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RESEARCH ARTICLE

STUDY OF EASTERN MOROCCO DESERT TRUFFLES

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ABSTRACT

Surveys were conducted in the forest of Beni Yaala (mining site of Jerada), Ain Beni Mathar, and Tendrara (North-eastern Morocco) have allowed harvesting 29 truffle fruiting body of five different locations and record information on fungal species encountered. In the laboratory, macro-and microscopic structure criteria for identifying of these species were determined. Five species Macromycetes Ascomycetes belonging to two genera *Tirmania* and *Terfezia* the Family of Pezizaceae: *Tirmania nivea*, *Terfezia olbiensis*, *Terfezia leptoderma*, *Terfezia boudieri* and *Terfezia claveryi* were studied and described in the study regions. The systematic position, the mycorrhizal association, the ethnological importance, etymological, environmental, gastronomic and human importance, well as their distribution in the world have been discussed in this work. The results are integrated into the contribution to determination of the fungal diversity of Morocco and valorization of edible forest mushrooms.

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INTRODUCTION

The Terfez or desert truffles are hypogeous ascocarps tuber shaped of some mycorrhizal Ascomycetes. They have a specific geographical distribution which is limited particularly to semi-arid and arid regions on the periphery of the Mediterranean Basin and the Middle East (Malençon, 1973; Awameh and Alsheikh, 1979; Awameh, 1981; Alsheikhand Trappe, 1983a, b; Bokhary, 1987; Janex-Favre *et al*., 1988; El-Kholy, 1989; Roth-Bejerano *et al*., 1990; Fortas, 1990; Bratek*et al.*, 1996; Gucin and Dülger, 1997; Lawrynowicz *et al*., 1997; Moreno *et al.*, 2000; Khabar *et al*., 2001; Khabar, 2002; Slama *et al*., 2006; Mendeeland Al-Laith, 2007). Some rare species are encountered in Asia (China, Japan), America (Mexico, USA), Australia and southern Africa (South Africa, Botswana and Madagascar) (Marasasand Trappe, 1973; Trappe *et al*., 2008a, 2010; Callot, 1999; Ferdman *et al*., 2005; Kovacs *et al*., 2008; Kagan-Zur *et al*., 2014). Desert truffles are the fruiting bodies of some hypogeum edible fungi belonging to the Phylum of Ascomycota and genus of *Tuber* which was classified in the Order of Tubérales then transferred in Order of Pezizales after phylogenetic studies (Donadini, 1983; Korf, 1973; Trappe, 1979; O'Donnell *et al*., 1997; Laessoe and Hanssen, 2007). The hypogean ascomycetes include several genera: *Terfezea, Termania, Delastria, Balsamia, Eremiomyces, Elderia, Kalahari tuber, Leucagium, Mycocleandia, Mattirolomyces, Phaeangium, Picoa, Reddelomyces* and *Ulurua* (Morte *et al.,* 2008; Trappe *et al*., 2008), Trappe *et al*. (2010) report that *Horakiella watarrkana* is the only Basidiomycetes which would be a desert truffle. The etymology of the word "truffle" varies regionally and languages of people all over the world, this word come from the Latin "tuber" which means "swelling". The classical Arabic name of desert truffles "Al-Kamah" means "covered" or "hidden", while the name "Al-Faaga'a" corresponds to a cracking of the soil above the fruiting body follows its swelling (Bokhary, 1987). In Morocco, the truffles are called "Terfess", "Nabat AL-Rahd", "Asqal", "Bidat Al-Ardh", "Afateeh" and "Bnat Ober" (Khabar *et al.*, 2002; Mendeeland Al-Laith, 2007). There are several potentially trufficoles areas in Morocco, among the most important, the cork oak forest of Mamora, located east of Rabat, and the highlands area of Alfa in East of Morocco, the region of Had Hrara, located east of the city of Safi and the cedar forests of the Middle Atlas and Rif (Cherkaoui, 2014). Furthermore, Moroccan truffles are represented by ten species. They are distinguished from each other by the harvesting area, the size, the color, the host to

