The effect of short-term heat treatment on vitamin C concentrations in camel milk

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The effect of pasteurization on vitamin C concentrations in camel milk was investigated. Fifty milk samples were collected from 10 dromedaries over a period of 2 months and analyzed for vitamin C concentration by HPLC before and after pasteurization. The mean vitamin C concentration of the fifty paired fresh and pasteurized camel milk samples was 40.9 mg/dl and 38.4 mg/dl, respectively. Although pasteurization resulted in a statistically significant reduction in vitamin C concentration of camel milk, the magnitude of this reduction was minimal, equating to a 6.1% reduction. The fact that the reduction in vitamin C concentration following pasteurization was minimal can be considered as tremendously advantageous for the consumer in arid and semi-arid countries where vitamin sources are scarce.

Der Effekt von Kurzzeitheizung auf den Vitamin-C-Gehalt in Kamelmilch

Der Einfluss der Kurzzeitheizung auf den Vitamin-C-Gehalt in Kamelmilch wurde untersucht. Dafür wurden 50 Milchproben von 10 Dromedaren über einen Zeitraum von 2 Monaten gesammelt und der Vitamin C-Gehalt der frischen und pasteurisierten Proben mit der HPLC analysiert. Der durchschnittliche Vitamin-C-Gehalt der 50 frischen Milchproben betrug 40,9 mg/dl und der pasteurisierten Proben 38,40 mg/dl. Obwohl die Pasteurisation eine statistisch signifikante Reduktion des Vitamin-C-Gehalts zur Folge hatte, war der Verlust mit 6.1% sehr gering. Für den Konsum in ariden oder semiariden Ländern, in denen Vitaminquellen selten sind, kann diese Tatsache von großem Vorteil sein.

38 Camel milk (short-term heat treatment and vitamin C content) 38 Kamelmilch (Kurzzeitheizung und Vitamin-C-Gehalt)

1. Introduction

Camel milk is commercially produced in few countries including Saudi Arabia, United Arab Emirates (U.A.E.), Mauritania and Kazakhstan where the milk is sold pasteurized. In the U.A.E., camel milk is also collected using automatic milking machines (1, 2, 3). The purpose of heat treatment of milk is either the partial destruction of micro-organisms or the complete sterilization of milk to prolong its shelf life. Very little is known about the effect of heat treatment on camel milk constituents. Limited studies have been performed on the effect of heat treatment on camel milk by Mohammedi (4). Wernery (5) compared 17 different milk constituents, including vitamin C, in raw and pasteurized camel milk samples and failed to identify any significant differences. However, only 6 samples of camel milk were tested.

The purpose of this study was to compare the vitamin C concentration of 50 fresh camel milk samples with the same paired samples following pasteurization.

2. Material and methods

Fifty milk samples were collected over a period of two months from 10 dromedaries kept at the Central Veterinary Research Laboratory (CVRFL) in Dubai. The milk was collected aseptically as possible (6), pooled from all four quarters and aliquoted into 20ml sterile plastic containers for vitamin C analysis. For the evaluation of vitamin C in pasteurized milk, 1 l of fresh camel milk were subjected to pasteurization at 72°C for 5 min in a small pasteurization machine (Presc.-Vac., home pasteurizer, Schluter, USA). Twenty millilitres of the pasteurized milk was then subjected to vitamin C analysis. The milk vitamin C concentration was measured by High Performance Liquid Chromatography (HPLC, Waters 600, Waters Corp., USA) using the following procedure:

Twenty millilitres of each camel milk sample was pipetted into a 100 ml cylinder to which 1 g of citric acid was added. This solution was carefully mixed, and 50 ml of meta-phosphoric acid (1.5 g meta-phosphoric acid in 100 ml of sterile distilled water, adjusted to pH 3.5 with a 60% KOH solution) added. After mixing gently, distilled water was added to the 100 ml mark. This solution was incubated for 5 min at room temperature and filtered through a Whatman filter (Whatman, 150 mm Dia, Cat No 1001 150). The milk filtrate was then treated with Chromsystems reagents.

