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## Assessment of Microbial Safety of Cheese and Sausage Products Sold in the Supermarkets of the City of Yerevan

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### ABSTRACT

The aim of this study is to assess the microbial safety of sliced sausage and cheese products sold in Yerevan. Microbiological indices defined by the Eurasian Economic Union (EAEU) technical regulations were studied in the products sampled from Nor Zovk, Yerevan City and SAS supermarkets. The results indicated that before being sliced in supermarkets, the studied food products met the established safety requirements. However, microbiological contamination was detected in 71.4 % of sliced sausage product samples and in 33.3 % of sliced cheese samples. Therefore, it can be concluded that cutting these food products at sale points can contribute to their microbial contamination, making these foods unsafe for consumption.

### Introduction

Nowadays, sliced sausages and cheese are one of the most widely consumed ready-to-eat food products around the world due to their convenience and good acceptance by consumers (Rodriguez, et al., 2010). Meanwhile, microbial contamination of ready-to-eat food products is one of the major food safety and public health concerns for both developed and developing countries (Shiowshuh and Cheng-An, 2010).

Based on epidemiological and microbiological studies conducted by researchers in different countries, microbial cross-contamination either at home or production site is one of the major issues of food safety (Shiowshuh and Cheng-An, 2010, Ehrampoush, et al., 2017). Product

can become contaminated via the environment, handlers and equipment, particularly slicing machines and cutting utensils during processing (Ehrampoush, et al., 2017). As a consequence, food items, including sausage and cheese products, can be contaminated with biological hazards, such as bacteria group of *Escherichia coli* (coliforms), mesophilic aerobic and facultative anaerobic microorganisms (MAFAM), *Staphylococcus aureus* (*S. aureus*), *Listeria monocytogenes*, salmonella (*Salmonella spp.*), sulfite-restoring clostridia, yeasts and molds.

Coliforms and MAFAM are considered as hygienic indicators. Consumption of foods rich in these types of bacteria can lead to gastrointestinal problems, accompanied by fever, dysbacteriosis, and nausea.

*S. aureus* is a facultative anaerobic bacterium, causes gastrointestinal diseases called staphylococcal food poisoning. Food contamination by *S. aureus* is caused by bacterial toxins that are resistant to heat and therefore cannot be destroyed during cooking (Le Loir, et al., 2003).

*Listeria monocytogenes* and *Salmonella spp.* are causes of most common foodborne diseases. Common symptoms of listeriosis include fever, muscle weakness and gastrointestinal problems. If the infection starts in the nervous system, the symptoms are headache, neck pain, anxiety, balance loss or convulsions. Salmonellosis causes diarrhea, abdominal pain and fever 8-72 hours after eating contaminated food (Bolton, et al., 2009).

Both molds and yeasts cause various degrees of deterioration and decomposition of foods. Several foodborne molds and yeasts may be hazardous to human health because of their ability to produce toxic metabolites known as mycotoxins (Tournas, et al., 2001).

Regarding sulfite-reducing clostridia, in the case of high amounts of these microorganisms, certain groups of people with low immune systems may develop acute intestinal infections, such as clostridiosis (Kouassi, et al., 2011).

Consumption of products contaminated with the abovementioned microorganisms is considered risky as it can have adverse effects on human health by causing food poisonings. Therefore, from the public health perspective, the quality and microbiological safety of food is very crucial. Hence, the aim of this study is to assess the microbial safety of cheese and sausage products sold in Yerevan.

### Materials and methods

During the research, sausage products and cheese were randomly sampled from SAS, Nor Zovk, Evrika and Yerevan City supermarkets in Yerevan. A total of 10 composite samples were studied. Detailed information regarding the samples is presented in Table 1.

Sausage product and cheese samples were transported to the laboratory in sterile, hermetically sealed containers to prevent cross-contamination.

The presence of MAFAM, coliforms, *S. aureus*, *L. monocytogenes*, *Salmonella spp.*, sulfite-reducing clostridia, yeasts and molds were studied in samples. In particular, both whole foods and sliced foods in supermarkets were studied to see if slicing the food at the retail stores possibly affects its microbial safety.

The methods for determining the presence of

microorganisms in samples are presented in Table 2. The analyses were carried out in “Standard Dialog” laboratory.

