

UDC: 637.33  
original scientific paper

*Acta Agriculturae Serbica, Vol. XIII, 25 (2008) 25-31*



## **Selection of Starter Cultures for the Production of White Cow Brine Cheese**

**Radmila Cobanova-Vasilevska**

*IMB "Mlekara"-Bitola Dairy, R. Macedonia*

**Sonja Srbinovska**

*Faculty of Agricultural Sciences and Food - Skopje, R. Macedonia*

**G. Talevski**

*Agency for Promoting the Development of Agriculture - Bitola, R. Macedonia*

**Z. Sireta**

*Macedonian Agriculture Advisory Support Program - Bitola, R. Macedonia*

---

**Abstract:** Aiming at the most optimal starter cultures to be selected, a research was conducted to evaluate the effect of 5 different combinations of starter cultures on the dynamics of lactic acid fermentation during the production of white brine cow cheese. The raw milk used for the cheese production demonstrated certain deviations of the chemico-physical and microbiological properties most probably resulting from mastitis.

The progressive acidity development was in the first 20 days of cheese ripening for all variants and after 60 days it ranged from 92.8 - 104.7 °SH. After the two-month aging period, the moisture percentage was 48.8 - 53.4%, the percentage of ripeness varying from 40 to 55 °Š. In order to produce 1 kg of cheese, 6.57 - 6.94 l of milk were used, or 14.41 - 15.22 kilograms of cheese were produced from 100 l of milk.

The best sensory evaluation results were achieved with the variant using a combination of several starter cultures being as follows: DVS mesophilic culture (*Str. lactis* i *Lb. casei* - 2:1), FRC 75 (*Lac. lactis subsp. lactis*, *Lac. lactis subsp. cremoris*, *Str. thermophilus* and *Lactobacillus delbruecki*, subspecies bulgaricus) and developed thermophilic culture (*Str. thermophilus* and *Lactobacillus delbruecki*, subspecies bulgaricus - 2:1).

**Key words:** milk, white brine cheese, milk-acidic process.

---

## Introduction

Cheese is among the oldest dairy products and, according to archeological data, it was produced as early as 8,000 years ago. It is a worldwide esteemed product of high nutritional and biological value. (Baltadžieva, 1993).

In the Republic of Macedonia white brine cheese, besides kachkaval and "bieno sirenje", has been traditionally consumed. The per-capita consumption of this kind of cheese amounts to 7.5 kg per annum showing a constant tendency to increase (Čobanova-Vasilevska, 2007). The autochthonous production of this cheese from non-pasteurized milk most commonly practised in the uplands in inappropriate hygienic conditions characterizes the production of white sheep and cow brine cheese in the country. Such production results in nonstandard-quality and low-yield cheese. However, recently, the majority of dairy industries have started cheese production using prescribed advanced technology.

The use of starter cultures in cheese making is a significant factor for a top-quality product to be achieved. Their role is to obtain a specific taste, common appearance, consistency and to increase the digestion and shelf life of the products.

According to Bintsis and Papademas (2002), different types of *Lctococcus*, mixtures of *Lctococcus* and *Lb. bulgaricus*, or even yogurt culture may give satisfying results as to milk acidification. Mesophilic and thermophilic starters may be directly added to milk during feta cheese production, although the level of proteolysis of thermophilic starters is higher later on.

The objective of this study is to show the results of the effect of 5 combinations of starter cultures on as many indices as possible during the production of white cow brine cheese. It will enable the selection of the most optimal culture in the process of production of this kind of cheese on an automated line.

## Material and Method

Bulk milk from the farm ZK "Pelagonija" - Bitola was used as a raw material for white cow brine cheese production. The analyses of chemico-physical and microbiological parameters were made in the IMB "Mlekara" Bitola Dairy laboratory and in the "Pelagonija-Mlekokontrol" Independent Laboratory - Bitola. The following methods were used during the research conducted on raw milk: active acidity (by pH-meter, model *Biotek*), titratable acidity (Soxlet-Henkel), relative density (lactodensimeter), milk fat, proteins, lactose and dry matter (by *Lactoscope*), fat-free dry matter (calculation), number of somatic cells (*Somascope*), total number of bacteria (*Bactoscan*) and the presence of antibiotics ( $\beta$ -star test).

The following additives were used in cheese production: CHY MAX powder rennet, granulated calcium chloride, lactic and citric acids, medium granulated iodized sea salt and 5 combinations of starter cultures.

The used starter cultures were marked as follows:

- Combination A - *Str. lactis* and *Lb. casei* (2:1)
- Combination B - *Str. thermophilus* and *Lactobacillus delbruecki, subspecies bulgaricus* (2:1)
- Combination FRC 75 - *Lac. lactis subsp. lactis*, *Lac. lactis subsp. cremoris*, *Str. thermophilus* and *Lactobacillus delbruecki, subspecies bulgaricus*.

