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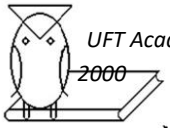

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The influence of different starter cultures on cheese yield and mass loss during ripening period of white brined cheese

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Abstract
White brined cheese yield is an important economic indicator in cheese production and it is presented as an amount of product obtained from 100 liters of milk. Cheese yield is one of the keys to improve the economy of cheese production. This parameter depends mostly on the percentage of casein and milk fats in milk, because in the process of white brined cheese production 90-95% of the casein and 80-97% of milk fats are transferred from milk into cheese. Mass loss is characteristic phenomenon during ripening period and is most due to moisture loss. In this research work the influence of three different starter cultures of three white brined cheese variants (A, B, C) has been examined regarding the cheese yield and mass loss during ripening period. The starter cultures that were used in variant A (SMCH - 5) contained the following bacteria strains: *Lb. bulgaricus*, *Str. thermophilus* and *Lb. acidophilus*, the variant B (Choozit Feta A): *Lac. Lactis* ssp. *lactis*, *Lac. lactis* ssp. *cremoris*, *Str. thermophilus*, *Lb. bulgaricus* and *Lb. helveticus* and the variant C (MOTC 092 EE): *Lac. lactis* ssp. *lactis*, *Str. thermophilus*, *Lb. bulgaricus*, *Lb. helveticus* and *Lb. casei*. The impact of the above mentioned three different starter cultures was determined over the cheese yield and mass loss during the process of ripening of the white brined cheese.

Keywords: starter cultures, cheese yield, mass loss, white brined cheese

Introduction

The cheese yield is an important economic indicator in the cheese industry and it is presented as a quantity of product obtained from 100 L of milk. This parameter, depends mostly on the percentage of casein and milk fat in the raw milk because during the technological process, the milk casein exceeds the highest percentage (90-95%), then the fats (80-97%) and to a lesser extent pass the minerals (15-30%) and lactose (5-10%) (Baltadzieva 1993).

Cheese yield depends on a number of factors, of which, according to Abd El-Gawadhi and Ahmed (2011), the most significant being: the chemical composition of milk, genetic variants of milk proteins, the number of somatic cells in milk, the stage of lactation, seasonal variations, raw milk quality, technological operations (cooling, standardization, bactofugation, pasteurization, homogenization), the type of starter cultures, methods of curd processing, salting, brining etc.

Najaf et al. (2008) indicate that the starter cultures and pH of the milk during coagulation play an important role in the production of Iranian white cheese and affect its physical and chemical changes.

Materials and Methods

Materials

In this survey the white brined cheese was manufactured from pasteurized cow milk in a local dairy plant "Milkom", village Nogaevci, Gradsko, Republic of Macedonia.

The chemical composition of the milk used for the production of white cheese was: 12.13% total solids, 3.70% fat, 3.21% protein, 0.67% ash, and 4.55% lactose. The milk was pasteurized at 72°C for 15 s and cooled at 34°C. The process of curding was done at temperature of 34°C.

Different starter cultures were added: for white brined cheese - Variant A - SMCH – 5, for white brined cheese - Variant B - Choozit Feta A and for white brined cheese Variant C - MOTC 092 EE. Further on $CaCl_2$ (0.02%) and blego color 10 ml/100 liters milk was added. The milk was coagulated with chymosin rennet completed in 45 min.

After that, the curd was cut in cubes of 1 cm^3, resting for 5 min and afterwards pressed in cheese molds for 3 h. Cheese blocks were placed in tinned cans filled with brine solution of 8 g NaCl/100g. During the ripening period of 30 d the cheese was held at 15-17°C, and stored at 2-4°C.

Methods

Milk and whey samples were analyzed for chemical composition (MilkoScan 4000, Foss, Denmark). Cheese samples were analyzed for dry matter according to Carić et al. (2000).

Theoretically, the cheese yields of examined cheese variants were calculated after 60 d ripening period using the formula of Baltadzieva (1993):

$$Y = \left[\frac{DMM\ \% - DMW\ \%}{DMC\%} x100\right] - F \qquad (1)$$

Y - cheese yield of 100 liters of milk;
DMM % - percentage of dry matter in milk;
DMW% - percentage of dry matter in whey;
DMC% - percentage of dry matter in cheese;
F - 0.3 - loss factor during processing
(white brined cheese = 0.3);

Results and Discussion

After the calculations, the following theoretical yields were obtained for the tested cheese variants:

- Variant A 12.14%
- Variant B 12.39%
- Variant C 12.23%;

Mateva (2012) received a lower theoretical yield in white brined cheese, compared with our results which ranging from 11.41% to 12.12% with an average of 11.72%.

