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EFFECT OF STORAGE PERIOD ON THE CONTENT OF FULL AND LOW FAT PASTEURIZED COW'S MILK

AlTamim, Ebtehal A.
Nutrition & Food Science Department, Home Economics College, Princess Noura Bint Abdulrahman University, Riyadh, Saudi Arabia

ABSTRACT

Pasteurized milk samples packaged in 2 liter plastic containers were collected from four factories in Riyadh city, named(1- A) ,(2-A) ,(3- A), and (4-A)for full fat milk and(1- B) ,(2-B),(3- B) , and(4- B) for low –fat milk. All samples were stored in the refrigerator at 4°C for 1, 3 and 8 days of production. Effect of refrigeration storage on the chemical composition of full and low – fat milk was followed. Vitamins (A) and Vitamin (D) contents were also determined in all samples during the same storage period. Effect of refrigeration storage was quite clear. Protein ,fat ,total solids and solids-not fat as well as vitamins (A) and (B) significantly decreased as the storage period progressed. Some samples were free from vitamins (D). so , consumption of pasteurized milk in the first days of production is the better.

INTRODUCTION

Milk is an emulsion or colloid of butterfat globules within a water-based fluid that contains dissolved carbohydrates and protein aggregates with minerals (Jost, 2002). The cow's milk is the most type of milk consumed in the world, where the amount consumed in the Kingdom of Saudi Arabia is approximately 335 million liters, and the average of person consumption is 30 liters / year, with an estimated market value of milk by $ 675 million. (AlSuhaibani and AlJnobi, 2004).

Milk has a high nutritional value and considered the best natural source of calcium that is essential for building bones, dental safety and prevention of osteoporosis. Also the consumption of an adequate amount of milk and milk products contributes to the weight loss, where calcium uses the body fat as an energy source and reduce its storage in the cells. (Fox,1995; Flynn,2003; Berkey *et al*, 2005; US Department of health & human service and FDA,2011)

It has been suggested that consumption of milk and its products may reduce the risk of colon cancer, as some nutrients like calcium, vitamin D and linoleic acid have that protective effect.(World Cancer Research Fund & American Institute for Cancer Research,2007)

A study suggested that children, who had consumed adequate quantities of milk and dairy products, had longer lives since 1/4 liter of milk per day can reduce the risk of death by ischemic stroke by 60%. (European Commission, 2006; TALA,2012)

In a case-control study of siblings of children with type 1 diabetes supported that high consumption of cow's milk during childhood can be diabetogenic in those siblings (Virtanen *et al*,2000). Also, that avoidance of

cow's milk products during the first few months of life may reduce the risk of type I diabetes (Gerstein, 1994).

In last decades, milk consumption was reduced in some western communities due to the side effects of milk and dairy products, as it contains high values of saturated fats, which are closely linked to heart disease or weight gain (Zemel *et al*, 2005;Quinn & Wang, 2008).

Effect of heat treatment on milk total protein or physical properties was investigated by many. The apparent viscosity was more linear correlated as protein concentration increased in milk (Carr,1999).

Also, the freezing effect on some milk ingredients like Protein & Fat has been investigated . (Van Hekken *et al*, 2005).

Therefore, the aim of this study was studying the effect of different storage periods on the content of full and low fat pasteurized cow's milk.

MATERIALS AND METHODS

Pasteurized milk samples packaged in 2 Liter plastic containers were collected from four factories in Riyadh city named(1-A),(2-A),(3- A)and (A-4) for full fat milk and(1- B) , (2-B),(3- B) , and (4-B) for low –fat milk . They were stored in the refrigerator at 4°C for 1, 3 and 8 days of production. All samples were analyzed chemically as the following:

Protein:

Protein value was estimated according to Association of Official Analytical Chemists (AOAC,1995) using Kjeldahl flask. Protein value was calculated on total Nitrogen basis.

Fat:

Fat value was determined according to (GSO/1994) by Gerber standard tube with rubber stopper and using sulfuric acid and pure amyl alcohol to separate the fat from the milk mixture in Gerber tube.

