NUTRITION REPORTS INTERNATIONAL

INFLUENCE OF ORAL CARNITINE ON THE BODY WEIGHT AND SURVIVAL TIME OF AVITAMINOTIC-C GUINEA PIGS

Eleri Jones and R.E. Hughes

Department of Applied Biology, University of Wales Institute of Science and Technology, Cardiff, Wales

ABSTRACT

Two groups of guinea pigs received 1% ascorbic acid in their drinking water to achieve tissue saturation and were afterwards maintained on an ascorbic acid-free regime till death. One group received fresh, aqueous DL-carnitine (10mg/ml/kg body weight) daily, the other an equivalent volume of water. The carnitine-supplemented group survived for a significantly longer period than the non-supplemented group ($p < 0.01$). The results suggest that carnitine synthesis is an important extra-antiscorbutic role of vitamin C.

INTRODUCTION

Historical accounts of human scurvy (avitaminosis C) have almost invariably indicated that fatigue and lassitude were the earliest features of the disease - a finding underlined more recently in reports of experimentally-induced scurvy in man (1). The current Recommended Daily Amount for vitamin C (ascorbic acid) in the United Kingdom (30 mg) is, however, based on the later emergence of the traditional symptoms of 'clinical' scurvy - enlargement and keratosis of hair follicles, formation of 'scorbutic spots' and characteristic gum changes (2,3).

Recent studies have provided a probable biochemical explanation of the role of ascorbic acid in the prevention of fatigue. Ascorbic acid is involved in two hydroxylation stages in the endogenous biosynthesis of carnitine from lysine (4) Carnitine, in turn, is necessary for the proper utilisation of fatty acids as a source of muscle energy; lassitude and fatigue are features of systemic carnitine deficiency (5).

A previous study with guinea-pigs indicated that hypovitaminosis C resulted in a significant fall in the skeletal muscle carnitine well before the emergence of any of the classical symptoms of guinea-pigs scurvy (6) - a situation which may be compared with human scurvy where lassitude and fatigue precede the emergence of the more traditional 'overt' signs.

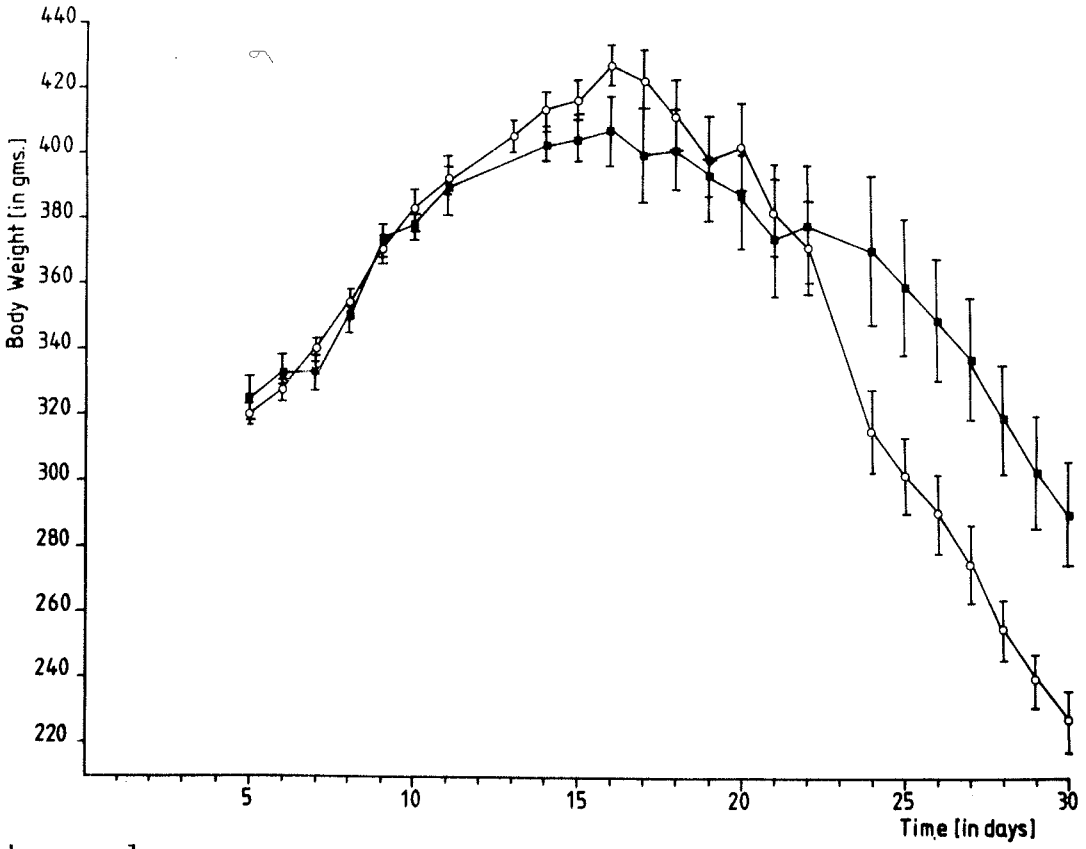
This report describes a study designed to extend this .ndings by determining the influence of carnitine ıpplementation on the body weight changes and survival .mes of guinea-pigs given a scorbutogenic diet.

