Desert Truffles 'Al-Kamah' of the Kingdom of Saudi Arabia. 2. Additional Contributions

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ABSTRACT. Two hypogeous desert truffles, collected from the northern part of Saudi Arabia, are identified as *Terfezia claveryi* Chatin (Terfeziaceae) and *Phaeangium lefebvrei* Pat. (Pyronemataceae) belonging to order Pezizales. The morphology and taxonomy of these species are discussed. A revised modified key for the identification of recently and previously reported Saudi Arabian truffles is also presented.

Truffles are hypogeous fungi of nutritive and economic value. They are generally eaten as a delicious food in parts of the Arab world (Bokhary 1987, AlSheikh and Trappe 1983 a, and Al-Delaimy 1977). Truffles are a delicacy of food in some parts of Continental Africa (Ahmad *et al.* 1981, Ackerman *et al.* 1975, Marasas and Trappe 1973, and Duggar and Pinoyi 1907), and are also known in the Continent of Europe (Moreno *et al.* 1986 and Fogel 1980).

Terfezia claveryi has been recorded earlier from Kuwait (Awameh and AlSheikh, 1979, 1980) and Syria (Chatin 1892). Distribution and morphology of *T. claveryi* is also studied in Europe (Moreno *et al.* 1986). The chemical composition of *Terfezia* spp. has been well investigated (Bokhary *et al.* 1987, Ahmad *et al.* 1981, Al-Delaimy 1977, Al-Delaimy and Ali 1970, and Ackerman *et al.* 1975). Medicinally *T. claveryi* is reported useful in the treatment of some eye diseases *e.g.* trachoma (Al-Marzooky 1981).

The bird truffle, *Phaeangium lefebvrei* Pat. is recorded earlier from Tunisia, Algeria, Iraq, and Kuwait (AlSheikh and Trappe 1983 b). This truffle is locally known as 'hober' and eaten by several bird species.

In Saudi Arabia, the morphology, ecology and geographic distribution of *Tirmania nivea*, *T. pinoyi* and *Terfezia bouieri* have recently been reported (Bokhary 1987). The chemical analysis of these species and that of *T. claveryi* has also been studied in Saudi Arabia (Bokhary *et al.* 1987 and Sawaya *et al.* 1985).

No report is available on the geographical distribution, morphology and ecology of *T. claveryi* in Saudi Arabia while *Phaeangium lefebvrei* was not reported before from Saudi Arabia.

This work was undertaken to investigate the morphology, ecology and geographic distribution of the two Saudi species, *T. claveryi* and *P. lefebvrei*.

Materials and Methods

For the collection of truffles, visits were made to the northern part of Saudi Arabia in the months of February-April 1981-1986. The areas previously searched were in the north-eastern region (Bokhary 1987) whilest Harrat al Harra, in the north-western region of Saudi Arabia, was only recently searched in 1987 (Fig. 1).



Fig. 1. A sketch map showing the sites 1-10 in which desert truffles are distributed in Saudi Arabia (after Bokhary 1987).

For identification, morphology and anatomical studies, the same methods were followed as described earlier by Bokhary (1987).

Results and Discussion

Two hypogeous fungi were collected from the localities indicated above. These are *Terfezia claveryi* Chatin and *Phaeangium lefebvrei* Pat. The former was reported earlier from Saudi Arabia (Sawaya *et al.* 1985) while the latter is a new record for Saudi Arabia. The geographical distribution, ecology and morphology of truffles indegenous to Saudi Arabia are described here for the first time.

Description and Taxonomy

Terfezia claveryi Chatin

Ascocarps hypogeous, potato-like, with basal attachment. Fresh weight ranges between 1.1-173 g. Surface of ascocarps light brown to dark brown or blackish brown. Asci variously shaped, double layered, hyaline, thin-walled, 2-8 spored (mainly 6-spored), 50-70 \times 53-80 µm. Ascospores hyaline, double layered, both smooth and reticulate, papillose reticulate spores measuring 21-24 µm while smooth spores 16-20 µm. Outer layer with papillose reticulation measuring 2-2.6 µm while inner layer 0.7 µm in size. Germpore 7-9 µm in size (Plate 1).