Total solids:

The value of Total solids was estimated by weight method (GSO/1994). The calculation of total solids percentage was as the following:

$$\text{Total solids \%} = \frac{\text{Dried sample weight} \times 100}{\text{Sample weight before Drying}}$$

Solids not-fat:

The value of non-fat solids was calculated as the following:

Solids-not-fat= Total solids % - milk fat %

Vitamin (D):

Vitamin (D) value was determined according to Association of Official Analytical Chemists (AOAC,1995) by High-performance Liquid Chromatography (HPLC).

Vitamin (A):

Vitamin (A) value was determined according to Association of Official Analytical Chemists (AOAC,1995)by Liquid Chromatography (LC),and spectrophotometer with wave length of 324.5nm.

Statistical analysis:

The results were obtained statistically analyzed according to Sendecor and Cochran(1976) method, using frequency tables, arithmetic mean and standard deviation to describe sample data. Also, Analysis of Variance (ANOVA) of SAS (SAS,1998) was applied to study the significant differences at $p \leq 0.05$ among the milk samples, storage periods, data charts and different comparing.

RESULTS AND DISCUSSION

Effect of storage period on the chemical composition of pasteurized cow´s milk:-

Protein, fat, total solids and solid not fat content of full and low fat pasteurized cow´s milk is shown in Tables (1) &(2).

Tables (1) &(2) as well as Figs (1) to (4) show that the refrigeration storage effect is quite clear. The protein, fat, total solids and solids – not fat contents of full and low fat pasteurized cow´s milk significantly decreased as the storage period progressed. The highest percentage decrease in protein content was 21.28%,8.57%(samples2-A,1-B) ,in fat content was 6.25% ,9.23(samples
1-A,1-B), in total solids content was 2.77%,18.20%(samples 3-A,4-B) and in solids-not fat was 4.96% ,9.07%(samples 2-A,2-B) after 8th days storage respectively. Results obtained are in agreement with those obtained by Wattiaux,(1996), Alkanhal *et al* (1994) , Alkanhal *et al* (1996),Yagoub(2008),Looper(2012) and Brien (2012) and disagree with the results obtained by Eid (2009).

Table (1): Effect of storage period on the chemical composition of full fat pasteurized cow's milk

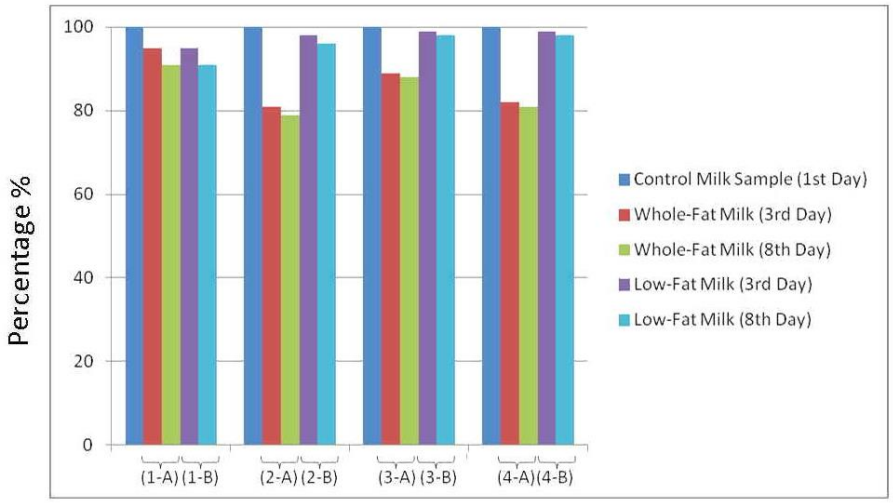
Samples	Storage Period	Nutrition ingredients			
		Protein	Fat	Total Solids	Solids-not-fat
(1-A)	1st Day	*3.48±0.017	*3.20±0.041	*11.90±0.012	*8.74±0.087
	3rd Day	*3.31±0.051	*3.16±0.052	*11.80±0.031	*8.64±0.087
	8th Day	*3.18±0.095	*3.00±0.015	*11.74±0.087	*8.48±0.017
(2-A)	1st Day	*3.90±0.012	*3.60±0.045	*11.77±0.052	*8.67±0.087
	3rd Day	*3.15±0.045	*3.58±0.017	*11.70±0.012	*8.22±0.072
	8th Day	*3.07±0.35	*3.50±0.080	*11.70±0.012	*8.14±0.045
(3-A)	1st Day	*3.70±0.012	*3.25±0.029	*11.91±0.012	*8.76±0.087
	3rd Day	*3.30±0.025	*3.23±0.035	*11.82±0.346	*8.59±0.127
	8th Day	*3.25±0.029	*3.15±0.045	*11.58±0.017	*8.38±0.029
(4-A)	1st Day	*3.90±0.012	*3.31±0.051	*12.30±0.025	*8.76±0.087
	3rd Day	*3.20±0.041	*3.27±0.031	*12.00±0.015	*8.69±0.012
	8th Day	*3.15±0.045	*3.24±0.040	*12.00±0.015	*8.63±0.026

