JIDC | THE JOURNAL OF INFECTION IN DEVELOPING COUNTRIES

Coronavirus Pandemic

The influence of vitamin-C intake on blood glucose measurements in COVID-19 pandemic

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Abstract

Introduction: Coronavirus disease 2019 (COVID-19) is declared as pandemic by the World Health Orgnazation (WHO) on March 2020. One of the heavily utilized measures during this pandemic is vitamin C (aka ascorbic acid). Unfortunately, vitamin C has been associated with glucose measurement interference and thus this study highlights the elevated levels of blood glucose correlated with the presence of vitamin C interference.

Methodology: Thirty samples were selected randomly and the blood glucose were measured prior and post the addition of spiked standard concentrations of vitamin C. The interference of vitamin C with glucose readings in COVID-19 pandemic were evaluated and observed employing the Auto Chemistry Analyzer machine.

Results: The addition of ascorbic acid (vitamin C) standards (spikes) into the isolated samples shows a correlated increment in the reading measures. Thereafter, the increments of Random Blood Sugar (RBS) readings after being spiked with the vitamin C standards shows a logarithmic correlation with good interesting R-squared ($R^2 = 0.9921$).

Conclusions: The authors find that the presence of vitamin C in blood actively and significantly alters the glucose level readings especially with the highly consumption of vitamin C during the COVID-19 pandemic.

Key words: Vitamin C; Ascorbic Acid; Blood Glucose; COVID-19 Pandemic.

J Infect Dev Ctries 2021; 15(2):209-213. doi:10.3855/jidc.13960

(Received 19 September 2020 – Accepted 10 January 2021)

Introduction

COVID-19 is an infectious disease resulted from the so-called Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). This disease was detected for the first time in Wuhan, China, at the end of 2019. Later on, the COVID-19 outbreak was considered by the WHO as pandemic on 11 March 2020 [1-3]. Coronaviruses are proved to raise the oxidative stress, which in turn, initiates cellular dysfunction leading to eventual organ [4,5]. It is agreed that acute respiratory distress syndrome (ARDS) is the fundamental cause of morbidity in humans regarding COVID-19. ARDS may be the result of the aroused oxidative stress due to the generation of both cytokines and free radicals [6]. Collectively, these processes resulted in serious cellular injury, multiorgan failure and unavoidable death [7]. Despite the absence of suitable vaccination and antiviral medications for COVID-19, the administration of anti-oxidative therapies alongside the approved traditional adjunctive agents is associated with an important role in controlling these medical issues [8-10].

Accordingly, vitamin C and other antioxidants are highly recommended agents to treat ARDS. The utilization of Intravenous (IV) Vitamin C has been considered a promising approach in China. The protocol of the administration of IV Vitamin C are established in "clinicaltrials.gov" for COVID-19 and other diseases. Currently, vitamin C is administered to treat COVID-19 as many physicians believed that vitamin C showed promising results towards COVID-19. Vitamin C is one of the naturally occurring antioxidants that can be administered safely and effectively in high IV doses [8]. However, the absorbed amount of vitamin C through the GIT is limited despite the high doses due to the requirement of the active transport mechanism [11].

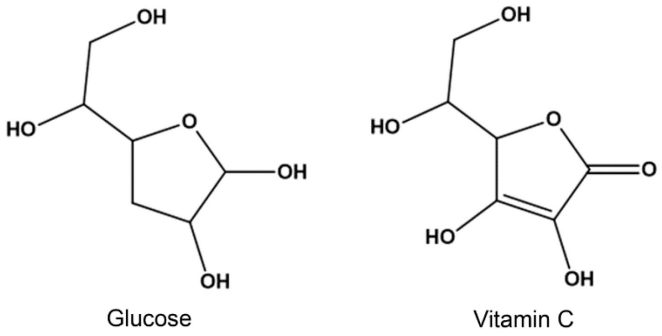
In respiratory infections, vitamin C is considered one of the widely utilized measures to treat these infections. In a systematic review, it has been clarified as five small scale clinical trials on patients with common cold were conducted. The results of these trials showed that the vitamin C group had a significant (up to 91%) reduction in the occurance of the common cold [12]. Nowadays, vitamin C is commonly employed as a safe, effective, and affordable price medication. Moreover, vitamin C is believed to enhance the immune system function via various mechanisms involving the reduction the cytokines storm or strengthening the antiviral effectiveness through unclear mechanisms [13].

Recent studies have shown the efficacy of vitamin C as antiviral characteristics via maintaining the lymphocyte activity, enhancing the interferon-α manufacturing, altering cytokines, and most importantly the suggested direct viricidal activity. For these reasons, the utilization of vitamin C could be effective in terms of mortality and secondary outcomes in the patients with COVID-19 pneumonia [14].

