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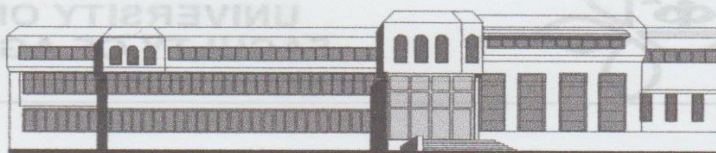


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The influence of storage time on the quality and safety of the opened tetrapak milk

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Abstract: Milk is a biological fluid with a very complex composition that has positive properties on human health. It is included in the group of nutritional nutrition necessary for all ages, because it with its composition satisfies the nutritional and immunological needs of the young organism, but also and for people of all ages. The purpose of this research is to determine the effect of the storage time of the refrigerator, after opening, on tetrapak sterilized (UHT) milk, by monitoring the physicochemical (pH, titration acidity, milk fat, protein, lactose, dry matter) and microbiological parameters. From the results obtained, it can be noticed that we have a steady increase in the total number of microorganisms in open milk. The biggest changes are observed in samples that have been stored for a long time in the retail network in inadequate conditions. Despite the increase in the number of microorganisms, UHT milk meets the quality requirements that are prescribed on the packaging.

Key words: tetrapak milk, storage time, quality and safety, UHT.

Introduction

An important aspect in the production and distribution of food is the provision of health security through the fulfillment of legal requirements in each stage of production and supply to the consumer, a process known as "from farm to table". Today, consumers pay great attention to the quality of the food they consume, and this also applies to dairy products (Brodziak et al., 2017), and milk in every way satisfies the nutritional characteristics and is a full-fledged food. When consumers purchase a product from a store it is important for the consumer to maintain the date of use, indicating the shelf life of the product stored under ideal conditions. This period largely depends on the quality of the

raw materials, the used technological processes and the conditions for production, storage, transport and home storage of the final product (WHO and FAO, 2009).

Milk in its characteristics is an appropriate medium for microbial growth. The microflora that is present in the milk can cause milk breakage if the temperature and the time of retention are met. The most common bacteria capable of growing in milk are: *Staphylococcus aureus*, *Escherichia coli*, *Listeria monocytogenes*, *Clostridium* and *Bacillus cereus* (Consuelo et al., 2009).

The temperature and storage time together with the pH value significantly affect the survival and growth of microorganisms. The growth of microorganisms in milk that is stable for several months can also be affected by factors such as the presence of moisture, pH, treatment and storage temperature (Ledenbach L.H., and Marshall R.T., 2010).

The aim of the thermal processing of milk is to ensure product safety as well as prolonging the shelf life (Brodziak et al., 2017). Sterilization is one of the thermal treatments used in the production of milk. Ultra-high temperature processing (UHT), ultra-heat treatment or ultra-pasteurization is a food processing technology that sterilizes liquid foods, mainly milk, with heating above 135 °C - the required temperature to kill spores in milk - for 1 to 2 seconds (Official Gazette of the Republic of Macedonia No. 96/2011). UHT milk in aseptic packaging is a product that is stable on a shelf. In addition, the application of high temperatures can lead to many unwanted changes, such as lactose degradation, mild reaction, changes in taste and smell, and the like (Brodziak et al., 2017).

Material and methods

The subject of the analysis in this research was milk packaged in a carton, intended for commercial use. UHT milk samples with 3.2% milk fat (UHT 1) (3 months before the expiration date) and UHT milk with 1.5% milk fat (UHT 2) were taken from the retail network (4 months before the expiration date), while as a control sample milk was taken milk at the initial date of shelf life i.e. in the first day after production - UHT milk with 3.2% milk fat (UHT 3) (6 months before the expiration date). From each group of milk was taken two samples and each of the products was packaged in a 1 liter carton, i.e. a total of 6 samples of tetrapak milk were used during the research.

