat (Decker and Cantor 1992). Fatty acid composition of egg can changed depending on the diet of laying hens. Heating is one of the main operations applied nuts, that can lead to various physicochemical changes (Alatas and Cital 2013; Ciemniowska-Zytkiewicz et al. 2014). Applied microwave treatment can be alternative to conventional process due to be faster and reduce energy costs (Giese 1992). Moreover, microwave treatment to hazelnuts decreases contamination of the aflatoxin (Basaran and Akhan 2010). Microwave energy and conventional heating are currently being used for cooking, drying, baking and pasteurization (Rosenberg and Bogl 1987; Megahed 2001). When compared to conventional heat processes, microwave process can offer several advantages such as speed of operation, energy savings, precise process control, faster start up and shut-down times (Megahed 2001). The objective of this study was to assess the effect of heating on oil yields and fatty acid composition of hen eggs cooked in microwave, oven, pan and hot water.

## Materials and methods

### Materials

Eggs were obtained from a local market in Konya, Turkey. All reagents and solvents were of analytical grade and purchased from Sigma-Aldrich Co.

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## Methods

Eggs were cracked in a bowl and whipped immediately. Scrambled eggs were put in petri dishes at equal amounts and cooked separately in microwave oven at 540 W, drying oven at 120 °C and pan without using oil until reach up to solid state. A microwave (Arçelik ARMD 580, Turkey) oven capable of generating 900 W power at 2450 MHz was used for the heating experiments. The dimensions of the microwave cavity were 34.5 × 34.0 × 22.5 cm. Also, as another processing, eggs were also boiled for six min after boiling water.

### Oil extraction

After eggs were extracted by petroleum benzine in soxhlet apparatus for 5 h, the solvent was removed with a rotary evaporator at 50 °C. Oil contents of samples were determined according to AOAC (1990) method.

### Fatty acid composition

After the egg oil (50–100 mg) was converted to their fatty acid methyl esters (FAME), it (1 µl) was analyzed by gas chromatography (Shimadzu GC-2010) equipped with flame-ionization detector (FID) and capillary column (Tecnocroma TR-CN100, 60 m × 0.25 mm, film thickness: 0.20 µm). The temperature of injection block and detector was 260 °C. Carrier gas was nitrogen with 1.51 ml/min flow rate. Split rate was also 1/40. Column temperature was programmed 120 °C for 5 min, and increased to 240 °C at 4 °C/min and held 25 min at 240 °C. Fatty acid methyl ester mixture (Sigma Chemical Co.) was used as standard to determine sample peaks. (AOAC 1990).

### Statistical analysis

Analysis of variance (ANOVA) was performed by using JMP version 9.0 (SAS Inst. Inc., Cary, N.C.U.S.A). The results are mean ± standard deviation (MSTAT C) of 25 independent egg samples (Püskülcü and İkiz 1989).

## Results and discussion

Oil contents and fatty acid compositions of eggs which boiled, cooked in drying oven, microwave and pan are given in Table 1 and Figs. 1, 2, 3 and 4. Oil content of egg samples ranged from 5.19 to 15.22% ( $p < 0.05$ ). Cooking methods had significant effect on oil contents. The highest oil (15.223%) was observed for egg cooked in drying oven, followed by boiled egg (7.72%), while the

lowest oil content was found in egg cooked in pan (5.19%). In previous study, oil contents of several eggs changed between 10.3 and 10.8% (Beynen 2004). The oil in eggs cooked with different methods showed nine fatty acids (Table 1). There were significant differences among the heating processing regarding oil content and fatty acid compositions of egg oils. Both oil content and fatty acid compositions were significantly influenced by different cooking processing.

