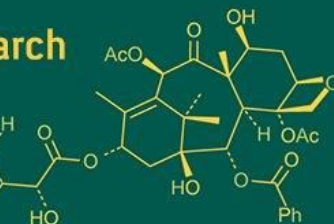


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Anti-oxidant and nutritive properties of wild edible mushrooms from distinct regions of West Bengal, India

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Abstract

Mushrooms belongs to the Basidiomycetes and Ascomycetes classes, are distributed across the globe. Thirty wild edible mushrooms from various forest regions of Indian state of West Bengal. These thirty mushroom strains were analyzed for their anti-oxidant activities, nutritional properties and anti-microbial activity. All the biochemical properties of mushroom strains were assessed by extractions of ethanol and methanol. The results of biochemical properties specify that, the BCKV 3366 (*Gymnopilus* sp.) had the highest content of phenols (29.191 mg GAE/g of dry weight) and flavonoids (10.29 mg QE/g of dry weight). BCKV 3382 (*Psathyrella* sp.) recorded the highest free radical scavenging activity (3.56 mg/ml of dry weight). The ascorbic acid content was significantly highest in BCKV 3387 (*T. microporus*) (7.84 mg/100g of dry weight). BCKV 3376 (*T. heimi*) had the highest amount of total soluble protein content (43.536 g/100g of dry weight). BCKV 3371 (*Termitomyces* spp.) showed the maximum amount of carbohydrate contents (47.31 g/100g of dry weight). BCKV 3369 (*Lentinus squarrosulus*.) had the highest moisture content (67.421% of dry weight). The results accomplished that, the methanol and ethanol extracts of various wild mushroom strains showed a remarkable potentiality for their anti-oxidant and nutritional properties.

Keywords: Wild edible mushrooms, anti-oxidant properties, nutritional properties, ethanol, methanol

Introduction

Commonly, the term "mushrooms" (or "higher fungi") is employed to describe fungi that create visible fruiting bodies on a larger scale. Mushrooms are categorized within the Basidiomycetes class, with some also falling under Ascomycetes. They serve as a widely available food source worldwide. Over time, individuals have collected Wild Edible Mushrooms (WEMs) from forests or grown them, finding pleasure in their nutritional importance, healing uses, and unique flavor (Kalac, 2016) ^[13]. Approximately 1069 species of mushrooms have been documented as edible (Boa, 2004) ^[5]. Undoubtedly, the tradition of gathering and consuming wild mushrooms as a food source is deeply rooted in numerous human cultures. Mushrooms possess abundant reserves of proteins, polysaccharides, and dietary fibers, which bestow upon them the classification of low-calorie health supplements (Ao and Deb 2019; Mridu and Atri 2017; Deb *et al.*, 2018) ^[2]. Mushrooms have maintained a longstanding connection with humanity, offering significant biological and economic advantages. The consumption of mushrooms is experiencing substantial worldwide growth, driven by their highly promising nutritional characteristics. These include their substantial content of carbohydrates, proteins, minerals, and vitamins, while being low in calories and fat (Rathore *et al.*, 2017) ^[22]. Mushrooms have maintained a longstanding connection with humanity, offering significant biological and economic advantages. The consumption of mushrooms is experiencing substantial worldwide growth, driven by their highly promising nutritional characteristics. These include their substantial content of carbohydrates, proteins, minerals, and vitamins, while being low in calories and fat (Rathore *et al.*, 2017) ^[22].

Mushroom fruiting bodies contain biochemical compounds such as phenols, flavonoids, ascorbic acid, tocopherols, and carotenoids, which offer positive effects on human health. These compounds establish mushrooms as a valuable reservoir of natural antioxidants (Sanchez, 2017; Sengkhampan and Phonkerd, 2014) ^[24, 25]. Inside their grown parts, edible mushrooms collect different useful compounds.

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These include phenolic and flavonoid compounds, as well as things like polysaccharides and steroids. Phenolic and flavonoid compounds act as strong sources of antioxidants. They can do good things like fighting tumors, stopping viruses, fighting off harmful microbes, cardiovascular and reducing inflammation and allergies.

