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PROBIOTIC STARTERS VERSUS TRADITIONAL STARTER IN QUARG PRODUCTION

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ABSTRACT

Quarg- an acid- precipitated cheese product was manufactured by standard procedure, on a small scale from batches of two types of milk: i) partially skimmed, with 1.6 % of fat and ii) whole milk, with 3.5 % of fat.

As starters, three cultures (*Chr. Hansen* A/S Denmark) were applied: i) two probiotic cultures, FD- DVS- Probio- Tec™ **ABT- 1**, *Lactobacillus acidophilus*- 5, *Bifidobacterium*- 12, *S. thermophilus* and DVS- Probio- Tec™ **ABT- 2**, *Lactobacillus acidophilus*- 5, *Bifidobacterium*- 12, *S. thermophilus* and ii) one traditional culture, Flora Danica **CH- N22**, *Lc. lactis* subsp*. lactis, Lc. Lactis* subsp. *cremoris, Leuconostoc mesenteroides* subsp. *cremoris, Lactococcus lactis* subsp. *lactis biovar diacetylactis*. Nutritive characteristics of all products were determined by standard methods.

The results of experiments show that fat-, protein- and phosphorous- content and energy value increase with the increase of **ABT-1** quantity, while lactose- content reaches minimum at **CH-N22**: **ABT-2** = 0.0075 %: 0.0025 %, in the products obtained from partially skimmed milk. On the other hand, fat- and phosphorous- content and energy value increase with the increase of **CH-N22** quantity, protein- content reaches maximum at **CH-N22**: **ABT-2** = 0.0055 %: 0.0045 %, while lactose- content reaches minimum at **CH-N22**: **ABT-1** = 0.005 %: 0.005 %, when whole milk is used.

Sensory characteristics of products were determined as well. It was proved that application of **ABT-2** probiotic culture and traditional culture (pure and combined) gives good products with typical mild flavour. Contrary, inoculation with pure **ABT-1** probiotic starter results in less quality products for both partially skimmed and whole milk. However, **ABT-1** combined with the traditional starter proved quite acceptable.

KEY WORDS:
probiotics, Quarg, nutritive characteristics, sensory characteristics

1. INTRODUCTION

The importance of probiotic- containing products for maintaining human health results in rapid growth of the market for such products. It has been proven that probiotic microorganisms (bacteria and/or yeasts)

exhibit a beneficial effect on the health of the consumers when ingested [1-2]. Very popular food delivery systems for these cultures are freshly fermented dairy products [3-5]. Special place belongs to Quarg – an acid-precipitated cheese. So, when the traditional starter cultures are replaced by adequate probiotic cultures, positive impact to consumers' health can be expected.

However, such a replacement can not be done arbitrarily; the probiotic substitute must guarantee: successful fermentation of lactose, coagulation of milk, formation of solid gel, decrease of pH value, production of anti- microbial component, decrease of oxidative - reductive potential of the system, etc. [6-10].

This investigation compares nutritive as well as sensory characteristics of products obtained by two probiotic cultures and the traditional starter, with the aim to suggest replacement of the traditional culture if possible.

2. MATERIALS AND METHODS

As raw materials, two kinds of milk were used; milk with 1.6% of fat and milk with 3.5% of fat. Their composition is presented in TABLE 1.

TABLE 1. MILK COMPOSITION

COMPONENT	MILK I	MILK II
Dry matter, %	10.09	12
Fat, %	1.6	3.5
Total proteins, %	3.00	3.44
Lactose, %	4.72	4.32
Ash, %	0.77	0.74
Lactic- acid, %	0.153	0.146
pH, 1	6.6	6.6
Acidity, ^{o}SH	6.8	6.6
Total nitrogen, %	0.47	0.54
Phosphorous, mg $(100\ g)^{-1}$	87.9	84.1

Raw milk was exposed to a process consisting of steps presented in Fig. 1 resulting in Quarg.

The starters, applied for inoculation of raw milks, were as follows:

- FD- DVS- Probio- Tec^{TM} **ABT- 1** (*Lactobacillus acidophilus*- 5, *Bifidobacterium*- 12, *S. thermophilus*) as a probiotic culture,
- DVS- Probio- Tec^{TM} **ABT- 2** (*Lactobacillus acidophilus*- 5, *Bifidobacterium*- 12, *S. thermophilus, Chr. Hansen*) as a probiotic culture and
- FLORA DANICA **CH- N22** (*Lc. lactis* subsp*. Lactis, Lc. Lactis* subsp. *cremoris, Leuconostoc mesenteroides* subsp. *cremoris, Lactococcus lactis* subsp. *lactis biovar diacetylactis*) as a traditional culture.