Oleic acid was predominant fatty acid in all eggs cooked by different methods. The two major unsaturated fatty acids determined were oleic and linoleic acid, which varied from 46.20 to 65.83% and 9.82 to 13.17%, respectively ( $p < 0.05$ ). Palmitic acid was found to be predominant saturated fatty acid with a range of 14.01–26.86%, followed by stearic acid with a range of 5.50–9.07%. Linolenic acid was present in a low proportion, observed between 0.113 and 0.397%. Other fatty acids, e.g., myristic, elaidic, behenic and arachidonic acids, were present at a lower levels. Results showed that fatty acids were significantly affected by cooking method. On the other hand, cooking in pan caused an increase in oleic acid and a significant decrease in palmitic acid compared to other cooking methods. The high oleic and low palmitic acid content contributed the oil better health properties. The highest level of palmitic acid (26.862%) and the lowest of oleic acid (46.201%) were observed in oil of egg cooked in microwave oven ( $p < 0.05$ ; Fig. 5). Additionally, the maximum stearic acid content (9.079%) and the minimum linoleic acid (9.822%) and linolenic acid (0.113%) levels were found in this oil of egg. Palmitic, stearic, palmitoleic, oleic, linoleic, arachidonic, docosahexaenoic, total oil contents of hen egg were determined as 26.1, 8.9, 3.2, 42.6, 16.2, 2.0, 0.7 and 25.1% (Cherian et al. 2002). In a previous study, Alatas and Cital (2013) reported that white egg oil purchased from market contained 23.75% palmitic, 7.09% stearic, 2.58% palmitoleic, 37.38% oleic, 22.63% linoleic acids. Table eggs oil contained myristic (0.28), palmitic (21.67%), palmitoleic (3.58%), stearic (9.80%), oleic (43.86%), linoleic (14.92%), C20:4(n-6) (2.60), C22:6(n-3) (1.34%) (Stibilj et al. 1999). In the experiment of Sehu et al. (2012), oleic acid was the key fatty acid of egg yolk. The amount of all fatty acids of eggs is different. The results of this work showed that cooking significantly effected oil contents and fatty acid composition of eggs. Compared with the cooking methods used in the study, oil from eggs cooked in pan has the largest oleic acid content (65.837%). In addition, linoleic acid content was at the low levels. Linoleic acid content in oils from eggs cooked in microwave oven and pan was lower than the other cooking processing. In addition, palmitic and stearic acids were significantly affected by

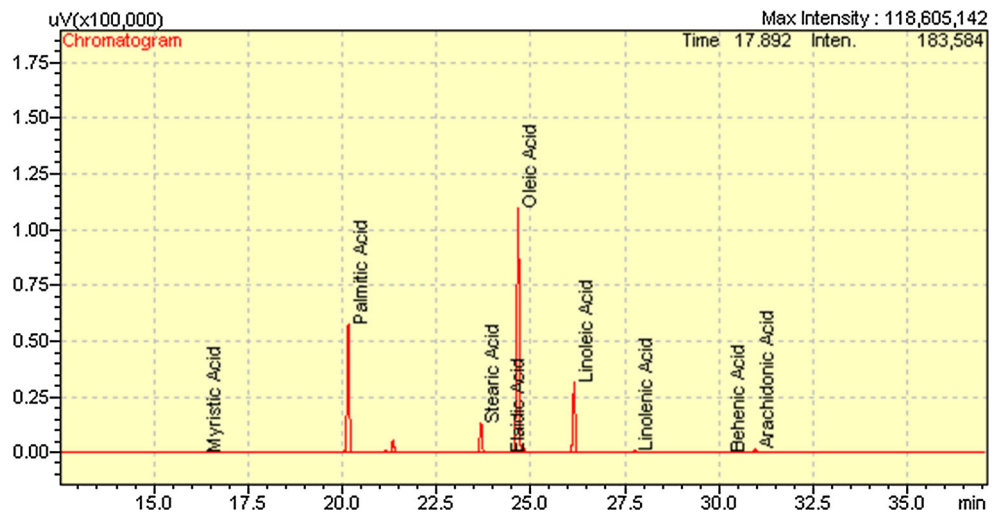
**Table 1** Oil contents and fatty acid compositions of egg samples (%)

