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Effect of Vitamin C and carotene on the absorption of calcium from the intestine

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With 3 tables

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Calcium is one of the most important minerals that has an indispensable role to human life. Calcium transport across the intestinal mucosal cells depends upon mitochondria, sodium ion, specific adenosine triphosphatase, a soluble intestinal calcium-binding protein and biologically active metabolites of vitamin D. It is, however, not yet established how for such an active mechanism of transport is affected by other nutrients present in the diet in combination with calcium ions.

The effect of temperature and pH, proteins, sugars on calcium retention was investigated by many authors (11, 7, 3, 2). *Ruoul* et al. (9) found that in guinea pigs deficiency in either vitamin C or D leads to a decrease in calcemia and mineralization. Also *Voroboeva* (12) found that supplementation of vitamin C to children increases the retention of calcium by 5–12.6 % of the amount ingested.

Information concerning the effect of vitamins as naturally occurring in their sources is still lacking from the literature. The present investigation aims to study the effect of vitamin C or carotene from authentic sources and as naturally occurring in orange, parsley and pepper juices on intestinal calcium absorption.

Materials and methods

The present study was carried out on normal albino rats with body weights ranging from 151 to 244 g from both sexes. The animals were categorised into 7 groups each of 5. Blood haemoglobin and plasma total protein concentrations were determined (table 1).

The rate of calcium absorption was tested alone and in combination with either ascorbic acid or carotene derived from authentic or natural sources as orange, parsley and pepper juices.

Rate of intestinal calcium absorption was evaluated by giving each rat an oral dose of calcium (equivalent to 20 mg/rat) in the form of calcium phosphate. The elevation in the level of plasma calcium was followed during intervals of 1, 2 and 3 hours after administration of the orally given dose.

To test the effect of added vitamins, 50 mg of vitamin C or 0.2 mg carotene were given. Carotene was dissolved in corn oil. When naturally accurring vitamins were supplied, 5 ml of each juice from parsley, pepper, or orange were given twice during the day before dosing, and another 5 ml together with the calcium dose.

Table 1. Body weight, plasma proteins and blood hemoglobin of rats used in this experiment.

Groups	Body weight g	Plasma proteins g %	Blood Hb g %
1. Calcium alone	153–180	6.33–7.50	14.58–17.82
	164.8 ± 4.3	6.70 ± 0.21	16.15 ± 0.57
2. + ascorbic acid	156–244	6.17–7.67	14.58–15.93
	209.8 ± 17.7	6.97 ± 0.28	14.85 ± 0.35
3. + carotene	157–205	6.17–7.67	14.85–17.01
	179.4 ± 9.2	7.03 ± 0.25	16.04 ± 0.49
4. + orange	165–240	6.17–6.67	14.77–17.82
	209.4 ± 13.7	6.40 ± 0.1	15.74 ± 0.74
5. + parsley	155–236	6.50–7.83	14.58–17.25
	200.6 ± 15.5	7.06 ± 0.23	15.66 ± 0.48
6. + pepper	151–221	6.17–7.33	14.58–17.55
	194.4 ± 13.2	6.67 ± 0.22	15.93 ± 0.59
7. + corn oil	156–220	6.50–7.50	15.12–17.93
	200.6 ± 13.7	6.90 ± 0.19	16.10 ± 0.48

Hemoglobin concentration was estimated as described by *Wong* (13). Plasma proteins and calcium in plasma were done according to the procedure of *Wootton* (14), Vitamin C and carotene in the fruits and vegetables (orange, parsley and pepper) were determined by the methods of Association of Vitamin Chemists, 1951.

Results

Body weight, plasma proteins and blood haemoglobin of rats are shown in table 1. The level of fasting plasma calcium and the values at 1, 2 and 3 hours after the oral dose of calcium phosphate given to normal rats are shown in table 2. Similar values obtained for rats given the calcium dose in addition to each of ascorbic acid and carotene doses or with orange, parsley or pepper juices are shown in table 2. The vitamin contents (C and carotene) of the three juices (orange, parsley and pepper) are tabulated in table 3.

Discussion

The importance of calcium is not only because it is the principal component of skeleton, but also due to its vital role in a variety of essential physiological and biochemical processes. Several studies were done to clarify the mechanism of calcium absorption from the intestine (6, 4). However, few studies were done to investigate the effect to different nutrients on calcium absorption (5, 10) and particularly as present in their natural sources.