**Table 1.** Information on studied products\*

Product type	Producer/product name	Code
Sausage products	Bacon /“Bagatir Balikovaya”	N1
	Bacon/“Bzhshkakan”	N2
	Moya Semya/“Smoked Singa”	N3
	Bari Samaratsi/“Germanakan”	N4
	Moya Semya/“Ham”	N5
	Atenk/“Gyumri”	N6
	Atenk/“Bzhshkakan”	N7
Cheese	Product containing processed (melted) cheese	N8
	“Badamere”	N9
	“Gauda”	N10

**Table 2.** Methods for the detection of the microbiological contamination\*

Products	Code	Microorganisms	Methods
Sausage products and cheese samples	N2, N4, N5, N7, N8	MAFAM	GOST 0444.15-94
	N1-N10	Bacteria group <i>Escherichia coli</i> (coliforms)	GOST 31747-2012
	N1-N7, N9, N10	<i>S. aureus</i>	GOST 31746-2012
	N1-N10	Pathogenic bacteria, including <i>Salmonella spp.</i>	GOST R 50455-92
	N1-N10	<i>Listeria monocytogenes</i>	MUK 4.2.1122-02
	N1, N2, N4, N5, N6, N7	Sulfite-reducing clostridia	GOST 10444.9-88
	N8	Yeasts Molds	GOST 10444.12-2013

\*Composed by the authors.

## Results and discussions

The results indicate that the studied products met the requirements set by technical regulations (TRCU021/2011, TRCU033/2013, TRCU034/2013) before slicing and handling in the supermarket. However, microbial contamination was identified in several samples of sliced sausage and cheese products.

The contents of MAFAM in the studied samples of sausage products (N2, N4, N5, N7) and cheese (N8) are presented in Figure.

According to the data presented in Figure, MAFAM contents in the studied samples are in the range of  $3.5 \times 10^3$ – $1 \times 10^5$  CFU/g. The highest content of MAFAM was reported in N4 sausage product sample, and the lowest one in N5 sample. It shall be noted that in all the samples presented in the figure, MAFAM contents exceed the permissible level set by the EAEU technical regulations (TRCU 021/2011, TRCU 033/2013). The contents of MAFAM in the studied sausage products exceed the permissible level ( $2.5 \times 10^3$ ) by 1.4–40 times. MAFAM content in processed (melted) cheese (N8) exceeds the permissible level twice.

Similar study was carried out in the city of Tripoli, Libya. According to the study results, the contents of MAFAM ranged from  $7 \times 10^4$ – $7.5 \times 10^9$  CFU/g (Hamza&Elshrek, 2019). Comparing these outcomes with the current study results, it can be noted that the MAFAM contents were higher in the samples from Tripoli rather than those from Yerevan.

The content of MAFAM in samples of cheese products sold in Sudan supermarkets ranged from  $6.0 \times 10^6$  –  $6.5 \times 10^7$  CFU/g (Suleiman, et al., 2011), exceeding the MAFAM contents in cheese products of the current study by 300–32500 times.

Detailed information about the presence of microorganisms in the studied sausage products and cheese samples is presented in Table 3 and Table 4, respectively.

According to Technical Regulation of the Customs Union on Food Safety, the presence of bacteria group of *Escherichia coli* (coliforms) is not allowed in 0.1 g of product. However, according to the results of this study (Table 3), even though coliforms were not detected in cheese samples, it was detected in some samples of sausage product (N2, N3).

The presence of these bacteria can be a consequence of improper sanitary and hygienic conditions (work surfaces, utensils, personal hygiene of salespeople) at the retail stores (Bolton, et al., 2009). It should be noted that food contaminated with coliforms can be dangerous to human health, therefore, the studied products are not safe for consumption and shall not be sold in markets.

The results of another study indicate that the contents of coliforms in ready-to-eat products sold in the Slovakian supermarkets range from  $10$ – $1.6 \times 10^3$  CFU/g, and are detected in 40 % of the samples (12/30) (Lopasovsky, et al., 2016).

