J. Mycopathol, Res, 51(1) : *1-12,* 2013; (ISSN 0971-3719)

11th Sir E.J. Butler Memorial Lecture, 2012

Certain Aspects of Wild Edible fleshy fungi of Manipur

N. IRABANTA SINGH
Centre for Advance Study in Life Sciences, Manipur University, Imphal- 795003

PREAMBLE

Sir Edwin John Butler was the pioneer mycologist in India and regarded as **"The Father of Indian Plant Pathology".** He was born on 13 August, 1874 in Kilkee, County Clare, Ireland. He completed graduation in Medicine from Queen's College, Cork (now University College of Cork) in 1898. He became the Imperial Mycologist in India in 1906 and later the first Director of the **Imperial Bureau of Mycology, England** in 1920. He was **Knighted** 1939. He was responsible for categorizing nearly 150 plant pathogenic fungal species. In 1918, he published a book entitled **"Fungi and Diseases in Plants"** which became a standard reference work for tropical plant pathologists. He was awarded the **"Order of The Indian Empire"** in recognition for his services to India especially in Mycological research in 1921. He worked in Aquatic Phycomycetes, Spike diseases of Sandalwood in India as well as on Panama disease of banana, Witches broom disease of cacao in Trinidad and Yellow Leaf disease of Nyasaland, etc. Sir E.J. Butler died on 4th April 1943 in Surrey, U.K. due to Influenza. Whatever we learned about mycology and plant pathology till today is because of this great soul. So, please accept my humble salute to you, sir.

INTRODUCTION

Mushroom research in India can be divided into two phases, viz. i) period of adaptive research and ii) period of strategic research after independence. Adaptive research covered from early sixty's to late eighty's. This phase is mainly emphasized on the research findings related to mushroom strains and agro-techniques practiced in other countries and finally testing under Indian condition to adopt for necessary modification. Help from International organizations like FAO and UNDP in transferring international technology concerning button mushroom cultivation marked an important landmark in the history of Indian mushroom research. Indian organizations like Department of Agriculture, Govt. of Himachal Pradesh, National Centre for Mushroom Research and Training (ICAR), Solan, CSIR, etc. have also contributed in this field. The strategic research on mushrooms has begun very lately and need to improve significantly through proper treatment. Thus, to fill up this gap new technology for mushroom cultivation, awareness about the mushroom uses as highly nutritious food, medicine, etc. have to be created among the Indian scientists. (Verma,1997)

MUSHROOM RESEARCH IN INDIA FOR HUMAN WELFARE

Due to the increasing awareness about food values of mushroom its demand is increasing rapidly. Nowadays, the mycologists concentrate more in research related to fungi and human health, food, evolution of fungi, biology of fungal cell, fungal genetics, fungal ecology, fungal biotechnology and more importantly medical mycology, etc. Since people are becoming more aware about the nutritive values, it is necessary to give training on simple

[1]Email: irabanta.singh@gmail.com

methods for wide successful cultivation of edible mushrooms having high nutritive value. (Bahl, 1995)

In India, cultivation of edible mushroom at commercial level did not exist till some decades back even though method of cultivation for some species have been known for many years. Experimental cultivation of paddy straw mushroom (*Volvariella*

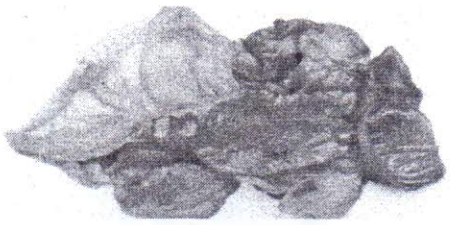
Table 1 : Distribution of wild edible fungi found in Manipur

Order	Family	Name	Local Name	Distribution
Auriculariales	Auriculariaceae	*Auricularia*	Uchina	IE,IW,TB,BN,UK,TL,CC,CD,SP.
		polytricha	Uchina	IE,IW,TB,BN,UK,TL,CC,CD,SP
		Auricularia auricula	Uchina	IE,IW,TB,BN,UK,TL,CC,CD,SP
		Auricularia delicata		
Agaricales	Agaricaceae	*Agaricus*	Chengum	SP,BN,TB,IE,IW,UK
		compestris	Chengum	TB,BN,IE,IW
		Agaricus silvaticus	Chengum	IE,IW
		Macrolepiota procera		
	Tricholomataceae	*Tricholoma*	Khongnang	IE,TB,BN
		giganteum	Chengum	BN,TL,UK
		Tricholoma terreum	Not known	IE,IW,TB,BN,UK,TL,CC,CD,SP
		Termitomyces	Phoubak chengum	IE,IW,TB,BN,UK,TL,CC,CD,SP
		clypeatus	Narin chengum	IE,IW,TB,BN,UK,TL,CC,CD,SP
		Termitomyces	Phoubak chengum	IE,IW,BN,TB
		eurrhizus	Not known	BN,CD
		Termitomyces	Not known	BN,CD
		robustus	Not known	
		Termitomyces microcarpus		
		Laccaria		
		amethystea		
		Laccaria laccata		
	Pluteaceae	*Volvariella*	Charuyen	IE,IW,BN,TB
		volvacea		
Aphyllophorales	Russulaceae	*Lactarius princeps*	Chengum	BN,CD,SN,UK,TL,CC
	Polyporaceae		Khomthokpi	
		Lentinula edodes	Thangjiyen	SP,TL,CC,CD,UK
		Lentinula lateritia	Thangjiyen	SP,TL,CC,CD,UK
		Lentinus cladopus	Tek-tekpan	IE,IW,BN,TB
		Lentinus connatus	Uyen	CC,TL,SP,UK
		Lentinus sajor-caju	Uyen	TL,CC,CD,SP,UK
		Lentinus tigrinus	Phouphou	TL,CC,CD,SP,UK
		Pleurotus	Uyen	TL,CC,CD,SP,UK
		flabellatus	Uyen	TL,CC,CD,SP,UK
		Pleurotus sp.	Not known	SP
		Polypilus frondosus	Paldang	CD,BN,CC,SP,TL
		Favolus spatulatus		
	Schizophyllacea	*Schizophyllum*	Kanglayen	IE,IW,TB,BN,UK,TL,CC,CD,SP
		commune		
	Clavariaceae	*Ramari sanguine*	Uchek khong	UK,BN,IE
		Ramari clabrunnea	Uchek khong	UK,BN,IE
	Cantharellaceae	*Cantharellus*	Not known	CD
		cibarius		
Sclerodermatales	Gomphaceae	*Gomphus floccosus*	Uyen	TB,BN,UK,TL,CC,CD,SP
	Sclerodermataceae	*Scleroderma*	Leibak marum	TB,BN,UK,TL,CC,CD,S
		verrucosum		
Lycoperdales	Lycoperdaceae	*Vascellum*	Leibak marum	IE,IW,BN,TB
		pratemse		

