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THE IMPACT OF SOFT CHEESE *Nigella sativa* SEED OIL ENRICHMENT ON MOISTURE PATTERN DURING RIPENING

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Abstract

Recent literature provides studies of the benefits of Nigella sativa cold pressed seed oil (NSSO) cheese enrichment, but insufficient data is available on the effect on the physico-chemical cheese properties. Three batches of traditionally manufactured raw milk brined cheese were considered: control cheese without NSSO and cheese samples enriched with 0.1 and 0.2 w/w NSSO. Experimental cheese samples were analyzed in duplicates for moisture contents, at 0, 14, 28, and 42 days of ripening, according to the AOAC Official Method 926.08. Data indicates moisture loss during ripening, which is consistent with most literature findings, and strong statistical significance could be associated to the trends of moisture decrease (f-ratio value - 59.07682; p-value - 0.00001), results being consistent with other sources which communicated p values <0.05 for moisture decrease findings. However, the slightly higher moisture values for the NSSO added cheeses were positively associated (p-value - 0.05). The data indicates slightly better moisture retention for 0.2% w/w NSSO cheese batch, which might be linked to a possible prevention of loss of body and texture loss during ripening of soft brined cheese.

Key words*: moisture, Nigella sativa seed oil, raw milk brined cheese, ripening.*

INTRODUCTION

Impersonation of refinement and real culinary delicacies in some countries, traditional Romanian cheeses are not only delicious, tasteful and flavorful food, but also powerful historical, social, economical and cultural symbols of the individuality of Romanian people (Tăpăloagă, 2018).

The trend in international scientific world is to understand the composition and dynamics peculiarities concerning the physicochemical, biochemical and microbiological changes that take place in raw milk cheeses during manufacturing, ripening and storing (Georgescu, 2014).

However, raw milk, traditional cheeses are not always safe, being associated with food borne infections or intoxications (Öner et al., 2006; Choi, 2016; Little, 2008; Prates Denise da Fontoura, 2017; Bintsis, 2002; Gao, 2017; Tăpăloagă, 2017; Ilie, 2018).

Various natural antimicrobial solutions have been proposed by extensive literature, for improving the microbiological quality of such cheeses, among which, *Nigella sativa* (Georgescu, 2018a; Georgescu, 2018b; Georgescu, 2018). *Nigella sativa* is known for a large variety of accepted or potential applications in the medical field, as numerous reviews of the literature communicate (Georgescu et al., 2018c).

Nevertheless, the antimicrobial activity of *Nigella sativa* against cheese contaminating microorganisms is not yet completely understood, especially because of the complexity of the microbiological and physicochemical processes which take place during cheese ripening (Georgescu et al., 2015).

Complex ripening processes affecting cheeses are extremely different among cheese types and the pattern of these modifications is difficult to predict, especially when cheeses are enriched with natural antimicrobials such as *Nigella sativa* seed oil (NSSO).

The unexplored implications of the particular microbiological and physicochemical dynamics occurring during ripening of traditional cheese, should also be considered because of the specificity for each cheese type.

The available scientific literature offers data on raw milk quality (Ilie, 2017a; Ilie, 2017b), but does not provide enough reports on this

important topic related to traditional raw milk cheeses.
In this context, the paper presents an assessment of the moisture fluctuation pattern for NSSO enriched cheese, in order to evaluate the impact of such enrichment over the primary composition of the product, during ripening.

MATERIALS AND METHODS

The experiment included three batches of cheese: control cheese without NSSO, 0.1% w/w NSSO enriched cheeses and 0.2% w/w NSSO enriched cheeses. *Nigella sativa* cold pressed seed oil. *Nigella sativa* (black cumin) cold pressed seed oil (Negriol) was purchased from a company in Romania, Aghoras Invent SRL, Bucharest. The NSSO was added to the mildly heated milk in the respective concentrations, before renneting. The content of the Ideal® rennet dose (8g) was diluted in 250 mL warm distilled water and 25 mL solution were added to 10 l warm milk (30-35°C), under continuous manual mixing for 10 minutes.
Coagulation time was 30-45 minutes. The soft curd was left for further solidification needed for processing, for 15-30 minutes.
Further stages of the technological process were followed according to the usual, traditional Telemea cheese manufacturing (Tăpăloagă, 2013).
The soft curd was processed through repeated pressing and then it was cut into pieces (Figure 1). It was left resting for 20 minutes before cutting to final size cubes (12/12 cm).
The brine concentration used for experimental Telemea was 6-8%. Brining was performed at maximum 16°C, for 24 hours and was followed by drying for 12 hours at 2-8°C on wood shelves. Experimental Telemea cheese was packed in vacuumed plastic bags and kept refrigerated (4-8°C) for 42 days.
Experimental Telemea cheese samples were analyzed in duplicates for moisture contents, at 0, 14, 28, and 42 days of ripening, according to the AOAC Official Methods of Analysis 926.08.
Data analysis was performed by One way analysis of variance (ANOVA) using SAS (ANOVA version 9.1. SAS institute Inc., Cary, USA, 2003). The threshold of significance level was $p<0.05$.

RESULTS AND DISCUSSIONS

No significant differences in moisture content were noticed between treatment groups of cheeses (the f-ratio value is 0.76808; the p-value is 0.476501) (Table 1), even though results indicated higher average values for NSSO added cheeses (56.43±0.6065 for 0.1% w/w NSSO and 56.49±0.3312 for 0.2% w/w NSSO, compared with 53.19±0.0907 for control, at 42 days of ripening) (Figure 2).

