



Review Article

INVESTIGATIONS ON IMMUNOMODULATORY EFFECT OF WHITE BUTTON MUSHROOM MEDICINAL PROPERTIES AGAINST COVID-19

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Abstract

The wave of a novel coronavirus is the source of (SARS) severe acute respiratory syndrome was completely remarkable, but perhaps not surprising. The family of viruses over the previous thirty years is acquainted with several of the features of CoVs biology, pathogenesis, and disease that manifested so dramatically in the worldwide SARS epidemic. COVID -19 of coronavirus infections occurred in Wuhan, (China) since December 2019 and shortly spread to nearly all parts of the world. The main objective of this review is to find out the source of medicinal properties of *A. bisporus* (WBM) to enhanced immunodeficiency and cure COVID -2019. WBM is a very significant normal source of nourishment and medicine. Apart from this white button mushroom additionally has against immunomodulatory, antimicrobial, antifungal, inflammatory, anticancer, antioxidant and hostile to atherosclerotic properties. *Agaricus bisporus* belongs to the epigenous Basidiomycetes family and additionally the utmost major commercially cultivated mushroom inside in the biosphere. WBM rich in nutrients like vitamins, minerals, proteins, carbohydrates, lipids and fibres. Moreover, the content of few active ingredients, like lectins, polysaccharides, peptides, lipopolysaccharides, vital essential amino acids, glycoproteins, nucleosides, triterpenoids, fatty acids and their by-products, present in WBM. This review relies on this current data and data published within in the medicinal and dietetic quality of WBM. To grant evidence to proliferation immunodeficiency, this reviewed an ancient classics used of mushroom as source of medicine might be helpful to combat against novel coronavirus. The wide spread of novel COVID-19, the proof of therapy for the severe acute respiratory syndrome (SARS) and prevention programs issued by various health authority worldwide.

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INTRODUCTION

Agaricus bisporus could be a good source of trace elements like sodium, potassium, phosphorus, associated antioxidants and unsaturated fatty acid. It can inhibit aromatase, and therefore may be ready to lower the estrogen levels inside the human body, which could reduce carcinoma breast cancer susceptibility [43, 84]. Vitamin C and phenols compounds are common antioxidants in WBM. Ascorbic acid, flavonoid, carotenoids, and phenol, concentrations contained within the *Agaricus sp.* In WBM phenol as a major antioxidant were present in the extracts. WBM extraction of little particle exerting directly cytotoxicity concerning antioxidant compounds like phenol and flavonoids have confirmed that chemotherapy brought about apoptosis and successive phagocytosis of cancer cells rely on the redox repute and therefore the intracellular balance between seasoned and antioxidants [6].

The phenolic compound like Ergo sterol, extracted from WBM showed inhibitory influence on breast carcinoma most cancers cellular line in vitro via aromatase inhibition without side effect [14]. The multiple respiratory diseases varying severity, including bronchiolitis, normal cold and pneumonia represent the Human coronaviruses (HCoVs) which are the main group of coronaviruses (CoVs). Present, six known HCoVs are identified, namely, HCoV-NL63, HCoV-HKU1, HCoV-OC43, HCoV-229E, severe acute respiratory syndrome coronavirus

(SARS-CoV) and Middle East respiratory syndrome coronavirus (MERS-CoV) of which, four HCoV-NL63, HCoVs (HCoV-229E, HCoV-OC43, and HCoV-HKU1) are globally spread within in the human population and contribute to about one-third of normal cold infections in humans [44,79].

In Guangdong, China SARS-CoV first emerged in 2002–2003 as unusual pneumonia marked by fever, headache and subsequent onset of respiratory symptoms like cough and pneumonia, which can be advanced grow into life-lethal respiratory failure and acute breathing distress syndrome [29].