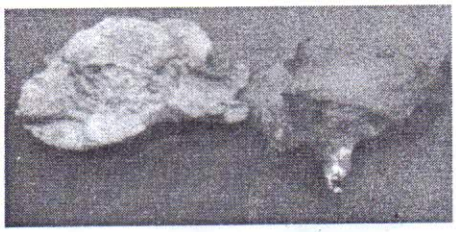
NB:Imphal East=IE, Imphal West=IW, Thoubal=TB, Bishnupur=BN, Ukhrul=UK, Tamenglong=TL, Churchandpur=CC, Chandel=CD, Senapati=SP

spp.) was first undertaken in India by the Agriculture Department, Madras (1939-1945) which was discontinued later. (Bahl, 1995). The only mushroom partially adopted by the farmers is the milky mushroom, *Calocybe indica*, Doshi *et al.*, 1989,1993) . I am also quite aware that this department is pioneer in the field of mushroom cultivation in India. This is supplemented by the publication of a book entitled "*Manual of Indian edible mushrooms*" by Purkayastha and Chandra (1985)

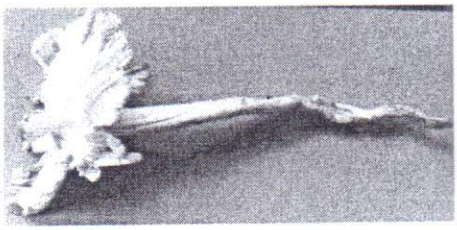
8cm wide & 1.5 mm thick
Auricularia polytricha (Mont.) Sacc



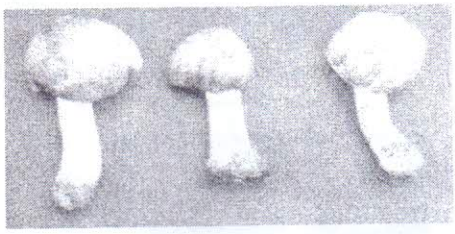
10 cm wide & 1.2 mm thick
Auricularia auricula (Ho) Underw.



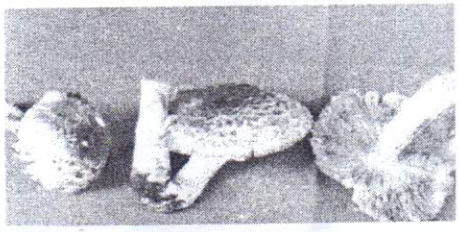
10 cm wide & 1.6 mm thick
Auricularia delicata (Fr.) Henn.



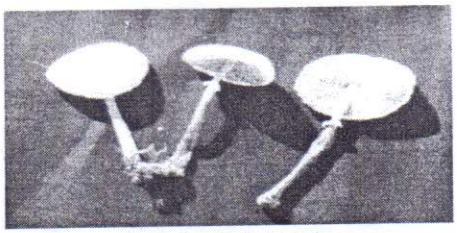
9 cm diameter & 8 cm long
Termitomyces robustus (Beeli.) Heim



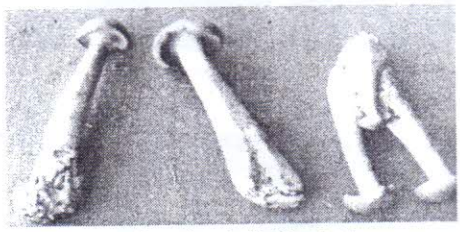
7 cm diameter & 6 cm long
Agaricus compestris L. ex Fr.



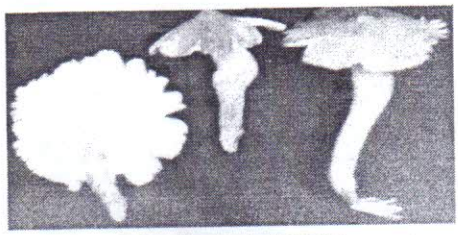
10 cm wide & 1.6 mm thick
Agaricus silvaticus Schaeff.



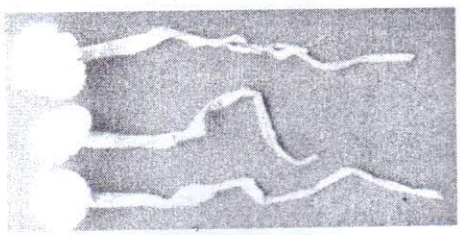
10 cm diameter & 10 cm long
Macrolepiota procera (Scop. Ex Fr.) Sing.



10 cm diameter & 10 cm long
Tricholoma giganteum Mass.



7.5 cm diameter & 10 cm long
Termitomyces clypeatus Heim.



7 cm diameter & 16 cm long
Termitomyces eurrhizus (Berk.)

