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Research Article

The Acidity of Ascorbic Acid: An Underestimated Property against Covid-19 and Respiratory Viruses

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Abstract

Background: The intake of vitamin C in flu syndromes and colds, especially citrus juices, is recommended, due to its antioxidant and immunostimulant properties.

Aim: The acid pH of these juices, as well as their ascorbic acid content, could contribute to the deactivation of viruses responsible for the disease.

Materials: Commercial tablets containing ascorbic acid and sodium ascorbate.

Methods: This study monitored the pH in samples of the saliva produced by human adult volunteers after the introduction into their mouth of a tablet of a commercial supplement of ascorbic acid (AA).

Results: The initial saliva pH of volunteers was 6.6 ± 0.4 and a tablet dissolved in 50 mL of distilled water yields a pH of 4.2 ± 0.1.

Conclusion: This work aims to highlight the possible role of vitamin C acidity in common viral illnesses.

Keywords: Acidity; Ascorbic Acid (AA); Sodium Ascorbate (NaAA); Covid-19; Sars-Cov-2

Introduction

It is a common practice to recommend the intake of fruit juices, especially citrus fruits, during winter flu epidemics, with the stated aim of providing an increase in vitamin C, named also ascorbic acid, to the body. Ascorbic acid (AA), certainly has many recognized activities including antioxidant and immunostimulant actions [1].

Recent literature suggests that vitamin C may play an adjunctive role in the treatment of a variety of viral infections [2]. Coppock., *et al*, hypothesized that high-dose ascorbic acid delivered intravenously to achieve pharmacologic concentrations may target the high viral phase of COVID-19 and thus improve early clinical outcomes [3].

Vitamin C is also an additive in food processing and our organism does not retain the excess of this compound [4].

A property, that is perhaps, not adequately considered, is its acidity, and in citrus juices, the acidity is also increased by the presence of other organic acids, up to 30-40g/L in lemon juice.

The agent of the current pandemic, the SARS-COV-2 virus, has a feature, already seen in all viruses: it is quickly deactivated at acid pH values [5]. Therefore, considering the pH of citrus juice, normally in the range of 2.3-2.5 we assume that this factor could be decisive to fight the vitality of the virus.

Of course, people can't drink juice all the time, but one can take advantage of the acidity that can be obtained in the buccal and pharynx cavities to affect the viral load that can be present in saliva [6].

Since it is common use to assume AA as a supplement during flu periods, to verify a possible way of protection from the virus, we monitored the pH in samples of the saliva produced by human volunteers after the introduction into their mouth of a tablet of a commercial supplement of AA.

Materials and Methods

Materials

As a source of ascorbic acid, commercial 500 mg tablets containing 250 mg of ascorbic acid (AA), and 281 mg of sodium ascorbate

(NaAA), equivalent to 250 mg of free AA, were used. This supplement was purchased from a local supermarket and it's commonly consumed.

Ten individuals adult volunteers placed a supplement tablet into their mouths.

pH measuring

The trend of the pH value in the saliva of volunteers was measured before and after taking the tablet. Every 3 minutes, about 2 mL of saliva was collected from each subject anonymously in a test tube, diluted 1:1 with a 0.02 M solution of KCl, and the pH was measured using a Seven Easy digital pH meter, equipped with an Ingold electrode (Mettler Toledo, Milan, Italy).

The individuals had not taken medicines, food or beverages excluding water or smoked within 3 hours before the measurements.

The initial saliva pH of individuals ranging between 6.5 and 6.9 and a tablet dissolved in 50 mL of distilled water determines a pH value of 4.2 ± 0.1.

Results

In volunteers, after taking the tablet, the pH was measured at various times until the whole tablet was dissolved by the saliva, gradually produced and swallowed. It's observed that there was a decrease of nearly 37% (from 6.7 to 4.2) of pH in 3 min. This parameter remains so up to about 20 min, when the tablet was completely dissolved, returning to the initial value at 30 min. Small differences among the test subjects might depend on the amount of saliva produced and swallowed by each subject.

It can be assumed that the measured pH value of the saliva samples is the same in the swallowed saliva, which is in contact both with the buccal mucosa and the pharyngeal tissue.

This fact can help to fight the spread of the virus in many situations, such as in crowded public transport. An average journey by metro or bus takes up to 20 min, like the dissolution time of the tablet used and since the salivary pH remains acidic for some more min, one can be sufficiently sure that any virus that has reached his throat during this time will be deactivated. This simple sanitization action is also favored by the fact that acidity stimulates salivation, which carries the virus to the more acidic gastric ambient.

