U. of K. J. Agric. Sci. 20(3), 347-361, 2012

Some Quality Measures of Pasteurized Milk Produced in Khartoum State, Sudan

Mohamed Osman Mohamed Abdalla and Raniya Adam Mahdi Tarik

Department of Dairy Production, Faculty of Animal Production, University of Khartoum, Shambat, Postal Code 13314, Sudan

Abstract: This study was conducted to evaluate the quality of pasteurized milk which is produced in three dairy plants in Khartoum State during a storage period of 10 days. Forty- five samples of pasteurized milk were randomly collected from three different plants (A, B and C) to determine the chemical composition {fat, protein, solids-non-fat (SNF), lactose, acidity and density} and microbiological quality {total viable bacteria (TVB), coliform bacteria and psychroptrophic bacteria counts} at 1, 4, 6, 8 and 10-day intervals. The results showed that fat, protein, lactose, density and acidity were significantly affected by the source of milk, while SNF was not affected. Coliform and psychrotrophic bacteria counts were significantly affected by the plant from which the milk samples were collected, whereas TVB was not affected. During the storage period, fat content decreased, while protein, density and acidity increased, and SNF and lactose contents did not significantly change. Coliform bacteria count decreased, while psychrotrophic bacteria count increased, and no significant change was obtained for total viable bacteria (TVBC) count.

Key words: Pasteurized milk; storage period; quality; dairy plants

INTRODUCTION

Milk is an important diet for the majority of the human population due to its high nutritional value. However, it is an excellent growth medium for microbial growth. If milk is produced unhygienically and handled carelessly, it gets contaminated very easily leading to its early spoilage (Chatterjee *et al*. 2006).

Milk is sold as raw through different traditional channels which result in poor quality of milk. Therefore, pasteurized milk is becoming the product of choice for the majority of consumers in Khartoum State due to its good quality compared with that distributed as raw. However, the quality of pasteurized milk should be checked frequently in order to correct any practices that lead to quality deterioration.

Pasteurization is a thermal process widely used in the dairy industry to minimize health hazards from pathogenic microorganisms and to prolong the shelf life which should not exceed 4 days if preserved at temperature lower or equal to 10ºC (SSMO 2007). Prolonging the storage of raw milk before pasteurization results in increasing the psychrotrophic, lipolytic and proteolytic bacteria which produce enzymes and cause changes in the milk, leading to problems in processing the milk and in the quality of its products (Burdova *et al*. 2002).

In the dairy industry, the presence of total and faecal coliforms indicates either contamination of faecal origin or technological or hygienic failure. The presence of faecal coliforms usually indicates recent faecal contamination, since these bacteria cannot survive away from the intestine for a long time and their number is generally proportional to the degree of contamination produced by faeces (Aggad *et al*. 2010).

The sources of contamination of the heat-treated milk are time and temperature combination, presence and activity of post pasteurization contaminants, types and activity of resistant microorganisms, the storage temperature of milk after heat treatment and poor seal or pinhole in the container (El Zubeir *et al*. 2007; Hassan *et al*. 2009).

Elmagli and El Zubeir (2006) reported that pasteurized milk distributed in Khartoum State is of low quality in terms of total bacteria, coliform counts and the presence of *E. coli*. They suggested the following measures to improve the quality of pasteurized milk: regular examination of factories, good standards of raw milk, adoption and implementation of

quality control measures in the dairy plants, prevention of post pasteurization contamination and implementation of quality assurance programme by the official authorities.

The aim of this study was to evaluate the quality of pasteurized milk produced and distributed in Khartoum State and to determine its shelf life.