Being surrounded by the subalpine highlands of the Eastern Himalayan region on one side and the coastal region of the Bay of Bengal on the other, West Bengal offers a broad range of forest biodiversity and ecological types (Saha *et al.*, 2021) [23]. In ecological research, edible wild mushrooms are crucial. They work in harmony with trees to support the development of both native plantations and commercial plantations of tropical forests. The saprophytic wild edible mushrooms are essential for recycling nutrients and benefiting rural and tribal populations economically. But, till date no extensive research work on wild edible mushrooms has been taken up in West Bengal, despite, the fact that not many studies have been done on wild grown edible mushrooms.

Considering the biodiversity of wild mushroom strains in West Bengal and their intriguing antioxidant attributes, an investigation was conducted on thirty (30) varieties of wild edible mushrooms. This study delved into properties such as phenolic and flavonoid content, ascorbic acid presence, and nutritional aspects like protein, carbohydrate, and moisture constituents.

Materials and methods

Thirty wild edible mushroom species were collected from different forest regions of West Bengal named as BCKV 3362 to BCKV 3391. The collected mushrooms were identified by morphological and cultural characters. 30 samples of edible wild isolates/strains and few have been identified and others are in process of identification by consultation with Directorate of Mushroom Research, Solan, and HP.

Mushroom sample preparation

Each type of basidiocarp was individually dried separately in a hot air oven at 40-60°C for 24 hours (Yuwa-amornpita *et al.*, 2020) [32]. Then the mushrooms were turned into powder and placed in sealed plastic bags. This mushroom powder was kept for future use in experiments.

Antioxidants attributes

Estimation of Total Phenolic Content (TPC)

Folin-Ciocalteu reagent method was followed to estimate the total phenol content of the wild mushroom sample extracts (Singleton and Rossi, 1965) [27]. 0.1 g of dried powder sample was added to 10 ml of 80% ethanol. The mixed solution was then filtered using Whatman's filter no. 1. The liquid left after filtering was heated in a water bath at 100°C until it dried up. The remaining substance was dissolved in 10 ml of double-distilled water. Aliquot (0.8 ml) was taken and added enough water to make it a total of 3 ml. Then, 0.5 ml of Folin-Ciocalteu reagent was added to it. After waiting for 3 minutes, 2 ml of a 20% Na₂CO₃ solution was added and mixed it well. The mixture was then placed in a water bath for 1 minute, and estimated at 650nm using a UV-VIS Spectrophotometer 371. Gallic acid was taken at different concentrations as the standard, and the samples were analyzed in 3 distinct replications.

Estimation of Total Flavonoid Content (TFC)

Estimation of total flavonoid content in the different samples of mushroom was done using the aluminum chloride (AlCl₃) method with some modifications (Ramos *et al.*, 2017) [21]. 0.1g dry powder sample was mixed with 10ml of methanol. After placed in a shaker at 200 rpm for 24 hours, the extract was filtered through Whatman's filter paper no.1. Then 0.5 ml of the mushroom sample extract was mixed with 1.5 ml of methanol, later the addition of 0.1 ml of AlCl₃ and 0.1 ml of 1 M potassium acetate was done. Then 2.8 ml of dH₂O was added to the solution and recorded the reading at 415 nm using UV-VIS Spectrophotometer 317. Quercetin was utilized at different concentrations as the standard, and the samples were examined in three distinct replications.

Estimation of Total Ascorbic acid Content

The Ascorbic acid Content in the mushroom sample extracts was determined by the colorimetric method with some modifications (de Quirós *et al.*, 2009) [9]. 0.1 g of dried mushroom powder was dissolved in 4 ml trichloro acetic acid (TCA) (6%) solution, centrifuged at 4500 rpm for 15 minutes. The extract was then filtered and 0.1 ml of the filtrate was mixed with 0.9 ml of distilled water and added 2 ml of 2% DNPH (2,4-Dinitrophenyl hydrazine) later 0.1 ml of 10% thiourea was added. The mixture was heated for 15 minutes in a water bath and then cooled at room temperature. After, gently mix 2 ml of chilled H₂SO₄ and the absorbance was immediately measured at 530 nm using UV-VIS Spectrophotometer 317. Ascorbic acid was utilized at different concentrations as the standard, and the samples were analyzed in three distinct replicates.

