

THE ACIDITY OF GOAT'S MILK IN TERMS OF HYDROGEN ION CONCENTRATION, WITH COMPARISONS TO THAT OF COW'S AND HUMAN MILK.

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Goat's milk is occasionally recommended in preference to cow's milk for infant feeding. For that reason the authors considered it of interest to determine the hydrogen ion concentration of goat's milk and thereby ascertain the relation that the acidity of goat's milk bears to that of cow's and human milk. Easy access to two herds of milch goats encouraged these studies. A series of determinations was made on freshly drawn milk, and also a series on milk allowed to sour at room temperature in the laboratory. The latter readings were made to determine the maximum acidity of soured goat's milk, in order that comparisons could also be made with the maximum acidity attained by cow's milk.

Method.

The colorimetric method was employed. The principles and procedures of this method of determining the hydrogen ion concentration of fluids are fully described in an excellent treatise on the subject by Clark.¹ The Sørensen mixtures of primary and secondary phosphates were used as standard buffer solutions for the pH range from 7.2 to 5.2; the Clark and Lubs standard mixtures of potassium hydrogen phthalate and sodium hydroxide from 5.2 to 4.0; and their mixture of potassium hydrogen phthalate and hydrochloric acid from 4.0 to 3.4. Brom-thymol blue was used as an indicator for the pH range from 7.2 to 6.0, methyl

¹ Clark, W. M., The determination of hydrogen ions, Baltimore, 1920 (contains complete bibliography).

red from 6.0 to 4.6, and brom-phenol blue from 4.6 to 3.4. Pyrex glassware was used throughout. The accuracy of the standard solutions was controlled.

The samples of milk were taken directly from the udder into a sterile flask and immediately taken to the laboratory. The readings were made within 1 hour, usually within 30 minutes. About 1 cc. of milk was dialyzed through a collodion sac against 2 cc. of neutral distilled water. (Distilled water gave us the same results as physiological salt solution, and the proportion of milk to water used the same as equal volumes.) $7\frac{1}{2}$ minutes were allowed for dialysis to take place. The proper amount of indicator was then added to the dialysate and the reading made. The maximum acidity of soured milk was determined by making daily readings on each sample until constant readings were obtained. In no case did a sample of sour milk show a decrease in acidity.

Results.

The results obtained from 160 determinations on fresh goat's milk varied from pH 6.7 to 6.4. The average pH for 86 morning samples was 6.52; for 74 evening samples 6.54; and 6.53 for the total number.

The end-points of 73 samples of soured goat's milk varied from pH 4.4 to 3.7, averaging 3.92.

Hydrogen Ion Concentration of Cow's and Human Milk.

Cow's Milk.

Van Slyke and Baker² state that the pH in 300 samples of cow's milk ranged from 6.5 to 7.2, 83 per cent of which were between 6.5 and 6.76. Taylor³ gives a pH of 6.8; Clark⁴ of 6.6; Van Dam⁵ of 6.74; Alleman⁶ of 6.61; Davidsohn⁷ of 6.52; and Mil-

² Van Slyke, L. L., and Baker, J. C., *J. Biol. Chem.*, 1919, xl, 345.

³ Taylor, H. B., *J. Proc. Roy. Soc. New South Wales*, 1913, lxxvii, pt. 2, 174.

⁴ Clark, W. M., *J. Med. Research*, 1914-15, xxxi, 431.

⁵ Van Dam, W., *Rev. gén. Lait*, 1908, vii, 121.

⁶ Alleman, O., *Biochem. Z.*, 1912, lxxv, 346.

⁷ Davidsohn, H., *Z. Kinderheilk.*, 1913, ix, 14.

roy⁸ of 6.8 to 6.64. These were all determinations on fresh cow's milk. Taylor³ found the maximum acidity of soured cow's milk to be 4.65.

Human Milk.

Davidsohn⁹ found that human breast milk gave a pH reading of 6.97, while Clark's⁴ determinations average 7.22. However, the latter author states it is safe to say that the average hydrogen ion concentration of human breast milk lies between 6.86 and 7.46. Terry¹⁰ states that cow's milk has about six times the potential acidity of human milk.

CONCLUSIONS.

The average hydrogen ion concentration of fresh goat's milk is 6.53; that of completely soured milk 3.92. Fresh goat's milk is therefore slightly more acid than fresh cow's milk, and appreciably more acid than human breast milk. Soured goat's milk is considerably more acid than soured cow's milk.

⁸ Milroy, T. H., *Pharmacol. J.*, 1914, xciii, 350.

⁹ Davidsohn,⁷ p. 11.

¹⁰ Terry, R. W., *J. Am. Pharm. Assn.*, 1919, viii, 538.