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Ethnomycological Aspects of Traditional Usage and Indigenous Knowledge about the Arid-Semi Arid Truffles Consumed by the Residents of the Eastern Anatolia Region of Turkey

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Abstract

This research consists of a cross-sectional survey studying the local knowledge about arid-semi arid truffles, their use and their ethnomycological aspects, in the hope of discussing the importance of truffles in socioeconomic life, for the local ecology and in folk traditions. 230 truffle gatherers from Eastern Turkey were interviewed. Truffles usually appear from early March to late April (68.3%), seen at barren areas that are not plowed (95.2%), and grow in sandy soils (97.8%). Truffle gatherers look for truffle types at areas where the soil bulges and cracks (97.0%), or where kumi plant grows (95.2%), and they find these using their personal experience (94.8%). Observed species included red, reddish brown, brown (100%), yellowish white (60.4%), and rarely black (30.0%) morphological types. The locals have expressed that they collect about 2 kg or less truffles per day (68.7%), and the financial profit is high (68.3%). They acquired information from their families and elders (92.6%) about mushrooms, and they gather truffles for nutrition (97.8%), for their high nutritious value (67.8%), as they are a natural food source (94.3%), and because of the feeling of satiety they provide (95.7%). Rain (97.8%), soil type (62.2%) and also host plant (*Helianthemum* spp.) affect the growth of the mushroom. Truffles are usually fried with eggs when cooking (84.8%), preserved in refrigerators (93.0%), and the quality of edibility is high (83.9%). *T. boudieri* is preferred for commercial use, whereas other types (*P. lefebvrei*, *T. olbiensis* and *P. juniperi*) are mostly used for daily consumption because they do not provide financial profit.

1. INTRODUCTION

Since ancient times, mushrooms have been used as functional foods to maintain good health and prevent ailments, and food-flavouring materials due to their unique flavour and texture, and as a source of medicine to treat diseases [1-3].

Truffles have been found so far in most of the geographical areas characterized by climate types, although historically, some of them have received more attention than other mushrooms [4-5]. They are edible hypogeous fruit bodies produced by many genera of fungi belonging to the class Ascomycetes G. Winter. Among these, *Terfezia* and *Tirmania* (Pezizaceae Dumort.), *Picoa* (Pyronemataceae Corda) and *Tuber* (Tuberaceae Dumort.) are classified in different taxa in Pezizales [6]. In some of areas, hypogeous fungal species adapted to dry environments are popularly known as desert truffles. They are encountered in arid zones of all continents except Antarctica [7]. However, they are best known from the Middle East and North Africa, the Mediterranean Basin, the African Kalahari, and the Australian Outback [8]. Arid and semi arid truffles are adapted to exploit different types of soil in association with specific hosts in the Cistaceae family [9-11]. They produce fruit bodies after the rainy season, and their fruiting is affected by the amount and distribution of rainfall [12]. Climatic factors are among the most important drivers of

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desert truffle occurrence. Their development in arid, semi arid region or hot deserts occurs after the fall of rains heralding the end of winter and the beginning of the hot season, with a specific temporal distribution of rainfall amounts along the year, but also depending on the type of soil and climate, and also abundance of host plants [4, 13-15].

Their popularity is not only due to their specific taste and nutritional value, but also to their therapeutic properties [7, 16-17]. They have been shown to provide a rich source of fiber, protein, amino acids, fatty acids, minerals, vitamins, and carbohydrates and to contain considerably higher values of potassium, and phosphate than many commonly consumed vegetables [18]. These fungi constitute a popular food and are particularly appreciated for their flavour and texture profiles in countries of the Mediterranean Basin as a whole. Desert truffles are traditionally gathered not just for nourishment, but also for their curative and aphrodisiac properties, treat eye, skin diseases, antimicrobial, antioxidant, antiviral, antimutagenic, anticarcinogenic, antiradical, hepatoprotective, immunosuppressants, antiinflammatory properties etc. [5, 19-21].

Well-developed truffle markets have been formed specifically in the the Mediterranean Basin, and even though the quantities of the truffles in the wild have been diminishing, their popularity has been rising in this area [5]. On ther hand, people from other regions have developed some awareness about truffles being an expensive food; but those who are aware of its value are reluctant to share the information in order to get maxium benefit out of its sale. However, those from these areas outside the Mediterranean Basin, who tried to make it a business are facing difficulties when trying to identify the species, finding market locations, meeting export standards, understanding the shipment process, etc. Unfortunately, truffle sale is not a successful business enterprise in these areas to date [22].