Plate 1. a. *Terfezia claveryi*, ascocarp found associated with *Helianthemum lippi* (indicated by arrows).

b. Eight reticulate spored asci

The description of *T. claveryi* resembled that of Awameh and AlSheikh (1980) except that a double layer of asci and ascospores are found. The outer layer of ascospores with papillose reticulation being thicker than the inner layer. The germpore is reported here for the first time.

Collection sites: As Sairah (March 1983, 1985); An Nugrah (March 1983); Ar Ruqi, near Kuwait (March 1985); Hail and Jouf (March 1983); An Nauriyah (March 1983); Ad Dughm (March 1983); As Sirr (March 1985); and Harrat al Harra (April 1987).

Phaeangium lefebvrei Patouillard

Ascocarps hypogeous, light to dark brown, smooth or slightly rough with brown tomentose, $1-2 \times 1-3$ cm in size. Gleba solid and milky-white. Spores round, globose to ellipsoid, $25-30 \times 20-25 \mu m$. Asci 2-(4-6)-8 spored, 50-110 $\mu m \times 50-75 \mu m$, hyaline and of various shapes (Plate 2).



Plate 2. a. *Phaeangium lefebvrei*, ascocarp. 1. Surface view. 2. Milky white gleba b. Asci and ascospores.

The morphological characters of the present collection of this species closely resembles the description given earlier by AlSheikh and Trappe (1983 b).

Collection sites: Harrat al Harra (April 1987)

Patouillard (1894) erected genus *Phaeangium* to accomodate this species. Saccardo (1899) proposed the name *Angiophaeum* for the genus *Phaeangium*. Hennings (1901) considered *P. lefebvrei* as *Terfezia* sp. Maire (1906) synonymised the type collection of *P. lefebvrei* and *T. schweinfurthii* and transferred it to the genus *Picoa* as *P. lefebvrei* (Pat.) Maire. Details of taxonomy and ecology of this species were reported by AlSheikh and Trappe (1983 b).

Spores of *P. lefebvrei* were considered smooth (Patouillard 1894, Trappe 1971, 1975, 1979). However, warted spores were noticed in the same species by Hennings (1901) and he also reported smooth young spores and granulose mature ones. Recently AlSheikh and Trappe (1983 b) confirmed the presence of warted spores and hence suggested the separation of this species from the genus *Picoa* and its inclusion into the genus *Phaeangium*.

Geographical Distribution

The localities of these truffles are shown in Fig. 1. The general location of these areas is between 26-47°E longitude and 30-32°N latitude (Northern part of Saudi Arabia bordering Kuwait, Iraq and Jordan). *Terfezia claveryi* was common in all localities shown on the map while *P. lefebvrei* was collected only from locality number 10 (Harrat al Harra), Al Jouf region. In the field *P. lefebvrei* occurred nearby where *Tirmania* spp. fruits (AlSheikh and Trappe 1983 b).

Rainfall, Soil types and Mycorrhizal Relationship

Rainfall is an important factor for the fructification of the truffles. The amount and distribution of rainfall are important for occurrence of truffles (Bokhary 1987, Awameh and AlSheikh 1979, and Halwagy and Halwagy 1974).

Soil characteristics were also discussed earlier and it was found to be sandy and alkaline (Bokhary 1987), gypsiferous saline, gravelly gypsiferous and saline (AlSheikh and Trappe 1983 a).

The mycorrhizal relationship between truffles and higher plants have also been discussed (Bokhary 1987, AlSheikh and Trappe 1983, a,b, Awameh and AlSheikh 1979, and Fallahyan 1968). During the present survey *Helianthemum lippi* was found to be associated with truffles.

