THE OPTIMAL RANGE OF EMBEDDING THE ESSENTIAL FATTY ACIDS FROM FISH OIL IN THE FAT GLOBULE OF RIPENED SPUN PASTE CHEESE

Hîlma Elena *

*University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048 Oradea, Romania, e-mail: hilma_elena@yahoo.com

Abstract

Spun paste cheese containing milk proteins rich in essential amino acids. Milk fat contain fairly large proportion of saturated fatty acids of carbon atoms numbering more than 10. This study is to incorporate the milk fat globule the essential fatty acids where the proportion of fatty acid to change so as to reduce colesteremiantă characteristic of the milk and to increase the biological value of the fat in the apun paste cheese. In this sense, made from sheep's milk spun paste cheese with added fish oil which has undergone homogenization at 70 ° C and a pressure of 200 bar. So fat globule membrane splits and fish oil adheres to the milk fat globule membrane and recover and includes essential fatty acids from fish oil. It analyzed the optimal limit of fish oil added to milk three essential fatty acids (linoleic acid, linolenic and acid γlinolenic) that are representative of sheep milk and fish oil. The following values were obtained for the concentration of fish oil to the raw milk for the three fatty acids: linoleic acid, 0.3051%, 1.0630 linolenic acid, 0.9909% γlinolenic. . These are values obtained in laboratory conditions.

Key words: ripened spun paste cheese polyunsaturated fatty acids

INTRODUCTION

Sheep milk is a raw material which is used preponderantly in the production of cheese because it is increased rich of casein, protein curd entering the structure. It can increase the percentage of protein by enriching food with protein or amino acids and substances then have higher values of urea in milk but no specific effect on consumption in the manufacture of cheese, but increases the nutritional value of dairy products (Giuseppe Pulina et al, 2006).

The bioactive milk proteins inhibit the growth of bacteria in the retention of nutrients that are essential for multiplication of bacteria.
Lactoferrin has been shown to inhibit the growth of harmful bacteria (eg. *Escherichia coli, Salmonella, Listeria, Shigella*) by binding iron so tightly that they can not access (Shi et al, 2000; Berkhout et al, 2003; Costin 2003). Similarly, vitamin B12 haptocorrin set so that bacteria are incapable of to use. By using sheep's milk collected from animals fed with green fodder enriches the flavor of the cheese. This significantly influences the fraction

of volatile milk and cheese, mainly due to the emergence of terpene hydrocarbons that pass directly from the grass into milk and milk products. In conclusion Chrysanthemum coronarium (daisies) cheese taste and smell prints mature product (Addis, 2006).

In recent years, our knowledge about the composition and properties of membrane fat globule increased significantly. It is now recognized that membrane fat globule is a highly complex structure. This is comprised of various proteins and lipids, components with outstanding nutritional and technological properties (Koen Dewettinck, 2008).

The fatty acids in milk fat composition are important to the biological value of milk and milk products. A beneficial role for the body they have polyunsaturated fatty acids, with role from essential fatty acids. Conjugated linoleic acid have been awarded numerous physiological beneficial properties for health: anticarcinogenic activity, modulator of lipid metabolism and immune function (Kelly, 2001, Lai et al, 2005). Enrichment sheep milk in essential fatty acids can with a special diet (Mierliță Daniel 2010). Sheep milk composition in essential fatty acids is influenced by the number of lactations (Mierliță Daniel 2009) and stage of lactation (Mierliță Daniel 2009).

Unsaturated fatty acids helps lower cholesterol and lipid membranes of enterocytes (Alvaro, 2010), have beneficial role in case of illness. Parkinson (Bousquet, 2009), schizophrenia (Ravinder et al, 2004) and generally in neurotransmission (Riemer, 2010). High levels of ω-3 fatty acids and ω-6 in heart tissue are associated with reduced mortality due to heart disease (Nipon et al, 2009). Knowledge of the cardioprotective benefits of ω-3 PUFA in particular and in general, have been used in nutritional orientations for improving cardiovascular health (Yuriko et al, 2010). Immunity and inflammation are mediated by polyunsaturated fatty acids and the influence of dietary fat and lipid metabolism (Ueda et al, 2008). In the contemporary environmental conditions are more affected by pollution. This causes and stress and increases the amount of toxins in the body affecting health. A healthy diet with a high content of polyunsaturated fatty acids can lower the body's intoxication and inflammatory processes. (Sofi F et al, 2008).

