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Letter to Editor

Can Edible Mushrooms with Antiviral Properties be used for COVID-19 Treatment?

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Dear Editor

The recent ongoing viral infection, COVID-19, caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has affected approximately 221 countries and territories globally, and the number of total deaths has reached the figure 4,705,461. Moreover the total coronavirus cases of September 20, 2021, 02:56 GMT globally is 229,288,247 (1-3). Several articles have discussed COVID-19 virus structure, and its entry mechanism into the cells. Nevertheless, its pathogenesis and cellular mechanisms have not been fully understood, and due to its increased human casualties, researchers are still trying to develop potential treatments (1-5). The percentage of people vaccinated for the first dose against the COVID-19 virus in September 19, 2021 was 43.1% of the world population, and 5.92 billion doses have been administered globally (6). For our own safety and that of others, it is very important to accelerate the vaccination pace and follow the guidelines issued by the World Health Organization (WHO) (7) such as wearing a mask, maintaining physical distance, proper hand washing etc(7). Some medications for the development of an effective antiviral and anti-inflammatory response such as Remdesivir, and corticosteroids have been identified and used for patients hospitalized with COVID-19 (7, 8).

Apart from the synthetic drugs, some edible mushrooms also possess antiviral and anti-inflammatory properties and contain valuable nutrients such as selenium, potassium, riboflavin, niacin, vitamin D etc. (9-11). Bioactive compounds derived from mushrooms, including polysaccharides, carbohydrate-binding protein, and peptides have antiviral activities, and polysaccharides such as glucan, β-glucan, mannoglucan, heteroglycan etc., can exhibit immune-modulatory, antioxidant and anti-inflammatory responses as reviewed very well by Zhao, Shuang, *et al* (12,13). Hence, consumption of such edible mushrooms may be useful for our health benefits. Commonly known edible mushrooms such as Maitake, Shiitake, Reishi, and Cordyceps have antiviral properties, and according to the website information (https://selfhacked.com/blog/maitake-mushrooms-coronavirus/), they are effective against respiratory complications similar to COVID-19 caused by different viruses including influenza (14, 15). It was reported that in infected kidney cells Maitake mushroom extract could stimulate macrophages and produce TNF-α, that helps inhibiting influenza virus growth (15).

In a study with lentinan (LNT-1), take out from *Lentinula edodes* mycelia was found active against infectious hematopoietic necrosis virus, where it

directly deactivates the oral replication. Furthermore, they reported that this LNT-1 has an important functional relation with the innate immunity as it helps down-regulate the pro-inflammatory cytokines (TNF-α, IL-2 and IL-11) and increase the expressions of IFN-1 and IFN- γ for the induction of immune modulatory and antiviral signaling (9,16). As in COVID 19, the inflammatory cytokines was found high (9), hence, the study required to comprehend the LNT-1effects. In another study with *Inonotus obliquus*, it was found that the aqueous extract could decrease the herpes simplex virus (HSV) infection in Vero cells and they also reported that aqueous extracts from *I. obliquus* could directly act on viral glycoproteins and prevent membrane fusion and HSV-1 entry (9). For viral entry, polyproteins maturation and secreted virions assembly process, viral or host protease play very important roles, and thus they are considered for drug targets (17). In a recent study using molecular docking and *in silico* ADMET analysis, researchers found that mushrooms derived compounds have the potential to inhibit the main viral protease (for COVID-19), which contributes to the replication cycle (18,19). Furthermore, we know that oxidative stress and inflammation are linked with COVID-19 pathogenesis (9). In this regards, a combination of *Ganoderma lucidum* aqueous extract and *Chlorella vulgaris* ethanolic extract could be effective (20) because research revealed that the combined extract could reduce lipopolysaccharide-induced inflammation and oxidative stress in WBCs by down regulating TNF-α, cyclooxygenase-2, nuclear factor kappa-beta and suppressed cellular nitric oxide (9,20). For all these, detailed laboratory study and solid evidences required on whether we can use them or not.

In this regard, edible mushrooms having antiviral and anti-inflammatory function may be seems promising for further investigation and detailed lab research for targeting COVID-19 virus. There is no real data confirming the efficacy of edible mushrooms or any derived compounds for COVID-19 treatment, and the final judgment could be considered only after the publishing of clinical trials results. Some current limitations are also listed below which need further clarifications.

The current limitations for edible mushrooms are as follow:

(i) Lacking of study on the effects on COVID-19

(ii) There is no solid data and approved dose for the use and application against COVID-19

(iii) We have to determine its efficacy when using combinational along with other antiviral drugs currently used for COVID-19 treatments. Characterization of the bioactive compounds, understanding the overall antiviral mechanisms as well as immunity improving proof should to be done in near future.

(iv) There is not sufficient research data that shows how much the effectiveness varies in different geographical regions.

(v) Its side effects are not clearly known.

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Conflict of Interest

The authors declare that they have no conflict of interest.

Declaration

The work is original. The author makes no representations that the data available in the referenced papers are free from error. No funding received for this article.

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