Ethnobotany

Various local Arabic names are attributed to truffles but commonly known as 'Al Faga'. The classic Arabic name for truffles is 'Al-Kameh or Kame' (Bokhary 1987). *Terfezia* spp. by virtue of it blackish ascocarps are locally known as 'Al-Kame-Al-Souda' and Al-Kame-Al-Bunia' (Kholasi). *P. lefebvrei*, which is commonly known as bird truffle, has also other local names 'Faga altoyoor' 'heberi' or 'hober'. This truffle is commonly eaten by birds in Kuwait (AlSheik and Trappe 1983 b) and also in Saudi Arabia.

Terfezia claveryi is commonly sold in the market of Saudi Arabia at a higher price than *Tirmania nivea*. While *P. lefebvrei* is not sold in the market but is reported to be eaten raw by Bedouins: its use as a trap to catch birds has also been reported (AlSheikh and Trappe 1983 b).

A key for the identification of Saudi Arabian truffles is presented. It follows the taxonomic arrangements of Bokhary (1987), AlSheikh and Trappe (1983 a,b) and Trappe (1971, 1979).

1.	Asci exhibit a positive reaction in Melzer's reagent
1.	Asci negative in Melzer's reagent (Terfeziaceae) 4
2.	Asci blue to green in Melzer's reagent (Pezizaceae)
2.	Asci pale yellow in Melzer's reagent, peridium tomentose, spores 2-8,
	ellipsoid-globose, smooth or warted, $23-30 \times 23-26 \mu\text{m}$ with hyaline papillae
	$0.2 \times 0.5 \ \mu m \ Phae angium \ lefebvrei \ \dots \ (Pyronemataceae)$
3.	Asci mostly 8-spored, spores subglobose to broadly ellipsoid,
	$16-26 \times 11-18 \mu m$
3.	Asci (4-) 8-spored, globose, 17-21 µm, mostly about 17 µm diameter
	Т. ріпоуі.
4.	Asci 2-5 spored, all spores similar, warty, 23-29 µm, globose
4.	Asci 2-8 spored, spores dissimilar, reticulate (21-24 µm) and smooth
	(16-20 μm) <i>T. clavervi</i>

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References

- Ackerman, L.G.L., van Wyk, P.J., and du Plassis, L.M. (1975) Some aspects of the composition of the Kalhari truffle of N'abba, S.A. Food Rev. 2(5): 145-147.
- Ahmad, A.A., Mohamed, M.A. and Hami, M.A. (1981) Libyan truffles "Terfezia boudieri Chatin", chemical composition and toxicity, J. Food Sci. 11: 927-929.
- Al-Delaimy, K.S. (1977) Protein and amino acid composition of truffles, Can. Inst. Food Sci., & Technol. J. 10(3): 221-222.
- Al-Delaimy, K.S. and Ali, S.H. (1970) Storage. spoilage and proximate food composition of Iraqi truffles, Bejr. Trop. Subtrop. Iantwirt Tropen. Med. 8(1): 77-81.
- Al-Marzooky, M.A. (1981) Truffles in eye disease, Proc. Int. Conf. Islamic Med. Kuwait, pp. 353-357.
- AlSheikh, A.M. and Trappe, J.M. (1983 a) Desert truffles: The genus *Tirmania*. *Trans. Br. Mycol. Soc.* 81(1): 83-90.
- AlSheikh, A.M. and Trappe, J.M. (1979) Laboratory and field study of four kinds of truffles (Kamah). Terezia and Tirmania species for cultivation, Mushroom Sci. 10: 507-517.
- Awameh, M.S. and AlSheikh, A.M. (1980) Features and analysis of spore germination in the brown Kame Terfezia claveryi, Mycologia 72: 494-499.

Bokhary, H.A. (1987) Desert truffle "Al-Kamah" of the Kingdom of Saudi Arabia. I. Occurrence, identification and distribution, Arab Gulf J. scient. Res., Agric. Biol Sci. B5(2): 245-255.

