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**Manju Lata**

Department of Biosciences  
MLSM College Sunder Nagar,  
District Mandi, Himachal  
Pradesh, India

**Mohammad Jamali**

Deputy Head, Khawarizmi  
International College, Abu  
Dhabi Campus, United Arab  
Emirates

## Nutritional, medicinal and indigenous use of *Diplazium esculentum* and *Morchella esculenta* for socioeconomic development of Seraj Valley, district Mandi, Himachal Pradesh

**Manju Lata and Mohammad Jamali**

### Abstract

Inhabitants of the Seraj valley largely depend on wild herbs for medicine, food and for economy. As the valley is the rich repository of wild medicinal herbs. Present study was carried out in the Thunag Tehsil (31.55°N, 77.17°E) at an altitude of 2052 m, of district Mandi (31.5892°N, 76.9182°E). Area are fed by fresh water lakes, streams, mullah from the mountains. These climatic conditions favour the growth of *Diplazium esculentum* (fern) in this area. *Morchella esculenta* commonly known as growing gold of mountains because it fetch good price in market. Favorable environmental conditions like thick coniferous forest, loamy soil rich in humus, high altitude, cool climate. All these conditions favour the natural growth of this fungus. It is found in coniferous forest habitat at a height of about 2500-3500 m. It is commonly found as a mycorrhizal or saprobic relationship with hardwood and coniferous trees. Its growing season is from March to July. It contains carbohydrates, proteins, fibres, all important vitamins, minerals and aromatic compounds. Due to its unique flavour, taste and texture it is used in different recipes all over the world. It contains a wide range of pharmacological properties which includes antioxidant, antitumor, antimicrobial and anti-inflammatory properties, it also acts as an immunostimulant due to the presence of various active constituents. The aim of this study was to investigate the nutritional, medicinal and judicious use of this herb for socioeconomic development of study area.

**Keywords:** Nutritional, medicinal, socioeconomic development

### Introduction

The Indian Himalayan Region (IHR) covers approximately 4,19,873 km<sup>2</sup> area (Rodger & Panwar, 1988) and cover 10 states namely, Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh, Meghalaya, Nagaland, Manipur, Mizoram, Tripura, and hill regions of 2 states viz. Assam and West Bengal of Indian Republic. Due to diverse habitats and large altitudinal range (200-8,000), it supports unique and socio-economically important floristic diversity. *Diplazium esculentum* is a seasonal fern commonly known as lingad or lingru. Occur naturally in cool, shady and damp places nearby fresh water bodies. It appears during March to July. Fern is rich in nutritional and medicinal values.

*Morchella esculenta* is a seasonal mushroom commonly known as guchhi or dunglu. Occur naturally in the coniferous forest floor. It appears during February to April as a saprophytic fungi in the coniferous forest floor or nearby forest vicinity.

*M. esculenta* is nourished for both nutritional and medicinal values because of the possession of many bioactive substances, including polysaccharides, proteins, trace elements, dietary fibres and vitamins (Litchfield *et al.*, 1963) [10]. The fruiting body of *Morchella esculenta* shows antioxidant activity (Elmastas *et al.*, 2006) [7]. Mycelia of *M. esculenta* contain beta-carotene and linoleic acid which exhibit antioxidant activities (Mau *et al.*, 2004) [13]. *Morchella esculenta* has been proven to have anti-inflammatory and antitumor activities (Nitha *et al.*, 2013) [15], which were attributed to the possession of polysaccharides (Yang *et al.*, 2014) [21].

### Material and Method

#### Study area

Himachal Pradesh (30° 22' 40" to 30° 12' 40" N latitudes and 75° 47' 55" to 79° 04' 20" E longitudes) is a North western Himalayan state of India which is a rich repository of ethnomedicinal flora.

