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Effect of heating on fatty acid composition of edible oils and fat

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Introduction

- Frying is one of the most important processes in the food industry. It is a fast process and food gets unique and delicious sensory characteristics (Tabee 2008; Mba et al. 2015).
- During the frying process, the oil is subjected to high temperature and the presence of oxygen and water. These conditions cause oxidative-degradation changes (Gerde et al. 2006; Zheljazkov et al. 2008).
- Different oils and fats have different thermal-oxidative stability according to their FAs composition (Gunstone 1996).
- Changes in the FAs composition can be monitored by analysis their methyl esters (FAME) by GC-MS (Petrovic´ et al. 2010).

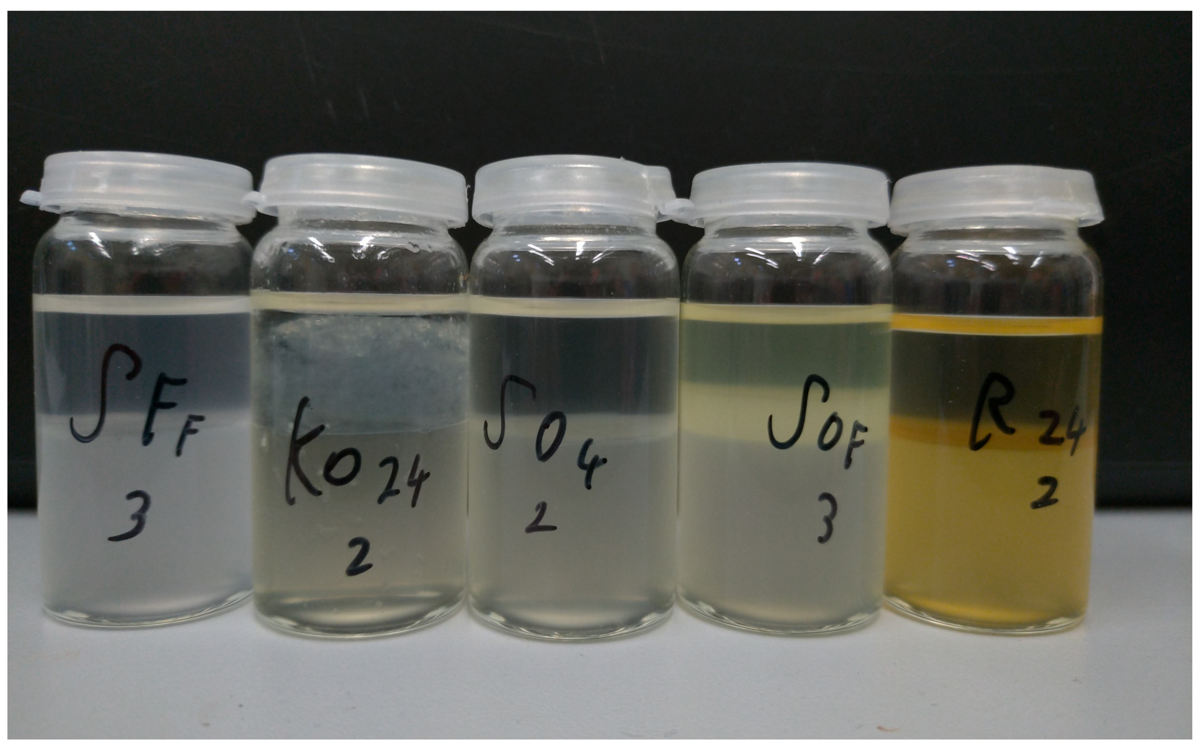
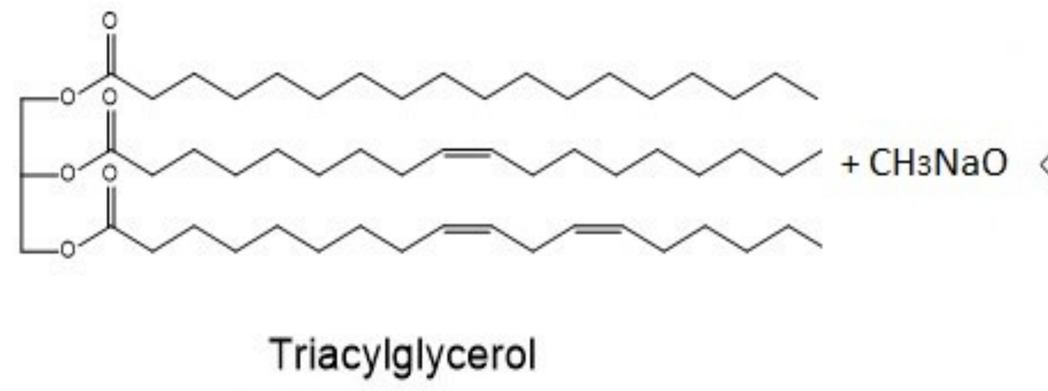