MERS-CoV reported cases frequently stem from outbursts within the centre of Middle Eastern countries or recent travel to the area [59]. Corona virus disease (COVID-19) is an infectious disease because of a newly discovered coronavirus. It is an enveloped by RNA viruses beneath the Coronaviridae family. Organized with Roniviridae, Artierivirdae and Coronaviridae are categorized below the Nidovirale order [51]. As anticipated through the global Committee for Taxonomy of Viruses, Co-Vs are similarly categorized into four predominant genera, α (*Alpha*), β (*Beta*), γ (*Gamma*) and (δ) *Delta coronaviruses* based on categorization comparisons of whole viral genomes [27,52]. These Co-Vs can contaminate like avian, swine, and people as an extensive range of hosts. HCoVs are regarded to be both within inside the

Alpha- or *Beta coronavirus* genera, together with *alpha-coronaviruses*, HCoV-229E and HCoV-NL63, and *beta-coronaviruses*, HCoV-HKU1, SARS-CoV, MERS-CoV and HCoV-OC43 as shown in (Table 1).

There's a hip record of the usage of traditional herbal components to cure the parasitic disorders, like malaria fever. Olden day's mushrooms are utilized for luxurious dietetic meals and therapeutic cause [53]. *Agaricus blazei* mushroom used as very well-known food and extensive medicinal drug [21]. *A. Blazei* contained bioactive mixtures and acts as an antioxidant and as immunomodulatory mediators [7, 75].

There is increased interest in these compounds in numerous disease states, like cancer [34, 49],

allergy [20, 34], inflammatory diseases [22], viral and bacterial infections, diabetes and IDL cholesterol biosynthesis [48, 60]. Furthermore, this mushroom use for the treatment of leishmaniasis and determined a very significant result [77, 78]. The utilization of WBM mushroom can be evaluated for the remedy of COVID-19.

Antiviral activity on Herpes Simplex Virus type 1 (HSV1) studied with 50µg/ml of *Agaricus blazei* extract. The extract turned into a more positive significance to HSV1 [10]. The sulphated polysaccharide from *Sargassum patens* in opposition to herpes simplex virus type 2 study for the antiviral property [17, 90].

Table 1. Classification of human coronavirus (Source: www.nih.gov/coronavirus)

| Coronavirinae Genera | Strains | Discovery | Host | References |
|----------------------|-----------|-----------|-------------------|-------------|
| Alpha-coronavirus | HCoV-229E | 1966 | Bats | [52,63, 81] |
| | HCoV-NL63 | 2004 | Palm Civets, Bats | [37, 52] |
| Beta-coronavirus | HCoV-OC43 | 1967 | Cattle | [79, 82] |
| | HCoV-HKU1 | 2005 | Mice | [1,28] |
| | SARS-CoV | 2003 | Palm Civets, Bats | [2,52,85] |
| | MERS-CoV | 2012 | Bats, Camels | [36,38] |
| | COVID-19 | 2019 | Bats | [88] |

Table 2. List of Drug for treatment underlying clinical trial, COVID-19

| Sr.No | Drug Interventions | Country | Sr.No | Drug Interventions | Country |
|-------|-------------------------------------|-----------|-------|---|---------|
| 1 | Drug: BCG Vaccine | Australia | 32 | Drug: Hydroxychloroquine | India |
| 2 | Drug: Ceftriaxone | Australia | 33 | Drug: Deferoxamine | Iran |
| 3 | Drug: Fixed-duration Hydrocortisone | Australia | 34 | Drug: Calcium Channel Blockers | Ireland |
| 4 | Drug: Placebo | Australia | 35 | Drug: Thiazide or Thiazide-like diuretics | Ireland |
| 5 | Drug: Sargramostim | Belgium | 36 | Drug: Piclidenoson | Israel |
| 6 | Drug: Siltuximab | Belgium | 37 | Drug: Tocilizumab Injection | Italy |
| 7 | Drug: Tocilizumab | Belgium | 38 | Drug: Tofacitinib | Italy |

