

# Changes in Fatty Acids Composition of Low Erucic Acid Rapeseed Oil During Frying

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## 1. Introduction

The frying fats are extensively used in the preparation of foods. They protect food particles from sticking together, transfer heat to the product and since during frying they get partly absorbed on it the consumer is made to eat them. Therefore the quality of frying fats is of vital importance from both nutritional and technological standpoints.

Frying causes deep changes in fats including hydrolysis, oxidation, polymerization, cracking as well as trans - izomerization of fatty acids. The plant oil are by far more liable to undergo decomposition as compared to hydrogenated fats. During frying the product can absorb relatively high amounts of fat so the application of plant oils is nutritionally much more advantageous. The purpose of the investigation was to establish the extent of changes in fatty acids of low erucic and rapeseed oil (LEAR) under simulated frying conditions, potato fries and cod fillets.

## 2. Experimental

### Frying process

The oil was heated at 170°C ( $\pm 10^\circ\text{C}$ ) in an electric 2000 W kitchen frying pot of the capacity 2500 ml equipped with thermostat. The specific surface was 0.17 cm<sup>2</sup>/g, and the surface of the oil exposed to air was 380 cm<sup>2</sup>. The heating took 30 hours, 6 hours daily for 5 days. In the case of oil heated under simulated conditions 150 g/h of steam was supplied to the bottom layers of the oil to attain water

contents typical of foods subjected to frying. The blanched potatoes and cod filets were fried in the amounts of 180 g/h in 15 minute cycles. The samples of oil (20 g) were taken for analysis every 6 hours.

### Analytical evaluation

#### Preparation of methyl ester

The fatty acid methyl esters (FAME) were prepared from 100 mg of oil by esterification with  $H_2SO_4$  - methanol (1). Prior to esterification to the mixture 5 mg heptadecanoate (17:0) were introduced, which served as an internal standard.

#### Gas - liquid chromatography

A Finnigan Instrument, model 9610 was used with flame ionization detector. A SCOT glass column (60 m x 0,34 mm I.D.) coated with Silar - 5 CP was used. The column oven was temperature programmed at  $2^\circ C/min.$  from  $160^\circ C$  to  $230^\circ C.$  Helium carrier gas at 16 psi input and a split ratio of 1:25 was used. Peak areas were measured with an integrator Spectra Physics. FAME were tentatively identified by comparing retention times of known standards and by comparing ECL (equivalent chain lengths) values with these cited in literature (2).

#### Combined gas - liquid chromatography / mass spectrometry (GLC - MS).

To confirm the identity of FAME in the samples the method of GLC - MS applied. GLC - MS was carried out with Finnigan model 3300 quadrupole instrument. The gas chromatography conditions were the same as those mentioned above. The spectrometer conditions were as follows: 70 eV electron energy, 1600 V voltage of the quadrupole and  $40^\circ C$  analyzer temperature.

#### Infrared spectrophotometry

Trans fatty acids were determined by infrared spectrophotometry by the method AOAC (3) with methyl elaidate as a standard. A Specord 75IR infrared spectrophotometer was used.

### 3. Results and discussion

In fig. 1 the changes are presented in qualities of LEAR oil under simulated frying condition and frying of cod fillets and potato fries. The heat treatment was found to cause statistically significant ( $p < 0.001$ ) changes in its physical and chemical properties under all the technological conditions applied. The intensity and extent of the changes depended mainly on the time of heating. The highest rate of hydrolysis as expressed by acid and smoking point values was found to occur at the final stage of heating. The like dependence was stated for the contents of oxidized fatty acids and viscosities characterizing oxidative and polymerization changes. The sensory evaluation showed a systematic drop in quality of the oil with the time of heating. Basing on DFG standards (4) the results obtained proved the oil to lose its frying applicability after 18 - 24 hours of heating. The changes occurring in the oil were found to be much affected by the products being fried as compared to those observed in simulated conditions. This confirms the opinion of Pokorny (5) concerning the effect of the product being heated on the rate and extent of changes occurring in the frying medium.

In table 1 the data are presented illustrate quantitative changes in fatty acids associated with frying. Total saturated fatty acids, total monounsaturated fatty acids as well as total polyunsaturated acids were showed a decreasing tendency with the time of heating. The highest changes were stated in the fraction of polyunsaturated fatty acids (PUFA). This confirms earlier observations, among others these of Lang (6), Perkins (7), and Causeret (8) proving PUFA to be much more liable to thermal oxidation and polymerization as compared to both monounsaturated and saturated fatty acids. Fig. 2 shows that both the time of heat treatment and the kind of the raw materials affect the extent of the changes. In the oil heated for 30 hours with steam supply and in that with potato fries and cod fillets a drop in linolenic acid amounted to 60%, 46%, and 31% and in linoleic acid amounted to 38%, 23% and 20% respectively.

