MODIFICATION IN TOCOPHEROL AND FATTY ACID CONTENT IN TWO DIFFERENT MARCHIGIANA CATTLE CUTS OF MEAT AFTER FRYING IN EXTRA VIRGIN OLIVE OIL

Carmina Viola, *Maria Carmela Polese*, Finizia Russo, Elena Coccia, Francesca Cimino, Marina Paolucci, Ettore Varricchio

Department of Science and Technologies, University of Sannio
Benevento, Italy, email: varricchio@unisannio.it

Abstract: Pan frying is the main method of cooking of cutlets, and often the choice of oil to use is controversial [1-2-3]. In this note, we proposed the use of extra virgin olive oil to cook Marchigiana cattle meat. In detail, we reported not only some data on the quality of extra virgin olive oil and meat, but also, the modification in α-tocopherol and fatty acid content in topside and silverside cuts of Marchigiana cattle, after frying. The results showed an improvement of quality of fatty acid content together an increase of α-tocopherol. In conclusion, considering our results, we promote the use of extra virgin olive oil, also, in the pan frying of cutlets.

Keywords: pan frying, cutlets, extra virgin olive oil, Marchigiana cattle.

1. INTRODUCTION

Among cooking oils and fats, virgin olive oil (VOO) is unique because of its composition in monounsaturated fatty acids and significant amounts of health-promoting micronutrients [5-6]; it has been extensively showed that during frying a two-way fat exchange between the frying medium and the meat takes place [8-9], so oil absorbed during the frying can increases the nutritive value of food.
Among the natural antioxidants, tocopherols are particularly important functional components in foods as they shave vitamin E properties and display antioxidant activity, which protects the body tissues against the damaging effects caused by the free radicals that result from many normal metabolic functions.
Italian olive oil contains α-tocopherol, the vitamin E homologue, which presents the highest biological potency; the concentration of α-tocopherol, reported in the literature, for good-quality VOO's, is usually in the range 50-300 mg/Kg [7].
The purpose of this work was to study the changes in the fatty acid profile in two different cuts of Marchigiana cattle meat, in order to identify the best fatty acid profile and, therefore, the most valuable nutritionally in terms of lipid contribution made with diet.
In addition the content in antioxidant substances and vitamin (tocopherols) was analyzed to assess the likely passage of beneficial substances, from oil to meat, during the frying process.
For this study, the topside and the silverside cuts of Marchigiana cattle were collected at 14th day of aging, fried in extra virgin olive oil 100% Italian (Biagio Mataluni S.p.A. olive oil industry, Montesarchio, BN): the meat samples were breaded with egg and breadcrumbs, in accordance with the defined frying mode "pan-frying", very widespread in household level, which gives the food a golden appearance and it also influences the palatability.
In detail, the study proposed the following objectives:
- Assess the changes in the fatty acid composition of two cuts of meat after the frying process in extra virgin olive oil;

- Verify the influence of the frying process on the nutritional quality of the meat with particular reference to the possible enrichment of the nutrient content of antioxidant present in the oil.

In this study, we have chosen the Marchigiana cattle for its commercial interest and meat quality. The meat of this animal is a PGI (Protected Geographical Indication) product and the name of the trade mark is "Vitellone Bianco dell'Appennino Centrale".

2. MATERIAL AND METHODS

2.1 SAMPLING

For the topside cut was used six slices of meat, three of which were breaded with breadcrumbs and eggs and then fried in olive oil and three further subdivided as follows: a whole slice and a half they have breaded with breadcrumbs and eggs, while a whole slice and the other half remained crude and not breaded.

For the silverside, twelve slices of meat were used, of which five were breaded with bread crumbs and eggs and then fried in extra virgin olive oil; the remaining four were breaded with breadcrumbs and eggs, three were crude and not breaded.

2.2 EXPERIMENTAL DESIGN

For frying tests, carried out on gas cooker, it was used a pan of 36 cm diameter; a sample was fried at a time, for each type of cut, replacing the oil bath to frying.

Samples were fried in 400 ml of olive oil for 5 minutes at a starting temperature of 160 °C (2 min 30s per side); then samples were cooled to room temperature (20-22°C) and immediately analysed.

The parameters of the entire frying process (oil quantity, time and temperature) have been standardized and are summarized below (Table 1).

Table 1. Parameters of the frying process

	topside	silverside
n. of meat samples	6	12
oil quantity (for each frying)	400ml	400ml
Heating time	5:00min	5:00min
oil heating time (at the start of frying	160°C	160°C
frying time	2:30 min for side	2:30 min for side
oil cooling after frying	15 min	15 min

The oil samples and meat were analyzed before and after the frying process.

On oil samples it was determined the content and composition of α-tocopherols by HPLC and analyzed the fatty acid composition by gas chromatography of methyl esters of fatty acids.

From each meat sample, lipid component was extracted according to Bligh and Dyer method [4], for the qualitative determination of the fatty acid component and the tocopherol content; this extraction method was also applied to the ingredients used for breading (egg and breadcrumbs). The atherogenic and thrombogenic indexes were also determined on both cuts of meat before and after the frying. On all meat samples, the moisture determination was also carried. On the cooked meat was, also, carried out the sensory analysis. The analytical determinations were performed in triplicate and statistical processing of the data was performed by analysis of variance (ANOVA) using the software XLSTAT 2006 version 2006.6 (Addinsoft, Paris, France).

