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Short Communication

Effect of Heat Treatments on the Constituents of Camel Milk

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AKL conducted the experiment and wrote the manuscript. AHS, GBK and MCM supervised the research, designed the experiment and guided. ASJ and ASM supported in the analysis of research data and reviewed the final manuscript. AAK helped in conducting experimental work and data collection.

Key words
Thermal stability, Camel milk constituents and nitrogen fractions

ABSTRACT

Heating is an essential step in the dairy industry. This study was carried out in order to observe the influence of heating and time combinations (63°C/30min; T_1, 72°C/15sec; T_2 and 100.17°C/10min; T_3) on physical and chemical characteristics of camel milk. The physical characteristics; pH value, acidity, specific gravity, viscosity (cP) and chemical constituents; ash, casein number (CN), non-casein (NCN), whey protein nitrogen (WPN) and whey protein denaturation (WPD) were significantly ($p<0.05$) varied at different heat treatments in contrast to control (T_0). The variation was also observed in conductivity, refractive index, moisture, fat, protein and lactose content, however, it was non-significant ($p>0.05$). Results are concluded that the nitrogen fractions markedly affected by different heating and time combinations followed by physical properties while less effect on the chemical components of milk ultimately nutritive value.

Camel population is about four million throughout the world. Pakistan ranks 8th with a population of about 1 million and mostly populated with dromedaries but a few herds of Bactrians (two-humped camels) are also found in the extreme northern areas (FAO, 2010). They are an important nutritional source for inhabitants in arid and semi-arid areas throughout the world. Globally, camel milk has been exploited for human health due to its nutritional and therapeutic properties (Gader and Alhaider, 2016). It has higher amounts of essential fatty acids (Shamsia, 2009), antimicrobial factors (i.e. lysozyme, lactoferrin, lactoperoxidase and immunoglobulins, antibacterial and antiviral protective proteins) and insulin-like protein which made it superior to the milk of other animals (Yadav *et al*., 2015).

Heat treatments (i.e. pasteurization, boiling and sterilization) are being practiced to increase the keeping quality and make it hygienic for human consumption (Walstra *et al*., 2005). People prefer to consume camel milk because it acts as anti-carcinogenic (Magjeed, 2005), hypo-allergic and anti-diabetic (Shabo *et al*., 2005). The knowledge regarding the influence of these treatments on the nutritional, biological and functional properties of has been studied but still knowledge scared on camel milk. Therefore, the present study was designed to evaluate the influence of various heat treatments on physico-chemical characteristics and the nitrogen fractions of camel milk.

Materials and methods

The raw camel milk was procured from the vicinity of Hyderabad, Sindh-Pakistan and brought to the Laboratory, Department of Animal Products Technology, Sindh Agriculture University, Tandojam. The camel milk was

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categorized as T_0, T_1, T_2, and T_3 (control/raw, heat treated at 63ºC for 30minutes; LTLT, 72ºC for 15 seconds; HTST and 100.17ºC for 10 minutes; boiling, respectively). All milk samples were analysed for physico-chemical characteristics and nitrogen fractions.

Physical properties include titratable acidity, specific gravity, viscosity (cp) and conductivity (ms/cm) of raw and heat treated camel milk was determined as reported in the Association of Official Analytical Chemists (AOAC, 2000). The pH value and Refractive Index of samples were analyzed by using a pH meter (Model-1 Hanna Instruments, Italy) and a refractometer (Model RX-5000a, Tokyo, Japan), respectively.

The chemical constituents such as moisture and ash content were determined as described by AOAC (2000), the fat content was analysed by the Gerber method as described by James (1995) and the protein content was estimated according to the method of British Standards Institution (BSI, 1990). Lactose percentage was determined by the difference formula James (1992). Nutritive value was calculated by the formula as reported by James (1995).

Among nitrogen fractions, total nitrogen (TN) in camel milk (heated and non-heated) was analysed according to method as reported by Ling (1987). Non-casein nitrogen (NCN) was analysed according to the method as described by Abbas *et al*. (2013). Non-protein nitrogen (NPN) was determined according to a method as mentioned by Abbas *et al*. (2013). Whey protein nitrogen (WPN), casein number (CN) and denaturation of WPN were determined according to the methods as used by Manji and Kakuda (1987).

