

Mite fauna associated with button mushroom (*Agaricus bisporus*) in Karaj Region , Iran

Katayoon KHERADMAND^{1,*}, Karim KAMALI¹, Yaghoub FATHIPOUR¹,
Edward UECKERMAN², Ebrahim Mohammadi GOLTAPPEH³

(1. Department of Entomology , Faculty of Agriculture , Tarbiat Modares University , P. O. Box : 14115 – 336 , Tehran , Iran ;

2. Plant Protection Research Institute , Private Bag X 134 , Queens Wood , Pretoria , South Africa ;

3. Department of Plant Pathology , Faculty of Agriculture , Tarbiat Modares University , P. O. Box : 14115 – 336 , Tehran , Iran)

Abstract : The mites occurring on button mushroom (*Agaricus bisporus*) in Karaj region of Iran were studied. Seventeen species belonging to three orders and nine families of mycophagus , predaceous and saprophagus mites were found , during a survey conducted from the spring 2004 to summer of 2006. The mites species were : *Macrocheles glaber* (Müller) , *Macrocheles merdarius* (Berlese) , *Macrocheles subbadius* (Berlese) , *Parasitus coleoptratorum* * (Linnaeus) , *Parasitus finetorum* (Berlese) , *Parasitus mammillatus* (Berlese) , *Sancassania rodionovi* Zachvatkin , *Tyrophagus putrescentiae* (Schrank) , *Uroobovella fimicola* (Berlese) , *Ameroseius fungicolus* * Masan , *Pediculaster kleeboni* * (Wicht) , *Pediculaster flechtmani* * (Wicht) , *Scutacarus longitarsus* (Berlese) , *Dendrolaelaps multidentatus* * Masan , *Arctoseius cetratus* (Sellnick) , *Lasioseius sugawarai* * Ehara and *Ameroseius plumigera* Oudemans . Six of them are new for the Iranian acarofauna that are indicated by asterisk . Twelve species are recorded for the first time from mushrooms .

Key words : Mite fauna ; *Agaricus bisporus* ; new records ; Iran

1 INTRODUCTION

The mushroom industry in Iran has developed dramatically over the past twenty years. Commercial mushroom production is a thriving industry in Iran of one thousands tones annually , however , production can be considerably affected by the presence of harmless mites (Clift , 1987 ; Al-Amidi , 1995). The insects and mite species associated with mushrooms are well known in other countries (Hussey *et al.* , 1969 ; Cantelo *et al.* , 1977 ; Clift , 1979 ; Rota and Serini Bolchi , 1979 ; Clift and Toffolon , 1981 ; White , 1982 ; Clift , 1983 ; Guang Rong *et al.* , 1996 ; Cobanoglu and Bayram , 1998 ; Lewandowski *et al.* , 1999).

The objective of this study was to identify the major mite species in commercial mushroom cultures in Iran in order to assess their importance .

2 MATERIALS AND METHODS

Samplings were carried out from the spring of 2004 until the summer of 2006. All commercial mushroom centers located in Karaj region including Mallard ,

Shahryar , Modammad Shahr , Eshtehard , Mehrshahr and Karaj were sampled three times during each of the two years. The mushroom bags were randomly chosen from different mushroom cropping stages (Spawning , Casing , Pinning , and Harvesting including flash I , II and III and Cook out). Samples were also collected from compost , mushroom caps and mushroom flies . Mites were extracted by means of a Berlese-funnel and examined .

The phoretic mites that use Diptera for transport were also collected from flies by using a stereomicroscope. The collected mites were preserved in 70% alcohol and cleared by keeping them in a lacto phenol solution for 24 h and then mounted in Hoyer 's medium. Determination of mites was based on Hyatt (1959) , Karg (1971) , Hughes (1976) , Hyatt and Emberson (1988) , and some other papers .

All of the identifications were confirmed by specialist from different countries and all specimens are deposited in the collection of Department of Entomology in Tarbiat Modares University , Tehran .

3 RESULTS

Seventeen species belonging to three orders and nine families were identified ; six of them were new for the

* Author for correspondence , Fax : + 98-21-44196524 ; E-mail : kkheradmand1354@yahoo.com

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Iranian acarofauna. All collected species are listed in Table 1 and discussed below.

