Microbiological Quality of UHT Milk Consumed in Turkey

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This investigation was aimed to determine the microbiological control of UHT milk sold in the cities of Bitlis, Van, and Hakkari in Turkey. A total of 75 UHT milk samples from different sale points were analyzed for the microbiological control. Sampling was based on the double collection of 15 various serial coded UHT milk from each 5 different milk trades. For the control of sterilization, total aerobic mesophilic microorganism counts (TABM) were performed on Milk Plate Count Agar at 30ºC for 15 days of incubation. The aerobic mesophilic microorganisms were not detected in any samples of A, B, C, and D trades, whereas the maximum counts of 2.04 $\log_{10}$ CFU/g and mean of 1.05 $\log_{10}$ CFU/g for TABM were detected in the samples of E. Furthermore, 6.67% of samples belonging to the E trade did not comply with the Turkish Food Codex. This was due to the differences of pH values above 0.5 and the counts of $> 10^2$ observed in pre and post incubation period. To conclude, majority of UHT milk samples from different trades did not include microorganisms. On the other hand, considering the samples which do not comply with the standards, it is essential to choose a good quality of milk used in the preparation of UHT milk as well as the regular monitoring of the microbiological quality of UHT milk for taking necessary precautions.

Key words: UHT, milk, microbiological, quality

Milk is a vital component of human nutrition. It is very essential source of Ca, P, riboflavin, vitamin B12, and high quality proteins even though not containing all the nutrition requirements needed in human nutrition. Moreover, it is one and only food sufficiently processing most of the nutrition components required for the energy, and structural and biochemical process of the body. (Guner & Tekinsen, 2003). With this in mind, unbalanced and insufficient feeding is one of the significant problems in the world, as well as in Turkey. (Aral *et al*., 1979; Yazicioglu, 1982). Necessity of the milk in nutrition has been amply documented (Kon, 1972; Tolgay, 1972; Tekinsen, 1973; Oysun, 1976; Inal & Ergun, 1990; Demirci, 1996; Metin, 1998). Consuming milk through drinking is the most effective way of profiting from it. Some components present in the milk are not sufficiently found in the milk products (Tekinsen & Tekinsen, 2005).

Nearly, 20% of the milk in Turkey is drunk as is (Tekinsen & Tekinsen, 2005). In recent years, 293,084 ton drinking milk has been produced and 131,105 ton being sterilized (DPT, 2001). Likewise, nearly 150 kg drinking milk is consumed in developed countries yearly while this value is approximately 24 kg, being 6 fold less in Turkey (Tekinsen & Tekinsen, 2005). However, this seems to be on the rise since the capacity and number of milk producing businness has been increasing and effective education programmers on milk consumption have been introduced to public.

In UHT milk, some faults might be seen due to the usage of microbiologically or physio-chemically abnormal raw milk and improper processing. Although several studies (Alfa, No date; Food Agriculture Organization, 1965; Burton, 1972; IDF, 1972; Gonc & Renner, 1979; Ashton, 1981; Robinson, 1986) have been reported on the microbiological control and processing technique of the UHT milk all over the world, very few studies have been done in Turkey yet (Uraz *et al.*, 1981; Yavuz, 1997; Yetisemeyen, 1997; Metin, 1998; Tekinsen & Tekinsen, 2005). Therefore, this paper documented the microbiological contents and sterilization control of the UHT milk samples consumed in some Turkish cities including Bitlis, Van, and Hakkari.

MATERIAL AND METHODS

Double samples from five different companies were obtained in retails stores in Bitlis, Van, and Hakkari in March-June of 2003. A number of 75 liter milk packages were brought to the laboratory (TSE, 1999).

Sterilization control. pH value of the each samples was determined at 25 ± 1ºC with pH meter (Precisa pH 900) by the following; One of the each sample before the incubation and the other after the incubation in its original package at 30ºC for 15 days (TSE, 2001).

Total aerobic mesophiles microorganisms were counted. It was performed on the samples incubated at 30ºC for days (Anon, 2000; TSE, 2001).

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10^{-1} diluted samples were prepared in sterile bags at stomacher (Bag mixer, Interscience), and the other dilutions up to 10^{-3} in 0.1% sterile buffered pepton water (Merck, 1.07228) (Harrigan 1998), the dilutions were then inoculated onto the Milk plate count agar (Plate count agar with antibiotic free skim milk). The plagues observed were incubated at 30C $\pm$ 1ºC for 72 h. The colonies occurred were finally counted by the indicated method (Bridson 1998).

Statistical analysis. Statistical analyses were done by SPSS, and descriptive statistical values of the data were determined by the indicated method (Ozdamar, 1997).

RESULTS

Table 1.1. pH values of the UHT milk samples before the incubation.

