

CLXV. COMPOSITION OF THE MILK FROM THE BREASTS OF NEWLY-BORN INFANTS

BY WILLIAM LEWIS DAVIES AND ALAN MONCRIEFF

From the National Institute for Research in Dairying, University of Reading, and from the Middlesex Hospital and Queen Charlotte's Maternity Hospital, London

(Received 26 May 1938)

It is well known that most infants of both sexes secrete milk when newly born, the secretion being termed witches' or sorcerers' milk. Halban [1904] described the phenomenon as a puerpural involution in the mammary glands of the newly born infants. Billard [1837] considered the secretion to be imperfect milk loaded with leucocytes, often ending in abscesses. Schlossberger [1852] has given an analysis of one sample, viz. total solids 3.25, fat 0.82, protein and sugar 2.83 and ash 0.5%. Three analyses by Gessner [1867] show the secretion to contain total solids 3.7-10.6, fat 0.8-1.5, total protein 1.1-2.8 and lactose plus ash 1.9-6.4%.

In the present investigation, 5 samples of such secretions were collected from infants of both sexes between 9 and 17 days old and submitted to as comprehensive an analysis as the small yields obtained permitted. The milk was obtained by gentle squeezing of the enlarged breasts, the milk then being sucked up by a pipette and transferred to small glass bottles containing a trace of formalin. The yields were variable but in no case exceeded 1.8 g.

By suitable management of fractions and adoption of microchemical technique, the following analytical data were collected: total solids, nitrogen distri-

Table I. *Composition of milk from breasts of infants*

Sample No.	1	2	3	4	5
Sex	M. and F.	M.	F.	M.	F.
Age (days)	8 (M.) and 17 (F.)	9	14	10	9
Yield (g.)	1.20	0.35	0.84	1.77	0.65
As % of milk:					
Total solids	8.67	12.50	7.36	9.76	10.57
Protein (N × 6.38)	3.40	7.23	4.60	2.68	8.31
Lactose	1.80	1.56	1.56	2.67	1.00
(as glucose)	0.99	0.86	0.86	1.47	0.55
Fat + ash, etc. (by difference)	3.47	3.71	1.20	4.41	1.26
Cl	0.14	0.10	0.14	0.10	0.12
Total N	0.53	1.13	0.72	0.42	1.30
Protein N	0.34	0.62	0.51	0.28	0.71
Casein N	0.22	0.52	0.36	0.21	0.56
Non-protein N	0.19	0.51	0.21	0.14	0.59
Osmotic equivalents:					
Lactose equivalent of Cl	2.74	1.96	2.74	1.96	2.35
Lactose equivalent of N.P.N. (calc.)	2.50	4.30	2.70	2.40	3.60
As % of total N:					
Protein N	65	55	70	67	55
Casein N	40	46	49	33	43
Non-protein N	35	45	30	34	45
Casein in protein %	63	84	70	50	79
Peroxidase	+	+	+	+	+
Phosphatase (units per 0.5 ml.)	7.6	7.4	7.5	5.1	6.9

bution, sugar and chloride content and evidence of the presence of peroxidase and phosphatase. The weights of samples were unfortunately too small to determine fat and mineral distribution; the amount of ash was in all cases too small to be determined accurately.

Total solids were determined by drying at 100°. Nitrogen distributions were studied by separating the casein at pH 4.6 with an acetate buffer and centrifuging, and total protein was determined by precipitation with 4% trichloroacetic acid at 70°; all the nitrogen fractions were determined by micromethods. Sugars were determined by Maclean's method for blood sugar. Peroxidase was tested for by the benzidine-H₂O₂ method and phosphatase by the Kay & Graham [1935] technique. Table I gives the results obtained for the 5 samples.

All samples appeared to contain fat since they showed the property of creaming on standing; no churning of the fat had occurred during transit in the post. The fat content was not determined.

Discussion of results

The total solids content was regularly higher than that reported by other workers, except a value for one sample given by Gessner. The highest total solids occurred around the 9th day, protein accounting for most (60–80%) of the solids. It is probable that the secretion is at first watery, rises in total solids and protein content to the 9th day, and then decreases in solids slowly and in protein rapidly, due to resorption in the following days.

The resorption period yields a secretion which is higher in lactose and chloride than the pre-resorption period. If the secretion obeys the same osmotic laws as normal milk, it can be stated that the higher non-protein nitrogen content of the secretions containing high total nitrogen contents balances osmotically the low contents of sugar and chloride. This was roughly tested out in the following manner. In normal milk with only 6% of the total nitrogen as non-protein nitrogen, the relationship between lactose and chloride is expressed by the formula:

$$\text{Lactose \%} + 19.6 \text{ Cl \% (A.)} = 7.0 \text{ [Davies, 1932].}$$

None of the present secretions obey this relationship, owing to the high non-protein nitrogen content. The value $7.0 - A.$ was plotted against the percentage of non-protein nitrogen for each case. This gave points which lay roughly on a straight line represented by the equation:

$$\text{Lactose equivalent of non-protein nitrogen} = \text{N.P.N. \%} \times 3 + 2.$$

Sugar, chloride and non-protein nitrogen are thus responsible for most of the osmotic pressure of these secretions.

Protein. The amount of the total true protein represented by casein was variable, ranging from 50 to 84%. Generally, casein percentage was highest when total nitrogen was highest. The non-casein protein, according to qualitative precipitation tests, contained globulin, as saturation of casein-free filtrates with Na₂SO₄ and MgSO₄ gave flocculent precipitates. The amount of non-casein protein was lowest for samples with high non-protein nitrogen content.

General. The secretions bear some resemblance in composition to those from the udders of pregnant heifers and dry non-pregnant cows [Woodman & Hammond, 1923], especially the latter. Close similarity exists in the low lactose, high total protein with low proportion of casein to total protein, and high non-protein nitrogen content. The appearance of globulin in amounts above those found in normal milk in the above and in infant secretions is undoubtedly associated with the abnormal functioning of the mammary glands, such as is found

before and immediately after parturition (colostrum). The secretion in infant breasts tends to resemble colostrum in composition, the main points of difference being the very low lactose and high non-protein nitrogen which does not occur in the latter.

The secretions gave strong peroxidase reactions, due probably to the presence of leucocytes which were observed in all samples by microscopic examination. The phosphatase content was of the same level as that found in normal cow's milk.

SUMMARY

The analyses of 5 samples of secretions from the breasts of newly-born infants from 8 to 14 days old are reported. The total solids, which range from 7.4 to 12.5 %, consist mostly of protein and lactose. Compared with normal milk, the secretions are low in lactose but high in globulin and non-protein nitrogen. The secretions contain appreciable amounts of peroxidase and phosphatase.

The authors are indebted to Dr S. J. Folley for his assistance and interest in the work.

REFERENCES

- Billard (1837). *Traité des Maladies des Enfants nouveau-nés*, 3rd edition, p. 717.
Davies (1932). *Analyst*, **57**, 79.
Gessner (1867). *Jb. Kinderheilk.* **9**, para. 160.
Halban (1904). *Z. Geburtsh. Gynäk.* **53**, 191.
Kay & Graham (1935). *J. Dairy Res.* **6**, 191.
Schlossberger (1852). *Ann. Chim. Pharm.* **87**.
Woodman & Hammond (1923). *J. agric. Sci.* **13**, 180.