***Mean ± Standard deviation**

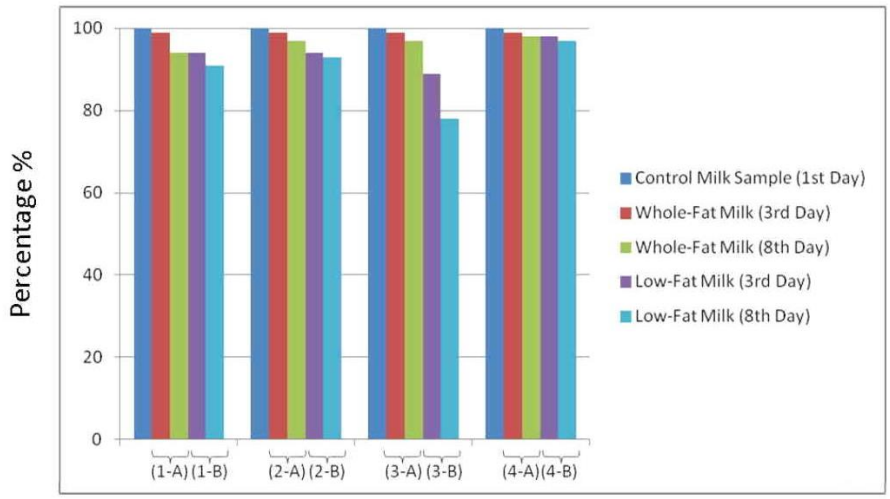
Table (2): Effect of storage period on the chemical composition of low-fat pasteurized cow's milk

Samples	Storage Period	Nutrition ingredients			
		Protein	Fat	Total Solids	Solids-not-fat
	1st Day	*3.50±0.080	*1.30±0.023	*11.90±0.012	*8.74±0.087
	3rd Day	*3.33±0.049	*1.22±0.072	*10.02±0.035	*8.28±0.029
(1-B)	8th Day	*3.20±0.042	*1.18±0.092	*9.90±0.012	*8.28±0.029
	1st Day	*3.25±0.029	*1.70±0.012	*9.87±0.046	*9.04±0.035
	3rd Day	*3.17±0.103	*1.60±0.045	*9. 82±0.035 LIII 82±0.035	*8.28±0.029
(2-B)	8th Day	*3.11±0.01	*1.58±0.017	*9.14±0.045	*8.22±0.158
	1st Day	*3.45±0.086	*0.89±0.012	*9.70±0.012	*8.91±0.012
	3rd Day	*3.41±0.025	*0.79±0.017	*9.65±0.087	*8.85±0.017
(3-B)	8th Day	*3.37±0.090	*0.69±0.012	*9.60±0.045	*8.48±0.017
	1st Day	*3.30±0.025	*1.00±zero	*9.89±0.012	*8.89±0.012
	3rd Day	*3.28±0.029	*0.98±0.035	*9.78±0.035	*8.81±0.012
(4-B)	8th Day	*3.22±0.158	*0.97±0.052	*9.71±0.012	*8.73±0.026

