1. INTRODUCTION

The name mushroom itself is thought to have been derived from the French word “mousseron”, a term that included edible as well as poisonous varieties of mushrooms, however, originally, the word “mushroom” was used for the edible members of macrofungi. Now most of these are agaricoid and are grouped under order Agaricales of class Agaricomycetes (Kirk et al., 2008).

The members of order Agaricales Underw. are cosmopolitan in distribution and grow on variety of substrates including leaf litter, plant debris, tree trunks, stems of herbs, shrubs, bark of trees, on sandy soil, grassy soil, termitaria, clothings, ropes and even on other agarics (Singer, 1986; Pegler, 1977). On the basis of their habitat they may be foliicolous, lignicolous, humicolous, coprophilous, termitophilous, terrestrial, etc. and appear mainly in the monsoon season (Singer 1986; Pegler, 1977; Atri et al., 2010).

The various sizes, colours, shapes of mushrooms, their exceptional flavour and nutritional properties have attracted the attention of mankind since times immemorial. The US academy of science has defined them as “functional foods”, simply because these encompass potentially healthful products.

From the dawn of civilization there have been references to mushrooms in the ancient Indian, Greek, Roman, Chinese, and other literature. Greek warriors regarded them as “strength food”, Romans considered them as “food of Gods” whereas Chinese regarded mushrooms as “elixir of life”. The Aztecs of South America referred mushrooms as “teo- nonacte” (God’s flesh) and worshipped a group of mushrooms as being divine. In the Indian Rigveda and other ancient literature much referred “somrus” was actually a decoction of mushroom that is known by different names as Kumpa in Sanskrit, Kukurmutta, Kawaka, Chhatra, Khumbi, Bhoomi kavak and Bhustrna in Hindi (Wasson, 1969).
Introduction

Like many other edible mushrooms the termitophilous and lepiotoid mushrooms on which the present work has been initiated have also attracted the attention probably since man recognized mushrooms as consumable. Both these groups of mushrooms are characterized by typical agaricoid fleshy carpophores having lamellate hymenophore (Kirk et al., 2008).

On worldwide basis the termitophilous mushrooms are represented by 30 species in comparison to approximately 550 species of lepiotoid mushrooms (Kirk et al., 2008). From India as many as 22 species of termitophilous mushrooms and approximately 130 species of lepiotoid mushrooms have been documented (Butler and Bisby, 1931; Vasudeva, 1960; Bilgrami et al., 1979; Bilgrami et al., 1991; Jamalludin et al., 2001; Kumar and Manimohan, 2009 a, b, c; Atri et al., 2010 and other recent literature).

Lepiotoid mushrooms are grouped under family Agaricaceae Chevall. and are largely represented by 6 genera namely Lepiota Pers. ex Fr., Cystolepiota Sing., Chamaemyces Earle, Smithiomyces Sing., Hiatulopsis Sing. & Crinling and Janauaria Sing. of tribus Lepiotae Fayod. Some other closely related agaricoid genera with lepiotoid features are Macrolepiota Sing., Chlorophyllum Massee, Chlorolepiota Sathe & Deshpande, Clarkienda (Berk.) Sing., Leucoagaricus (Locquin) Sing., Leucocoprinus Pat. and Ripartitellla Sing. All these are characterized by relatively fragile variously coloured basidiocarps having free to narrowly adnate, thin to slightly thickened lamellae with or without ring on the stipe, ovoid-ellipsoid to amygdaliform spores with or without germ pore.

The termitophilous mushrooms belong to family Lyophyllaceae Jülich, which is one of the smallest family of order Agaricales (Kirk et al., 2008). These mushrooms are represented by only one genus Termitomyces Heim (Kirk et al., 2008). Like
lepiotoid mushrooms, termitophilous mushrooms are light spored and are unique in the sense that they grow in intimate association with termites. The fruit bodies of most of these fungi are connected to combs in the termite nests.

Many of the lepiotoid and termitophilous mushrooms are practically important for their edibility and nutraceutical utility. The main work on various aspects of these mushrooms including diversity, sociobiology, edibility, ecology and conservation aspects has been done in Europe, North America and Africa. Because of their delicious nature wide variety of these mushrooms are being regularly hunted from their natural habitats for consumption and earning revenue. Their fresh fruit bodies are sold in the markets of Thailand, at roadsides in Old World Tropics (Jones et al., 1994; Turnbull and Watling, 1999) and many parts of India (Harsh et al., 1993 a, b; Bhaben et al., 2011; Atri et al., 2005 b). Atri et al., (2005 b) elaborated the edibility and sociobiological aspects of termitophilous mushrooms in Punjab state where vendors are seen selling these mushrooms to the consumers at Rs 20 - 25 for 250 gm of fresh mushrooms.