One hundred millilitres of reconstituted precipitation reagent (65005), which contains the internal standard (65004) was pipetted into a light protected reaction vial, to which 100 µl of camel milk filtrate was added. For the standard and controls, 100 µl of standard and control samples were added to the precipitation reagent instead of milk. All sample tubes were vortexed for 10 s, incubated at 4°C for 10 min and centrifuged at 13,000 rpm for 5 min. Then 20 µl of the supernatant was injected into the HPLC column. The setting of HPLC for vitamin C was as follows:

Flow rate – 1.2 ml/min;
UV detector wavelength: 245 nm;
Run time – 7 min;
Reagents from Chromsystems GmbH, Heimburgstr. 3, Munich, Germany
65001 – Mobile phase of vitamin C in plasma
65100 – HPLC column for vitamin C
65003 – Plasma calibration standard for vitamin C
0074 – Vitamin C plasma controls (level 1 + 11);

The vitamin C values were expressed as mean and standard deviation (50) and differences between pre-
and post-pasteurization samples was assessed using the paired student t-test. Statistical significance was assumed if \( p < 0.01 \).

3. Results

The results of individual vitamin C analyses are presented in Fig. 1. The mean vitamin C content in fresh and pasteurized samples was 40.9 ± 10.5 mg/dl and 38.4 ± 9.7 mg/dl, respectively. Although there was a statistically significant difference (\( p < 0.001 \)) between the paired fresh and pasteurized samples, the magnitude of this difference (mean 2.5 mg/dl; 95% CI 1.9–3.1) was consistently small, equating to a 6.1% reduction in mean vitamin C.

![Graph showing vitamin C concentrations in fresh and pasteurized milk](image)

Figure 1 demonstrates extremely good correlation (\( R^2 = 0.96 \)) between the paired pre- and post-pasteurised milk vitamin C concentrations. The consistent reduction in vitamin C concentration following pasteurisation is demonstrated by the fact that all (except one) of the data points lie below the diagonal line, which represents perfect correlation and agreement. However, the fact that all data points lie extremely close to the diagonal line is supportive of the consistently minimal pasteurisation-associated reduction in milk vitamin C concentration.

4. Conclusion

The results of this study indicate that pasteurization had a minimal effect on the vitamin C level of camel milk. Although heating the milk samples for 5 min at 72°C significantly reduced the vitamin C levels, the magnitude of reduction and consequently the effect on nutritive value was minimal. Previous work by WERNER (5) failed to demonstrate this pasteurization-associated reduction in vitamin C, however only a small number (n = 6) of samples were analyzed in that study.

Consistent with our results, of all the vitamins, vitamin C is the most susceptible to degradation; primarily due to oxidation and secondly to heating RENNER (7). Conversely, the fat soluble vitamins A, D and E as well as vitamins of the B complex are relatively insensitive to heat. Although there are generally no losses of these vitamins when milk is heated, slight reductions may occur in vitamins A, E and B2 when milk is sterilized. Losses in vitamins A and E are more likely to be caused by the effect of oxygen rather than heat RENNER (7).

Camel milk has 4 to 6 times more vitamin C than cow milk (8) making it invaluable for desert inhabitants where vitamin sources are scarce. Therefore, the fact that pasteurization resulted in a minimal reduction in vitamin C concentration, with pasteurization concentrations remaining well in excess of cow milk, is extremely advantageous for people living in arid or semi-arid countries.

5. References

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Proteolytic activity of different starter cultures in ewe’s milk

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Four different starter cultures (yogurt-, biyogurt-, sour milk-, and kefir culture) were evaluated for their proteolytic activity in ewe’s milk. The degree of proteolysis in the beverages in 1, 2, 4, 6, 8, 16, 20, 22 h after inoculation as well as on 1, 7, 14 days of storage at 4°C using o-phthalaldehyde (OPA) method was determined. One hour after inoculation the amount of free amino groups sharply decreased in all beverages. In the next hours starter cultures demonstrated different