MATERIALS AND METHODS

Source of milk samples

Forty-five pasteurized milk samples were randomly collected from three different plants, two (A and B) are located in Khartoum State, and one (C) in Kenana area, 300 km south of Khartoum. Milk samples from plants A and B were collected directly from the plants immediately after manufacture, while samples from plant C were collected from groceries in Khartoum on the day of arrival which was the same day of manufacture. Milk from plants A and C was packed in polyethythene bags, and milk from plant B was packed in cartons. One litre milk samples were collected and stored in ice bags at 5°C and transported to the laboratory for analysis. On arrival at the laboratory, the samples were stored at 5°C and chemical and microbiological testing was carried out at 1, 4, 6, 8 and 10 day intervals.

Chemical analysis

The samples were analyzed for fat, protein, solids-non-fat, lactose and density by Lactoscan Milkanalyser 90 (Aples Industries Services, France). The machine was calibrated according to the manufacturer's instructions. The temperature of milk was brought to 20°C, followed by mixing gently for 5 minutes to homogenize, and 25 ml were transferred into the sample holder for analysis. The results were read on the screen. The titratable acidity was determined according to AOAC (2000).

Microbiological examination

Serial dilutions were prepared (Houghtby *et al*. 1992) by adding a homogeneous sample (11 ml) to a sterile 99 ml peptone water (Scharlau Chemie S.A., Barcelona, Spain) to make 10^{-1} dilution. From the dilution (10^{-1}), 1 ml was transferred to a sterile test tube containing 9 ml sterile

peptone water to make 10^{-2} dilution, and this process was continued to make serial dilutions. From the appropriate dilution, 1 ml was transferred into a sterile Petri dish, and the medium was added.

Total viable bacteria count was determined by the pour plate method using plate count agar (Scharlau Chemie S.A., Barcelona, Spain); the plates were incubated at 32±1°C for 48 hrs, and the colonies were counted. Coliform bacteria count was determined using MacConkey agar medium (Scharlau Chemie S.A., Barcelona, Spain), incubated at 32±1°C for 24 hrs and the typical colonies were counted (Christen *et al*. 1992). Psychrotrophic bacteria count was determined using plate count agar medium, incubated at 7±1°C for 10 days and colonies were counted (Frank *et al.* 1992). Typical colonies on MacConkey agar (coliform bacteria) and plate count agar (psychrotrophic bacteria) were picked, and biochemical tests were carried out according to Barrow and Feltham (1993).

Statistical analysis

Statistical Package for Social Sciences (SPSS ver. 16.0) was used to analyze the data, and mean separation was carried out using Duncan multiple range test at $P \leq 0.05$.

RESULTS AND DISCUSSION

Chemical composition of pasteurized milk

All chemical components of pasteurized milk were significantly affected by the plant from which the samples were collected except for solids-non-fat (SNF). The fat content was high in milk from plant B (4.27%), protein content was high in milk from plant C (3.23%) and lactose was high (4.45%) in milk from plant A. The density was high in milk from plant C, and the acidity was high in milk from plants A and B (Table 1). During the storage period of 10 days, fat content significantly decreased after day 4, while protein content, density and acidity significantly increased (Table 2). The density of milk from plant A significantly decreased at day 4, before slightly increasing towards the end, while fat, protein, SNF and lactose contents were not significantly affected.

Table 1. Initial chemical composition and microbiological count (Log_{10} cfu/ml) of pasteurized milk from plants A, B and C

Parameter	Dairy plant			S.E. ±	S.L.	SSMO standard
	A	B	C			
Fat (%)	4.23[a]	4.27[a]	3.55[b]	0.011	***	≥3.0
Protein (%)	3.17[b]	3.18[b]	3.23[a]	0.001	***	N.A.
Solids-non-fat (%)	8.14[a]	8.14[a]	8.31[a]	0.002	N.S.	≥8.5
Lactose (%)	4.45[a]	4.28[c]	4.38[b]	0.038	**	N.A.
Density	1.0281[b]	1.0280[b]	1.0291[a]	0.074	***	N.A.
Acidity (%)	0.200[a]	0.200[a]	0.190[b]	0.002	***	≤0.18
Total viable bacteria	9.21[a]	9.05[a]	9.15[a]	0.084	N.S.	4.7
Coliform bacteria	8.17[a]	7.84[b]	6.96[c]	0.019	***	nil
Psychrotrophic bacteria	6.00[a]	5.79[a]	3.46[b]	1.380	***	N.A.