MATERIALS AND METHODS

Three samples were analyzed spun paste from cheese sheep's milk with added fish oil 0%; 0.05%; 0.15%. Fish oil has been incorporated into the fat molecule by homogenization.

Organoleptic analysis: according S.T.A.S. 66345-95.

Physico-chemical analysis: determining acidităţii- according STAS 6353-85; determination of grăsime- according S.TA.S. 6352 / 2-87; determining the percentage of NaCl in cheese according STAS 6354-84; determination of protein substances and degree of maturare- according STAS 6355-89.

Analysis fish oil: aspect is determined by visual inspection; color is normally determined in accordance with the European Pharmacopoeia, current edition, monograph,, IECORIS Asella Oleum "Relative density is normally determined in accordance with the European Pharmacopoeia, current edition, Chapter 2.2.5; absorbance, is made according to European Pharmacopoeia monograph,, Omega-3 triglycerides ACIDORUM "and chapter 2.2.25.

Gas chromatographic analysis of fatty acids: extraction was performed with organic solvents fat milk (0.6% ammonia solution, 2 ml of ethanol, 4 ml ethyl ether and 4 ml. hexane). The fatty acids were converted to methyl esters by reaction with boron trifluoride / methanol and they were extracted with hexane. Gas chromatographic analysis of fatty acid methyl esters was performed using a Shimadzu gas chromatograph GC-17A. Total analysis time: 39.25 minutes.

Methods of statistical analysis: for multiple comparisons were used, Turkey test, and Fisher Duncan and for comparison with the control using Dunnett's test. To determine the optimum concentrations of fish oil to be embedded in fat globule was used for statistical analysis with comparative method ROC curves (Receiver Operator Characteristic = Operating Characteristic), Fourier correlations (Teusdea, A, 2008; Teusdea A, 2009)).

RESULTS AND DISCUSSION

To determine the optimal dose of fish oil from organoleptic and technological point of view, they were made three versions of spun paste cheese: a version without the addition of fish oil and two progressive concentrations of 0.05% and 0.15%. Samples were coded according to Table 1.

Table 1

Codification of samples of ripened spun paste cheese from sheep's milk rich in essential fatty acids

Addition of fish oil %	sample	
	raw sheep milk	Ripened spun paste cheese
samples without fish oil	LC_0	Cm_0
0,05	$LC_{0,05}$	$Cm_{0,05}$
0,15	$LC_{0,15}$	$Cm_{0,15}$

After the point of sensory spun paste cheese matured with the addition of fish oil is the same as the sensory characteristics without added fish oil.

The physico-chemical characteristics of the samples does not change with the addition of fish oil compared with controls without added.

To determine the optimal threshold potting fish oil globule of fat ripened cheese with spun paste they were considered representative of three essential fatty acids composition of sheep's milk and fish oil: linoleic acid, linolenic and γlinolenic acid.

After the the overlapping of the chromatograms, retention times in the area of the three essential fatty acids (between times 28.75 and 31.75 minutes), it is noted that the sample concentration falls with the addition of fish oil from fish oil and those of the milk. The samples are approximately in the order of added fish oil concentrations in milk (figure 1).