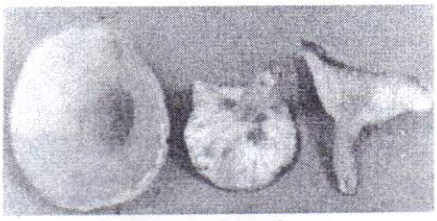
Fig. 1 : Some of the edible fleshy fungi found in Manipur

MUSHROOM RESEARCH IN MANIPUR

A. BIO-RESOURCES OF WILD EDIBLE FLESHY FUNGI (MUSHROOM)

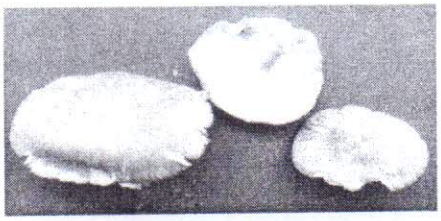
Information on most of the wild mushrooms found in the forest area as well as in local markets of Manipur was compiled (Singh *et al*, 1993; Singh and Singh 2001; Singh and Singh, 2005). Out of 60 species of wild fleshy fungi identified, 42 species under 24 genera in 13 families were found to be edible. Important edible types were *Auricularia polytricha*, *A.delicata*, *A. auricula*, *Lactarius princeps*, *Lentinus cladopus*, *Lentinula edodes*, *L.lateritia*, *Volvariella volvacea*, *Schizophyllum commune*, *Tricholoma gigateum*, *Termitomyces* spp.,

PLATE II

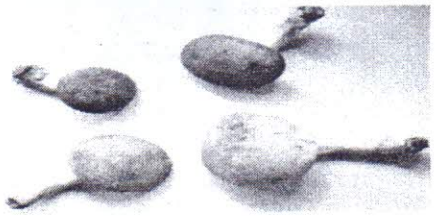


8cm diameter & 5cm long
Lactarius princeps Berk.

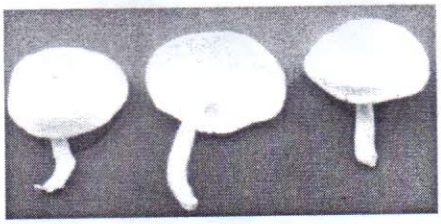
10.5 cm diameter & 7 cm long
Volvariella volvaceae (Bull.ex.Fr) Singh.



12 cm diameter & 7 cm long
Lentinula edodes (Berk.) Pegler

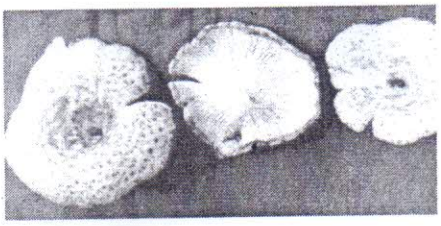


7 cm diameter & 7 cm long
Lentinula lateritia (Berk.) Pegler

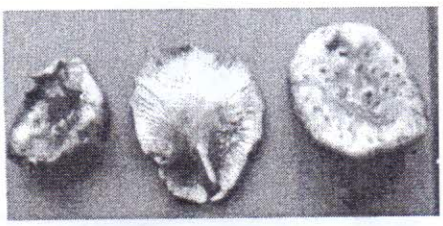


7.5 cm diameter & 8 cm long
Lentinus cladopus Lev.

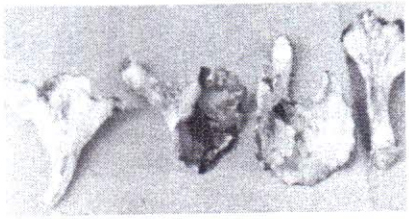
12 cm diameter & 6 cm long
Lentinus connatus Berk.



10 cm diameter & 5 cm long
Lentinus tigrinus (Bull.ex.Fr.) Fr.



12 cm diameter & 5 cm long
Lentinus sajor-caju (Fr.) Fr.



8 cm diameter & 6 cm long
Gomphus floccosus (Schw.) Sing.

7 cm diameter & 3 cm long
Lentinus squarrosulus Mont.

Pleurotus spp., etc.. *Lactarius princeps* was found in highest amount whereas *Schizophyllum commune* was found the lowest.

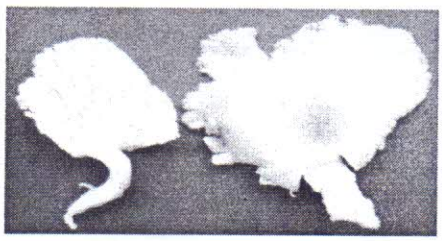
The fat, total ash and crude fibre contents varies from 1.5 to 8.5%, 4.75 to 21.0% and 3.25 to 13.0% respectively. The artificial cultivation of six *Pleurotus* species revealed that the yield reaches up to 66.6% biological efficiency (B.E.). This study was an attempt to explore fleshy fungal resources of Manipur for their possible use in sustainable economic development for the poorer sections of the society. (Singh *et al*, 1993, Singh and Singh, 2001).

The distributions chart of mushrooms found in Manipur is provided (Table I). It is also supplemented by the photographs of important edible fleshy fungi found in Manipur (Plate I to III). Further, names of the wild edible fungi found in the markets of Manipur are also provided along with their respective market prices (Table 2) (Singh and Singh, 2001).

