CCIV. THE VITAMIN A CONTENT OF CHEESE

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THE vitamin A content of cheese was investigated by Morgan [1926] who found that samples of American Cheddar and Limburger restored growth and cured xerophthalmia in rats when given in doses of 1 g., later reduced to 0.5 g. In the case of a Swiss cheese 1.0 g. daily was required.

More recently Coward & Morgan [1935], in a comprehensive study of the amounts of vitamins A and D in many common foodstuffs, have reported a potency of 55 I.U. per g. for one specimen of English Cheddar cheese. This value seems high compared with values quoted by other workers for butter fat. Thus Booth *et al.* [1934] assess the vitamin A contents of winter, autumn and summer butter fats at 40, 65 and 85 I.U. per g. respectively. Assuming the fat of cheese to have a vitamin A potency equal to that of butter fat, and taking the fat content of Cheddar cheese as 26.8% [Hutchison & Mottram, 1933], these values for butter fat would indicate values between 11 and 23 I.U. per g. for the cheese, according to whether it were made from winter or summer milk.

The high value given by Coward & Morgan might therefore imply either that the specimen of cheese examined had been prepared from milk of exceptionally high potency, or alternatively that cheese has a vitamin A activity disproportionately greater than its fat content. This latter possibility might arise either through the vitamin being concentrated in some way in the protein fraction of the milk, or through a better absorption of the vitamin from the intestinal tract. In view of the interest of these implications, and of the importance of cheese as an article of diet, we have carried out an independent test of its vitamin A activity.

EXPERIMENTAL

Colorimetric estimations. A sample of English Cheddar cheese was purchased locally and examined for vitamin A and carotene by colorimetric methods. Since these substances were present in very small concentrations the results obtained were of a low degree of accuracy, being useful only as a rough indication of the order of activity to be expected in biological tests. Vitamin A, as determined by the SbCl_3 method applied to the unsaponifiable residue of the cheese fat (extracted by digestion with alkali), was present to the extent of about 5 B.U. per g., equivalent to about 3 I.U. per g. [Moore, 1937]. The carotene content determined by the tintometer, with the use of a reference curve, was about 3.5 μg . (6 I.U.) per g. expressed as the gross yellow colour of the unsaponified cheese fat, or 1.8 μg . (3 I.U.) per g. expressed as the gross yellow colour of the non-saponifiable matter. The first of these values may be high through the inclusion of yellow or brown substances other than carotene, the second low on account of the loss of pigment during manipulation.

When the values obtained for vitamin A and carotene are combined the total vitamin A activity of this cheese would appear to be about 6–9 I.U. per g. Since

the fat content of the cheese was found to be about 33 % these values would be equivalent to 18–27 I.U. per g. of fat.

An attempt to confirm the vitamin A content by the determination of absorption at 328 m μ was unsuccessful on account of the intensity of the general absorption at this position.

Biological tests. Young albino rats of body weights 39–66 g. were given a basal diet of caseinogen (alcohol-extracted) 20 %, cane sugar 60 %, arachis oil 15 %, salt mixture 5 %, with dried yeast 10 %, Radiostol (vitamin D) 1 drop per rat per week. Growth ceased after 37–40 days. To one group of two male and two female rats a solution of the International Standard carotene was given at a level (12.8 I.U. every 4 days) found by previous experience to give fairly rapid growth. To two other similar groups cheese was given at the levels of 250 mg. and 1750 mg. per 4 days. These levels were chosen so as to be equivalent to the dosage of carotene on the basis of cheese containing 35 I.U. per g. and 7.5 I.U. per g. respectively. (On recalculation after the experiment these doses were found to be slightly out of adjustment, actually corresponding to 13.7 and 13.1 I.U. per 4 days.) To save time in weighing, the doses of cheese were given as portions of uniform diameter cut by a cork borer, the lengths necessary for the dose being found by experiment. They were consumed rapidly by the rats. The growth responses were as follows.

	Calculated equivalent in I.U. per day taking cheese = 55 I.U. per g.	Calculated equivalent in I.U. per day taking cheese = 7.5 I.U. per g.	Mean wt. increase per rat per day (groups of 2 ♂ and 2 ♀ rats g.)
Daily addendum			
3.2 I.U. of standard carotene	—	—	1.24
62.5 mg. of Cheddar cheese	3.4	0.47	0.69
437 mg. of Cheddar cheese	24	3.3	1.36

Colorimetric tests on other types of cheese. Colorimetric estimations were carried out on several other types of cheese. Amounts of vitamin of the same order as those found in Cheddar cheese were found in other cheeses made from whole milk (Camembert, Cheshire, Empire red, Empire white, Gruyère, Stilton). Smaller amounts were found in cheeses of lower fat content (Dutch Edam and Danish blue).

DISCUSSION

In the above experiments nearly equal growth responses (1.36 and 1.24 g. per day) were obtained when English Cheddar cheese and the International Standard carotene were given as sources of vitamin A in equivalent doses, calculated on the assumption that the cheese contained vitamin A and carotene in the amounts found by colorimetric methods. When the equivalent doses were calculated on the basis of Coward & Morgan's value of 55 I.U. per g. the growth response with cheese (0.69 g.) was much lower than that with the carotene. It is clear that the difference between the activity found in our experiment and that reported by Coward might be accounted for if her cheese had been made from an exceptionally rich milk. No data on this point or on the activity of the milk from which our own sample of cheese was made are available. Our own experiments however indicate that the vitamin A potency of the cheese examined by us was certainly not greater than would have been anticipated from its content of milk fat. We have therefore no evidence of any hidden form of activity in cheese, or of exceptionally efficient utilization of the vitamin.

SUMMARY

English Cheddar cheese was found in biological tests to have a vitamin A potency of an order (*ca.* 7.5 I.U. per g.) that would be expected from its milk fat content, and from the result of colorimetric estimations of vitamin A and carotene. Colorimetric determinations on other full-milk cheeses gave similar results. Lower values were found for cheeses of lower fat content.

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REFERENCES

- Booth, Kon & Gillam (1934). *Biochem. J.* **28**, 2169.
Coward & Morgan (1935). *Brit. med. J.* (ii), 1041.
Hutchison & Mottram (1933). *Food and the principles of dietetics*. Edward Arnold and Co.
Moore (1937). *Biochem. J.* **31**, 155.
Morgan (1926). *Amer. J. Physiol.* **78**, 11.