Bokhary, H.A., Suleiman, A.A.A., Basalah, M.O. and Parvez, S. (1987) Chemical composition of desert truffles from Saudi Arabia, Can. Inst. Food Sci. & Technol. J. 20(4): (In press).

Chatin, A.D. (1892) La Truffle, J.B. Bailliere et fils, Paris, 371 p.

- Duggar, B.M. and Pinoyi, E. (1907) Sur le parasitisme des Terfas, Soc. Bot. France. Session Extraordinaire en Orapie. 16 Avril 1906, 53: 72-74.
- Fallahyan, F. (1968) Hypogeous fungi of Iran. Rev. Mycol. (Paris), 33: 416-417.
- Fogel, R. (1980) Addition to the hypogeous mycoflora of the Canary Island and Madeira Spain, Contrib. Univ. Mich. Herb. 14: 75-82.
- Halwagy, R. and Halwagy, M. (1974) Ecological studies on the desert of Kuwait. 1. The physical environment, J. Univ. Kuwait (Sci) 1: 75-86.
- Hennings, P. (1901) Aliquot fungi Africae borealis, Hedwigia. 40(4): 98-101.

Maire, R. (1906) Notes mycologiques, Ann. Mycol. 4: 329-335.

Marasas, W.F.O. and Trappe, J.M. (1973) Notes on Southern African Tuberales, Bothalia 11: 139-141.

Moreno, G., Galan, R., and Ortega, A. (1986) Hypogeous fungi from Continental Spain I, Cryptogam. Mycol. 7(3): 201-230.

Patouillard, N. (1894) Les Terfez de la Tunisie, J. Bot. 8: 153-156.

- Saccardo, P.A. (1899) Sylloge fungorum Omnium Hucusque Cognitorum XIV. R. Friedlander & Sohn, Berlin.
- Sawaya, W.N., Al-Shalhat, A., Al-Soair, A., and Al-Mohammad, M. (1985) Chemical composition and nutritive value of truffles of Saudi Arabia, J. Food Sci. 50(2): 450-453.
- Trappe, J.M. (1971) A synopsis of the Carbomycetaceae and Terfeziaceae (Tuberales), Trans. Br. mycol. Soc. 57: 85-92.
- Trappe, J.M. (1975) Generic synonyms in the Tuberales, Mycotaxon 2: 109-122.
- Trappe, J.M. (1979) The order, families, and genera of hypogeous Ascomycotina (Truffles and their relatives) *Mycotaxon* 9(1): 297-340.

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الكمأة الصحر اوية «الفقع» بالمملكة العربية السعودية ٢ _ إضافة جديدة للأنواع السابقة

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تم جمع عينتين اضافيتين من الكمأة لم يسبق تسجيلهما بالمملكة العربية السعودية من منطقة حرة الحرة بشمال غربي المملكة (تنمو الكمأة ما بين خطوط الطول ٤٦ ـ ٤٧ درجة شرقاً، وخطوط العرض ٣٠ ـ ٣٢ درجة شمالاً في المملكة العربية السعودية) وهما من الفطريات الزقية (الأسكية) تحت الأرضية التي تصلح غذاءً للإنسان والتي لها أهمية اقتصادية كبيرة نظراً لندرتها وارتفاع ثمنها إضافة إلى قيمتها الغذائية العالية ونكهتها الميزة (تحتوي هذه الفطريات على مواد كربوهيدراتية ـ سكريات ـ بروتينات وفيتامينات ومواد معدنية مختلفة).