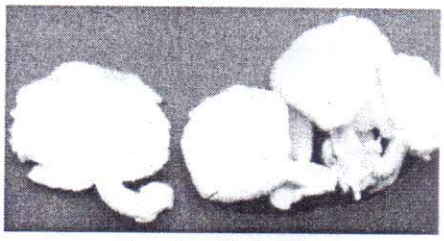
A. CULTIVATION OF CERTAIN WILD FLESHY FUNGI

For the successful mushroom cultivation appropriate conditions for temperature, moisture, ventilation and good spawn are necessary. Some novel techniques were initiated in the Manipur University

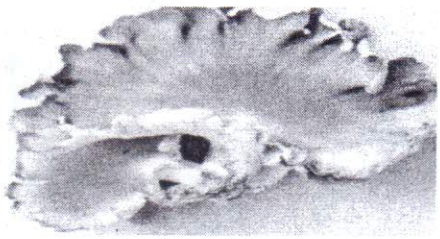
PLATE III



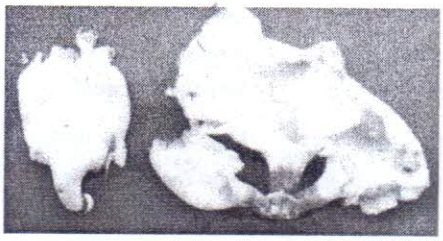
6.5 cm broad & 4 cm long
Pleurotus cornucopiae (Paulet ex Pers.) Rolland



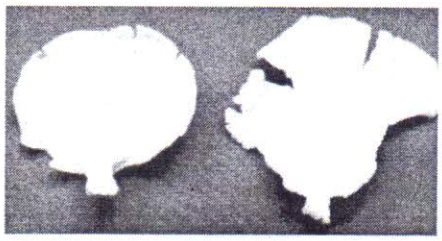
10 cm broad & 4 cm long
Pleurotus platypus (Cooke and Massee) Sacc.



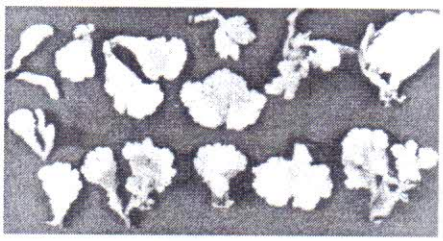
10 cm broad & 2 cm long
Pleurotus ostreatus (Jacquin ex Fr.) Kummer



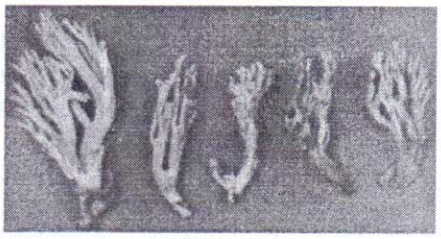
6 cm broad & 2 cm long
Polypilus frondosus (Fr.) Karsten



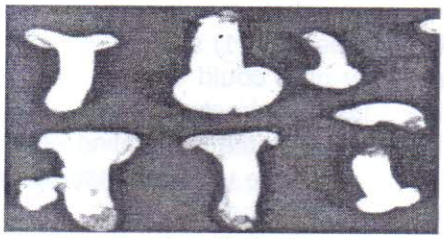
8 cm broad & 2 cm long
Favolus spatulatus (Jungh.) Lev



2 cm broad long
Schizophyllum commune Fr.



10 cm high
Ramaria calobrunnea Corner, Thind & Anand



6 cm broad & 6 cm long
Cantharellus cibarius Fr.

for cultivation of certain wild edible mushrooms.

B.1 Artificial cultivation of wild edible *Pleurotus* spp. (Oyster mushroom)

A total of 6 *Pleurotus* spp. viz. *P. ostreatus*, *P. flabellatus*, *P.eous*, *P. platypus*, *P. cornucopiae* and *P. columbinus* were collected and identified. A study on artificial cultivation of locally available *Pleurotus* spp. using eleven (11) different substrates viz. paddy straw, sugarcane bagasse, maize straw, mustard straw, pea straw, coir, rice husk, pine needles, banana pseudostem, saw dust and waste-paper reveals that in all the substrates *P.columbinus* failed to develop mature fruiting body but a good crop of asexual coremial spores was formed all over the surface of the substrates. It was also observed that out of the eleven (11) substrates used, waste paper and saw dust could support sporophore development for *P. ostreatus* only whereas other species fail to develop mature fruiting body. The biological efficiency of the yield reaches up to 99.59% on mustard straw substrate.

The study on nutritional/food value content of the *Pleurotus* spp. on different substrates reveals that the moisture content ranged from 83.16% to 98.8%, the protein content ranged from 16% to 40.6%, the crude fat value ranged from 1.7% to 4% whereas crude fiber ranged from 10% to 12.5% and the total mineral ash content ranges from 6.14% to 16.7%. In all the *Pleurotus* spp. studied it was found that the nutritional content of each species varied with the type of the substrate used. *Pleurotus* spp. had a very good lingo-cellulose degrading ability. It was found that the percentage reduction of cellulose content ranged from 9% to 51.16%. The study also reveals that the natural enhancement in the nitrogen content of the substrate after 45 days of inoculation. The increase in the nitrogen content ranged from 0.2% to 1.6%.

Table 2 : Wild edible fungi found in the markets of Manipur and their price

Name	Period of availability	Market name/ District	Price (Rs. per kg.)
Auricularia spp.	Throughout the year (dried) March-September (Fresh)	All districts	160 to 200 40 to 60
Schizophyllum commune	Throughout the year (dried) March-September (Fresh)	All districts	140 to 185 40 to 60
Lentinula edodes	March-June (Fresh)	All districts	40 to 70
Lentinula lateritia	March-June (Fresh)	All districts	40 to 70
Volvariella vulvacea	June-August (Fresh)	All valley districts of Manipur	40 to 50
Termitomyces eurrhizus	May-September (Fresh)	All districts	20 to 30
Termitomyces clypeatus	May-September (Fresh)	All districts	20 to 30
Tricholoma giganteum	June-September (fresh)	Imphal, Thoubal and Bishnupur Districts	30 to 35
Lentinus cladopus	June-September (fresh)	Imphal, Thoubal and Bishnupur Districts	30 to 35
Lentinus sajor-caju	June-September (fresh)	All districts	20 to 30
Lentinus tigrinus	April-September (fresh)	All districts	20 to 30
Favolus spatulatus	April-September (fresh)	All districts	20 to 30
Ramaria spp.	June-August (fresh)	All districts	20 to 30
Pleurotus spp.	May-August (fresh)	All districts	30 to 35

Studies on the control and management of the fungal competitors reveals that chemical fungicides were more effective than the phytoextracts used but the use of phytoextracts has been recommended because of the residual effect of the chemical fungicides.

