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Muhammad Hamayun*, Sumera Afzal Khan**, Habib Ahmad***, Dong-Hyun Shin* and In-Jung Lee*

*Department of Agronomy, Kyungpook National University, Republic of Korea

**Centre of Biotechnology, University of Peshawar, Pakistan

***Department of Botany, Hazara University, Pakistan

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Abstract

Morel comprise the most delicious and prized group of edible fungi. In Pakistan, morels are collected traditionally from the northern mountain ranges of Hindu-Kush, Himalayas and Karakorum. Seven species of morels are collected from the temperate forests of Hindu-Kush mountain region of Swat. The morel collection is a seasonal and part time activity in the area. The collectors are poor people and include 33% women, 27% men and 40% children. The morels are sold in the local market, from where they are exported to Europe and Middle East. Morel exports thus play a significant role in the socioeconomic condition of Swat. Huge quantities of morel are lost each year due to improper collection, storage and processing techniques.

Key Words: Morel; Marketing of morel; Hindu-Kush mountains; Swat

Introduction

Forests comprise 4.8% of the total area of Pakistan and about 80% of livelihood of people living in extreme poverty depends upon the forest resources (Latif *et al*, 2004). The important non timber forest products include morels, honey, fruits and nuts, vegetable, condiments and spices, mazri palm, silk cocoon. Morel make top of the list and contribute most to the local economy as it fetch high prices in the international markets and thus most of the morels collected from the temperate forests of Pakistan are exported abroad. The collectors use traditional methods of collection, processing, packing, drying, marketing of morels. The morels, after collection, cleaning and drying are sold to the middlemen who then sell it into main market of Lahore, Karachi, Peshawar and Swat. More than 65% of the product is lost during the processing from raw to finished product (Latif *et al*, 2004). Extensive research is needed to study market trends and monopolies, wastage and unsustainability during different steps of processing, and government attitude toward morel and mushrooms. Bottom line studies should be conducted to ensure proper planning, better quality and quantity of morels, sustainable income through sustainable utilization, training and capacity building of people involved in morel business, sustainable marketing and community involvement for sustainable harvest. In North West Frontier Province of Pakistan, local people collect about 55 to 65 tons of dried morels, which equals to the weight of 500 tones of fresh morels. It was reported that more than 70% of mushrooms are produced in NWFP (Iqbal, 1991).

Morels are normally found in temperate forest. Their mycelium connects with tree roots; these relationships can be mycorrhizal or saprobic. *Morchella* typically form relationships with hardwood and conifer trees. They can often be found around ash, dying elms and apple orchards.

Swat Valley

The Hindu-Kush mountain region of Swat is one of the most scenic places of sub-continent and is some times called mini Switzerland of Pakistan. The valley lies adjacent to the meeting point of three big mountain viz. Himalayas, Hindu-kush and Karakorum and thus exhibit diverse and unique flora and fauna. The valley of Swat is situated at the northwest corner of Pakistan. It lies from 34° 34' to 35° 55' north latitudes and 72° 08' to 72° 50' east longitudes. It is surrounded on the north by Chitral and Ghizer valleys, on the east by Kohistan and Shangla, on the south by Buner and Malakand protected area and on the west by Dir. The total area of the district is 5337 square kilometers (Hamayun *et al*. 2003).



Fig. 1: Map of Swat

Swat can be divided into two regions i.e., Swat-Kohistan and Swat Proper. Swat-Kohistan is the mountainous country on the upper reaches of the Swat River up to Ain in the south. The whole area south of Ain is Swat proper, which can be further divided into: Bar Swat meaning upper Swat and Kooz Swat meaning lower Swat.

Swat has predominantly rural population. Pashtuns (mainly Yousafzai tribe), Kohistanis, Gujars and Pirachas inhabit the valley of Swat. The Pashto speaking Yousafzai Pashtuns are the descendants of Pashtuns from Afghanistan. They inhabit the lower fertile valleys and farming, orchards are their prime sources of income. The Kohistanis belong to the Kohistani Dard tribe and they inhabit the mountainous areas called Swat Kohistan. They speak Kohistani language. They are land owners and share holders in forest revenues. The Gujars live in the upper inhospitable valleys. They belong to Gujar clan and speak Gujro language. The Gujars are mostly farmers but they do not enjoy any share in forest revenues. The nomadic Gujars (also called Ajars) form a substantial part of the Gujar population. The Ajars rear livestock and also work as peasants. The Piracha is the business class and they occupy almost all business in the main city of Mangora.