إحدى العينتين هي الفطرة Terfezia claveryi Chatin وهي من الفصيلة الثيرفيزية (Terfeziacca) والشانية هي : . Phaeangium lefebvrei Pat. وهي من الفصيلة (Terfeziaccae) والبيرونياتيسية (Pyronemataccae) ويعرف النوع الأخير أيضاً باسم «فقع الطيور» أو «الهوبر» لأن ثماره الزقية تنتج رائحة مميزة وجذابة لبعض أنواع الطيور، والفطرتان تتبعان تصنيفيا رتبة البيزبزات (Pezizales) التي تتميز بثمرتها الزقية الكأسية أو القرصية الشكل (Discomycetes) التي تتميز بثمرتها الزقية الكأسية أو القرصية الشكل (Discomycetes) التي تتميز بثمرتها الزقية الكأسية أو القرصية الشكل (Discomycetes) التي تتميز بثمرتها الزقية الكأسية أو القرصية والشكل (Discomycetes) التي تتميز بثمرتها الزقية الكأسية أو القرصية والشكل (Discomycetes) والتي غالبا ما تكون ثانية جرائيم، وإن كانت أعداد الجرائيم وأشكالها وأحجامها وتفاعلها تتباين مع الصبغات باختلاف الجنس. كما يتضمن البحث كشافا (مفتاحا) تصنيفيا للأنواع المنترة في الملكة العربية السعودية. كما وأشكالها وأحجامها وتفاعلها تتباين مع الصبغات باختلاف العربية السعودية كما وأشكالها وأحجامها وتفاعلها تتباين مع الصبغات باختلاف الجنس. كما يتضمن البحث كشافا (مفتاحا) تصنيفيا للأنواع المنترة في الملكة العربية السعودية. كما وأشكالها وأمحيامها وتفاعلها تتباين مع الصبغات باختلاف الجنس. كما يتضمن البحث كشافا (مفتاحا) تصنيفيا للأنواع المنترة في الملكة العربية السعودية كما وأشكالها وأمحيامها وانتشار الكمأة (الفقع) في مختلف مناطق الملكة . ويتطرق إلى البحث لافور إلى الملكة العربية السعودية وانتشار الكمأة (الفقع) في مختلف مناطق الملكة . ويتطرق إلى العلاقة ما بين هذه الفطريات تحت الأرضية والنباتات الراقية أي ما يسمى بالعيشة الملكة . ويتطرق إلى الجذر فطرية (واليزايزان الرضية والنباتات الراقية أي ما يسمى العربية الخيرة الخيرة والغيرة والنباتات الراقية أي ما يسمى الموري إلى الملكة . ويتطرق إلى العلائة ما يلغيشة والنباتات الراقية أي ما يسمى بالعيشة والخل واليزة واليزيانات الراقية أي ما يسمى بالعيشة الجذر فطرية (واليزيزات الرافية والنباتات الراقية أي ما يسمى المي والملكة . ويتطرق الملغي الملكة الجذر والي الملغي ما الملغي الغي الغيرفي الملغي الملغي الملغي الغي الفل

ولقد دلت الدراسات على نمو هذه الفطريات ووجودها تحت الأرض بالقرب من هذه النباتات (المتكافلة أو الجذر فطرية)، ولم يلاحظ حتى الآن نمو هذه الفطريات في الحقل في غياب هذه النباتات (المتكافلة أو الجذر فطرية). ولقد دلت الزيارات لمناطق أو «الرقروق» وعلميا باسم الراقي (المتكافل) وهو ما يعرف محليا «بالأرزه» أو «الرقروق» وعلميا باسم النواتي (المتكافل) وهو ما يعرف محليا «بالأرزه» ويساعد هذا النبات على نمو هذه الفطريات بامدادها بالمصدر الكربوني الذي لا يستطيع الفطر تكوينه خلال مراحل نموه، ويتشقق سطح التربه ويتفكك ويشاعد هذا النبات على نمو هذه الفطريات بامدادها بالمصدر الكربوني الذي وهذا هو السبب في إطلاق اسم الفقع على هذه الفطريات). كما تلعب العوامل البيئية (كمية وسقوط المطر ووقت سقوطه ودرجة حرارة الجو) دوراً مؤثر في نمو الكمأة، ولقد تمت في هذا البحث أيضا مناقشة مختلف العوامل البيئية والاحيائية التي تؤثر على توزيع هذه الفطريات بالأماكن الصحراوية الملكة العربية السعودية.