ESTIMATING SHELF-LIFE OF COTTAGE CHEESE BASED DESSERT PRODUCT

Mohamed Tarek[a], *Zoltán Győri*[b]
[a]Septoclean Bt., H-4531, Nyírpazony, Ifjúság u. 9, Hungary
[b]University of Debrecen, Centre for Agricultural Sciences and Engineering. 4032 Debrecen, Hungary, Böszörményi út 138.
e-mail: tilistyakj@t-online.hu

ABSTRACT

Cottage cheese based dessert samples were stored at three temperature: 10, 12, and 15 °C. Microbial counts were analyzed over time to determine the shelf-life. Mathematical analysis was used to calculate the shelf-life of the products by the mean of regression analysis. From results, examined dessert stored at 10 °C had a nominal shelf-life of 23 days, whereas dessert stored at 12 and 15 °C had a nominal shelf-life of 16 and 7 days.

1. INTRODUCTION

Consumer concern about treats associated with food is growing. Due to recent food crises in Europe, food quality and food safety become a hot topic in mass media. Food safety and food quality is a broader term, which means an assurance that food will not cause harm to the consumer when it is prepared and eaten according to its intended use (Raspor, 2008). Because food is inherently perishable and depending on its physical and chemical properties and the storage conditions, there comes a point when either its quality is unacceptable or it becomes harmful to the consumer. At this point it has reached the end of its shelf-life. The ability to predict the shelf-life is of great value to the food industry when defining storage and distribution conditions and limits, formulating products, assessing manufacturing process and doing quantitative risk assessment. It is important to identify which factors influence the shelf-life of the product.(Gacula and Kubula, 1975, Reichart, 2005) These may be microbiological, chemical or physical factors, the technology, the packaging and the storage conditions.
The use of mathematical models can help to reduce the need for storage trials, challenge tests, product reformulations and process modifications, which are labour intensive, time consuming and expensive.
In food microbiology, mathematical modelling techniques are commonly applied to predict growth or inactivation of spoilage bacteria and foodborne pathogens (Armitage, 1997; Pin and Baranyi, 1999).

In case of dairy products the shelf-life of raw milk depends on the hygiene of fresh milk, subsequent transport and storage conditions. Post heat treatment contamination by Gram negative psychrotrophic bacteria is the major determinant of shelf-life of pasteurized products. In cultured dairy products, yeast and mould contamination is the most usual cause of spoilage.

The aim of our recent study was to determine the shelf-life of cottage cheese based dessert products, which were produced by the determinative, multinational diary factory working in the North-Great Plain region of Hungary. We checked the hygiene level of producer factory and monitored the transportation and storage conditions in the supply chain. We made model experiment of storage at three different temperature to measure the yeast propagation and we calculated the mathematical equation of probability of shelf-life.

2. MATERIALS AND METHODS

Sampling: Checking the keeping of producer's protocol for transportation and storage conditions (in different depots and stores) we repeted sampling 14- times.
For storage model experiment samples of cottage cheese dessert were obtained on the day of production from the factory. Samples were collected, and were immediately stored at 10, 12, and 15°C. Storage temperatures varied ± 1 °C. For each day of sampling, physical-chemical and microbiologyical evaluation were made.
Fat content: The fat content was read from butyrometer vessel.
Total solid content: Total solid content of the sample were determined by using oven drying method. The difference in weight before and after drying for 4 hours at 100 °C gives the results of solid content.
Determination of transportation and storage temperature in depots: During packaging of product in the factory we put mobile, pre-programmed digital thermometers in three different identified product's pack. We placed these packs onto different product-pallets. The variation of temperature was monitored in 3 days. Data were recorded in every five minutes, and recovered with legal software.
Determination of core temperature of the product: we used ET-DM 9258 type manual digital thermometer, measuring were in duplicate.
Determination of *Enterobacteriaceae*: VRBD agar was used for the enumeration of *Enterobacteriaceae*. Plates were incubated at 37°C for 24 h.
Yeast and mould enumeration: YGC Agar was used for yeast and mould enumeration.
Plates were incubated at 25°C for 5 days.
The experiment was repeated 14 times to collect sufficient data for mathematical-statistical analysis.

3. RESULTS AND DISCUSSION

For the first step we checked the hygiene of production process in case of the end-product. We did not detected presence of *Enterobacteriaceae* in any of the samples that means very high level of factory hygine.

We determined the null-point of the shelf-life experiment, the initial chemical and microbiological parameters of samples, shown below in Table 1.
However the results are confirmed to Hungarian laws, we can see that these parameters are very suitable for growing all kinds of examined microorganisms. In case of the cultured milk product the most important quality risk factor is the yeast number. For this reason potassium sorbate is used as preservative substance but it is not suitable enough because of its little effect on yeast at higher pH.

Table 1. Initial chemical and microbiological parameters of examined products

Parameters	Value	SD
pH	5,08	0,178
Dry matter (%)	53,03	0,112
Fat content (%)	8,97	0,072
Enterbacteriaceae (cfu/g)	<10	-
Yeast content (cfu/g)	<100	-
Mould content (cfu/g)	<100	-

We examined the variation of temperature during storage and transportation. Temperature was monitored in every 5 minutes.The results are shown in Table 2. We concluded, that in depots the storage temperature is adequate, but during the transportation the temperature was higher than the allowed maximum value, sometimes it was above 10 °C. The low temperature plays an important role aganist yeast growth in cottage cheese based dessert. The certificated storage temperature (defined by the producer) is between 2 and 10 °C. This low temperature must be applied in the food supply chain (production, transportation and storage).