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which they are associated. Thus, we speak of "Terfess red of Tafilalet" of "white Terfess of Tafilalet" or "Ezzebdi" of "Terfess rose of Mamora" or "Terfess smooth" and "Terfess Indicator" or "Ezzouber" of "Terfess male" and "Terfess of Taida" (that means Terfess pine) and "Taida Terfess of bitter." Most species are spring; some appear soon against by the months of November and December. Works on Moroccan truffles are very few. The studies are essentially taxonomic order, floristry, ultra-structural and cytological (Chatin, 1891a, 1896 b; Maireand Werner, 1937; Malençon, 1973; Khabar, 1988, Khabar *et al*., 1994; Khabar, 2001; Abourouh, 2000). In this study, we present the macroscopic and microscopic study of desert truffles species harvested from the forest of Beni Yaala in Jerada mine site, Ain Beni Mathar and Tendrara (North-eastern Morocco), the systematic position, the mycorrhizal association, the ethnological importance, etymological, environmental, gastronomic and human, and their distribution in the world have been discussed in this work.

MATERIALS AND METHODS

Jerada is located in Northeastern Morocco, includes in the forest of Beni Yaala which is an artificial plantation of Aleppo pine (*Pinus halepensis*), on red Mediterranean soils, leached, crusty and brown (Aboulabbes, 2005). The climate is arid to semi-arid and the annual rainfall is 518 mm (Azzedine, 2004). Besides its socio-economic role, the forest of Beni Yaala, plays an ecological role. In this forest, fungi develop during different periods, when the climatic conditions become favorable (El Akil *et al.*, 2012, 2013, 2014a, 2014b, 2014c, 2015). Ain Beni Mathar and Tendrara are an extension of the Eastern Highlands. The two areas have an altitude ranging between 1000 and 2000 m, the climate is semi-arid, arid to sub-Saharan, mean annual precipitation of around 246 mm, an annual average temperature de 17.1°C (Aboulabbes, 2005; Abourouh, 2000) and soil usually marly clay types of Mio-Pliocene-Quaternary (Stretta, 1952; Mediouni, 1969; Wardi, 1997; Abderbi and Khattach, 2010). Truffles desert of Jerada region (forest of Beni Yaala and Ain Beni Mathar) have been very little studied before (Bouziani, 2009), the determination of their diversity in this region must be conducted in the context of the contribution to the determination of the fungal diversity of Morocco. Investigations have been carried out since 2010 until 2015 in the region of study follows several exits to the city of Jerada, Ain Beni Mathar, Tendrara and the forest of Mamora, during the period from the end of January to end of April. During these exits, we harvested a great number of fresh fruiting Terfez. Collecting these ascocarps was conducted in accordance with the orientations and advice gatherers encountered in the study areas (the method known as to the brand). Some gatherers use sticks and patted soil or fraudulent conduct dig practices that lead to irreversible damage to ecosystems in which these fungi grow, as the choice of depression zones and the strong dominance of the genus *Helianthemum*. Generally, the Moroccan truffles are harvested in the vicinity of herbaceous plants in the genus *Helianthemum: H. guttatum, H. salicifolium, H. ledifolium, H. hirtum, H. apenninum* and *H. lipii* (perennial and annual) or genus *Cistus*: *Cistus salviifolius*, *C. ladaniferus, C. monspeliensis* and *C. albidus* or *Pinus*genus: *Pinus pinaster* var. *atlantica* and *P. halepensis*, with which they form mycorrhizal associations (Abourouh, 2011) (Fig. 1).

Before harvest, ascocarps are photographed certain details are also noted, and then brought back to the laboratory for identification. The macroscopic descriptions have worn on the size, shape, color, appearance and other peculiarities of the ascocarp and completed by a microscopic description of the cuts at the peridium, gleba, the asci and ascospores dimensions. Microscopic observations are performed in tap water and determining the genus of species harvested is based on the ownership of asci after staining Melzer. Species identification truffle is based on morphological characteristics of the fruit bodies and color of gleba and the spore size, and morphology of asci.

