



## Can vitamin C of Baobab pulp Tablet be a nutritional adjuvant to COVID 19 treatment?

Sandrine Kouton<sup>\*1,2</sup>, Waliou Amoussa Hounkpatin<sup>2</sup>, Noel Tovidé<sup>3</sup>,  
Mohamed Soumanou<sup>1</sup>

<sup>1</sup>Unité de Recherche en Genie Enzymatique et alimentaire, Ecole Polytechnique d'Abomey, Calavi (EPAC), Université d'Abomey, Calavi (UAC), Benin

<sup>2</sup>Ecole de Nutrition et Science des Aliments, Faculté des Sciences Agronomiques (FSA), Université d'Abomey, Calavi, Cotonou, Benin

<sup>3</sup>Laboratoire de Microbiologie et des Technologies Alimentaires, Faculté des Sciences et Techniques, Université d'Abomey, Calavi, Cotonou, Benin

**Key words:** Coronavirus disease 2019, Vitamin C, Tablet, Baobab pulp, Nutritional adjuvant, Treatment

Article Published: 15 September 2021

### Abstract

The relation between immunity and nutrition is high for well-being and against infections. In order to combat the coronavirus 2019 (COVID-19) viral pandemic, increased attention must also be paid to this relationship. However, the nutritional status of patients with COVID-19 is affected. The immunopathological changes in COVID-19 patients have affected their nutritional status and induced chronic damage in their organism. In this review, we highlight the nutritional treatment of COVID 19 with vitamin C therapy based on Baobab pulp tablets. Research has shown that high doses of 6 to 8g/day of vitamin C have been used for the treatment of several viral respiratory diseases such as COVID 19. We suggest that this pharmacological dose of vitamin C per day to enhance immunity and improve the nutritional status of COVID 19 patients. According to the nutritional profile of Baobab pulp Tablet, one hundred (100)g of this Tablet contains 428mg of vitamin C. Therefore, more than 14 Tablet of Baobab pulp can be used for moderate treatment of COVID 19. Thus, in this study, it is suggested that vitamin C therapy based on Baobab pulp tablet be used as an adjuvant to nutritional treatment of COVID 19. Clinical studies are required to confirm this hypothesis.

\*Corresponding Author: Sandrine Kouton ✉ [sandrineskouton@yahoo.fr](mailto:sandrineskouton@yahoo.fr)

## Introduction

COVID 19 is a viral respiratory disease that appeared in early 2020. This disease was caused by the coronavirus (SARS-CoV), a new highly contagious respiratory virus that has spread rapidly worldwide (WHO, 2020). According to the World Health Organization (WHO), human-to-human contamination is highly transmissible with coronavirus acute respiratory distress syndrome, a multiple disorder of several organ disorders and critical cases that progress to death. In fact, it is a pandemic viral respiratory disease has become a serious global public health problem as viral diseases continue to increase (Carr *et al.*, 2020). Actually, 90% persons aged to 65 years death to COVID 19 in worldwide (WHO, 2020). Data provided by the WHO Health Emergency Dashboard report in worldwide, globally there are more than 39 744 002 confirmed cases of coronavirus disease 2019, with more than 27 311 054 cure cases with more than 1 110 120 death (WHO, 2020). The level of death was 2,79%, the level of cure was 68,72% and 28.49% cases in treatment.