### Correspondence

**Manju Lata**

Department of Biosciences  
MLSM College Sunder Nagar,  
District Mandi, Himachal  
Pradesh, India

Most of these plant species find their use in traditional medicine, folk uses and also in modern industry. Present study was carried out in the Seraj valley of Thunag Tehsil (31.55°N, 77.17°E) at an altitude of 2052m, of district Mandi (31.5892°N, 76.9182°E) Himachal Pradesh. Thick coniferous forest and rich humus soil favour the growth of wild mushroom *Morchella esculenta*. Its Life cycle is from February to April. The major soil groups are brown hill soil and red loamy soil. Most soil in this region are acidic in nature. Being a hilly valley climate is cool and temperate with

three distinct season; the winter (October to March), the summer (April to June), the monsoon (July to September). Highest temperature is recorded during May and June varying between 30 to 35°C. Lowest temperature is recorded during December and January month. The annual rainfall is around 1240 mm. It covers approximately 313.57 Km<sup>2</sup> areas, and comprises 22 Panchayats, 171 villages with 10,872 households and 50,308 human populations. (Statistical Department Mandi)

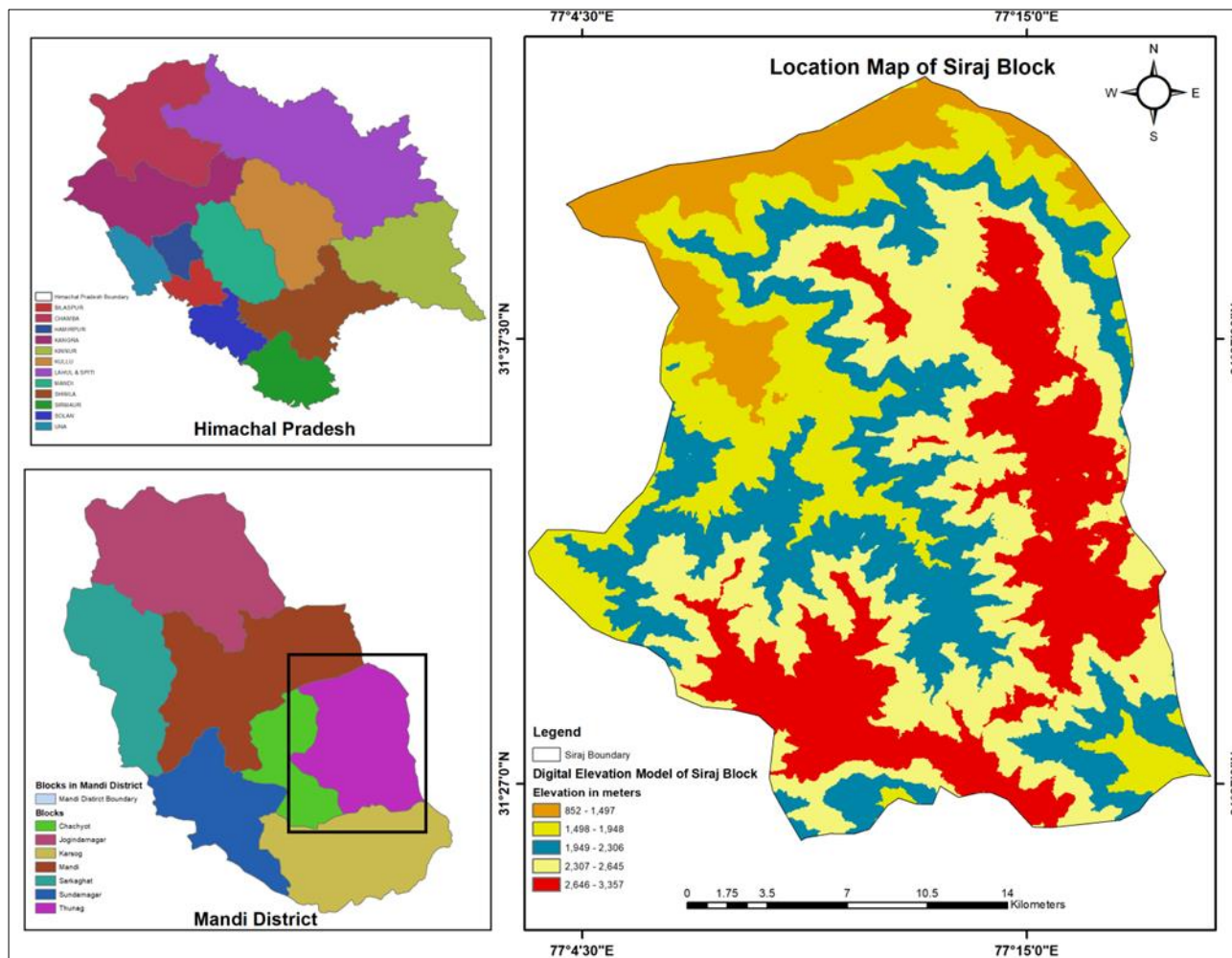


Fig: Map of study area

**1.2 Methodology**

For the assessment of *Morchella esculenta*, surveys were conducted in different villages of Seraj Valley namely Bagsaid (1848m), Jarol (2012m), Janjehli (2018m), Rod (2030m), Chapper (2054m), Majakhal (2014m), Tungadhar (2025m), Bhanvas (2017m), Danhyar (2032m), Thunag (2052m). Local people were interviewed and information on the wild edible mushroom was gathered. The language used while interacting with the informants was the local dialect of the study area viz. *Mandyali, Saraji* and in certain cases, Hindi also. People hardly use these morels for edible