All this data, macro and microscopic morphological structures were compared with those reported by different authors (Trappe 1979; Awameh and Alsheikh 1980a; Janex-Favre *et al*., 1988; Fortas 1990; Trappe and Castellano, 1992; Fortas *et al.* 1992; Khabar *et al*., 1994; Tadja 1996; Khabar, 2001; Bessah, 1999; Bradai *et al*., 2013). The harvested Terfez belong to three genera: *Terfezia* and *Tirmania.* The genus *Terfezia* is represented by 4 species: *Terfeziaolbiensis* Tul. 1851, *T. leptoderma* Tul. 1851, *T. boudieri* Chatin 1892 and *T. claveryi* Chatin1892. The genus *Tirmania* is represented by a single species: *Tirmania nivea* Trappe 1971. The Melzer test can distinguish between spores genera*Terfezia* and *Tirmania* distinguished by the color of their spores. Among representatives of the first genus, the spores are colored in yellow and those of the second genus, the spores are a blue gray tint (Al sheikh 1994).

RESULTS

Ascocarps of harvested truffles have generally a globular appearance, lobed shape and having a foot (pedicel) to the base. The observation under a binocular magnifier for all species has showed that the peridium surface is relatively smooth, bristling with small scales. The gleba is traversed with small yellowish pale veins, cream and white. Color peridium and the gleba differ from one species to another according to the stage of ripening.

Tirmania nivea (Desf.) Trappe, 1971.
Tirmania africana Chatin 1892.
Tirmania cambonii Chatin 1892.
Tirmania ovalispora (Pat.) Pat. 1894.
Tirmaniao valispora var. *ovalispora* (Pat.) Pat 1899.
Tirmania ovalispora var. *tellieri* Pat. 1899.
Tuber niveum Desf., 1799 (Kirk *et al*., 2008).

Species harvested April 8th 2015, on sandy soil, associated with *H. lipii*, in the Tendrara region. Ascomata (Fig. 2A) up to (14)12 x 4 (3) cm, often a subglobose form, sometimes flattened, white to cream, then yellowish, short pedicel, which may be smooth, wrinkled and cracked. Peridium (Fig. 2 A and B)up to 0,5 - 2 mm in thickness, pale yellowish-white to light brown color, smooth. Gleba (Fig. 2D) white or yellow, fleshy, traversed by small veins (furrows) white, solid. The microscopic examination of the gleba of *Tirmania nivea* shows that it is formed by a large number of hyphae containing ascospores. Asci (Fig. 2C) (80) 56 -73 x 38-47 µm, pedicelled, have an ellipsoid shape to ovoid and contain most 8 ascospores amyloid. Their wall is thin and short pedicel.

Fig.1-Ascomata near *H. guttatum* A; *Terfeziaclaveryi* and *Tirmanianivea* near *H. lipii* B.

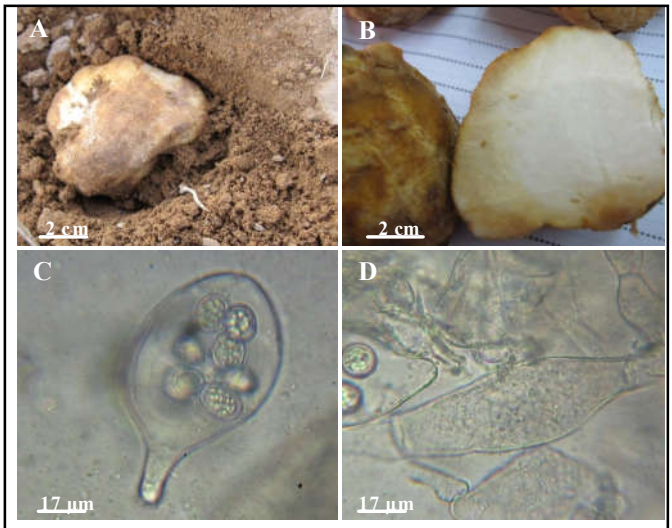

Fig. 2. ***Tirmanianivea*****: Ascomata** ***in situ*** **A; cross section of the ascocarp show the color of the gleba B; ascicontaining 8ascospores C; filaments containing spores D; the microscopic observations are made in the Melzer reagent to asci and water at the magnifications of x 400**