According to WHO, public health and social measures were implemented to slow or stop the spread and reduce the transmissions of COVID-19. In waiting of discover a vaccines treatment, researchers must develop an adjuvant for treatment and saving life (Carr *et al.*, 2020). COVID 19 disease induced reducing iron in blood circulation, increasing viral replication, anti-inflammatory and reducing immunity (Carr *et al.*, 2020). Thus, the nutritional status of COVID 19 patient is also affected (Jae Hyoung Im *et al.*, 2020). COVID 19 disease induced a significant reduction of vitamins and mineral in leukocyte of infected patient and also reduce the nervous and immunity. Jae Hyoung Im *et al.* (2020) showed that the COVID 19 patient suffer of on and more nutrient deficiency with a reducing of 50% concentrations of some vitamins and minerals in 50 patients with COVID-19. Carr *et al.* (2020) showed a large decrease in blood vitamin C dose (23 $\mu$ mol/L) in patients with severe respiratory disease and pneumonia compared to healthy patients (56 $\mu$ mol/L). The most severe patients in intensive care had mean levels of 11 $\mu$ mol/L, which is the level that defines

scurvy (Carr *et al.*, 2013). Several studies have shown that high doses of oral supplementation of vitamin C and other essential nutrients can reduce COVID-19 infection (Carr *et al.*, 2020; Jae Hyoung Im *et al.*, 2020).

Vitamins increases the immunity against the infections and we expect an increasing of immunity against COVID 19 (Jae Hyoung Im *et al.*, 2020). Vitamin C or ascorbic acid is a hydro solvable vitamin necessary for vital function of human organism (Hemila *et al.*, 2019). Vitamin C supplementation has showed an effectiveness treatment of chronic respiratory diseases with excellent clinical responses for enhance immunity (Cheng *et al.*, 2020). Vitamin C has been shown since 80 years to be effective in strengthening the immunity of patients with severe viral respiratory diseases (Hemila *et al.*, 2019; Player *et al.*, 2020). Researchers have successfully treated influenza and pneumonia with very high doses of vitamin C Contagion to COVID 19 depends largely on host sensitivity (Saul, 2020). In vivo, vitamin C would stimulate immunity in addition to the direct inactivation of viral nucleic acids (Yejin *et al.*, 2013). The antiviral mechanism of vitamin C at pharmacological concentrations appears to be different from that of a physiological concentration (Yejin *et al.*, 2013).

Some fruits and vegetables are rich in vitamin C and have high antioxidant activity (Balz Frei *et al.*, 2012; Vodouhè *et al.*, 2020). Among these fruits and vegetables, baobab pulp is very rich in vitamin C. Consumption of baobab pulp could be used to improve nutritional status and enhance the immunity of COVID 19 patients. Tablet are a form of confectionary products usually dried to low moisture content.

It is emergency to identify of novel therapies for treating COVID-19 infections. Thus, in order to reduce the damage of coronavirus 19, that successful standardized treatment protocols are recommended. In the development of strategies for efficient treatment of COVID 19 disease, we aim to show that vitamin C therapy based on functional Tablet of Baobab pulp (*Adansonia Digitata*), *Moringa Oleifera* and *Ocimum gratissimum* leaves with medicinal

activity could be used to enhance the immunity and also improve the nutritional status of COVID-19 patients. In this review article, we suggest that Vitamin C therapy based on Tablet of Baobab pulp could be used an adjuvant to enhance immunity and also improve nutritional status of COVID 19 patient.

*Physiological functions and characteristic of Vitamin C*  
Vitamin C (ascorbic acid) is a water-soluble essential vitamin and is involved in various physiological functions as an antioxidant and cofactor of many enzymes (Balz Frei *et al.*, 2012). Due to the loss of function of the L-gulonolactone oxidase gene, the gene coding for the enzyme essential in vitamin C biosynthesis, humans must rely on exogenous intake of this vitamin to maintain normal physiological functions (Balz Frei *et al.*, 2012). Vitamin C contributes to the normal formation of collagen to ensure the normal functioning of blood vessels, bones, gums, teeth, cartilage and skin. It also increases iron absorption (Balz Frei *et al.*, 2012).