Table 1 List of mites found on button mushroom , *Agaricus bisporus*

Acari	Families	Species	Number of specimens
Mesostigmata	Macrochelidae	<i>Macrocheles glaber</i>	20 ♀ , 6 ♂
		<i>Macrocheles merdarius</i>	14 ♀ , 3 ♂
		<i>Macrocheles subbadius</i>	14 ♀ , 2 ♂
	Parasitidae	<i>Parasitus coleopteratorum</i> *	18 ♀ , 8 ♂
		<i>Parasitus fimetorum</i>	15 ♀ , 3 ♂
		<i>Parasitus mammilatus</i>	9 ♀ , 1 ♀
	Ascidae	<i>Arctoseius cetratus</i>	1 ♀
		<i>Lasioseius sugawarai</i> *	20 ♀ , 16 ♂
	Uropodidae	<i>Uroobovella fimicola</i>	22 ♀
	Ameroseiidae	<i>Ameroseius fungicolus</i> *	2 ♀
		<i>Ameroseius plumigera</i>	2 ♀
Astigmata	Digamasellidae	<i>Dendrolaelaps multidentatus</i> *	1 ♀
	Acaridae	<i>Sancassania rodionovi</i>	79 ♀ , 40 ♂
		<i>Tyrophagus putrescentiae</i>	130 ♀ , 56 ♂
Prostigmata	Siteroptidae	<i>Pediculaster flechtmanni</i> *	2 000 ♀
		<i>Pediculaster kneeboni</i> *	35 ♀
	Scutacaridae	<i>Scutacarus longitarsus</i>	1 ♀

* : New records for Iran.

3.1 Family Macrochelidae
Macrocheles glaber (Müller)

Holostaspis glaber Müller

This species is characterized by lines and punctures located on sternal , genital and ventral shields. Dorsal shield with a distinct procured transverse line and setae j₁ , j₄ and z₄ pilose (Halliday , 1986).

Habitat : Most often collected on coprophagus beetles including *Geotrupes pyrenaeus* , *G. spiniger* and *G. vernalis* (Hyatt and Emberson , 1988). Gwiazdowicz (2000) had reported this species from sarcophagus insects.

World distribution : It is well documented from Europe and the Mediterranean region (Hyatt and Emberson , 1988). Outside these areas it has been recorded throughout Canada (Glida *et al.* , 2003). In Iran the species was recorded from houses , *Trifolium* sp. , soil samples , and honey bee hives (Kamali *et al.* , 2001).

Local distribution : It has been reported from East Azerbaijan , Hamedan , Kurdistan , Mazandaran , Tehran and West Azarbaijan (Kamali *et al.* , 2001).

Records : In compost , from Mohammad Shahr and Mallard. This is the first time that the species is recorded from mushroom media.

Macrocheles merdarius (Berlese)

Holostaspis adulescens Berlese
Holostaspis merdarius Berlese

According to Halliday (2000) this species can be recognized by the ornamentation on sternal shield , namely : semicircular line in anterior half jointing 3 – 4 transverse lines or pattern of irregular polygons. Postero-lateral margins of ventrianal shield slightly

concave. Dorsal shield with setae j₁ and j₃ subequal in length and bases of j₁ separated by a distance greater than the diameter of their insertion sockets.

Habitat : This species is a predacious mite species in the compost and humus of green houses and growing chambers. It is also phoretic on houseflies (Rota and Serini Bolchi , 1979). In Iran the species has been recorded from stored onion (Kamali *et al.* , 2001).

World distribution : The species is widespread in temperate regions (Halliday , 2000).

Local distribution : It has been reported from Fars , East Azarbaijan and Tehran (Kamali *et al.* , 2001).

Records : In compost , from Shahryar. It is the first record of the species from mushroom media.

Macrocheles subbadius (Berlese)

Holostaspis subbadius Berlese

This species can easily be distinguished from the previous species by having sternal shield strongly punctuated and having only two pairs of enlarged dorsal setae (Hyatt , 1959).

Habitat : Phoretic on houseflies and also occur in garden refuse. It has also been found in manure (Hyatt and Emberson , 1988). In Iran it has been collected from bee hives and onion (Kamali *et al.* , 2001).

World distribution : This species has a worldwide distribution (Karg , 1971).