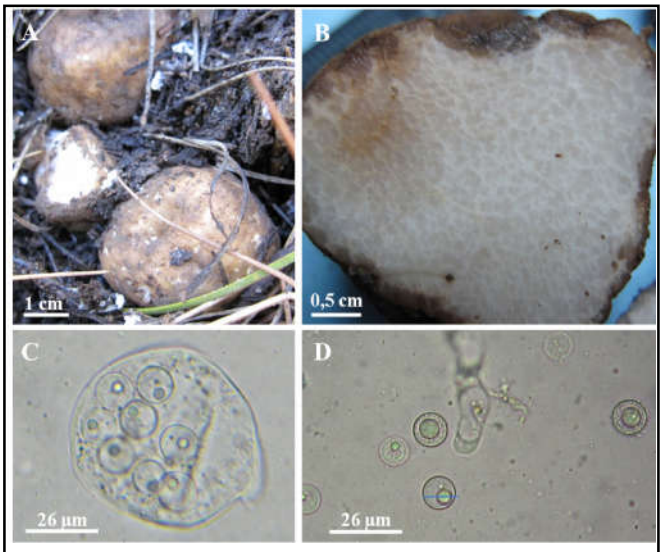

Fig.3.*Terfezia olbiensis*: Ascomata*in situ* A; cross section of the ascocarp showing the color of the gleba B; asci containing 8 ascospores C; Ascospores D; microscopic observations are made in water at the magnifications of x 400

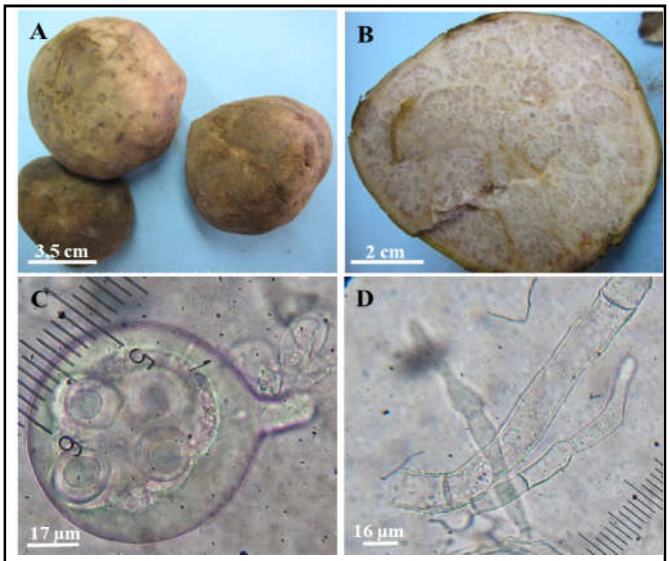

Fig. 4. ***Terfezia leptoderma*****: Ascomata relieved of its substrate A; in the cross section showing the ascocarp color gleba B; asci containing 8ascospores C; sterile hyphae veins D; microscopic observations are made in water at the magnification of x400**

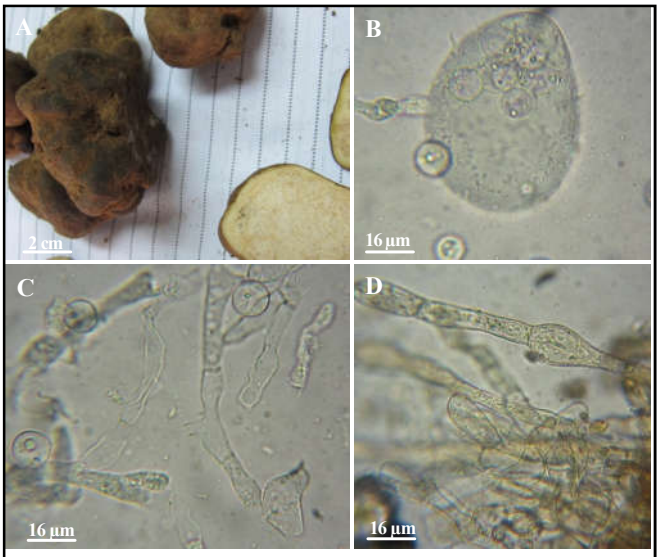

Fig.5. ***Terfezia boudieri*****: Ascomata removed from their substrate and cross section showing in ascocarp color Gleba A; asci containing 6 ascospores B; sterile hyphae of gleba and ascospores C; peridium structure D; microscopic observations are made in water at the magnification x 400**