purposes, they use them for only commercial purposes. Fresh morels were collected by inhabitants followed by drying.

**1.3 Drying**

Drying should be done very carefully and with patience with no moisture content left behind to increase its shelf life. Dried Morels should be kept in an air tight container. Dried morels are transported to different parts of India. These plants are mostly exported to the France, Belgium, Switzerland, Austria, Germany and Middle East. Dried Morels are sold with a price of 8,000 to 15,000 per kg by local inhabitant.

**Table:** Profile of the local people who collected gucchi in feb – april 2018

Sr. No.	Name	Age	Education	Village	Profession	Morchella /Gucchi collected
1.	Het Ram	43	12 <sup>th</sup>	Chhapar	Orchard	500gm
2.	Atma ram	40	Graduation	Chhapar	Farmer	620gm
3.	Sonu	27	12 <sup>th</sup>	Kothi	Farmer	530gm
4.	Kanu	13	7 <sup>th</sup>	Kothi	Student	200gm
5.	Prem	35	10 <sup>th</sup>	Road	Farmer	470gm

6.	Lata Devi	40	10 <sup>th</sup>	Ghatadhar	Farmer	300gm
7.	Besar Singh	40	10 <sup>th</sup>	Chhapar	Farmer	600gm
8.	Kesar Singh	55	10 <sup>th</sup>	Neend	Farmer	400gm
9.	Roshan	48	8 <sup>th</sup>	Neend	Farmer	460gm
10.	Rajni	44	12 <sup>th</sup>	Bagsaid	House wife	590gm
11.	Anu	25	Graduation	Bagsaid	House wife	700gm
12.	Tota Ram	40	8 <sup>th</sup>	Road	Farmer	1kg
13.	Kaushilya	40	8 <sup>th</sup>	Jarol	Farmer	580gm
14.	Narottam	50	10 <sup>th</sup>	Road	Farmer	690gm
15.	Madan lal	42	10 <sup>th</sup>	Ghamrwala	Farmer	490gm
16.	Dinesh	43	10 <sup>th</sup>	Gughand	Farmer	580gm
17.	Reena	47	10 <sup>th</sup>	Ghamrwala	Farmer	400gm
18.	Sharda	45	12 <sup>th</sup>	Garahan	Farmer	580gm
19.	Sita Devi	54	10 <sup>th</sup>	Garahan	Farmer	200gm
20.	Hansa	43	10 <sup>th</sup>	Baila	Farmer	690gm
21.	Besar	45	10 <sup>th</sup>	Road	Farmer	790gm
22.	Geeta Nand	44	10 <sup>th</sup>	Baila	Orchard	680gm
23.	Alam chand	52	10 <sup>th</sup>	Bhnvas	Farmer	800gm
24.	Dharmu	45	10 <sup>th</sup>	Road	Farmer	1kg
25.	Meena	52	12 <sup>th</sup>	Thunag	Farmer	580gm



**Fig 1, 2:** Man searching Morchella.



**Fig 3, 4:** Thick coniferous forest of Shikari Devi and Bulah.



**Fig 5:** Man with Morchella in Chhapar forest





Fig 6, 7, 8: Morchella in the forest of Ghatadhar, Shillh, Thunag. Fig 6, 7, 8 respectively.



Fig 9: Harvested Morchella by a man at Bagsaid.



Fig 11: Diplazium in natural habitat Fig 12. Harvested fronds



Fig 10: Morchella are dried and woven into a garland by womens to sale out in local market.