DPPH radical scavenging activity

Analysis of radical scavenging activity of the mushroom sample extracts using the method given by Braca *et al.*, 2001 [7], with some modifications. Extract of each mushroom sample (0.1 ml) was mixed with 3 ml of DPPH methanol solution (0.004 mg of 2, 2-diphenyl-1-picrylhydrazyl dissolved in 100 ml of methanol). The combination was left in the dark for 30 minutes, and then the absorbance at 517 nm was determined. The extraction solvent was utilized as a reference, and for the control, 100 µl of DPPH was added to 100 µl of methanol. Three separate repetitions for the samples in each treatment were done. The readings were transformed into the percentage of radical scavenging capacity using by the below equation:

$$\text{DPPH radical scavenging assay (\%)} = [(A_o - A_e) / A_o] \times 100$$

Where A_o = Absorbance without extract, A_e = Absorbance with extract.

Nutritional attributes

Estimation of Total Protein Content

The total protein content of the mushroom was determined as per Lowry's method (Lowry *et al.*, 1951) [18]. 0.5 g of dried powder samples were taken in 10 ml of buffer solution (pH-7.0%). Then the samples were centrifuged at 10,000 rpm for 5 minutes at 27 and the preparation was then used for the estimation of protein as per Lowry's method. Take 0.1ml stock solution and makeup 1ml with dH₂O. Then 5ml of reagent C is added to each tube and kept aside for 10 minutes (Reagent A - 20g Na₂CO₃ + 4g NaOH in 1lit

distilled water, Reagent B-1g CuSO₄ in 100ml dH₂O; Reagent C- Reagent A+ Reagent B). To the above-mentioned solution, 0.5ml of FCR was added. It was placed in darkness for a duration of 20 minutes. Finally, readings were taken at 660 nm with a UV- VIS Spectrophotometer 371. Bovine Serum Albumin (BSA) was utilized at different concentrations as the standard, and the samples were analyzed in three distinct replicates.

Estimation of Total Carbohydrate Content

The total carbohydrate content of was assessed using Anthrone reagent method (Hedge and Hofreiter, 1962) [12]. 100 mg mushroom dry powder was mixed with 5 ml HCl (2.5N) and place in a water bath for 3 hours. Then, a pinch of Na₂CO₃ was added to make up to 100ml to prepare the anthrone reagent: 200 mg anthrone was mixed in 100 ml of chilled 95% H₂SO₄. It was prepared freshly just before use. 0.8 ml of dH₂O was mixed to 0.2 ml extract of stock solution and 4ml of anthrone reagent was added. Then kept in a water bath for 10 minutes. Finally, readings were taken at 630 nm with UV-VIS Spectrophotometer 317. Glucose was utilized at different concentrations as the standard, and the samples were analyzed in three distinct replicates.

Estimation of Moisture Percentage

The moisture percentage of the freshly collected mushrooms was taken. Later the dry weight of the mushroom samples was taken after air drying. Results were expressed as grams of dried mushroom samples (Ouzouni *et al.*, 2007) [19].

Moisture percentage (%) = [(Fresh weight - dry weight) / fresh weight × 100].

Results and discussion

Antioxidants attributes

Total Phenol Content

Total phenol content was recorded for 30 isolates of wild edible mushroom isolates/strains. The maximum total phenol content was recorded in BCKV 3366 (*Gymnopilus* sp) - 29.191 mg GAE/g of dry weight, followed by BCKV 3367 (*Volvariella volvaceae*) (23.923mg GAE/g of dry weight), BCKV 3387 (*Termitomyces microporus*) (22.77 mg GAE/g of dry weight), and BCKV 3376 (*Termitomyces heimii*) (21.99mg GAE/g of dry weight) and BCKV 3382 (*Psathyrella* sp) showed the lowest amount of phenolic compounds (3.655mg GAE/g of dry weight) (Table no. 1). Similar range of phenol content was found with Butkhup *et al.*, 2018; Boonsong *et al.*, 2016; Sanchez, 2017 [6, 8, 24].