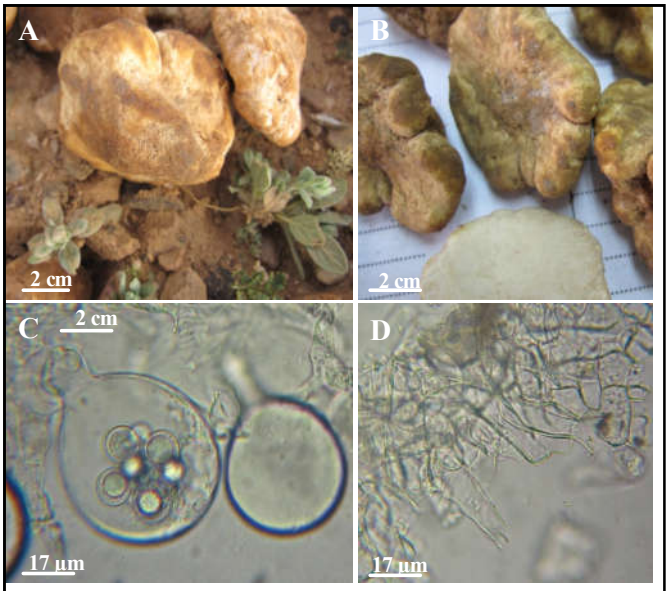

Fig. 6. *Terfezia claveryi*: Ascomata removed from their substrate near H. *lipii*A; ascocarps and in cross-section showing the ascocarp color gleba B; asci containing 6-8 ascospores; peridium structure D; microscopic observations are made in water at the magnification x 400

Ascospores (Fig. 2C and D) hyaline, smooth, are freely disposed within the ascus, ellipsoidal shape with a smaller diameter 12-14 µm.

***Terfezia olbiensis* Tul. & C. Tul., 1845.**

Species harvested January 27th 2013, on sandy soil in the forest of Beni Yaala Jerada under *Pinus halepensis*. Ascomata (Fig. 3A) up to (2) 3-4 (6) cm, globose to subglobose, in early off-white to pale brown surface, at maturity reddish brown and wrinkled much. Gleba (Fig. 3B) fleshy, harsh and compact, gray-pink brink and green-gray olive-green with sterile veins. Peridium 420-600 µm in thickness, separable, greyish or olive green to pale yellow with a brown area close to the surface; constituted of angular cells, sometimes with swollen cells 40-130 × 25-60 µm, having walls of ± 1 µm in thickness. Asci (Fig. 3C) 60-90 × 60-80 µm, dispersed in the gleba, in mature subglobose to ellipsoid, octosporus. Ascospores(Fig. 3D) 15-18 × 15-19 (20) µm excludes the ornamentation, globular, first of hyaline, uniguttulate, then yellowish brown and adorned with thorns, pointed, right, separate. Odor, slight, distinctive. Sweet taste.

***Terfezia leptoderma* Tul. & C. Tul., 1844.**

Species harvested April 3rd 2013, on sandy soil, associated with *Helianthemu*m *sp*. Ain Beni Mathar. Ascomata (Fig. 4A) up to 4-9 (13) cm, subglobose to globose, yellowish brown tinged with red, yellowish brown tinged with red, smooth furrowed surface. Peridium 1-1.6 mm thick. Gleba(Fig. 4B) fleshy, yellow to dark brown, has fertile pockets separated by sterile terminal veins white color to yellowish, spongy appearance. Asci (Fig. 4C) 60-70 (80) µm, globular sometimes ellipsoid to spherical, pedicelled, containing eight spores, not amyloid. Ascospores (Fig. 4B) 18-25 × 16-23 µm, subglobose, spherical spiny tight light colored subhyalines. The odor is mild and similar to the coconut.

