HUMAN MILK STUDIES.

IV. A NOTE ON THE VITAMIN A AND B CONTENT OF COW’S MILK.

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Beginning with the report of Hopkins in 1912 (1) on the growth-promoting value of small quantities of cow’s milk in synthetic diets, the literature contains many papers on the importance of this nutrient as a source of certain factors required for growth and maintenance. Yet the data from different laboratories are difficult of comparison, because of the variation in experimental technique and growth standards and because of the rapidly changing status of our knowledge of vitamins. For instance, Osborne and Mendel (2) and Johnson (3) have demonstrated that at least 16 cc. of cow’s milk were required to supply adequate vitamin B to the growing rat, i.e. 8 times the amount reported by Hopkins (1); Dutcher and associates (4) likewise, have found that 2 cc. of milk fed as the source of vitamin A with an irradiated ration was as satisfactory for growth as 10 cc. in the absence of the antirachitic factor (5). Since it was of particular interest and importance to determine the comparative vitamin values of milks used in infant feeding, and since the standards in this series of investigations vary somewhat from those used in other laboratories, a study of the vitamin A and B content of cow’s milk has been made under the identical experimental conditions maintained in the human milk studies (6).

Raw certified cow’s milk,¹ comparable to the human milk pre-

¹ The milk was purchased from the Walker-Gordon Laboratories of the Detroit Creamery Company and received fresh daily in tightly stoppered bottles packed in ice. We are indebted to this company for information regarding the care and feeding of the dairy herd.

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previously studied, was selected for this investigation. It was produced under the best of hygienic and nutritive conditions and had the additional value of being the kind recommended in artificial infant feeding. This milk represented a composite from a herd of Holstein cows, 450 in number, fed a monotonous unchanging standard dairy ration consisting of ensilage and alfalfa hay together with a concentrate containing 600 pounds of corn gluten feed, 400 of bran, 400 of hominy, 300 of ground oats, 200 of steamed bone meal, and 20 of salt. A possible seasonal variation in the vitamin A and B content of the milk due to a change in the food of the cows was, therefore, eliminated.

Vitamin A in Cow’s Milk.

In this study the standard test rats, 21 to 26 days old, were first depleted of their store of vitamin A by feeding them an irradiated vitamin A-free ration. At the first appearance of xerophthalmia and failure to grow, certified cow’s milk was fed separately in amounts of 1.5, 2, 2.5, and 3 cc. daily. On all levels of milk growth was resumed, but the most satisfactory results were obtained when the rats received 3 cc. daily (Chart I). At the end of the experimental period all rats, with the exception of the two showing persistent xerophthalmia, appeared to be in good physical condition, but upon detailed examination at autopsy either single or double mastoid involvement was found in 77 per cent of the cases. The results indicate that, although 3 cc. of fresh raw cow’s milk daily may contain adequate vitamin A to produce satisfactory growth in the rat, this small amount does not always protect against secondary pathological conditions.

Vitamin B in Cow’s Milk.

The vitamin B content of cow’s milk was determined by standardized methods (6) in which rats, 21 to 26 days of age, were held on raised screens and fed the standard vitamin B-free ration.

In these experiments the basal ration, fed ad libitum, consisted of 18 per cent casein, 76 per cent dextrin, 4 per cent salt mixture (Osborne and Mendel), and 2 per cent agar. In the vitamin A studies this ration was exposed to ultra-violet light for 30 minutes at a distance of 15 inches. A daily amount of 0.4 gm. of yeast was fed separately. In the vitamin B studies 5 drops of cod liver oil and 2 drops of wheat germ oil were fed fresh daily apart from the basal ration.
CHART I. The deportment of rats in a curative type of experiment when 1.5, 2.0, 2.5, and 3.0 cc. of cow's milk daily served as the only source of vitamin A in an otherwise adequate ration. Although growth was satisfactory when the higher levels of milk were fed, nasal hemorrhages and pus in the mastoids were encountered in many cases.
Chart II. The growth of rats on a diet in which 12, 16, 20, and 25 cc. of cow's milk daily furnished vitamin B. After the cessation of growth on the higher levels of milk the addition of fresh dried yeast, in contrast to autoclaved yeast, produced a marked increment in body weight.
until growth ceased. Upon the addition of 12 cc. of certified cow's milk daily, the increment in weight was normal for 4 weeks only (Chart II), whereas 16 cc. produced satisfactory growth for a period of 8 weeks. A daily quantity of either 20 or 25 cc., however, allowed for excellent growth, average or above, for about 12 weeks, at which time growth was interrupted. The daily feeding of 0.4 gm. of autoclaved yeast produced no change in the deportment of the latter group; in contrast, the same quantity of fresh dried yeast brought about an immediate response in growth. This

would indicate that, of the two factors associated with the growth-promoting properties of vitamin B, the thermostabile fraction is the limiting factor which prevents rats from attaining the average adult weight.

The weekly basal food intake of these rats has been averaged for the period beginning with the addition of milk and ending at the cessation of growth, and is recorded in Table I. From a survey of this table it is noted that the rats receiving 25 cc. of milk daily ate, as an average, approximately the same amount of basal food as was consumed by those given but 20 cc. The data obtained from feeding these amounts of milk to rats as a source of vitamin

<table>
<thead>
<tr>
<th>Rat No.</th>
<th>16 cc. daily.</th>
<th>20 cc. daily.</th>
<th>25 cc. daily.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average weekly food intake</td>
<td>Ratio food: milk</td>
<td>Average weekly food intake</td>
</tr>
<tr>
<td>653♀</td>
<td>43.2</td>
<td>1:2.5</td>
<td>763♀</td>
</tr>
<tr>
<td>661♀</td>
<td>35.0</td>
<td>1:3.2</td>
<td></td>
</tr>
<tr>
<td>674♂</td>
<td>41.8</td>
<td>1:2.0</td>
<td>761♂</td>
</tr>
<tr>
<td>673♂</td>
<td>36.0</td>
<td>1:3.1</td>
<td>762♂</td>
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<tr>
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<td>41.0</td>
<td>1:2.7</td>
<td>759♂</td>
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<td>36.4</td>
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<td></td>
</tr>
<tr>
<td>652♂</td>
<td>45.2</td>
<td>1:2.2</td>
<td></td>
</tr>
<tr>
<td>Average for ♀...</td>
<td>40.1</td>
<td>1:2.7</td>
<td>♂</td>
</tr>
</tbody>
</table>
B show that the ingestion of large quantities of milk causes no diminution in the amount of basal food eaten.

BIBLIOGRAPHY.