

Unfortunately the cases were so few that no controls for comparison were available. It cannot be stated from the facts available that none of them reacted to iron. Captain Barber who was in charge of the last 3 cases did not put them on iron in view of his previous experience of a few similar cases in the Middle East. The first two cases were treated with blood transfusion because liver extract was not available; it cannot be stated whether they could have improved on liver as it was never given a trial; nor they could be classed as pseudoplastic.

The last three cases reacted to liver therapy. It could be concluded that there was deficiency of hæmatinic factor; unfortunately the nature of these factors is still a puzzle to the physiologists. No conclusion can be based on the information available from treatment.

Relative incidence amongst the regulars and recent recruits.—Three out of the five had 10 years' service, one 5½ years and the other 1½ years only. Four out of these five had more than 2 years' service overseas.

Age incidence.—The incidence of pernicious anæmia increases with age. I do not think the higher incidence of macrocytic anæmia amongst the regulars could be associated with older age.

The number of cases is far too small to satisfy a statistician, but the whole data presented in this report suggests that it is not improbable, although it can be disputed, that anæmia in these men resulted from a state of dietary deficiency. Whether it was a protein deficiency or hypovitaminosis can be established by further work only.

Summary

1. Five cases of macrocytic anæmia amongst vegetarians in the Indian Army are described.
2. The evidence available is suggestive of a deficiency in dietary.

Acknowledgments

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GHEE AS A SOURCE OF VITAMIN A IN INDIAN DIETARIES: THE EFFECT OF COOKING ON THE VITAMIN CONTENT OF FOODS

By G. KARMAKAR

(From the Department of Biochemistry, Nutrition and Physiological Hygiene, All-India Institute of Hygiene and Public Health, Calcutta)

The place of ghee in Indian dietaries.—Ghee forms one of the chief sources of vitamin A in

the diet of Indians and specially of vegetarians. It is consumed as ghee and in fried preparations such as puri, fried fish, meat cutlet, vegetable curry, mutton curry and sweetmeats. There is a considerable variation in the vitamin A content of butter and ghee prepared from the milk of cows in different parts of India.

Quantity of ghee consumed in different provinces of India.—The diet surveys in different provinces of India are not yet complete. The data obtained so far provide some information on the consumption of ghee in different parts of India. These figures refer apparently to raw ghee and not to ghee in the cooked form.

From table 1 we have an idea of the quantity of vitamin A available from the Indian dietaries. The highest recorded amount of ghee consumed is 2.0 oz. (D. D. Mitra, 1939). The highest value of vitamin A in ghee so far recorded is 55 I.U. per gramme (Muthanna and Seshan, 1941). On this basis, 3,000 I.U. of vitamin A is consumed in 2 ounces of ghee. This however is only approximately the minimum daily requirements. It is also obvious that in the majority of the provinces the consumption is below 1 oz., making vitamin A consumption less than half of the minimum requirements. This amount is made still lower if ghee with a lower vitamin A content such as 15 I.U. (Muthanna and Seshan, *loc. cit.*), or even if the average type of ghee with 20 to 25 I.U. is consumed.

Effect of heating.—Many workers have recorded loss of vitamin A in ghee on heating. It has been shown that heat in the presence of air, aeration and hydrogenation is destructive to vitamin A (Grewar, 1935; Drummond, Channon and Coward, 1925). Banerjee and Doctor (1938) studied the loss of vitamin A in ghee due to exposure, irradiation and auto-oxidation. It has also been reported that vitamin A is destroyed in milk as a result of boiling (Decaro and Speier, 1935).

Effect of cooking.—Little information is available with regard to loss of vitamin A in ghee as a result of its use for cooking. In order to elucidate this point, it was thought worth while to carry out experiments on the estimation of vitamin A in the (1) original ghee, (2) ghee left over after cooking and (3) ghee extracted from the cooked food. Almost all the methods of cooking done with ghee were employed.