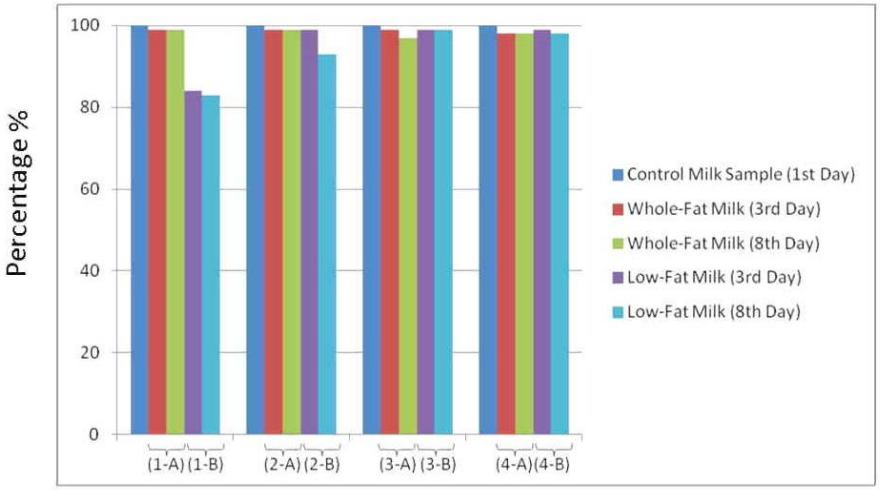
***Mean ± Standard deviation**



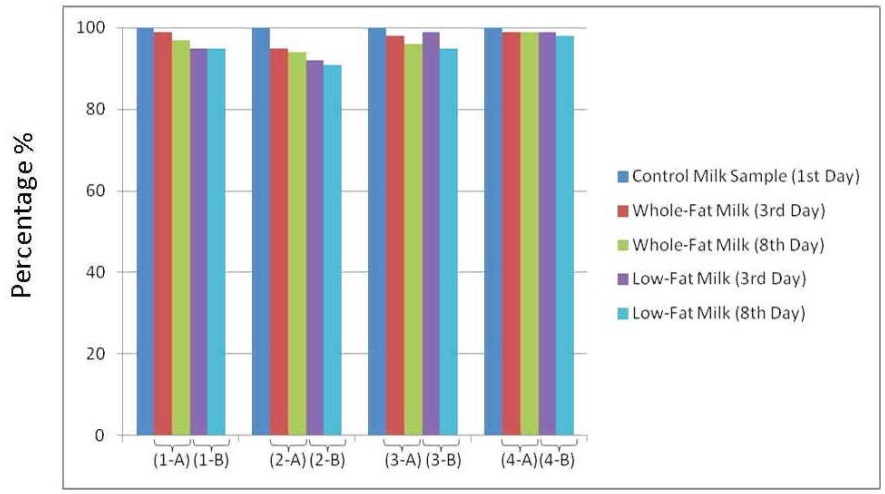
Fig(1) :Protein Percentage in Whole & Low Fat Milk Samples during Storage Periods



Fig(2):Fat Percentage in Whole & Low Fat Milk Samples during Storage Periods



Fig(3):Total Solids Percentage in Whole & Low Fat Milk Samples during Storage Periods



Fig(4):Solids-not-fat Percentage in Whole & Low Fat Milk Samples during Storage Periods

Effect of storage period on Vitamins (A) and(D) content of pasteurized cow´s milk:

Vitamins (A&D) content of full and low fat pasteurized cow's milk is shown in Tables (3) and (4). Figs (5) and (6) show the percentage decrease in the vitamins throughout the storage period of milk.

Vitamin(A) decreased in all samples and the highest decrease was in sample(4-B) being 16,63% in the 3rd day and 18.71% after eight days storage.

Vitamin(D) was also greatly affected during the storage period as compared with the control sample. The highest percentage decrease was47.41% in sample(2-B) after eight days of storage. However, data obtained indicated that samples (3-A), (3-B) and (4-B) were free from vitamin D . In other words , they are not consider a good source for vitamin (D) supply and consequently violate the Saudi Standards .