Local distribution : The species has been recorded from Khuzestan , Fars and Tehran (Kamali *et al.* , 2001).

Records : In compost , from Mohammad shahr. This is the first record of the species from mushroom media.

3.2 Family Parasitidae

Parasitus coleopteratorum (Linnaeus)

Acarus coleopterorum Linnaeus

Gamasus coleopterorum (Linnaeus)

The species exhibits the following characteristics : Female with setae j_1 , j_4 , z_5 , r_3 and Z_3 stout and serrated, tectum with a strong tapered prominence arising from a sharply toothed and tapered base, the sternal shield of the deutonymph has a pale anterior transverse strip, st_1 is occasionally finely pilose, and five pointed tectum with median point prominent. Dorsal setae of male are similar to that of female.

Habitat : This species is possibly the most common European member of the genus. The deutonymphs are well known as Paraphages of Coleoptera (Hull, 1918; Hyatt, 1959). The adults are found less frequently than the deutonymphs and they are confined mainly to compost, manure and humus (Hyatt and Emberson, 1988).

World distribution : The species has been recorded from England (Evans, 1957), Finland (Nordberg, 1936), the Netherlands (Karg, 1971), Italy (Berlese, 1906, 1913) and Germany (Karg, 1971).

Local distribution : This is the first record from Iran.

Records : In compost and on mushrooms, from Eshtehard and Mehrshahr. This is the first record of this species on mushroom.

Parasitus fimetorum (Berlese)

Gamasus fimetorum Berlese

Parasitus affinis Oudemans

Parasitus eta Oudemans and Voigts

Parasitus hibernicus Turk

This species is distinguished from previous species by having a bifid corniculus and tectum covered with long slender tines. The female of this species can be distinguished by the long and convoluted posterior hypostomatic setae and 8 pairs of setae on opisthogaster shield. In the deutonymph, anterolateral setae on palp femur are deeply bifurcate and the tectum is trispinate with the central prong invariability broken off or even deformed.

Habitat : This is one of the most widespread European species of the genus *Parasitus*. They were found in compost, manure and dung. Some are recorded from mammal nests (*Sorex*, *Neomys*, *Nicrophorus*, *Atholus*), bumble bees and a dead fox *Vulpes vulpes* (Brady, 1970). White (1995) demonstrated that this species is a potential predator of nematodes and pest mites in mushroom cultures and Binns (1973) confirmed it. In Iran the species was recorded from manure, compost, a bird's nest, bee hives and chicken manure (Kamali *et al.*, 2001).

World distribution : It is recorded from Iceland, Holland, Belgium, Germany, Austria and most of the countries of the Middle East (Hyatt and Emberson,

1988).

Local distribution : It was recorded from Semnan, Mazandaran and Tehran (Kamali *et al.*, 2001).

Records : In compost, from Shahryar, Mallard and Karaj.

Parasitus mammillatus (Berlese)

Rhabdocarpis mammillatus (Berlese)

Eugamasus consanguineus (Oudemans)

Parasitus setosus Oudemans and Voigts

Female with sternal setae st_1 forked tectum with 3 prongs, median prong longest and acute distally.

Habitat : This species is commonly recorded from decaying vegetables, compost, saprophgous beetles such as *Aphodius rufipes* (Hora, 1934). In Iran it has been recorded from onion, hey and *Trifolium* sp. (Kamali *et al.*, 2001).

World distribution : The species was recorded from Holland, Belgium, Germany, Russia, Greece and Israel (Karg, 1961).

Local distribution : This species was recorded from Fars and Hamedan (Kamali *et al.*, 2001).

Records : In compost, from Mallard. This is the first record of the species from mushroom media.

3.3 Family Acaridae

Sancassania rodionovi Zachvatkin

Sancassania berlesei (Michael)

Caloglyphus berlesei (Michael)

Tyroglyphus mycophagus Megnin

This species can be recognized by the well developed supra coxal setae, seta sci which is very short, 8 to 9 times shorter than sce, presence of 5 pairs of micro anal setae, posterior 4 pairs are placed at approximately equal distance from each seta in a curved line on either side of anal opening (Zachvatkin, 1941).

