THE RELATIONSHIP BETWEEN THE BIOSYNTHESIS OF VITAMIN C IN THE HUMAN BODY AND THE DEGREE OF ABSORPTION FOLLOWING THE ADMINISTRATION OF DIETARY SUPPLEMENTS

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RESEARCH ARTICLE

Abstract

Studies that conceptualize how diet and dietary supplements affect the absorption of vitamin C in the body are important because they educate consumers about the significance of methods for assessing vitamin C intake and absorption before any empirical attempts to increase immunity are made. Due to the dose dependence of vitamin C's bioavailability, supplements should be used under strict control rather than topically or empirically. Any dietary advice assessing the effects and antioxidant function of vitamin C is based on an analysis of the vitamin's quantitative and qualitative dietary content, with the goal of enhancing consumers' nutritional status and, ultimately, their health.

In order to educate consumers about the circumstances in which vitamin C supplements can be taken, the purpose of this study was to demonstrate the actual effects of high-dose administration. The results show that absorption decreases to less than 50% when vitamin C intake exceeds 1000 mg. This occurs as a result of the body's tissues becoming saturated, which lowers absorption; any surplus is subsequently expelled through the urine.

Supplementation should only be used in specific situations because vitamin C is absorbed similarly whether it is synthetic or found in food. Nutritional studies are crucial in identifying food products that, when consumed in amounts that correspond to nutritional recommendations, can provide an optimal amount of vitamin C with beneficial effects on the body. By doing this, it is also possible to lessen the negative social media influence associated with the intake of this vitamin, thereby reducing unhealthy eating habits.

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INTRODUCTION

Based on research, the recommended daily intake of vitamin C is 60 mg (Iqbal et al., 2022), with at-risk individuals requiring up to 250 mg.

While the bioavailability of vitamin C varies with dose (Frei et al., 2012), transport saturation occurs at doses of 200–400 mg/day (Kubler and Gehler, 1970). Although 500 mg doses per day result in about 70% absorption, more than 50% of the absorbed dose is unmetabolized and eliminated in the urine (Institute of Medicine US, 2000). When doses of vitamin C exceed 1000 mg, absorption drops to less than 50% (Levine, 1996, Levine, 2001). A dosage of 1250 mg has a 50% absorption rate, meaning that over 85% of it will be eliminated (Carr, 2016). Accordingly, moderate daily intakes of 200–400 mg of vitamin C are necessary for its complete absorption of roughly 70–90% (Iqbal et al., 2022).

It is important for consumers to understand the functions of vitamin C in the body (Bjelakovic, 2007). Because of its antioxidant capacity, it plays a significant role in the production of collagen and elastin, the absorption of iron in the digestive tract, the reduction of allergic reactions, and the inhibition of histamine release (Horska, 2011). A strong reducing agent, vitamin C takes part in a number of significant hydroxylation reactions. The entry of vitamin C into cells is facilitated by Na-coupled transporters+ (Malo and Wilson, 2000). Vitamin C is regenerated from DHA by glial cells in the brain (Corpe, 2013). It is also required for collagen biosynthesis, l-carnitine production, collagen development, and the production of neurotransmitters, catecholamines and bile acids. Oxalate is a natural degradation product of vitamin C (Engelking, 2015).

Vitamin C uses Fe^{++} and Cu^{++} as cofactors, and enhances intestinal absorption of Fe^{++} (Engelking, 2015). Therefore, in addition to its antioxidant effect, vitamin C assimilation also influences the capacity of the body to absorb non-heme iron, which is found in plant foods such as leafy greens. An intake of less than 25 mg of vitamin C per day results in an of absorption of only 3% of non-heme iron. A daily intake of 50 mg of vitamin C results in 5% absorption, whereas a daily intake of more than 70 mg of vitamin C results in 8% absorption of non-heme iron. Drinking a small glass of 100% fruit juice or including a vitamin C-rich food with meals can help to stimulate iron absorption (Paidi, 2014; Sogaard, 2014)

Normal skin typically contains high concentrations of vitamin C, which promotes collagen production and protects against UV damage. If vitamin intake is adequate through diet, vitamin C acts on the skin and, in fact, on all tissues of the human body. According to research, topical vitamin C may not offer many advantages because little of the vitamin can be absorbed by surface of the skin through creams and serums, and even if consumed in sufficient quantities through food or supplements, it won't have any further effects (Pullar et al., 2017).