Fig 12: Harvested fronds



Fig 13, 14, 15: Diplazium esculentum pickle and vegetable

**Medicinal use of Morchella esculenta**

**Anti-tumour activity of Morchella esculenta** the ethanol extract of *M. esculenta* mycelium shows significant antitumor activity against both as cites and solid tumour. The extract contains both curative and preventive properties against solid tumour in a dose-dependent manner. The extract is also significantly effective against ascites tumour. These results suggest that the mycelia of *M. esculenta* contain compounds that may modulate tumorigenesis at

different stages or may act at the same stage. Polysaccharide isolated from the fruiting bodies of *M. esculenta* has been reported to exhibit Immuno stimulatory activity (Duncan *et al.*, 2001). Mushrooms are also used in Traditional Medicines which may help to prevent heart diseases, diabetes, cancer and obesity. There are more than 7000 species but a little over 100 species are suitable for human consumption. The rest mushrooms are non-edible or poisonous. Some of the edible morels if not

properly used can cause benign neurologic effects. The effects show generally after a delay of 6–12 hours and included mainly of ataxia and visual disturbances. It shows toxicity if eaten in large amount as a raw. If eaten raw it causes nausea and vomiting. An explanation may be that the assumed neurotoxin is volatile or unstable and the morels contain only small quantities. In the cases of intoxication, the mushrooms may have been cooked for too short time to remove all of the poison and the morels were eaten in large amounts (Fayaz *et al.*, 2012, Nautiyal *et al.*).

#### Immune enhancement

An Immunostimulatory high-molecular-weight (~1000 kDa) galactomannan polysaccharide has been isolated from morel fruit bodies. This polysaccharide, which accounts for about 2.0% of the morel's dry weight, contains 62.9% mannose, 20.0% galactose, and smaller amounts of N-acetyl glucosamine, glucose and rhamnose. The Immunostimulatory activities of various morel extracts were measured using a luciferase reporter gene bioassay, where luciferase expression results from the binding of NF-kappa B. It was determined that at a concentration of 3.0 µg/mL, the galactomannan polysaccharide increased NF-kappa B directed luciferase expression in THP-1 human monocytic cells to levels 50% of those achieved by maximal activating concentration (10 µg/mL) of lipopolysaccharide. It may have therapeutic effects by interacting directly with the mucosal immune system of the gastrointestinal tract (Duncan *et al.* 2002) [5].

#### Anti-inflammatory activity

Anti-inflammatory activity of a 50% ethanolic extract of *Morchella esculenta* mycelium grown in submerged culture has been determined by carrageenan induced acute and formalin induced chronic inflammatory models. Oral administration of 500 mg/kg body weight of extract showed 66.6% and 64.2% inhibition of acute and chronic inflammation, respectively

#### Nutritional value

The mineral content of *M. esculenta* fruit bodies has been determined by inductively coupled plasma atomic emission spectrometry. (Dursun *et al.*, 2006) [6].

Values (in mg/kg) obtained were as follows:

Ag = 0.4±0.4  
 Al = 17286±779  
 As = 9.6±0  
 B = 19.7±8.5  
 Bi = 0  
 Ca = 33787±707  
 Cd = 1.1±0.1  
 Cr = 59.2±27.6  
 Cu = 12.7 ± 0.5  
 Fe = 7858.9 ± 188.3  
 Ga = 4.5 ± 2.6  
 K = 808.3 ± 354.5  
 Li = 19.5 ± 1.2  
 Mg = 4254.9 ± 18.4  
 Mn = 157.7 ± 6.5  
 Na = 4193.5 ± 260.6  
 Ni = 73.2 ± 2.2  
 P = 14 607.6 ± 447.9  
 Pb = 2.3 ± 0.4  
 Se = 8.0 ± 3.1  
 Sr = 90.6 ± 3.3  
 Ti = 0