Preparation of puri and other articles: Puri.—Atta was mixed with a requisite amount of water and ghee and kneaded into a uniform dough of proper consistency. Portions of that dough were rolled into circles of uniform thickness and fried in ghee. The ghee was first heated for about 3 minutes and the frying was continued from 12 to 15 minutes at a temperature between 200°C. and 250°C. The average weight of each puri thus prepared was about 20 gm. Three such puris were then cut into small pieces and dried in a vacuum desiccator overnight. Then they were placed within an extraction tumbler and the ghee was extracted with freshly distilled ether in a Soxhlet five or six times. The ether was evaporated and the ghee obtained from the three puris was about 10 gm. Its vitamin A content was estimated.

TABLE I
Consumption of ghee in different provinces

Province	District	Population	Quantity per consumption unit per day, oz.	Surveyed by
Madras ..	Mayanur and Chingleput.	Rural	Only 3 families out of 44 found to consume ghee 0.5 to 0.9	Aykroyd and Krishnan (1937).
Mysore ..	Mysore	Do.	0.1	
Orissa ..	Puri	Urban	0.2	Singh (1939).
C. P. and Berar	Nagpur	Rural (poor class)	0.14	Bhave (1941).
	Tirodi	Do.	0.3	Do.
	Warud	Rural	Nil	Do.
Bengal ..	Calcutta	Urban (well-to-do)	2.0	D. D. Mitra (1939).
Bihar ..	Jamshedpur	Urban	0.5 to 1.8 (ghee and vegetable oil).	K. Mitra (1940).
			0.5	
Delhi ..	Najafgarh	Rural	0.5	Shourie (1939).
		Semi-urban	0.3	Do.
U. P. ..	Narendranagar	Rural	0.4	
Punjab ..	Ferozepore	Rural	1.2	Ahmad and Gore (1938).
		Urban (middle class)	1.5	Do.
		Sweepers	0.4	Do.
Hyderabad ..	Nizamabad	Small agriculturists.	0.08 to 0.16	Daver and Ahmed (1942).
		Depending on agriculture only.	0.2 to 0.4	Do.
Coorg ..	Mercara Town	Urban	0.1 (Ghee + butter)	Bhave and Bopaiya (1942).
	Villages near Mercara Town.	Rural	Nil	Do.
Bombay ..	Bombay City	Urban (middle class)	0.7	Niyogi and Sukhatankar (1939).
		Sweepers	Nil	Do.

Brinjal, potato chip and fish.—Chips of brinjal, potato and fish were coated with a paste made up of dal, flour, salt and spices and were fried in fresh quantities of ghee in each case. The temperature during the process of frying was between 200°C. and 220°C. and it was continued for 8 to 10 minutes. The fried articles were then dried in a vacuum desiccator and ghee was extracted in a soxhlet as described above. Its vitamin A content was estimated.

Mutton cutlet.—Mutton was chopped into pieces and then coated with egg white mixed with bread crumbs. The raw cutlets were then fried in ghee for 5 minutes at a temperature of about 200°C. Ghee was then extracted from the fried cutlets, and its vitamin A content was estimated.

Mutton curry and vegetable curry.—A few sliced onions were fried in some ghee at about 200°C. Then some pieces of mutton were spiced with the fried sliced onion and cooked for 16 minutes as usual. The temperature during cooking ranged from 95°C. to 99°C.

In a similar manner vegetable curry was prepared with lady's finger, cauliflower, potato, etc. and the temperature during cooking was about 97°C.

In the case of curry, the solid materials were ground in a mortar and the whole mass was diluted with water. The solution was then extracted with distilled ether. The ether solutions were orange-coloured in the case of both the curries, and so they were shaken for a minute or two with *norite* charcoal just sufficient to remove the pigments only. The ether being evaporated, ghee was obtained.

Sweetmeat (lady-canning and chanar jilipi).—Small balls of chana (chana mixed with requisite amount of flour) were prepared and fried in ghee for 11 to 12 minutes. The temperature of frying was between 140°C. to 160°C. The fried balls were then dipped into hot dilute sugar solution, which are popularly called 'lady-cannings'. In this way, three lots of lady-canning were prepared.

Another variety of sweetmeat of different shape called 'chanar jilipi' was prepared in a similar manner but

the frying was continued for a lesser period, say 7 to 8 minutes. After frying they were dipped into the same sugar solution which was finally heated for 6 minutes at 93°C.

The lady-canning and chanar jilipi were separately ground in a mortar, diluted with water and extracted with ether. The ether solution was then evaporated to dryness to obtain the fat.