The data so obtained was analysed by using Analysis of Variance (ANOVA) and least significant difference (LSD) at 5% probability through the computerized statistical package, Student Edition of Statistix (SXW), Version 8.1 (Copyright 2005, Analytical software-USA) (Gomez and Gomez 1984).

Results and discussion

The current study revealed that the physical characteristics (Table I) of camel milk were significantly ($P<0.05$) changed by applying different heat treatments except for conductivity and refractive index where the differences existed non-significant ($P>0.05$). The pH value and acidity have an inverse relationship and showed significant ($P<0.05$) variations. These results

Table I. Effect of heat treatments on the characteristics of camel milk.

Characteristics	T_0	T_1	T_2	T_3	LSD (0.05) SE ±
Physical properties					
Acidity (%)	0.16[a]	0.13[b]	0.15[ab]	0.14[ab]	0.0263±0.0121
pH	6.55	6.65	6.56	6.66	0.0937±0.0430
Specific Gravity	1.0299[b]	1.0319[a]	1.0306[b]	1.0326[a]	0.008 ±0.0003
Viscosity (cP)	1.393[c]	1.809[ab]	1.600[bc]	2.017[a]	0.3060 ±0.1404
Conductivity (mS/cm)	5.84	6.28	6.38	7.15	NS
Refractive Index	1.3462	1.3456	1.3454	1.3455	NS
Chemical constituents (%)					
Moisture	89.5	88.1	88.6	87.2	NS
Fat	3.02	3.62	3.42	3.92	NS
Protein	2.72	2.85	2.78	2.99	NS
Lactose	4.2	4.5	4.3	4.7	NS
Ash	0.75[b]	0.86[b]	0.78[b]	0.99[a]	0.1127±0.0517
NV (K. cal./ 100g)	54.9	62	59.2	66.1	NS
Nitrogen fractions (%)					
Total nitrogen	0.5205	0.5205	0.5205	0.5205	NS
Non-casein nitrogen	0.1568[a]	0.1428[ab]	0.1268[ab]	0.1097[b]	0.0390±0.0179
Non-protein nitrogen	0.0310	0.0298	0.0293	0.0278	NS
Whey protein nitrogen	0.1258[a]	0.1125[ab]	0.0975[ab]	0.0820[b]	0.0349±0.0160
Casein number	67.07[c]	70.27[bc]	73.17[b]	76.95[a]	3.3711±1.5472
WPN denaturation	0[d]	10.553[c]	22.15[b]	34.3[a]	2.9439±1.3511

* Values having different superscripts within the row are significantly different from one another. T_0 (control/raw), T_1 (heat treated at 63ºC for 30minutes; LTLT), T_2 (72ºC for 15 seconds; HTST) and T_3 (100.17ºC for 10 minutes; boiling). NS=non-significant, NV=nutritive value.

are in line with the findings of Alkaladi *et al*. (2014) who reported that the pH of milk slightly increased with heat treatments (pH 6.5 at 63°C 30min and 6.4 of control milk). The specific gravity and viscosity also have an inverse relationship and significantly (P<0.05) varied at T_1 and T_3 and non-significant at T_1 than that of control (T_0). It is of importance to note that the heating of milk causes evaporation of moisture while enhancing the proportion of total solid that makes it more viscous and resulting in the increase of specific gravity. It was also found the changes in conductivity and refractive index but were non-significant, (P>0.05).

In the current study, the effect of various heat treatments on chemical components (Table I) such as moisture, fat, protein and lactose contents of camel milk was found to be non-significant (P>0.05), except for ash contents where differences existed significant (P<0.05) in contrast to control (Table I). The ash contents are in ranges with the findings of Khanna and Rai (1993). However, a slight variation was observed in all components of camel milk due to the evaporation of water under different temperature regimes. The nutritive value (Table I) of the milk was increased non-significantly (P>0.05) under different heating and time combination.