The existence of vitamin C in urine can cause false-positive findings for some test targets. This is considered problematic especially for glucose, which is detected via the peroxidase enzymatic reaction [15]. Moreover, vitamin C has a serious false positive increment in blood glucose measurments. This is due to the false hyperglycemic levels after IV infusion of 66 mg/kg/hr in seven patients suffering from burns. This requires the utilization of hypoglycemic agents or commonly insulin that will lead definitly to the life threatening hypoglycemia [16].

Increased blood levels of vitamin C is capable to elevate measurements of the commonly used glucose meters, which may misdiagnose the hypoglycemic patients and hence, potentiates the mortality rates. The alteration in the readings of glucose meters can be correlated the closely similar structures of both molecules as shown in Figure 1. Falsely measures of high blood glucose levels is crucial when treated as such and therefore, become life-threatening when this treatment resulted in hypoglycemia. Accordingly, it is highly recommended to revise the substances that can falsely cause elevated blood glues prior to interevent with any hypoglycemic protocol [17]. The aim of this study is to determine the effect of vitamin C on blood glucose level measurements during the period of COVID-19 pandemic.

Figure 1. Chemical structures of glucose and vitamin C.



This figure reveals the closeness and similarity of the structures of both glucose and vitamin C.

Methodology

Materials

Ascorbic acid (vitamin C) standard was gifted by Samarra Drug Industry (SDI), Iraq.

Instruments

Auto Chemistry Analyzer, (Model: BK-500 (DIAMOND)) BIOBASE, Shandong, China. Four digits sensitive balance (Model: Radwang, Wagi-Elektroniczne), Poland. Ultrasonic cleanser with heater (Model: SRI, Copley scientific), United Kingdom.

Methods

Ascorbic Acid Standard preparation

A stock solution was prepared by dissolving accurately weighed 1000 mg of Vitamin C standard in a final volume of 4 mL and sonicated for 10 minutes to

Table 1. Vitamin C standard concentration in serum sample.

#	Serum vol. (µL)	Vit. C STD Conc. mg/mL	Vit. C STD added vol. (µL)	Vit. C STD final conc. in samples (µg/mL)
Blank	500	0	0	0
STD1	500	25	2	100
STD2	500	25	3	150
STD3	500	25	4	200
STD4	500	25	7	350
STD5	500	25	10	500
STD6	500	25	20	1000
STD7	500	250	20	10000

get a concentration of 250 mg/mL. Then, 1-mL aliquot was further diluted up to 10 mL to get a concentration of 25 mg/mL.

Sample preparation

Thirty patients were selected randomly to conduct this study. No inclusion or exclusion criteria was employed. From each patient no less than 10-mL blood was drooped and the serum was isolated. Thereafter, the serum was divided into 0.5-mL aliquots. The addition of Vitamin C standard and the final concentrations are tabulated in Table 1.

Results

The addition of ascorbic acid (vitamin C) standards (spikes) into the isolated samples shows a correlated increment in the reading measures for the same sample in respect to the blank serum as explained in Figure 2.

The increments of RBS readings were calculated and the grafts against the concentrations of vitamin C is tabulated in Table 2 and shown in Figure 3.

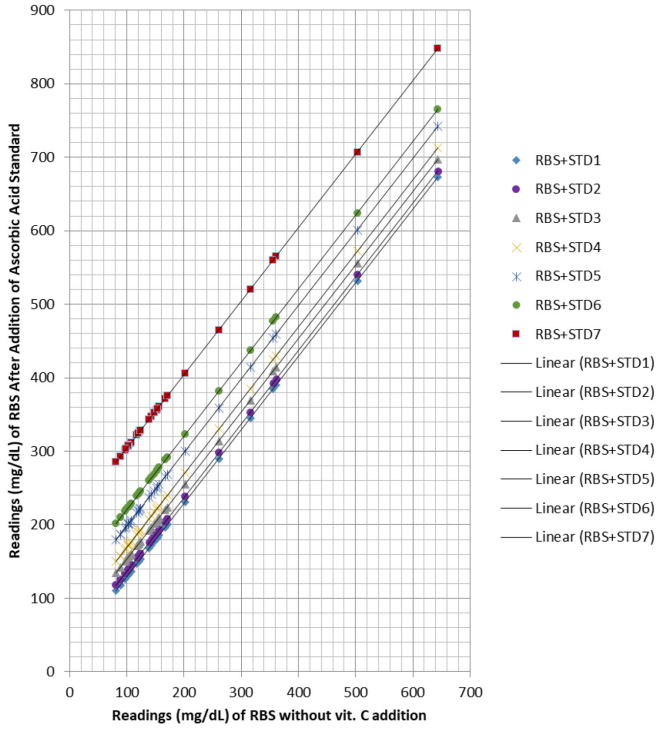
Discussion

Vitamin C is a powerful reducing agent found in many foods in variable contents. For instance, a fifty fold vitamin C is found in wild fruit when compared to ordinary oranges [18]. The antioxidant properties of vitamin C are believed to improve immunity as well as prevent other ailments such as cardiovascular diseases and aging. For this reason, consuming vitamins has become very popular [19]. Moreover, vitamin C has been used with success in treating moderate to severe COVID-19 patients [20]. On the other hand, it has been observed that the use of different doses of vitamin C has been associated with falsely elevated blood glucose measurmnets. Therefore, vitamin C is considered as a prototypical example of a substance that has a strong effect in changing blood glucose measurements [17], and herein, we researched and studied the influence vitamin C on blood glucose levels in patients within the period of COVID-19 pandemic.