This study evaluated the degree of vitamin C absorption following dietary supplementation, based on the biosynthesis of the vitamin in the body, The study aimed to highlight the impact and role of antioxidant score of diet on the body. These studies can significantly contribute to educate consumers through specific nutritional interventions to adopt a healthy lifestyle, correlated with physiological status.

The objectives of this study are related to the fact that any nutritional recommendations assessing the antioxidant role and impact of vitamin C will be based on a quantitative and qualitative analysis of the nutrient's content in foods, with the view of improving consumers' nutritional status and overall health.

MATERIAL AND METHOD

It is vital to develop an investigative strategy and methodology that is specific to the various theoretical orientations and carriers of implicit or explicit ideology within dietary supplements and nutrients in order to evaluate and investigate their diversity as adjuvant health supporting factors (Cook, 2007; Heart Protection Study Collaborative, 2002; Sesso, 2008).

The results of this study are based on the observation of five consumers (n=5), who appeared to be in good health, ate a regular diet, and willingly agreed to raise their vitamin C intake to the recommended level. Intakes were supplemented with doses of 500 mg/day, 1000 mg/day, and 1500 mg/day, respectively, based on information obtained from social media about the benefits of vitamin C supplementation, in the absence of a specific cause.

The following research methods were applied in this scientific study:

a) The clinical approach, based on nutritional anamnesis, which was applied in order to make judicious clinical assessments of the consumers' nutritional and physiological status, as well as any pathological disorders that could be identified based on particular paraclinical analysis. This approach entailed surveillance, correlation of cases of vitamin C overdosage or underdosage, and analysis of events under study.

b) The nutritional approach, which was based on: the assessment of nutritional intake; a nutritional anamnesis, which gathered data on the type and quantity of food consumed; and nutritional and energy calculations based on the makeup of the food consumed over the course of a day. Information about the existence or lack of risk factors for nutritional diseases was obtained through nutrient intake assessment.

c) The paraclinical approach, carried out in a private medical laboratory, was based on macroscopic evaluation, biochemical evaluation of the primary metabolites, and microscopic evaluation in order to assess vitamin C excretion by urine examination. Although not all urine biochemistry tests include ascorbic acid, which is the eleventh parameter, its assessment is crucial because it may alter certain biochemical tests.

RESULTS AND DISCUSSIONS

Due to its use as a flavor enhancer and preservative in a variety of food and pharmaceutical products (vitamin complexes), ascorbic acid is frequently consumed in high amounts. As a result, it can alter urine biochemistry without any pathologic justification. To avoid producing erroneous results, it is crucial to detect it through tests that also include this parameter (Lykkesfeldt, 2020).

An important and noteworthy feature of this study was the analysis of the mixed diet situation according to a seven-day diet plan. All study participants accepted the recommended

diet plan, which included a range of food types and considered their vitamin C content and preparation methods, which have a significant impact on vitamin C intake (Table 1).

Table 1

Nutrient estimates of vitamin C intake according to the dietary plan

Diet/Nutritional plan	*EV (kcal/day)*	*Vitamin C_i (mg/day)*	*Vitamin C_{abs} mg/day*
DAY I	2742,49	107.2	87.76
DAY II	1687,28	78.12	70.31
DAY III	1687,28	88.12	79.31
DAY IV	2335,49	104.19	88.56
DAY V	3236,73	196.26	137.38
DAY VI	1678,18	98.45	88.61
DAY VII	1044,57	105.09	89.33

*VE - energy value; Vitamin C_{i_alim} - Vitamin C ingested; Vitamin C_{abs} - Vitamin C absorbed

Dietary energy value and vitamin C intake were linked; higher dietary energy values resulted in higher vitamin C intake, and higher intake raised absorption.

