

RESEARCH CONCERNING THE MEAT PARAMETERS CHANGES IN RELATION WITH THE TYPES OF THE FRYING FATS

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Summary

The objective of this study was to determine the way in which different types of culinary fat used all over the world, affected the color, the oxidation of lipids and the fat composition of pork and beef meat marketed in Romania. The main types of culinary fat used in this study were olive oil, sunflower oil, milk butter and grease from different species of animals. Each one of these fat types influenced in a different way the final color of meat. The lipid oxidation was measured by TBA-RS technique. After experimentally frying the meat, there were used a series of solvents to extract the color substances, which were analysed for absorbance at 420 nm. These values were significantly higher for the samples fried in type 1 of fat, in comparison to the ones fried in type 3. The fatty acid profiles were also modified considering the neutral lipid composition as well as the free fatty acid fractions. Regarding neutral lipids composition, the samples fried in type 4 fat did not differ significantly from the raw meat samples. The fatty acids with C12, C14 and C16 increased by 10, 2.5 and 1.5 fold in pork meat, when type 3 fat was used.

Key words: frying; culinary fat; oxidation of lipids, meat color

Meat is a major source of fat in the diet, especially considering the saturated fatty acids, which have been implicated in diseases associated with modern life in developed countries. Nevertheless, meat is consumed only after thermal treatment which can imply boiling, roasting or deep-frying. All the thermal processing practices can determine modifications in fatty acid profiles of meat lipids, thus altering the desirable fatty acid profiles obtained by dietary means. During frying, the culinary fat or oil acts as a heat transfer medium and becoming an important ingredient of the fried food due to water loss as well as penetration of oil into the food. Moreover, undesirable changes might occur during frying including thermal oxidation and losses of some nutrients such as essential fatty acids, minerals, and vitamins. Also, oxidation can have an important impact because it provokes the apparition of positive flavors as well as rancid ones, which can reduce the sensory traits. The temperatures above 100°C reduce the development of lipid oxidation, this being attributed to Maillard reaction antioxidant reaction.

Fat consumption is a major factor for the increment of health risks such as diabetes, cancer and hypertension, but also heart diseases. The purpose of this paper was to study how deep fat frying of pork and beef meat in different culinary fats affected the colors, the lipid oxidation, and the fatty acid composition of meat.

Materials and methods

The culinary fats were refined ones, with an acidity of 0.4. The selection of these types was based on fatty acid composition. Concerning the meat, several pieces of pork and beef meat were selected and subjected to frying, in order to evaluate the modifications produces by each type of fat.

The frying was performed in stainless steel fryers, the meat being weighed before and after frying as well. The meat pieces had an average value of weight of 40 g. Each type of fat was used to prepare 10 pieces of meat. The ratio between meat and fat type was 40 g/100 ml. The frying was performed by deeply introducing the meat pieces in the culinary fat. Once fried, the meat was left to drain for a couple of minutes, and afterwards dried by using clean towels. The meat losses by frying were calculated by comparison between the meat weight before and the one after frying. The moisture of the samples was determined by drying the samples at 100°C.

After determining the moisture of the fried meat, fat extraction was performed, in order to analyze the fatty acid profiles. The lipids were extracted using methanol and the fractions were analyzed using gas chromatography. The oxidation of lipids was also assessed, by using the TBA method, the values of this parameter being calculated taking into account a standard curve of malondialdehyde, and the unit was kg^{-1}/g meat. The measurement of color was realized after the cooling of the fried meat. This parameter was measured by using a colorimeter. For color evaluation, there were determined the hue, the brightness and vividness of the tint. Eight measurements were taken of each sample surface and averaged for statistical analysis. The Maillard reaction color substances were measured by absorbance at 420 nm, but firstly they were extracted using different solutions. The browning degree is often used as a parameter to assess the extent of Maillard reaction of thermal processing of food. After extraction, the tubes were hermetically closed and placed on a shaker, and after 1 h, they were centrifuged at 5000 g for 10 minutes. The absorbances at 420 nm of the supernatants were evaluated.

Results and discussions

Type 2 of fat had a high PUFA content, while type 3 was very rich in saturated fatty acids. Type 4 was very high in saturated fatty acids as well, but with a relative high MUFA content as well (table 1).

Considering the water content, all cases showed a significant decrease considering this parameter, after frying, but water losses for meat when fried in type 1 fat were low in comparison to the other types. The frying losses were significantly high when using type 2 fat (42.10 %), in comparison to fat type 4 (41.75 %), while type 1 and type 3 of fat were close as value (42.5 and 42.6 %)

Frying caused a significant increase when talking about oxidation of lipids, in all fried samples, determined by TBA-RS methods. Hence, the TBA-RS values increase 3 times when using type 2 of fat, 2 times when using type 4 and type 1, and only 1 time type 3 fats. These differences are due to the composition in fatty acids, which is distinct for each fat type.

