Factors Influencing Gelation and Rennetability of Camel Milk using Camel Chymosin

Hailu, Yonas; Ipsen, Richard; Hansen, Egon Bech; Seifu, Eyassu; Eshetu, Mitiku

Publication date:
2015

Document Version
Publisher's PDF, also known as Version of record

Factors Influencing Gelation and Rennetability of Camel Milk using Camel Chymosin

Yonas Hailu[¤¥], Richard Ipsen[¥], Egon Bech Hansen[$], Eyassu Seifu[§] and Mitiku Eshetu[¤].
[¤]*Haramaya University, Ethiopia,* [¥]*University of Copenhagen,* [§]*Technical University of Denmark,* [§]*Botswana College of Agriculture, Botswana*

ABSTRACT
Effect of temperature (T), pH and chymosin (CHY-MAX®M) concentration (CC) on caseinomacropeptide (CMP) release and gelation of camel milk was studied. Results revealed significant ($p < 0.05$) effects of T, pH and CC on the rate of κ-casein (κ-CN) hydrolysis and the interaction between T and CC significantly ($p<0.05$) affected gel development. A high level of CC (85 IMCU L^{-1}) and T (40°C) was needed to obtain satisfactory gelation parameters and in all cases > 95 % CMP was found to be released from the casein (CN) micelle prior to aggregation.

INTRODUCTION
The composition of camel milk protein differs from milk of other species and CN micelles from camel milk have a larger average diameter (~380 nm) than bovine CN micelles[1]. The distribution of the different CNs is also substantially different, mainly in that camel milk has a smaller proportion of κ-CN (3.5% of the total CN) and relatively much more β-CN (65% of total CN)[2] than bovine milk, where the proportions are 12% and 33%, respectively[3]. Until recently a suitable coagulant enzyme (i.e. camel chymosin) was not obtainable, hence very limited studies are available on κ-CN hydrolysis and gelation of camel milk.

METHODOLOGY
The release of CMP was determined by size exclusion HPLC[4]. Rennetability and gelation of camel milk were followed using a free oscillating rheometer (ReoRox G2, Medirox, Nyköping, Sweden). Rate constant (K) for κ-CN hydrolysis was determined by fitting in to a first order kinetics model (*i.e.* $\boldsymbol{CMP = CMP_{\infty}(1 - e^{-Kt})}$. Gelation time ($t_g$), time interval from t_g until G' reached a value ($\frac{G'_{\infty}}{e}$) ($\boldsymbol{\tau}$), G' value at t= ∞ (G'_{∞}), were predicted using Scott Blair equation (i.e. $\mathbf{G' = G_{\infty} * e^{(-\tau/(t-t_g))}}$. Where (t) is time after chymosin addition and (G') is storage modulus.

RESULTS
Gelation of caseins started after > 95% CMP released from casein micelle. Variation in lag phase of gel development was observed for different levels of T (Fig. 1).

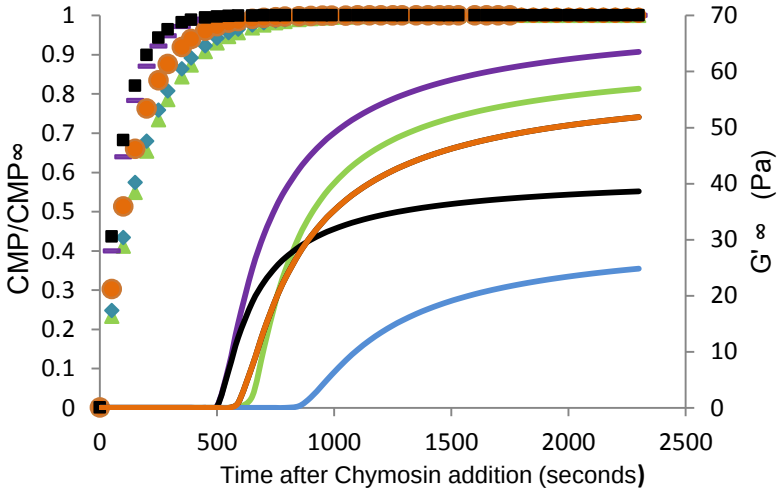

Fig 1. Effect of T, CC and pH on camel κ -CN hydrolysis and gelation (solid lines). T (♦) 30 °C and ((●) 40 °C, 55 IMCU L^{-1}) and CC (■) 85 IMCU L^{-1}; pH (▲) 6.6 and (—) 6.0.

The κ-CN hydrolysis rate has a negative correlation of 0.693 with t_g

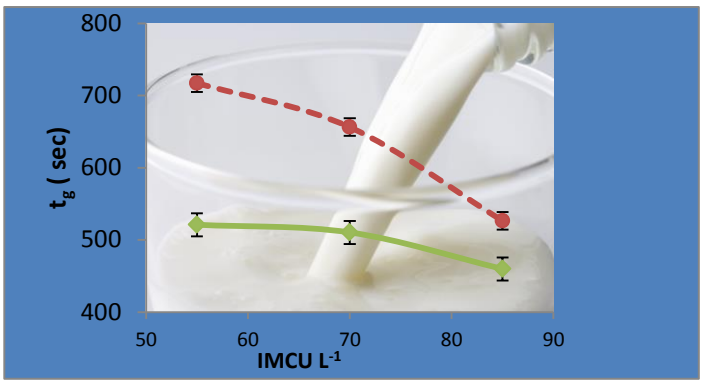

Fig 2. Gelation time (t_g) of camel milk as a function of T and CC. … (30°C) & — (40 °C).

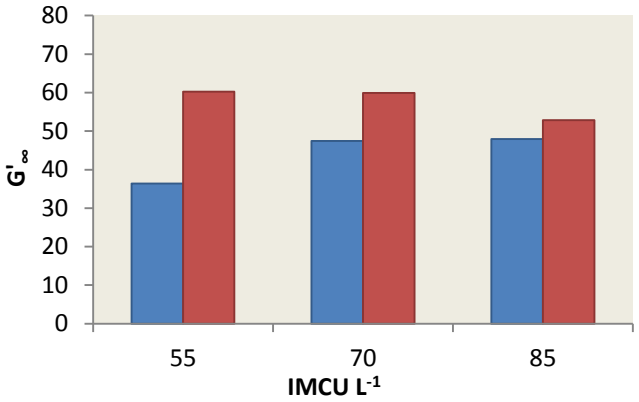

Fig 3. Storage module development at different T and CC. ■ 30 °C & ■ 40 °C.

CONCLUSION
More than 95% of the CMP has to be released from the κ-CN of camel milk for the aggregation and gel formation to commence. The time of gelation was shown to be mainly affected by temperature (t_g shorter at 40 than 30 °C) and by using a higher CC (85 IMCU L^{-1}) a comparable G'_{∞} was obtained irrespective of temperature.

REFERENCES
1. Bornaz et al. (2009). *IJDT*. 62(4):505-513.
2. Kappeler, S. (1998). PhD Thesis, ETH Zürich.
3. Walstra, P. et al. (2006). Dairy Science and Technology
4. Van Hooydonk A.C.M., and Olieman C. (1982). NMDJ. 36.

Acknowledgments; *Wholehearted gratefulness to Prof. Karsten Bruun Qvist for his dedicated guidance and encouragement. DANIDA is sincerely acknowledged for financial support.*