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**Research Article**

# Effect of heating on shelf life and sensory characteristics of camel milk

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## Abstract

This study was aimed to analyze the sensory characteristics and keeping quality of raw and heat treated (63°C for 30 minutes, 72°C for 15 seconds and 100.5°C for 10 minutes) camel milk. The sensory scores for taste (36.3, 34.8 and 33.2), texture (24.4, 24.0 and 22.3) and overall acceptability (7.4, 7.7 and 7.0) in comparison to control (32.2, 21.4 and 6.9) were observed at 63°C for 30 minutes, 100.5°C for 10 minutes and 72°C for 15 seconds, respectively. Statistically, the difference was significant ($p<0.05$) in between control and heat treated samples, however, the insignificant ($p>0.05$) among different treatments. The scores for colour was 7.6, 7.5 and 7.3 (72°C/15sec, 100.5°C/10min and 63°C/30min, respectively) than that of control (7.8). Statistically, the variation was non-significant ($p>0.05$) among different heat treatments and time combinations. The keeping quality of camel milk also enhanced under different heat treatments and storage temperatures. Heat treated (100.5°C/10min, 63°C/30min, 72°C/15sec) and raw camel milk were spoiled on 76, 64, 56 and 24 hrs, respectively at ambient temperature, while at the refrigeration temperature, the shelf life was 42, 39, 27 and 18 days, respectively. Statistical analysis showed the significant difference (($p<0.05$) among all heat treatments and time combinations. It was found that the heat treatment (63°C/30min) was the best for sensory characteristics because it received the highest score for taste and texture while the heat treatment (100.5°C/10min) was the best for the shelf life as the highest keeping quality of camel found at that temperature.

**Keywords**: Camel milk; Heat treatments; Shelf life; Sensory properties

## Introduction

Globally, camel milk and its products have been gaining a wide demand due to their versatile health promoting properties. It contains good qualities of lactoperoxidase, lactoferrin, lysozyme, antiviral and antibacterial protective protein, that make it more superior over cow milk [1]. Furthermore, it contains low sugar, low cholesterol, high mineral (copper, sodium, iron, zinc, potassium and magnesium), high vitamin A, $B_2$, C and E, low protein and high concentration of insulin [2]. From way back, it has been utilized by human

beings due to its health promoting properties. In Pakistan, the camel populations and its milk production were one million and 875 tons, respectively [3].

Sensory characteristics of milk are most important for rating as well as consumer's preference for milk and milk products. It can be done on the basis of color, consistency, texture and flavor. Moreover, it provides estimated information to the processors and producers regarding the consumers' preference and acceptance for their products [4]. The taste of camel milk is sweet, sharp and sometimes salty. The physicochemical properties of milk is varied with the species which ultimately change the sensory characteristics of milk [5]. The flavor is considered as the most important attributes for the acceptability and preference to milk [6].

Camel milk's keeping quality is superior to the milk of other ruminants because of its protein component which inhibits the microbial growth. Farah and Fische [7] reported that raw milk of camel could be a saleable commodity, even though at basic hygiene and high temperature for a short period of time. Currently, the bulk of camel milk is utilized in the fresh state. However, the different heat treatments such pasteurization (63°C for 30 minutes and 72°C for 15 seconds), sterilization and boiling may be applied to milk in order to extend its keeping quality and improve the products' quality by curtailing the load of microorganisms, hence minimizing the risk of food poisoning [8, 9]. However, these treatments are not always applied to ascertain microbiological safety but also applied to improve the organoleptic properties of its products [10]. The different characteristics of camel milk in comparison to other ruminants' milk fascinated for the present study. It was aimed to evaluate the sensory characteristics and shelf life of camel milk.

## Materials and methods

### Study Area

Samples (n=20) of camel milk were collected from the nearby areas of Hyderabad and transported (4±1°C) to the Department of Animal Products Technology, Laboratory of Milk and Meat Chemistry, Sindh Agriculture University, Tandojam, Sindh Pakistan for the analysis of sensory properties and shelf life of camel milk.

### Heat treatments

Each milk sample was distributed into four equal parts and codded as A, B, C and D. One part (A) was kept as the control without any treatment while remaining three parts of samples (A, B, and C) were thermally treated at 63°C/30 minutes, 72°C/15 seconds and 100.5°C/10 minutes, respectively. For heat treatments, each sample was transferred to the flask, had a long neck closed tightly with a stopper. The flask was placed in a container filled with hot water and heated for specified time and temperature. During heating, milk was stirred continuously and finally cooled after specified time using running tap water.