Materials and Methods

Present project was carried out in 2003 with the objective to investigate morel collection in the remote Hindu-Kush region of Swat. The project area was surveyed extensively. 70 morel collectors were interviewed from different parts of Swat. The information obtained from the collectors was cross checked in order to get a more representative data. Questionnaire method was employed during the field study. The traditional collection, cleaning, drying, storage was observed. The dealers involved in the business of morels were visited and interviewed. The collected species of morels were identified in the herbarium of Quaid-i-Azam University Islamabad. The data was checked with available literature.

Results

Morels grow naturally in the temperate forests of Hindu-Kush, Himalayas and Karakorum mountains. In Pakistan, the morels are collected from Swat, Dir, Chitral, Mansehra, Afridi Tirah, Orakzai Tirah, Kurram Agency (NWFP), Murree (Punjab), Bagh and Chakoti (Azad Jammu & Kashmir), Zayarat (Baluchistan). Most of the morels collected from the forests is sold in the market from where they are exported to different parts of the world. In Swat, morels are collected from mid March to June. The local name used for different species of *Morchella* is Gujai. The Kohistani sometimes call it Kasee.

During the study, it was found that seven species of Genus *Morchella* are collected from Swat. The species with a brief description are given.

***Morchella conica* Fries** (Conical morel)

This is the most abundant species in the Hindu-Kush mountains of Pakistan. This species of *Morchella* is endowed as queen of edible mushrooms. In Swat, it is primarily collected from Kohistan, Chail valley, Miandam and Malam Jabba (from 2000 m to 4500 m). The local name of *Morchella conica* is Kohistani Kasee/Gujai. The body ridges of *Morchella conica* extend longitudinally and run parallel from base to top. *Morchella conica* exhibits grayish color in the beginning but on maturity it attains somewhat bluish color. *Morchella conica* mainly grows in pine forests, under *Pinus willichiana*. It makes 48 % of the total morels collection of Swat. When fresh, its size ranges from 4 cm to 25 cm but after drying the size reduces and ranges from 0.1 cm to 11 cm.

***Morchella esculenta* (L.) Pers.** (Common morel)

Morchella esculenta is collected from the temperate forests of Kohistan, Chail, Miandam, Midyan, Chuprial and Shangla. Local people called it Speena Gujai (Speena means white). This species is found under thick mixed coniferous vegetation. The color is somewhat creamy white in early stages but changes to yellow at maturity. It makes 32 % of the total collection of morels in the area. In fresh form its size varies from 2 cm to 25 cm while on drying the size reduces to 0.1 to 10 cm.

***Morchella rotunda* (Fr.) Boud.** (Rounded morel)

Morchella rotunda is collected in small amounts from the temperate forests of Swat. Commercially it is not as important as *Morchella conica* or *Morchella esculenta*. Locally it is called Ghounda Gujai (Ghounda means rounded). The color of the fruiting body is yellow but becomes bluish when in contact with any substance. It amounts only 6 % of the total collection of morels in Swat. In fresh form, its size varies from 5 cm to 25 cm but after drying the size reduces (3 cm to 9 cm).

***Morchella deliciosa* Fr.** (Tulip morel/white morel)

This medium sized morel is locally called Pashakalai Gujai (Pashakal means month of July) as it is collected during the months of July. The fruiting body is pencil shaped, with sparse ridges and pits that are usually arranged more or less vertically. It is usually found under apple trees and sides of streams and rivers but rarely found near coniferous trees. *Morchella deliciosa* is of yellowish color. It makes about 7 % of the total collection of morels. When fresh, its size varies from 6 cm to 30 cm but on drying the size ranges from 4 cm to 15 cm.

***Morchella semilibera* DC.** (Half-free morel)

This morel is locally called Topai Sawree (capped) Gujai. It grows rarely under the pine trees. These morels are collected during spring and rainy season. The ascocarp is pitted and ridged while the stalk is of larger size compared to cap. When young, its color is pale but on maturity changes to black. This morel is not important commercially and is produced in small quantities. *Morchella semilibera* makes 3 % of the total morels collection from Swat. Fresh and dried size of *Morchella semilibera* varies from 2 cm to 10 cm and 0.1 cm to 4 cm respectively.