Total Flavonoids Content

Total flavonoid content was recorded for 30 isolates of wild edible mushroom isolates/strains. The highest flavonoid content was observed in BCKV-3366 (*Gymnopilus* sp) - 10.29 mg QE/g of dry weight, followed by BCKV-3367

(*Volvariella volvaceae*) (8.401mg QE/g of dry weight), and BCKV-3388 (*Termitomyces heimii*) (6.036 mg QE/g of dry weight). The least flavonoid content was recorded in BCKV-3382 (*Lentinus* sp) (0.862 mg QE/g of dry weight) (Table no. 1). The range of flavonoid content observed in our studies are in corroboration to the findings of Butkhup *et al.*, 2018; Woldegiorgi *et al.*, 2014 and Pereira *et al.*, 2012 [8, 20].

Total Ascorbic acid Content

The ascorbic acid content was significantly higher in BCKV-3387 (*Termitomyces microporus*) (7.84 mg/100g of dry weight) followed by BCKV-3369 (6.96 mg/100g of dry weight) and BCKV 3378 (6.88 mg/100g of dry weight). While BCKV-3371 (*Termitomyces* spp) showed significantly lower ascorbic acid content 2.98 mg/100g of dry weight, respectively (Table no. 1). The range of ascorbic acid content observed in our studies are in corroboration to the findings of Tsai *et al.*, 2009 [29].

DPPH Radical Scavenging Activity

The highest free radical scavenging activity was recorded in BCKV 3382 (*Psathyrella* sp) with (3.56±0.10 mg/ml of dry weight), followed by BCKV 3388 (3.44±0.10 mg/ml of dry weight), BCKV 3387 (3.132±0.06mg/ml of dry weight), and BCKV 3380 (3.223±0.03mg/ml of dry weight). While the lowest free radical scavenging activity was recorded in BCKV 3366 (*Gymnopilus* sp) showed (0.29±0.01mg/ml of dry weight) as shown in below (Table no. 1). A similar range of free radical scavenging activity found with Kim *et al.*, (2018) and Tan *et al.*, (2015) [15, 28].

Nutritional attributes

Total Protein Content

The highest protein content was found in BCKV- 3376 (*Termitomyces heimii*) (43.536 g/100g of dry weight), followed by BCKV-3388 (43.243 g/100g of dry weight), BCKV-3387 (40.113 g/100g of dry weight), BCKV-3371 (38.216 g/100g of dry weight). Whereas the lowest protein content in BCKV-3382 (*Psathyrella* sp) (16.726 g/100g of dry weight) as shown in (Table no. 1). A similar range of total protein content found as observed by Sifat *et al.*, 2020; Ao, and Deb, 2019 [2, 26].

Total Carbohydrate Content

The highest total carbohydrate content was observed in BCKV-3371 (*Termitomyces* spp) (47.31 g/100g of dry weight), followed by BCKV-3388 (*Termitomyces heimii*) (46.95 g/100g of dry weight). While the lowest carbohydrate content was in BCKV-3385 (*Lentinus* sp) (21.103g/100g of dry weight), and BCKV-3386 (22.16 g/100g of dry weight) as shown in (Table no. 1).The findings of the current investigation are in correspondence to observations made by Kakotiet *et al.*, 2021; Kumari *et al.*, 2020 [16, 17].

Table 1: Biochemical properties of collected different mushroom isolates/strains from West Bengal.

S.no.	Mushroom isolate codes	Total Phenol Content (mg GAE/g.dw)	Total Flavonoid Content (mg QE/g.dw)	Total Ascorbic acid Content(mg /100g.dw)	DPPH RSA(mg/ml)	Total Moisture (%)	Total Protein Content (g/100g.dw)	Total Carbohydrate Content (g/ 100g.dw)
1	BCKV 3362 (<i>Lentinus</i> sp)	5.636 ^{op} ±0.02	2.671±0.16 ^{hi}	6.13±1.96 ^e	0.656±.01 ^l	45.466±0.891 ^m	22.993± 0.08 ^{kl}	36.76± 0.20 ^{fg}
2	BCKV 3363 (<i>L.sajor caju</i>)	8.687 ^{jk} ±0.54	4.687 ±0.09 ^e	4.93±0.54 ^h	0.587±.01 ^l	60.289 ±1.02 ^d	26.103±0.11 ^{hi}	39.14± 0.07 ^e
3	BCKV 3364 (<i>L.</i>	5.486 ^{op} ±0.14	4.624±0.16 ^e	6.44±0.69 ^{cd}	0.579 ±0.02 ^l	38.182±0.99 ⁿ	26.22± 0.09 ^h	35.14± 0.04 ^{hi}