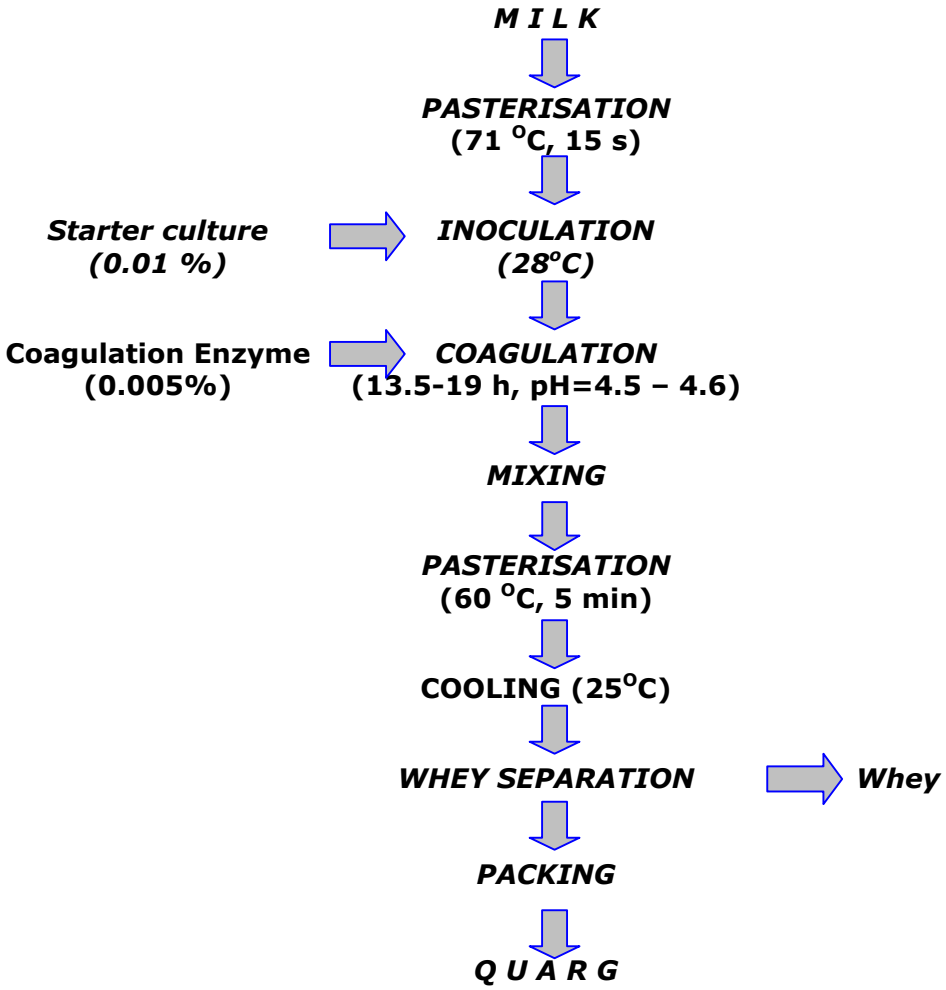

FIG. 1. QUARG MANUFACTURE PROCESS

In order to investigate impact of starters' type and quantity upon the nutritive and sensory characteristics of the products, the experiments were planned as presented in Fig. 2.

Coagulation was performed by enzyme Hannilase L 2235-microbiology protease, isolated from *Rizomucor miehei*, *Chr. Hansen,* A/S, Denmark.

