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Effect of Different Packaging Materials on Some Vitamins and Minerals of the Pasteurized Camel Milk

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ABSTRACT

In this study the level of Pasteurized camel milk vitamins and minerals, vitamin A (Retinyl Acetate), Vitamin C (Ascorbic Acid), Selenium were monitored, Phosphorus and Calcium for 30 days period started day 0, through day 7, day 14, day 21 and day 30, different types of packaging materials (I) (PET) Bottle, (ii) (PP) Cup,(iii) (PS) Cup,(iv) (LDPE) Bottle,(v) (LPET) Bottle,(vi (HDPE) Bottle,(vii) Aluminum Cans, (viii) Glass(Emerald Green**)** and (ix) Cartoon bottles (250 ml size) were dispensed with the Pasteurized camel milk (80 ˚C, 16 s) at Aseptic condition and storage temperature 5 ˚C, to find out best packaging materials to transport high value from this nutrient to the end consumers, Result shown there is significant differences within packaging materials responds of test results about (Vitamin A), So The best packaging materials on Vitamin A of pasteurized Camel Milk is: Carton, Aluminum Can, Glass bottle) Respectively, Vitamin C shown significant differences within packaging materials responds of test results, So the best packaging materials on Vitamin C is:(Aluminum Can, Carton, Glass bottle) Respectively. Minerals results shown that there were no significant differences within packaging materials responds of test results about (Selenium (Se)) because the sig = (0.997) more than 0.05 and 0.01. so we can say responds in group equally at all packaging materials, Calcium results shown that there were significant differences within packaging materials, So the best packaging materials for Calcium (Ca) is:(HDPE, PET, LDPE) Respectively. Phosphorus also shown significant differences within packaging materials because the sig = (0.000) Less than 0.05 and 0.01. so responds in group not equally at all packaging materials, the best packaging materials on Phosphorous (P) s:(LDPE, HDPE, PET) respectively.

Introduction

The camel milk has a good nutritive quality and can be a convenient source of nutrient in human diet in arid and semi-arid zones (Igbal and Younas, 2001). The vitamin composition of camel milk is regarded by many authors as partly the origin of some of its health benefits for consumers (Al-Haj and Al-Kanhal, 2010; Claeys *et al.,* 2014; Mullaicharam, 2014; Kumar *et al.,* 2015; Yadav *et al.,* 2015; Jilo and Tegegne, 2016; Kaskous, 2016, Alavi *et al.,* 2017; Singh *et al.,* 2017; Abrhaley and Leta, 2018, Bulca, 2018). Also Camel milk is known to be a rich source of vitamins, especially vitamin C, which 3 to 5 times higher levels than in cow milk with absolute values up to 40.9 mg/l (Farah *et al.,* 1992; Stahl *et al.,* 2006, Wernery *et al.,* 2005; Haddadin *et al.,* 2008; Wang *et al.,* 2011). Also Vitamin C is the more abundant vitamin in camel milk. However, it is highly unstable especially with temperature changes for both low or high temperatures. Vitamin A is involved in the protection of the tegument and in the vision. In consequence, hypovitaminose A could affect the skin provoking hyperkeratosis and the vision provoking a specific crepuscular blindness. Vitamin A plays also an important role in the protection of mucosa, which would explain its specific role in reproductive performances (Clagett-Dame and Knutson, 2011) (Konuspayeva *et al.,* 2010a; Konuspayeva *et al.,* 2010b; Konuspayeva *et al.,* 2011). Stahl *et al.,* (2006) reported that vitamins A, E, B1, and β-carotene were significantly lower in dromedary milk Also Camel milk is well known for its richness in minerals (Farah, 1993; Konuspayeva *et al.,* 2008; Al-Wabel, 2008; Al haj and Al Kanhal, 2010; Wang *et al.,* 2011; Yadav *et al.,* 2015). Levels of potassium, magnesium, iron, copper, manganese, sodium and zinc are higher in camel's milk than in cow's milk (Sawaya *et al.,* 1984; Abu-Lehia, 1987; Yadav *et al.,* 2015). Farah (1993) found low levels of potassium and phosphorus in Egyptian dromedaries. Wang *et al.,* (2011) found that calcium, magnesium and iron content in camel milk were highest than other milk from cows, goats and human. It is known that the mineral content of milk raised under hot and dry desert conditions, such as Saudi Arabia. Konuspazeva *et al.,* (2008) have determined some minerals in the camel milk in Kazakhstan and the mean values Journal of Camel Practice and Research April 2017 / 21 were 1.232±0.292 g/l, 1.003±0.217 g/l and 2.02±1.24 mg/l of calcium, phosphorus and iron, respectively. These concentrations of minerals covered the most daily requirement for adult, when the consumption reached 500 ml per day of camel milk. On the other hand, Food packaging is one of the stages of food production that enables foods to reach consumers safely. By selecting the appropriate packaging material and technologies for different food products shelf life of food is increased and food quality and freshness can be preserved. The aim of this study to find out the best packaging materials to store pasteurized camel milk to reach the end consumers with high nutrient value from vitamins and minerals mainly vitamin A, C, Selenium, Phosphorus and Calcium.

