The Urinary Excretion of Vitamin A by the Dog

By A. N. WORDEN, J. BUNYAN AND A. W. DAVIES

Cromwell House, Huntingdon

AND C. E. WATERHOUSE

Research Laboratories, Bob Martin Ltd., Southport

(Received 3 November 1954)

Catel (1938) reported that vitamin A was present in appreciable amounts in the urine of normal dogs, although absent from that of normal human beings, rabbits and rats. In four dogs (two male and two female, varying in body weight from 7 to 31.5 kg.) from which he obtained seven spontaneous or catheterized samples, the concentration of vitamin A ranged from 0.2 to 2.0 mg. (66 to 660 i.u.) per 100 ml. In two samples a proteinuria was detected but no other abnormalities were recorded. Lawrie, Moore & Rajagopal (1941) found that random samples of urine obtained from an apparently healthy male Fox Terrier contained from 90 to 450 i.u. per 100 ml., the latter value being equal to the highest recorded in human patients with pneumonia.

EXPERIMENTAL

In the course of our experiments on the urinary excretion of B vitamins by the dog (Worden, Waterhouse & Partington, 1952, 1954; Worden & Waterhouse, 1955) we have taken the opportunity of determining the vitamin A content of 24 hr. urine samples voided by four dogs in metabolism cages. The animals were all healthy specimens that had been maintained under known dietary conditions for periods of from 1 to 3 years, and were adapted to the experimental procedures involved. The urine samples were extracted by the method described by Lawrie *et al.* (1941), and the vitamin A was estimated by the method of Carr & Price (1926) with the aid of a Unicam diffraction-grating spectrophotometer calibrated against vitamin A acetate. In some instances a pink fluorescence developed on evaporation of the ether extract. The responsible substance was, however, found to be water

Table 1. *Vitamin A content of dog urine*

Experimental animal	Urine sample collected 24 hr. ending	Vitamin A content of urine	
		i.u./100 ml.	Total excretion i.u./24 hr.
'Pat': 4 yr. old male smooth-coated mongrel Terrier; weight 22.2-22.6 kg.	6. v. 53	6.5	37.0
	7. v. 53	4.5	27.2
	23. iii. 54	7.5	43.5
	26. iii. 54	7.5	72.7
	25. v. 54	3.75	23.2
'Scottie': 3 yr. old male Scotch Terrier; weight 8.6-9.5 kg.	19. iv. 53	6.9	45.1
	22. iv. 53	2.5	14.3
	24. iv. 53	6.0	25.2
	16. ii. 54	13.3	56.0
	14. v. 54	15.2	101.0
	21. v. 54	24.0	134.0
'Roxy': 6 yr. old female black-and-white Cocker Spaniel; weight 12.2-14.5 kg.	20. i. 54	21.2	89.5
	21. i. 54	16.2	108.0
	22. i. 54	14.3	95.0
	26. i. 54	7.1	44.0
	29. i. 54	4.8	40.0
	5. ii. 54	4.2	10.9
	12. ii. 54	2.7	18.6
	23. iv. 54	17.5	89.5
	28. iv. 54	47.5	235.0
	30. iv. 54	25.8	180.0
	3. viii. 54	12.5	46.2
	4. viii. 54	4.2	28.4
'Dusty': 2 yr. old male Husky; weight 32.7 kg.	23. viii. 54	12.5	73.4
	2. ix. 54	3.7	36.0
	8. ix. 54	6.75	58.7
	9. ix. 54	1.75	17.0

soluble and to be removed completely by a further saponification followed by re-extraction with ether. The results are given in Table 1.

DISCUSSION

Lawrie *et al.* (1941) believed that the fluctuations in the urinary vitamin A level of the dog studied by them were determined by factors other than the supply immediately available from the diet. This seemed to be true for the much smaller fluctuations noted by us, for in all the observations other than those involving the two samples collected on 5 and 12 February 1954 from 'Roxy' the animals were receiving standard amounts of a cooked rabbit meat-wholemeal bread-milk diet as described elsewhere (Worden *et al.* 1952) and containing from 15 to 21 i.u. vitamin A per ounce. Prior to the experiment in which the first five values for 'Roxy' were recorded, this animal had received considerable quantities of a special diet containing carotene equivalent to at least 2000 i.u. vitamin A per ounce, and it was thought that this might have accounted for the initial somewhat higher levels of vitamin A excreted in her urine. For the experiment during which the two observations on 5 and 12 February 1954 on this animal were made, however, the same carotene-rich diet was fed throughout, but there was no apparent effect on the level of urinary excretion of vitamin A.

These results confirmed that small quantities of vitamin A were present in the urine of normal dogs, but the levels obtained were of a much lower order than those recorded by Catel (1938) and by Lawrie *et al.* (1941). It is known that there are marked variations in the liver vitamin A reserves of apparently healthy dogs (Bradfield & Smith, 1938; Linton & Brownlee, 1939), but the excretion of very large amounts in the urine is suggestive of some pathological condition. There is a high incidence of nephritis among domestic dogs, and although clinical recovery may occur, with survival for many

years, tests of renal efficiency in such animals, or measurements of arterial pressure (McCubbin & Corcoran, 1953) will indicate some impairment of function. Alternatively, the urinary excretion of vitamin A may be linked with the high plasma levels of the vitamin attained in this species (Behr & Gaebler, 1950).

In samples (24 hr.) of urine obtained from a cat confined to a metabolism cage, no detectable amount of vitamin A was found.

SUMMARY

Vitamin A levels have been determined in 24 hr. urine samples collected from four normal dogs in metabolism cages. The levels have been found to range from 2.5 to 47.5 i.u. vitamin A per 100 ml., or 14.3-235.0 i.u. per day.

The authors wish to express their thanks to Dr T. Moore of the Dunn Nutritional Laboratory, Cambridge, for his helpful interest, and to Messrs Nutrex Ltd. for permission for one of us (A.W.D.) to participate in this work.

REFERENCES

- Behr, W. T. & Gaebler, O. H. (1950). *J. Nutr.* **37**, 447.
Bradfield, D. & Smith, M. C. (1938). *Amer. J. Physiol.* **124**, 168.
Carr, F. H. & Price, E. A. (1926). *Biochem. J.* **20**, 498.
Catel, W. (1938). *M Schr. Kinderheilk.* **73**, 316.
Lawrie, N. R., Moore, T. & Rajagopal, K. R. (1941). *Biochem. J.* **35**, 825.
Linton, R. G. & Brownlee, A. (1939). *Nature, Lond.*, **144**, 978.
McCubbin, J. & Corcoran, A. C. (1953). *Proc. Soc. exp. Biol., N.Y.*, **84**, 130.
Worden, A. N. & Waterhouse, C. E. (1955). *Brit. J. Nutr.* **9**, 5.
Worden, A. N., Waterhouse, C. E. & Partington, H. (1952). *Vet. Rec.* **64**, 836.
Worden, A. N., Waterhouse, C. E. & Partington, H. (1954). *Vet. Rec.* **66**, 169.