In our survey the actual yield of examined variants was calculated by weighing of the produced brined cheese (obtained from 100 L of milk) and it was:

- Variant A 6.95%;
- Variant B 6.71 %;
- Variant C 6.84 %;

These results are consistent with literature data from multiple authors. In this context, Chomakov et al. (2000) indicate that the yield of white brine cheese ranges from 6.75 to 6.89 L of milk per 1 kg of cheese. Similar results with ours were obtained by Chobanova-Vasilevska (2007), which established

variations from 6.57 to 6.94 L of milk per 1 kg of cheese produced by using different starter cultures.
Talevski (2011) obtained similar results with our, for the yield at 3 examined variants of white brine cheese ranging from 6.62 to 6.90 L of milk per 1 kg of cheese. Our results are approximate to the data given by Edgaryan and Panayotov (2012) which indicate that 6,66 L of milk are needed for the production of 1 kg of cow cheese (with 52% moisture). From the results obtained for this parameter it can be concluded that variant B produced by the starter culture Choozit Feta A had the best yield that is in direct correlation with the acidification of the cheese curd and the retention of moisture in the cheese.
This variant had a moderate tempo of acidification which contributes to the maintenance of a greater amount of moisture than the variants where there is a faster increase in titratable acidity, greater dehydration of the cheese mass and a weaker cheese yield.
In the industrial production of brine cheese, an important element for the yield is controlled ripening temperature, which should be 15 - 17°C, to allow optimum development of the lactic acid bacteria.
Also, cheese should be placed at low temperatures (2 - 4°C) in 3 - 4 d before being put into the commercial network, because in this way there is a reversible process of absorbing a part of the moisture that has migrated into the brine and thus has a partial yield improvement. Cheese mass loss during ripening occurs predominantly under the influence of the migration of water, protein, fat and gases from the cheese curd in the brine. Loss of cheese weight is an important economic parameter in the technological operation of dairy facilities.
On the one hand it is a normal process in getting a quality product with expected chemical-physical and sensory characteristics, but on the other hand it must not be above the standard values for this type of cheese because it negatively affects the profitability of dairies. The mass loss of the tested varieties of cheese in this study is presented in Table 1. From the results it can be noticed that the largest mass loss occurs during the first 10 d of fermentation when there is an intensive migration of moisture from the cheese and penetration of salt in the opposite direction.
After 10 d, weight loss in the examined variants was approximately equal and ranged from 8.12 to 8.57% and the loss of mass at approximately the same pace continued to day 30 (15.66% was measured for variant A, variant B - 14.81% and variant C - 15.20%).
After two months of ripening, the greatest mass loss was found in the variable A (18.73%), then in the variant C (18.23%) and the slightest loss in variant B (17.76%), which coincides with the obtained real cheese yield.
According to Yener (1989) the yield of white brined cheese in Turkey after pressing was 11.27 - 14.16%, while during ripening the percentage of weight loss was about 10%, which is in accordance with our results. The authors El Owni and Hamid (2008) found that the loss of mass of Sudanese white brine Cheese "Gibna Bayda" after 60 d was 22.64 ± 16.7%. This high percentage of loss is due to the fact that this cheese is fermented to 35 - 37°C, compared with our research where fermentation occurred at 15 - 17°C.

Conclusions

From the results obtained for the parameter-cheese yield it can be concluded that variant B produced by the starter culture Choozit Feta A had the best yield that is in direct correlation with the acidification of the cheese curd and the retention of moisture in the cheese. The actual yield of examined variants was: Variant A - 6.95%, Variant B - 6.71% and Variant C - 6.84%. After two months of ripening, the greatest mass loss was found in the variant A (18.73%), then in the variant C (18.23%) and variant B (17.76%), which coincides with the obtained real cheese yield.
Due to the loss of cheese mass, starter cultures have a significant impact in the production process of white brined cheese. If the lactic acid bacteria are not active and the desired acidity is not achieved, then cheese must be kept for a longer period at higher temperatures in order to complete the fermentation process which will cause greater loss of mass.

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Table 1: **Dynamics of mass loss of white brine cheese**

Variants	Day 1	Day 10	Day 30	Day 60
Variant A	0	8.57	15.66	18.73
Variant B	0	8.12	14.81	17.76
Variant C	0	8.34	15.20	18.23