Fatty acids	Boiled egg		Egg cooked in oven		Egg cooked in microwave oven		Egg cooked in pan	
Myristic	0.312	±0.002*a	0.270	±0.005b	0.434	±0.018a	0.175	±0.001c
Palmitic	25.075	±0.035b**	24.558	±0.088c	26.862	±0.388a	14.015	±0.054d
Stearic	5.882	±0.014bb	6.206	±0.026b	9.079	±0.001a	5.504	±0.015
Elaidic	0.157	±0.002b	0.199	±0.001a	0.176	±0.021a	0.095	±0.002c
Oleic	49.735	±0.166b	50.482	±0.187b	46.201	±0.389c	65.837	±0.084a
Linoleic	13.170	±0.133a	11.877	±0.245b	9.822	±0.116c	10.947	±0.002c
Linolenic	0.397	±0.007a	0.240	±0.002a	0.113	±0.059b	0.172	±0.032b
Behenic	0.113	±0.004c	0.145	±0.002b	0.159	±0.002a	0.050	±0.001d
Arachidonic	0.649	±0.012b	1.121	±0.011a	0.880	±0.070b	0.048	±0.002c
Oilcontent	7.723	±0.594b	15.223	±1.650a	6.667	±0.196c	5.195	±0.050c

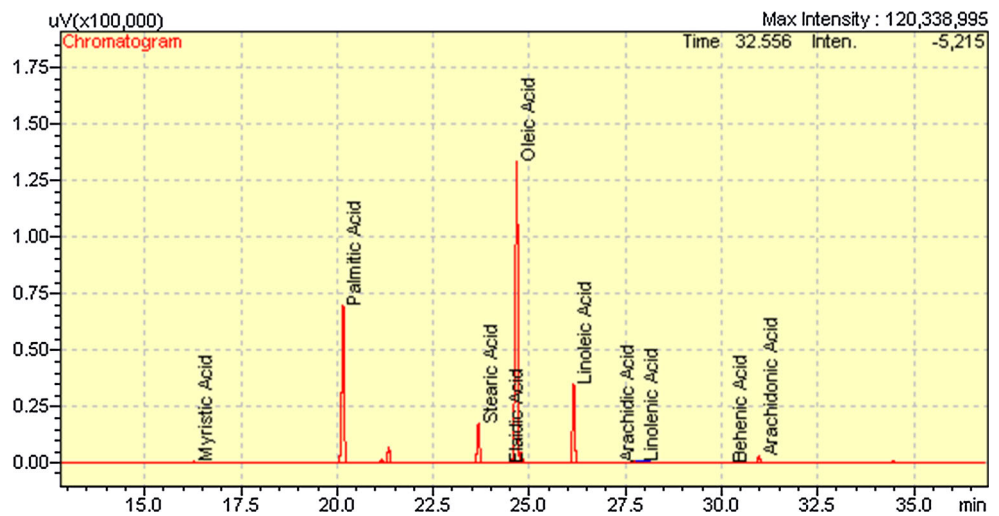
\* mean ± standard deviation

\*\* values within each column followed by different letters are significantly different ( $p < 0.05$ )