Leerbeck & Sandergaard(1980) mentioned that the content of vitamin(D) in cow's milk is approximately 5-35 IU/L, and accordingly milk is not considered to be a significantly source of that vitamin and should be added to milk. Hurley (2009) said that in some countries like the United States of America , Vitamins (A&D) are added to milk .According to Nickerson and Ronsivalli (1980), human boby needs 2.5mg of vitamin (D) daily and 5000IU of vitamin (A) has an important role in vision , bone growth and helps to fight infections.

Table (3):Comparing Mean Vitamins contents and Storage Periods in Full-Fat Milk

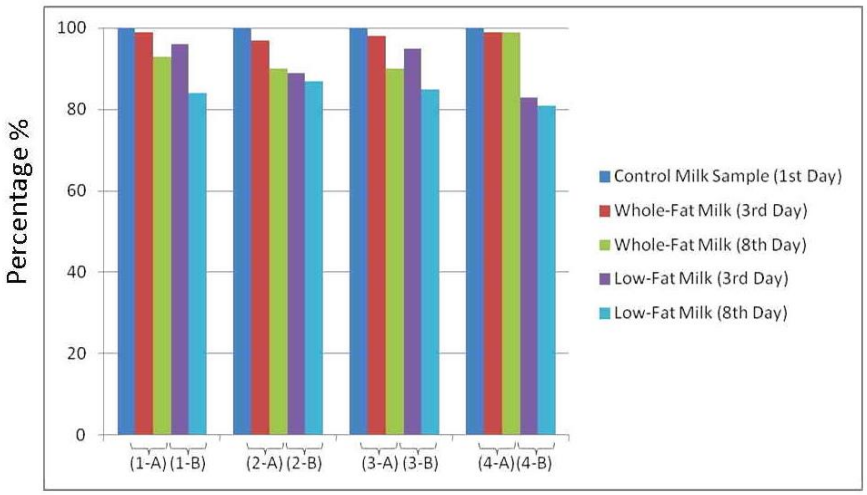
Samples	Storage Period	Vitamins	
		Vitamin (a)	Vitamin (b)
	1st Day	*4785 ±1.732	*109±3.098 8.74±0.087
	3rd Day	*4731±5.132	*85±1.732 8.28±0.029
(1-A)	8th Day	*4456±7.810	*73±8.66 8.28±0.029
	1st Day	*1479 ±1.732	*105 ±3.464 9.04±0.035
	3rd Day	*1432 ±5.132	*92±3.464 8.28±0.028
(2-A)	8th Day	*1331 ±5.132	*70±1.732 8.22±0.158
	1st Day	*871 ±1.155	- 8.91±0.012
	3rd Day	*855±8.083	- 8.85±0.017
(3-A)	8th Day	*781±1.155	- 8.48±0.017
	1st Day	*1637±9.074	*110 ±1 8.89±0.012
	3rd Day	*1628±3.055	*95±3.098 8.81±0.012
(4-A)	8th Day	*1616 ±5.196	*79±1.732 8.73±0.026

***Mean ± Standard deviation**

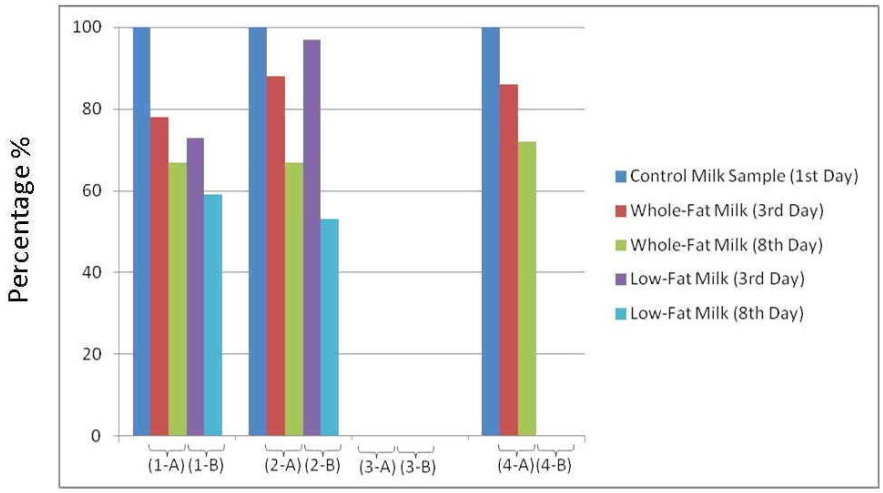
Table(4):Comparing Mean Vitamins contents and Storage Periods in Low-Fat Milk

