CLXXV. THE VITAMIN CONTENT OF THE MANGO FRUIT.

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IN a preliminary investigation [Perry and Zilva, 1932], the vitamins A, C and D of three varieties of mango, namely Alphonso, Cawasji Patel and Shendrya, were assayed. It was found that the vitamin A content of the first variety was approximately that of a good butter and that the other two varieties were about half as active. The antiscorbutic activity of the three fruits showed a much greater variation. Thus whilst the Alphonso was about twice as active as lemon juice, little vitamin C was found in Shendrya, and Cawasji Patel, although not as active as Alphonso, showed nevertheless a very good vitamin C content. The presence of vitamin D on the other hand could not be established in any of the fruits in the doses tested.

In this communication, experiments are described which show that the above observations on the relative vitamin potency of the varieties mentioned were not accidental, but that they very probably hold true in general.

Guha and Chakravorty [1933] claim that the mango varieties Bombai, Langra and Fozli are rich in vitamin A but vary in their vitamin C content. Their experimental details are however not fully documented.

EXPERIMENTAL.

Treatment of experimental material. The mangoes on arrival in England were ripened in a warm, airy room if necessary. Owing to their perishable character and in order to preserve the vitamins, the fruits were then placed in a refrigerator at -20° and kept at that temperature during the tests, vitamin C being stable under these conditions [Bracewell *et al.*, 1931]. As the daily weighing out of so many small doses would have been inaccurate and unnecessarily laborious, a week's supply was weighed out for each animal and one sixth of the weekly ration administered every day except Sundays. The weekly doses were stored at -20° and thawed immediately before being administered to the experimental animals.

Methods. Vitamin A was assayed on rats by a curative growth method based on Steenbock's principle [Crawford *et al.*, 1932].

Vitamin C was tested prophylactically [Bracewell *et al.*, 1930].

The method of Chick *et al.* [1926] was used in the determination of vitamin D.

The three Poona varieties: Alphonso, Cawasji Patel and Shendrya, were despatched in two consignments, on June 11th and June 17th, 1932. The analytical data are given in Table I. These two consignments were pooled for the biological tests. Two other samples of Alphonso, of Surat and Bombay origin, were despatched on June 25th and tested separately. The analytical data

Table I. *Chemical composition of mangoes tested.*

Mangoes despatched from India, June 11th, 1932.

	Alphonso (Poona)	Shendrya (Poona)
Acidity in terms of H_2SO_4 } % of	0.28	0.16
Total sugars as glucose } pulp	14.21	16.19

Mangoes despatched from India, June 17th, 1932.

	Alphonso (Poona)	Cawasji Patel (Poona)	Shendrya (Poona)
Acidity in terms of H_2SO_4 } % of	0.23	0.29	0.11
Total sugars as glucose } pulp	13.84	16.04	20.26

Mangoes despatched from India, June 25th, 1932.

	Alphonso (Surat)	Alphonso (Bombay)
Acidity in terms of H_2SO_4 } % of	0.33	0.37
Total sugars as glucose } pulp	15.09	16.69

Table II. *Tests for vitamin A value of mango pulp.*

Alphonso (Poona)				Cawasji Patel (Poona)				Shendrya (Poona)			
Dose in g.	Number of rat, litter and sex	Change in weight during 4 weeks g.		Dose in g.	Number of rat, litter and sex	Change in weight during 4 weeks g.		Dose in g.	Number of rat, litter and sex	Change in weight during 4 weeks g.	
0.05	2689 VIII ♂	*		0.05	2672 VI ♂	15		0.05	2674 VI ♂	*	
	2698 IX ♂	34			2691 VIII ♂	7			2686 VIII ♂	*	
	2750 XI ♂	32			2700 IX ♀	*			2706 X ♀	*	
	2760 XII ♂	28			2751 XI ♀	*			2758 XI ♀	29	
	2807 XVIII ♀	12			2810 XVIII ♀	*			2764 XII ♀	19	
	2834 XXI ♂	20			2837 XXI ♂	22			2833 XXI ♀	*	
0.1	2655 IV ♂	64		0.1	2661 IV ♂	*		0.1	2663 IV ♂	4	
	2664 V ♂	43			2670 V ♀	9			2685 VIII ♀	3	
	2688 VIII ♂	14			2694 VIII ♂	*			2753 XI ♀	29	
	2755 XI ♂	40			2773 XIII ♀	*			2772 XIII ♂	70	
	2770 XIII ♀	45			2777 XIV ♀	21			2794 XVI ♀	29	
	2814 XVIII ♂	37			2813 XVIII ♂	41			2811 XVIII ♀	25	
0.2	2648 III ♂	46		0.2	2633 I ♂	71		0.2	2640 I ♂	45	
	2761 XII ♂	56			2681 VII ♂	53			2683 VII ♂	54	
	2767 XIII ♀	4			2695 IX ♀	50			2762 XII ♂	64	
	2779 XIV ♀	31			2766 XII ♀	56			2776 XIII ♀	43	
	2792 XVI ♀	32			2778 XIV ♀	37			2780 XIV ♀	*	
	2815 XVIII ♀	*			2793 XVI ♀	*			2795 XVI ♀	34	

Positive controls. Cod-liver oil

Dose in g.	Number of rat, litter and sex	Change in weight during 4 weeks g.
0.1	2662 IV ♀	70
	2679 VII ♀	81
	2692 VIII ♀	65
	2712 X ♂	70
	2765 XII ♀	76
	2768 XIII ♂	93
	2809 XVIII ♂	74
	2839 XXI ♂	60

Negative controls

Dose	Number of rat, litter and sex	Change in weight during 4 weeks g.
No dose	2667 V ♂	*
	2675 VII ♀	*
	2690 VIII ♀	*
	2709 X ♂	*
	2759 XII ♀	*
	2774 XIII ♂	*
	2840 XXI ♂	*

* Lost weight and died.