Relevant characteristics of raw milk were determined as follows:

- Dry matter (DM), measured by drying at 105°C, IDF ISO 21A: 1982
- Fat (F), according to Gerber, IDF ISO 105/1981
- Total Nitrogen (TN), according to Kjeldahl, IDF/ISO 20:1962
- Total proteins (TP), calculated by multiplying Total Nitrogen by 6.38 %
- Lactose (L), measured by titration, IDF/ISO method 28: 1964
- Ash (ASH), measured by burning at temperature 550°C, IDF/ISO 90/1979 [11]
- Lactic- acid, based on Soxlet- Henkel measurements and data in the reference [11]
- pH, measured by pH- meter Iskra, MA 5713, Kranj, Slovenija [11]
- Acidity, according to Soxlet- Henkel [11], °SH
- Phosphorous (P), according to JUS ISO 13730 method (1999)

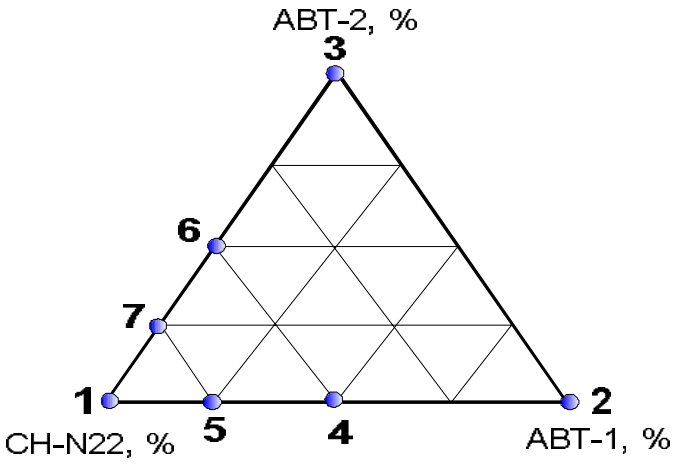

FIG. 2. PLAN OF EXPERIMENTS

Relevant characteristics of Quarg were determined as follows:

- Dry matter (DM), measured by drying at 105°C, IDF ISO 21A: 1982
- Fat (F), according to Van Gulik [11]
- Total Nitrogen (TN), according to Kjeldahl, IDF/ISO 20:1962
- Total proteins (TP), calculated by multiplying Total Nitrogen by 6.38%
- Lactose (L), calculated by formula: DM-(TP+F+ASH)
- Phosphorous (P), according to JUS ISO 13730 method (1999)
- Energy value (EV), calculated by formula:

$$EV=4.186*(9.3\ F+4.4\ TP+\ 4.1\ L),\ kJ\ (100\ g)^{-1}$$

3. RESULTS

The process, whose algorithm is presented in Fig 1, was applied to two types of milk; milk I was partially skimmed with 1.6 % of fat and milk II was whole milk with 3.5 % of fat. Both milks were inoculated with three types and various quantities of the chosen starter cultures, two probiotic and one traditional. The samples (products), classified into two series (see Tables 2- 3), were obtained. Their nutritive characteristics are given in Tables 2- 3.

TABLE 2. MEASURED CHARACTERISTICS OF QUARG SAMPLES IN THE SERIES I

Sample	Starter quantities, %			Particular characteristics of product				
	CH-N22	ABT-1	ABT-2	Fat %	Protein %	Lactose %	P $mg(100g)^{-1}$	EV $kJ(100g)^{-1}$
Milk I	0	0	0	1.6	3	4.72	87.9	199
1	0.01	0	0	9	14.22	3.5	205.5	672
2	0	0.01	0	13	15.95	6.23	245	907
3	0	0	0.01	8	14.04	5.25	207	660
4	0.005	0.005	0	10	15.57	3.70	231	740
5	0.0075	0.0025	0	12	13.14	4.31	241	783
6	0.005	0	0.005	12	13.35	3.55	210.5	774
7	0.0075	0	0.0025	11.5	12.25	2.62	164	718

TABLE 3. MEASURED CHARACTERISTICS OF QUARG SAMPLES IN THE SERIES II

Sample	Starter quantities, %			Particular characteristics of product				
	CH-N22	ABT-1	ABT-2	Fat %	Protein %	Lactose %	P $mg(100g)^{-1}$	EV $kJ(100g)^{-1}$
Milk II	0	0	0	3.5	3.44	4.32	84.1	274
8	0.01	0	0	18.5	10.21	2.36	186	949
9	0	0.01	0	15	10.91	4.12	186	856
10	0	0	0.01	16	10.02	4.01	145	876
11	0.005	0.005	0	17	10.53	0.22	133	860
12	0.0075	0.0025	0	16.5	10.14	1.80	160	860
13	0.005	0	0.005	17	11.29	3.54	181	930
14	0.0075	0	0.0025	16	11.04	5.79	185	926

These results were also presented as 3D- diagrams in Figs. 3- 7.

