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COMPARATIVE STUDY OF THE MAXIMUM INCORPORATION OF ESSENTIAL FATTY ACIDS IN THE MANUFACTURE OF YOGHURT COMPARED TO TELEMEA CHEESE

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Abstract

Yogurt is an lactic acid product obtained by acidic coagulation and in the teleme cheese production process, enzymatic coagulation is used. Also raw milk is pasteurized at high temperature for yoghurt and at medium temperature for telemea cheese. The operation of homogenizing milk mixed with fish oil is common to both products, and is thus encompassed by the inclusion of essential fatty acids in fish oil within the fat globule membrane of the milk composition.For production were used sheep milk from the first lactation period and fish oil purchased from HOFIGAL.It was analyzed The evolution of the concentration of three essential fatty acids (linoleic acid, linolenic acid and γ-linolenic acid), specific to both sheep milk and fish oil, was followed.It analyzed the evolution of the concentration of three essential fatty acids (linoleic acid, linolenic and γ linolenate) specific to both sheep's milk and fish oil. The analysis resulted in the fish oil concentration of milk for fresh teleme cheese of 0.138% and in the case of yogurt of 1.742%, the concentrations taken into account at the optimum threshold of incorporation of those three essential fatty acids taken into consideration.

Key words: yoghurt fresh teleme cheese ω-3 ω-6 fatty acids

INTRODUCTION

Yogurt and teleme cheese are dairy products most often encountered in the processing of milk. This is due to a tradition that lasts for a long time, but also because they are products with high nutritional value.

Some lactic bacteria used in yogurt can synthesize phospholipids from fatty acids. Only the order of Lactobacillales may use exogenous fatty acids to synthesize phospholipids entirely from exogenous fatty acids (Jiangwei Yao 2017).

The synergistic actions of the various antimicrobial compounds produced by lactic acid bacteria by the lactic acid formed prevent the growth of microorganisms in food. Antimicrobial peptides and phenolic compounds from lactic bacteria have been successfully applied in the preservation of wheat grains against fungi. Other than to the elimination of mycotoxins, some of these bioactive substances in lactic acid bacteria have

antioxidant and anti-cancer potential and also increase nutritional value and food safety (Kontham Kulangara Varsha 2016) .

The homogenization applied to milk for cheese production increases lipolysis but has no impact on proteolysis. An acceleration of the lipolysis reaction was clearly observed in the case of cheeses made with homogenized milk at the beginning of maturation. During the maturation of the biochemical transformations of fatty acids resulting from lipolysis, taste and flavor substances are formed such as: methyl ketones, lactones, diacetyl (María A. Vélez 2017).

Essential fatty acids (EFA) play important roles in human biology, affecting organ systems and cellular and intracellular functions. Omega-3 and omega-6 are precursors of eicosanoids, locally acting hormones involved in mediating inflammatory processes. Generally, eicosanoids derived from omega-3 are anti-inflammatory. Recent studies have also confirmed the efficacy of essential fatty acids in the treatment of dry eye diseases (Elana S. Rosenberg 2010).

MATERIAL AND METHOD

In order to obtain yoghurt and cottage cheese was used sheep milk known physico-chemical characteristics (Mierliţă D., 2009), to which was added fish oil for enrichment in essential fatty acids.

Collection of average samples for analysis, raw milk, according *S.TA.S. 9535/1-74;STA.S. 9535/2-74.*

Organoleptic examination: according *S.T.A.S. 6345/95;*

Physico-chemical analysis:

✓ determination of acidity: for raw milk, according S.R. ISO 6091/2008; for acidic dairy products, for cheeses S.R. ISO 6091/2008; for cheeses, according S.T.A.S. 6353-85;

✓ determination of pH: was used the HANNA brand pH meter;

✓ determination of fat content: for raw milk, according *S.T.A.S. 6352/1-88* ; for acidic dairy products, according *S.TA.S. 6352/2-87;* and for cheeses according S.TA.S. 6352/2-87;

✓ determination of the percentage of NaCl in cheese, according S.T.A.S. 6354-84,

✓ determination of protein content, according S.T.A.S. 6355-89.