Habitat : *Sancassania rodionovi* (Zachvatkin), is a free-living mite species commonly found feeding on decaying plant material, such as fruits, bulbs, root/rhizomes, vegetables, ornamental plants, potatoes and mushrooms. They occur frequently in compost, greenhouses, mushroom houses and field cultivation as well as in stored products, e. g. grain, various plant seeds and foodstuffs (Chmielewski, 2003). This species was also found on dead insects like grubs of scarab beetles (Rawden *et al.*, 2000). Hypopi of *Sancassania* are sometimes found under the wings attached to the surface of abdominal segments of scarab beetles or on the body surface of larvae and pupae of these beetles, e. g. *Amphimallon solstitialis* L., *Melolontha melolontha* L. and *Phyllophthora horticola* L. (Coleoptera : Scarabeidae) (Chmielewski, 2003). In Iran the species has been recorded from animal food and honey bee hives (Kamali *et al.*, 2001).

World distribution : The species is cosmopolitan

(Rawden *et al.* , 2000).

Local distribution : The species was recorded from Hamedan and Fars (Kamali *et al.* , 2001).

Records : In compost , from Mallard and Karaj.

Tyrophagus putrescentiae (Schrank)

Tyrophagus brauni Turk.

Tyrophagus castellanii Hirst

Tyrophagus noxius Zachvatkin

This species can be recognized by seta d_2 , which is always more than twice the length of l_2 . The presence of "eye " patches on prodorsal shield , supracoxal setae which are expanded and bearing fairly long pectinations , the supporting arms of the penis which point outwards and the penis which curves twice like a coffee pot spout.

Habitat : *Tyrophagus putrescentiae* (Schrank) is found in a variety of habitats including stored products , decaying organic matters , plant seeds (grass and sugar beet seeds) , medicinal plants and mushroom beds (Eraky , 1995 ; Solarz and Solarz , 1996 ; Chmielewski , 1999). Eraky (1995) reported extensive losses in mushroom production due to this species. Even fairly high populations may cause obvious symptoms until the failure of the spawn from the mycelium being attacked soon after spawn run. In Iran the species was recorded from stored products , oily seeds , tree roots , animal food , beetles like *Trifolium* , citrus , tea and honey bee hives (Kamali *et al.* , 2001).

World distribution : The species is cosmopolitan (Hussey *et al.* , 1969).

Local distribution : The species has been recorded from different parts of Iran (Kamali *et al.* , 2001).

Records : In compost , Mohammad shahr , Mallard , Karaj and Shahryar.

3.4 Family Uropodidae

Uroobovella fimicola (Berlese)

This species can be recognized by the well developed pedofossae and dorsal shield (Wisniewski , 1998).

Habitat : These mites can be phoretic on flies , especially on Phorids. Also they have been reported from some beetle genera (Gwiazdowicz , 2000). For the first time , Wisniewski (1982) reported this species from beetles of the genus *Copris* , *Necrophorus* and ants of the genus *Formica* . In Iran the species was recorded from stored products (Kamali *et al.* , 2001).

World distribution : It is distributed in England , France , Poland and some countries of the middle east (Gwiazdowicz , 2000).

Local distribution : The species has been reported from Kerman and Sorkhe hesar (Kamali *et al.* , 2001).

Records : In compost and on mushrooms , from Shahryar. This is the first recorded from mushrooms.

3.5 Family Ameroseiidae

Ameroseius plumigera Oudemans

Kleemannia plumigera (Oudemans)

Zercoseius gracei Hughes

This species is close to *A. plumosus* (Oudemans) , but differs from the latter in that the dorsal setae are longer , slender and pectinate , whereas those of *A. plumosus* are leaf-shaped with pectinate edges (Hughes , 1976).

Habitat : Most of them are phoretic on insects , they also are fungivorous and feed on parasite fungi on vegetables (Halliday , 1997).

World distribution : The species was reported from England , Ireland , Germany , Holland and Russia (Makarowa , 2004).

Local distribution : This is the first record from Iran.

Records : In compost and on mushrooms , from Mallard , Shahryar and Mohammad shahr. The species is recorded for the first time from mushrooms.

Ameroseius fungicolis Masan

The species can easily be recognized by the lanceolated , pilose setae on dorsal shield and in having an anal shield (Masan , 1998). It is similar to *A. callosus* Masan , from which it differs only in the ornamentation of the dorsal shield , not reticulated but with a rough surface , opposed to reticulated in *A. callosus* .