Several workers have estimated the nutritional values of fruiting bodies of *Termitomyces* species from Africa and Asia and reported these species to be superior to all other edible mushrooms and common vegetables in this regard (Bano et al., 1964; Mukiibi, 1973; Parent and Theon, 1978; Purkayastha and Chandra, 1975, 1985; Botha and Eicker, 1992). These species are highly ranked mushrooms followed by *Pleurotus* species and *Polyporus tenuiculus*. Amongst the *Termitomyces* species most favoured species are *T. microcarpus*, *T. mammiformis*, *T. heimii*, *T. tyleranus*, *T. aurantiacus*, *T. eurhizus* and *T. clypeatus*. *Macrolepiota procera* is the most sought after mushroom amongst the lepiotoid agarics in this regard.
These mushrooms are reported to contain higher dry matter, protein and fiber content and lower fat content. It is well recognized that these mushroom contains all essential component of a balance food. Infact, they are rich in highly digestible lysine rich proteins, vitamins, minerals and lacks fat and are low in carbohydrates (Chang, 1991; Jiskani, 2001). They are also rich in important minerals like phosphorus, potassium, calcium, copper and iron. In place of starch, mushrooms contain sorbitol and linoleic acid (an unsaturated fatty acid). They are an excellent source of folic acid, thiamine, riboflavin, niacin, pantothenic acid and biotin. Furthermore these mushrooms are also reported to have high medicinal attributes. These properties make them important from the human health point of view. In the trade and manufacture of valuable compounds from these mushrooms, scientists from African countries and South-East Asian countries like South Africa, Thialand, Old Tropics, Tanzania, China and North America are doing lot of work (Kurtzman, 1975; Chang and Buswell, 1996; Cheung, 1997; Wasser, 2002; Wasser and Weis, 1999; Helpern and Miller 2002; Ferreira et al., 2009, 2010).

Lepiotoid and termitophilous mushrooms also play a role in ecosystem replenishment and perform a wide variety of ecological roles as saprophytes, mutualists and parasites. Termitophilous mushrooms are always found in association with termites while lepiotoid mushrooms are saprophytic by nature and are found on the decaying leaf litter and even on the rotting logs of timber etc. in the rainy season. Some of these mushrooms were constantly found growing in association with a particular tree as is the case of *Leucocoprinus cepaestipes* with *Dalbergia sissoo*, *Leucocoprinus birnbaumii* with *Pinus roxburghii* and *Lepiota castaneidisca* with *Grevillea robusta*, a tree of multipurpose utility. There are few more similar such cases which needs in depth investigation. Therefore, many of these mushrooms
besides supplementing human nutrition play an important role in mycorestoration of the environment.

It is apparent from the above discussion that lepiotoid and termitophilous mushrooms are an excellent source of a number of nutritional as well mineral constituents in them because of which these mushrooms have been widely acclaimed as superior in taste to every other edible mushroom. There is an urgent need to understand the diversity and potential of these mushrooms by undertaking investigations and for more effective utilization, and their conservation in the Indian context. Although some scattered reports are available about the occurrence and utilization of these mushrooms from North West India, however, as a group these mushrooms still remain unexplored for their diversity and sociobiological relevance.

Keeping in view the vast scope and importance of the problem to ecosystem maintenance in general and human nutrition in particular, the present investigation concerning “Diversity, Sociobiology and Conservation of lepiotoid and termitophilous mushrooms of North-West India was initiated with the following objectives of study.

1.1 Objectives of the study:-

The specific objectives of the study are given under three main headings: field study, laboratory examination and data documentation and identification.

1.1.1 Field study: -

i. To conduct exhaustive survey of the various localities and sub-localities for the collection of material and to study the ethno-mycological and ecological aspects of lepiotoid and termitophilous mushrooms in the field.

ii. To note the macroscopic features of systematic importance and to screen the collected taxa into edible and inedible types.

iii. To examine the habit, habitat, soil types, climate, distribution, etc. in order to understand the ecological aspects of the investigated taxa.
1.1.2 Laboratory examination:-

i. To examine the collected material for their microscopic details and to draw Camera Lucida drawings and take microphotographs of the internal features of systematic importance.

ii. To raise the pure culture so as to domesticate and conserve the interesting taxa for further use.

iii. To work out the proximate composition of edible taxa so as to understand the nutritional and nutraceutical value of these mushrooms.

1.1.3 Data documentation and identification: -

i. Documentation and identification of the various worked out taxa.

ii. Preparation of their account with details containing information about edibility, ecology, seasonal availability and nutraceutical relevance along with workable key for identification of various genera and species investigated.

During the present study 152 collections have been worked out for the macroscopic and microscopic details and identified. Investigations based on as many as 41 species belonging to eight genera of family Agaricaceae Chevall. namely *Clarkienda* (Berk.) Sing., *Macrolepiota* Sing., *Chlorophyllum* Massee, *Chlorolepiota* Sathe & Deshpande, *Leucoagaricus* (Locquin) Sing., *Leucocoprinus* Pat., *Lepiota* (Pers.) Gray, *Cystolepiota* Sing. and 14 species belonging to genus *Termitomyces* Heim of family Lyophyllaceae Jülich has been documented in this thesis.