3. RESULTS

3.1 MOISTURE AND FAT CONTENTS

Changes in moisture and in fat contents in the two cuts are shown in Table 2.

Table 2. Moisture and fat contents in meat before and after pan-frying process.

		silverside	topside
		%	
Moisture	*raw meat*	74,97	73,36
	pan meat	71,48	65,6
	pan-fried meat	53,26	57,57
Fat	*raw meat*	6,6	5,7
	pan meat	11,0	10,3
	pan-fried meat	17,5	25,9
	breadcrumbs	1,4	1,4
	eggs	7,5	7,5
	oil	100	100

Moisture content decreased from 75% to 53% in the silverside cut and from 73% al 57% in the silverside one during the "pan-frying" process. The total fat content of raw meat from the silverside cut showed a higher level of lipids (6,6%) than the topside (5,7%), but after frying lipidic content was greater for the topside cut (25,9% against 17,5%).

3.2 FATTY ACID PROFILE

The fatty acid profile of extra virgin olive oil before and after pan-frying is shown in Table 3. There are no significant differences both for silverside and topside cuts.

Linoleic acid/palmitoleic acid ratio is used to evaluate oxidative degradation during the frying process; polyunsaturated fatty acids are more susceptible to oxidation so their percentage content decreased during cooking processes, while the percentage content of saturated fatty acids increased, as they are more resistant to alteration.

As can we see from Table 3, this ratio did not change after the frying process for the silverside while it showed a slight reduction for the topside cut.

Table 3. Fatty acids composition of extravirgin olive oil, before and after frying process.

	% fatty acids		
	oil before pan-frying	oil after pan-frying	
Fatty acids		**silverside**	**topside**
myristic	0,01	0,04	0,03
palmitic	11,77	12,11	12,86
palmitoleic	0,82	0,83	0,88
heptadecanoic	0,04	0,05	0,05
heptadecenoic	0,08	0,08	0,08
stearic	2,55	2,67	2,67
trans oleic	0,01	0,01	0,0
oleic	77,69	77,32	76,64
linoleic	5,57	5,66	5,51
arachidic	0,36	0,32	0,29
linolenic	0,65	0,59	0,6
eicosenoic	0,25	0,23	0,21
behenic	0,11	0,07	0,07
lignoceric	0,04	0,01	0,05
linoleic/palmitic	0,47	0,47	0,43

Concerning the acid profile of meat samples, we observed that the percentage of oleic acid was high in raw meat, especially in the topside (54,18%) and it increased significantly after the frying process. Raw meat of the topside showed a higher concentration of monounsaturated fatty acids than the silverside; breaded meat silverside showed a higher concentration of saturated fatty acids, while polyunsaturated fats increased in both cuts. In cooked meat, monounsaturated fatty acids were high for both cuts while the saturated ones decreased. Both cuts, topside and silverside, were nutritionally valid thanks to the composition in monounsaturated fatty acids, in particular oleic acid.

Raw meat from topside cut showed the lower ***Atherogenic index*** due to the high content in

oleic acid; following the frying process this index decreased in all the samples, perhaps because the interlipidic changes between extravirgin olive oil and meat. In fact, the meat cooked was enriched by the typical lipid component (monounsaturated fatty acids) of the oil used for frying.

The evaluation of organoleptic properties did not show significant differences between the two cuts relative to taste, smell and tenderness of cooked meat.

3.3 TOCOPHEROL CONTENT

In the table 4, is described the quantitative data relating to the content of α-tocopherol extra virgin olive oil before and after frying process of the two different cuts.

α-tocopherol content in the oil was reduced after frying in both cuts; this variation is correlated to the fact that tocopherols was degraded to heat and to exposure to sunlight or to atmospheric oxygen, but could also be due to the fact that during the frying process take place an exchange between oil and meat.

Raw meat did not show a detectable content of α-tocopherol, but following the process of breading it was enriched with tocopherols thanks to the contribution of eggs, whose lipid fraction is rather rich in tocopherols, and breadcrumbs. After the frying process all the samples showed an enrichment in tocopherols and the most significant increase was found in cooked meat topside (0.51%) compared to the same cutting breaded (0.27%).

Table 4. α- tocopherol content

		topside	*silverside*
		mg α-tocopherol/100 g	
α-tocopherol	*oil before frying*	25,58 ± 0,03	25,58 ± 0,05
	oil after frying	22,63 ± 0,02	21,63 ± 0,04
		mg α-tocopherol/100 g, fresh weight	
	raw meat	-	-
	breaded meat	0,27 ± 0,04	0,44 ± 0,03
	pan-fried meat	0,51 ± 0,03	0,49 ± 0,02
	breadcrumbs	0,2 ± 0,05	0,2 ± 0,07
	eggs	2,65 ± 0,04	2,65 ± 0,04

4.CONCLUSIONS

The use of extravirgin olive oil in the frying produced a change in the fatty acids and tocopherols content in the meat. For both cuts the oleic acid content is greatly increased in cooked meat and as a result of the process of breading, meat is enriched with tocopherols thanks to the contribution of eggs and breadcrumbs, whose lipid fraction is rather rich in tocopherols. Both cuts considered, after 14 days of aging, were a nutritionally valuable for the higher content of monounsaturated fatty acids to saturated fats. The use of extravirgin olive oil also led to a reduction of atherogenic index, as it is rich source of oleic acid, absorbed by the meat during frying.

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