Materials and Methods

Area of Study

The Emirates Industry for Camel Milk and Products, the world's first large-scale dairy camel farm located in Dubai, United Arab Emirates (25° N, 55° E) in Dubai Al Ain Road, Exit 26, Um Nahad 3 area.

Camels, Management of the Farm, and Milking of the Animals

The animals belonging to different breeds or ecotypes were between 5 to 19 yr. of age and had variable parity. Dromedaries were kept in groups of 12 or 24 animals in open paddocks. Calves were weaned partially and were kept in adjacent paddocks next to their dams throughout lactation. They were allowed to suckle after each milking.

The normal daily ration consisted of 5 to 6 kg of wheat bran and 6 to 7 kg of alfalfa hay (~15% CP) distributed with feeding wagons as TMR in 2 portions per day throughout the year. Further details of farm management have been described elsewhere (Nagy *et al.*, 2013a, b). Dromedaries were milked twice a day with an automatic system in a 2 × 12 herringbone milking parlor. Milk yield (kg) of individual dromedaries was measured during each milking with a milk meter approved by the International Committee for Animal Recording (ICAR).

Packaging Materials

The plastic Packaging materials, Poly ethylene tetra phthalate (PET), Polypropylene (PP), polystyrene (PS) Low density polyethylene (LDPE), Light Proof Polyethylene tetra phthalate (LPET), High density Polyethylene (HDPE) were supplied from Precision Plastic Products CO. LLC-Dubai, Glass (Emerald Green**)** from Al tajir Glass Industries-Dubai, Aluminum Cans from Can Pack Middle East LLC -Dubai and the cartoon from Parksons Packaging Ltd- India.

Milk samples

Pasteurized camel milk Samples were obtained from the Emirates Industry of Camel Milk and products Company plant in Umm Nahad 1 area at 6 O'clock in the morning in Sterilized Steel Containers and were kept in Ice boxes then transferred to Al Rawabi Dairy Company Laboratory in Al Khawaneej area both area in Dubai, United Arab of Emirates. The study was conducted Between January and February 2018, 2019 (Winter Season) respectively.

Sample preparation and handling

Pasteurized camel milk (80˚C, 16 s) was obtained from the Emirates Industry of Camel Milk and products Company plant in Umm Nahad 1 area at 6 O'clock in the morning in Sterilized Steel Containers and were transferred in Ice boxes to Al Rawabi Dairy Company quality control plant, the milk was aseptically dispensed into clean bottles, cups, cans and coated paperboard cartons in the plant laboratory. Bottles were sealed using polyethylene twist caps (plastic bottles), glass bottles with crown caps, cups with pail lid, while coated paperboard cartons were sealed on the production line sealer, all packaging materials size 250 ml. The filled packaging materials were stored inside the fridge at 5˚C for a period up to 30 days,

Chemical Analysis

Vitamin A (Retinyl Acetate), Vitamin C (Ascorbic Acid), Selenium, Phosphorus and Calcium were examined on 0 day, 7d,14d,21day and 30 day.

Determination of Vitamin A and C

Applicable to the quantification of vitamin A adult/pediatric nutritional formula and other nutritional foods by ultra-performance LC (UPLC®)-FLD and UV. Samples are initially mixed with methanol, which precipitates proteins and disrupts micelles freeing lipids for extraction. Samples are then extracted with isooctane and centrifuged to separate the isooctane layer from the alcohol-water layer. A 20 f. L L aliquot of the upper isooctane layer is injected in to the HPLC system. The detection is by UV at 32S nm (A acetate). Ascorbic acid is extracted from the sample using trichloroacetic acid (TCA) in the presence of Tris [2- carboxyethyl] phosphine (TCEP) as a reducing agent. Ascorbic acid is then determined by UPLC-UV at 265 nm. Separation takes place on a C18 column with sodium acetate (pH 5.4) as the eluent, combined with TCEP and decylamine as an ion-pairing agent.

Official methods of analysis of AOAC international, 2012- 2012.22.