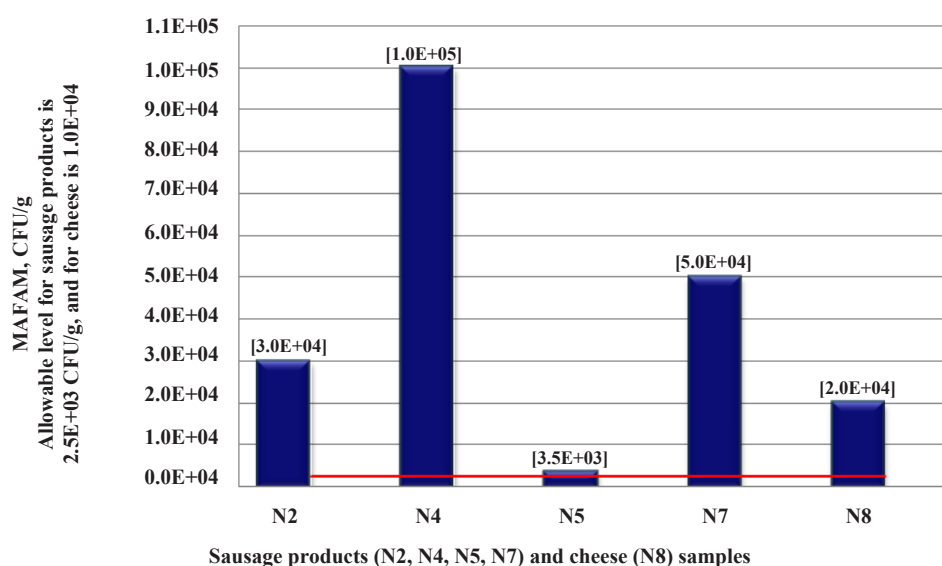


Figure. MAFAM content in samples (composed by the authors).

**Table 3.** Microorganisms in sausage products\*

Sample codes	Coliforms	<i>S. aureus</i>	<i>Salmonella spp.</i>	<i>Listeria monocytogenes</i>	<i>Sulfite-reducing clostridia</i>
	Permissible level according to Technical Regulation (TR CU 021/2011, TR CU 034/2013)				
	n/a in 1 g	n/a in 1 g	n/a in 25 g	n/a in 25 g	n/a in 0.1 g
N1	n/d	n/d	n/d	n/d	n/d
N2	+	n/d	n/d	n/d	n/d
N3	+	n/d	n/d	n/d	n/d
N4	n/d	+	n/d	n/d	n/d
N5	n/d	n/d	n/d	n/d	n/d
N6	n/d	n/d	n/d	n/d	n/d
N7	n/d	n/d	n/d	n/d	n/d

**Note.** n/a - not allowed, "+" - detected, "n/d" - not detected.

**Table 4.** Microorganisms in cheese samples\*

Sample codes	Coliforms	<i>S. aureus</i>	<i>Salmonella spp.</i>	<i>Listeria monocytogenes</i>	Yeasts	Molds
	Permissible level according to Technical Regulation (TR CU 021/2011, TR CU 033/2013)					
	n/a in 0.1 g	n/a in 0.001 g	n/a in 25 g	n/a in 125 g	<100 CFU	<100 CFU
N8	n/d	-	n/d	n/d	<10	<10
N9	n/d	n/d	n/d	n/d	-	-
N10	n/d	n/d	n/d	n/d	-	-

**Note.** n/a - not allowed, "n/d" - not detected, "-" - the content of the microorganism wasn't investigated in the sample, CFU – colony forming unit

\*Composed by the authors.

Overall, according to the results of the microbiological safety assessment, *Listeria monocytogenes* and pathogenic bacteria, including *Salmonella spp.*, were not detected in the studied samples of sausage and cheese products. However, *S. aureus* was detected in one sample of sausage product (N4). It shall be highlighted that the presence of the latter in the ready-to-eat product is prohibited and is risky from the point of view of public health.

In 1 % of 2972 samples of sausage products sold in London supermarkets, the content of *S. aureus* was higher than  $10^2$  CFU/g and exceeded the acceptable level (the sufficient level is  $<20$  CFU/g, the insufficient level is  $1 \times 10^2 - 1 \times 10^4$  CFU/g, and the unacceptable or potentially dangerous level is  $\geq 1 \times 10^4$  CFU/g) (Gormley, et al., 2010).

The results of the study indicate that sulfite-reducing clostridia were not detected in the samples of sausage products, while yeasts and molds were not detected in the cheese samples.

### Conclusion

According to the results of this study, the overall microbial contamination (MAFAM content) of 5 sliced sausage product samples (N2, N4, N5, N7, N8) and of 1 cheese sample from supermarkets in Yerevan exceed the maximum permissible level set by the EAEU Technical Regulations. In addition, coliforms were detected in 2 samples of sausage products (29 %) and *S. Aureus*

was detected in 1 sample of sausage products (14 %). Overall, the results of the study indicate that 71.4 % of sausage products samples and 33.3 % of cheese samples do not meet food safety requirements and are dangerous to consumer health since their consumption can lead to food poisoning.

Therefore, in order to prevent microbial contamination, it is necessary to follow the proper safety and hygiene requirements in the supermarkets. This will minimize microbiological risks of food by effectively controlling all food-related processes in the supermarket and ensuring the safety of ready-to-eat products.

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