Five cheese variants were produced from the above starter cultures combined as follows:

- Variant 1 - (2/3 A and 1/3 B)
- Variant 2 - (2 A + 5 liters B + 2 FRC 75)
- Variant 3 - (B + 5 FRC 75)
- Variant 4 - (3 A + 5 liters B) and
- Variant 5 (3 A + 5 liters B + 1 FRC 75).

The investigation of the five cheese variants was conducted on a mechanized white cheese production line ("Sordi", Lodi, Italy) at the IMB "Mlekara" – Bitola Dairy.

Acidity dynamics (pH and titratable acidity - °SH) in the cheese and the brine was tested, as well as cheese moisture dynamics, ripeness level (according to Šilovič) and yield, with cheeses being sensor assessed eventually.

The results achieved have been generated in compliance with the statistical methods described by Snedecora and Cochran (1971) and shown in tables and graphs.

## Results and Discussion

The white cow brine cheese is produced at the IMB "Mlekara" – Bitola Dairy according to the schematic diagram of the manufacturing process given below:

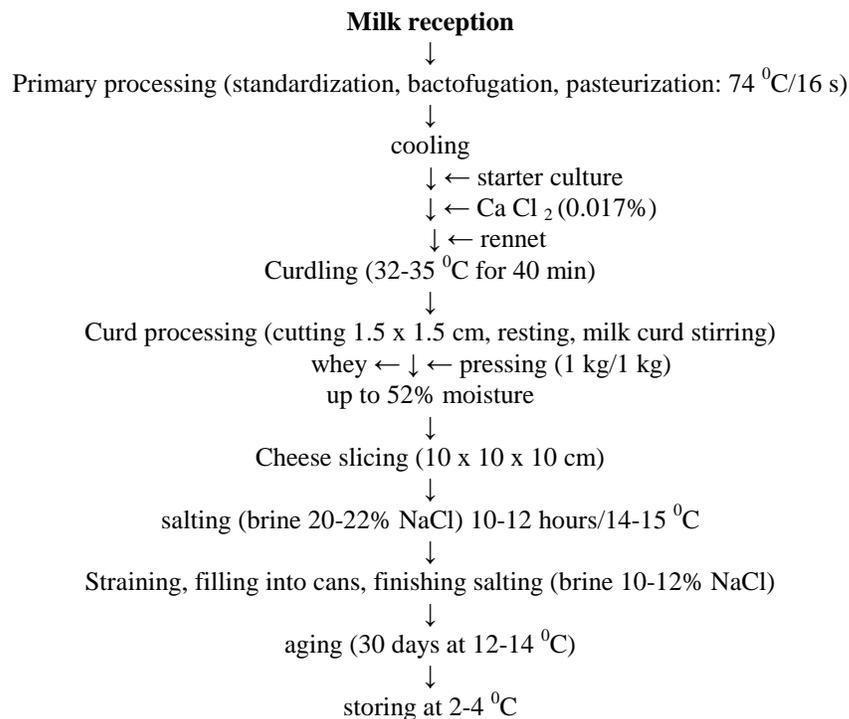


Figure 1. The white cow brine cheese manufacturing process

The cheese was produced from antibiotic-free raw milk, its average chemico-physical and microbiological parameters being shown in Table 1.

Table 1. Chemico-physical properties and microbiological quality of raw cow milk

Parameter	$\bar{x}$	c	s
Relative density (kg/cm <sup>2</sup> )	1.0297	0.003	0.0004
Titrateable acidity (°SH)	6.17	3.88	0.24
Active acidity (pH)	6.71	0.74	0.05
Lactic fat (%)	3.60	1.94	0.07
Proteins (%)	3.30	2.72	0.09
Lactose (%)	4.58	1.31	0.06
Dry matter (%)	12.23	0.89	0.11
Fat-free dry matter (%)	8.60	0.69	0.06
Number of somatic cells/ml	505.000	24.36	123.023
Total number of bacteria/ml	321.000	62.81	201.624

Table 1 shows certain changes in the physico-chemical properties and poor microbiological quality of the milk most probably resulting from the presence of sub-clinical mastitis. The low titrateable acidity, the decreased percentage of lactose and dry matter as well as the relatively higher number of somatic cells and bacteria lead to that conclusion. The dynamics of cheese titrateable acidity (°SH) in the five cheese variants is shown in Chart 1.

