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The prevalence of Staphylococcus aureus in milk-based food products

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ABSTRACT: For the presence of staphylococci, specifically Staphylococcus aureus, we have tested 35 samples of fine cottage cheese, 14 samples of whole winter "bryndza," 29 samples of Ondava cheese, 18 samples of skim kephir milk, 18 samples of whole acidophilous milk, 5 samples of strawberry-flavored yoghurt milk, and 50 samples of fresh butter (Rajo). We collected all of the samples for the microbiological investigation straight from the stores in the market. With levels of 100, 65, 5, 75, and 60 CFU/ml of Staphylococcus aureus bacteria, none of the yogurt milk samples tested met the requirements set forth by the Codex Alimentarius. All of the other food items that were tested for staphylococci met the existing requirements.

Keywords: bovines, ovines, their milk, staphylococci, and Staphylococcus aureus

INTRODUCTION

Contamination of dairy products with *Staphylococ- cus aureus* (*S. aureus*) bacteria may influence consider- ably their harmlessness, decrease their shelf-quality and endanger the health of consumers.

S. aureus causes diseases both in people and ani- mals (Park *et al*., 1994; Nishijima *et al*., 1997; Moretti *et al*., 1998; Leski *et al*., 1998; Wallace *et al*., 1998; Her- mans *et al*., 1999; Jensen *et al*., 1999, etc.) and thus attracts considerable attention particularly from the point of view of food hygiene (Paulsen *et al*., 1995; Yazdankhah *et al*., 1998, *etc*.). The recent research in this field has focused on the direct detection of staphy- lococci enterotoxins in foods (Rasooly and Rasooly, 1998; Bhatti and Micusan, 1999; Yazdankhah *et al*., 1999 and others).

Contamination of food products with *S. aureus* pathogens may result primarily from their presence in the basic raw material, milk. In such cases, the source of pathogen is the dairy cow or sheep (Sol *et al*., 1994; Enevoldsen *et al*., 1995; Moretti *et al*., 1998; Elečko *et al*., 1998; Annemüller *et al*., 1999; Osteras *et al*., 1999; Pozza *et al*., 1999, *etc*.) or the milker (Beličková, 1999; Brisabois *et al*., 1999).

Bacterial contamination of food products may also result from violation of technology and production hy- giene rules (Grieger *et al*., 1990; Dudriková *et al*., 1999).As the incidence of alimentary diseases in human population increases, the food inspection must follow a similar trend. Additional complications arise out of the constant expansion of international food trade, exten- sion of the range of available foods, increase in tourism and the number of people taking advantage of canteens and other food serving establishments (Curtis, 1998; Heir *et al*., 1998; Bohačenko *et al*., 1999; Brisabois *et al*., 1999, *etc*.).

As the liberalisation of trade on an international scale goes along with the liberalisation of food legisla- tive, its global co-ordination is needed to reach a uni- fied qualitative level (Kanjuka and Šutiak, 1990).

With regard to the diverse situation in import, pro- duction and distribution of foods in this country as well as decreased transparency and therefore also the effica- cy of complex inspection we tried to determine the sta- tus of microbial contamination of some final milk products available on the market focusing on patho- gens, particularly on the increasingly important *S. aureus.*

MATERIAL AND METHODS

The microbiological analysis of milk products per- formed in our study was based on the valid methods for detection and determination of staphylococci and *S. au-reus* counts in raw materials and foods of animal origin (STN ISO 6888,1999; Codex Alimentarius, 1998).

Samples of fine cottage cheese, whole winter "bryndza", Ondava cheese, skim kephir milk, whole acidophil- ous milk, yoghurt milk flavoured with strawberry and fresh butter Rajo were purchased directly from market establishments.

Baird-Parker agar, produced by Imuna, Šarišské Michaľany (Slovak Republic), was used as a nutrient medium for microbiological detection.

Staphylococci and *S. aureus* counts were determined by spreading 0.1 ml of a suitably diluted sample onto the surface of Baird-Parker agar plates. The inoculated plates were incubated at 37°C for 48 hours. As staphy-

lococci were regarded only black, glossy, convex colonies with a diameter of 1−1.5 mm were counted.
As *S. aureus* were regarded the colonies surrounded with a 1−2.5 mm lighter zone visible in the cloudy agar and with positive coagulase test PK − Stafylotest (Imuna, Šarišské Michaľany, Slovak Republic).
According to the Bulletin of the Ministry of Agriculture, Slovak Republic, Vol. XXX, section 21, suppl. No.3, 1998, no *S. aureus* are allowed in the final milk prod- ucts.