METHODS

Two groups of eight male albino guinea-pigs (Dunkin-ırtley strain) were used. Both groups received a semi-'nthetic scorbutogenic diet (6) and, for 3 days prior to ıe depletion period, a supplement of 1% ascorbic acid in ıeir drinking water to produce tissue saturation. After ıis no further ascorbic acid supplements were given. On ıy 5 of the depletion period, and daily for the remainder : the experiment, the animals in the test group received daily oral supplement of 10 mg DL-carnitine/ml/kg body ;ight, dissolved in water; the control group received an ıuivalent volume of water. All animals were weighed ıily and survival periods noted.

RESULTS

The influence of the carnitine supplement on the body ;ights and survival times of the scorbutic guinea-pigs is ıown in Figures 1 and 2. Carnitine supplementation



igure 1 :
nfluence of DL-carnitine (10 mg.kg^{-1}.day^{-1}) on the body ;eights of guinea-pigs. Differences are significant from ay 24 onwards. (o—o control group, ■—■ carnitine group)

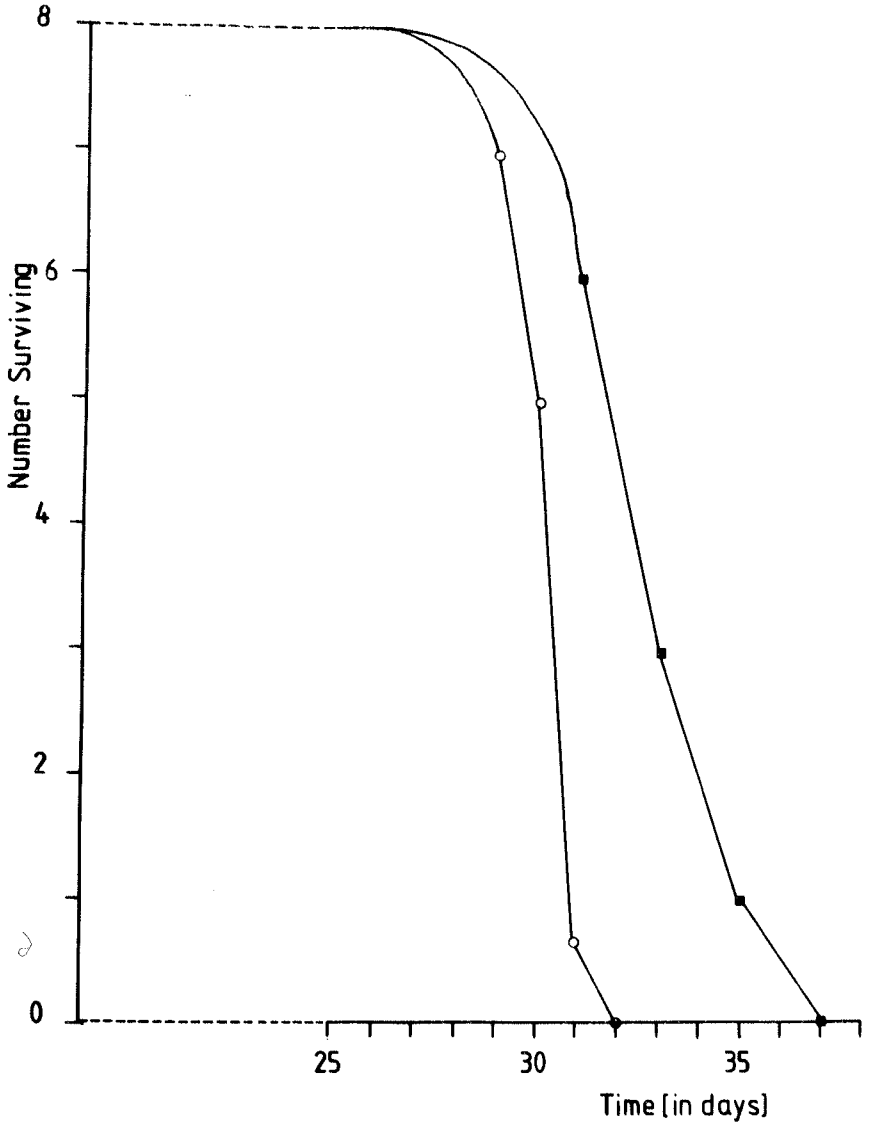


Figure 2 : Influence of DL-carnitine on the survival time of guinea-pigs. (o—o control group, ■-■ carnitine group).

produced a significant increase in the mean life span; the survival time for the control group was 30.6 ± 0.3 days and for the supplemented group 33.5 ± 0.7 days (mean values with standard errors, $P < 0.01$). There was no significant difference between the mean body weights at the beginning of the test. On day 24 of the depletion period, and daily thereafter until the end of the experiment, the mean body weight of the carnitine-supplemented group was significantly greater than that of the controls.

DISCUSSION

This influence of carnitine on the body weight and survival time of the scorbutic guinea pig may be inter-