Gas-chromatographic analysis of fatty acids: for the analysis of the biological value of sheep's milk and milk products has been taken into account in the composition of fatty acids in general, and essential fatty acids in particular. They were determined 19 saturated fatty acids (SFA), monounsaturated fatty acids (MUFA) and polinesatuaraţi (PUFA). Also, fatty acids were analyzed taking into account the evolution of the fatty acid groups of the studied samples. The results of the analyzes are expressed as a

percentage of total fatty acids. Milk fat extraction was performed by mixing 1 ml of well-homogenized yogurt and 0.6% ammonia solution, 2 ml ethyl alcohol, 4 ml ethyl ether and 4 ml. hexane, after which the mixture was stirred for 3 min. In case of cheese, 1 g of the sample was pre-mixed in 10 ml of distilled water and then 0.6% ammonia solution, 2 ml ethyl alcohol, 4 ml ethyl ether and was added 4 ml hexane, after which the mixture was stirred for 3 min. After this process, the lower ammoniacal layer was removed and the mixture was filtered through a filter with cellulose and sodium sulphate (Na_2SO4) and dried. The transesterification fatty acid methyl esters was carried out by reaction with boron trifluoride / methanol at 80 ° C for two hours in a closed tube of Pyrex glass. The content was transferred to a separating tube. Extraction of methyl esters was performed using 10 ml of hexane. The hexane fractions collected were dried using anhydrous sodium sulfate, filtered, concentrated under a stream of nitrogen and finally taken up in 1 ml of hexane. Gas chromatographic analysis was performed using a Shimadzu gas chromatograph GC-17A equipped with a Chrompack capillary column of 25 m length and a diameter of 0.25 mm, stationary phase (a polyethylene glycol derivative) is deposited in the column form a thin film of 0.2 μm. It used a FID detector and the mobile phase was helium 99.9% purity.

Methods of statistical analysis: for multiple comparisons were used Tukey's, Fisher and Duncan test. For comparison with the sample control was used Dunnett's test. The limit of incorporation of fatty acids into the fat globule was determined using the ROC curves (Receiver Operator Characteristic (Teusdea, A, 2008, 2009).

RESULTS AND DISSCUSIONS which represents

The research in this article presents fresh teleme cheese compared yoghurt to sheep milk, assortments appreciated by consumers and which represents more than 85% of the total dairy production in Romania.

In order to obtain fresh teleme cheese and yogurt enriched with essential fatty acids, it was necessary: determining the quantity of fish oil added to sheep's milk, both organoleptically and technologically; adaptation of the classic technological scheme to obtain cottage cheese enriched with essential fatty acids to achieve a higher degree of embedding of fish oil and reduce the loss of whey and brine; determining the retention of polyunsaturated fatty acids in fresh cheese and the dynamics of these acids during the technological process; determining the quality of teleme cheese rich in essential fatty acids by determining the organoleptic, physical-chemical and microbiological analyzes and comparison with traditional cottage cheese. The study was conducted on 4 variants (control and 3

samples with fish oil added) to the following results. The limits of incorporation of the three essential fatty acids studied in yoghurt, taking into account the concentration of fish oil in raw milk, are shown in table 1.

Table 1

Concentrations of fatty acids
at the maximum incorporation limit in yogurt samples

Fatty acids	Conc. Fish oil (%)	The threshold asymptotically
Linoleic	2.8978	of the regression values
Linoleic	2.8979	of the regression derived values
Linoleic	0.7294	theoretical
Linolenic	1.2708	of the regression values
Linolenic	1.2711	of the regression derived values
Linolenic	1.3825	theoretical

The statistical analysis showed that γ-Linolenic acid has no inclusion limit in the fat globule.

Table 2 shows the optimal concentration of fish oil calculated to the optimal threshold of incorporation of the three fatty acids in yogurt.

Table 2

Number of values, sample averages, standard deviation

Variable	No. of values	No. of valid values	No. of invalid values	sum of percentages	sample averages	standard deviation
Conc. fish oil (%)	6	6	0	6	1.742	0.924

Table 3 shows the limits of incorporation of the three essential fatty acids studied in fresh teleme cheese, taking into account the concentration of fish oil in raw milk.