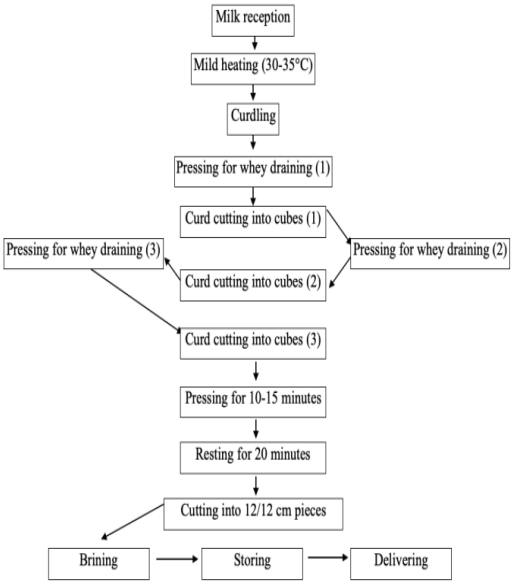

Figure 1. Soft brined raw milk cheese manufacture diagram

Our data indicates moisture loss during ripening, which is consistent with most literature findings (Levkov, 2014), and strong statistical significance could be associated to the trends of moisture decrease (the f-ratio value is 59.07682; the p-value is <0.00001) (table 2).
These results are consistent with other sources which also communicated p values <0.05 for moisture decrease findings (Mahgoub, 2013).
Moreover, most authors report lower moisture values for similar type cheeses throughout processing and ripening (Hassanien, 2014; Hasanzadeh et al., 2017).
This might be explained by not using calcium chloride, not starter culture in cheese manufacturing and by using lower brine concentrations than those reported by the literature (Mestani, 2017; Pappas, 2007).

Table 1. Moisture content of experimental Telemea cheeses over 42 days of ripening (%)

Assessment time	control	0.1% w/w NSSO	0.2% w/w NSSO
fresh	62.64±0.17	62.74±0.11	63.33±0.07
Day 14	59.21±0.04	61.57±0.02	62.18±0.12
Day 28	56.47±0.09	58.88±0.06	59.38±0.03
Day 42	53.19±0.09	56.43±0.6	56.49±0.33

When comparing the values of moisture registered for 0.2% w/w NSSO cheese batch, with those obtained for the control batch, it is obvious that there are slightly higher water percent numbers for the NSSO enriched cheeses. Data analysis indicates that this moisture improvement for the NSSO enriched cheese is strongly associated ($p< 0.05$) (Table 3). This is suggesting that NSSO enrichment might have a positive impact on water loss in such soft cheeses during ripening, which is a positive aspect, strongly related to consumers perception over the sensory qualities of cheese. These results are consistent with similar other research findings provided by the scientific literature (Hassanien et al., 2015).

Table 2. Data analysis for the trends of moisture decrease

Data analysis item	Treatments				Total
	Fresh	Day 14	Day 28	Day 42	
N	9	9	9	9	36
∑X	548.93	548.93	524.21	498.36	2139.6
Mean	63.1222222	60.9922222	58.2455556	55.3733333	59.433
St.dev.	0.65840295	1.35892216	1.35096365	1.6695134	3.2095
	Result details				
	SS (sum of squares)	**Df**	**MS (mean square)**		
Between treatments	305.3921	3	101.7974		
Within treatments	55.1403	32	1.7231		
Total	360.5324	35			
f-ratio value	59.07682				
p-value	< .00001				
The result is significant at $p < 0.05$.					

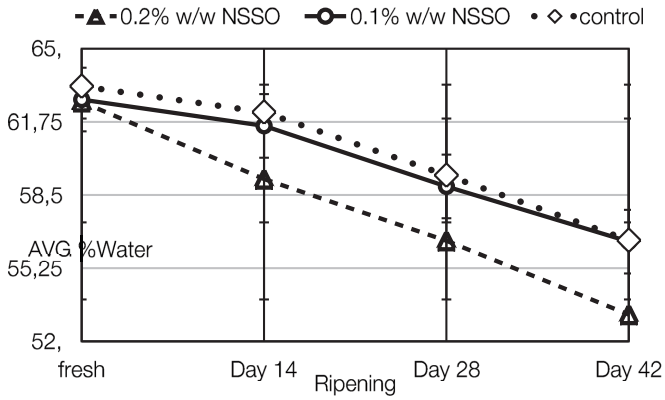

Figure 2. Moisture content of NSSO enriched soft brine cheese over ripening, compared to control cheese batch

Table 3. Data analysis for the moisture retention comparison – control batch versus *0.2% w/w NSSO cheese batch*

Data analysis item	**Treatments**				**Total**
	Control	**0.2% w/w NSSO cheese batch**			
N	9	9			18
∑X	506.65	534.19			1040.84
Mean	56.2944	59.3544			57.824
∑X2	28576.1187	31755.3701			60331.4888
Std.Dev.	2.611	2.4703			2.9255
	Result details				
	SS	**Df**	**MS**		
Between treatments	42.1362	1	42.1362		
Within treatments	103.3578	16	6.4599		
Total	145.494	17			
f-ratio value	6.52277				
p-value	0.021232				
The result is significant at $p < 0.05$.					

CONCLUSIONS

Data revealed slightly higher moisture values for ripened NSSO treated cheeses, which links positively to higher consumers' appreciation of treated cheeses by the end of ripening. However, the slightly higher moisture values for the NSSO added cheeses were positively associated (p-value - 0.05).

The data indicates slightly better moisture retention for 0.2% w/w NSSO cheese batch, which might be linked to a possible prevention of loss of body and texture loss during ripening of soft brined cheese.

This study shows that NSSO could be used as a natural enhancer of Telemea cheese flavor and taste and could be a possible solution for the improvement of the sanitary quality of this artisanal raw milk soft, brined cheese.

Without compromising the original characteristics and nutritional value, NSSO enrichment of cheese could ease the successful promotion of more traditional cheeses, safe for consumption, on the national and international market.

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