Table III. *Tests for vitamin A value of mango pulp.*

Alphonso (Surat)			Alphonso (Bombay)		
Dose in g.	Number of rat, litter and sex	Change in weight during 4 weeks g.	Dose in g.	Number of rat, litter and sex	Change in weight during 4 weeks g.
0.05	2784 XV ♂	-6	0.05	2805 XVII ♂	-19
	2798 XVII ♀	*		2820 XIX ♀	34
	2817 XIX ♀	*		2826 XX ♀	*
	2823 XX ♀	12		2848 XXIII ♀	*
	2858 XXIV ♀	19		2868 XXV ♀	20
	2872 XXVI ♀	10		2873 XXVI ♀	-2
0.1	2789 XV ♀	*	0.1	2804 XVII ♀	*
	2806 XVII ♀	18		2822 XIX ♀	25
	2816 XIX ♀	*		2849 XXIII ♂	34
	2842 XXII ♂	46		2854 XXIII ♂	*
	2853 XXIII ♂	57		2874 XXVI ♀	15
	2876 XXVI ♂	27		2877 XXVI ♂	16
0.2	2790 XV ♂	77	0.2	2788 XV ♂	46
	2801 XVII ♂	*		2802 XVII ♀	1
	2824 XX ♀	22		2845 XXII ♀	25
	2843 XXII ♀	21		2864 XXV ♀	35
	2850 XXIII ♀	21		2870 XXV ♂	35
	2867 XXV ♂	50		2875 XXVI ♀	-1
	2879 XXVI ♀	33			
Positive controls. Cod-liver oil			Negative controls		
Dose in g.	Number of rat, litter and sex	Change in weight during 4 weeks g.	Dose	Number of rat, litter and sex	Change in weight during 4 weeks g.
0.1	2783 XV ♀	72	No dose	2785 XV ♀	*
	2799 XVII ♀	52		2797 XVII ♀	*
	2829 XX ♂	47		2821 XIX ♀	*
	2863 XXIV ♂	73		2830 XX ♂	*
	2869 XXV ♂	90		2847 XXII ♀	*
				2859 XXIV ♂	*
				2866 XXV ♂	*

* Lost weight and died.

Table IV. *Summary of tests for vitamin C of mango pulp.*

Dose in gm.	0.25	0.5	1	2	Approximate equivalents in vitamin C international units per g.
Alphonso (Poona)	+	+++	+++		20-30
Cawasji Patel	⊥ to +	+++	+++		15-20
Shendrya	-	-	⊥	+ to + ⊥	2
Alphonso (Surat)	+++	+++ ⊥	+++		20-30
Alphonso (Bombay)	+ ⊥ to ++	+++	+++		20-30
Dose in cc.	0.5	1	1.5		
Decitrated lemon juice	+	+++ ⊥	+++		

for these are also given in Table I. The range of acidity (as H_2SO_4) was from 0.11 to 0.37 % and of sugar content (as glucose) from 13.84 to 20.26 %, whilst the corresponding figures for the experimental batches used in 1931, which were less ripe when picked, were from 1.06 to 3.74 % for the acid content and from traces to 8.05 % for the sugar content.

The results of the biological tests are incorporated in Tables II to IV.

Vitamin A. It will be seen from Table II that, as in the 1931 experiment, the best results were obtained with 0.2 g. of the Alphonso variety although in this case also growth was not optimum. The other two varieties did not show such high activity. From a comparison of Tables II and III it transpires that the vitamin A activity of the Alphonso variety does not seem to be affected by the place of origin.

Vitamin C. The results are summarised in Table IV. Almost complete protection was obtained with a dose of 0.5 g. of any of the Alphonso mangoes, showing the potency to be of a similar order to that of the fruit of the 1931 season. The results with the lowest dose (0.25 g.) suggest that the Alphonso (Surat) and Alphonso (Bombay) varieties are rather more potent than Alphonso (Poona). The Cawasji Patel variety is rather less potent than Alphonso, and Shendrya shows only slight activity. This observation is similar to that made on the varieties in 1931.

Vitamin D. Owing to the negative results obtained in 1931 with 0.2 g. of mango of any variety, doses of 0.6 g. of Alphonso (Poona), Cawasji Patel and Shendrya and of 1 g. of Alphonso (Surat) and Alphonso (Bombay) were tested in 1932. The results as before were all negative.

CONCLUSIONS.

In the experiments carried out on the mangoes grown in 1931, fruits were utilised which arrived in an unripe condition. It was therefore desirable in repeating this work to employ experimental material which was riper at the time of picking, in order to ascertain whether the maturity factor had any bearing on the vitamin content of the mango. No striking indications were obtained in this direction. The vitamin C content was found to be somewhat higher in 1932 than in 1931. The difference in activity is however not very great and is most probably accidental.

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