	<i>squarrosulus</i>)							
4	BCKV 3365 (<i>Lentinus</i> sp)	5.132 ^p ±0.22	3.719 ±0.11 ^g	4.73±2.00 ^{hi}	2.019± 0.04 ^f	57.713±0.99 ^{ef}	19.213± 0.28 ^o	37.203± 0.08 ^f
5	BCKV 3366 (<i>Gymnopilus</i> sp)	29.191 ^a ±0.12	10.29±0.16 ^a	2.98±0.32 ⁿ	0.292± 0.01 ^m	54.337±0.76 ^{hi}	28.133± 0.12 ^g	28.41± 0.06 ^l
6	BCKV 3367 (<i>V. volvaceae</i>)	23.923 ^b ±0.12	8.401±0.14 ^b	5.42±1.34 ^g	0.301± 0.04 ^m	55.665±1.02 ^{gh}	28.64± 0.02 ^g	45.483± 0.03 ^b
7	BCKV 3368(<i>L.squarrosulus</i>)	5.992 ^o ±0.15	2.733±0.30 ^h	3.78±1.38 ^l	2.607± 0.27 ^c	51.522±0.98 ^{jk}	29.64± 0.02 ^f	46.943±0.03 ^a
8	BCKV 3369 (<i>L.squarrosulus</i>)	9.979 ^{hi} ±0.28	2.513±0.30 ^{hij}	6.96±0.59 ^b	0.877± 0.02 ^k	67.421±1.57 ^a	30.633± 0.02 ^e	33.896± 0.05 ^j
9	BCKV 3370 (<i>Lentinus</i> sp)	7.107 ^m ±0.30	2.132±0.11 ^j	6.62±0.67 ^c	0.345± 0.01 ^m	58.071±0.95 ^e	26.12± 0.07 ^{hi}	32.343± 0.03 ^k
10	BCKV 3371 (<i>Termitomyces</i> spp)	14.229 ^f ±0.14	5.608±0.21 ^d	2.28±0.67 ^o	0.563± 0.02 ^l	56.141±1.00 ^{efgh}	38.216± 0.03 ^c	47.31± 0.02 ^a
11	BCKV 3372 (<i>Termitomyces</i> spp)	10.349 ^h ±0.31	4.147±0.14 ^f	5.86±067 ^f	0.829± 0.01 ^k	52.676±0.99 ^{ijk}	35.866± 0.06 ^d	35.636± 1.72 ^h
12	BCKV 3373 (<i>L.squarrosulus</i>)	9.285 ^{ij} ±0.27	2.655±0.16 ^{hi}	6.91±1.27 ^b	0.865± 0.02 ^k	51.263±1.52 ^k	21.31± 0.06 ^m	34.943± 0.03 ^j
13	BCKV 3374 (<i>Russula delica</i>)	5.48 ^{op} ±0.17	2.592±0.21 ^{hi}	4.88±0.27 ^h	1.296± 0.06 ^j	55.872±1.00 ^{fgh}	21.32±0.03 ^m	38.81± 0.02 ^e
14	BCKV 3375 (<i>Russula rosea</i>)	7.132 ^m ±0.18	1.576±0.28 ^l	5.44±1.15 ^g	0.381± 0.01 ^m	60.528±0.99 ^d	26.236± 0.04 ^h	34.536± 0.57 ⁱ
15	BCKV 3376 (<i>T. heimi</i>)	21.994 ^d ±0.15	3.624±0.64 ^g	6.44±0.64 ^{cd}	2.541± 0.17 ^{cd}	56.407±1.00 ^{efg}	43.536± 1.68 ^a	39.91±0.03 ^d
16	BCKV 3377(<i>Russula</i> spp)	6.948 ^{mn} ±0.23	1.417±0.14 ^l	4.45±0.58 ^j	1.748± 0.21 ^{gh}	45.424±1.13 ^m	23.916± 0.06 ^j	22.75± 0.04 ^m