In the oil heated for 30 hours the occurrence was stated of trans fatty acids to the amounts of 1%. The comparison of ECL data with those reported by Ackman and Hooper (9,10) and the mass spectra obtained suggest the acids to be cis-12,trans-15,  $C_{18:2\omega 6}$ ; cis-9,cis-12,trans  $C_{18:3\omega 3}$ , and trans-9,cis-12,cis-15  $C_{18:3\omega 3}$ .

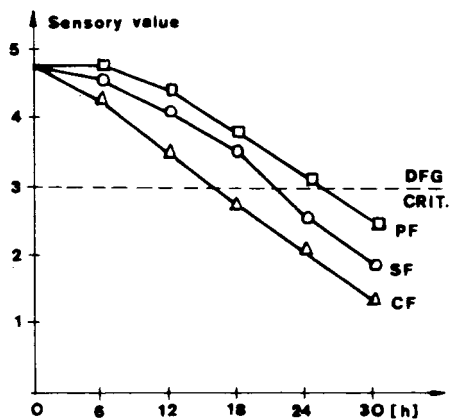
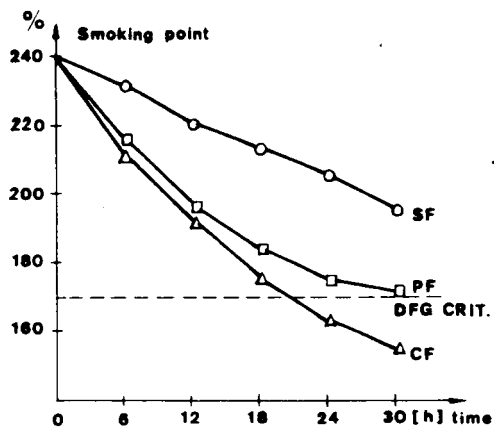
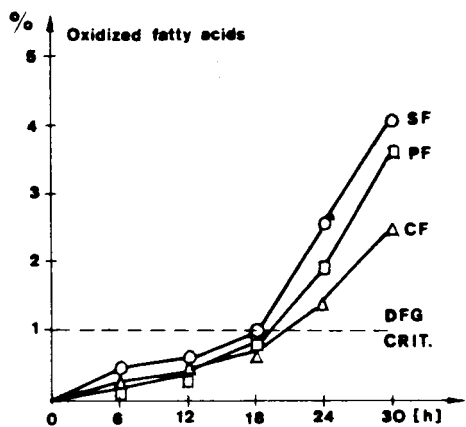


Fig.1 Changes occurring in LEAR oil under simulated frying conditions (SF), frying of potato fries (PF) and frying of cod fillets (CF).

Table 1

Changes of fatty acids contents occurring in FEAR oil under simulated frying conditions (SF), frying of potato fries (PF) and frying of cod fillets (CF)

Frying	Fatty acids	Time of frying (hours)					
		0	6	12	18	24	30
		Fatty acid contents mg/g of oil					
SF	Total Monounsaturated	573	565	559	551	514	472
	Total Polyunsaturated	291	259	246	223	190	157
	Total Saturated	72	69	69	68	67	66
PF	Total Monounsaturated	573	553	536	513	510	499
	Total Polyunsaturated	291	256	230	222	215	199
	Total Saturated	72	64	62	63	62	57
CF	Total Monounsaturated	573	547	513	510	501	523
	Total Polyunsaturated	291	256	236	223	211	215
	Total Saturated	72	70	67	62	62	61

#### 4. References

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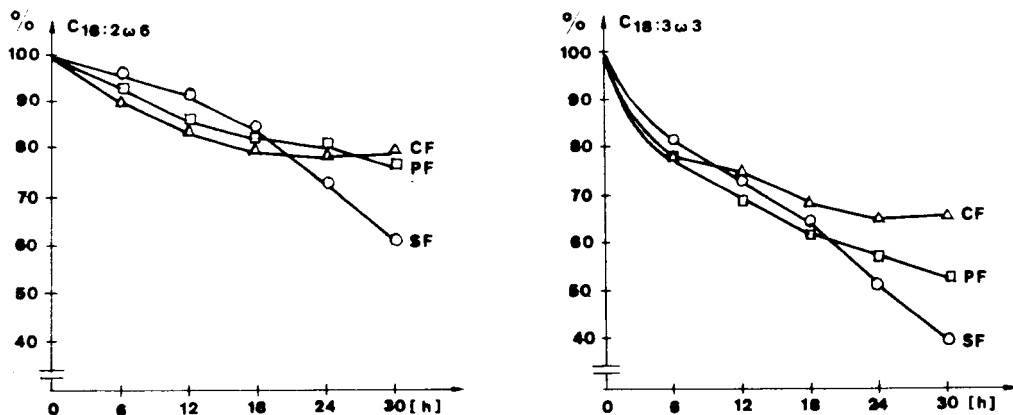


Fig.2 Changes in linolenic and linoleic acids content occurring in LEAR oil under simulated frying conditions (SF), frying of french fries (PF) and frying of cod fillets (CF).