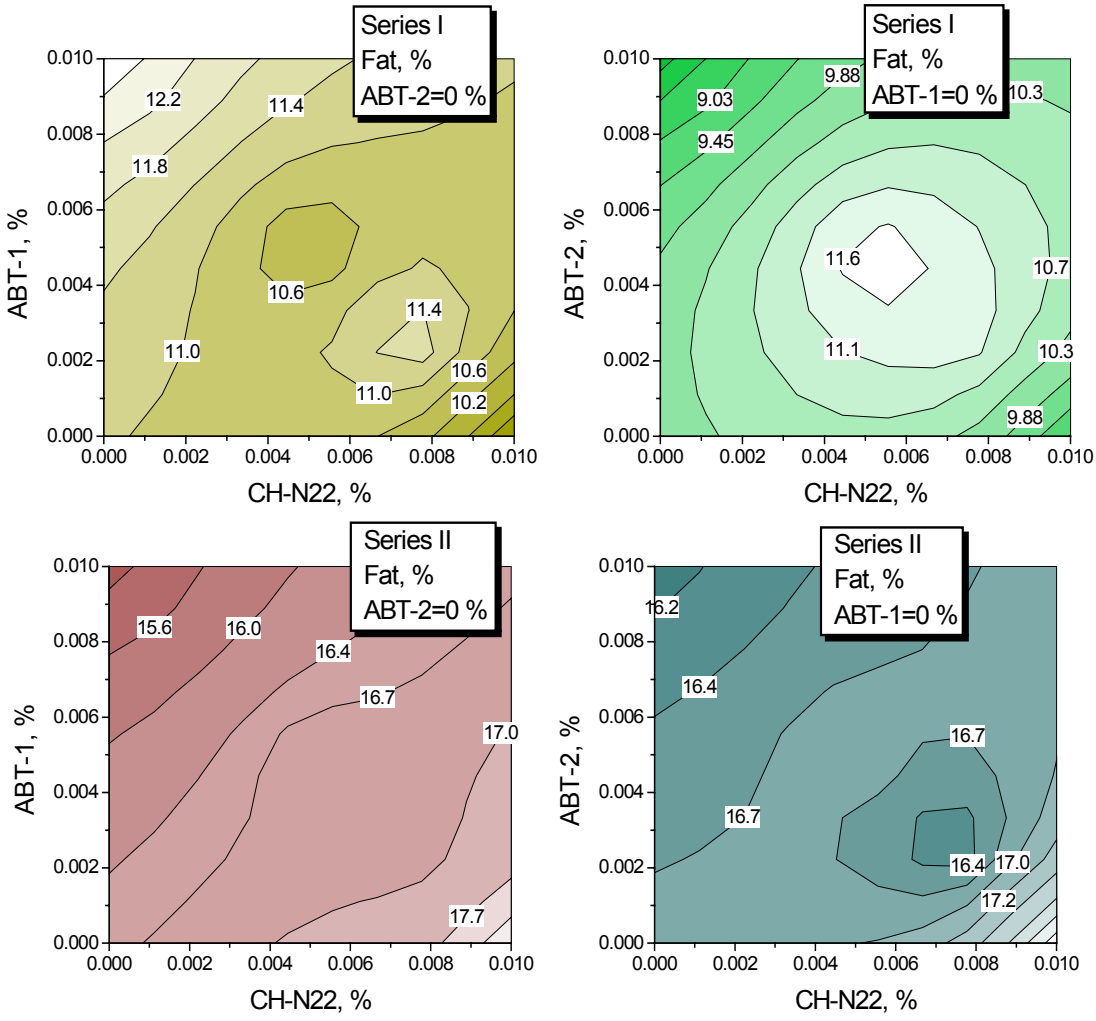

FIG. 3. FAT CONTENT IN SERIES I AND SERIES II
AS A FUNCTION OF STARTERS' TYPE AND QUANTITY

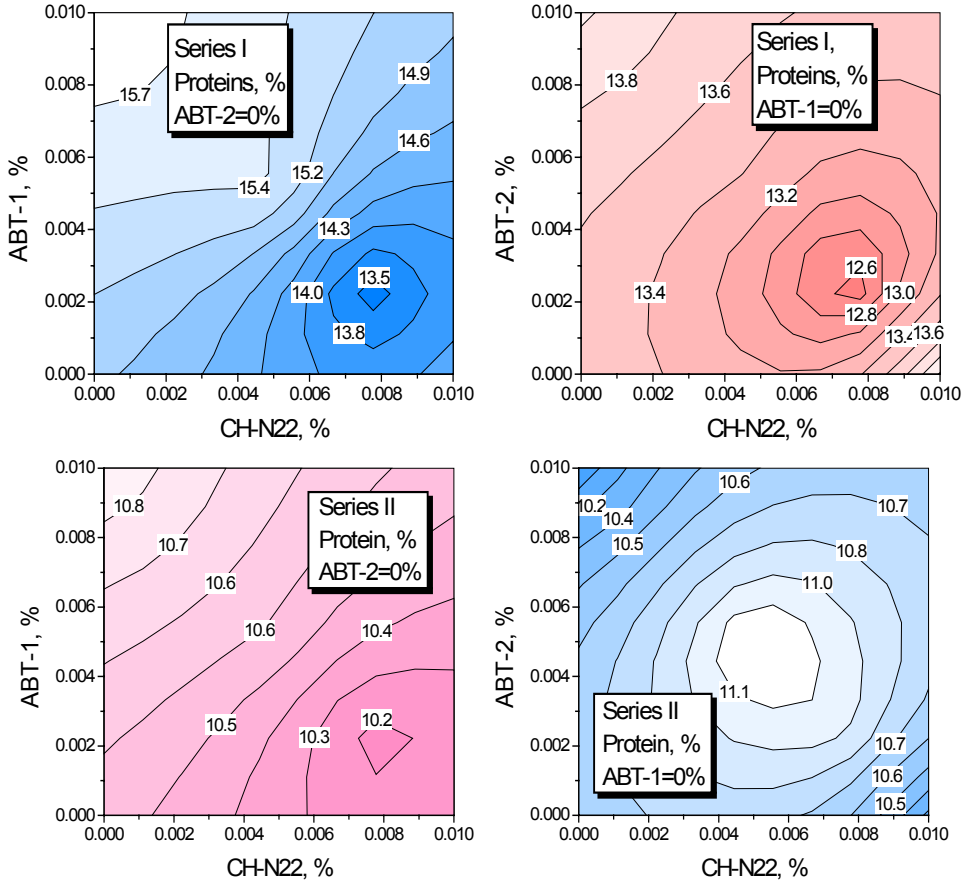

FIG. 4. TOTAL PROTEIN IN SERIES I AND SERIES II AS A FUNCTION OF STARTERS' TYPE AND QUANTITY

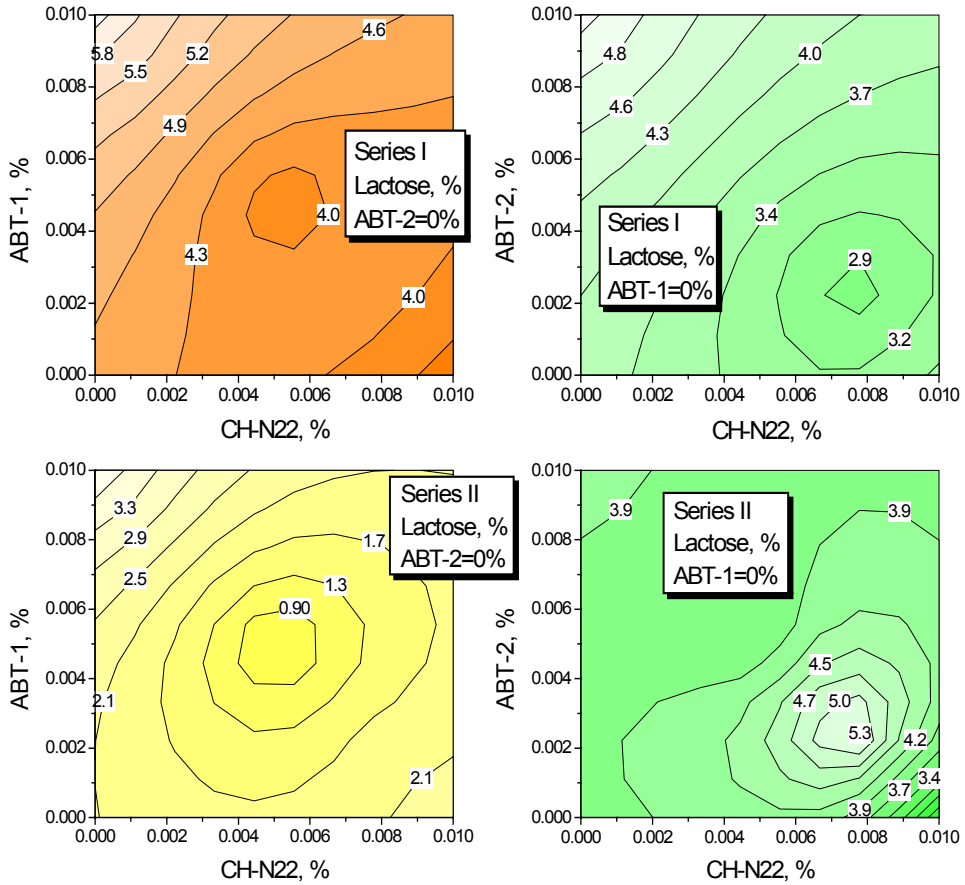

FIG. 5. LACTOSE CONTENT IN SERIES I AND SERIES II AS A FUNCTION OF STARTERS' TYPE AND QUANTITY