Indigenous people have used desert truffles wherever the truffles grow, but most of these cultures were strictly oral and have not left written records. In recent years studies have been carried out on the biology, cultivation, nutritional and medicinal status of some desert truffles [7]. However, indigenous knowledge about truffles has not been given significant attention among desert inhabitants. The indigenous knowledge about truffles that has been accumulated and passed orally from generation to generation could serve as a powerful springboard for studies on different properties of local truffles in different areas [12, 14-15, 23].

The purpose of this study was to evaluate the potential ethnomycological data that included the demographic characteristics of the truffle collectors, different characteristics of and information about truffles, and the level of knowledge of the consumers about arid-semi arid truffles in Eastern Turkey.

2. MATERIAL AND METHODS

2.1. Study Areas and Description of Species

According to Akyüz et al. [24], samples belonging to five species of truffles: *Picoa lefebvrei*, *P. juniperi*, *Terfezia boudieri*, *T. claveryi* and *T. olbiensis* were collected from Malatya and Elazığ, Turkey (N 38° 19'- 43' E 038° 19 '- 51', 690-1375 m). They live in mycorrhizal association with *Helianthemum salicifolium* and rarely *H. ledifolium* (Cistaceae) in arid-semi arid areas of Eastern Turkey where ascocarp appear from early March until June, and rarely until mid-July. The specimens were identified by using the information provided by Kagan-Zur et al. [7].

2.2. Ethnomycological Characteristics of the Truffle

The study was conducted throught interview with 230 truffle gatherers in the Elazığ-Malatya region of Turkey. In this work the ethnomycological characteristics of truffle types were tried to be represented based on the views and suggestions of the locals. In order to determine the ethnomycological features of arid-semi arid truffles, a questionnaire form that includes the demographic characteristics of the local people was filled. In this form, information about the ethnomycological data that included the

demographic characteristics of the truffle collectors (gender, age, level of education, occupation, whether they are locals or came from elsewhere), different characteristics of and information about truffles (daily amount collected, sizes, average weight, morphological colours, prices, mycorrhizal plant or host plant, local names, times of appearance, different types, prevalant habitat, how frequently they are seen, how they are collected, how many centimeters deep under the surface they are collected from, from which types of soil they are collected, when they are collected, how long it takes to collect them, methods used for searching truffles, how they are consumed, how they are preserved, quality of food), and the level of knowledge of the consumers about truffles (the most common and preferred types, areas they spread at, the effect of environmetal factors and the soil on the formation of truffles, whether the species can be identified and how familiar they are with these, the aim of collecting truffles, the nutritional aims, whether its consumption is required in terms of human health, why they are preferred when compared with other food types, their relations with orther organisms and their classification, factors that enable them to to reach to a certain size, the financal profit from truffles for the collectors, their importance in terms of health and purpose of use) were represented. In the analysis of the data frequency, chi-square and ANOVA tests using a statistical software package were applied.

3. RESULT AND DISCUSSION

It was determined during the study on the ethnomycological charactersitics of truffles that the scale which was used was very reliable based on the Cronbach's Alpha Reliability test ($0.80 \leq 0.829 < 1.00$) see in Table 1.

Table 1. *The reliability analysis of the scale used during the research*

Number of Articles	**Cronbach-α reliability**	***p***
57	0.829	0.000*

*: $p<0.05$

A 33.9% of the truffle types used in this study were collected from the Malatya Province and its vicinity, and 66.1% were collected from the Elazığ Province and its vicinity (Table 2). These are also areas where we interviewed the inhabitants of the region about truffles.

Table 2. *Locations from where truffles were collected and where the villagers were interviewed*

Malatya	**Number**	**(%)**
Kale	4	1.7
Kıyıcak Village, Kale	11	4.8
Kapıkaya Village, Centre	3	1.3
Çolaklı Village, Centre	3	1.3
Yeniköy Village, Centre	3	1.3
Meydancık Village, Battalgazi	10	4.3
Yarımcahan Village, Battalgazi	8	3.5
Çolakoğlu Village, Battalgazi	7	3.0
Adagören Village, Battalgazi	5	2.2
Ağılyazı Village, Battalgazi	7	3.0
Kuluşağı Village, Battalgazi	4	1.7
Şişman Village, Battalgazi	4	1.7
Gümüşlü Village, Arguvan	3	1.3
Morhamam Village, Arguvan	3	1.3
Karababa Village, Arguvan	3	1.3
Total	**78**	**33.9**
Elazığ	**Number**	**(%)**
Hacımehmetli Village, Baskil	4	1.7