Terfezia boudieri Chatin, 1892.
Terfezia boudieri var. *arabica* Chatin 1892.
Terfezia boudieri var. *auzepii* Chatin1893.
Terfezia boudieri var.*boudieri* Chatin 1892.
Terfezia boudieri var. *microspora* Pat. 1894.
Terfezia boudieri var. *pedunculata* Pat.1897 (Kirk *et al.*, 2008).

Species harvested March 24th 2014, on sandy soil in Tendrara, associated with *Helianthemum lipii.* Ascomata (Fig. 5A) up to 15-18 µm, hypogeous generally as tubers, with an attachment to the base, wet weight, between 20-150 g per ascomata, brown to dark brown or blackish brown. Peridium (Fig. 5D) 0, 75- 1.6 mm thick, composed of interlaced hyphae 3- 8 µm in width, brownish. Gleba (Fig. 5A) fleshy, off-white then becoming greyish-yellow or purple, with whitish veins to off-white, spongy appearance. Asci (Fig. 5B) up to 60-80 µm, globular non pedicellate, containing 5-8 spores. Ascospores up to 18-25 × 16-23 µm, subglobose, smooth.

***Terfezia claveryi* Chatin, 1892**

Species harvested April 2nd 2015, on sandy soil in Tendrara, associated with *Helianthemum lipii*. Ascomata (Fig.6A) up to 4.5-10 (12) cm, smooth, subglobose, lobed, irregular shape, often flattened, brownish yellow becoming darker with age, often ochraceous to brown, at maturity light brown. Peridium (Fig .6D) 1-1.5 mm thick, orange-brown color, composed of thin walled hyphae parallel or plus or minus rounded with partitions, hyaline, with thicker walls in the outermost layers. Gleba (Fig. 6B) fleshy, compacted first yellowish to whitish, and then reddish at maturity divided by paler veins, hyphae sterile and fertile veins have more or less thick walls of 9-12 µm in width. Asci 78- 97(110) × 62 -74 µm, globular, 6-8 ascospores randomly disposed in the tissue of hyphae, short pedicel (Fig.6C). Ascospores (Fig.6C) 17-22 µm broad excluding the ornamentation of straight, globular, hyaline, uniguttulées and smooth, then yellow and adorned with warts 2 µm of languor.

DISCUSSION

Truffles, known for several millennia, are described, according to a text of 1600 BC, as being mysterious products of the earth (Miozzi, 2003). In Antiquity, truffles were considered products of rainstorms (Theophrastus III century BC.), As amended silt by heat from the center of the earth (Nicandre, II century BC.), as roots (Dioscorides, 1st century BC.) as tumors or callosities of the earth (Pliny the Elder, 1st century AD.), and as due to the action of rain, thunder and heat Plutarque (45-125) (Callot, 1999; Riousset *et al.*, 2001). According to Cesalpino (1583), truffles are considered fungi with hypogeous fruiting bodies. The truffles are part of the gastronomic and cultural heritage of several regions in Europe, such as the Périgord, Quercy, southeast of France; Piedmont, the Marches in Italy; Teruel province in Spain; regions of Bechar, Ghardaya, Ourgla and Tamenrasset in Algeria; the regions of Medenine, Gafsa and Tozeur in Tunisia and regions Jerada and Figuig in Morocco (Bouazza, 2013). Truffles have a human interest; in fact, they maintain a human presence in disadvantaged regions. They often grow in cultures not conducive to traditional zones; it is therefore, for the farmer, a good means of diversification. Given their price, they provide good additional revenue and