The nutritional analysis revealed that the highest values were recorded on the fifth day of analysis. The average absorption of vitamin C was 137.38 mg/day, which translates to an average percentage absorption of 70% of the ingestion. The mean percentage of vitamin C absorbed on the third and twelfth days of analysis averaged 90% of the intake on both days. These average proportions are due to the fact that the bioavailability of vitamin C depends on the ingested dose. However, it is crucial to note that moderate vitamin C intake results in 70–90% absorption.

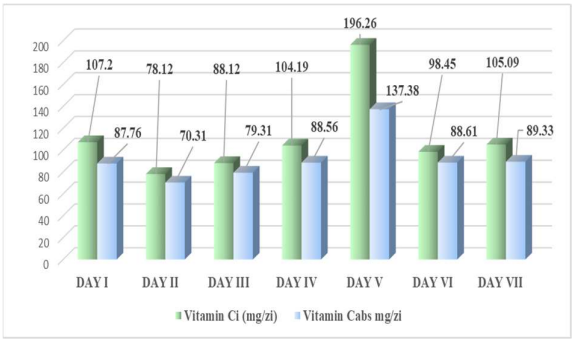

Figure 1. Distribution of mean vitamin C intake correlated with mean dietary vitamin C intake per day

The lowest average vitamin C intake was determined on day 2, being 78.12 mg/day, leading to an average absorption of 70.31 mg/day, which can provide on average 93.75% of the RQ/day.

Table 2

Evolution of vitamin C absorption, excretion and metabolic utili*zation after supplementation with doses of 500, 1000 and 1500 mg/day

Diet/Nutrition Plan	Vitamin $C_{\_i\ alim}$ *(mg/day)*	*Vitamin $C_{\_i\ alim}$ + more (mg/day)*			*Vitamin C_{excr} mg/day*			*Vitamin C_{UT} mg/day*		
		Vitamin C_{abs}_S_500 (mg/day)	Vitamin C_{abs}_S_1000 (mg/day)	Vitamin C_{abs}_S_1500 (mg/day)	Vitamin C_{ex}_S_500 (mg/day)	Vitamin C_{ex}_S_1000 (mg/day)	Vitamin C_{ex}_S_1500 (mg/day)	Vitamin C_{UTM}_S_500 (mg/day)	Vitamin C_{UTM}_S_1000 (mg/day)	Vitamin C_{UTM}_S_1500 (mg/day)
DAY I	107.2	364.32	553.60	482.16	182.16	332.16	385.72	182.16	221.44	96.43
DAY II	78.12	**404.68**	***539.06***	552.34	**202.34**	***323.43***	441.87	**202.34**	***215.63***	110.46
DAY III	88.12	382.27	544.06	**555.84**	191.13	326.43	**444.67**	191.13	217.63	**111.16**
DAY IV	104.19	362.51	552.09	481.23	181.25	331.25	384.98	181.25	220.84	96.24
DAY V	196.26	***348.13***	***598.13***	***424.06***	***174.06***	**358.87**	***339.24***	***174.06***	**239.26**	84.81
DAY VI	98.45	359.07	549.22	479.53	179.53	329.53	398.02	179.53	219.69	***81.50***
DAY VII	105.09	363.05	552.54	481.52	181.52	331.52	385.21	181.52	221.02	96.30

*Vitamin $C_{\_ialm}$ - Dietary ingested Vitamin C; Vitamin C_{abs} - Absorbed Vitamin C, Vitamin C_{ex} - Excreted Vitamin C, Vitaniba C_{UTM} - Vitamin C metabolically utilized

Following dietary intake plus supplementation, the C_{abs} _S_1000 mg/day variant was associated with the highest absorption of vitamin C (598.13 mg/day) (Table 2), while the C_{abs}_S_500 mg/day variant showed the lowest absorption (348.13 mg/day). The amount of vitamin C consumed in all three variants remained the same, based on the dietary plan that all study participants followed, but supplementing with 1500 mg/day of the vitamin produced a downward trend when compared to supplementing with 1000 mg/day.