Karakaş Village, İpşir hamlet, Baskil	3	1.3
Topaluşağı Village, Baskil	3	1.3
Habipuşağı Village, Baskil	7	3.0
Pınarlı Village, Baskil	10	4.3
Kadıköy Village, Baskil	21	9.1
Kuşsarayı Village, Baskil	9	3.9
Alangören Village, Baskil	7	3.0
Deliktaş Village, Baskil	12	5.2
Gemici Village, Baskil	5	2.2
Konacık Village, Haydarkulu hamlet, Baskil	5	2.2
Çiğdemlik Village, Hacıyusuflar hamlet, Baskil	13	5.7
Kızıluşağı Village, Baskil	3	1.3
Yalındam Village, Baskil	3	1.3
Situşağı Village, Baskil	3	1.3
Söğütdere Village, Baskil	7	3.0
Harabekayış Village, Baskil	12	5.2
İmikuşağı Village, Baskil	3	1.3
Tabanbükü Village, Baskil	3	1.3
Altınuşağı Village, Baskil	3	1.3
Bilaluşağı Village, Baskil	5	2.2
Suyatağı Village, Baskil	4	1.7
Höyükköy Village, Baskil	4	1.7
Kumlutarla Village, Baskil	3	1.3
Total	**152**	**66.1**
General Total	**230**	**100.0**

Of 230 truffle collectors who were studied, the majority were male (87.8%), were withing the age range of 41-50 (27.0%), had a high school education (46.5%), were farmers (35.2%) and locals (88.7%), based on their demographic characteristics (Table 3). Based on similar studies on truffle collectors in Bahrain and Algeria [12, 15], the demographic characteristics were understood to change based on the number of test subjects, their gender, age, level of education and occupation.

Table 3. *Demographic characteristics of the surveyed truffle gatherers*

	Number	**(%)**
Gender		
Female	28	12.2
Male	202	87.8
Ages (years)		
≤ 20	28	12.2
21-30	34	14.8
31-40	61	26.5
41-50	62	27.0
50 ≥	45	19.6
Level of education		
Illiterate	10	4.3
Primary and secondary education	102	44.3
High school	107	46.5
University	11	4.8
Occupation		

Farmer	81	35.2
Grazier	22	9.6
Self-employed	33	14.3
State officer or labour	18	7.8
Retired	18	7.8
Student	31	13.5
Housewife	27	11.7
Truffle gatherers		
Local	204	88.7
Outsider	26	11.3
Total	**230**	**100.0**

It was determined that truffles usually appear in March-April (68.3%), seen at hilly areas (81.7%), near the roads (94.8%) and at barren areas that are not plowed (95.2%), and grow in sandy (97.8%) and pebbly soils (90.9%), 1-3 cm below the surface (38.3%) see in Table 4. Similar studies on *Terfezia*, *Tirmania* and *Picoa* species have shown that the truffle types can grow under the soil during similar time periods and at similar growing environments [12-13, 15, 25-26].

Truffle hunters have indicated that they look for truffle types at areas where the soil bulges and cracks (97.0%), and where kumi plant grows (95.2%), and they find them using their personal experience (94.8%). Species that have red, reddish brown, dark brown (100%), yellowish white, whitish (60.4%), and rarely black morphological colours (30.0%) were observed (Table 4). The locals have expressed that they call the local truffle types "domalan" and "kumi", they collect about 2 kg or less per day (68.7%), and the financial profit is high (68.3%). Based on similar studies, it was determined that similar methods were used for collecting different truffle types, the morphological colours can vary based on the type, identical species can be locally named differently at different geographical areas, that they were found at areas where similar host plants grow, the daily amount that is collected can vary, the financial profit can change based on the truffle type, where they grow, and the level of demand [12-13, 15, 25-26].