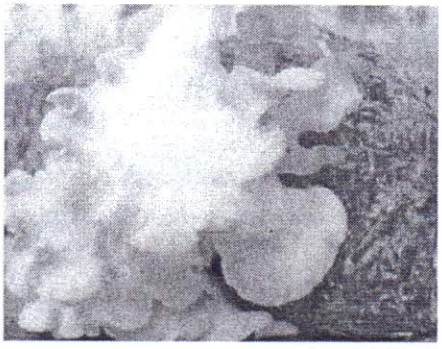
Thus, this study was an attempt to conserve the fungal genetic resources of Manipur as well as management of these agro-forest wastes available

in Manipur by recycling through mushroom cultivation. The study was also an attempt to transfer oyster mushroom cultivation technology from research laboratory to landless farmers for sustainable economic development (Plate IV). (Nivedita and Singh 2004, 2005, Singh *et. al*, 2003).

PLATE IV

***Pleurotus* cultivation in different agro-forest wastes**

Pleurotus ostreatus grown on paddy straw



Pleurotus eous grown on paddy straw

Pleurotus platypus grown on paddy straw

Pleurotus cornucopiae grown on paddy straw

Pleurotus flabellatus grown on mustard straw

B.2 Artificial cultivation of *Auricularia* spp. (Jew's Ear)

On the basis of the external and internal characteristics, 3 (three) *Auricularia* species were identified viz., *Auricularia delicata*, *A. polytricha* and *A.auricula*. All of them were found to be edible. Wide range in diversity was observed in these three species. More quantity of *Auricularia* spp. was recorded from the 5 hill districts as compared to the 4 valley districts. Among the three *Auricularia* spp., *Auricularia delicata* was found more frequently in all the districts as compared to the other two species. Physiological and nutritional studies were carried out for these three species.

Among the solid media used, the best mycelium growth of *A. delicata* was found in potato dextrose

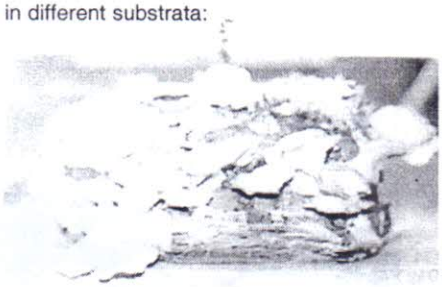
agar followed by yeast potato dextrose agar. Malt extract agar medium supported the best mycelial growth of *A. polytricha* followed by wheat extract agar. Yeast potato dextrose agar supported the best mycelial growth of *A.auricula* followed by the Malt extract agar. Among the liquid media, potato dextrose was found to support the maximum mycelial growth of all the three *Auricularia* species. pH 6.5 was the best for mycelial growth of three *Auricularia* species. The optimum temperature for the mycelial growth for *A. delicata* and *A. polytricha* was 28°C the best mycelial growth for *A. auricula* was 30°C. The effect of different incubation period revealed that *A.delicata* continue to increase their mycelial growth till 25 days of incubation period whereas 20 days of incubation period gave the maximum mycelial yield for *A. polytricha* and *A. auricula*. Among the different wastes materials tested, the best mycelial growth of *A. delicata* was recorded in rice husk followed by paddy straw and sugarcane bagasse respectively. No mycelial growth was found in banana pseudostem. Among the isolated fungi, *Humicola grisea*, *H. lanuginosa* and *H. insolens* were important microfungi which were responsible for the bio-degradation of sawdust into a suitable nutrient medium for the growth of *Auricularia* mycelium.

A. delicata and *A. polytricha* were selected for artificial cultivation using different types of substrates. The substrates used for their cultivation were sawdusts of *Quercus* sp., *Phoebe* sp., *Dipterocarpus* sp. and paddy straw. In partially decomposed sawdust substrates, the yield of *A. delicata* and *A. polytricha* was higher in the saw dust of *Quercus* sp. (470.00 g and 354.87 g) followed by saw dust of *Phoebe* sp. (326.75 g and 271.12 g). However, the yield of *A.delicata* was better than *A.polytricha* in all the sawdust substrates tested and reached up to 23.50% biological efficiency (B.E.). In paddy straw, the yield was found better in *A.delicata* (280.00 g) than *A.polytricha* (185.00 g). The yield reached upto 14.00% biological efficiency (B.E.).

PLATE V

Cultivation of *Aucularia delicata* in different substrata:

On partial decomposed sawdust of *Quercus* sp.



On partial decomposed sawdust of *Phoebe* sp.

On paddy straw.

Analysis of food value of the *Auricularia* spp. tested indicated that moisture content of *A. delicata* was found to be higher than the *A. polytricha*. On the other hand, the crude protein, crude fat, crude fiber and total ash contents were found higher respectively in *A. polytricha* than *A. delicata*. (Devi and Singh, 2011).

C. WILD EDIBLE FLESHY FUNGI (MUSHROOMS) AND THEIR FOOD VALUES

Mushrooms occupy as an important food among people in several parts of the world. It has high nutritive values in the form of proteins, carbohydrate, vitamin and minerals (Bahl, 1995). So, the

food values for 20 species of wild edible fleshy fungi found in Manipur had been analysed. Analysis was carried out dealing with moisture, crude protein, crude fat, total ash and crude fibres contents for each mushroom type.