It participates in the good functioning of the nervous system, the psychological functions of the body's defences (immune system) and against viral infections in people subjected to high stress against the common cold (Saul, 2020). Vitamin C is an antioxidant that contributes to protect cells from oxidative stress. This vitamin helps reduce fatigue and blood pressure. It also allows the detoxification of carcinogenic substances such as heavy metals (especially lead). To improve its nutritional state, the exogenous intake of vitamin C is essential to maintain the normal physiological functions of the human organism (Balz Frei *et al.*, 2012). Vitamins have no energy value, i.e. they do not release any calories. It is nevertheless necessary for the body to function normally (Saul, 2020) and also in case of infection. Vitamins help to maintain vital balance because they are the source of energy and nutrients for cells to use.

When there is insufficient vitamin C in the diet in case of infection, humans suffer from the potentially lethal deficiency disease scurvy (Cheng *et al.*, 2020).

Studies have shown that vitamin C in vitro has been shown to inactivate several viruses at concentrations equivalent to the oral supplementation dose in humans. In vivo antiviral mechanism of vitamin C is believed to stimulate immune activities in addition to the direct inactivation of viral nucleic acids (Yejin *et al.*, 2013; Carr *et al.*, 2020). Antiviral treatment of vitamin C is accomplished by the production of hydrogen peroxide under the catalysis of transition metal ions and inactivates viruses without harming host cells, inhibiting virus replication in the cell and reducing viral infectivity (Player *et al.*, 2020).

Acidic fruits and vegetables are generally rich in vitamin C (Vodouhè *et al.*, 2020). Among fruits and vegetables rich in vitamin C, baobab pulp is a high source of vitamin C and also has antioxidant properties. Baobab pulp and leaves have a high antioxidant activity when compared to other fruits and can consequently be considered as so-called functional foods, which may have a positive impact on health in addition to their role as a food. The baobab pulp presents a high nutritional value and bioavailability of the minerals and vitamins especially high vitamin C content in baobab foods (Vodouhè *et al.*, 2020).

In this study, a functional tablet based on a mixture of Baobab pulp, *Moringa Oleifera* and *Ocimum gratissimum* leaves was developed. The tablet of Baobab pulp was composed of 80% Baobab pulp, 10% *Moringa Leaf Powder* and 10% *Ocimum gratissimum Leaf Powder* which contains 428mg of vitamin C for 100 g. This Bio Tablet was composed of Baobab pulp very rich in vitamin C, and was composed of the medicinal leaf of *Moringa Oleifera* also rich in proteins and micronutrients with high antioxidant activity and the leaves of *Ocimum gratissimum*, which present high repairing, anti-fungal, anti-microbiological, antiviral, and antioxidant activities. The vitamin C of Baobab tablet has biological, antiviral and antioxidant activities that enhance the immunity and can directly denature many viruses. This tablet was developed as adjuvant to help to nutritional treatment COVID 19 and enhance immunity such as, also in the supply of protein for the repair, construction and renewal of cells.

#### *Clinical symptoms and pathogenesis of COVID 19 disease*

COVID 19 disease is a newly emerged viral respiratory disease which caused actually a pandemic affection in worldwide (WHO, 2020). COVID 19 patients showed mild, moderate and several symptoms but the aged person are highly vulnerable. In COVID 19 symptoms, 15% evolve to severe pneumonia and 5% approximately progress to acute respiratory distress and multiple damage of organs, immune and nutritional status (Huang *et al.*, 2020). The clinical symptoms of coronavirus disease 2019 (COVID-19) is characterized by cough, fatigue, fever, respiratory distress and gastrointestinal infections (Huang *et al.*, 2020). The severe cases of COVID 2019 included liver dysfunction, pneumonia, lymphopenia, and exhausted lymphocytes a cytokine storm (WHO, 2020). COVID 19 disease caused acute myocardial injury, increasing of ferritin levels and enter iron into the lungs and organs dysfunction and reducing platelet counts and erythrocyte sedimentation rate and chronic damage in immunity and cardiovascular systems (Haung *et al.*, 2020). This is a viral respiratory disease caused by chronic damage in organs and decreased the immune reaction. This viral respiratory disease induced significant decreasing of organism strength. Defining the immunopathological changes in patients with COVID-19 provides potential targets for drug discovery and is important for clinical management (WHO, 2020). The several viral pandemics of COVID 19 significantly reduces the immune system of patients and exposes them to serious consequences and even death in patients over 50 years of age (Stipp *et al.*, 2020).