Table 3

Concentrations of fatty acids at the maximum incorporation limit in
fresh teleme cheese samples

Fatty acids	Conc. Fish oil (%)	The threshold asymptotically
Linoleic	0.0150	of the regression values
Linoleic	0.0250	of the regression derived values
Linoleic	0.1600	theoretical
Linolenic	0.0350	of the regression values
Linolenic	0.0350	of the regression derived values
Linolenic	0.1716	theoretical
γ -Linolenic	0.1450	of the regression values
γ -Linolenic	0.1850	of the regression derived values
γ -Linolenic	0.4668	theoretical

Table 4 shows the optimal concentration of fish oil calculated at the optimum threshold of incorporation of the three fatty acids in fresh teleme cheese.

Table 4

Number of values, sample averages, standard deviation

Variable	No. of values	No. of valid values	No. of invalid values	sum of percentages	sample averages	standard deviation
Conc. fish oil (%)	9	9	0	9	0.138	0.142

From multiple comparisons (Table 5), it is statistically observed that yogurt encompasses fish oil in the highest concentration and in the smallest proportion of teleme cheese.

Table 5

Concetraţiile medii în ulei de peşte a iaurtului şi brânzei telemea proaspătă la limita de înglobare a acizilor graşi esenţiali

Product	sample averages	standard deviation	high limit	low limit
Yogurt	1.7416	0.9242	0.8174	2.6657
Fresh teleme cheese	0.1376	0.1419	-0.0043	0.2795

It is worth mentioning that we proposed the addition of fish oil at doses of 0.05% ÷ 0.15%, lower than the optimum values for the maximum incorporation of fatty acids, the size of the addition being limited by the awarding of the fish flavor of the manufactured products.
Following sensory analysis by unauthorized people, there was a disappearance of fish taste after 7 days of keeping the finished products at refrigeration temperature.
The analysis shows that the fatty acids in the fish oil added to the raw sheep's milk are incorporated differently within the milk fat globe by homogenizing it. By following the fish oil concentration, taking into account the optimal threshold is higher for yogurt than for fresh cheese. This may be due to different heat treatment. Yogurt is pasteurized at high temperature, under these conditions the fat globe membrane is thermally split and the fish oil adheres to the milk fat. Also in the case fresh teleme cheese production occurring inevitable loss of fat in whey.

CONCLUSIONS

In conclusion, the fatty acids are optimally incorporated in yogurt at a concentration of 1,742% fish oil and in fresh teleme cheese in at a

concentration of 0,38%.Taking into account the dry substance concentration of up to 50% in the case of the manufacture of telemea fresh cheese compared to the dry substance content of yoghurt which is approximately 14%, it can be concluded that there are no very large differences in the concentration of essential fatty acids in the manufacture of yoghurt compared to fresh teleme cheese. Considering that the human body has a small daily need for essential fatty acids, the addition of fish oil to the production of these two dairy products contributes to increasing their biological value.

REFERENCES

1. Maria Semenova, 2017, Advances in molecular design of biopolymer-based delivery micro/nanovehicles for essential fatty acids, Food Hydrocolloids, Volume 68, July 2017, Pages 114-121;
2. Jiangwei Yao, Charles O. Rock, 2017, Exogenous fatty acid metabolism in bacteria, Biochimie, Volume 141, October 2017, Pages 30-39;
3. Kontham Kulangara Varsha, Kesavan Madhavan Nampoothiri, 2016, Food Control, Volume 69, November 2016, Pages 61-64;
4. María A. Vélez, Erica R. Hynes, Carlos A. Meinardi, Verónica I. Wolf, María C. Perotti,2017, Cheese milk low homogenization enhanced early lipolysis and volatiles compounds production in hard cooked cheeses, Food Research International, Volume 96, June 2017, Pages 215-225;
5. Elana S. Rosenberg, Penny A. Asbell, 2010, Essential Fatty Acids in the Treatment of Dry Eye, The Ocular Surface , Volume 8, Issue, January 2010, Pages 18-28;
6. Merliţă 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;
7. 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;
8. 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;
9. 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);
10. 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.