The study reveals that *Lactarius princeps* had highest moisture content whereas *Schizophyllum commune* had the lowest moisture content. Crude protein was found to be highest in *Pleurotus ostoreatus* while lowest was in *Auricularia delicata. Favolus spatulatus* contained highest fat level. *Schleroderma verrucosum* contained the highest fibre (Singh *et al*, 2003 and Devi and Singh, 2011). (Table 3. and Fig.1).

mune) were identified from Manipur.

Ethanolic extract of *Auricularia auricula* had strong antioxidant property and significantly increased *in vitro* NO production which indicated that it can be used for several fatal diseases. (Acharya *et al.*, 2004 and Rai *et al.*, 2007). *Schizophyllum commune* had schizophyllan which can quenched superoxide radical and thereby can act as a antioxidant (Sakagami and Aoki, 1991, Acharya, 2007).

Auricularia polytricha , *Lentinus edodes* and *Pleurotus ostreatus* can also be used against cardiovascular diseases.(Acharya, 2007 and Susiki *et.al.*, 1974).

Lentinus edodes produced anti-microbially active

Table 3 : Percentage proximate composition of some wild edible fleshy fungi of Manipur

Mushroom Types	Local Name	Moisture	Crude Protein (%)	Crude Fat (%)	Total Ash (%)	Crude Fibre(%)
Auricularia polytricha	Uchina	87.78	8.89	1.50	5.50	9.00
Favolus spatulatus	Paldang	85.70	19.93	8.50	6.00	7.00
Lentinus cladopus	Tek tek pan	86.80	17.17	6.50	10.25	5.00
Lentinus conatus	Changeng	84.89	27.29	3.00	12.00	3.25
Lentinus tigrinus	Pouphou	83.26	10.11	3.00	4.75	7.75
Lentinula edodes	Thangjiyen	80.11	15.94	3.00	5.25	7.25
Lentinula lateritia	Thangjiyen	84.15	15.02	2.5	4.5	7.5
Lactarius princeps	Chengum Khomthokpi	92.92	14.10	6.25	7.50	9.25
Laccaria laccata	Not Known	91.13	19.01	2.00	12.00	5.00
Schizophyllum commune	Kangla yen	40.07	14.41	2.50	8.50	5.50
Schleroderma verrucosum	Leibak marum	87.76	20.24	2.00	10.25	13.00
Termitomyces eurrhizus	Narin chengum	85.74	22.08	3.50	7.50	7.00
Termitomyces clypeatus	Phoubak chengum	86.98	23.00	3.50	6.75	9.00
Trichotoma giganteum	Khongnang Chengum	86.02	18.09	2.50	9.25	5.25
Cromphus floccosus	Uyen	92.00	15.33	4.00	21.00	4.00
Auricularia delicata	Uchina	93.21	7.30	1.40	4.60	6.90
Pleurotus ostoreatus	Uyen	89.73	28.50	3.00	9.80	11.70
Pleurotus flabellatus	Uyen	89.65	24.50	2.20	8.17	11.00
Pleurotus eous	Uyen	91.41	26.00	1.80	8.13	11.60
Pleurotus platypus	Uyen	89.62	26.50	2.60	9.40	10.10

D. FUNGI (MUSHROOMS) AND THEIR MEDICINAL VALUE

Eventhough some mushrooms are poisonous, some are medicinally useful. Medical application of mushrooms is mainly concerned in antidiabetic, anti-microbial, antioxidant, anti-cancer and immunomodular activities.Therapeutically useful six (6) mushroom species two each from *Pleurotus* (*Pleurotus ostreatus, Pleurotus cornucopiae*) and *Auricularia* (*Auricularia auricula, Auricularia polytricha*), one each from *Lentinus* (*Lentinus edodes*) and *Schizophyllum* (*Schizophyllum com-*

component like oxalic acid, eritadenine, cortinellin, etc. Lignin (LIM sulfated lentinum) was also present in *L.edodes* which can be used against HIV (Acharya, 2007). Due to the presence of lentinan, *L.edodes* can be used as immune modulator.(Murata *et.al.*, 2002).

Mannegalactoglucan, an anti-tumor compound is present in *Pleurotus cornucopiae* and so can be utilized in cancer treatment (Kim *et.al.*, 1994).

Proper verification regarding medical application of these mushrooms needs further study.

E. MYCOLOGY AND BIOINFORMATICS

Integration of bioinformatics, IT and mycological knowledge has opened up a new era toward the mycological research activities. Digitization of mycological data of Manipur for the development of database has been initiated since June, 2012 with special reference to wild edible fungi of Manipur.

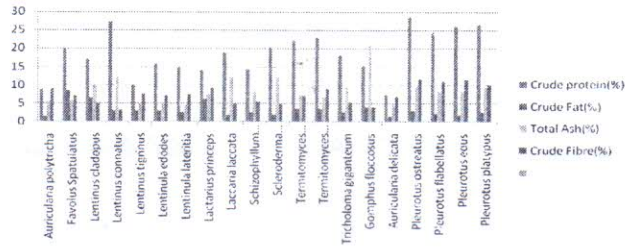


Fig. 1 : Food values for 20 wild edible fleshy fungi found in Manipur

We have collected primary data from unpublished theses, articles, books, etc. and convert them into secondary resources through digitization and database construction with special reference to food values of those wild edible fungi found in Manipur.

E.1. Digitization of Mycological Database using Bioinformatics

Information on most of the wild mushrooms found in the forest area as well as in local markets of Manipur was compiled from the previous works done, related articles, books, *etc.* on morphological as well as other data for 42 species of wild edible fungi have been collected. These fungal species fall under 24 genera in 13 families. So, a fungal database construction has been just initiated at Bioinformatics Infrastructure Facility Centre, Manipur University, Canchipur. For fungal database development, at first the data had been converted into secondary data using Microsoft Word, Microsoft Excel 2007, etc. Then, these data was used for fungal database construction in Microsoft Excess 2007 for mushroom found in Manipur. This database is mainly concerned with edible fungi that are found wild in Manipur and medicinally important. This fungal database is divided into two sections viz. (i) database for wild edible fungi (mushroom) of Manipur and (ii) database for medicinal fungi of Manipur.