Analyzes were made in duplicate. Milk was opened on the beginning of the study (day - 0) shortly before the start of the analysis. Milk samples were taken at day 0, and later on 3, 5, 7 and 10 days after opening, which coincides with the way consumers behave. Each time the milk was opened, 200 ml of milk were taken for analysis. Milk was stored at a temperature of 4-6 °C during the study.

The chemical composition of the milk was examined using the LactoScope FTIR Advanced; titration acidity ($^{\circ}\text{SH}$) according to the Soxhlet Henkel method; active acidity (pH) - (MP120FK Mettler Toledo, Greifensee, Switzerland).

In order to obtain a results of the microbiological quality of milk, the reductase test was used (Trajkovska, 2017). The peroxidase test was used to control the sterilization process (Caric, et al., 2000). The samples for analysis were first heated in a water bath at a temperature of $37,5^{\circ}\text{C}$ and then cooled to room temperature (about 20°C).

Results and discussion

The shelf life of the tetrapak milk is about 180 days from the date of production (Elrahman et al., 2013), precisely for these reasons the results were divided in terms of milk purchased at the store and milk taken from the dairy on the day of production, with in order to determine whether there are significant changes that occur during the storage of the product. According to the obtained results shown in Table 1, it can be noted that all milk meets the safety requirements on the first day of opening (0-day), while in relation to the physicochemical milk meets the prescribed legal norms for consumption milk, according to the Rulebook (Official Gazette of the Republic of Macedonia No. 96/2011).

During the storage of samples, the largest changes in the active acidity (pH) and titration acidity ($^{\circ}\text{SH}$) were observed, where their gradual decrease was observed, but these values did not exceed the prescribed legal limits for UHT milk (Official Gazette of the Republic of Macedonia no. 96/2011). According to Elrahman et al., (2013) UHT milk can be considered fresh in terms of acidity and after the fifth day of opening, unless it is also exposed to light. On the other hand, we can notice that pH was changes dramatically in milk with higher milk fat (Table 1). These results are confirmed by the studies made by Szpakowska M., and Tymoszuk, (2011).

The changes that occur in relation to the acidity of the milk are directly related to the storage time and the total number of microorganisms (Elrahman et al., 2013). From the results shown in (Table 2), it can be noted that by storing the product in the refrigerator we have an increase in the total number of bacteria, just after the third day of examination, the same results have been confirmed with the reductase test.

Table 1: Table display of the chemical composition of the opened tetrapak milk kept in the refrigerator during 10 days

Days of storage	Fats (%)	Lactose (%)	Dry non-fat matter (%)	Proteins (%)	pH	°SH
UHT 1						
0	3,2	4,31	8,23	3,02	6,55	7
3	3,21	4,27	8,23	2,985	6,56	7,15
5	3,2	4,295	8,24	3,02	6,55	7
7	3,21	4,305	8,295	3,055	6,45	6,55
10	3,225	4,27	8,27	2,975	6	6,65
UHT 2						
0	1,67	4,85	8,85	3,02	6,55	7
3	1,665	4,855	8,85	3,01	6,59	6,85
5	1,67	4,85	8,825	3	6,57	6,85
7	1,655	4,82	8,82	3,005	6,53	6,75
10	1,685	4,855	8,89	3,045	6,50	6,85
UHT 3						
0	3,25	4,25	8,2	3,12	6,66	6,2
3	3,24	4,22	8,21	3,12	6,67	6,15
5	3,24	4,21	8,02	3,125	6,67	5,95
7	3,23	4,225	8,21	3,125	6,64	5,85
10	3,235	4,22	8,225	3,12	6,55	5,85

According to Anderson et al., (2011), *E.coli* and *Enterobacteriaceae*, they are often found in raw milk and they do not survive pasteurization, but if they are present in heat-treated milk, they are indicative of inadequate processing or post contamination of the product. From the obtained results we can conclude that the storage conditions of the retail network and the time of production of the product affect the product safety, since inadequate transport and temperature variations in the retail network can result in continuous aging (Anderson et al., 2011). The obtained negative results for the cleanliness of the refrigerator only confirm that there was no post-contamination over time while the product was kept open at 4°C in the refrigerator.