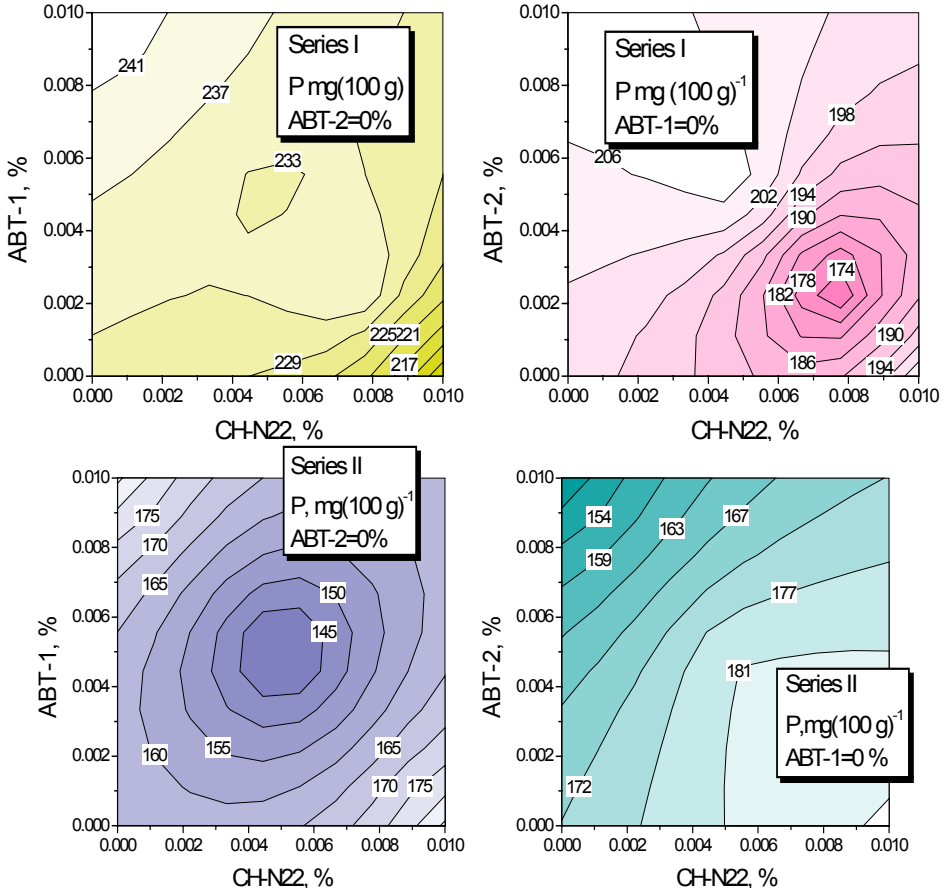

FIG. 6. PHOSPHOROUS CONTENT IN SERIES I AND II AS A FUNCTION OF STARTERS' TYPE

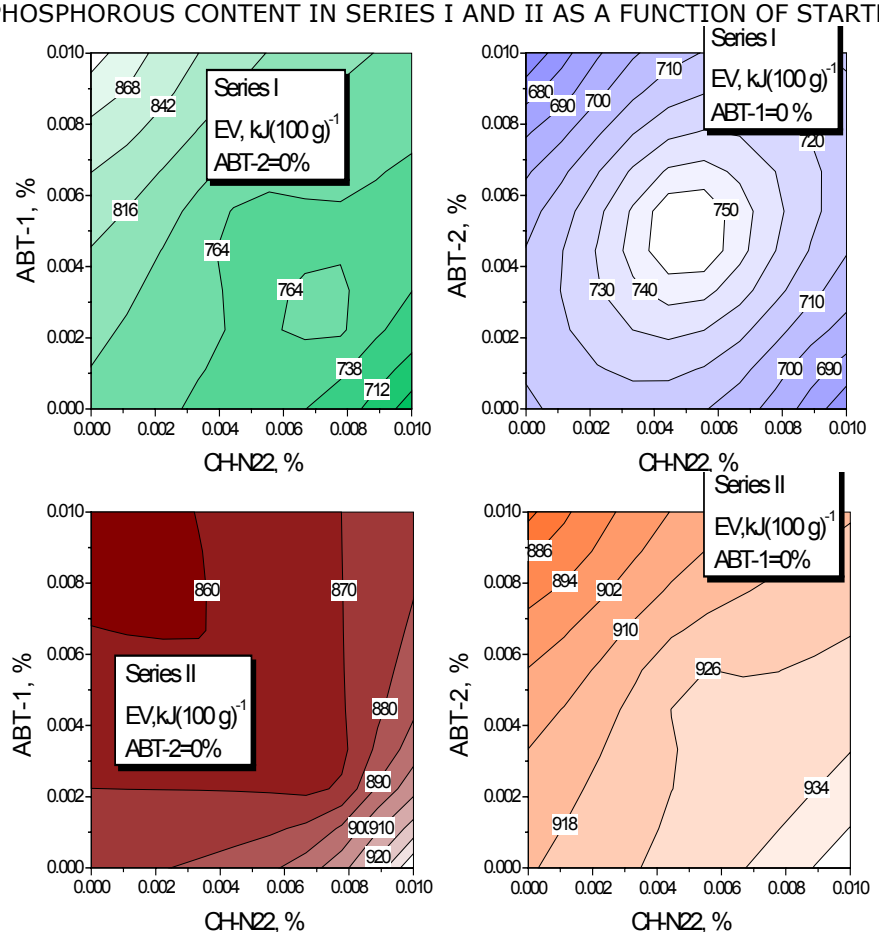

FIG. 7. ENERGY VALUE FOR SERIES I AND SERIES II AS A FUNCTION OF STARTERS' TYPE AND QUANTITY

An analysis of the results from the point of view of starters' impact leads to the following conclusions. For series I, fat-, protein- and phosphorous- content and energy value increase with the increase of **ABT-1** quantity (see Figs. 3, 4, 6 and 7), while lactose- content reaches minimum at **CH-N22: ABT-2** = 0.0075 %: 0.0025 % (see Fig. 5). For series II, fat- and phosphorous- content and energy value increase with the increase of **CH-N22** quantity (presented in Figs. 3,6 and 7), protein-content reaches maximum at **CH-N22: ABT-2** = 0.0055 %: 0.0045 % (in Fig. 4), while lactose- content reaches minimum at **CH-N22: ABT-1** = 0.005 %: 0.005 % (see Fig. 5). When comparing two series of products, it was concluded that Quarg from milk with lower content of fat (series I) possesses significantly lower content of fat and energy value, but has significantly greater content of protein, lactose and phosphorous, regardless to the type and quantity of the applied starter.