Means in each row bearing the same superscript are not significantly different (P>0.05).
***: P=0.001
**: P=0.01
N.S. = Non significant (P>0.05)
S.E. = Standard error
S.L. = Significance level
N.A. = Not available

Table 2. Effect of storage period on the chemical composition and microbiological quality (Log_{10} cfu/ml) of pasteurized milk (as a mean of the three plants)

Parameter	Storage period (days)					S.E. ±	S.L.
	1	4	6	8	10		
Fat (%)	4.02[b]	4.10[a]	4.01[b]	4.01[b]	4.01[b]	0.011	*
Protein (%)	3.19[b]	3.20[b]	3.21[b]	3.27[a]	3.29[a]	0.001	***
Solids-non-fat (%)	8.20[a]	8.21[a]	8.21[a]	8.36[a]	8.38[a]	0.002	N.S.
Lactose (%)	4.37[a]	4.28[a]	4.35[a]	4.37[a]	4.39[a]	0.038	N.S.
Density	1.028[b]	1.028[b]	1.029[a]	1.029[a]	1.029[a]	0.074	***
Acidity (%)	0.20[b]	0.22[b]	0.24[b]	0.53[a]	0.63[a]	0.002	***
Total viable bacteria	9.14[a]	9.10[a]	9.14[a]	9.10[a]	9.04[a]	0.019	N.S.
Coliform bacteria	7.66[a]	7.61[a]	7.28[b]	7.39[b]	7.38[b]	0.084	***
Psychrotrophic bacteria	5.08[e]	.68[d]	6.27[c]	6.87[b]	7.09[a]	1.380	***

Means in each row bearing the same superscript are not significantly different (P>0.05).
***: P=0.001
* : P=0.05
N.S. = Non significant (P>0.05)
S.E. = Standard error of means
S.L. = Significance level

The acidity increased significantly from 0.2% at the beginning to 1.03% at the end of storage. The protein content of plant B significantly increased towards the end, while SNF significantly decreased to a minimum at day 6, then increased thereafter. The density showed no

significant change till day 6 and then slightly increased. The acidity significantly increased with time. The fat content of plant C significantly increased till day 4, then gradually decreased, and density was constant till day 6 followed by a slight increase towards the end. The acidity significantly increased towards the end (Table 3). The Sudanese standard for pasteurized milk (SSMO 2007) specifies that pasteurized milk should have fat content of not less than 3.0%, solids-non-fat (SNF) content of not less than 8.5% and acidity (expressed as percentage of lactic acid) of not more than 0.18% (Table 1).

The fat content of milk samples collected from the three dairy plants satisfied SSMO standards. It was higher than that reported by El Zubeir *et al.* (2007) for pasteurized milk (2.868%) in Western Cape, South Africa, by Hassan (2008) for low pasteurized (LP) milk (3.23%) and high pasteurized (HP) milk (3.17%) and by Hossain *et al.* (2011) for liquid pasteurized milk in Bangladesh (3.34%-3.72%). During the storage period, the fat content slightly decreased, and this is in agreement with the findings of Hassan (2008) for LP and HP milk.

The protein content is similar to that reported by Hossain *et al*. (2011) and Hassan (2008), and higher than that of El Zubeir *et al.* (2007) and Shojaei and Yadollahi (2008). The increasing trend of protein content during storage period is in disagreement with Hassan (2008) who found a decreasing trend of protein which was attributed to the proteolytic enzyme activity.

The lactose content is slightly higher than that reported by El Zubeir *et al.* (2007) and Hassan (2008) and lower than that of Hossain *et al*. (2011). During the storage period, lactose content decreased at day 4 and then increased towards the end. This is in disagreement with the findings of Hassan (2008) who reported a regular decreasing trend of lactose.