Habitat : This species is commonly found on wood destroying fungi (Masan , 1998).

Local distribution : This is the first record from Iran.

Records : In compost and on mushrooms , from Eshtehard. This is the first record of the mite on mushrooms.

3.6 Family Pygmephoridae

Pediculaster kneeboni (Wicht)

Pygmephorus kneeboni Wicht

Among the mites recorded from commercial mushrooms , some pygmephorids are of economical importance (Wicht , 1970). Namely , *P. fletchmanni* , *P. kneeboni* , and *P. lambi* . *P. kneeboni* is characterized by having simple setae on propodosoma (Martin , 1978).

Habitat : This species is fungivorous and can cause serious damage to commercially grown mushrooms (Wicht , 1970).

World distribution : Wicht (1970) recorded this species from Pennsylvania , but it was also recorded from Poland (Lewadowski *et al.* , 1999) , New Zealand , Australia and South Africa (Camerik and Coetzee , 1997).

Local distribution : This is the first report from Iran.

Records : On mushroom caps and in compost , from Mallard.

Pediculaster fletchmanni (Wicht)

Pygmephorus fletcheri Wicht

The mushroom mite, *Pediculaster fletcheri* Wicht, is a nuisance pest in the cultivation of the button mushroom *Agaricus bisporus* (Lange) worldwide. Large reddish brown clumps of mites accumulated on mushroom caps and lumps of peat, before occurrence of third flush. They can be on annoyance and sometimes cause allergic symptoms to pickers, spoil the appearance of cut mushrooms and occasionally become serious problems in soup processing kitchens (Gurney and Hussey, 1967; Wicht and Snetsinger, 1971).

Habitat: This species is fungivorous and can cause economic losses in commercial mushroom cultures (Clift, 1979). Wicht and Snetsinger (1971) demonstrated that *Musca domestica* L. and *Lycoriella mali* (Fitch) could transfer these mites between isolated fungal cultures. Clift (1979) reported that *P. fletcheri* was often found swarming in large numbers attached to adult *Lycoriella agarici* Louden and *Megaselia halterata* Wood.

World distribution: The species was reported from USA, New Zealand (Smiley, 1978) and England (Baker and McGarry, 1997).

Local distribution: The species is new for Iran.

Records: On mushroom caps, from Mallard.

3.7 Family Ascidae

Arctoseius cetratus (Sellnick)

Arctoseius bispinatus Weis-Fogh

Arctoseius erlangensis Sellnick

Lasioseius cetratus Sellnick

The species can be distinguished by peritremes extending anteriorly to mid-level of coxae II and fixed chela with a row of 6 – 8 teeth (Halliday *et al.*, 1998). According to Karg (1993), the dorsal shield is a schizodorsal shield, the anal shield become broader posterior and the tectum has two smooth prongs.

Habitat: This species was reported from cow dung and compost (Halliday *et al.*, 1998). They are phoretic on mushroom flies *Lycoriella auripila* and are potential predators of their eggs (Binns, 1972). In Iran they have been recorded from *Lilium* (Kamali *et al.*, 2001).

World distribution: It was recorded from England, Australia, Ireland and USA (Halliday *et al.*, 1998).

Local distribution: The species was recorded from Hamedan (Kamali *et al.*, 2001).

Records: In compost and on mushrooms, from Eshtehard and Karaj. This is the first record of the species from mushrooms.

Lasioseius sugawarai Ehara

The species can easily be recognized by the reticulated dorsal shield with most setae trispinate distally. Ventrianal shield large, subtriangular, reticulate, with 4 pairs of pre anal setae. Tectum with

three denticulate processes. Fixed cheliceral digit with 13 – 15 teeth, movable digit with 3 teeth and tarsus II with a long setae, basitarsus IV with one macrosetae and tarsus IV with one dorsal and one ventral macroseta (Ehara, 1964).

Habitat: The species can be found in soil, humus, animal manure, scolide galleries and honey bee hives (Lindquist, 1961).

World distribution: It has been recorded from Australia (Lindquist, 1961) and Japan (Ehara, 1964).

Local distribution: This is the first record from Iran.