| | | | | | |
|----|---|------------|----|--|----------|
| 8 | Drug: Hydroxychloroquine + azithromycin | Brazil | 39 | Other: Hyper immune plasma | Italy |
| 9 | Drug: Remdesivir | California | 40 | Drug: Aspirin 75mg | NA |
| 10 | Drug: Azithromycin | Canada | 41 | Drug: Azithromycin Tablets | NA |
| 11 | Drug: Colchicine | Canada | 42 | Drug: Clopidogrel 75mg | NA |
| 12 | Drug: Hydroxychloroquine sulfate | Canada | 43 | Drug: Eculizumab | NA |
| 13 | Drug: Lopinavir/ritonavir | Canada | 44 | Drug: Ibuprofen | NA |
| 14 | Drug: Vitamin C | Canada | 45 | Drug: Rivaroxaban 2.5 MG | NA |
| 15 | Drug: Favipiravir | China | 46 | Dietary Supplement: Glucose tablets | Pakistan |
| 16 | Drug: Remdesivir placebo | China | 47 | Drug: Azithromycin 500Mg Oral Tablet | Pakistan |
| 17 | Drug: Ribavirin | China | 48 | Drug: Hydroxychloroquine 200 Mg Oral Tablet | Pakistan |
| 18 | Drug: Ritonavir+Oseltamivir | China | 49 | Dietary Supplement: Vitamin D | Spain |
| 19 | Drug: Tetrandrine | China | 50 | Drug: Placebo: Hydroxychloroquine | Spain |
| 20 | Drug: thymosin alpha 1 | China | 51 | Drug: Placebos | Spain |
| 21 | Drug: γ -Globulin | China | 52 | Drug: Tocilizumab (TCZ) | Switzerl |
| 22 | Drug: Bevacizumab Injection | China | 53 | Drug: High dose vitamin C | Turkey |
| 23 | Drug: Plasma | Colombia | 54 | Drug: Plaquenil 200Mg Tablet | Turkey |
| 24 | Drug: Camostat Mesylate | Denmark | 55 | Combination Product: Hydroxychloroquine Sulfate + Azithromycin | US |
| 25 | Drug: Kevzarasc | Denmark | 56 | Dietary Supplement: Zinc | US |
| 26 | Drug: RoActemra iv | Denmark | 57 | Drug: Ascorbic Acid | US |
| 27 | Drug: Interferon Beta-1A | France | 58 | Drug: Losartan | US |
| 28 | Drug: Lopinavir and ritonavir | France | 59 | Drug: Nitric Oxide | US |
| 29 | Drug: Nivolumab | France | 60 | Drug: Nitric Oxide Gas | US |
| 30 | Drug: Placebo of Hydroxychloroquine | France | 61 | Drug: Chloroquine phosphate | Vietnam |
| 31 | Other: NaCl 0.9% | France | | | |

Table 3. Carbohydrate Compounds on Fresh

| Components | Contents |
|------------------|----------|
| Total Sugar | 4.5 |
| Fructose | 2.62 |
| Mannitol | 23.62 |
| Trehalose (%) DW | 1-3 |
| β -glucans | 8.6 |
| Chitin | 9.6 |

Table 4. Amino acid content on Dry Weight basis of (WBM) White Button Mushroom mg/g

| Sr.No | Essential Amino Acid | Chemical Formula | Other Name | Content mg/gm | | | | Mean | S.D ± |
|---|----------------------|---|--|----------------|------------------------|------------------------|--------------------------|------|-------|
| | | | | Hays,1976 [33] | Sudheep etal,2014 [74] | Cherno etal, 2016 [15] | Muszyńska,etal,2017 [55] | | |
| 1 | Histidine (H) | C ₆ H ₉ N ₃ O ₂ | 2-Amino-3-(1H-imidazole-4-yl) propanoic acid | 0.64 | 1.5 | 2.7 | 14.1 | 4.73 | 5.46 |
| 2 | Isoleucine(I) | C ₆ H ₁₃ NO ₂ | (2S,3S)-2-amino-3-methylpentanoic acid | 1.28 | 2.3 | 3.6 | 1.0 | 2.04 | 1.02 |
| 3 | Leucine(L) | C ₆ H ₁₃ NO ₂ | 2-Amino-4-methylpentanoic acid | 2.16 | 7.3 | 7.25 | 0.8 | 4.39 | 2.95 |
| 4 | Lysine(K) | C ₆ H ₁₄ N ₂ O ₂ | (2S)-2,6-Diaminohexanoic acid (L-lysine) | 1.62 | 4.5 | 3.7 | 3.5 | 3.33 | 1.06 |
| 5 | Methionine(M) | C ₅ H ₁₁ NO ₂ S | 2-amino-4-(methylthio)butanoic acid | 0.39 | 1.7 | 2.9 | 0.8 | 1.44 | 0.96 |
| 6 | Phenylalanine(F) | C ₉ H ₁₁ NO ₂ | (S)-2-Amino-3-phenylpropanoic acid | 1.55 | 2.5 | 4.2 | 2.1 | 2.59 | 0.99 |
| 7 | Threonine(T) | C ₄ H ₉ NO ₃ | 2-Amino-3-hydroxybutanoic acid | 1.48 | 3.2 | 4.75 | 1.3 | 2.69 | 1.41 |
| 8 | Tryptophan(W) | C ₁₁ H ₁₂ N ₂ O ₂ | 2-Amino-3-(1H-indol-3-yl)propanoic acid | 3.94 | 1.2 | 1.3 | NA | 2.15 | 1.27 |
| 9 | Valine(V) | C ₅ H ₁₁ NO ₂ | 2-Amino-3-methylbutanoic acid | 1.63 | 2.9 | 4.15 | 2.3 | 2.74 | 0.93 |
| Conditionally Essential Amino Acid | | | | | | | | | |
| 10 | Arginine (R) | C ₆ H ₁₄ N ₄ O ₂ | 2-Amino-5-guanidinopentanoic acid | 1.9 | 3.8 | 4.85 | 2.2 | 3.18 | 1.20 |