### Sensory analysis

Milk samples were analysed for sensory characteristics by a panel of judges. A total of 30 panelists (of different age and sex) were selected from the Master of Philosophy students. They were familiarized with the questionnaires for sensory characteristics and following vocabulary was used for the sensory characteristics, maximum scores 10 for appearance/color, 45 for flavor/taste and 30 for texture/body [11]. The samples were also served among the judges for overall acceptability (maximum 10score) that was evaluated with Hedonic Scale [12]. Biscuits were used to neutralize the tastes in between samples.

### Shelf life evaluation

All the treated and control samples were further divided into two parts, one was kept at ambient temperature while other was placed at refrigeration (4±1°C) for the shelf life evaluation. The former (ambient temperature) was evaluated first at the interval of 24hrs and then at the interval of 4 hours and the second part (refrigerated)

was analysed at the interval of 3days. The shelf life of camel milk was analysed by using titratable acidity and clot on boiling (COB) tests.

**Titrable acidity (%)**

The developed acidity (%) of camel milk was observed by titration with sodium hydroxide. Camel milk (10ml) was transferred in a conical flask and 3-4 drops of phenolphthalein were added and titrated against N/10 NaOH (sodium hydroxide) till the change of colour. Finally, the reading of burette was used in formula for the determination of titrable acidity **[13]**.

**Clot on boiling test**

Clot on boiling test in addition to titrable acidity was used for the analysis of shelf life of camel milk. Camel milk (5 ml) was added in screw cap test tubes and heated for boiling. Once the milk starts boiling, it was heated further for 5 minutes. The time was noted by using stopwatch. The precipitation of milk showed that the milk expired which cannot be used for the manufacturing of any products or for consumption **[14]**.

**Statistical analysis of data**

The collected data was interpreted by the Student Edition of Statistix (SXW), a computer program version 8.1 (Analytical software-USA, Copyright 2005). The LSD (least significant difference) and Analysis of variance were also used for the observation of variation in between different heat treatments **[15]**.

## Results and discussion

**Effect of heat treatments on sensory characteristics of camel milk**

The effect of thermal treatments on sensory characteristics is shown in (Table 1). The sensory properties of camel milk significantly ($p<0.05$) improved when heated at different temperatures and time combinations such as the score for taste, texture and overall acceptability (36.3, 24.4 and 7.4, respectively) was noted at $63^0$C for 30minutes followed by $100.5^0$C for 10minutes (34.8, 24.0 and 7.7, respectively) and $72^0$C for 15seconds (33.2, 22.3 and 7.0, respectively) in comparison to the control (32.2, 21.4 and 6.9). The significant difference ($p<0.05$) was found between control and heat treated camel milk. On the other hand, the scores for colour were decreased with heat treatments and time combinations. However, the analysis of variance showed non-significant ($P>0.05$) difference among different heat treatments and time combinations. The flavor imparted by heating is the cause of this significant variation in the sensory characteristics. Present findings are well supported by the results of Gandy et al. **[16]** who stated that the heat treatments altered the consumers' preference. They further reported that the consumer preferred the pasteurized milk at 79°C in comparison to pasteurization at 77, 82 and 85°C. A similar type of research on skim milk was conducted by ul Ha et al. **[14]** who reported that the heat treated skim milk was preferred by the panel judges in comparison to the raw skim milk.

**Table 1. Sensory characteristics under different heat treatments and time combinations**

| Sensory attributes | Treatments | | | | SE± | LSD (0.05) |
|---|---|---|---|---|---|---|
| | Control | 63°C/30min | 72°C/15sec | 100.5°C/10min | | |
| Color/appearance (max 10) | $7.8^{a}$ | $7.3^{a}$ | $7.6^{a}$ | $7.5^{a}$ | 0.361 | 0.716 |
| Taste/flavor (max 45) | $32.2^{b}$ | $36.3^{a}$ | $33.2^{ab}$ | $34.8^{ab}$ | 2.009 | 3.979 |
| Body/texture (max 10) | $21.4^{b}$ | $24.4^{a}$ | $22.3^{ab}$ | $24.0^{a}$ | 1.076 | 2.132 |
| Overall Acceptability (max 10) | $6.9^{b}$ | $7.4^{ab}$ | $7.0^{b}$ | $7.7^{a}$ | 0.314 | 0.623 |

