

Ascorbyl Palmitate as a Source of Tissue Ascorbic Acid

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ABSTRACT

Ascorbyl palmitate prevented the appearance of scurvy in guinea-pigs given a scorbutogenic diet. There was no significant difference between the tissue concentrations of ascorbic acid in two groups of male guinea-pigs given equimolar amounts of ascorbic acid and ascorbyl palmitate, respectively, as a dietary supplement.

INTRODUCTION

Ascorbic acid is widely used in the food industry as a technological aid. Because of its relatively unstable nature, the bulk of this additive ascorbic acid is lost during food processing and makes only an insignificant contribution to the body vitamin C status (Thomas, 1984).

The palmityl derivative (ascorbyl palmitate; E 304, 6-O—palmitoyl-L-ascorbic acid, $C_{22}H_{38}O_7$) is used as an antioxidant and colour preservative with an ADI of 0-1.25 mg/kg body weight (FAO/WHO, 1984; Kläui & Pongracz, 1981). Ascorbyl palmitate is more stable than the free acid and, when used as a technological aid, could contribute to the consumers' vitamin C intake. Because of its comparatively low ADI, the dietary contribution of additive ascorbyl palmitate is unlikely to be substantial, except perhaps when the intake of the free acid is inadequate or when its absorption is impaired, as in elderly humans (Davies *et al.*, 1984). There appears to be no information on the absorption and tissue

retention of ascorbyl palmitate. This study was designed to compare the tissue concentrations of ascorbic acid in two groups of guinea-pigs given equimolar dietary supplements of free ascorbic acid and ascorbyl palmitate, respectively.

METHODS

Two groups of five 12-weeks old male albino guinea-pigs received, without restriction, the semi-synthetic scorbutogenic diet, MGI, prepared as described previously (Williams & Hughes, 1972) and a daily dose of 0.015 mmoles/kg body weight of ascorbic acid (group A) and ascorbyl palmitate (group B), respectively, both in 40% ethanol to facilitate solution of the palmitate; both groups thereby received equivalent doses of 'free' ascorbic acid. Food intakes were measured and the animals were weighed daily at the time of dosing. After 45 days the animals were killed and the ascorbic acid measured in the adrenals, brain, liver and spleen by the indophenol dye method (Williams & Hughes, 1972).

RESULTS AND COMMENT

The results are summarised in Table 1. There was no significant difference between the food intakes, gain in body weight or final body weight in the two groups. There was no significant difference between the ascorbic acid concentrations in the organs examined in the two groups: the total ascorbic acid in the adrenal glands was significantly greater in the 'palmityl' than in the 'free acid' group.

The survival of the guinea-pigs in group B for 45 days on a scorbutogenic diet implies that ascorbyl palmitate has full vitamin C activity. The tissue analyses indicated that, in the guinea-pig, ascorbyl palmitate is at least as potent a source of tissue ascorbic acid as the free acid; whether it is absorbed unchanged or after conversion to the free acid is not known. Any additive ascorbyl palmitate surviving food processing should therefore be regarded as a possible source of vitamin C.

This finding could be of potential application in human nutrition. The half-lives of mmolar solutions of ascorbic acid and ascorbyl palmitate at pH 6.5 and 37°C are 33 min and 108 min, respectively

TABLE 1
Tissue Concentrations of Ascorbic Acid after Administration of 0.015 mmoles/kg Body Weight of Ascorbic Acid (Group A) and Ascorbyl Palmitate (Group B), Respectively. (Means \pm Standard Error)

Group	A	B
Supplement	Ascorbic acid	Ascorbyl palmitate
<i>Body weight (g)</i>		
<i>Initial</i>	467 \pm 14	509 \pm 56
<i>Final</i>	673 \pm 13	717 \pm 49
<i>Liver</i>		
<i>Weight (g)</i>	27.4 \pm 1.07	29.0 \pm 3.01
<i>Ascorbic acid (mg/100g)</i>	3.19 \pm 0.025	2.97 \pm 0.18
<i>Adrenals</i>		
<i>Weight (g)</i>	0.430 \pm 0.014	0.472 \pm 0.021
<i>Ascorbic acid (mg/100g)</i>	15.1 \pm 0.67	16.5 \pm 0.84
<i>Spleen</i>		
<i>Weight (g)</i>	0.862 \pm 0.042	1.06 \pm 0.069
<i>Ascorbic acid (mg/100g)</i>	4.70 \pm 0.64	3.97 \pm 0.70
<i>Brain</i>		
<i>Weight (g)</i>	4.03 \pm 0.092	4.20 \pm 0.067
<i>Ascorbic acid (mg/100g)</i>	3.68 \pm 0.11	3.34 \pm 0.11

(R. E. Hughes and E. Jones, unpublished data). The comparatively low vitamin C status of elderly subjects is at least in part attributable to an impaired gastrointestinal absorption of the vitamin (Davies *et al.*, 1984). The use of ascorbyl palmitate could, by increasing the exposure time to the absorption processes, have an advantage over the use of the free acid in vitamin C supplementation studies.

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