| | | | | | | | | | |
|---------------------------------|---------------------|--|---|------|-----|-------|-----|-------|------|
| 11 | Cysteine (C) | C ₃ H ₇ NO ₂ S | 2-Amino-3-sulfhydryl-propanoic acid | 0.18 | 1.7 | 4.05 | 1.1 | 1.75 | 1.43 |
| 12 | Glutamine(Q) | C ₅ H ₁₀ N ₂ O ₃ | 2,5-Diamino-5-oxopentanoic acid | 7.06 | NA | NA | NA | 7.06 | NA |
| 13 | Glycine (G) | C ₂ H ₅ NO ₂ | 2-Aminoethanoic acid | 1.2 | 3.0 | 5.35 | 2.0 | 2.88 | 1.56 |
| 14 | Proline(P) | C ₅ H ₉ NO ₂ | Pyrrolidine-2-carboxylic acid | 2.5 | NA | 5.6 | 6.1 | 4.73 | 1.59 |
| 15 | Tyrosine(Y) | C ₉ H ₁₁ NO ₃ | L-2-Amino-3-(4-hydroxyphenyl)propanoic acid | 0.78 | 2.3 | 3.05 | 4.2 | 2.58 | 1.24 |
| Non-essential Amino Acid | | | | | | | | | |
| 16 | Alanine (A) | C ₃ H ₇ NO ₂ | 2-Aminopropanoic acid | 2.4 | 5.4 | 5.7 | 5.8 | 4.84 | 1.41 |
| 17 | Aspartic acid (D) | C ₄ H ₇ NO ₄ | 2-Aminobutanedioic acid | 3.14 | 7 | NA | 3.4 | 4.52 | 1.78 |
| 18 | Asparagine (N) | C ₄ H ₈ N ₂ O ₃ | 2-Amino-3-carbamoylpropanoic acid | NA | NA | 11.5 | NA | 11.35 | NA |
| 19 | Glutamic Acid (E) | C ₅ H ₉ NO ₄ | 2-Aminoglutaric acid | NA | 6.5 | 19.05 | 5.6 | 10.39 | 6.13 |
| 20 | Serine (S) | C ₃ H ₇ NO ₃ | 2-Amino-3-hydroxypropanoic acid | 1.89 | 3.3 | 5.85 | 3.1 | 3.54 | 1.44 |

Table 5. Fatty acids content on Dry Weight basis of White Button Mushroom-mg/100g

| Components | Content |
|-------------------------------|----------------|
| Total unsaturated fatty acids | 79.72 |
| Linoleic acid | 67.29 |
| Total saturated fatty acids | 20.28 |
| Palmitinic acid | 13.35 |
| Oleic acid | 6.07 |
| Palmitoleic acid | 4.84 |
| Stearic acid | 3.72 |
| Total lipids(%) | 2.70 |
| Linolenic acid | 1.52 |
| Caprylic acid | 1.08 |
| Miristic acid | 0.94 |
| Arachidic acid | 0.92 |
| Caprinic acid | 0.85 |
| Pentadecanoic acid | 0.23 |
| Lauric acid | 0.11 |