Analyzing the evolutionary results of excretion (Table 2), on the basis of paraclinical data of vitamin C dosage in urine, in the case of variant C_{abs} _S_500 mg/day it was observed that from the amount absorbed after ingestion, the excretion rate was of 50%, resulting in a metabolic utilization of at most 202.34 mg/day on the second day of analysis.

In the variant C_{abs}_S_1000 mg/day it was observed that the excretion was about 60%, resulting in a metabolic utilization of at most 239.26 mg/day. And in the C_{abs} _S_1500 mg/day variant, the excretion was of about 80%,

resulting in a metabolic utilization of at most 111.16 mg/day. These excretion results are inversely proportional to vitamin C ingestion and absorption due to the fact that metabolic saturation of tissues with vitamin C occurred.

The highest metabolic utilization of vitamin C (Table 2) was found on the first day of analysis in variant C_{UTM}_S_1000 (mg/day), followed by variant C_{UTM}_S_500 (mg/day) on the second day, with 202,34 mg/day, and variant C_{UTM}_S_1500 (mg/day) on the third day of analysis, with 111,16 mg/day. This was based on the analysis of metabolic utilization in all three experimental variants, C_{UTM}_S_500 (mg/day), C_{UTM}_S_1000 (mg/day), and C_{UTM}_S_1500 (mg/day).

The C_{UTM}_S_500 mg/day variant was associated with the lowest metabolic utilization of vitamin C, at 174.06 mg/day on day 5, while the highest dietary intake was 196.26 mg/day (Table 2). In the C_{UTM}_S_1000 mg/day variant, the lowest amount of vitamin C metabolically utilized was determined on day 2, i.e. 215.63 mg/day, where the lowest dietary intake was also determined.

On day six of analysis, the variant C_{UTM}_S_1500 mg/day had the lowest metabolically utilized vitamin C (Table 2), at 81.50 mg/day.

The detection of a high level of ascorbic acid in the urine requires a re-evaluation of some biochemical parameters: glucose, bilirubin, hemoglobin and nitrite. For glucose and bilirubin, a high amount of ascorbic acid induces a false result by lowering the limit of detection so that alert values may appear as pathological values without particular significance, but appear as mismatches between biochemical parameters (Henriquez-Sanchez, 2009.

Any pathology that calls for the prescription of vitamin C supplements necessitates an analysis and an intervention in the metabolism of the body; therefore, the prescription must be in line with all available scientific data regarding the disease and must take into consideration the body's entire pathophysiologic context, including the drug treatment and its metabolic implications. Since nutrition is known to play a significant role in promoting and maintaining good health throughout life, the advantages of specialized nutritional interventions have already been demonstrated. This should serve as a warning for both healthy and mono- or poly-infected organisms.

The findings of the nutritional analysis of vitamin C intake and absorption on health improvement led to the conclusion that these physiologically active nutrients might help reduce the high prevalence of certain diseases, as well as the expenses associated with diet management.

CONCLUSIONS

A daily intake of roughly 500 mg of vitamin C from food plus supplements will result in an approximate 70% absorption rate, of which, according to metabolic data correlated with paraclinical data, more than 50% will be excreted.

When vitamin C intake exceeds 1500 mg/day, absorption is approximately 25–35%, with excretion exceeding 85%. Therefore, the higher the vitamin C intake above 1500 mg/day, the lower the absorption.

Consuming more than 1000 mg of vitamin C per day increases the risk of developing renal diseases, especially in those who already have hyperoxaluria.

70–80% of vitamin C is absorbed at moderate doses, and bioavailability varies with dosage.

The reduction of vitamin C deficiency is positively correlated with lifestyle factors, including diet.

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