17	BCKV 3378 (<i>A. bisporus</i>)	7.698 ^{lm} ±0.68	1.303±0.14 ^{lm}	6.88±0.25 ^b	1.554± 0.09 ⁱ	65.57±0.99 ^b	23.233± 0.05 ^k	33.916± 0.03 ^j
18	BCKV 3379 (<i>Russula</i> spp)	6.181 ^{no} ±0.16	3.449±0.28 ^g	5.63±0.21 ^{fg}	2.235± 0.08 ^e	57.776±1.00 ^{ef}	19.313± 0.09 ^{no}	45.503± 0.05 ^b
19	BCKV 3380 (<i>Xerocomellus</i> sp)	7.135 ^m ±0.21	1.29±0.16 ^{lm}	4.57±0.65 ^{ij}	3.223± 0.03 ^b	56.222±1.49 ^{efgh}	19.83± 0.02 ⁿ	43.546± 0.04 ^c
20	BCKV 3381 (<i>Lentinus</i> sp)	6.958 ^{mn} ±0.20	1.274±0.11 ^{lm}	5.51±0.50 ^g	2.389± 0.13 ^{de}	45.556±1.00 ^m	22.633± 0.02 ^l	38.656± 0.02 ^e
21	BCKV 3382 (<i>Psathyrella</i> sp)	3.655 ^q ±0.30	0.862±0.09 ^m	6.51±0.66 ^{cd}	3.561± 0.10 ^a	62.537±0.96 ^c	16.726± 0.19 ^p	28.336±0.02 ^l
22	BCKV 3383 (<i>L.squarrosulus</i>)	10.26 ^h ±0.09	3.64±0.14 ^g	4.70±0.52 ^{hi}	1.177± 0.05 ^j	59.935±1.00 ^d	28.313± 0.04 ^g	45.926±0.01 ^b
23	BCKV 3384 (<i>Gymnopilus</i> sp)	13.593 ^f ±0.2	4.163±0.17 ^f	2.49±0.64 ^o	1.867± 0.09 ^{fg}	55.873±1.01 ^{fgh}	24.346±0.03 ^j	46.72± 0.61 ^a
24	BCKV 3385 (<i>Lentinus</i> sp)	11.354 ^s ±0.25	2.227±0.07 ^{ij}	2.86±0.53 ⁿ	1.663± 0.10 ^{hi}	52.928±1.00 ^{ijk}	28.59± 0.04 ^g	21.103±0.04 ^o
25	BCKV 3386 (<i>Lentinus</i> sp)	7.666 ^{lm} ±0.10	3.64±0.09 ^g	4.13±0.67 ^k	1.877± 0.08 ^{fg}	55.853±0.96 ^{fgh}	24.26± 0.04 ^j	22.16±0.05 ⁿ
26	BCKV 3387 (<i>T. microporus</i>)	22.77 ^c ±0.20	3.37±0.36 ^g	7.84±0.31 ^a	3.132± 0.06 ^b	56.863±1.04 ^{efg}	40.113± 0.03 ^b	43.83±0.02 ^c
27	BCKV 3388 (<i>T. heimi</i>)	20.812 ^c ±0.14	6.036±0.52 ^c	3.32±0.46 ^m	3.44± 0.10 ^a	54.32±0.98 ^{hi}	43.243± 0.03 ^a	46.95±0.04 ^a
28	BCKV 3389 (<i>A. bisporus</i>)	4.145 ^q ±0.17	2.624±0.11 ^{hi}	6.31±0.78 ^{de}	2.265± 0.10 ^e	48.093±1.00 ^l	26.303± 0.05 ^h	36.446±0.03 ^g
29	BCKV 3390 (<i>Lentinus</i> sp)	7.979 ^{kl} ±0.20	2.1±0.38 ^{jk}	6.63±0.39 ^c	1.641± 0.06 ^{hi}	51.116±1.01 ^k	25.64± 0.05 ⁱ	39.84±0.02 ^d
30	BCKV 3391 (<i>Lentinus</i> sp)	6.177 ^{no} ±0.12	1.703±0.16 ^{kl}	6.88±1.35 ^b	1.285± 0.17 ^j	53.266±0.99 ^{ij}	23.296± 0.05 ^k	43.233± 0.02 ^e