SNF content of milk from plants A and B did not comply with SSMO (2007), and only 40% of the samples from plant C (13% of the total samples) complied with the standard (data not shown). SNF was higher than that of Hossain *et al.* (2011) for pasteurized milk in Bangladesh (5.83%-7.60%) and El Zubeir *et al.* (2007) for pasteurized milk in Western Cape (6.09%).

The density of milk is inversely proportional to the fat content, so skimmed milk can have a density of more than 1.036 at 20ºC (Aggad *et al*. 2010) . The values in this study are within the range of whole milk, supporting the fact that the dairy plants under study use whole milk for pasteurized milk manufacture. Aggad *et al.* (2010) stated that the mean density of pasteurized milk in Algeria is 1.028; they found that 43% of the surveyed samples were not satisfactory for density. They attributed the reduction in density to damping to increase volume, dairy cow feed or fraud by exaggerated dilution of the powder used for the preparation of milk.

The acidity of milk was 0.20%, and only 40% of the samples from plant C (13% of total samples) satisfied SSMO (2007) (data not shown). Aggad *et al.* (2010) found that 28% of the samples tested were not satisfactory and that the mean acidity of milk was 0.1837. Shojaei and Yadollahi (2008) reported lower acidity of pasteurized (0.16%) and ultra high temperature (0.15%) milks in Iran. The acidity steadily increased during the storage period due to the growth of lactic acid bacteria converting lactose into lactic acid. Milk acidity is an indicator of quality of milk at delivery, and its increase is indicative of microbial growth (Hassan 2008).

Microbiological quality of pasteurized milk

The microbiological quality of milk from different plants showed that, while no significant variation in TVBC was obtained between plants, coliform bacteria and psychrotrophic bacteria counts were higher in plant A (Table 1). TVBC was not significantly affected by the storage period, while coliform bacteria count significantly decreased to a minimum at day 6, before slightly increasing towards the end of storage. Psychrotrophic bacteria count significantly increased during storage reaching a maximum at day 10 (Table 2). Coliform bacteria count in plant A fluctuated during the storage period showing the lowest decrease at days 6 and 10, while in plant C the count increased at day 4 followed by a slight decrease at day 6 before steadily increasing towards the end. Psychrotrophic bacteria count in plant C significantly increased during the storage period (Table 4).

Table 3. Chemical composition (%) of pasteurized milk from three plants during storage

Parameter	Storage period (days)					S.L.
	1	4	6	8	10	
			Plant A			
Fat	4.23^{a}	4.24^{a}	4.24^{a}	4.24^{a}	4.25^{a}	N.S.
Protein	3.17^{a}	3.18^{a}	3.18^{a}	3.19^{a}	3.20^{a}	N.S.
Solids-non-fat	8.14^{a}	8.09^{a}	8.12^{a}	8.11^{a}	8.12^{a}	N.S.
Lactose	4.45^{a}	4.13^{a}	4.36^{a}	4.19^{a}	4.17^{a}	N.S.
Density	1.028^{a}	1.027^{b}	1.028^{a}	1.028^{a}	1.028^{a}	***
Acidity	0.20^{c}	0.227^{c}	0.248^{c}	0.800^{b}	1.03^{a}	***
			Plant B			
Fat	4.27^{a}	4.29^{a}	4.19^{a}	4.31^{a}	4.28^{a}	N.S.
Protein	3.18^{b}	3.18^{b}	3.19^{b}	3.36^{a}	3.41^{a}	***
Solids-non-fat	8.14^{b}	8.19^{b}	8.15^{b}	8.57^{a}	8.62^{a}	***
Lactose	4.28^{a}	4.30^{a}	4.29^{a}	4.52^{a}	4.54^{a}	N.S.
Density	1.028^{b}	1.028^{b}	1.028^{b}	1.030^{a}	1.030^{a}	***
Acidity	0.200^{b}	0.217^{b}	0.225^{b}	0.430^{a}	0.487^{a}	***
			Plant C			
Fat	3.55^{b}	3.75^{a}	3.59^{ab}	3.47^{b}	3.49^{b}	***
Protein	3.23^{a}	3.25^{a}	3.28^{a}	3.26^{a}	3.27^{a}	N.S.
Solids-non-fat	8.31^{a}	8.35^{a}	8.35^{a}	8.40^{a}	8.42^{a}	N.S.
Lactose	4.38^{a}	4.40^{a}	4.38^{a}	4.43^{a}	4.46^{a}	N.S.
Density	1.029^{b}	1,029^{b}	1.029^{b}	1.030^{a}	1.030^{a}	***
Acidity	0.19^{b}	0.202^{b}	0.255^{ab}	0.347^{a}	0.360^{a}	***