The immunopathological changes of COVID 19 patients affected their nutritional status and induced chronic damage in their organism (Stipp *et al.*, 2020; Jae Hyoung Im *et al.*, 2020). The bio functional Tablet developed with the Baobab pulp, Moringa leaf powder and medicinal leaves of *Ocimum gratissimum* can be used for enhance immunity and nutritional rehabilitation of COVID 19 patients. How can proceed in used vitamin C of Baobab pulp tablet for establish an efficient nutritional rehabilitation of COVID 19 patient and enhance their immunity.

#### *Use of vitamin C of Baobab pulp Tablet for nutritional treatment of COVID 19 patient*

Vitamin C deficiency can be detected from early signs of clinical deficiency, such as the follicular hyperkeratosis, lethal deficiency disease scurvy, petechial haemorrhages, swollen or bleeding gums, and joint pain, or from the very low concentrations of ascorbate in plasma, blood, or leukocytes (Imram *et al.*, 2014). The amount of vitamin C required to prevent or cure early signs of deficiency is between 6.5 and 10mg/day. This range represents the lowest physiological requirement (Hemila *et al.*, 2019). During infection, the number of circulating leukocytes increases and these take up vitamin C from the plasma (Carr *et al.*, 2013).

The oral vitamin C of Baobab pulp supplementation can used as nutritional treatment for enhance the immunity and improve the nutritional status of COVID 19 in order to minimizing damage from COVID 19 disease. Oral supplementation is safe and well-tolerated when not taken beyond intestinal tolerance. Intestinal tolerance is indicated by mild gastrointestinal symptoms such as flatulence, eructation, slight rumbling of the digestive tract, increased stool frequency and loose stools (Imram *et al.*, 2014). According to Hemila *et al.* (2019) the usual dosage of intestinal tolerance depends on the severity of the disease. Intestinal tolerance levels of vitamin C, taken in divided doses throughout the day, is a clinically proven antiviral that is second to none. The antiviral mechanism of vitamin C in pharmacological concentrations appears to be different from that of a physiological concentration (Hemila *et al.*, 2013). It would be difficult to establish a spontaneous and effective treatment to enhance the immunity during an COVID 19 infection, but instead the patient can be treated with a dose of vitamin C to reduce respiratory viral disease depending on the type and severity of the disease (Du *et al.*, 2020).

Vitamin C treatment would probably enable a faster recovery in COVID 19 infected patients. This treatment would reduce the multiple signs of clinical vitamin C deficiency induced by COVID 19. The application of vitamin C treatment could be reducing

the different damage of COVID 19 disease, such as lung infection, multiple organ dysfunction and death. The pharmacological treatment of vitamin C deficiency begun with high doses 3000-4000mg/jour (Khan *et al.*, 2014). COVID 19 is a serious respiratory disease consequently the dose of vitamin C for therapy must be higher than the pharmacological dose. According to Saul (2020), doses of vitamin C above the pharmacological dose (4000mg/day) should be taken several times a day to help in the treatment of COVID 19. In the treatment of influenza, one study showed that people treated with 3000mg/day of vitamin C had rapid improvements in their cold infections compared to the group that did not receive it (Hemila *et al.*, 2013). Influenza infection has the same clinical forms as COVID 19. Viral illness at COVID 19 can be considered the severe form of influenza (Hemila *et al.*, 2013). However, to assist in the treatment of COVID 19, the determination of the dose of vitamin C for COVID 19 therapy is important. Given that COVID-19 is often much more severe than regular viral infections, the above estimates may justify nutritional therapy with a steady increase in the pharmacological dose of vitamin C of at least 6000mg/day (in divided doses). When a person is infected with a serious viral disease, the amount needed increases dramatically.