Table 6. Vitamins content on Dry Weight basis of White Button Mushroom-mg/100g

| Components | Content |
|----------------------|----------------|
| Vitamin C | 17.00 |
| Vitamin B1 | 0.60 |
| Vitamin B2 | 5.10 |
| Vitamin B3 | 43.00 |
| Niacin | 42.00 |
| Folic acid (µg/100g) | 450.00 |
| Vitamin B12(µg/100g) | 0.80 |
| Vitamin D(µg/100g) | 3.00 |

Table 7. Ergosterol Compounds on Fresh Weight basis of White Button Mushroom-g/100g

| Components | Content |
|----------------------|----------------|
| Ergosterol | 186.1 |
| Ergosta.7.enol | 1.73 |
| Ergosta.5,7-dienol | 6.05 |
| Ergosta-7, 22 dienol | 2.45 |

Table 8. Phenolic compounds content on Dry Weight Weight basis of White Button

Dry

Weight basis of White Button Mushroom Mushroom-g/100g-mg/Kg

| Components | Content |
|-------------------|---------|
| Total Phenols | 277-687 |
| Free Phenols | 176-487 |
| Myricetin | 2729.46 |
| Caffeic acid | 392.51 |
| Procatechuic acid | 83.26 |
| Catechins | 56.74 |
| Ferulic acid | 42.83 |
| Gallic acid | 28.45 |
| p-coumaric acid | 2.31 |
| Cinnamic acid | 0.38 |

Table 9. Tocopherol content on Dry Weight basis of White Button Mushroom-mg/100g

| Components | Content |
|----------------------|---------|
| α -Tocopherol | 1-4 |
| γ -Tocopherol | 2-3 |
| δ -Tocopherol | 1.00 |

Table 10. Minerals contents on Dry Weight

Basis of White Button Mushroom-mg/Kg

| Sr.No | Se | Ni | P | N | Mn | Fe | Na | Mg | Cu | Zn | Ca | K | S |
|--------------|-------|-------|--------|-------|--------|--------|-------|-------|-------|--------|---------|-------|--------|
| 1 | NA | 29.5 | NA | NA | 0.4779 | NA | NA | 113.4 | 29.75 | NA | 58.25 | 3260 | 190.58 |
| 2 | 1.4 | 0.99 | 7490 | NA | 7.36 | 84.35 | 86 | 391 | 38.22 | NA | 159.375 | NA | NA |
| 3 | 0.66 | NA | NA | NA | NA | 29.3 | 326.6 | NA | 98 | NA | 22.6 | 4833 | NA |
| 4 | 0.15 | 0.778 | 17300 | NA | NA | 400 | 860 | 2275 | 125 | 112.75 | 990 | 45200 | NA |
| 5 | 0.49 | 30.75 | 1300 | 80 | 45 | 350 | 19 | 100 | 698.5 | 81.6 | 12.3 | NA | NA |
| 6 | 0.56 | 21 | 500 | 60 | 10 | 200 | 20 | 230 | 637 | 89.8 | 10.3 | NA | NA |
| 7 | 0.093 | NA | 860 | NA | 0.48 | 5.0 | 50 | 90 | NA | 5.2 | 30 | 3180 | NA |
| 8 | 0.91 | 21.76 | 2923.3 | 71.33 | 7.54 | 151.66 | 20.33 | 195 | 117.7 | 79.2 | 51.98 | 3910 | 629.23 |
| Average Mean | 0.609 | 17.46 | 5062.2 | 70.44 | 11.808 | 174.33 | 197.4 | 484.9 | 249.2 | 73.71 | 166.851 | 12077 | 409.91 |
| 10 | 0.416 | 12.26 | 5956.2 | 8.189 | 15.275 | 141.81 | 289 | 737.2 | 267.2 | 36.246 | 314.355 | 16572 | 219.33 |

Table 11. Indole compounds content on Dr Weight basis of White Button Mushroom mg/100g

| Components | Contents |
|--------------------|----------|
| L -Tryptophan | 0.39 |
| Serotonin | 5.21 |
| Melatonin | 0.11 |
| Tryptoamine | 0.06 |
| Kyruneric acid | 6.21 |
| Indole Acetic Acid | 0.19 |