In every column, different alphabets (“a” to “z”, being “a” as the highest value and “z” as the lowest value) mean± S.D between-sample variations that are statistically significant ($p < 0.05$).

(*T. microporus* -*Termitomyces microporus*), (*A. bisporus*-*Agaricus bisporus*), (*T. heimi*- *Termitomyces- heimi*), (*L. squarrosulus*- *Lentinus squarrosulus*), (*V. volvaceae*-*Volvariella volvaceae*)

Total Moisture Percentage

The highest moisture percentage (67.421% of dry weight) were observed in BCKV-3369 (*Lentinus* sp) followed by BCKV-3378 (65.57% of dry weight) (Table no. 1). BCKV-3364 (*Lentinus* sp) showed the least amount (38.182% of dry weight). A similar range of moisture percentage was reported by Hassan and Medany (2014); Tulek (2011) [11, 30].

Multivariate analysis

Principal Component Analysis (PCA) is a valuable statistical technique employed to simplify the initial variables (such as total phenol content, total flavonoid content, total ascorbic acid content, DPPH radical scavenging activity, total protein content, total carbohydrate content, and total moisture percentage). This reduction

yields fundamental variables (Principal Components) that unveil connections among the variables and highlight the most meaningful relationships. The initial Principal Component (PC) is consistently utilized to define sample variations, and subsequent PCs progressively destruct the original variance into smaller components. Consequently, less correlated variables are attributed to individual PC, whereas more correlated variables are attributed to a similar PC. (Fig no. 1) displays the principal component analysis (PCA) and its association. The first element, PCA 1, accounts for 45.7% of the data's variability, whereas the second factor, PCA 2, accounts for 24.5%. In Figure 2, all biochemical parameters were situated on the right side of the biplot. among all the parameters the carbohydrate and moisture% on the upper quarter of the right side of the biplot are with the negative loading whereas the total phenol content, and total flavonoids content and total protein on the lower quarter of the right side of the biplot are with the positive loading besides these DPPH RSA (%) and ascorbic content was detected on the left upper side of the biplot with high positive loading. This indicates a positive correlation among DPPH, phenols, flavonoids, and ascorbic acid. The results found were similar to Keles, Koca, and Genccelep, (2011) [14].

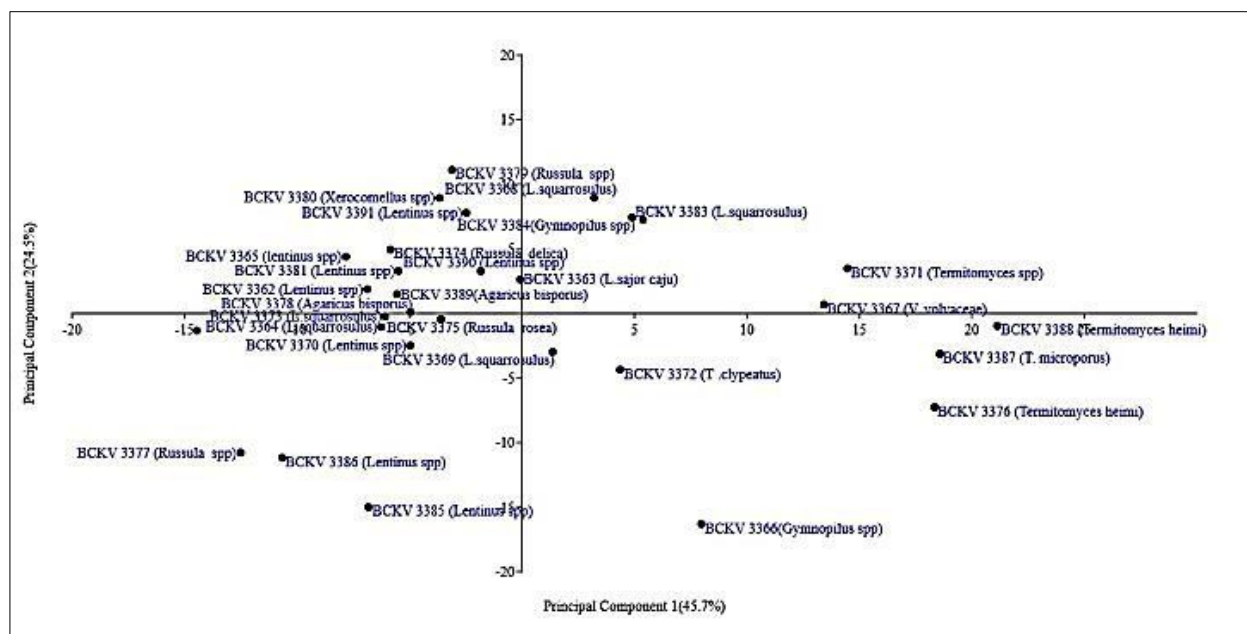


Fig 1: Multifactorial comparison of different wild edible mushroom isolates/strains for biochemical parameters using principal component analysis (PCA).