Zn = 57.5 ± 1.2

Fruiting body of *Morchella esculenta* is edible. It is highly nutritious, delicious and healthy. It is rich in protein, carbohydrates, vitamins particularly vitamin B and trace amount of vitamin A, C and D. They are also low in fat and contain low calories (Negi, C.S. Morels, 2006, Mattila *et al.*, 2001) [13, 12]. *Morchella esculenta* contains 38% carbohydrates, 32.7% protein, 17.6% fibre, 9.7% ash and 2.0% fat. It also contains 195mg/g Iron, 98.9 mg/g Zinc, 62.6 mg/g Copper and 54.7 mg/g Manganese, 23.5 mg/g Potassium, 3.49 mg/g Phosphorus, 1.82 mg/g Magnesium, 0.85 mg/g Calcium, 0.18 mg/g Sodium (Wahid *et al.*, 1988). Earlier studies reported a variety of aromatic compounds including phenol, alcohol, acids, esters, aldehydes, ketones, and terpene. The main aromatic compound present in *M. esculenta* is phenol about 50.88%, alcohol about 15.55%, and ester and carbamic acid about 11.37% (Genccelep *et al.*, 2009) [8]. Proteins obtained from the mycelia of *M. esculenta* are comparable to vegetative protein and can be used as a good source of protein supplement (Taskin, 2013) [18]. It is rich in proteins which can be more easily digested than other vegetables. *M. esculenta* is rich in B-complex vitamins and minerals. It has been discovered that *M. esculenta* is useful in the treatment of illnesses like cold, stomach/ headaches, and hepatitis B. It can reduce fatigue and sleeping problems as well as blood cholesterol levels. *M. esculenta* shows a good alternative for anaemia and it also helps to regulate the blood sugar level (Ying *et al.*, 1987, Mahmood *et al.*, 2011, Sher *et al.*, 2011, Sharma *et al.*, 2017, Collins, 1999, Kumar *et al.*, 2000, Nitha and Meera, 2006, Duncan *et al.*, 2001) [11, 17, 16, 4].

**Nutritional value of *Diplazium esculentum*:** It contains protein, fat, fibre, mineral beta carotene. (Anonymous, 1952) [3].

#### Antibacterial activity

Antibacterial activity of *Diplazium esculentum* and its active constituents would be helpful in treating various kinds of diseases. The rhizome and root extracts inhibited the microorganism growth. Amit, *et al.* traditionally used to treat many diseases (Kirtikar KR, BD Basu, 1935) [9].

#### Production of *Diplazium* and *Morchella*

People mostly depends on the natural habitat nearby lakes, streams, nullaha coniferous forest floor or fields.

Natural *Diplazium* production is restricted to a particular time period or seasons from March to July. Inhabitants used to collect fronds of this edible ferns from nearby vicinity. Inhabitants of the area used to consume this for vegetable and often make pickle.

Few men and women collect this for commercial purposes. They used to sell it 40 to 50 Rs per kg. Few women used to make its pickle which fetch good price in market 300-400 per kg.

On the other hand natural *Morchella* production is totally restricted to a particular season. To collect these morels round the year one have to adopt other means of its cultivation like to cultivate in polyhouses. But this technique is in its infancy stage.

#### Collection of *Diplazium* and *Morchella*

Mostly women and childrens are engaged in this task. They have to haunt in a difficult terrain in search of these valuable

herbs. Some women and men used to collect these from nearby lakes, streams, nullaha and from forest floor.

### Suggestion

For large scale commercial production, round the year production one should promote *Morchella* cultivation in polyhouses. From natural habitat it is difficult to collect them in an abundant scale or people have to restrict for a particular season. Whereas *Diplazium* is found in abundant in the study area but its harvesting needs skilled hands.

### Discussion and Conclusion

*Morchella esculenta* is a seasonal herb which grow in the coniferous forest floor or fields nearby forest territory during the month of February to April. Loaded with high nutritional and medicinal values it fetch good price. Inhabitant of this region generally harvest and collect this herb only for commercial purposes. They rarely consume this as a vegetable in spite of its high nutritional value. Mostly women and children are involved in this, though man also took part sometimes. Searching these morels is a time consuming and tedious work.

### Recommendation

*Diplazium esculentum* and *Morchella esculenta* are harvested from natural habitat i.e. nearby lakes, streams, from forest floor or fields. People have to spend their lot time first to reach at the difficult terrain of the forest and then to search these fronds and morels. It's not pretty sure that people will get these morels at forest. Few may return with empty handed after spending their whole day.

Those who are able to find these morels, most of them harvest them unprofessionally they used to extract whole morel from the soil.

Professional training is very much necessary to guide people of the study area. They should be recommended to carry out knife, scissors or any other tools to harvest these morels above from ground and cover the base with soil s that will help conservation of mycelium and may persist for next growing seasons.

As *Morchella esculenta* fetch good price (10,000-15,000 /kg) in this region it is very important herb to raise the socio economy of the people. But for commercial production it needs to be cultivated in large scale. Need of an hour is to train people for its commercial production.

*Diplazium esculentum* also attracts good no of buyers due to its deliciousness, nutritional and medicinal values.

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