

## Distribution of carotene and vitamin A in liver, pancreas and body fat of Ghanaians

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1. The carotene and vitamin A levels of liver, pancreas and body fat were determined in seventeen Ghanaians coming from areas where carotene-rich foods were freely available.
2. The liver was confirmed as the main storehouse of vitamin A, and vitamin A values for it were exceptionally high. Values for the other tissues were not higher than average.
3. In the study the carotene and vitamin A concentrations in the liver were higher in the females than in the males.
4. Under the conditions of high intake of carotene-rich foods, carotene was found to be distributed more evenly in various tissues than vitamin A.

Previous papers have reported the carotene and vitamin A levels in serum, liver, and pancreas of Ghanaians (Dagadu, 1963, 1965; Dagadu & Gillman, 1963). The levels of carotene and vitamin A were shown to be high in areas where palm oil and carotene-rich fruits and vegetables are consumed in large quantities. Most of the tissues analysed were taken from different groups of subjects at various times in different places. In the study now presented emphasis has been placed on the distribution of carotene and vitamin A in various tissues taken from the same subject at the same time.

### EXPERIMENTAL

The subjects, who had died at the Korle Bu Hospital, Accra ('a carotene-rich' area; Dagadu, 1963) and been brought to the mortuary for autopsy, ranged in age from 5 months to 75 years. There were nine females and eight males. Specimens from each of the seventeen subjects were taken from the liver, the pancreas and the body fat. In most Ghanaian subjects the pancreas and body fat are highly pigmented. Carotene and vitamin A levels were determined in each of the samples by the methods recommended by Glick (1957).

### RESULTS

The carotene and vitamin A concentrations of the various samples from the individual subjects are arranged according to age in Table 1. The cause of death and sex of the patients are also shown.

*Carotene.* Carotene concentration in the livers ranged from 380 to 15 000  $\mu\text{g}/100\text{ g}$ , the lowest values being for infants. The mean for liver carotene for the whole group was 5900  $\mu\text{g}/100\text{ g}$ ; this is lower than the mean of 9200  $\mu\text{g}/100\text{ g}$  previously reported from our laboratories (Dagadu & Gillman, 1963), but is almost twenty times the value reported for accident victims by Berger (1954). In the samples of pancreas, carotene

Table 1. Carotene and vitamin A concentrations ( $\mu\text{g}/100\text{ g}$ ) in liver, pancreas, and body fat of Ghanaians

Age	Sex	Cause of death	Liver		Pancreas		Body fat	
			Carotene	Vitamin A	Carotene	Vitamin A	Carotene	Vitamin A
Infants	5 months	Acute enterocolitis	380	32 000	26	37	0	44
	1½ years	Diffuse pharyngolaryngitis	420	12 000	260	150	250	230
Children	6 years	Burkitt's tumour, jaw	10 000	73 000	3 600	74	2 400	380
	7 years	Subcutaneous abscess, thigh	1 800	35 000	1 700	110	1 600	310
	7 years	Encephalomalacia	13 000	190 000	4 200	240	9 300	240
	12 years	Encephalitis	3 000	44 000	2 300	110	2 200	320
14 years	Chronic endocarditis, mitral valve	5 400	16 000	2 400	110	960	140	
Adults	24 years	Marked fatty changes of liver	12 000	49 000	5 800	130	1 900	170
	26 years	Ruptured tubal pregnancy	15 000	72 000	5 800	98	800	230
	28 years	After childbirth	3 600	28 000	3 900	270	1 600	28
	32 years	Cirrhosis of liver	1 200	3 000	450	72	1 200	150
	40 years	Brain tumour	3 700	38 000	3 000	160	3 000	290
	45 years	Cirrhosis of liver	3 800	37 000	4 500	290	5 100	950
	45 years	Atherosclerosis	2 000	19 000	2 700	110	9 800	130
	50 years	Basal fracture of skull	7 500	31 000	19 000	120	3 200	390
	67 years	Ex-ulcerative eosophageal neoplasm	15 000	130 000	9 500	330	—	—
	75 years	Acute fibrinous pericarditis	2 300	24 000	—	—	700	190

content ranged from 26 to 9500  $\mu\text{g}/100\text{ g}$ , the mean being 3200  $\mu\text{g}$ . This is similar to the mean reported for samples of highly pigmented pancreas from subjects in Accra (Dagadu, 1964). The carotene levels of the body fat varied from zero in the pale sample obtained from the 5-month-old baby to a high value of 9800  $\mu\text{g}/100\text{ g}$  in one of the highly coloured samples of fat from the adults. The mean value for the whole group was 2800  $\mu\text{g}/100\text{ g}$ , this being about four to five times the values obtained by Peirce (1954) for highly pigmented specimens of human fat.