***Morchella elata* Fr.** (Black morel)

This morel is similar to *Morchella deliciosa* or *Phallus impudicus* morphologically. Locally it is called Da Khawar Gujai. The pileus is blackish brown with deep elongated pits running down the cap. *Morchella elata* grow in shady and damp places and near the river. It makes about 2 % of the total morels collected in the area. When young, its size ranges from 5 cm to 25 cm but on maturity the size reduces i.e. from 3cm to 13 cm.

***Morchella crassipes* (Vent.) Pers. (Thick-footed morel)**

This morel is locally called dabbala Gujai. The pileus and stipe of *Morchella crassipes* are thick as compared to other morels. *Morchella crassipes* grow on soils with rich organic components. This morel constitutes 2 % of the total collection of morels in Swat and thus not significant commercially. The size varies from 4 cm to 15 cm when fresh but reduced to 2 cm - 12 cm after drying.

Traditional uses of morel in Swat

Morels are collected in Swat for marketing purposes but sometimes, they are used as traditional medicine and flavoring agent. Morels are fried in Desi Ghee and taken after meal as general body tonic. The plant is also crushed to powder and used as bandage for stopping extensive bleeding from an injured part of the body. In some areas, the plant is boiled in milk with Cow Ghee and used for joints aches or potency. Morels are believed to be helpful in the treatment of insomnia, enterogastitis, indigestion and poor appetite.

Traditional Drying and Storage Methods

Fresh morels contain huge amounts of water. It is clear from the fact that one kg fresh morels reduces to 100 gm after drying. Drying is done by collectors or local dealers called Pansaris. The traditional method of drying is to make a garland of morels and hang it to the wall or house rafters. The morels are first clean from mud as mud is attached to the stalk in some instances and are kept for drying for 2 to 3 days in sunlight. After drying the morels are stored.

Morels need a lot of care in storage as their quality deteriorates very quickly. The successful storage technique is to keep morels dried and cool with a little ventilation. They are kept in closed chambers as in open they may absorb moisture and start to decompose. Occasionally, insect larva infests the morel during storage. In such cases, morels are properly fumigated with insect killing tablets in a separate chamber. Some times, morels get spoiled by mosses which grow on morels in hot humid conditions. The spoiled morels are washed with water but it deteriorates the quality of morels as they become black.

Causes of Morel Spoilage

Main causes of morel spoilage are the following.

1. Hot and humid conditions cause great loss to morels as hot conditions and increased moisture contents make the morels susceptible to insect attacks and moss growth.
2. When fresh morels are kept in air tight plastic bags, spoilage take place as a result of suffocation.
3. While growing, the morels got injured due to storms, running water or a piece of wood. Such morels become black after drying and counted as inferior quality.
4. Insects and ants also cause great damage to morels.

Morel Collectors

Morel collectors are usually poor villagers. Morel collection is there part time activity besides farming and live stock keeping. The collectors include 33% women, 27% men and 40% children. They collect morels during spring and early summer season which starts from March to July and sell it in the local market to earn their living hood. Morel collection is a hectic job and requires a lot of physical exertion, devotion and passion. Some times the collectors spent days in the forest collecting morels and other plants of economic importance, especially medicinal plants like *Acorus calamus*, *Podophyllum emodi*, *Paeonia emodi*, *Valeriana jatamansi* and *Bistorta amplexicaulis*. In most cases, the collectors sell morels in fresh form to the local dealers or in the markets of Madyan and Mingora after drying the morels. The collectors sold it to local shopkeepers or in the markets of Madyan and Mingora. *Morchella* fetch high prices and thus play an important role in the economy of Swat.

Marketing of morels

The collectors sold it to local shopkeepers or in the big markets of Madyan, Matta and Mingora. *Morchella* fetch high prices and thus play an important role in the economy of Swat. Morels collected from the forests of Swat are exported to France, Belgium, Switzerland, Austria and Germany. The main species exported are *Morchella conica* and *Morchella esculenta*. About 90% of the total morel produce of Pakistan is collected from the HinduKush and Himalayan mountain

ranges. Morels are actually the growing gold of these mountains.

The trade and earnings depends upon the export of morels, which is based on quality control. The shopkeepers buy morels from the collectors. These purchases are made under certain rules made by dealers of morels. The shopkeepers pay differently to the collectors depending on the quality of morels. When the shopkeepers or middlemen have sufficient stock, they sold it to exporters in the markets of Mingora, Madyan and matta. The same rule of gradation is yet again followed.