Fig. 1 Base-transesterified oil samples



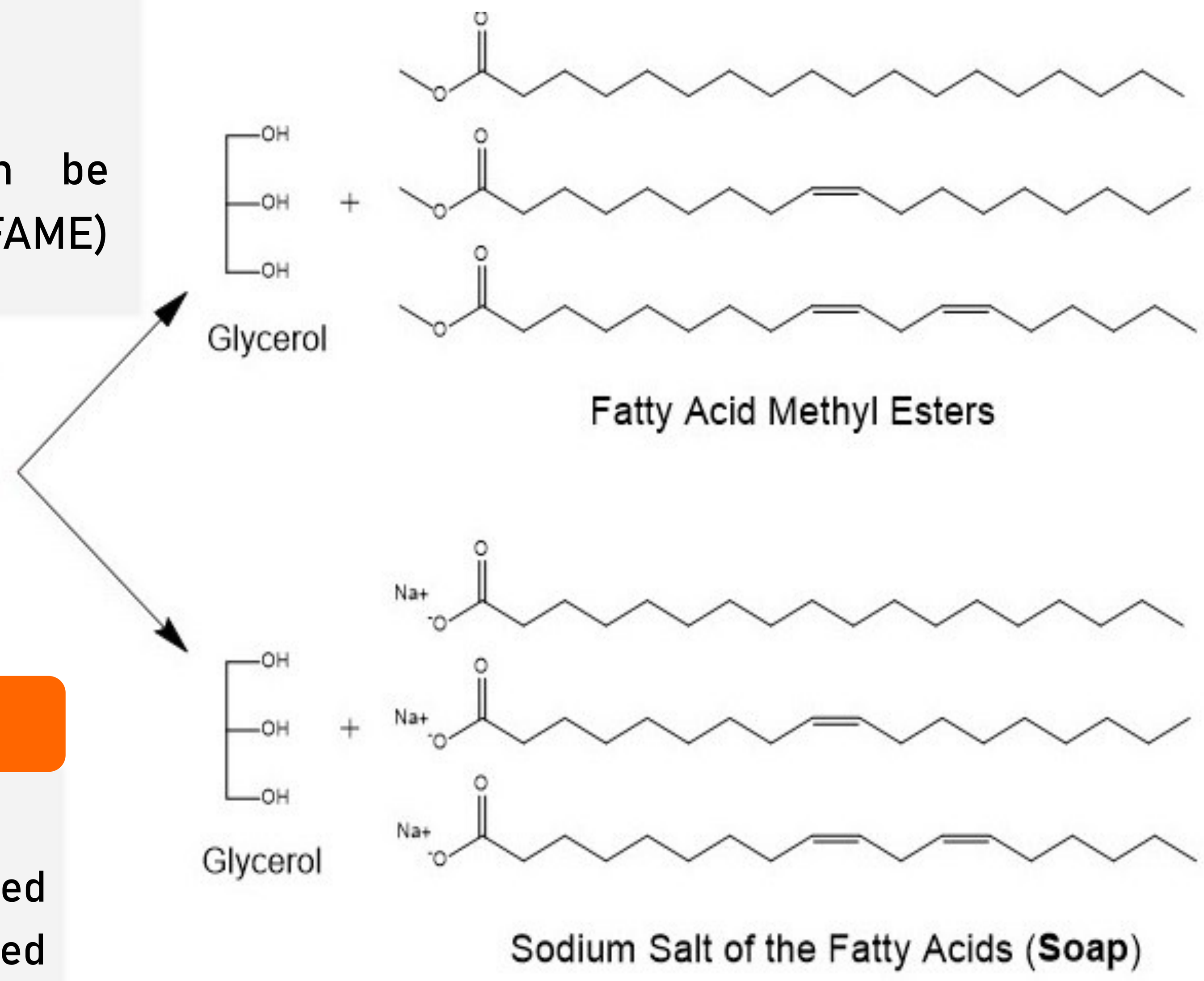


Fig. 2 Transesterification by Sodium methoxide
(Source: Gebremariam & Marchetti 2017)

Methods

- For analysis, seven types of edible oils (coconut oil, palm oil, soybean oil, rapeseed oil, rice bran oil, sunflower oil, high-oleic sunflower oil) and one type of fat (hog lard) were used. All of them were one by one heated in a conventional fryer for 24 hours at 190 °C.
- Base-catalyzed transesterification was performed on each sample. As a catalyst, the CH_3NaO was used.
- In order to determine the composition of FAMEs the GC-MS analysis was performed.
- Results were processed by MassHunter Workstation, compared with FAME mix 37 and analysed by software IBM SPSS Statistics.

Results

- Overall, 27 different types of FAs were detected and after 24 hours of heating were all tested oils and fat more saturated.
- The best thermal-oxidative stability has palm oil, followed by rapeseed oil. The least stable FAs composition has coconut oil and rice bran oil.
- The most significant changes are in the representation of (9Z,12Z)-octadeca-9,12-dienoate. (e.g. In rice bran oil its content decreased from 41.94 % in fresh to 20.17 % in 24h heated samples).
- Exist a significant correlation in the change in the relative representation of FAs with the identical carbon number during heating.

