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Adeqate Allowance for Vitamin C*)

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With 1 figure

(Received October 2, 1963)

It appears to be generally accepted that less than 10 mg. per day of ascorbic acid – perhaps not more than about 5 mg. – is needed to prevent manifest scorbut in the adult. This is some times referred to as the minimum requirement.

It is also generally assumed that an amount of ascorbic acid which is just about enough to prevent the occurrence of clinical deficiency symptoms may not be sufficient to ensure full physical fitness. An adequate allowance, therefore, should provide for such extra amount as needed for full benefit and for a reasonable safety margin on top of that.

The question then is, how much would be needed to fulfill these requirements. It is here that opinions diverge widely, and thus "recommended allowances" range from 20–30 mg. on the lower side to 75 mg. and upwards.

The highest levels of intake recommended appear to be based on the assumption that a state of saturation or near saturation is required for full benefit to be attained from vitamin C. This has, however, not been shown conclusively to be the case, nor is it possible to point out any particular level of ascorbic acid in blood as the lower limit of normality.

A priori it would seem unlikely that an increase to more than tenfold the minimum requirement dose is needed for optimum results. Anyhow, this would put vitamin C in a rather unique position among the known nutritional essentials. But more significant is that experience does not seem to substantiate the highest claims in so much as one can point out population groups which, for all evidence, have thrived well at vitamin C intake levels of not more than $^1/_3$ to $^1/_4$ of that required for saturation.

As an example we may take the population of Iceland. In bygone ages, and before the introduction of potatoes, milk was the all-important source of vitamin C and the intake level has probably not been much above 10 mg. Scurvy occurred at times but apparently only when milk was not available or where it was scarce as in the sea coast villages.

*) Read at the 6th International Congress on Nutrition, Edinburgh, August 9–15, 1963.

It is true that general health conditions at these times were very poor and the mortality was excessive, especially when epidemic diseases prevailed and in hard years when there was a general food shortage. But it is not possible to say whether, or to what extent, subclinical vitamin C deficiency has contributed to diminished resistance of the population. Certainly other factors were more prominent.

Potatoes were first introduced to Iceland in the second half of the 18th century, but it took long time before they became a regular item in the diet.

In more recent times much more of C vitamin is obtainable in the daily food than formerly, but still the milk remains an important source.

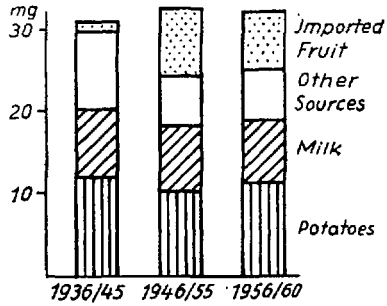

Fig. 1. Vide Text.

The diagram shows the estimated average intake of vitamin C, per day and per capita, for three periods after 1935. These estimates are based on production- and trading reports.

The most important sources are potatoes and milk – not only because together they provide about 60% of the average total intake but also because the consumption of these items is universal throughout the year. (The estimated amount obtained from potatoes is here based on mid-winter values). Swedes (Brassica napus, var. napobrassica), included in "other sources", provided a significant amount of C vitamin in the first period but much less in the later periods (2). This, however, has been more than counterbalanced by increased import of fresh fruit in the more recent years.

The total amount is remarkably similar for all three periods – little over 30 mg. It should be noted, however, that the distribution of imported fruit, supplying a fair amount of vitamin C in the two later periods, is very uneven. Most of it goes to the towns, especially Reykjavik, whereas in rural districts the consumption is very small as a rule. The same also applies, with few exceptions, to green vegetables here included in the group "other sources".

For the rural population, therefore, the average intake of vitamin C would hardly exceed 25 mg. except perhaps in late summer and autumn. But in winter and spring it would probably often be about or below 20 mg., little more than what is supplied by milk and potatoes. In conformance with this winter and spring values for ascorbic acid in blood plasma have been found to be about 0.2–0.1 mg/100 ml. for those who have not had access to fruit or some other extra sources of vitamin C (3, 4).

Compared to the higher levels of recommended allowances these intakes would be considered very low, even to be in the pre-scorbutic range. Yet, there is no obvious indication of vitamin C deficiency leading to lack of physical fitness, and in so far as can be judged by the common statistical health indices as expectation of life and mortality rates the general health conditions would be deemed to be in the highest range. In particular it may be mentioned that the infant mortality rate, perhaps the most sensitive of these indices, has for some time been among the lowest, and often the very lowest on record. It has now for 10 years been well below 20 per thousand.

Of course it may be argued that these so-called health indices could not be expected to reflect some minor nutritional deficiencies. But it does not seem likely that it would not show some where if the intake level for vitamin C actually has been only a fraction – less than $^1/_2$ or $^1/_3$ – of what is required for normality.