Determination of Calcium, Phosphorus and Selenium

Test portion is digested in HNO/HCI04 and elements are determined by ICP emission spectroscopy. Vigorously shake container of camel milk sample to ensure complete mixing.

Measure 15.0 m Lofrcady to feed (I 0.0 mL) sample into I 00 mL Kjeldahl flask. Add 30 mL HN03·HCI04 (2 + I) to flask along with 3 or 4 glass boiling beads. Let test portions sit overnight in acid. Carry 2 reagent blanks through entire procedure along with test portions. Before starting digestion, have ice bath available for cooling Kjeldahl flasks. HN03 should also be readily available. To start digestion, place each Kjeldahl flask on heating mantle set at low temperature.

Once boiling is initiated, red-orange fumesofN0 2 will be driven off. Continue gentle heating untill-IN03 and H20 have been driven off. At this point effervescent reaction occurs between organic material and HC104• Place flask on cool heating mantle and let digestion proceed with occasional heating from mantle. It is important that reaction between organic material and HClO not go too fast, because charring will occur. If charring occurs, immediately place flask in ice bath to stop digestion. Add I mL HN03 and resume gentle heating. After reaction of test portion with HCI04 is complete (identified by cessation of effervescent reaction between organic material and HCIO) apply high heat for ca 2 min; do not heat to dryness because this can cause explosion. Remove flask from heating mantle and let cool. Transfer each digest to 50 mL volumetric flask and dilute to volume with H_20.

Some precipitation is likely to occur (especially with high salt content products) after dilution. Precipitate will dissolve if shaken and allowed to sit overnight. Final acid content of digests is ca 20% HCI04• Elemental determination is accomplished by inductively coupled plasma (ICP) emission spectroscopy. Calibration of instrument is done through use of known calibration standards. Calibration standards may be used as single standards (i.e., one element per standard) or as mixed standard containing 2 or more elements. Whether single or mixed standards.

AOAC Official Method 984.27 Calcium, Phosphorus and Selenium.

Statistical Analysis

Analysis of variance was obtained using Statistical Package for the Social Science (SPSS V. 25). The P value for significance was stated in P< 0.05.

Results and Discussion

Chemical Analysis of the pasteurized Camel Milk (Vitamins & Minerals)

Vitamin A

From the table.1 there is significant differences within packaging materials responds of test results about (Vitamin A) because the sig = (0.000) less than 0.05 and 0.01. So we can say responds in group not equally at all packaging materials. The best packaging materials on Vitamin A of

Pasteurized Camel Milk is: Carton, Aluminum Can, Glass bottle) respectively.

Vitamin C

From the table.2 there is significant differences within packaging materials responds of test results about (Vitamin C) because the sig = (0.000) less than 0.05 and 0.01. so we can say responds in group not equally at all packaging materials, the best packaging materials on Vitamin C of Camel Milk is:(Aluminum Can, Carton, Glass bottle) Respectively.

Calcium (Ca)

From the table.3 there is significant differences within packaging materials responds of test results about Calcium (Ca) because the sig = (0.000) less than 0.05 and 0.01. so we can say responds in group not equally at all packaging materials, the best packaging materials on Calcium (Ca) of Camel Milk is: (HDPE, PET, LDPE) Respectively.

Selenium (Se)

From the table above there is no significant differences within packaging materials responds of test results about (Selenium (Se)) because the sig = (0.997) more than 0.05 and 0.01. So we can say responds in group equally at all packaging materials.

Phosphorous (P)

From the table.4 there is significant differences within packaging materials responds of test results about (Phosphorous (P) because the sig = (0.000) Less than 0.05 and 0.01. so we can say responds in group not equally at all packaging materials, the best packaging materials on Phosphorous (P) of Camel Milk is: (LDPE, HDPE, PET) respectively.

Vitamin A

From the results shown in the present study and from Ninth types of packaging materials found the best packaging materials on Vitamin A of Pasteurized Camel Milk is: (Carton, Aluminum Can, Glass bottle) Respectively, the packaging materials barrier is the common factor between this packaging and the ability to protect the milk content from the light it is very clear here, so this results agreement with Cox *et al*., (1957), studied the effect of exposure of pasteurized whole milk and skim milk on retention of vitamin A, the milk was packaged in amber glass bottles, plain glass bottles and waxed paperboard cartons and was exposed to the diffused daylight and to a short time irradiation with direct sunlight, care wax taken to avoid temperature change. it was found amber glass bottle and paperboard cartons offered good protection. But plain glass bottles did not prevent considerable losses of the vitamin. Hankin and Dillman, (1972) reported a similar study in 31 U and 33 U of milk in glass and plastic containers were oxidized as a compared with 4.4 U in paper carton. Homogenized milk packaged in polyethylene containers exposed to fluorescent light showed both flavor and vitamin deterioration (Hansen *et al.,* 1975). (Deman, 1980) reported that vitamin A in whole milk packaged in plastic, pouches dropped to 67.7 U of it is original content by 30 hours after exposure to 2.200 LX intensity fluorescents light and remain a constant t for further 18 hours. (Moyssiadi, 2004) confirmed that good protection of milk packaged in all packaging materials with regard to microbiological and chemical parameters assessed over the 7-day test period.