Sample		pH				
Company	n	$\bar{x}$	$S\,\bar{x}$	S	Min	Max
A	15	6.810	0.0029	0.0113	6.78	6.82
B	15	6.809	0.0025	0.0096	6.79	6.82
C	15	6.813	0.0021	0.0080	6.80	6.82
D	15	6.813	0.0023	0.0090	6.80	6.82
E	15	6.803	0.0021	0.0082	6.79	6.82

$\bar{x}$: Mean, $S\,\bar{x}$: Standard error, S : Standard deviation

Table 1.2. pH values of the UHT milk samples after 15 days at 30 °C of incubation

Sample		pH					Positive sample*	
Company	n	$\bar{x}$	$S\,\bar{x}$	S	Min	Max	n	%
A	15	6.791	0.0027	0.0103	6.77	6.80	-	-
B	15	6.791	0.0019	0.0074	6.78	6.80	-	-
C	15	6.793	0.0025	0.0096	6.77	6.80	-	-
D	15	6.794	0.0024	0.0091	6.78	6.80	-	-
E	15	6.728	0.0364	0.1411	6.22	6.79	1	6.67

x: Mean , $S\,\bar{x}$: Standard error, S : Standard deviation
* : pH difference > 0.5 before and after the incubation

pH values of the UHT milk samples before and after 15 days at 30ºC of incubation were displayed in table 1.1, and table 1.2. As seen in Table 1.1 and Table 1.2, pH values of the samples from the companies A,B,C, and D did not show differences bigger than 0.5 before and after the incubation. However, there was difference bigger than 0.5 in the pH values of the 6.67% of the samples from E company between the values before and after the incubation.

Table 2. Counts results of the total aerobic mesophiles microorganism in the UHT milk samples.

Sample		Count of microorganism (Log_{10} cfu/ml)				
Company	n	$\bar{x}$	$S\,\bar{x}$	S	Min	Max
A	15	0.00	0.00	0.00	0.00	0.00
B	15	0.00	0.00	0.00	0.00	0.00
C	15	0.00	0.00	0.00	0.00	0.00
D	15	0.00	0.00	0.00	0.00	0.00
E	15(2)	1.05	0.91	1.50	0.00	2.04

$\bar{x}$: Mean, $S\,\bar{x}$: Standard error , S : Standard deviation
( ) number showing the positive samples.

Count results of the total aerobic mesophiles microorganism in the UHT milk samples incubated at 30 ºC for 15 days were displayed in table 2. Frequency distribution was also shown in table 3.
As displayed in table 2 and 3, there was no aerobic mesophilic microorganism detected in the samples of the companies A,B,C, and D. On the other hand, two samples of the company E were positive for the aerobic mesophilic microorganism. The numbers were 11-100 in the 6.67% and 101-1000 CFU/ml in the 6.67 of the samples.

Table 3. Frequency distribution of the total aerobic mesophilic microorganism in the UHT milk samples.

Counts (cfu/ml)	Company				
	A	B	C	D	E
0	15 (100)	15 (100)	15 (100)	15 (100)	13 (86.7)
1 - 10	- -	- -	- -	- -	- -
11 - 100	- -	- -	- -	- -	1 (6.67)
101 - 1000	- -	- -	- -	- -	1 (6.67)

( ) shows the % of the sample number

DISCUSSION

In this study, the sterilization control and the number of the total aerobic mesophilic microorganism were determined in the UHT milk consumed in Bitlis, Van, and Hakkari. The results hereby are significant contributions on determining microbial quality of the UHT milk consumed in Turkey.
In UHT sterilization methods, performing the effective heating process in closed arrangements provides very high bactericide effect, and using aseptic package systems

decreased the contamination risk down to the zero (Burton 1983, Yetişmeyen 1997, Tekinşen ve Tekinşen 2005). On the other hand, several researches (Uraz *et al.* 1981, Burton 1983, Yetismeyen 1997, Metin 1998, Tekinsen & Tekinsen 2005) indicate that sensorial, chemical and, particularly microbiological qualities of the UHT milk under process affect directly the quality of the final products. Because of that, milk under process for the UHT milk should have very high quality characteristics. Just as, Food Codex (Anon, 2000) indicates the total number of the bacteria in the milk used in the production of drinking milk to be 300.000 per ml at most.

Turkish Standard Institution (TSE, 2001) indicates in UHT milk that, in sterilization controls, the difference in pH values and after the incubation (at 30ºC for 15 days or at 55ºC for 7 days) should be lower than 0.5. Additionally, Food Codex (Anon, 2000) suggests that the number of total alive bacteria should be 10 or less in 0.1 ml after 15 days of incubation at 30ºC. As can be seen in Table 1.2, the samples from A,B,C, and D companies reach the legal criteria whereas the data obtained from the samples of the E company have not complied with the food codex criteria, as shown in table 3.

In the study, the difference in pH values before and after the incubation during the UHT process, which is an important criterion in microbiological control, was higher than 0.5 in the 6.67% of the samples from E company (table 1.2). Thus, the number of the total aerobic mesophilic microorganism was 11-100 in 6.67%, and 101-1000 CFU/ml in 6.67% in the same samples. This was probably due to either low microbiological quality of the milk under process and/or contamination after heating process, as was suggested by several report (Uraz *et al.* 1981, Burton 1983, Yetismeyen 1997, Metin 1998, Tekinsen & Tekinsen 2005)

Consequently, most of the UHT milk samples from different companies have been shown not to aerobic mesophilic microorganism. However, since the samples of one company were determined to be positive, it is of importance to conclude that milk in the first should be chosen of extreme care, and microbiological controls should be done more frequently on the chosen milk for the UHT milk.

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