The experience as outlined here is also in full agreement with the results of the well known Sheffield experiments carried out on volunteers which lead to the conclusion that an allowance of 30 mg./day is not only fully adequate but allows for a considerable safety margin.

Time does not permit to discuss the several arguments which have been advanced in support of the high level allowances many of which have been based on animal experiments. It may only be pointed out that the results of such experiments are often difficult to interpret because of physiological differences. There are indications of a considerable increase in the catabolism of ascorbic acid at the higher intake levels (1, 3), but this, as the increased urinary excretion might be interpreted only as a means to deal with surplus intake.

Briefly, having regard to the observations made here, among other things, it is our opinion that a daily amount of 20–30 mg. of vitamin C is adequate and that it remains to be shown conclusively that an increased intake above that level is of any benefit under otherwise normal conditions.

In the meantime, therefore, we would agree with those who find that there is no need to recommend a higher allowance for vitamin C than the standard of 30 mg./day for the adult adopted by the Technical Commission on Nutrition of the League of Nations.

Summary

Observations on C-vitamin nutrition in Iceland do not lend support to the assumption that a state of near-saturation is required for full benefit to be attained from this vitamin. Here a great part of the population rarely exceed 30 mg./day and values of about 20 mg. and less are frequent. Yet, the standard of health is in the highest range.

In general, these observations are in concord with the results of the well known Sheffield experiments.

It is maintained that it remains to be shown conclusively that an increased intake above 20–30 mg. per day is of any benefit under otherwise normal conditions. The apparent increase of catabolism of ascorbic acid at the higher intake levels might, as the increased urinary excretion, be interpreted as a means to deal with surplus intake.

According to present knowledge, therefore, it is found that there is no need to recommend a higher allowance for vitamin C than the standard of 30 mg./day for the adult adopted by the Technical Commission on Nutrition of the League of Nations.

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Zur Frage der Vitaminversorgung durch die Darmflora

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Mit 4 Abbildungen und 3 Tabellen

(Eingegangen am 18. Oktober 1963)

Entscheidend für die Ausnutzbarkeit der von der Darmflora synthetisierten Vitamine ist ihre Resorptionsfähigkeit; diese wird durch die Zustandsform der Vitamine und die Resorptionskapazität der distalen Darmabschnitte bestimmt. Da sich mit konventionellen Methoden nicht feststellen läßt, ob ein im Darm vorliegendes Vitamin aus der Nahrung, der mikrobiellen Biosynthese oder den Verdauungs- und Darmsäften stammt, haben wir versucht, mit Hilfe von radioaktiv markiertem Vitamin B_1 als Modellfall und Ratten als Versuchstieren Aufschlüsse über den Anteil der Darmflora an der Vitaminversorgung des Makroorganismus zu gewinnen.

Einer Reihe neuerer Befunde an Tieren (1–4, 6, 20, 29, 31–33) stehen Versuche von FUJITA und Mitarb. (25, 26, 34, 35) am Menschen entgegen, die nach Zugabe von 2% Zellulose zur Kost einer Versuchsperson zur Stimulierung der intestinalen Vitaminsynthese und einem an der Harnausscheidung erkennbaren Vitamin-B_1-, -B_2-, -B_6-, Folsäure-, Pantothensäure- und Niacinangebot durch die Darmflora geführt haben. Die Möglichkeit, über eine zellulosereiche Kost die Vitaminversorgung zu verbessern, wäre von praktischer Bedeutung. Wir haben darum an mehreren Personen einen Ernährungsversuch mit einer entsprechenden Diät durchgeführt und die Ausscheidung einiger B-Vitamine im Harn verfolgt.

Versuchsanordnung

1. Zur Untersuchung der Ausnutzbarkeit in Bakterien gebundener Vitamine werden nach der früher beschriebenen Arbeitsweise (15) in mehreren Ansätzen jeweils 1,8 l, ^{35}S-Thiaminbromid-hydrobromid (1. Ansatz: 160 mg, 27,2 mc) enthaltende Nährlösungen mit einer 12 Std. in Peptonwasser vorbebrüteten Coli-Kultur beimpft und 18 Std. inkubiert. Die abzentrifugierten Zellen werden 7mal mit 50 ml physiologischer Kochsalzlösung gewaschen und mit einem Homogenisator suspendiert.

Das in der Nährlösung verbliebene unverbrauchte ^{35}S-Thiamin wird durch Eindampfen der auf p_H 2 gebrachten Lösung im Vakuum der Wasserstrahlpumpe, Aufnahme des Rückstandes in 500 ml 96%igem Alkohol, Filtrieren, erneutes Eindampfen, Aufnahme in 70 ml