Prices of Morels

Prices of morels greatly depend upon the quality, processing and area of collection. The prices also vary from species to species. The price of *Morchella conica* is always higher than other species. One kilogram of dried morel fetches Rs.3000 to collector, Rs.10000 to the wholesaler, Rs. 13000 in the National market and Rs. 20000 to 25000 in the International markets (1 US dollar = 60 Pak Rupees). Thus the exporters are the main beneficiaries followed by middlemen. The collector get nominal benefits as prices are very low in the area as compared to international markets.

Table 1: Different categories of *Morchella* and their prices in the local market (2003)

No.	Category	Parts Sold	Price per Kg (Rupees)
1	Special	Heads only	5000
2	Extra	Heads with 2cm stalk	4600
3	Standard	Sold as collected	4200
4	Tail	Pieces of stalk only	200

Main Exporters of Morels in Pakistan

There are four main exporters of morels in Pakistan. They are

1. Rehman Traders, Mingora, purchase and export about 12000 to 17000 kg of morels per year.
2. Salman Traders, Islamabad, purchase and export about 15000 to 17000 kg of dried morels per year.
3. M. Hussain and Co. Mingora, purchase about 7000 to 10000 kg of morels each year.
4. Essa Jaffer and Co. Karachi, purchases about 5000 to 8000 kg of morels from Peshawar and exports it abroad.
5. Umer and Haji trading companies in Peshawar purchases about 4000 to 6000 kg morel and supply it to Lahore and Karachi.

Discussion

Pakistan has 56 edible species of edible fungi. These include 4 species from Baluchistan Province, 3 from Sindh Province, 5 from Punjab Province and 44 from NWFP Province and Azad Kashmir (Sultana *et al.*, 1996). Morels are found in the northern areas, in the Himalayan, Karakoram and Hindukush mountain ranges. The altitudinal limits for morel ranges from 1,800 to 3,000 meters above sea level (Rehman, *et al.* 2000). In Asia, morels are mainly found in Turkey, Pakistan, India and China from where they are exported to other countries. According to Latif *et al* (2005), small quantities of morels from Afghanistan are exported via Pakistan. They grow in temperate latitudes around the world, in both conifer and hardwood forests.

In Swat, the collectors include 33.0% women, 27% men and 40% children. However, Iqbal (1991) reported that in NWFP, local people (children 54%, women 24%, men 22% in NWFP) collect them in fresh form from the forest. About 289,000 forest dwellers, mainly children and women, are involved with collection and processing of morels in NWFP. Many people in local communities collect part time in addition to their regular jobs, such as grazing animals, collecting fodder and fuelwood etc. The role of women is really crucial in all the processes like collecting, cleaning and drying (Shah, 1991). Morels are collected in Swat during spring season. The collectors are poor local people and morel collection is their part time activity.

Present investigations confirmed that seven species of *Morchella* are collected in Swat. However, present findings are different from those of Ali (2002), who reported that 9 different types of morels are collected from the Hindu Kush-Himalayan region of Swat. They either sell their collected morels to a local shopkeeper or in the big markets of Madyan and Mingora where morels fetch comparatively

high prices. Morel business is growing in Swat as it provides economic relief to the poor population of the area. The other reason of morel collection is mythical as people in the Swat believe that morel collectors are fortunate people. The collector some times put Mamera (*Corydalis gowaniana*) in his/her eyes as there is a myth that such collectors will collect more morels. Iqbal (1993) observed that NWFP, the dried mushrooms are traditionally sold on barter trade basis or for money to the near by local grocers. The grocers sell these dried mushrooms to "Middle Men" in to the main trading markets that supply mushrooms to main trading centers like Lahore, Karachi and Rawalpindi or even directly exported abroad from Mingora in Swat. In main trading centers, they are well processed according to the demand of importer, which cost 90 to 110 rupees/Kg (Iqbal, 1993). The annual production of dry morels in Pakistan is approximately 100,000 kg. Most of this collection comes from the Hindukush mountain region of Swat.

Morels are highly priced of all wild harvested mushrooms because of their marvelous flavor and superb taste. Rotzoll *et al.* (2005) conducted interesting experiments using taste dilution analysis (TDA) technique to understand what causes the unique taste of morels, as well as the mouth-drying sensation they cause. It was found that gamma-aminobutyric acid is the agent responsible for the mouth-drying sensation. A mixture of (S)-malic acid 1-O-alpha-d-glucopyranoside and (S)-malic acid 1-O-beta-d-glucopyranoside was investigated to be involved in the taste. This mixture works along with l-glutamic acid, l-aspartic acid, and succinic acid, which were already known to be important components of the taste.

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