*Vitamin A.* Vitamin A concentration in the liver samples varied from 3000 to a high value of 190000  $\mu\text{g}/100\text{ g}$ . The mean was 49000  $\mu\text{g}/100\text{ g}$ , which is similar to a previously reported high mean value (Dagadu & Gillman, 1963). It is, however, higher than that reported by Smith & Malthus (1962), twice as high as values reported in Bantus by Leonard (1964), and from about two to twenty times the values reported by various workers as reviewed and tabulated by Smith & Malthus (1962). In the samples of pancreas analysed vitamin A content ranged from 37 to 330  $\mu\text{g}/100\text{ g}$ , with a mean of 150  $\mu\text{g}/100\text{ g}$ ; this mean was lower than the value obtained previously for samples of highly pigmented pancreas (Dagadu, 1964). For the samples of body fat, vitamin A levels ranged from 28 to 950  $\mu\text{g}/100\text{ g}$ , with a mean of 260  $\mu\text{g}/100\text{ g}$ ; this mean was higher than the value reported by Moore (1957), but similar to the values observed by Peirce (1954) for two samples of highly coloured body fat.

#### DISCUSSION

In agreement with Moore (1957), we found that liver contains much larger amounts of vitamin A than do other tissues. Except in one or two subjects, the vitamin A content of the other tissues was under 1% of that of the liver. It can therefore be said that when large amounts of carotene-rich foods, mainly palm oil, are eaten, the liver still acts as the main storehouse of vitamin A and accumulates large amounts of the vitamin. Age was found to have no effect on the amount of vitamin A stored in the liver. This observation has been reported by other workers (Cleland, 1954; Krause & Sanders, 1956; Moore, 1957). The vitamin A content of the other tissues did not vary with the sex of the subject, but the mean liver vitamin A content for the females was higher (59000  $\mu\text{g}/100\text{ g}$ ) than for the males (37000  $\mu\text{g}/100\text{ g}$ ). This is contrary to observations by Cleland (1954). The number of subjects was not large enough to enable grouping with respect to vitamin A levels and cause of death.

Moore (1957) reported that carotenoids tend to be more evenly distributed in the body than vitamin A. The same was observed in this study. Although the mean values for the content of carotene samples of pancreas and body fat appeared to be 50% of those for the liver, in individual instances carotene contents were not always lower in these tissues than in the liver. In certain subjects, the values for the pancreas or body fat, or for both, were higher than the values for the liver (Table 1). Apart from low levels of carotene observed in infancy, age had no effect on the accumulation of carotene in the tissues; in females, again, mean liver carotene contents were higher (7000  $\mu\text{g}/100\text{ g}$ ) than in the males (4000  $\mu\text{g}/100\text{ g}$ ); in the other tissues carotene contents did not vary according to the sex of the subject.

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## REFERENCES

- Berger, S. (1954). *Roczn. Państ. Zakł. Hig.* **5**, 207. Quoted in *Nutr. Abstr. Rev.* 1955, **25**, 225.  
Cleland, J. B. (1954). *Med. J. Aust.* **i**, 588. Quoted in *Nutr. Abstr. Rev.* 1956, **26**, 773.  
Dagadu, J. M. (1963). *Ghana med. J.* **2**, no. 4, p. 153.  
Dagadu, J. M. (1964). *Ghana med. J.* **3**, no. 2, p. 89.  
Dagadu, J. M. (1965). *Ghana med. J.* **4**, no. 3, p. 121.  
Dagadu, J. M. & Gillman, J. (1963). *Lancet* **i**, 531.  
Glick, D. (1957). *Methods of Biochemical Analysis*. Vol. 4. New York: Interscience Publishers Inc.  
Krause, R. F. & Sanders, P. L. (1956). *Am. J. clin. Nutr.* **4**, 68.  
Leonard, P. J. (1964). *E. Afr. med. J.* **41**, 133. Quoted in *Nutr. Abstr. Rev.* 1965, **35**, 1087.  
Moore, T. (1957). *Vitamin A*. London: Elsevier Publishing Company.  
Peirce, A. W. (1954). *Med. J. Aust.* **i**, 589. Quoted in *Nutr. Abstr. Rev.* 1956, **26**, 773.  
Smith, B. M. & Malthus, E. M. (1962). *Br. J. Nutr.* **16**, 213.