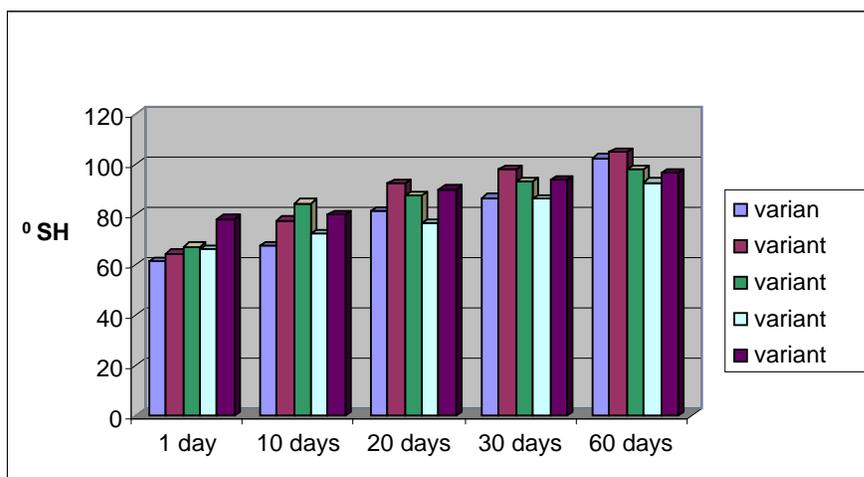


Chart 1. Dynamics of cheese titrateable

The chart suggests that there is a constant increase in acidity starting from the date of production to the 60 days of cheese aging. The five variants of cheese

differ due to the use of various starter cultures during production. The cultures, coupled with the enzymes, transform lactose into lactic acid, regulate the cheese moisture content and affect the formation of texture and sensor properties.

In cheese processing, whey pH is a highly important index which should range between 5.6 - 5.7 units in the last extracted quantity after pressing. During our research, pH varied from 6.39 - 6.47 at curd cutting showing a tendency to decrease, its value obtained after pressing being within a 5.55 - 6.12 range (Chart 2).

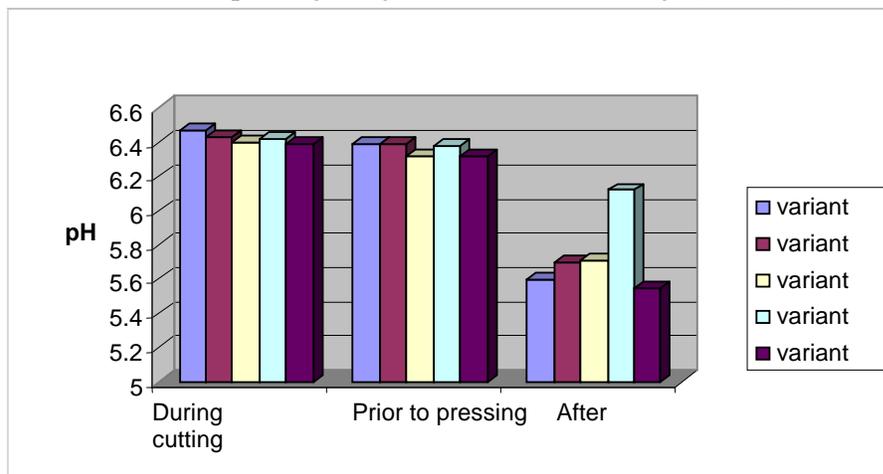


Chart 2. Dynamics of whey acidity (pH)

The acidity of cheese amounted to 5.25 - 5.40 on the first day of aging, reaching 4.50 - 4.80 units after 60 days. With the variants 2 and 3, pH was found to be 4.50, inducing a reduced moisture content and the occurrence of hard and crumbly consistency.

The moisture of the cheese variants after the 60-day aging period ranged from 48.8% (variant 2) to 53.4% (variant 4). The established differences were due to the variation in acidity which resulted in bulk cheese dehydration, a specific way of aging and changes in the components. According to Maćej at all (2006), the water content of NFM is an important regulator in the process of aging and an indicator of the degree of proteolysis. Proteins hydrolyze faster in the cheese with a higher percentage of water in NFM.

The acceleration of cheese ripening is most affected by the rennet and starter culture enzymes (Kršev, 1989). Our research proved higher ripening intensity with all cheese variants in the first 30 days. After 60 days of aging they reached a good level of ripeness ranging from 40 °Š (variant 3) to 55 °Š (variant 5). Major factors affecting the speed of cheese aging include water content, salt content, acidity, slice dimensions, etc.

The yield of different cheese variants ranged from 14.41 kg (variant 1) to 15.22 kg (variant 3). The average yield of aged cow brine cheese is about 14.5 kg produced from 100 liters of milk (Dozet at all., 1996). These results are within expectations, but they can be improved by advanced manufacturing process

standardization, appropriate choice of starter cultures, proper thermal treatment and some production line modifications.