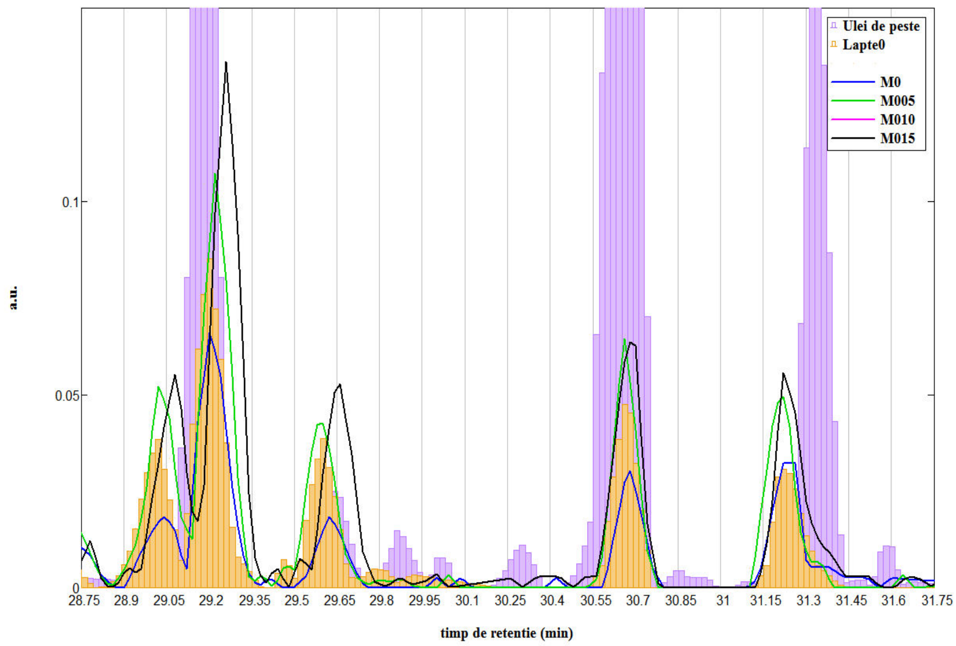

Figure 1The graph chromatograms stacked samples for sheep milk, sample ripened cheese spun paste, and fish oil - the detection of essential fatty acids studied

Analyzing potting limits of linoleic acid in milk fat globule of using logistic regression function, resulting limits vary between 0.065% and that 0.17% fish oil added to milk (figure 2).

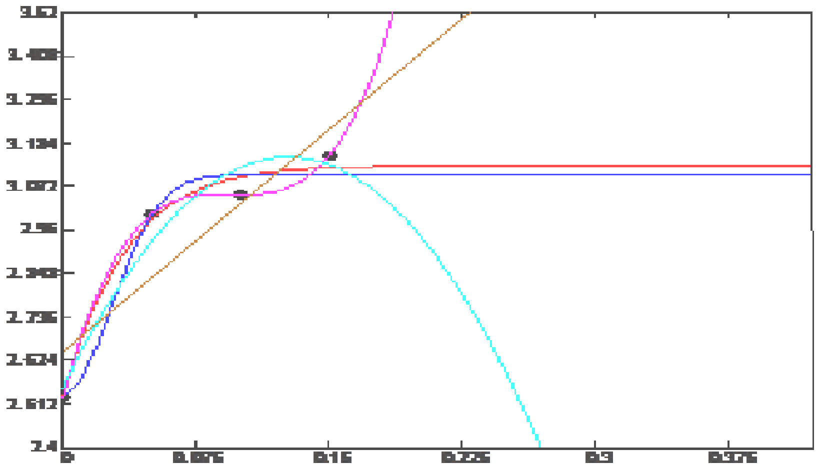

Figure2 The threshold of linoleic acid incorporation in ripened spun paste cheese

Analyzing the threshold values of embedding linoleic acid results in a theoretical amount of 0.365% added fish oil in milk (table 2).

Table 2

Values of embedding threshold for linoleic acid in the ripened spun paste cheese

Precision	Saturation threshold (from regression)	Saturation threshold (the derivative regression)	Saturation threshold (theory)
0,0001	0,225	0,325	0,365200829

In the case of linoleic acid, embedding it in the limit of the fat globule, the proportions range between 0.05% and 0.18% fish oil added to the milk (figure 3).

In the theoretical threshold of saturation of fat globule of this is achieved, if linolenic acid to a value of 0.44% added fish oil in raw milk (Table 3).

Table 3

Values of embedding threshold for linolenic acid in the ripened spun paste cheese

Precision	Saturation threshold (from regression)	Saturation threshold (the derivative regression)	Saturation threshold (theory)
0.0001	1.374130024	1.374188097	0.440775772

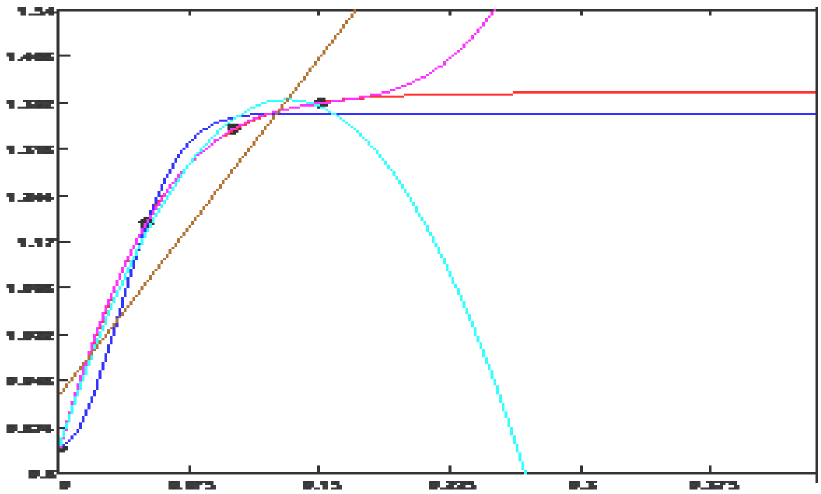

Figure 3 The threshold of linolenic acid incorporation in ripened spun paste cheese

If we consider γ-linolenic acid, one of the three common essential fatty acids composition of fish oil and sheep milk) potting limit in milk fat globule approximate values range between 0.04% and 0.16% oil fish added milk (using logistic regression function). This is shown graphically in figure 4).