Table 2. Vitamin C increment in RBS.

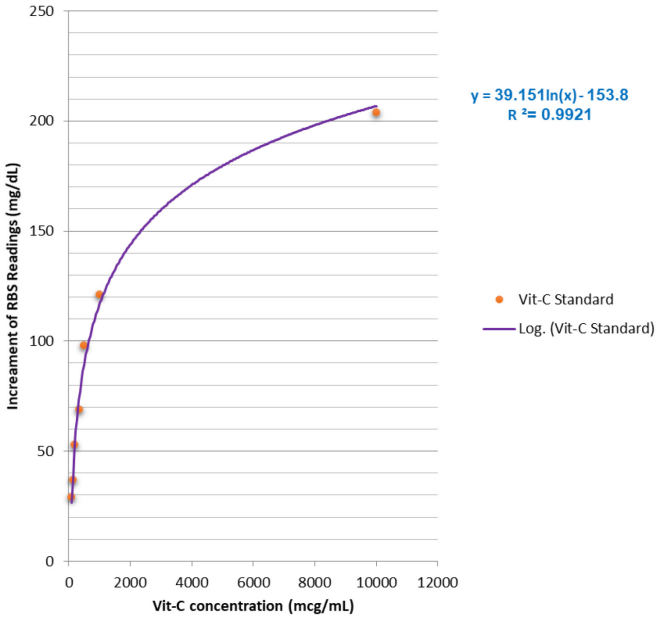
#	Vit. C STD conc. (µg/mL)	Blood glucose level increment (mg/dL)
1	0	0
2	100	29
3	150	37
4	200	53
5	350	69
6	500	98
7	1000	121
8	10000	204

Figure 2. RBS with and without Vit-C STD



This figure reveals the influence of vitamin C standards (STD) at the (y-axis) on random blood sugar (RBS) readings (x-axis), where the STD1, STD2, STD3, STD4, STD5, STD6, and STD7 concentrations are (100, 150, 200, 350, 500, 1000, 10000) µg/mL, respectively.

Figure 3. The increment of RBS Vs. Vitamin C STD Conc.



This figure shows the increment in RBS readings (y-axis) for the added (spiked) vitamin C standards (x-axis).

In this study, the researchers observed that when different doses of ascorbic acid were administered, this resulted in an associated significant increase in readout scales for the same sample with respect to serum blank and this would cause a "false positive" on blood glucose. This is of great importance in COVID-19 patients who receive this supplement especially in diabetic patients. These results are consistent with Tang *et al.* (2000) when it was suggested that ascorbic acid is a strong reducing agent that reacts with hydrogen peroxide. Since ascorbic acid consumes hydrogen peroxide, little hydrogen peroxide is available for the reaction with the dye on the test. Hence, the development of the color of the dye is incomplete, resulting in incorrectly increased glucose readings [21]. Ascorbic acid increases the glucose reading measurments rather than reduces them [22]. Furthermore, as shown in figure 3 logarithmic correlation was found to govern the increment of blood glucose level in respect to vitamin C concentration, thus even with small concentrations of vitamin C, there are an appreciated influence to the measures. This is very interesting especially with a regression coefficient R^2 of 0.9921. This tiny amounts of vitamin C can be obtained with oral doses and might affect the readings of RBS with the assumed oral doses. Consequently, alongside with the heavy consumption of vitamin C during COVID-19 pandemic, this can affect the RBS readings and the patient therefore, must be asked for their consumed vitamin C doses prior to take any therapeutic action.

Conclusions

The authors conclude that the existence of vitamin C in blood can actively alter the glucose level readings due to their stractural proximity and bearing in mind the highly consumption of vitamin C during the COVID-19 pandemic.

Acknowledgements

The authors would like to acknowledge the Samarra Drug Industry (SDI), Iraq for the supply of the Vitamin C standard for research purposes.

This study was conducted in accordance with the Declaration of Helsinki. It was approved by the University of Alkafeel, College of pharmacy, Al-Najaf, Ethical Scientific Committee, Institutional Review Board Approval No. (25820IRB).

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Conflict of interests: No conflict of interests is declared.