	SFAs	MUFAs	PUFAs
Coconut oil	11.96	-9.14	-
Palm oil	1.93	-0.93	-1.00
Rapeseed oil	2.07	4.27	-6.34
Rice bran oil	5.93	15.85	-21.79
Hog lard	10.48	-4.43	-6.06
Sunflower oil	6.23	-2.02	-4.21
Soybean oil	3.41	5.51	-8.92
HO Sunflower oil	6.02	1.82	-7.84

Fig. 3 Changes in the representation of SFAs, MUFAs, and PUFAs after 24 hours of heating against the fresh sample

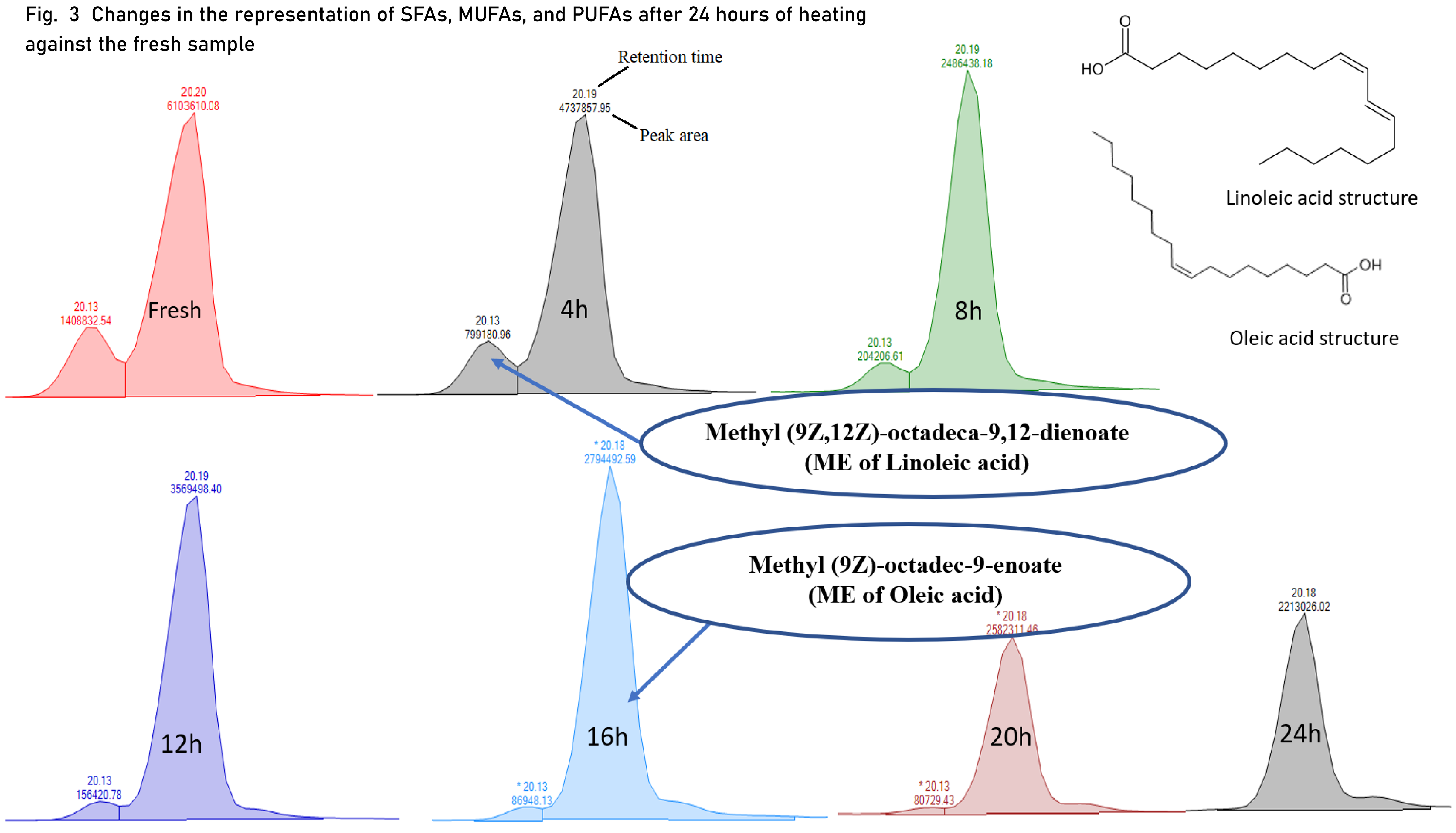


Fig. 4 Chromatographic peaks of ME linoleic acid and ME oleic acid. It illustrates changes in the representation of these FAs in coconut oil

Conclusion

- Heating cause degradation of fatty acid's double bonds.
- Oils and fats rich in SFAs have better thermal-oxidative stability.
- HOSO has better thermal-oxidative stability than the sunflower oil.
- It seems, that the oils which contain fewer types of FAs are more stable than oils rich in differ FAs species.

References

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