XXIII. VITAMINS OF ELEPHANT'S MILK

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FOLLOWING the birth of an elephant at the Warsaw Zoological Garden in June 1937 (the twelfth recorded case in Europe), a study of the chemical composition of elephant's milk was undertaken by Dr J. Królikowski of the Department of Genetics and Animal Dietetics of the School of Agriculture, Warsaw. The present paper describes the results of a comparison of the vitamin content of the milk, supplied to us by Dr Królikowski, with that of cow's milk. The samples of milk were taken periodically over the term of a year, commencing 8 weeks after parturition, one teat being milked while the calf was sucking another; the milk was delivered at the laboratory within an hour of milking. The staple food of the mother over the period consisted of grass, hay, wheat-bran, oil-cake, carrots and fodder beets. Prior to parturition, the fodder was supplemented with milk, and immediately after calving steamed linseed and wheat-bran were also given.

In view of the limited amount of milk available, the various vitamins were not determined simultaneously, but successively. This somewhat detracts from the value of the results obtained, since the relative contents of the individual vitamins may vary according to the season of the year, duration of lactation, nature of fodder and other variable factors. Raw cow's milk supplied by the Piaseczno Dairy was taken for comparison; the cows were fed on hay, grass, wheat-bran, oil-cake, soya bean, fodder beets and swedes. Studies were made of vitamins A, B₁, the B₂ group, C and D.

Experimental

Vitamin A. This was assayed by the curative method on rats given Mellanby's vitamin A-deficient diet [Green & Mellanby, 1928]. The increase in weight during a 4-week period of administration of milk was compared with that produced by the addition of 2-3 I.U. daily of vitamin A (International standard). The experiments were conducted in March and April (11th and 12th months of lactation). The results are given in Table I.

Table I. *Vitamin A*

Source of vitamin	Daily dose	No. of rats in group	Duration of experiment days	Mean wt. increase g.
International standard	2 I.U.	3	28	24
	3 „	3	28	37
Cow's milk	2 ml.	6	29	30
Elephant's milk	2 „	9	28	3
	2.5 ml.	4	28	5

The symptoms of xerophthalmia disappeared from rats given the International standard or 2 ml. of cow's milk daily, but not from those receiving elephant's milk. The latter animals did not increase in weight and at necropsy

exhibited the characteristic suppurative foci of avitaminosis-A. It may be concluded that the milk contained less than 1 I.U. of vitamin A per ml.

Vitamin B₁. This was assayed by the curative method on rats aged 3-4 weeks. Table II gives the average increase in weight of groups of rats maintained for 3 weeks on Evans' fat-free vitamin B₁-deficient diet [Evans & Lepkovsky, 1929], supplemented with varying amounts of milk, or with the International standard vitamin B₁ preparation (1 unit daily). The assays were carried out from September to November (5th to 7th months of lactation).

Table II. *Vitamin B₁*

Source of vitamin	Daily dose	No. of rats in group	Duration of experiment days	Mean weekly wt. increase g.
International standard	10 mg. (= 1 I.U.)	6	21	10.0
Cow's milk	8 ml.	5	21	4.0
	10 "	4	21	5.0
Elephant's milk	3 "	5	21	7.5
	5 "	5	21	14.0
	8 "	5	21	14.5

It follows from the results obtained that elephant's milk contains $\approx$ 25 I.U. of vitamin B₁ per 100 ml., compared with < 10 I.U. in cow's milk.

Vitamin B₂ complex. This complex was assayed on rats weighing 50-60 g. Their mean weight increases during 4 weeks on a diet deficient in B₂-vitamins [Sherman & Spohn, 1923], supplemented with 2 I.U. daily of vitamin B₁ and with 4 ml. daily of cow's or elephant's milk, are given in Table III. The assays were made from July to September (3rd to 5th month of lactation).

Table III. *Vitamin B₂ complex*

Source of vitamin	Daily dose	No. of rats in group	Duration of experiment days	Mean weekly wt. increase g.
Elephant's milk	4 ml.	5	28	10.7
Cow's milk	4 "	5	28	13.0

It may be concluded that the amounts of vitamin B₂ complex are approximately the same in cow's and elephant's milk.

Vitamin C. This was determined chemically according to the modification by Birch *et al.* [1933] of the method of Tillmans [1932]. Kon & Watson [1936] have shown that ascorbic acid is readily converted in the presence of light into dehydroascorbic acid, which does not react with Tillmans' reagent and which is reduced to ascorbic acid by H₂S. Reducing substances other than ascorbic acid were removed by the method of Emmerie and Van Eekelen [1934].

The ascorbic acid content of elephant's milk, tested in February (10th month of lactation), was 8.80 mg. per 100 ml. for skimmed, and 7.72 mg. for full cream, milk; the corresponding values for cow's milk were 2.18 and 2.12 mg. per 100 ml.

Vitamin D. This vitamin was assayed by the preventive method on rats receiving the rachitogenic diet No. 2965 of Steenbock & Black [1925], supplemented with 10, 12 or 15 ml. of elephant's milk daily, or with 1 I.U. of calciferol (international standard). The rats were sacrificed on the 30th day and epiphyseal ossification was examined by the line test and by means of X-ray photographs. The rats receiving 10 and 12 ml. of milk had well-marked rickets, not differing in severity from vitamin D-deficient controls. Those given 15 ml. of milk daily

suffered from mild rickets, whilst those receiving 1 unit of international standard preparation showed normal ossification. Comparison with cow's milk was not performed in this case, but the author has found (unpublished) that 10 ml. of cow's milk contain about 1 I.U. of vitamin D. The assays were performed in November and December (7th and 8th months of lactation).

SUMMARY

1. Elephant's milk has a lower content of fat-soluble vitamins (A and D) than has cow's milk.
2. Its vitamin B₁ content exceeds that of cow's milk, being 25 I.U. per 100 ml., as compared with 10 I.U. for the latter.
3. Elephant's and cow's milks have approximately the same content of vitamin B₂ complex.
4. Elephant's milk contains 7.72 mg. per 100 ml. of ascorbic acid, as compared with 2.12 mg. in cow's milk.

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