The sensory evaluation of cheese was carried out as recommended by Baltić (1992). The following characteristics were assessed: general appearance, color, texture, structure and flavor in all cheese variants with a maximum of 20 points gained. Cheeses were graded as follows: 10 (variant 4), 12 (variant 3), 15 (variant 1), 17 (variant 2) and 19 (variant 5).

The sensor assessment suggests that variant 5 scored best and recommends that the starter culture combination used with this variant be used during the industrial production of white brine cow cheese.

All cheese variants complied with the legal requirements and did not contain *Escherichia coli* and *Proteus* varieties in 0.01 g.

### Conclusion

Proper starter culture selection in the white brine cheese production enables regular dynamics of the lacto-acidic process. Starter cultures have different effects on the cheese fermentation process, being reflected in cheese titratable acidity ranging from 28 to 44 °SH during pressing and reaching 104.7 °SH after 60 days of aging.

Moisture with all 5 variants of cheese after 60-day aging varied from 48.8 - 53.4%, the ripeness level from 40 - 55 °Š and the yield from 14.41 to 15.22 kg produced from 100 l of milk. The best sensor properties were found with variant 5 which scored 19 points out of 20, the starter culture used in its production being recommended for the manufacture of white brine cow cheese.

### References

- Baltadžieva M. (1993) Tehnologija na mlečnite produkti. Zemizdat. Sofija.
- Baltić M. (1992): Kontrola namirnica. Institut za higijenu i tehnologiju mesa. Beograd.
- Bintsis T., Papademas P. (2002) International Journal of Dairy Technology, 55 (113-120).
- Čobanova-Vasilevska R. (2007) Vlijaniето na vidot na starternite kulturi vrz osnovnite pokazateli pri proizvodstvoto na belo kravjo salamureno sirenje. Magisterski trud. Fakultet za zemjodjelski nauki i hrana.
- Dozet N., Adžić N., Stanišić M., Živić N. (1996) Autohtoni mlječni proizvodi. Beograd.
- Dozet N., Mačej O. (2006) Autohtoni beli sirevi u salamuri. Poljoprivredni fakultet. Beograd.
- Kršev Lj. (1989) Mikrobne kulture u proizvodnji mlječnih proizvoda. Zagreb.
- Pravilnik o mikrobiološkoj ispravnosti namirnica u prometu. Službeni list SFRJ br. 45/1983.
- Snedecor G., Cochran W. (1971) Statistical methods. The Iowa State University Press Ames, Iowa. USA.

## **IZBOR STARTER KULTURA KOD PROIZVODNJE BELOG KRAVLJEG SALAMURENOG SIRA**

- originalni naučni rad -

**Radmila Čobanova-Vasilevska**  
*IMB "Mlekara"-Bitola, R. Makedonija*

**Sonja Srbinovska**  
*Fakultet za poljoprivredne nauke i hranu - Skopje, R. Makedonija*

**G. Talevski**  
*Agencija za promociju i razvoj poljoprivrede - Bitola, R. Makedonija*

**Z. Sireta**  
*Program za podršku i savetodavne usluge u poljoprivredi- Bitola, R. Makedonija*

### **Rezime**

Sa ciljem izbora najoptimalnije starter kulture, ispitivan je uticaj 5 različitih kombinacija starter kultura na dinamiku mlečno-kiselinske fermentacije pri proizvodnji belog salamurenog kravljeg sira. Sirovo mleko koje se koristilo za proizvodnju sira, ispoljavalo je određena odstupanja kod hemijsko-fizičkih i mikrobioloških osobina koji su najverovatnije rezultat pojave mastitisa.

Porast kiselosti kod svih varijanti bila je najveća u prvih 20 dana, a nakon 60 dana ona je varirala u opsegu 92.8-104.7 °SH. Posle dvomesečnog perioda zrenja, procenat vlage iznosio je 48.8-53.4%, dok je stepen zrelosti varirao u intervalu od 40 do 55 °Š. Potrošnju mleka za izradu 1 kg sira iznosio je 6.57-6.94 l, odnosno od 100 litara mleka dobija se 14.41-15.22 kg sira.

Senzornom analizom najbolje rezultate pokazala je varijanta 5. Kod nje je korišćena kombinacija nekoliko starter kultura i to: DVS mezofilnu kulturu (*Str. lactis* i *Lb. casei* - 2:1), FRC 75 (*Lac. lactis subsp. lactis*, *Lac. lactis subsp. cremoris*, *Str. thermophilus* i *Lb. bulgaricus*) i razvijenu termofilnu kulturu (*Str. thermophilus* i *Lb. bulgaricus* - 2:1).