This is illustrated by the decreased levels of vitamin C in white blood cells, which are essential for the immune response, during colds and serious viral infections such as COVID 19. An intake of 6 g/day has been shown to restore normal levels of vitamin C in white blood cells during several viral infection (Van Straten *et al.*, 2002). This suggests that similar daily doses may be needed to reduce symptoms. Studies of 3 and 6 g or 4 and 8 g/day have shown that the higher dose, the greater effect, with a significant reduction in COVID 19 symptoms (Carr *et al.*, 2013). During an infection, most people can tolerate 1 g/hour without diarrhoea (Carr *et al.*, 2017). Studies by Cathcart (2011) have shown that during severe respiratory illness, nutritional therapy with vitamin C can began with a lower dose of 4g, then take 1g/hour until symptoms disappear. Based on these estimates, we hypothesize an oral dose of vitamin C of up to 6 g/day

for the moderate form and up to 8g/day for the severe form of COVID 19. According to the nutritional profile of Baobab pulp Tablet, one hundred (100)g of this Tablet contains 428mg of vitamin C. Based on the nutritional therapy of vitamin C against COVID 19, an oral dose treatment of more than 14 tablets of 100 g of Baobab pulp Tablet per day is required.

The duration of oral vitamin C treatment and the doses required depend on the severity of COVID-19 infection and its progression (Carr *et al.*, 2017). Therefore, the progression of viral respiratory disease should be closely monitored and doses of Baobab pulp tablets adjusted consequently.

### Conclusion

Vitamin C of Baobab pulp therapy has been used as high antiviral for several viral diseases treatment and enhance the immunity and nutritional status of COVID 19 patients. Vitamin C treatment from fruits would probably enable a faster recovery in COVID 19 infected patients. COVID 19 damage induced depends of organism type. On based of high pharmacologic dose of oral vitamin C therapy used to treat the several viral diseases in previous research, we suggest a high pharmacological dose 6 to 8g/jour of vitamin C were used for enhance the immunity and nutritional status of COVID 19 patients.

Consequently, it is possible to used more of 14 functional tablets of Baobab pulp of 100g for help to COVID 19 moderate treatment. Therefore, this research shows that vitamin C therapy of Baobab pulp tablet could become a nutritional adjuvant to enhance the immunity and improve the treatment of COVID 19 pandemic. In order to confirm this Bio nutritional treatment hypothesis of COVID 19, the studies based on a clinical treatment are required.

### Acknowledgements

Authors would like to thank the three Laboratory for their help to carry out the experiment.

### Conflicts of interest

Authors declare that they have no conflicts of interest.