Table 12. General supportive treatments for Coronavirus

| Nutritional interventions | Virus targeted and functions related |
|--|---|
| Combination of B1, B2, B3, B5, B6, B7, B9 and B12 vitamins | MERS-CoV (Middle East respiratory syndrome coronavirus), ventilator induced lung injury |
| Ascorbic acid -C ₆ H ₈ O ₆ (Vitamin C) | Avian coronavirus; lower respiratory tract infections |
| Ergocalciferol-C ₂₈ H ₄₄ O(Vitamin D | Bovine coronavirus |
| Vitamin E (Tocopherol) | Coxsackievirus, bovine coronavirus |
| Omega 3-polyunsaturated fatty acids | Influenza virus, human immunodeficiency virus |
| Se | Influenza virus, avian coronavirus; viral mutations |
| Zn | Measles virus, SARS-CoV |
| Fe | Viral mutations |
| Intravenous gamma globulin | SARS-CoV(Severe Acute Respiratory Syndrome Corona Virus) |

COVID-19 severe complications with respiratory illness to other diseases

Severe difficulties of influenza include respiratory failure, encephalopathy pneumonia, and seizures, and could grow from infection with other respiratory viruses [56, 89]. This virus own family is recognized to infect diverse animals and is also moreover regarded to mutate easily. Sometimes coronavirus types that infect animals (like; bats, civet cats, and camels) mutate to infect humans, and this may have lethal consequences. Worldwide, humans get unwell from the four types of coronavirus that cause milder infections on a day to day basis. But three types—those that reason SARS, MERS,

and COVID-19 (SARS-CoV-2) can be fatal, and every of those has led to a foremost global outbreak[30, 83].The global coronavirus COVID-19 outbreak of 2020 was caused by the utmost transmissible anxiety of serious coronavirus yet. The WHO (World Health Organization) declared COVID-19 an outbreak pandemic disease on March 11. SARS-CoV-2 is that the virus that causes the disease COVID-19 may be potentially deadly breathing contamination that originated in Wuhan City, China in December 2019. COVID-19 mostly affect on to lung infections, human beings with those may experience cough and fever, together with shortness of breath. The affected by COVID-19 have been reports of patients with

stomach problems like diarrhoea, vomiting and no sense of smell [11].

Is there a treatment?

There isn't any specific antiviral treatment alternative for COVID-19, and no vaccine is presently available. The treatment is symptomatic, and oxygen treatment says to the very giant remedy for patients with extreme contamination. Mechanical aeration may also be crucial in times of breathing failure and unmanageable to oxygen remedy, at the same time as hemodynamic assistance is essential for dealing with septic shockwave. Long run complexities among overcomers of infection with SARS-CoV-2 having clinically huge COVID-19 sickness aren't but accessible. Mechanical ventilation could be with decrease tidal volumes (4 to 6 ml/kg predicted body weight, PBW) and lower inspiratory weight, reaching a plateau pressure (Pplat) < 28 to 30 cm H₂O. PEEP ought to be as excessive as achievable to keep up the using pressure (Pplat-PEEP) as low as should be predicted beneath the conditions (< 14 cmH₂O). Based on currently available records and scientific medical expertise, following pills used for remedy underlying run medical trial for COVID-19 [12, **Table 2**].

White button mushroom and future scope for covid-19 treatment

Carbohydrate

These mushrooms comprise naturally very active polysaccharides that typically belong to the cluster of beta-glucans. Those elements rise host immune protection through

activating supplement system, improving macrophages and natural cytotoxic killer cellular characteristic. WBM contained digestible carbohydrates include of general sugar, fructose, mannitol and oligosaccharides like Trehalose and non-starch polysaccharides consisting of chitin and β -glucans [8, 16, 42, (**Table 3**)]. Basidiomycota is known to provide healing traits which can be being recognized with its glucan and different polysaccharides. β -glucan own intimate of mixtures and appear to exert their anti-tumorigenic final results through enhancement of cellular immunity [86]. WBM (*Agaricus bisporus*) possesses latent fitness benefits for boosting mucosal immunity. The nutritional intake of *Agaricus bisporus* substantially speeds up secretory immunoglobulin "A" secretion [39].