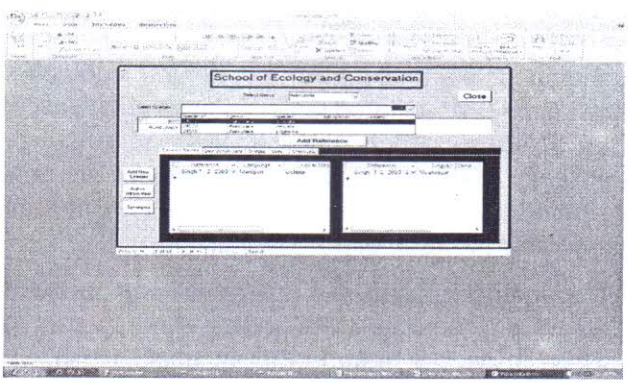


Fig. 2 : Database for Wild Edible Fungi of Manipur developed using Microsoft Access 2007 provided by School of Ecology and Conservation, GVK, Bangalore.

(i) Database for Wild Edible Fungi (mushroom)

So far, digitization of 20 (twenty) types of wild edible mushrooms found in Manipur has been initiated for construction of database. This database will contain morphological characters of individual mushroom including size, shape, fungal nature, *etc.* Photographic views of the fungal species will also be included. It also includes data on distributions, its mode of uses and various food values. A model for the database is shown below (Fig.2-7).

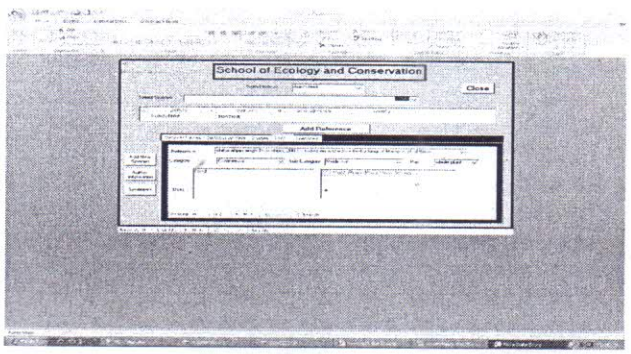


Fig. 3 : Entering the uses of a particular mushroom in Database for Wild Edible Fleshy Fungi of Manipur.

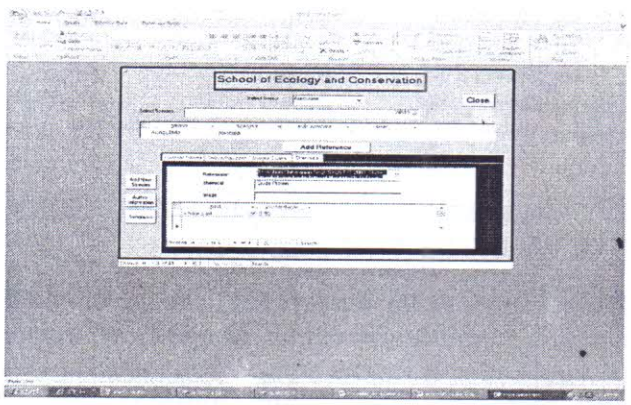


Fig. 4 : Entering the Food values for a particular mushroom in Database for Wild Edible Fleshy Fungi of Manipur.

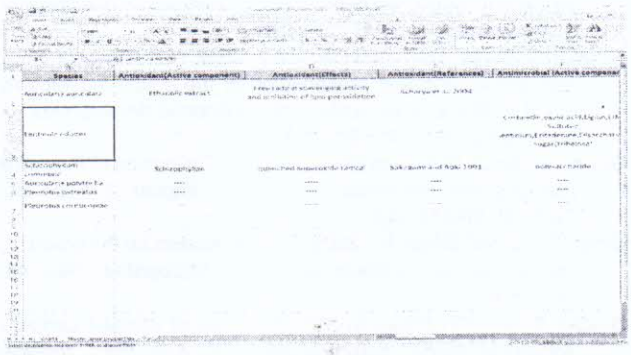


Fig. 5 : Database for Medicinal Fungi of Manipur developed using Microsoft Access 2007

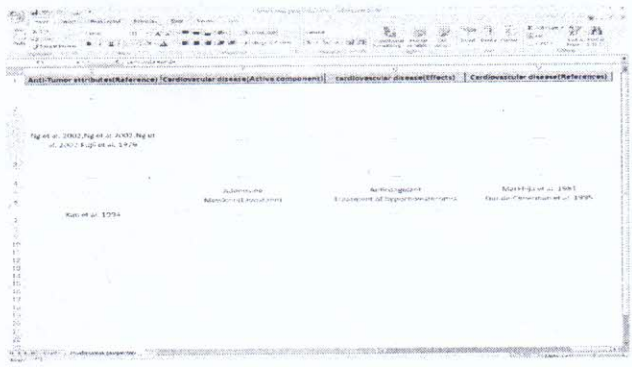


Fig. 6 : Entering data in Database for Medicinal Fungi of Manipur.

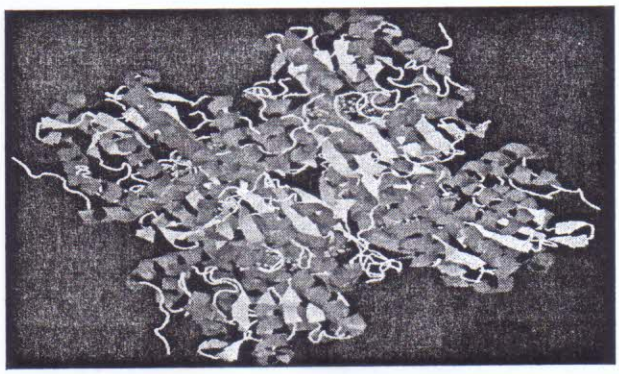


Fig. 7 : View of 3-D structure of Eritadenine, active component found in *Lentinus edodes* having medicinal effect against cardiovascular diseases (downloaded from **rcsb**-site).