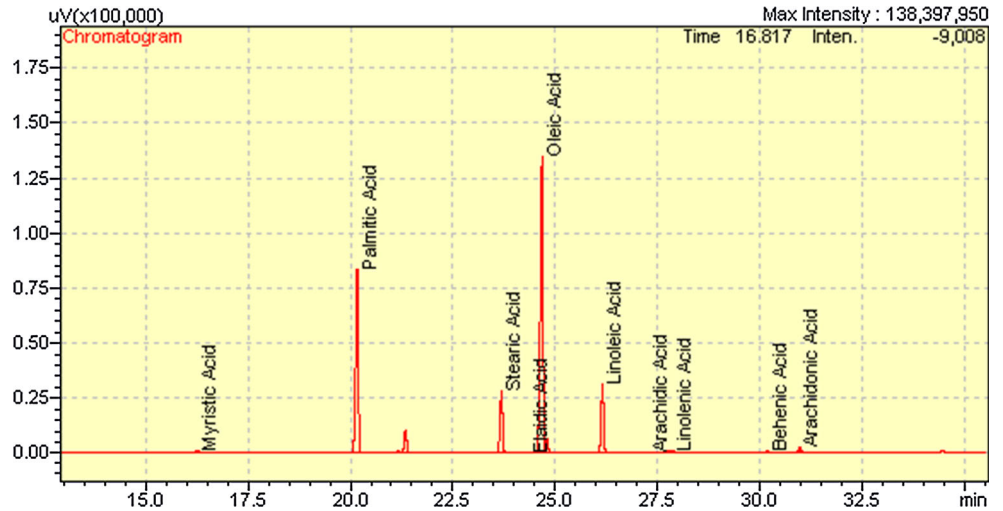
**Fig. 1** Boiled egg



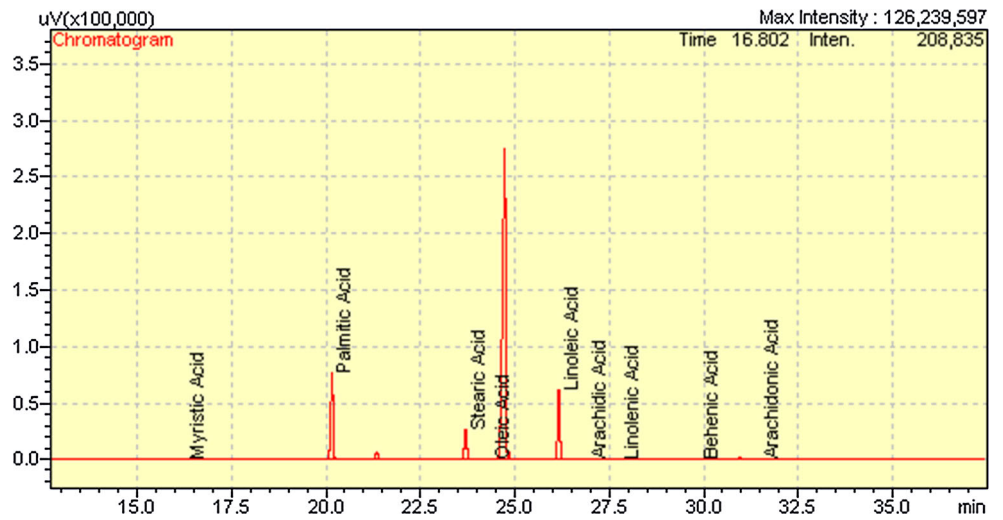
**Fig. 2** Cooked egg in oven



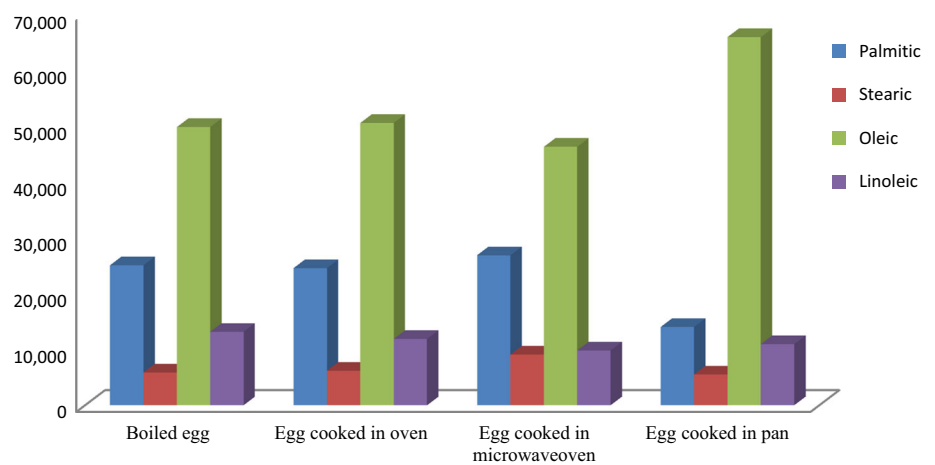
**Fig. 3** Cooked egg in microwave



**Fig. 4** Cooked egg in pan



**Fig. 5** Dominant fatty acids of cooked egg samples (%)



pan cooking method. But, fatty acid composition of egg oils treated were affected by pan cooking. In view of these results, it would be highly recommendable to

increase oleic acid contents and decreased oil content. This study confirmed that the heat processing influenced the oil contents and fatty acid composition of egg.

## Conclusion

The amount of all fatty acids of eggs is different, that is, it is possible to say that change fatty acid composition of the whole egg. With respect to roasting process in microwave oven, fatty acid composition of samples did not show dramatically alteration. Therefore, cooking treatment had significantly affected on fatty acid composition and oil contents of eggs.

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