can even be a valuable substitute for agricultural production in less competitive regions. Therefore trufficulture fight against desertification (Maurat-Fuminieux, 2004). For some time past a trufficulture was developed used as interesting factor of rural development. For example, the trufficulture of Debdou and Imouzzar realized by Lakbakbi (ANAP, 2010). In the world there exists some sixty species of truffles (Trappe, 1979) including twenty present in Europe (Gandeboeuf *et al.*, 1997; Riousset *et al.*, 2001; Maurat-Fuminieux 2004). Some ten species there are namely In Morocco: *Picoa juniperi, Terfezia arenaria, T. boudieri, T. claveryi, T.leonis, T. leptoderma, Tirmania pinoyi, T. nivea, T.ovalispora, Delastria rosea, Tuber asa, T. oligospermum* (Tahiri 1997; Khabar *et al.*, 2001; Khabar, 2002; Bouziani, 2009; Abourouh, 2011; Boutahir *et al.,* 2013). The development of the Moroccan truffles necessitates, firstly, the particular climatic and edaphic conditions and secondly, the presence of host plants in high density and in full vigor as *Helianthemum guttatum, H. lipii, Helianthemum sp., Pinus pinaster* var. *atlantica* and *P. halepensis* (Abourouh 2011). They need, in general, well-structured sandy soil aired and allowing better circulation of minerals. From climatic point of view, they are adapted to temperate conditions with alternating seasons (Khabar, 2001). Their production is conditioned by favorable levels of precipitation in early autumn, for some species, or more often in winter and spring for others. However, their life cycles can be disrupted by excessive or poorly distributed precipitation or prolonged periods of cold or heat waves (Khabar, 2001). Five species are harvested and consumed in the Jerada region (forest of Beni Yaala, Ain Beni Mathar, and Figuig (Tendrara), *Terfezia claveryi, Tirmania nivea* are the most popular species and the most expensive, then *Terfezia leptoderma* least appreciated and least costly. According to interviewees, the harvest begins in mid-February to April and it is a function of the rainfall distribution in space and in time and also the abundance of symbiotic plants. The new systematic, based on molecular phylogeny and morphological characteristics, has transferred the genus *Tirmania* belongs *Tirmanianivea* to the Family of Pezizaceae, Order of Pezizales, Subclass of Pezizomycetidae, Class of Pezizomycetes, Sub Division of Pezizomycotina, Division of Ascomycota, and Kingdom of Fungi (Laessoe *et al*., 2007). The morphological and anatomical descriptions *Tirmanianivea*, harvested in Tendrara, are in agreement with those reported by different authors (Malençon 1973; Alsheikh *et al*., 1983a; Bokhary, 1987; El-Kholy, 1989; Moreno *et al*., 2002; Ferdman *et al.,* 2005). *Tirmanianivea* is encountered in Saudi Arabia, Bahrain, Algeria, Mauritania, Egypt, Spain, Portugal, Italy, Iraq, Kuwait, Libya, Palestine, Oman, Qatar, Tunisia and Morocco in mycorrhizal association with certain plants the family of Cistaceae and especially of the genus *Helianthemum* (Bouazza, 2013). The symbiotic plant varies according to the biogeographic sector, in the Middle East's desert truffles are often found associated with *Helianthemum* species *Helianthemum ledifolium* and *H. salicifolium* (Morte, 2009), they are encountered with *Helianthemum lippii* in North Africa (Algeria and Morocco) (Mandeel *et al*., 2007; Morte *et al.,* 2009). The white truffle from the sand (*Tirmania nivea*), considered the true "desert truffle", is the most appreciated in the Arab countries for its various virtues and singular gastronomic characteristics (Bradai *et al*., 2013).

