

CRYOSCOPY AND REFRACTION IN MILK

by

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PRITZKER¹ (1917) observed that the freezing point and the refractometric reading of the calcium-chloride serum were both influenced, as is to be expected, according to the amount of calcium chloride added to the milk. Further, he reported that the freezing point of milk varies correspondingly with the refractometric reading of the milk serum. This may be explained by the fact that the solutes in milk which cause a depression of the freezing point are also responsible for the refractive index of the milk serum (plus that of the added calcium chloride). Therefore, added calcium chloride remaining the same, it follows that any variations in the content of the milk solutes bring about corresponding changes in both the freezing point of milk and the refractive index of the serum.

A method was recently devised by the author² for the estimation, with the Abbé refractometer, of the refractive index of milk, as distinct from that of milk serum. It would be of interest to determine any relation that might exist between the freezing point and the refractive index of milk. Such a relation could, perhaps, throw light on the significance of refraction in milk. The freezing point and the refractive index of a number of samples of milk have therefore been recorded and discussed in this paper.

EXPERIMENTAL PROCEDURE

Fresh samples of both individual and bulk cow and buffalo milk were used for this experiment. The samples of cow milk were drawn from five breeds, but the buffalo milk was only available from the Murrah breed.

The refractive index was measured as before², and the freezing point was estimated with the Hortvet apparatus according to the standard procedure^{3, 4}. The density, refractive index, refractive constant (k , calculated as before), and the freezing point of the samples are all given in Table I.

DISCUSSION

It is clear from the above figures that there is little correlation between the depression of the freezing point and the refractive index or refractive Constant of milk. This lack of relationship, in contradistinction to the relationship between freezing point of milk and refractive index of *milk serum*, is to be attributed to the fact that while the refractive index of *milk* is a function of solids-not-fat of milk, the freezing point is governed only by the lactose, mineral salts and other minor constituents that are in true solution.

TABLE I
REFRACTIVE INDEX AND FREEZING POINT OF COW AND BUFFALO MILK

Breed	Density (20° C)	R.I. (40° C)	K	Freezing point
<i>Cow-Individual</i>				
Sindhi	1.0287	1.3467	0.2073	— 0.549
Sindhi	290	72	75	— 0.544
Sindhi	284	60	69	— 0.552
Sindhi	313	68	69	— 0.553
Sindhi	304	70	71	— 0.547
<i>Cow-Bulk :</i>				
Crossbred	1.0293	1.3463	0.2070	— 0.548
Crossbred	298	60	66	— 0.555
Sahival	314	68	71	— 0.549
Gir	293	63	71	— 0.550
Gir	282	59	70	— 0.550
Sindhi	298	67	71	— 0.540
Sindhi	1.0300	1.3458	0.2065	— 0.549
Tharparkar	290	58	67	— 0.544
Tharparkar	310	60	65	— 0.540
<i>Buffalo-Individual :</i>				
Murrah	1.0331	1.3497	0.2083	— 0.562
Murrah	254	80	88	— 0.547
Murrah	297	79	80	— 0.545
Murrah	315	77	76	— 0.548
Murrah	313	85	80	— 0.557
<i>Buffalo-Bulk :</i>				
Murrah	1.0329	1.3487	0.2077	— 0.548
Murrah	319	78	75	— 0.569

Acknowledgement

I wish to thank the Director of Dairy Research for kind permission to conduct experiments in the laboratories of the Imperial Dairy Research Institute, Bangalore, and to Dr N. N. DASTUR, Mr DHARMARAJAN and Mr VENHATAPPAYA for the values on the freezing point of milk.

I am indebted to Mr N. B. BANERJEE and Prof. SUBRAHMANYAN for their kind interest and encouragement in all these investigations.

SUMMARY

The refractive index, refractive Constant and the freezing point of milk shows that there exists hardly any correlation between the freezing point and either of the other two physical constants of milk. This is accounted for by the fact that, unlike in the case of the freezing point depression, constituents other than those in true solution come into play in the refractive index and Constant of milk.

RÉSUMÉ

Il n'existe pas de corrélation entre l'indice de réfraction et la constante de réfraction d'une part et le point de congélation du lait, d'autre part. Ceci s'explique par le fait que, contrairement à ce qui a lieu pour l'abaissement du point de congélation, l'indice de réfraction et la constante de réfraction du lait dépendent de constituants autres que ceux qui sont en solution vraie.

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ZUSAMMENFASSUNG

Der Brechungsindex, die Refraktionskonstante und der Schmelzpunkt von Milch zeigen, dass kaum irgendeine Korrelation zwischen dem Schmelzpunkt und einer der beiden anderen physikalischen Konstanten von Milch besteht. Dies wird durch die Tatsache erklärt, dass im Gegensatz zum Falle der Schmelzpunkterniedrigung, bei dem Refraktionsindex und der Refraktionskonstante der Milch auch Bestandteile, die nicht in wahrer Lösung vorhanden sind, eine Rolle spielen.

REFERENCES

- ¹ PRITZKER, *Z. Nahr.-Genussm.*, 34 (1917) 69, 112.
- ² K. S. RANGAPPA, *Proc. Indian Acad. Sc., B.*, 25 (1947) 86.
- ³ HORTVET, *J. Assoc. Off. Agr. Chem.*, (1923) 424.
- ⁴ ELSDON AND STUBBS, *Analyst*, 59 (1934) 585; 60 (1935) 147.

Received March 11th, 1948