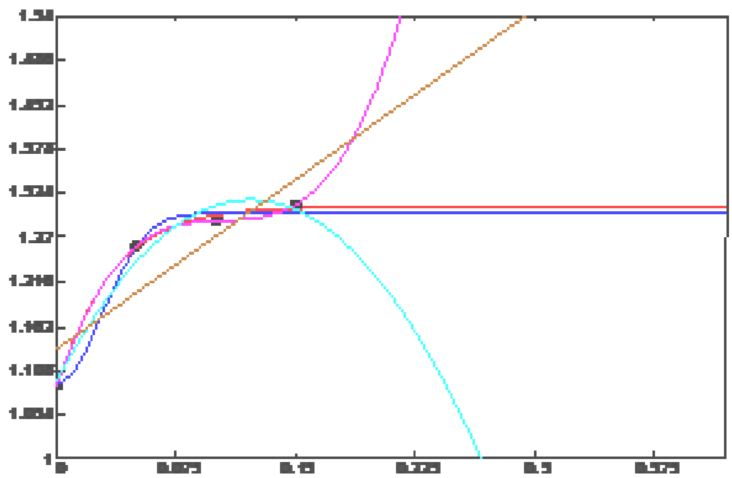

Figure 3 The threshold of γ-linolenic acid incorporation in ripened spun paste cheese

The theoretical threshold of milk fat globule saturation is reached at the amount of 0.37% fish oil added to the milk of sheep used for the manufacture (table 4).

Table 4

Values of embedding threshold for γ-linolenic acid in the ripened spun paste cheese

Precision	Saturation threshold (from regression)	Saturation threshold (the derivative regression)	Saturation threshold (theory)
0.0001	1.300223475	1.300267753	0.372092766

For determining the optimum concentration of fish oil to be added to milk, in view of embedding the globule of fat essential fatty acids was analyzed centrally three essential fatty acids under analysis (table 5).

Table 5

The concentrations in fish oil sheep milk to a maximum of embedding samples of spun paste cheese matured a three-essential fatty acids

Fatty acds	Percentage concentration of fish oil in sheep milk	Limit potting
Linoleic	0.2250	from regression values
Linoleic	0.3250	regression of the values of the derivative
Linoleic	0.3652	theoretical
Linolenic	1.3741	from regression values
Linolenic	1.3742	regression of the values of the derivative
Linolenic	0.4408	theoretical
γ -Linolenic	1.3002	from regression values
γ -Linolenic	1.3003	regression of the values of the derivative
γ -Linolenic	0.3721	theoretical

Average concentrations of fish oil added to the milk of sheep, for the three fatty acids, is presented in table 6.

Table 6

Average concentrations of fish oil added to the milk of sheep, for the three essential fatty acids

Sample	The concentration of fish oil (%)
Cm_0-linoleic acid	0.3051
$Cm_{0,05}$- linolenic acid	1.0630
$Cm_{0,10}$- **γ**linolenic acid	0.9909

CONCLUSIONS

In order to obtain matured spun paste cheese enriched in essential fatty acids, the role of functional product by the addition of fish oil and gave the following average values for each of the three essential fatty acids to be studied: linoleic acid- 0.351%; linoleic acid- 1.0630% and γlinolenic acid - 0.9909. Limit potting average of the three essential fatty acids is 0.7863% and varies from 0.2601% and 1.3126% fish oil added to raw milk. In conclusion it may be made from sheep milk spun paste cheese matured with the addition of 015% fish oil without having to modify sensory and physicochemical characteristics. To implement the system of industrial production further investigation is needed. It is recommended to use a rate of 0.15% fish oil, which is added to milk sheep because working conditions in the industrial system are different from the laboratory.