Means within each row bearing the same superscripts are not significantly different (P>0.05).

***: P=0.001

N.S. = Non significant (P>0.05)

S.L. = Significance level

Table 4. Microbiological quality (Log_{10} cfu/ml) of pasteurized milk from three plants during storage

Parameter	Storage period (days)					S.L.
	1	4	6	8	10	
				Plant A		
Total viable bacteria	9.21[a]	9.19[a]	9.16[a]	9.07[a]	9.03[a]	N.S.
Coliform bacteria	8.17[a]	7.62[ab]	7.46[b]	7.55[b]	7.44[b]	***
Psychrotrophic bacteria	6.00[a]	6.18[a]	6.43[a]	6.63[a]	7.22[a]	N.S.
				Plant B		
Total viable bacteria	9.05[a]	9.05[a]	9.13[a]	9.14[a]	9.15[a]	N.S.
Coliform bacteria	7.84[a]	7.60[a]	7.58[a]	7.64[a]	7.54[a]	N.S.
Psychrotrophic bacteria	5.79[a]	6.21[a]	6.97[a]	7.16[a]	7.21[a]	N.S.
				Plant C		
Total viable bacteria	9.15[a]	9.07[a]	9.14[a]	9.08[a]	9.00[a]	N.S.
Coliform bacteria	6.96[b]	7.61[a]	6.81[b]	6.97[b]	7.18[ab]	***
Psychrotrophic bacteria	3.46[b]	4.66[b]	5.40[b]	6.83[a]	6.83[a]	*

Means within each row bearing the same superscripts are not significantly different (P>0.05).

***: P=0.001

* : P=0.05

N.S. = Non significant (P>0.05)

S.L. = Significance level

High total bacterial count was obtained in pasteurized milk of the three dairy plants (Log 9.05-9.21cfu/ml). The results are far below those reported by Elmagli and El Zubeir (2006) who found a total bacteria count of $7.9x10^{13}$ cfu/ml in pasteurized market milk in Khartoum. Aggad *et al.* (2010) reported that 25% of pasteurized milk samples tested was not satisfactory, and that the mean aerobic mesophilic flora was $16.3x10^{4}$ cfu/ml. The high total bacterial count may be attributed to insufficient hygiene at milking, during collection and transport, insufficient industrial treatment (Aggad *et al*. 2010), microbial quality of raw milk, post pasteurization contamination, storage conditions of milk after processing or due to improper packaging of milk (Elmagli and El Zubeir 2006). Hassan *et al.* (2009) reported low total bacterial level in HP and LP milk which significantly increased during storage of 30 days. Likewise, Shojaei and Yadollahi (2008) reported low total bacterial count of $71x10^{4}$ cfu/ml in pasteurized milk.