References

Anderson M., Hinds P., Hardin S., Miller P., McGowder D., Alexander R.L. (2011): The microbial content of unexpired pasteurized milk from selected

Table 2: Microbiological quality of the tetrapak milk stored in the refrigerator over 10 days

Days of storage	CFU/ml	<i>E.coli</i>	Mold and yeast	<i>Enterobacteriaceae</i>	Reductase test
UHT 1					
0	0	0	0	0	/
3	<1.000.000	0	0	0	*
5	>1.000.000	0	0	0	*
7	>1.000.000	10	0	10	*
10	>1.000.000	100	0	100	*
UHT 2					
0	0	0	0	0	/
3	502	0	0	0	*/*
5	505	0	0	0	*/*
7	<1.000.000	0	0	0	*
10	>1.000.000	0	0	0	*
UHT 3					
0	0	0	0	0	/
3	500	0	0	0	*/*
5	501	0	0	0	*/*
7	<1.000.000	0	0	0	*
10	<1.000.000	0	0	0	*

Legend: "/" – no color change, "*/*" – partial discoloration & "***" – complete discoloration.
CFU – colony - forming units

Conclusion

In the context of the above results, it can be concluded that the storage time of an open carton of milk at a temperature of 0 to 4 °C does not seriously affect its quality, i.e. milk keeps its nutritional characteristics. However, in terms of product safety, it is necessary to pay more attention to the way the product is stored in the retail network. According to the obtained results, we can conclude that the prescribed instructions on carton packaging fully meet the requirements, since it is stated that the product can be used up to three days after the opening. Our results confirmed the same thing that after the third day we noticed an increase in the number of microorganisms in the product, and because of the reduction of the safety of the product, it is necessary to follow the instructions of the milk producer and not use this milk after the third day of the opening.

References

Anderson M., Hinds P., Hurditt S., Miller P., McGrowder D., Alexander R.L. (2011): The microbial content of unexpired pasteurized milk from selected

- supermarkets in a developing country Asian Pac J Trop Biomed. 1(3): 205–211. doi: [10.1016/S2221-1691(11)60028-2]
- Brodzirak A., Krol J., Zygmunt L., Zaborska A., Crezerncki T. (2017): Effect of storage time under home refrigeration conditions on the quality of opened drinking milk *Mljekarstvo* 67 (4), 283-296;
- Caric M., Milanovich S., Vucelja D (2000): Standardne metode analize mleka i mlecnih proizvoda.
- Consuelo M.V., Vásquez E., Martinez J., Rueda A.M. (2009): Detection of *Listeria monocytogenes* in raw whole milk for human consumption in Colombia by realtime PCR. *Journal of Food Control*, 20(4): 430–432. DOI: 10.1016/j.foodcont.2008.07.007;
- Elrahman SMAA., Ahmed AMEMS., Zubeir IEYME., Owni OAOE, Ahmed MKA. (2013): Effect of storage temperature on the microbiological and physicochemical properties of pasteurized milk. *Annals. Food Science and Technology* 14, 115-121.
- Ledenbach L.H., Marshall R.T. (2010): Microbiological Spoilage of Dairy Products. In: *Compendium of the Microbiological Spoilage of Foods and Beverages*, eds. W.H. Sperber and M.P. Doyle, 41–67;
- Official Gazette of the Republic of Macedonia No. 96/2011;
- Szpakowska M., Tymoszek E. (2011): Investigation of UHT milk freshness after every day opening of its container, during storage in cooling conditions. *Zeszyty Naukowe Uniwersytetu Ekonomicznego w Poznaniu* 196, 162-169;
- Trajkovska B. (2017): Hygiene, control and supervision of animal products (internal script). University St. "Kliment Ohridski", Bitola, Faculty of Biotechnical Sciences, Bitola;
- WHO and FAO (2009): *Codex Alimentarius*.