Table 4. *Principal characteristics of truffles*

	Number	**(%)**
Times of appearance		
March-April	157	68.3
May	73	31.7
Habitat types *		
Mountain slopes	113	49.1
Hilly areas	188	81.7
Coastline	140	60.9
Roadside	218	94.8
Flat areas	179	77.8
Oak woodlands	26	11.3
Barren areas	219	95.2
Soil types that truffles grow in*		
Sandy	225	97.8
Clayey	169	73.5
Pebbly soils	209	90.9
Red earth	59	25.7
How deep under the surface they are collected from*		
1-3 cm	19	8.3
4-6 cm	38	16.5

7-10 cm	6	2.6
Surface and 1-3 cm	88	38.3
Surface and 4-6 cm	66	28.7
Surface and 7-10 cm	13	5.7
Methods used for searching truffles*		
Observing soil bulges and cracks	223	97.0
Observing where the kumi plant grows	219	95.2
Observing where birds gather	4	1.7
Personal experience	218	94.8
Morphological color *		
Red, reddish brown, pink (*T. boudieri* and *T. claveryi*)	230	100.0
Brown (*P. lefebvrei*)	230	100.0
Yellowish white, whitish (*T. olbiensis*)	139	60.4
Black (*P. juniperi*)	69	30.0
Local names *		
Domalan, kumi, kırmızı - pembe mantar (for *T. boudieri* and *T. claveryi*)	230	100.0
Beyaz kumi, beyaz domalan (for *T. olbiensis*)	112	48.7
Maf, makelik, maklik, kuş mantarı (for *P. lefebvrei*)	179	77.8
Siyah kumi, siyah domalan (for *P. juniperi*)	80	34.8
Daily amount of truffles collected		
≤ 2 kg	158	68.7
3 - 5 kg	44	19.1
6 - 10 kg	28	12.2
The level of income from truffle gathering		
Low	11	4.8
Average	62	27.0
High	157	68.3
Total	**230**	**100.0**

*: More than one choice has been ticked

Truffle gatherers who were questioned indicated that they acquired information from their families and elders (92.6%) about mushrooms, and they gathered truffles for nutrition (97.8%), for their high nutritious value (67.8%), as they are a natural food source (94.3%), and the feeling of satiety they provide (95.7%) as seen in Table 5. Other studies [12-13, 15, 25-26] on truffles have shown that families and friends, together with media provide information to people about these mushrooms. These studies have also shown that these were collected as a hobby, for sports, to continue traditions, for daily income, for nutrition (high nutritious level, easy digestion, natural source of food), and for health (as an aphrodisiac, against anaemia, against eye infections, for satiety, and for energy).

Table 5. *The level of knowledge of the consumers about truffles*

	Number	**(%)**
The sources of truffle related information*		
Families or elders	213	92.6
Friends or relatives	174	75.7
TV - radio - internet	91	39.6
Books - newspaper	25	10.9
The aim of collecting truffles *		
For leisure	100	43.5
To stay healthy and fit	68	29.6
Continuing traditions	103	44.8

Commercial use	64	27.8
Nutrition	225	97.8
Commercial use and nutrition	69	30.0
Nutritional reasons for collecting*		
High protein level	38	16.5
Rich mineral-vitamin content	34	14.8
High nutritional value	156	67.8
Being easily digestible	147	63.9
Positive effect on health	151	65.7
Natural food source	217	94.3
Reasons for consumption in terms of human health *		
Anemia	10	4.3
Eye infections and diseases	70	30.4
Against tiredness and weakness	51	22.2
Being natural food	213	92.6
Nutritious and providing a feeling of fullness	220	95.7
Why they are preferred when compared with other food types		
Being natural	148	64.3
Appearing at a certain time of the year	50	21.7
Appearing at a certain area	32	13.9
The effects of environmetal factors on the formation of truffles *		
Rain	225	97.8
Soil types	143	62.2
Rain and soil types	181	78.7
Factors that enable the truffles to reach a certain size *		
Storm and spring showers	21	9.1
Winter showers	184	80.0
Average spring temperature	58	25.2
The density of the host plant	219	95.2
How they are consumed*		
Raw	45	19.6
Grilled	69	30.0
Fried with eggs	195	84.8
Cooked with other food	36	15.7
How they are preserved *		
Frozen	164	71.3
Kept in a refrigirator	214	93.0
Daily consumption	217	94.3
Quality of food		
Medium	37	16.1
High	193	83.9
The most common and preferred types *		
Brownish type	110	47.8
Yellowish white, whitish type	137	59.6
Red, reddish brown, pink type	222	96.5
Black type	16	7.0
Total	**230**	**100.0**