Coliform bacteria count was high and increased during the storage period; it was far below that reported by Elmagli and El Zubeir (2006) for pasteurized milk ($4.23x10^{11}$ cfu/ml). The high level of coliform bacteria may be attributed to improper handling and/or poor cleaning and storage of the equipment (Elmagli and El Zubeir 2006). None of the samples from the three dairy plants satisfied SSMO (2007). Chatterjee *et al*. (2006), in India, found that out of 10 pasteurized milk samples tested for coliform bacteria, 7 samples had low coliform count. The presence of total coliforms is an indication of contamination of faecal origin or due to technological or hygienic failure (Aggad *et al.* 2010).

The high psychrotrophic bacteria count may be due to storage conditions (Elmagli and El Zubeir 2006). The contamination of psychrotrophic bacteria is a detrimental factor for extending the shelf life (He *et al*. 2010). The results of this study are not in line with those reported by Elmagli and El Zubeir (2006) who found a mean psychrotrophic count of $7.5x10^{13}$ cfu/ml. Kumaresan and Villi (2008) reported that the psychrotrophic bacteria count of 8 brands of pasteurized milk samples

ranged between Log 3.35 and 3.91 cfu/ml, and that the laboratory pasteurized samples had the lowest psychrotrophic count of Log 0.41 cfu/ml. Burdova *et al*. (2002) reported a psychrotrophic count in pasteurized full cream or skimmed milk to be in the range of Log 6.8388 and Log 8.3594 cfu/ml, depending on the storage temperature and temperature under which milk was kept before storage. It is to be noted that psychrotrophic bacteria count significantly increased during storage due to favourbale storage conditions, since psychrotrophic bacteria survive under refrigerator temperature (7ºC or less) representing a causative agent of spoilage (He *et al*. 2010).

CONCLUSION

It is necessary to improve the production and processing methods of pasteurized milk by the dairy plants. The Sudanese Standards and Metrology Organization (SSMO) should take more responsibility to control and reduce the risk of contamination of milk during production and subsequent processing.

REFERENCES

Aggad, H.; Bridja, M.; Aek, B.; Benaouali, M. and Djebli, A. (2010). Some quality aspects of pasteurized milk in Algeria. *World Journal of Dairy and Food Sciences* 5(1), 21-24.

AOAC (2000). *Official Methods of Analysis*, 17th Edition. AOAC International, Gaitherburg, MD, U.S.A, Official Methods 920.124, 926.08, 955.30, 2001.14. Association of Official Analytical Chemists (AOAC), U.S.A.

Barrow, G.I. and Feltham, R.K.A. (1993). *Manual for the Identification of Medical Bacteria*, 3rd edition. Cambridge University Press, Cambridge, U.K.

Burdova, O.G.; Baranova, M.; Laukova, A.; Rozanska, H. and Rola, J.G. (2002). Hygiene of pasteurized milk depending on psychrotrophic microorganisms. *Bulletin of Veterinary Institue Pulawy* 46, 325-329.

Chatterjee, S.N.; Bjattacharjee, I.; Chatterjee, S.K. and Chandra, G. (2006). Microbiological examination of milk in Tarakeswar, India, with special reference to coliforms. *African Journal of Biotechnology* 5(15), 1383-1385.

Christen, G.L.; Davidson, P.M.; McAllister, J.S. and Roth, L.A. (1992). Coliform and other indicator bacteria, pp. 247-269. In: *Standard Methods for the Examination of Dairy Products*, 16th edition. R.T. Marshal (Edt.). Washington, D.C.: American Public Health Association.

Elmagli, O.A.A. and El Zubeir, E.M.I. (2006). Study on the hygienic quality of pasteurized milk in Khartoum State (Sudan). *Research Journal of Animal and Veterinary Sciences* 1(1), 12-17.

El Zubeir, E.M.I.; Gabriechise, V. and Johnson, Q. (2007). Study on some quality control measures of pasteurized milk of the Western Cape, South Africa. *International Journal of Dairy Science* 2(4), 372-379.