Table 2. Temperature changing of examined products during storage and transportation.

	Storage temperature (°C) in depots	Transportation temperature (°C) on trucks
Average	3,68	9,65
SD	1,8	2,18

We also studied the core temperatures of cottage cheese based dessert in different shops. The results are shown in Table 3. The core temperature is sometimes above 15°C especially in retail shops.

Table 3. Storage temperature of examined products in various shops

	Average of core temperature (°C)	Standard deviation
Retail shops	13,10	5,47
Supermarket	7,57	1,27
Hypermarket	5,27	0,57

From the results above we can see that sometimes the storage temperature is higher, than the upper limit. This relatively high temperature influences the product shelf-life and may cause consumer complaint, based on typical, unpleasant yeast smell.

To determine the microbiological quality of examined samples we measured the yeast contamination, shown in Table 4. The results indicate that both the incubation temperature and storage period have strong effect on yeast propagation. The counts of yeast increase significantly thoughout the testing period (35 day) when the samples were stored at 10 °C. Samples stored at 12 and 15 °C showed more higher yeast counts throughout storage.

Table 4. Logaritmic values of yeast contamination at different incubation temperature

Days of storage / Incubation temp.	0.	7.	14.	21.	28.	35.
10 °C	1,57	2,80	4,10	5,10	5,10	5,14
12 °C	1,57	3,06	4,44	5,77	5,51	5,51
15 °C	1,57	4,61	6,25	6,04		

We calculated the growth rate of yeast (shown in Table 5.) at different temperatures as $\Delta logN/\Delta t$, where N, as yeast number;
t, as incubation time.

Table 5. Growth rate (Δ logN / Δ t) of yeast in the product at different incubation temperature

	10 °C	12 °C	15 °C
growth rate (1/day)	0,126	0,134	0,361
SD	0,056	0,049	0,074

In this study we aimed to determine the shelf-life of examined products in relation of yeast number. The results are shown in Figure 1. Shelf life were calculated in case of yeast according to the equation :

$$\text{Shelf-life} = (lgN_k - lgN_0)/b,$$

where:

lgN_k, as critical yeast number ($lgN_k = 4{,}0$);
b, as growth rate (1/day);
lgN_0, as initial yeast number.

The critical yeast number was declared by producer.

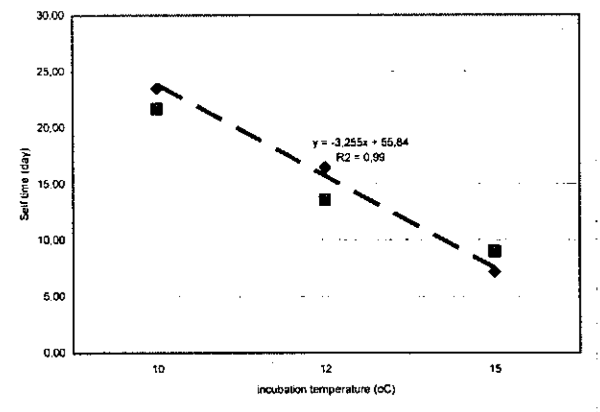

Figure 1. Shelf-life of the samples at different incubation temperatures

4. CONCLUSION

The cultured milk based dessert this type of dessert is the most famous in Hungary and very popular.
In the recent study we measured the chemical and microbiologyical parameters of these dairy products, which were adequate.
We checked the hygiene level of producer factory and we stated that it sufficient to the rules of food safety. We also monitored the transportation and storage condetions in the supply chain, and we concluded that those temperature not always fitted to the temperature specified by the producer.
We made model experiment of storage at three temperature to measure the yeast propagation. Samples were stored at three different temperature: 10, 12, and 15 °C. Microbial counts were analyzed over time. The results indicated that storage (incubation) temperature and storage time have strong effects on yeat propagation. The counts of yeast increase significantly throughout the testing period (35 day) when the samples were stored at 10 °C. Samples stored at 12 and 15 °C showed more higher counts throughout storage.
Mathematical analysis was used also to calculate the shelf-life of the products by the mean of regression analysis. From results, examined dessert stored at 10 °C had a nominal shelf-life of 23 days, whereas dessert stored at 12 and 15 °C had a nominal shelf-life of 16 and 7 days.
In spite of the fact that the producer is responsible for the safety of its products, it is evident that this responsibility has to be shared with transporter, retailer and consumer.

REFERENCES

1. Armitage, N.H (1997): Use of predictive microbiology in meat hygiene regulatory activity. International Journal of Food Microbiology, vol. 36, p. 103-109.
2. Gacula, M. C., Kubula, J. J. (1975): Statistical models for shelf-life failures. Journal of Food Science, p. 4404.
3. Pin, C., Baranyi, J. (1998): Predictive models are means to quantify the interactions of spoilage organisms. International Journal of Food Microbiology, vol. 41., p.59-72.
4. Raspor, P. (2008): Total food chain safety: how good practices can contribute?. Trends in Food Science & Technology, vol. 19. p. 405-412.
5. Reichart, O. (2005): Kísérlettervezés és értékelés a mikrobiológiai gyakorlatban. Jegyzet. Budapest, or http://www.muszeroldal.hu/measurenotes/reichardtcikk.pdf