RESULTS AND DISCUSSION

The results of microbiological detection of staphylococci in food samples of milk origin taken directly from the market are presented in Tables 1 to 4.The microbiological analysis of fine cottage cheese samples for the presence of staphylococci, particularly *S. aureus,* is shown in Table 1. These bacteria were present in all 35 samples examined ranging from 9×10^2 to 1.07×10^4 CFU/g. Similar investigations were carried out by Elečko *et al.* (1998), who failed to detect *S. au- reus* in any of 13 examined samples.
Another milk product tested was the whole winter "bryndza" (Table 2) produced as a mixture of stored (barrel) sheep cheese and fresh dairy cottage cheese. Staphylococci were observed in all samples, their counts ranging from 9.11×10^3 to 8.56×10^4 CFU/g. No
S. aureus was found in any of the examined samples. Similar results were obtained by Grieger *et al*. (1979), Beličková *et al*. (1993) and others, who investigated "bryndza" for the presence of staphylococci.
Additional products tested for staphylococci were samples of Ondava cheese. None of the 29 samples examined showed the presence of staphylococci or *S. aureus* (Table 3), which is very important from the hygiene point of view. Similar results were presented by Vernozy *et al*. (1994), who investigated cheese for the presence of coagulase negative staphylococci.
Microbiological analysis of 18 samples of skim kephir milk and 18 samples of whole acidophilous milk showed (Table 3), that not a sample contained staphylococci, which indicated that the starting raw material, microbial culture and production hygiene were on a good level (Burdová, 1999).
Staphylococci including *S. aureus* have been determined also in 50 samples of fresh milk butter Rajo (Table 3).

Table 1. Counts of staphylococci and *S. aureus* in fine cottage cheese

Sample No.	Staphyloccci (CFU/g)	*S. aureus* (CFU/g)	Sample No.	Staphyloccci (CFU/g)	*S. aureus* (CFU/g)
1	9.45×10^2	0	19	9.40×10^3	0
2	1.02×10^3	0	20	7.80×10^3	0
3	9.00×10^2	0	21	7.35×10^3	0
4	9.85×10^2	0	22	1.00×10^4	0
5	7.46×10^3	0	23	1.07×10^4	0
6	8.50×10^3	0	24	4.70×10^3	0
7	7.90×10^3	0	25	5.55×10^3	0
8	1.02×10^4	0	26	5.05×10^3	0
9	6.76×10^3	0	27	5.25×10^3	0
10	6.76×10^3	0	28	4.35×10^3	0
11	6.90×10^3	0	29	5.50×10^3	0
12	5.75×10^3	0	30	5.05×10^3	0
13	6.45×10^3	0	31	4.25×10^3	0
14	4.35×10^3	0	32	5.45×10^3	0
15	9.45×10^3	0	33	4.85×10^3	0
16	8.50×10^3	0	34	4.90×10^3	0
17	6.25×10^3	0	35	6.10×10^3	0
18	1.05×10^4	0			

Table 2. Counts of staphylococci and *S. aureus* in "bryndza" foods

Sample No.	Staphylococci (CFU/g)	*S. aureus* (CFU/g)
1	9.50×10^3	0
2	1.01×10^4	0
3	9.11×10^3	0
4	1.02×10^4	0
5	6.76×10^4	0
6	8.56×10^4	0
7	6.70×10^4	0
8	6.40×10^4	0
9	4.30×10^4	0
10	5.98×10^4	0
11	6.22×10^4	0
12	5.70×10^4	0

Table 3. Counts of staphylococci and *S. aureus* in investigated samples

Product	Examined samples	Positive samples: Staphylococci	Positive samples: *S. aureus*
Ondava cheese	29	0	0
Skim kephir milk	18	0	0
Whole acidophilous milk	18	0	0
Fresh milk butter Rajo	50	0	0

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Table 4. Counts of staphylococci and *S. aureus* in yoghurt milk

Sample No.	Staphylococci (CFU/g)	*S. aureus* (CFU/g)
1	2.75×10^2	1.0×10^2
2	2.55×10^2	65
3	2.40×10^2	5
4	3.75×10^2	75
5	3.50×10^2	60

Neither staphylococci nor *S. aureus* were found in the tested samples. This corresponds with the data of a number of authors that staphyloentero-toxicosis originating from butter occurs very rarely (Beličková *et al*., 1999, *etc*.). Grieger *et al*. (1990) stressed that violation of production technology enhanced substantially the mul- tiplication of micro-organisms in butter.

Yoghurt is one of the most widely consumed milk product (Grieger *et al*., 1990, *etc*.) It is a nutritionally valuable food article with good organoleptic properties and longer shelf-life compared to milk. It is increasingly popular with children. All analysed samples of yoghurt milk with strawberry flavour (Table 4) contained staphy- lococci on the level of 2.89×10^2 CFU/ml, on average. All the tested samples were positive for *S. aureus* averaging 61 CFU/ml. In conclusion, all analysed foods of milk origin complied with the current standards except for yoghurt milk with strawberry flavour in which *S. aureus* was found on the level of 100, 65, 5, 75, and 60 CFU in 1 ml of exam- ined samples although the standard allows no presence of *S. aureus*.

The fact that of the wide range of analysed milk products the most popular and widely used product did not comply with the hygiene standard indicates clearly the need for systematic and on-the-spot inspection of this final milk product in order to identify the etiological fo- cus of contamination and eliminate it efficiently in the interest of protection of consumers' health.

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