Our data showed that giving authentic samples of ascorbic acid together with calcium enhanced the rate of its intestinal absorption. This enhancing action was also noted when naturally occurring vitamins were administered. Similar findings were previously reported by *Leichsenring* et al. (5), who reported that during supplementation with ascorbic acid

Table 2. Fasting plasma calcium and its values 1, 2 and 3 hours after the given dose of calcium either alone or with different compounds.

Compound	Plasma calcium mEq/liter fast	1 hour	2 hours	3 hours	Absorption
1. Alone	4.5–5.1 4.7 ± 0.12	5.0–6.1 5.6 ± 0.19	4.8–5.2 5.0 ± 0.07	4.2–4.8 4.6 ± 0.12	1.20
2. + ascorbic acid	4.3–5.0 4.7 ± 0.14 0.4	4.8–5.5 5.1 ± 0.13 0.3	6.3–6.7 6.5 ± 0.08 0.025	4.5–5.3 4.9 ± 0.16 0.3	1.40
3. + carotene	4.5–4.9 4.8 ± 0.08 0.4	4.7–5.4 5.0 ± 0.15 0.3	4.9–5.9 5.6 ± 0.18 0.1	4.5–5.5 4.9 ± 0.17 0.1	1.18
4. + orange	4.8–5.2 5.0 ± 0.03 0.1	6.6–7.9 7.1 ± 0.23 0.005	4.8–5.6 5.5 ± 0.17 0.3	4.6–5.2 5.0 ± 0.11 0.3	1.41
5. + parsley	4.3–5.6 5.2 ± 0.33 0.1	5.2–7.9 6.4 ± 0.4 0.025	5.2–6.1 5.8 ± 0.15 0.2	5.5–7.5 6.1 ± 0.4 0.025	1.24
6. + pepper	4.1–4.9 4.5 ± 0.07 0.3	5.9–6.6 6.2 ± 0.13 0.025	4.5–4.9 4.8 ± 0.23 0.025	4.2–4.9 4.5 ± 0.24 0.3	1.38
7. + corn oil	4.4–4.6 4.5 ± 0.05 0.1	5.2–5.9 4.6 ± 0.15 0.05	4.1–6.8 4.9 ± 0.5 0.05	3.8–4.7 4.2 ± 0.15 0.025	1.24

or orange juice, calcium absorption was significantly increased. Pepper, although its vitamin C content is more than that of orange, showed absorption index less than that of orange. The enhancing action of orange juice on calcium absorption may be attributed to its content of citric acid. *Nordio* and *Bruni* (8) reported that citric acid administration to rats caused a marked decrease in urinary calcium excretion. The latter may indicate higher rate of renal tubular reabsorption. Parsley, which is the richest in vitamin C content among the three juices used, did not affect calcium absorption.

Giving carotene together with the calcium phosphate did not affect calcium absorption. However, the level of plasma calcium after the first hour was lower and reached the maximum at the second hour. This may

Table 3. Vitamin C and carotene content of the three juices used in this experiment.

English name	Latine name	Vitamin C mg %	B-carotene mg %
Orange	Citrus sinesis	48	2.6
Pepper	Capsicum annum	147	1.5
Parsley	Petroselinum crispum	176	25.0

indicate that although carotene did not hinder intestinal calcium absorption, yet it may retard this process to a little extent. This may explain the non-effective action of parsley to absorption of calcium in spite of being rich in vitamin C. Parsley is very rich in carotene, contains about 16 times that of pepper and 10 times as orange.

Summary

The effect of vitamin C or carotene either in the authentic form or naturally occurring as in orange, parsley and pepper juices on calcium absorption was studied. Results obtained revealed that ascorbic acid, orange and pepper juices enhanced intestinal calcium absorption. Carotene and parsley proved to be without effect.

Zusammenfassung

Die Wirkung von Vitamin C und Carotin in Orangen-, Petersilien- und Pfeffersäften auf die Calciumabsorption im Darm wurde untersucht. Die Untersuchungsergebnisse zeigen, daß Ascorbinsäure, Orangen- und Pfeffersaft die Calciumresorption im Darm steigern. Carotin und Petersilie scheinen keine Wirkung zu haben.

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