REFERENCES

1. Alvaro Adriana, Roser Rosales, Lluís Masana, Joan-Carles Vallvé. 2010. *Polyunsaturated fatty acids down-regulate in vitro expression of the key intestinal cholesterol absorption protein NPC1L1: no effect of monounsaturated nor saturated fatty acids*. The Journal of Nutritional Biochemistry, Volume 21, Issue 6, June Pages 518-525.
2. Bousquet M. , C. Gibrat, M. Saint-Pierre, C. Julien, F. Calon, F. Cicchetti. 2009. *Modulation of brain-derived neurotrophic factor as a potential neuroprotective mechanism of action of omega-3 fatty acids in a parkinsonian animal model*. Progress in Neuro-Psychopharmacology & Biological Psychiatry 33 1401–1408.
3. Koen Dewettincka, Roeland Rombauta, Natacha Thienponta, Thien Trung Lea, Kathy Messensb, John Van Campc. 2008. *Nutritional and technological aspects of milk fat globule membrane material*. International Dairy Journal 18, 436–457.
4. Mierliţă D., C. Maerescu, St. Daraban, F. Lup. 2009. *Effects of energy and protein content in the diet on milk yield and milk fatty acid profile in dairy ewes.* Bulletin USAMV Cluj-Napoca, Animal Science and Biotechnologies, 66(1-2), ISSN 1843-5262, p: 67-73.
5. Mierliţă D., F. Lup, C. Maerescu. 2009. *Nutritional and technological factors inorder to obtain functional food enriched with PUFA Omega 3 and CLA at sheep: a review. Analele Univ. din Oradea, Fascicula:* Ecotoxicologie, Zootehnie şi Tehnologii de Industrie Alimentară, ISSN 1583-4301.
6. Nipon Chattipakorna, Jongkolnee Settakornc, Petnoi Petsophonsakula, Padiphat Suwannahoid, Pasuk Mahakranukrauhd, Somdet Srichairatanakoole, Siriporn C. Chattipakornb. 2009. *Cardiac mortality is associated with low levels of omega-3 and omega-6 fatty acids in the heart of cadavers with a history of coronary heart disease*. Nutrition Research, 29, 696–704.
7. Riemer Sabine , Michael Maes , Armand Christophe , Winfried Rief. 2010. *Lowered ω-3 PUFAs are related to major depression, but not to somatization syndrome.* Journal of Affective Disorders, 123, 173–180.
8. Shi Y., Kong W., Nakayama K. 2000. *Human Lactofermn Binds and removes the Hemoglobin Receptor Protein of the Penodontopathogen Porphymonas gingivalis*. Journal of Biological Chemistry, 275, 39, 30002-30008.
9. Sofi F., A. Buccioni, F. Cesari, A.M. Gori, S. Minieri, L. Mannini, A. Casini, G.F. Gensini, R. Abbate, M. Antongiovanni. 2010. *Effects of a dairy product (pecorino cheese) naturally rich in cis-9, trans-11 conjugated linoleic acid on lipid, inflammatory and haemorheological variables: A dietary intervention study, Nutrition*. Metabolism and Cardiovascular Diseases, Volume 20, Issue 2, 117-124
10. Teusdea, A.C. & Gabor, G. 2009. *Iris Recognition with Phase-Only Correlation*. Annals of DAAAM for 2009 & Proceedings of the 20th International DAAAM Symposium, ISBN 978-3-901509-68-1, ISSN 1726-9679, pp 690-691, Editor B. Katalinic, Published by DAAAM International, Vienna, Austria.
11. Teuşdea, A. C., Modog, T., Mancia A., Drăgan Dan. 2008. *Deformations analisys with fourier correlation*. Annals of DAAAM for 2008 & Proceedins of the 19th International DAAAM Symposium, "Intelligent Manufacturing & Automation: Focus on Next Generation of Intelligent Systems and Solutions", 22-25th October, ISBN 978-3-90150-958-X (ISI Proceedings M/IT).
12. Teuşdea, A.; Modog, T.. 2008. *Fourier correlations of dam horizontal movements time series*. Journal of Electrical and Electronics Engineering, ISSN 1844 – 6035, Editura Universităţii din Oradea, Oradea, pg. 267-270.
13. Ueda Yukiko, Yuko Kawakami, Daisuke Kunii, Hiroyuki Okada, Masami Azuma, Duc Son N.T. Le, Shigeru Yamamoto. 2008. *Elevated concentrations of linoleic acid in erythrocyte membrane phospholipids in patients with inflammatory bowel disease*. Nutrition Research, Volume 28, Issue 4, 239-244.
14. Yuriko Adkins, Darshan S. Kelley. 2010. *Mechanisms underlying the cardioprotective effects of omega-3 polyunsaturated fatty acids*. Journal of Nutritional Biochemistry, 21, 781–792.