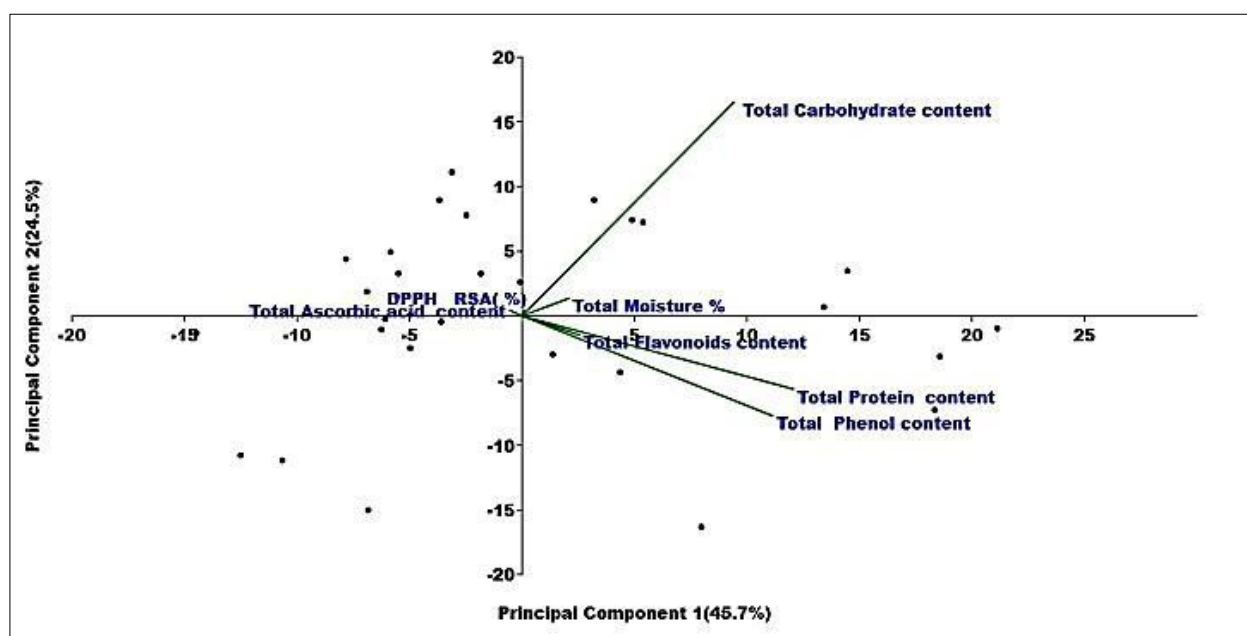


Fig 2: Scatter plot illustrating different biochemical factors (mean values) of 30 wild edible mushroom isolates.

Conclusion

Even though wild edible mushrooms are important for the economy and food security in both rural and urban areas, there is not enough information about the different types of wild edible mushrooms in West Bengal and their nutritional and functional characteristics. While numerous mushroom species in Bengal are safe for consumption and offer noteworthy nutritional value, there remains a traditional belief that consuming wild mushrooms can pose risks, potentially leading to danger and even fatality.

Within the pharmaceutical industry, mushroom species can serve as a conveniently accessible reservoir of natural antioxidants, while also holding promise as a potential dietary supplement. The primary factors responsible for the antioxidant activity in the extracts of all mushroom species appear to be phenolic, flavonoid, and ascorbic acid

compounds. It will assist in preserving human cells. An accessible supply of natural nutritional elements (protein, carbohydrates, and moisture) is the species of wild mushrooms. According to our research, methanol and ethanol extracts of various mushroom species show higher levels of antioxidants and dietary components under *in-vitro* conditions.

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