Frank, F.J.; Christen, L.G. and Bullerman, L.B. (1992). Tests for groups of microorganisms, pp. 271-286. In: *Standard Methods for the Examination of Dairy Products*, 16th edition. R.T. Marshal (Edt.). Washington, D.C.: American Public Health Association,

Hassan, B.A.N. (2008). *Effect of Heat Treatment and Storage Conditions on the Quality of Cow Milk*. M.Sc. thesis. University of Khartoum, Sudan.

Hassan, B.A.N.; Abdalla, M.O.M. and Nour, M.A.A. (2009). Microbiological quality of heat-treated milk during storage. *Pakistan Journal of Nutrition* 8(12), 1845-1848.

He, H.; Li, Y.; Castro, L.A.; Dong, J. and Lee, C.N. (2010). Microbiological quality of pasteurized milk in Hawai'i. *Pacific Agriculture and Natural Resources* 2, 20-25.

Hossain, T.J.; Alam, M.K. and Sikdar, D. (2011). Chemical and microbiological quality assessment of raw and processed liquid market milk of Bangladesh. *Continental Journal of Food Science and Technology* 5(2), 6-17.

Houghtby, A.G.; Maturin, L.J. and Koenig, K.E. (1992). Microbiological count methods, pp. 213-246. In: *Standard Methods for the Examination of Dairy Products*, 16th edition. R.T. Marshal (Edt.). Washington, D.C.: American Public Health Association.

Kumaresan, G. and Villi, A.R. (2008). Incidence of *Pseudomonas* species in pasteurized milk. *Tamilnadu Journal of Veterinary and Animal Sciences* 4(2), 56-59.

Shojaei, Z.A. and Yadollahi, A. (2008). Physicochemical and microbiological quality of raw pasteurized and UHT milks in shops. *Asian Journal of Scientific Research* 1(5), 532-538.

SSMO (2007). Pasteurized milk. Sudanese Standard No. 189. Sudanese Standards and Metrology Organization (SSMO), Khartoum, Sudan

مجلة جامعة الخرطوم للعلوم الزراعية : المجلد العشرين - العدد الثالث ، 2012م

بعض معايير الجودة للبن المبستر المنتج بولاية الخرطوم- السودان

محمد عثمان محمد عبدالله و رانيا آدم مهدي تارك

قسم انتاج الألبان - كلية الانتاج الحيواني، جامعة الخرطوم
شمبات - الرمز البريدي 13314 – السودان

المستخلص: اجريت هذه الدراسة لتقييم جودة اللبن المبستر المنتج بولاية الخرطوم خلال فترة تخزين قدرها عشرة ايام. جمعت 45 عينة من اللبن المبستر عشوائيا من ثلاثة مصانع (أ، ب، ج) لتحديد التركيب الكيميائي (نسبة الدهن، البروتين، الجوامد غير الدهنية، اللاكتوز، الكثافة، الحموضة العيارية) والجودة الميكروبية (العد الكلي للبكتيريا الحية، بكتيريا القولون، البكتيريا المحبة للبرودة) في الأيام 1 و4 و6 و8 و10. أوضحت النتائج ان نسبة الدهن والبروتين واللاكتوز والكثافة والحموضة تأثرت معنويا بمصدر اللبن المبستر (المصنع الذي انتج اللبن)، بينما لم تتأثر الجوامد غير الدهنية. تأثرت بكتيريا القولون والبكتيريا المحبة للبرودة بمصدر اللبن ولم يتأثر العدد الكلي للبكتيريا الحية. خلال فترة التخزين نقصت نسبة الدهن، بينما زادت نسبة البروتين والكثافة والحموضة، ولم يتغير معنويا محتوي الجوامد غير الدهنية واللاكتوز. نقص عدد بكتيريا القولون خلال فترة التخزين، بينما زاد عدد البكتيريا المحبة للبرودة ولم يتأثر العدد الكلي للبكتيريا الحية بفترة التخزين.