The original 'chana' had been examined before and found to contain no vitamin A.

Method of estimation of vitamin A.—The spectrophotometric method was employed for vitamin A determination.

About 5 to 10 grammes of ghee were saponified and the non-saponifiable fraction was dissolved in about 10 c.cm. cyclohexane. The quartz cell was then filled with this solution and the compensating cell with the solvent. A series of exposures were given by gradually reducing the aperture of the rotating sector and the spectra were photographed in a medium-size quartz spectrograph. The extinction coefficient of a 1 per cent solution in 1 cm. cell at 328 m μ was determined from the photograph. This value of the extinction coefficient multiplied by the factor 1,600 gives the potency of vitamin A in International Units.

The potency of vitamin A was also determined by the colorimetric method for comparison.

In this method the blue colour produced by the action of saturated solution of SbCl₅ in chloroform on a certain known volume (0.2 c.cm.) of the non-saponifiable fraction of ghee in chloroform was matched with the standard blue-coloured glasses in the Lovibond tintometer. The blue units were then multiplied by the conversion factor (which is about 50 for a 20 per cent solution in a 1 cm. cell) for obtaining the potency in International Units.

TABLE II
Frying of puri, etc., in ghee

Name of fried articles	Temperature of cooking, °C.	Duration of cooking, min.	Weight of the cooked articles, gm.	Quantity of ghee extracted, gm.	Quantity of ghee from 100 gm. of food, gm.
Puri ..	200-250	12-15	60	10	16.6
Brinjal ..	200-220	8-10	60	9	15.0
Potato chip ..	200-220	8-10	45	7	15.5
Fish ..	200-220	8-10	55	8	14.5
Mutton cutlet ..	180-200	6	83	12	14.5
Mutton curry ..	{ 200 98	1½ } 17½ 16 }	95	11	11.6
Vegetable curry ..	{ 200 97	1½ } 10½ 9 }	102	8	7.8
<i>Sweets:</i> Lady-canning ..	140-160	11 for each lot.	90 with sugar solution.	10	11.0
Chanar jilipi ..	140-160	8	80 with sugar solution.	8	10.0

Results.—Table II gives the amount of ghee present in the various cooked foods. Table III gives details of vitamin content of original ghee (3 samples) and of ghee left over after cooking or obtained from the cooked food.

TABLE III
Effect of frying and cooking on vitamin A content of ghee obtained from a village near Calcutta

Name of fried or cooked articles	Quality of ghee	POTENCY OF VITAMIN A	
		Spectro-photometric method, I.U./gm.	Colorimetric method, I.U./gm.
	Sample I	24	26
Puri ..	Left after frying puri. Extracted from puri.	Nil	Nil
Brinjal ..	Left after frying brinjal. Extracted from brinjal.	4	5
Potato chip	Left after frying potato chips. Extracted from potato chips.	5	Not done
Fish ..	Left after frying fish. Extracted from fried fish.	5	3
	Sample II	18	15
Mutton cutlet	Left after frying mutton cutlet. Extracted from mutton cutlet.	4	5
Mutton curry	Extracted from curry.	3	4
Vegetable ..	Extracted from curry.	3	4
		2	Not done

TABLE III—concl'd.

Name of fried or cooked articles	Quality of ghee	POTENCY OF VITAMIN A	
		Spectro-photometric method, I.U./gm.	Colorimetric method, I.U./gm.
	Sample III	25	28
Lady-canning	Extracted from lady-canning. Left after frying the first lot.	4	5
	Left after frying the third lot.	11	15
Chanar jilipi	Extracted from jilipi. Left after frying jilipi.	Nil	Nil
		13	15
		17	16

Discussion.—At the high temperature of frying, which is above 200°C., most of the vitamin A present in ghee is destroyed, and consequently the ghee extracted from the fried articles is found to be very poor in vitamin A content. Traces of vitamin A detected in fried fish, brinjal, potato chip, and other articles may be due to the fact that the ghee was heated only for a short time. For large-scale preparations as required in families and shops, the heating of ghee is prolonged more than 10 minutes, in which case practically all the vitamin A will probably be destroyed. It would appear that from the dietary survey made so far it will not be possible to assess the real intake of vitamin A by means of estimating the consumption of ghee.