Amino acids

The steady important natural amino acid compound intake as a part of an oral food regimen is powerful in taking flight muscle catabolism, promoting muscle anabolism, and restoring immunological characteristic. Arginine found in WBM fruit bodies delays tumour boom, metastasis and incorporate as nutritional dietary supplements for patients with cancers [57]. *Agaricus bisporus* mushroom consists of all essential and non-essential amino acids. A majority of these amino acids are beneficial as a weight-reduction plan for the fitness and healing advantages [15, 33, 54-55, 74, Table 4).

Fatty acids

WBM contained higher PUFAs (Polyunsaturated fatty acids) and features as endogenous anti-bacterial, anti-parasitic, and anti-viral molecules [18-19]. PUFAs increase the anti-bacterial movements of synthetic antibiotics in opposition to drug-resistant bacteria [25]. There's evidence to suggest that PUFAs can inactivate HIV (human immunodeficiency virus), an enveloped virus, and thus, is of advantage in AIDS (acquired immunodeficiency syndrome) [19, 58].

Agaricus bisporus is low in fat content material however they include a few important fatty acids [62, Table 5]. The whole quantum of fatty acids ranged from 180-5818 mg/kg dry matter in WBM. Linoleic acid may be very important for human fitness. They also help to reduce High Density Lipoprotein inside the blood. Unsaturated fatty acids which include linoleic acid and linolenic acid were proven to inhibit aromatase motion and subsequent reduction of estrogen using extracts of mushroom that helps to mechanism for influents on estrogen receptor revolutionary tumours [4, 67, 69].

Vitamins

2019 new coronavirus (2019-nCoV) inflamed pneumonia, namely severe acute respiratory tract infection (SARI) has triggered a global situation and emergency. Effective focused antiviral drugs are scarce, and symptomatic supportive treatment continues to be this main remedy. Vitamin C is very significant to the human body and plays an essential role in reducing the inflammatory response and

preventing normal cold. Besides, a few researches have proven that diet vitamin C (ascorbic acid) deficiency is associated with the increased threat and severity of influenza infections [87].

WBM has considered a very decent supply of vitamins. It was mentioned that the foremost abundant nutrition content like a vitamin in Agaricus bisporus is Niacin, followed by vitamin B3, Vitamin C, folic acid, Vitamin B2, Vitamin B1, Vitamin D, and B12 fats-soluble diet such as vitamin [8,42,Table 6].

Mushrooms are natural source of Vitamins D and fat soluble vitamin observed in large quantum in wild mushrooms in comparison to cultivated mushrooms. For the fitness of bones vitamin D is very essential. Ergosterol might also be a biological precursor to dietary element vitamin D and is of fungal cellular membranes. It discovered with wide-ranges between 1.73 -186.1mg/100g do (desk 7). Ergosterol is correlated with their antioxidant activities [70-71].

Phenolic Compounds

The phenolic and antioxidant properties of WBM have stated with the aid of many authors [6, 13, 50, 66]. Phenolic compounds are reported due to the fact of very important antioxidant components in mushroom (Table 8). As an herbal phenolic compound Gallic acid is observed in numerous herbal and medicinal plants. It's possess numerous health benefits to treatment of various disorder like HIV-1 integrase, transcriptase, protease

dimerization, HCV, and HSV attachment and penetration.

Gallic acid plays very significant role in Haemophilus influenza A and B debris [35, 45, 46, 91]. Phenolic acids are precise vital compounds that originate within the plant domain through specific structural similarities, presence of carboxylic group. The various beneficial acids reported in mushroom. The recommended dose of (PCA) protocatechuic acid, caffeic acid, Gallic acid and (PC) p-coumaric acid are 100 mg per kg of body weight. These compound work as very powerful anti-inflammatory, antioxidant, antihyperlipidemic antibacterial, anticancer, and antidiabetic[41, 68].

Tocopherol

Tocopherol (TCP) is fat-soluble antioxidants however also seem to possess other functions inside the fruit body. In WBM three forms of tocopherol found (Table 9). Alpha-tocopherol is that the type of nutrition vitamin E that is fat-soluble vitamin preferentially absorbed and stored in humans [66]. As a food- additive, tocopherol is labelled with these E numbers: E306 (tocopherol), E307 (α -tocopherol), E308 (γ -tocopherol), and E309 (δ -tocopherol) [76].