## References

- Balz Frei, Ines Birlouez-Aragon, Jens Lykkesfeldt.** 2012. Authors' Perspective: What is the Optimum Intake of Vitamin C in Humans? *Critical Reviews in Food Science and Nutrition* **52(9)**, 815.
- Carr AC, Bozonet SM, Vissers MCM.** 2013. A Randomised Cross-Over Pharmacokinetic Bioavailability Study of Synthetic versus Kiwifruit-Derived Vitamin C. *Nutrients* **5(11)**, 4451-4461.
- Carr AC, Rosengrave PC, Bayer S, Chambers S, Mehrtens J, Shaw GM.** 2017. Hypovitaminosis C and vitamin C deficiency in critically ill patients despite recommended enteral and parenteral intakes. *Critical Care* 21:300. <https://pubmed.ncbi.nlm.nih>.
- Carr AC, Spencer E, Dixon L, Chambers ST.** 2020. Patients with community acquired pneumonia exhibit depleted vitamin C status and elevated oxidative stress. *Nutrients* 12:1318. <https://www.mdpi.com/20726643/12/5/1318>.
- Cathcart RF.** 2011. The third face of vitamin C. *Journal of Orthomolecular Medicine* **7**, 197-200.
- Cheng R.** 2020. Successful high-dose vitamin C treatment of patients with serious and critical COVID-19 infection. *Orthomolecular* **31**, 03. <http://orthomolecular.org/resources/omns/v16n18.shtml>.
- Du Li-ping, Mei Dan, LI Da-kui, Chen Qi, Wang Zi-hou.** 2020. Le traitement à fortes doses de Vitamine C dans les infections virales respiratoires graves. *Orthomolecular Medicine News Service* **10**, 203-212.
- Hemila H, Chalker E.** 2013. Vitamin C for preventing and treating the common cold. *Cochrane Database System Review*, 1: CD000980. <https://pubmed.ncbi.nlm.nih.gov/23440782>.
- Hemila H, Chalker E.** 2019. Vitamin C can shorten the length of stay in the ICU: a meta-analysis. *Nutrients*. 11 (708). <https://www.mdpi.com/2072-6643/11/4/708>.
- Huang C.** 2020. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* **395**, 497-506.
- Imran MK.** 2014. Efficacy of Vitamin C in Reducing Duration of Severe Pneumonia in Children. *Journal of Rawalpindi Medical College (JRMC)* **18(1)**, 55-57.
- Jae Hyoung Im, Young SooJe, JihyeonBaek, Moon-HyunChung, Hea Yoon Kwon, Jin-SooLee.** 2020. Nutritional status of patients with coronavirus disease 2019 (COVID-19). *International Journal of Infectious Diseases (Elsevier)* **10**, 1016 <https://doi.org/10.1016/j.ijid.2020.08.018>.
- Khan IM.** 2014. Efficacy of vitamin C in reducing duration of severe pneumonia in children. *J Rawalpindi Med Col (JRMC)* **18(1)**, 55-57. <https://www.journalrmc.com/volumes/1405749894>.
- Player G, Saul AW, Downing D, Schuitemaker G.** 2020. Published Research and Articles on Vitamin C as a Consideration for Pneumonia, Lung Infections, and the Novel Coronavirus (SARS-CoV-2/COVID-19). *Orthomolecular Medicine News Service*.
- Saul AW.** 2020. Nutritional treatment of coronavirus. *Orthomolecular Medicine News Service*.
- Stipp MM.** 2020. SARS-Cov2: Micronutrient optimization in supporting host Immuno Competence. *International Journal of clinical case reports a Reviews* **2(2)**, 1-11.
- Van Straten M, Josling P.** 2002. Preventing the common cold with a vitamin C supplement: A double-blind, placebo-controlled survey. *Advanced Therapy* **19**, 151.
- Vodouhè Sènan, Kouton Sandrine E, Hounkpatin Waliou Amoussa, Soumanou Mohamed M.** 2020. Bioavailability of Micronutrient in Functional Tablet Developed from Blend of Baobab pulp, Moringa Leaf Powder and Malted maize Flour for Iron Deficient Pregnant. *International Journal of Applied Biology and Pharmaceutical Technology* **11(3)**, 200-214.

**World Health Organization.** 2020. Infection prevention and control during health care when COVID-19 is suspected. [https://www.who.int/publications-detail/infection-prevention-and-control-during-health-care-when-novel-coronavirus-\(ncov\)infection-is-suspected-20200125](https://www.who.int/publications-detail/infection-prevention-and-control-during-health-care-when-novel-coronavirus-(ncov)infection-is-suspected-20200125).

**Yejin K, Hyemin K, Seyeon B.** 2013. Vitamin C is an essential factor on the anti-viral immune responses through the production of Interferon-  $\alpha/\beta$  at the initial stage of Influenza A virus (H3N2) infection. *Immune Network* **13(2)**, 70-74. <https://immunetwork.org/DOI>