Samples	Storage Period	Vitamins	
		Vitamin (a)	Vitamin (b)
	1st Day	*3792 ±3.464	*162±3.464 8.74±0.087
	3rd Day	*3648±1.732	*118±8.660 8.28±0.029
(1-B)	8th Day	*3203±3.464	*96±1.732 8.28±0.029
	1st Day	*4535 ±0.66	*213 ±1 9.04±0.035
	3rd Day	*4058 ±1.549	*207±3.464 8.28±0.028
(2-B)	8th Day	*3923 ±3.464	*112±1 8.22±0.158
	1st Day	*191 ±1.155	- 8.91±0.012
	3rd Day	*181±1.155	- 8.85±0.017
(3-B)	8th Day	*162±3.464	- 8.48±0.017
	1st Day	*481±1.155	- 8.89±0.012
	3rd Day	*401±2.309	- 8.81±0.012
(4-B)	8th Day	*391 ±1.155	- 8.73±0.026

***Mean ± Standard deviation**



Fig(5):Vitamin (A) Percentage in full & low fat milk samples during storage periods



Fig(6)Vitamin (d) Percentage in Whole & Low Fat Milk Samples during Storage Periods

Conclusion

This study concludes that storage period had strong effect on protein, fat, total-solids and solids-not-fat of full & low fat milk. All these ingredients decreased as the storage period increased. Milk content of Vitamin (D) was more decreased than other ingredients. This Decrease limits the shelf life of milk. It is recommended to be other further research regarding the storage period effect on milk components.

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دراسة تأثير مدة التخزين على المحتوى الغذائى فى الحليب البقرى الكامل والقليل الدسم المبستر

ابتهال عبدالعزيز التميم

قسم التغذية وعلوم الاطعمة-كلية الاقتصاد المنزلى-جامعة الاميرة نورا بنت عبدالعزيز– الرياض– المملكة العربية السعودية.

أجريت هذه الدراسة لمعرفة تأثير فترة التخزين على مكونات الحليب الكامل والقليل الدسم المبستر، وتم أخذ عينات من أربع مصانع منتجة للحليب المبستر المعبأ في عبوات بلاستيكية من مدينة الرياض وحفظت على درجة حرارة ٤ ْم لمدة ١، ٣ و ٨ أيام من تاريخ التصنيع . وتم تقدير كل من البروتين، الدهن، المواد الصلبة الكلية، المواد الصلبة اللادهنية والفيتامينات (أ) و (د). وأجريت الاختلافات عند فروق معنوية بمقدار ($p\leq0.05$). وأوضحت نتائج الدراسة أن مكونات الحليب انخفضت في جميع العينات خلال الفترة ٣ و ٨ أيام من التخزين مقارنة باليوم الأول. كذلك أظهرت الدراسة خلو بعض العينات من فيتامين د . ولذا يتضح من نتائج هذه الدراسة اهمية استهلاك الحليب المبستر خلال الايام الاولى من تاريخ التصنيع وذلك افضل من الناحية الغذائية مع المحافظة على ظروف التخزين الجيدة خاصة فى الثلاجة المنزلية.

قام بتحكيم البحث

أ.د / مسعد عبد العزيز ابو ريا	**كلية الزراعة – جامعة المنصورة**
أ.د / فوزيه حسن عبد ربه	**كلية الزراعة – جامعة القاهره**