Minerals content

WBMs are recognized to be a superb accumulator of minerals from the environment wherein they grow [5, 9, 54, 61, 64-65, 72-73, 80]. Agaricus bisporus may be a noble source of K, Fe, Zn, Cu, Ca, Na, Se, Mn and Mg (Table 10).WBM fruiting bodies often provide an

enormous quantum of absorbable minerals ingredients. Agaricus bisporus fruiting bodies are often suggested to supplement the diet with all the minerals which can be vital for health.WBM showed that there has been excessive content of those elements in fruiting bodies, which may be used as nutraceuticals [26].

The lack of zinc in baby causes lower respiratory tract respiration infections and also effect on measles associated morbidity and mortality. The supplementation of pyrithione zinc ionophores via intracellular properly weaken the replication of RNA viruses.In some instances the treatment for SARS-CoV, the inclusive of zinc and pyrithione at low quantum found very powerful impact [3].Consequently, zinc dietary supplements may have an impact on COVID-19 related signs and symptoms like diarrhoea and lower breathing tract breathing infection but additionally on COVID-19 itself.

Indole Compounds

In WBM Indole compounds present in the form of L-tryptophan, Kynurenic acid, and other compounds [31,Table 11].The most general causes of acute liver failure are drug- triggered liver damage , virus infection, and autoimmune diseases [13,32,47]. The utilization of KYNA as a replacement of a prophylactic or therapeutic approach for the remedy of ALF needs to be considered. Moreover, since KYNA may be a constituent of food existing during a considerably high amount in designated products the use of diet containing high KYNA or KYNA-enriched supplements seems to be

reasonable, especially in subjects with a high risk of ALF [23]. Therefore Indole compounds are also useful for the treatment of COVID-19.

Conclusion

WBM (*Agaricus bisporus*) might also provide sizable support towards COVID-19 because of high nutritional and medicinal properties. Consumption of WBM isn't beneficial just in case of nourishment but also existing as anticancer, anti-cardiovascular diseases, anti-diabetes, antioxidant and antimicrobial. In earlier decades, the edible mushroom has remained used as a foundation of treatment. Most of the investigation has proven that nutraceutical therapy may be a promising source of recent therapeutics against COVID-19 diseases. Furthermore, vitamins B treatment drastically withdrawn neutrophil intrusion into the lungs with an effective anti-inflammatory impact in the way of the ventilator induced lung damage. As scarcity of vitamins B may additionally weaken host immune response, they need to be supplemented to the virus-infected sufferers to enhance their immune system [41]. The nutritional deficiency impacts no longer only on the immune response, but moreover the viral pathogen itself. The selenium deficiency in body causes oxidative stress within the host and can regulate a viral genome order that a typically benevolent or slightly pathogenic virus can emerge as exceedingly virulent inside the poor host [24, 37].¹¹The reaction (immune) has often been confirmed to be

weakened by using inadequate nutrients in many model systems similarly to human research. However, the nutritional position of the host, till currently, has no longer been considered as contributing component to the emergence of viral infectious sicknesses. Consequently, to confirm the nutritional property of coronavirus disease (COVID-19) infected patient's earlier than the administration of popular treatments. Besides, additionally discovered that coronavirus disease precise treatments and against viral remedies had been very useful for the remedy of SARS and MERS. Therefore, might be considered as potential treatments for coronavirus disease infection [88, Table 12].

Nutritional deficiency impacts not only the immune response but also the viral pathogen itself.¹⁰ Dietary selenium deficiency that causes oxidative stress in the host can alter a viral genome so that a normally benign or mildly pathogenic virus can become highly virulent in the deficient host under oxidative stress. The immune response has often been shown to be weakened by inadequate nutrition in many model systems as well as in human studies. However, the nutritional status of the host, until recently, has not been considered as a contributing factor to the emergence of viral infectious diseases. Therefore, we propose to verify the nutritional status of COVID-19 infected patients before the administration of general treatments. Besides, we also found coronavirus-specific treatments and antiviral treatments were very useful for the treatment of SARS and MERS. They should also be

considered as potential treatments for COVID-19 infection. Although bioactive molecules present in WBM may additionally constitute an important advance for their characterization as a source of medicine, more clinical statistics data are needed for the medicinal benefits of COVID-19.

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Conflicts of interest

The authors declare that they have no conflict of interest.

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