eted as indicating a 'sparing' effect upon endogenous mands for tissue ascorbic acid and supports previous idence of a nutritional role for ascorbic acid in the nversion of lysine to carnitine (1,4,6). The results e in contrast with a previous study where dietary pplementation with cholesterol failed to influence the fe span of scorbutic guinea-pigs although there is idence that the vitamin is involved in cholesterol tabolism (7). This could mean that the involvement of corbic acid in carnitine metabolism is nutritionally gnificant and underlines the possible inadequacy of a commended Daily Amount for ascorbic acid based on nsiderations which do not include a probable role in rnitine metabolism.

ACKNOWLEDGEMENTS

This study was supported by a Beecham Products Ltd, search grant. Mr Stuart Barnett, assisted with the imal husbandry.

REFERENCES

1) Hughes, R.E. 'Vitamin C, Some Current Problems'. itish Nutrition Foundation, London (1981).

2) DHSS Report 'Recommended Daily Amounts of Food ergy and Nutrients for Groups of People in the United ngdom' HMSO, London (1981).

3) Bartley, W., Krebs, H.A. and O'Brien, J.R.P. tamin C Requirement of Human Adults. Medical Research uncil Special Report Series No. 280 HMSO, London (1953).

4) Hulse, J.D., Ellis, S.R., and Henderson, L.M. rnitine biosynthesis : β-hydroxylation of trimethyllysine an α-ketoglutarate-dependent mitochondrial dioxygenase. biol. Chem. 253 1654-1659 (1978).

5) Hughes, R.E. Recommended Daily Amounts and ochemical Roles : the Vitamin C, Carnitine, Fatigue lationship. In 'Vitamin C' (editor: J. Counsell), plied Science Publishers, London, (1982) (in the press).

6) Hughes, R.E., Hurley, R.J. and Jones, Eleri. etary ascorbic acid and muscle carnitine in guinea-pigs . J. Nutr. 43, 385-388 (1980).

7) Jones, P.R., Hurley, R.J. and Hughes, R.E. Dietary olesterol, sex and scurvy in Guinea-pigs. Nature 242 1-522 (1973).

cepted for publication: November 18, 1981.