Table.1 Source of variation in responds of Vitamin A in packaging materials

S.O.V	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.000	8	.000	17.196	0.000
Within Groups	.000	18	.000		
Total	.000	26			

Table.2 Source of variation in responds of Vitamin C in packaging materials

S.O.V	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.000	8	.000	14.861	0.000
Within Groups	.000	18	.000		
Total	.001	26			

Table.3 Source of variation in responds of Calcium (Ca) in packaging materials

S.O.V	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	32223.333	8	4027.917	877.046	0.000
Within Groups	82.667	18	4.593		
Total	32306.000	26			

Table.4 Source of variation in responds of Selenium (Se) in packaging materials

S.O.V	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.000	8	.000	<1	0.997
Within Groups	.000	18	.000		
Total	.000	26			

Table.5 Source of variation in responds of Phosphorous (P) in packaging materials

S.O.V	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	931.333	8	116.417	28.575	0.000
Within Groups	73.333	18	4.074		
Total	1004.667	26			

Fig.1 Vitamin A Level in Pasteurized Camel Milk

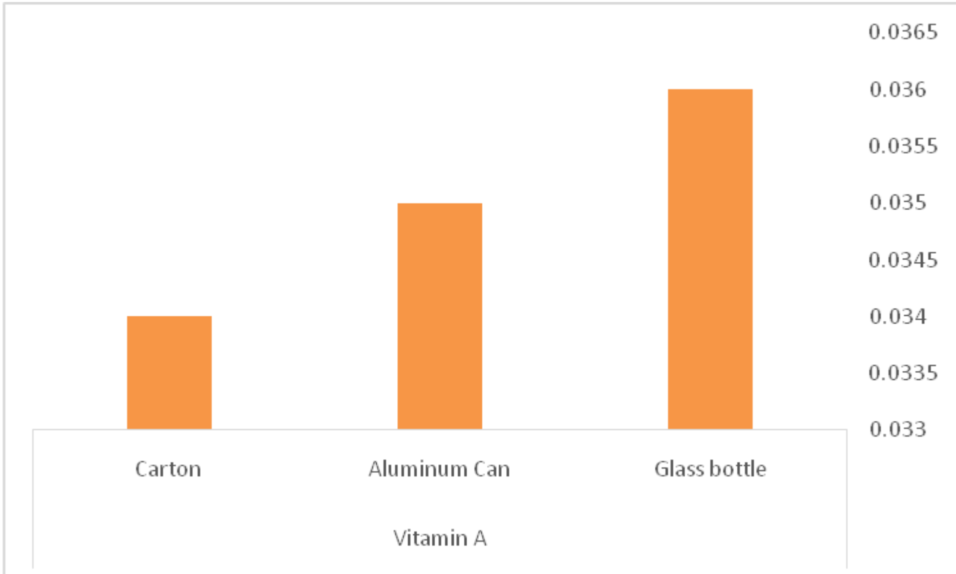
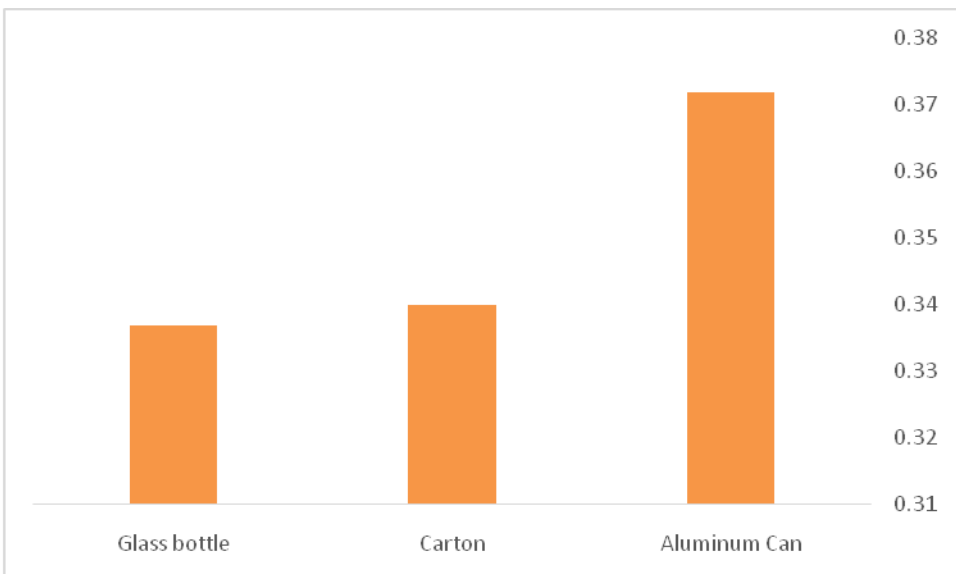