(i) Database for Medicinal Fungi

Till now, this database includes six mushroom species having medicinal values and also found in Manipur. These species are *Auricularia auricula, Lentinus edodes, Schizophyllum commune, Auricularia polytricha, Pleurotus ostreatus* and *Pleurotus cornucopiae.*

Other than these, more number of mushroom species having medicinal properties are being compiled through primary resources and started uploading into the Microsoft Access 2007 for respective database construction. The medicinal values consider here are anti-microbial, antioxidant, immune modulator and anti –cancer activities, *etc.* This database will also contain information on their 3-D (three dimensional) structure of target site, its active compound which is downloaded from PDB site.

Wild edible fleshy fungi found in Manipur which have high food values and also medicinal properties needs to be explored further. Mycology along with Bioinformatics and Information Technology will be a new mycological research approach. Construction of mycological database for Manipur have been initiated regarding wild edible fleshy fungi and their medicinal values.

ACKNOWLEDGEMENT

I am grateful to the Executive Committee, Indian Mycological Society, Kolkata for awarding me 11th Sir E.J. Butler memorial lectureship, 2012. Thanks are also due to Ms. Beebineeta, Ms. Y. Nganthoi, Dr. Mrs. M. Babita, Ms. Sunibala W. and Mr. M. Ghanashyam for their help in the compilation of this lecture.

REFERENCES

Acharya, K.2007. *Advances in Medicinal plant Research.* Research Signpost, Kerala. 215-236

Acharya, K., Samui, K., Rai, M., Dutta, B.B. and Acharya, R.2004. Antioxidant and nitric oxide synthase activation properties of *Auricularia auricular. Ind.J. Expt. Biol.***42**:538-540p.

Bahl, Nita.1995. *Handbook on Mushrooms.* Third Edition. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

Devi, M.B. and Singh, N.I. 2011. Evaluation of proximate nutritional value of edible *Auricularia delicata* and *A. polytricha* from Manipur. *J. Mycopathol. Res.***49:** 199-200.

Doshi, A., Sharma S.S. and Trivedi, A. 1993. A promising Edible Mushroom for the tropics: *Calocybe indica* P. and C. *Mushroom Information* 10(5/14):pp14-22.

Doshi, A., Sidana N. and Chakravarti B.P.(1989). Cultivation of summer mushroom, *Calocybe indica* (Purkayastha and Chandra) in Rajasthan. *Mush. Sci.***12:** 395-400

Kim, Y.S., Park, K.S., Park H.K., and Kim S.W.1994. Compositional sugar analysis of polysaccharides by high performance liquid chromatography and gas chromatography. *Arch. Pharmacol. Res.* (Seoul).**17:** 337-342

Murata, Y., Shimamura, T., Tagami, T., Takatsuki, F. and Hamuro, J.2002. The skewing to Th1 induced by lentinan is directed through the distinctive cytokine production by macrophages with elevated intracellular glutathione content. *Int. Immunopharmocol.* **2:** 673-689

Nivedita, L. and Singh, N.I.2004. Lignocellulose degradation by mushroom (*Pleurotus ostreatus*). *Env.Biol and Conservation.* **9:** 89-90

Nivedita, L. and Singh, N.I.2005. Recycling of agro-forest wastes through mushroom cultivation. *J. Mycopathol. Res.***43 :** 271-

273

Purkayastha, R.P. and Chandra, A.1985.*Mannual of Indian Edible Mushrooms.* Today and Tomorrow's Printers and Publisher, New Delhi: 266

Rai, M., Biswas, G. and Acharya, K.2007. Antioxidant and nitric oxide synthase activation properties of *Polyporus grammocephalus* Berk.. *Int. J. Biomedical and Pharmaceutical Sc.***1:**160-163

Sakagami, H. and Aoki, T.1991. Induction of immunopotentiation activity by a protein bound polysaccharide PSK. *Anticancer Res.* **11:** 993-1000p.

Singh, N.I. and Singh, Th.C. 2001. Non wood forest products of Manipur State: wild edible fleshy fungi found in the forests and market. *Proceedings of Int. Symp.-Tropical forestry Res. Challenges In the new millennium, 2001.* (Edited by Varma ,R.V.; Bhat K.V.; Muralidharan, E.M. and Sharma, J.K.): 247-250

Singh, N.I., Nivedita, L. and Devi, M.B. 2003. Artificial cultivation of *Pleurotus sajor-caju* (F r.) Singer in Manipur using certain agrowastes and forest byproducts for sustainable dvelopment. *J. Mycopathol. Res.* **41:** 221-223

Singh, N.I., Singh, Th.C. and Devi, M.B. 2003. Nutritional composition, processing and preservation of the edible mushrooms found in Manipur for sustainable economic development. *J. Mycopathol. Res.* **41:** 243-244p.

Singh, N.I.,Singh, S.M. and Devi, L.S.1993. Cultivation of *Pleurotus platypus* and *Pleurotus sajor-caju* in Imphal. *J. Food Sc. Technol.* **30:**444-446.

Singh, Th.C. and Singh, N.I.2005. Cultural studies on the growth of two isolates of *Lentinula lateritia. J. Mycopathol. Res.* **43:** 267-269p.

Susuki, S. and Ohshima, S.1974. Influence of shiitake *Lentinus edodes* on human serum cholestrerol. *Ann. Rept. National Inst. Nutri.* **25:** 89-94

Verma, R.N. 1997. *Recent Advances in Mushroom Research in India.* Advances in Mushroom Biology and Production. Proceedings of the Indian Mushroom Conference 1997.1-29