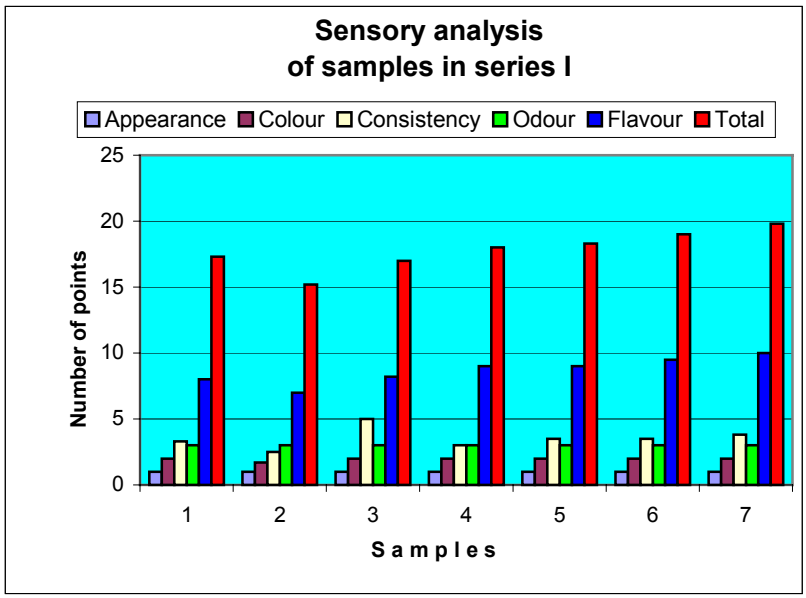

FIG. 8. SENSORY CHARACTERISTICS OF SAMPLES FROM SERIES I

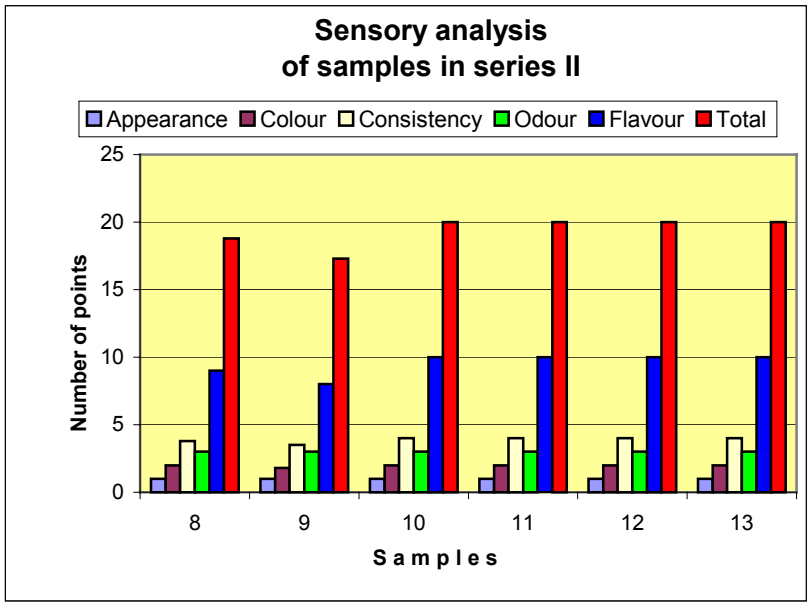

FIG. 9. SENSORY CHARACTERISTICS OF SAMPLES FROM SERIES II

Sensory characteristics of products were determined as presented in Figs. 8 and 9. Analysis of the results in Figs. 8 and 9 shows that application of **ABT-2** probiotic culture and traditional culture (pure and combined) gives good products with typical mild flavour.

On the contrary, inoculation with pure **ABT-1** probiotic starter results in less quality products for both partially skimmed and whole milk (sample 2 in Fig. 8 and sample 9 in Fig. 9). However, **ABT-1** combined with the traditional starter proved quite acceptable.

When comparing two types of milk, that one with higher content of fat gives products with better consistency and flavour as well as total quality (Fig. 9).

4. CONCLUSION

Increasing demand for foods containing probiotics requires research and development of such products. Quarg cheese can undoubtedly be a delivery system for viable probiotic cultures if manufactured by application of probiotic starters.

By this study, it has been proven that probiotic culture FD- DVS- Probio- Tec™ **ABT- 1** (*Lactobacillus acidophilus*- 5, *Bifidobacterium*- 12, *S. thermophilus*) should not be used pure, but combined with the traditional culture.

As for the other probiotic culture, DVS- Probio- Tec™ **ABT- 2** (*Lactobacillus acidophilus*- 5, *Bifidobacterium*- 12, *S. thermophilus*) can be applied pure and combined with the traditional culture.

Both conclusions are drawn based on the nutritive as well as sensory characteristics of the obtained products.

5. ACKNOWLEDGEMENT

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