Summary.—The highest level of intake of vitamin A through consumption of fresh and genuine ghee never reaches more than the minimum requirement in India. Vitamin A in ghee is destroyed at the high temperature of frying, and the ghee carried along with the fried

articles contain practically no vitamin A. Even with small-scale preparations, however, when ghee is heated for a short while, it is found to contain only 25 per cent or less of the original vitamin A.

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ERRATUM

THE following is the description of plate XXII (figures 1 to 16) illustrating the article on 'Developing gametocytes and schizonts of *Plasmodium falciparum* : A case showing all stages in the peripheral circulation', by B. M. Das Gupta and S. K. Ganguli, published in the October issue of the *Gazette* (p. 458) which was, by error, omitted.

Figures 1 to 7 developing crescents, 6 and 7 showing two immature crescents in the same corpuscle.

Figure 8, mature female crescent.

Figure 9, developing schizont.

Figure 10, a schizont and a gametocyte in the same corpuscle.

Figures 11 and 12, mature schizonts phagocytosed by polymorphonuclear leucocytes.

[Figures 1 to 12 drawn with camera lucida to the same magnification.]

Figures 13 and 14, two crescents in the same corpuscle. In figure 14, the crescents appear as if they are fused together.

Figures 15 and 16, schizonts phagocytosed by polymorphonuclear leucocytes.

[Figures 13 to 16, photomicrographs ($\times 4000$ approx.).]

Note.—The pigment is scattered in developing crescents but occurs as a compact mass in all stages of asexual development.

A Mirror of Hospital Practice

AN UNUSUAL ACCIDENT

By MANORANJAN CHANDA, L.M.F.

Chanda Niketan, Manikganj, Dacca

A BOY, aged 11 years, climbed a guava tree to pluck fruit, and he fell on to a bamboo stump, 6½ feet tall which had been cut off diagonally leaving a sharp end. The bamboo stump pierced the left axilla, came out under the middle part of the left clavicle, then pierced the outer and lower part of the neck on the left side passing behind and tearing the oesophagus and came out behind the right ear crushing the right jaw and its articulation (see figure). The boy was hanging on the stump in this position for about 15 minutes when

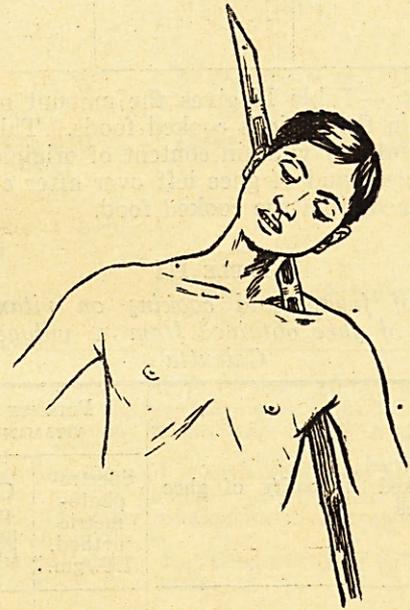


Figure showing the bamboo stump, pierced with its sharp end.

help came. The bamboo stump was broken off, and was then pulled out of the wound. The local doctor stitched the wound and applied bandages, and the patient was then brought ten miles to a hospital in an unconscious state. The bleeding was profuse and shock was marked. Intravenous saline and glucose were administered; the wounds were washed with acriflavin in normal saline and were dusted with sulphanilamide powder. Some bleeding from the nose and mouth continued, and some blood was vomited. That night the temperature was very high; the pulsating carotid artery was visible through the upper wound. The wound became septic, and some stitches were removed and local treatment was applied.

The patient regained consciousness on the third day and on the fourth day swallowed a little fluid with difficulty but most of it was returned through the nose. Some fragments of bone were removed from the upper part of the wound. For the next two months there was a hectic type of temperature, and at the end of this time about ¼ inch of bone was discharged from the upper wound, and then the fever declined and the wound healed. Apart from some stiffness of the articulation there is no serious disability. About 1½ months after the healing of the wound, an x-ray was taken which revealed no abnormality except some loss of bone from the right mandibulo-maxillary joint.