Scores with different superscripts show significant difference

**Effect of heat treatments and time combinations on the shelf life of camel milk**

The results regarding the shelf life of raw and heat-treated camel milk are presented in (Figure 1 & Table 2). It was found that the heating for different times enhanced significantly ($p<0.05$) the keeping quality of camel milk. The maximum shelf life of camel milk was noted at 100.5°C for 10 minutes as both titrable acidity (TA) and clot on boiling (COB) test were performed to found that the camel milk was expired on 76 hrs and 42 days (at ambient and refrigerator temperature, respectively). At the ambient temperature, keeping quality of raw and heat treated came milk was 76, 64, 56 and 24 hrs (100.5°C for 10 minutes, 63°C for 30 minutes, 72°C for 15 seconds and control, respectively). However, when kept under refrigeration temperature, the keeping quality of raw and heat treated camel milk was 42, 39, 27 and 18 days (at 100.5°C for 10 minutes, 63°C for 30 minutes, 72°C for 15 seconds and control, respectively). The keeping duration of camel milk is longer in comparison to the other milk because it contains antibacterial constituents [17, 18]. It was observed that the heat treatments and time combinations enhanced the normal shelf life of camel milk due to killing spoilage microorganisms. These findings are correlated with the results of Said *et al.* [19] who observed that the keeping quality of pasteurized milk (36 days) is higher compared to the raw milk of camel. The refrigeration temperature further extended the keeping quality of camel milk in comparison to ambient temperature because it inhibits the growth of spoilage micro-organisms in addition to antibacterial constituents.

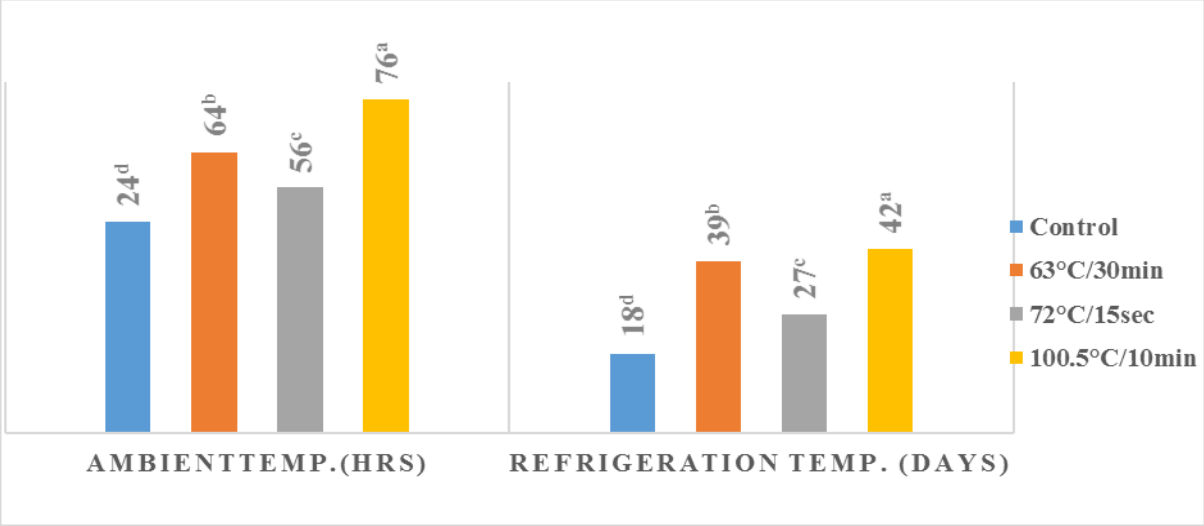


**Figure 1. Comparison of raw and heat treated camel milk under different storage temperatures**

**Table 2. Shelf life of raw and heat treat camel milk stored at ambient and refrigerator temperatures**

| Treatments | Shelf life of camel milk | |
|---|---|---|
| | ambient temperature (Hrs) | refrigerator temperature (days) |
| Control/raw | $24^{d}$ | $18^{d}$ |
| 63°C/30min | $64^{b}$ | $39^{b}$ |
| 72°C/15sec | $56^{c}$ | $27^{c}$ |
| 100.5°C/10min | $76^{a}$ | $42^{a}$ |
| **S.E ±** | 0.9317 | 0.8841 |
| **LSD (0.05)** | 1.8557 | 1.7608 |

Variables with different superscripts show significant difference

## Conclusion

Present findings lead to the conclusion that the heating treatments and time combinations improved the sensory properties of camel milk. These treatments changed the salty taste of camel milk into a sweetish taste that's why the Panel of judges preferred the heat treated camel milk in comparison to control. The milk of camel treated at 63°C for 30minutes got the highest score for taste and texture while camel milk treated at 100.5°C for 10 minutes received the highest score for overall acceptability of sensory characteristics. In addition to sensory properties, it was found a major improvement in the keeping quality of camel milk under different temperatures and time combinations. The shelf life of camel milk was found maximum at 100.5°C for 10 minutes. The keeping duration further extended when heat treated camel milk kept under refrigeration temperature.

## Authors' contributions

Conceived and designed the experiments: AK Lund, AH Shah, MC Malhi & GB Khaskheli, Performed the experiments: AK Lund & MA Khanzada, Analyzed the data: Q Kalwar & AA Khaskheli, Contributed materials/ analysis/ tools: AH Shah & GB Khaskheli, Wrote the paper: AK Lund & AS Jatoi.

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