The heating along with time combination had a significant (P<0.05) effect on nitrogen fractions (Table I) except total nitrogen (TN) and non-protein nitrogen (NPN) that were varied non-significantly (P>0.05) than that of control. The total nitrogen was also unchanged in the study carried out by Hattem *et al*. (2011). Denaturation of whey protein increased significantly (P<0.05) with the increasing temperature and time combinations. Furthermore, researchers reported that the NCN and WPN decrease with the heating (Hassan *et al*., 2009) while casein number and denaturation of whey protein increases under heat treatments (Farah, 1986).

Conclusion

The conclusion of the present study is that the heating and time combination has great influence on the nitrogen fractions and physical properties while insignificant effect observed on the chemical constituents of camel milk.

Statement of conflicts of interest

The authors have declared no conflict of interest.

References

Abbas, S., Hifsa, A., Aalia, N. and Lubna, S., 2013. *Int. Res*., **2**: 85-98.

Alkaladi, A., Afifi, M., Kamal, R., and Afifi, M., 2014. *Bothalia J.*, **44**: 301-311.

Association of official analytical chemistry-AOAC 2000. *Dairy products*. In: official Methods of Analysis. Association of Official Analytical Chemists, Inc. Gaithersburg, U.S.A.

BSI, 1990. *Determination of nitrogen content of liquid milk*. In: Methods of chemical Analysis of liquid milk and cream. BSI: 1741, British Standards Institution, London, UK.

Farah, Z., 1986. *Milchwissenschaft*, **41**: 763-765. https://doi.org/10.1055/s-1986-31769

Food and Agriculture Organization, 2010. *FAOSTAT. FAO statistics division 2013*, 05 january 2013.

Gader, A. and Alhaider, A., 2016. *J. Taibah Univ. Med. Sci*., **11**: 98-103. https://doi.org/10.1016/j.jtumed.2015.12.007

Gomez, K.A., and Gomez, A.A., 1984. *Statistical procedures for agricultural research*. John Wiley and Sons.

Hassan, Z., Azza, M., and Mona, A., 2009. Ann. Agric. Sci. (Cairo), **54**: 137-147.

Hattem, H.E., Manal, A.N., Hanna, S.S., and Elham, A.A., 2011. *J. Brew. Distill.*, **2**: 51-55.

James, C., 1995. *Lon. R. Soc. Chem. Minist. Agric., Fish. Fds*., **5**: 18-94.

James, M.J., 1992. *Analysis of dairy products. Modern food microbiology (4th edition)*. Chapman Hall, New York, London.

Khan, B., and Iqbal, A., 2001. *Pak. J. Agric. Sci.,* **38**: 64-68.

Khanna, N.D. and A.K. Rai. 1993. *Asian Livest*., **18**: 19-21.

Ling, E.R., 1987. *Textbook of Dairy Chemistry. Second and revised edition*. Volume Champan and Hall Ltd., London.

Magjeed, N., 2005. *J. Saudi Chem. Soc*., **9**: 253-263.

Manji, B. and Kakuda, Y., 1987. *J. Dairy Sci*., **70**: 1355-1361. https://doi.org/10.3168/jds.S0022-0302(87)80156-X

Shabo, Y., Barzel, R., Margoulis, M., and Yagil, R., 2005. *Isr. Med. Assoc. J. Ramat Gan.*, **7**: 796.

Shamsia, S., 2009. *Int. J. Genet. Mol. Biol*., **1**: 52-58.

Walstra, P., Geurts, T.J., Noomen, A., Jellema and van Boekel., M.A.J.S., 2005. *Text book of Dairy technology: Principles of milk properties and processes*.

Yadav, A.K., Kumar, R., Priyadarshini, L., and Singh, J., 2015. *Asian J. Dairy Fd. Res.*, **34**: 83-91. https://doi.org/10.5958/0976-0563.2015.00018.4

Yadav, J.S., Grover, S. and Batish, V.K., 1993. *Time and temperature combination*. A comprehensive dairy microbiology. Metropolitan New Delhi-1100002, India.