Records: In compost and on mushrooms, from Mallard and Shahryar. This species is the first record from mushrooms.

3.8 Family Scutacaridae

Scutacarus longitarsus (Berlese)

The species can identify by tibia and tarsus of leg 4 which are fused into a long segment.

Habitat: The female mites can be phoretic on Halictidae, Andrenidae, Scarabeidae and mice. They also are recorded from humus, termite nests, organic material, compost and nests of birds and small mammals (Delfinado and Baker, 1976). In Iran the species was recorded from soil (Kamali *et al.*, 2001).

World distribution: The species is cosmopolitan (Karg, 1971).

Local distribution: It has been recorded from East Azerbaijan (Kamali *et al.*, 2001).

Records: In compost and on mushrooms, from Eshtehard. This is the first record of the mite from mushroom cultures.

3.9 Family Digamasellidae

Dendrolaelaps multidentatus Halbert

The species can be identified by the movable digits of the chelicerae which have 4 large teeth.

Habitat: The species actually lives in decaying organic matters such as compost and manure. Deutonymphs are phoretic on insects and they seem to be predators of nematodes and small insects (Lindquist, 1975).

World distribution: The species has been recorded from Poland and Australia (Lindquist, 1975).

Local distribution: This is the first record from Iran.

Records: In compost and on mushrooms, from Mallard and Shahryar. This is the first record of this species from mushrooms.

4 CONCLUSION

This is the first study dealing with the mites associated with button mushroom in Iran. Seventeen species of mites were identified, among them four species, *Pediculaster fletcheri*, *P. kneeboni*, *Tyrophagus putrescentiae* and *Sancassania rodionovi* are

economically important. The other species are probably saprophagous or predacious on mites or larvae and eggs of flies. Presence of mites during the growing cycle indicates incorrect compost preparation (personal observations ; Martin , 1978). If the preparation had correctly been done , mite survival would have been limited. Prediction of mite biodiversity is one of the most essential parts in an IPM program for mites associated with mushrooms and managing mites in commercial mushroom cultures in Iran needs more research.

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伊朗 Karaj 地区双孢蘑菇上的螨类调查

Katayoon KHERADMAND^{1,*} , Karim KAMALI¹ , Yaghoub FATHIPOUR¹ , Edward UECKERMANN² , Ebrahim Mohammadi GOLTAPEH³

- (1. Department of Entomology , Faculty of Agriculture , Tarbiat Modares University , P. O. Box : 14115 – 336 , Tehran , Iran ;
2. Plant Protection Research Institute , Private Bag X 134 , Queens Wood , Pretoria , South Africa ;
3. Department of Plant Pathology , Faculty of Agriculture , Tarbiat Modares University , P. O. Box : 14115 – 336 , Tehran , Iran)

摘要 : 2004 年春季至 2006 年夏季期间 , 调查了伊朗 Karaj 地区双孢蘑菇上的螨类 , 发现了 3 目 9 科 17 种食菌性、捕食性和腐食性螨类 , 包括 : 光滑巨螯螨 *Macrocheles glaber* (Müller) , 粪巨螯螨 *Macrocheles merdarius* (Berlese) , 近褐巨螯螨 *Macrocheles subbadius* (Berlese) , 甲虫寄螨 *Parasitus coleopratorum* (Linnaeus) , 粪堆寄螨 *Parasitus fimetorum* (Berlese) , 乳突寄螨 *Parasitus mammillatus* (Berlese) , *Sancassania rodionovi* Zachvatkin , 腐食酪螨 *Tyrophagus putrescentiae* (Schrank) , *Uroobovella fimicola* (Berlese) , *Ameroseius fungicolus* * Masan , *Pediculaster kneeboni* * Wicht , *Pediculaster flechtmanni* * Wicht , *Scutacarus longitarsus* (Berlese) , *Dendrolaelaps multidentatus* * Masan , 柴特北绥螨 *Arctoseius cetratus* (Sellnick) , *Lasioseius sugawarai* * Ehara 和 *Ameroseius plumigera* Oudemans。其中有“ * ”号标记的 6 个种为伊朗新纪录种 , 12 个种为在蘑菇上首次发现。

关键词 : 螨类 ; 双孢蘑菇 ; 新记录 ; 伊朗

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