Discussion

The common suggestion that vitamin C may be beneficial in viral and influenza infections, is based on its immunomodulatory properties, but there is limited evidence-based clinical data to support this thesis. There is, however, emerging literature to suggest that the use of vitamin C may play an adjunctive role in the treatment of viral infections, but this therapy has not been reported in patients [7]. The purpose of this work is a revival of the chemical character of vitamin C for possible administration in respiratory illnesses.

Based on these considerations, in this study conducted on adult volunteers, we assume that acidity is one of the main factors for the antiviral action of vitamin C, then this action could be reinforced. Consequently, you could use the same total amount of AA (sum of AA and NaA) present in the tablet but change the ratio between the two components. In fact, if the ratio instead of being 1:1 was 3:1, the pH developed by the tablet would decrease from 4.2 to 3.7, with increased disinfectant efficacy, without bringing problems to the health of the teeth.

The pH lowering effect could also be achieved with the introduction into the composition of the tablet of a low amount of tartaric (E334), and/or malic (E296) and/or citric (E330) acid, all compounds already used in foods as acidulant additives. As a matter of fact, some effervescent tablets contain citric or tartaric acid, but their solutions are administrated in a few seconds, as occurs for fruit juice, so the effect of lowering the mouth pH is not lasting, as happens for tablets.

While immunization with the vaccine is the main way to eradicate or make less severe the pandemics, other ways have been proposed as a palliative. The main ones are aimed at interacting in some way with the virus as it enters the airways.

Nasal sprays based on various components have been suggested, including acidic components [8], baby detergents [9], hydrogen peroxide [10], or hypochlorous acid [11]; a spray containing trypsin from arctic fish was also commercialized [12]. A citric acid-based spray (Taffix™) in a medium viscosity system, which seems to be effective against the spread of the virus in crowded places was recently introduced. Each of these products can cause sensitization problems and interference with mucociliary clearance.

Furthermore, they interact with the proteins of the virus as well as with the proteins of the nasal cavity: all of them can be processed by trypsin and all can be oxidized; in this last aspect, it must be taken into account that radical oxidation can originate long-lasting macroradicals.

On the contrary, the mouth and the pharyngeal mucosa are used to encounter acid pH values, since practically all the fruits that we eat have a pH between 2.5 and 4.5, due to their content in di/tricarboxylic acids, like malic, tartaric, and citric acid. It would be interesting to check whether other refreshing drinks, such as soft drinks, which contain phosphoric or citric acid and have a pH value between 2 and 3, could interfere with the infectivity of the virus.

Recently, Dai., *et al*. [13] reported that consumers who drink moderate amounts (within guidelines) of red and white wine are less prone to infection by COVID-19 than those who drink apple cider or beer, due to the high polyphenolic content in wines.

While the presence of rather high total polyphenolic content in wines must surely be considered, we think that the high content of organic acids in wines (normal values of about 6g/L) might act on the virus: the pH value ranging from 3.2 to 3.7 in white wines and red wines from 3.3 to 3.8. On the other hand, apple cider and beer contain both less polyphenols and acids, with a pH value > 4 and about 6 respectively.

Such facts must be taken into account when performing Covid tests, like evaluating testing the presence of active virus in saliva specimens, since false positive results could be possible. A virus broken apart in its components can give a positive response, but it will not be able to replicate and cause infection.

Conclusions

Vitamin C appears to have clinical benefits in patients with infections due to a variety of influenza viruses. In this study conducted on adult volunteers, we assume that the acidity represents important factors for the antiviral action of vitamin C. In volunteers, after taking the tablet containing ascorbic acid, it's observed, a decrease from about 6.7 to 4.2 of pH in 3 min. This parameter remains up to about 20 min, when the tablet was completely dissolved, returning to the initial value at 30 min. The pH-lowering effect could also be achieved with the introduction into the composition of the tablet of a low number of acids, already used in foods as acidulant additives and could reduce the risk of common viral illnesses.

Author Contributions

All authors have contributed substantially to the conception and design of the work.

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Informed Consent Statement

Informed consent was obtained from all individual included in the study. The participation was voluntary and anonymous.

Institutional Review Board Statement

This study was in line with the principles of the Declaration of Helsinki as revised in 2013 and meet ethical guidelines by the Institutional Review Board and comply to the legal requirements of the study country.

Conflicts of Interest

The authors declare no conflicts of interest.

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