Fig.2 Vitamin C Level in Pasteurized Camel Milk



Vitamin A losses recorded were 11% for multilayer and monolayer pigmented HDPE and pigmented PET bottles vs. 16% for the paperboard cartons and 31% for the clear PET bottles after 7 days of storage, in this study the Author was not agreement with us because confirmed that the best overall protection in terms of vitamin retention to the product was provided by the pigmented HDPE bottles. And he proposed that multilayer (white pigment/black pigment/white pigment) pigmented and monolayer white pigmented HDPE or white pigmented PET bottles in thickness 550–600 and 300–350 mm, respectively, may be used as possible alternatives to the coated paper board carton for fresh milk packaging.

Vitamin C

There are significant differences within packaging materials responds of test results about (Vitamin C) because the sig = (0.000) less than 0.05 and 0.01. so we can say responds in group not equally at all packaging materials, the best packaging materials on Vitamin C of pasteurized Camel Milk is:(Aluminum Can, Carton, Glass bottle) Respectively. From the literature reviews also many studies confirmed that there is a different effect of the packaging materials about vitamin C stability, (Gliguem H, 2005) confirmed that vitamin C degradation curve in fortified milks as a function of storage time. The milk batch was fortified with 256 mg/L of vitamin C before sterilization treatment.

Observed a dramatic drop in the vitamin C content of samples stored in 3-layer bottles, and slow degradation in 6-layer bottles. Milk was exposed to fluorescent light at intensities of 100 or 200 ft-c at a temperature of 5°C for periods of 3, 6, 12 or 24 hours. Ascorbic acid content examined for flavor changes by a duo-trio taste panel difference test. Four packaging materials were used clear pouch, opaque pouch, carton and plastic jug. Light transmittance of the packaging materials in the spectral range 380-750 nm was determined. Significant losses of ascorbic acid occurred in all containers. (Sattar, A, 1973). (Sattar, A 1983) reported significant effects of the packages and light on ascorbic acid contents of milk ($P<0.01$). Brown glass gave the best protection followed by Tetra Pak, green and clear glass bottles. Chemical stability of PET-bottled milk was demonstrated by the degradation of the ascorbic acid concentration in the product at 60 d of refrigerated storage. (Solano-Lopez, 2005).

Minerals (Calcium, Phosphorus and Selenium)

Results of the minerals shown significant differences within packaging materials responds of test results about Calcium and Phosphorous and not equally at all packaging materials, the best packaging materials on Calcium is:(HDPE, PET, LDPE) Respectively and Phosphorous is:(LDPE, HDPE, PET) Respectively. But Selenium there are no significant differences within packaging materials responds of test results about we can say responds in group equally at all packaging materials. From the literature reviews (Hedrick, T. I., 1975) and in the same line reported that Samples in eight trials were analyzed for seven minerals. Mean values for the minerals in all milks packaged in paperboard or plastic revealed no significant change when the samples were subjected to the three treatments. Minerals found in control samples. (mg/100 g milk) were: calcium 119-203, average 161: phosphorus 110-178. Average 128; sodium 39.5-50.4, average 44.5: magnesium 13-19, average 16; zinc 0.12-0.38, average 0.27: manganese 0.012-0.036, average and iron 0.012-0.036, average 0.015.

From the results reported on this study we can say there is a significant effect of packaging materials on the vitamin A and C and this effect related to the ability of the packaging materials to protect the pasteurized camel milk from the light transmission because the best packaging material on both vitamins (Carton, Aluminum Can, Glass bottle), so the relation between this packaging materials the protection from light transmission and this results agreement with many studies.

The present study suggested to use this packaging materials for pasteurized camel milk storing at the refrigerator at 5˚ C. minerals showed stability on selenium results in all types of packaging, but the calcium and phosphorus showed significant difference between packaging types HDPE, PET, LDPE and this plastic type we can say suitable to transfer the minerals with high value for the end consumer.

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