Table 1

The effect of using a certain type of frying fat on moisture, fat content, cooking losses, oxidation of lipids and color of raw pork and beef meat

	Raw meat		Culinary frying fat							
	Pork	Beef	Type 1		Type 2		Type 3		Type 4	
			Pork	Beef	Pork	Beef	Pork	Beef	Pork	Beef
Moisture	658,58	615,39	550,21	514,46	412,62	401,98	509,77	501,18	520,15	529,38
Fat	58,75	54,38	24,12	22,95	26,71	26,15	22,64	25,25	26,94	27,16
Cook losses (%)	-	-	43,15	42,84	44,98	45,22	55,35	52,85	54,85	54,65
TBA-RS	0,21	0,47	0,55	0,57	0,34	0,39	0,51	0,56	0,65	0,68
Abs. 420 nm (g/kg ⁻¹)	46,24	44,85	69,18	68,77	69,39	64,21	75,17	72,65	71,21	71,85

The color was also modified after frying, the yellowness and hue presenting increased values, these changes being attributed to the browning process performed by the Maillard reaction. Considering the absorbance at 420 nm of the colored substances extracted by using solvents, when using methanol the obtained values were higher than the case when acetone was used, in all samples, except for type 4 fat.

The frying process involves an exchange of fatty acids between the lipids in the pork and beef meat and the culinary fat used, which caused significant modification considering the fatty acid composition of the meat. Fatty acids are highly susceptible to oxidative processes when they are in the free form. Moreover, polyenoic acids, such as linoleic acid, are much more sensitive towards oxidation and the rate of peroxide formation is much faster in their case. Considering these results, development of rancidity during storage of type 2 fat-fried samples might be more likely than in samples fried in the other culinary fats. All these results indicate that the lipids' composition of the fried loin chops tends to be similar to the frying culinary fat agreeing with previous studies.

Taking in account the fatty acid composition and nutritional recommendations and in the light of reported findings, olive-oil-fried meat had a more „safe” fatty acid profile and nutritional ratios than did the meat pieces fried in the other types of culinary fats. On the other side, butter-fried meat had an unbalanced fatty acid profile and nutritional ratios very far from nutritionist recommendations, particularly the high content of saturated fatty acids.

Conclusions

Different culinary fat types were used to fry several pieces of pork and beef meat, these being responsible for the development of Maillard reaction in different extent.

This process determines different colors of the meat and the alteration of the oxidative status of the meat, which can affect the shelf-life of this food product.

In addition to the components of fatty acids, there are other factors, such as the type of fat used for frying, which has to be considered when estimating the intake of different specific classes of dietary fatty acids.

References

1. **Bastida, S., Sanchez-Muniz, F.J.**, Thermal oxidation of olive oil, sunflower oil and a mix of both oils during forty discontinuous domestic fryings of different foods, *Food Science and Technology International*, 2001, 7, 15-23.
2. **Bendinghaus, A.J., Ockerman, H.W.**, Antioxidative Maillard reaction products from reducing sugars and free amino acids in cooked ground pork patties, *Journal of Food Science*, 1995, 60, 992-995.
3. **Cava, R., Ruiz, J., Lopez-Bote, C., Martinn, L., Garcia, C., Ventanas, J., Antequera, T.**, Influence of finishing diet on fatty acid profiles of intramuscular lipids, triglycerides and phospholipids in muscles of the Iberian pig, *Meat Science*, 1997, 45, 263-270.
4. **Enser, M.**, The role of fats in human nutrition. In Rossell, B. (Ed.), *Oils and fats*, Vol. 2: Animal carcass fats, 2001, pp. 77-122.
5. **Fillion, L., Henry, C.J.K.**, Nutrient losses and gains during frying: a review. *International Journal of Food Science and Nutrition*, 1998, 49, 157-165.
6. **Fogliano, V., Monti, S. M., Musella, T., Randazzo, G., Ritieni, A.**, Formation of coloured Maillard reaction products in a gluten-glucose model system, *Food Chemistry*, 1999, 66, 293-299.
7. **Romero, A., Cuesta, C., Sanchez-Muniz, F.J.**, Cyclic fatty acid monomers and thermoxidative alteration compounds formed during frying of frozen foods in extra virgin olive oil, *Journal of American Oil Chemists' Society*, 2000, 77, 1169-1173.
8. **Salih, A. M., Smith, D. M., Price, J. F., Dawson, L. E.**, Modified extraction 2thiobarbituric acid method for measuring lipid oxidation in poultry, *Poultry Science*, 1987, 66, 1483-1489.
9. **Satyanarayan, V.T., Honnikel, K.O.**, Effect of different cooking methods on warmed-over flavour development of pork, *Zeitschrift fuer Lebensmittel-Untersuchung und Forschung*, 1992, 194, 422-425.
10. **Yoshimura, I., Iijima, T., Watanabe, T., Nakazawa, H.**, Antioxidative effect of maillard reaction products using glucoseglycine model system, *Journal of Agriculture and Food Chemistry*, 1997, 45, 4106-4109.