Currently, genus *Terfezia* belongs *Terfeziaolbiensis* was transferred to the Family of Pezizaceae, Order of Pezizales, Subclass of Pezizomycetidae, Class of Pezizomycetes, Sub Division of Pezizomycotina, Ascomycota of Division, and Kingdom of Fungi (Laessoe *et al.,* 2007). *Terfeziaolbiensis* grows in limestone soils, clay, associated with *Pinus sp*. and *Quercus ilex*, without the presence of Cistaceae (Trufamanía, 2008) and is found in France, Spain, Mexico and Morocco (Bouazza, 2013). It is regarded as an immature form of *Terfezia leptoderma* and treated as synonyms by several authors. It is characterized by small ascocarps and small ascospores (16-18 µm), with short spines 1-2 µm, a pseudoparenchymateux peridium in comparison with *Terfezia leptoderma*. The new systematic, based on molecular phylogeny and morphological characteristics, has transferred the genus *Terfezia* belongs *Terfezia leptoderma* the Family of Pezizaceae, Order of Pezizales, Subclass of Pezizomycetidae, Class of Pezizomycetes, Sub Division of Pezizomycotina, Division of Ascomycota, and Kingdom of Fungi (Laessoe *et al*., 2007). *Terfezia leptoderma* is found in France, Spain, Italy, Turkey and Morocco (Bouazza, 2013) in association with *Geranium*, *Helianthemum sp*, *Cistus albidus*, *Cistus monspeliensis, Pinus pinaster* (1999; García *et al*., 2001a; Tejedorei *et al*., 2008). The new systematic, based on molecular phylogeny and morphological characteristics classified *Terfezia boudieri* at the Family of Pezizaceae, Order of Pezizales, Subclass of Pezizomycetidae, Class of Pezizomycetes, Sub Division of Pezizomycotina, Division of Ascomycota, and Kingdom of Fungi (Laessoe *et al*., 2007). *Terfezia boudieri* was reported in countries around the Mediterranean and the Middle East (Morocco, Algeria, Egypt, Saudi Arabia, Spain, Portugal, Italy, France, Iraq, Iran, Kuwait, Libya, Palestine, Turkey, Tunisia) and even Namibia, Botswana (Marasasand Trappe, 1973; Trappe *et al*., 2008a, 2014a.). It was observed from March to April in Spain (Murcia and Canary Islands), from January to March in the Middle East and North Africa in arid sandy soil on limestone. The period of fruiting *Terfezia boudieri* is highly dependent on rainfall and temperature; sporocarps sometimes disappear for a few years when weather conditions are not adapted. The new systematic has transferred *Terfezia claveryi* the Family of Pezizaceae, Order of Pezizales, Subclass of Pezizomycetidae, Class of Pezizomycetes, Sub Division of Pezizomycotina, Division of Ascomycota, and Kingdom of Fungi (Trappe, 1979). *Terfezia claveryi* is found in Algeria, Tunisia, Egypt, Spain, Turkey, Italy, Saudi Arabia, Kuwait, Bahrain, Qatar, Iraq, Iran, Jordan, Syria, Madagascar, USA. And Morocco (Dib, 2012). In Morocco, *Terfezia claveryi* is found in areas with arid climate in sub-Saharan Africa and between altitudes 1000-2000 m (Abourouh, 2011). It is associated with *Helianthemum sp*. in basic soils and is characterized by big ascocarps, reddish brown and rounded spores decorated with warts. The study of the ultrastructural organization of the mycorrhizal *Helianthemum guttatum*, shows that *Terfezia claveryi* and *Terfezia arenaria* form on the same host plant, depending on the culture substrate or ectomycorrhizal with a Harting network of well-differentiated but fungal coat on a substrate rich in phosphorus, either ectendomycorhizes without a coat on a substrate low in phosphorus (Dexheimer *et al*., 1985; Roth-Bejerano et *al.,* 1990).

Conclusion

Through this study, we showed the diversity of truffles in the regions of Jerada, Ain Beni Mathar and Tendrara and gave certain information about their bio-ecology. Desert Truffles are mushrooms ascocarps hypogeous, presenting gleba surrounded by a smooth often cracked rough surface of peridium. The studied Terfez are divided into two genera and five species developing in symbiotic association with *P. halepensis*, *H. lipii*, *H. guttatum H.* and *H.* sp. In all the distribution areas of desert truffles, geomorphological habitat characteristics are common, but their abundance and production remain depending on soil and climatic conditions of the environment. The natives consider truffles desert, irrespective of the species, as appreciated mushroom because knowledge transmitted from one generation to another. The natural production of truffles in Morocco is falling, forcing all stakeholders to react to guard and protect this natural resource that has an important economic and ecological interest and a means of revaluation the arid, semi-arid and sub- Saharan ecosystems.

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