*: marked more than one option,

Red, reddish brown, pink (*T. boudieri* and *T. claveryi*), brown-brownish (*P. lefebvrei*), yellowish white, whitish type (*T. olbiensis*), black (*P. juniperi*)

It was determined that truffle types were prefered because they are a natural food source (64.3%), rain (97.8%), soil type (62.2%) and host plant (*Helianthemum* spp.) affect the growth of the mushroom, that the truffles are usually fried together with eggs when cooking (84.8%), they are kept in refrigerators (93.0%), the quality of edibility is high (83.9%), the most preferred types are the red, reddish brown, pink morphological truffles (96.5%) whereas the least preferred type is the black one (7.0%) as seen in Table 5. Similar observations [12-13, 15, 25-26] have shown that truffles are preferred because they are a natural source of food, they appear at certain times of the year for a short time and only in certain areas, rain, soil type, temperature and the host plant affect the growth of the truffles, but the preferred truffle types, the way they are consumed and preserved, and the quality of edibility can vary based on te mushroom type and regional cultural differences. It was also indicated that the local climate, host plant, location, altitude, period and type of vegetation, illumination level, temperature, precipitation, speed of wind, and the chemical and physical characteristics of the soil affect the growth and size of truffles [4, 7, 9-13, 15, 27-30].

It was determined that the types with red, reddish brown, pink morphological colours (*T. boudieri* ve *T. claveryi)* have an average size and weight of 5.09±1.61 cm and 137.07± 82.65 g, type with yellowish white, whitish morphological colour (*T. olbiensis)* has an average size and weight of 3.40±0.87 cm and 25.55±14.13 g, type with dark brown-brownish morphological colour (*P. lefebvrei)* has an average size and weight of 2.55±0.65 cm and 11.15±8.12 g, and the type with black morphological colour (*P. juniperi)* has an average size and weight of 3.23±0.76 cm and 19.01±7.56 g (Table 6). The types that are locally called "domalan or kumi'' are sold in between 25 and 55 TL, with an average price of 45 TL (~15$). The hight cost might be due to their scarcity with poor yield in certain season in each country as stated in the aforementioned studies. On the other hand, it was seen that the red-pink types are preferred for commercial use and sold, whereas other types (brown, white and black) are mostly used for daily consumption because they do not provide financial profit (Table 6). It was observed that *T. boudieri* is the only product that has an economic value as it brings profit. *P. lefebvrei*, *T. olbiensis* and *P. juniperi*, which are used for daily consumption and are more popular amongs to the locals, don't have an economic value, as the first one is too small, the second one degrades quickly, and the third one can be found rarely and is very hard. It was observed that *T. claveryi* can be rarely found in the area and can be confused with *T. boudieri* by the local people [31]. Other similar studies conducted on *Terfezia*, *Tirmania* and *Picoa* species determined that the morpohological colours, sizes, weights, prices and the preferred types of species can be similar or different based on the location and environment of growth [7, 12-13, 15, 26, 32-33]. Desert truffle are not so strongly flavoured, compared with forest truffles (*Tuber* spp.). Popularity of truffles are believed to be due to their nutritional value and unique flavour, texture and delicious taste.

Table 6. *The average size, weight and price of truffles*

	Min - Max	$\bar{X} \pm SD$
Average size		
Red, reddish brown, pink	2.0 - 10.0 cm	5.09 ± 1.61 cm
Yellowish white, whitish	2.0 - 5.0 cm	3.40 ± 0.87 cm
Brown-brownish	1.2 - 4.0 cm	2.55 ± 0.65 cm
Black	2.0 - 5.0 cm	3.23 ± 0.76 cm
Average weight		
Red, reddish brown, pink	13 - 400 gr	137.07 ± 82.65 gr
Yellowish white, whitish	4 - 45 gr	25.55 ± 14.13 gr
Brown-brownish	0.3 - 45 gr	11.15 ± 8.12 gr
Black	5 - 35 gr	19.01 ± 7.56 gr
Average price (TL)	25 - 55 TL	43.86 ± 10.95 TL

Red, reddish brown, pink (*T. boudieri* and *T. claveryi*), brown, brownish (*P. lefebvrei*), yellowish white, whitish type (*T. olbiensis*), black (*P. juniperi*)

No clear difference could be observed between the white truffle type (*T. olbiensis*) and the study area (p>0.05). However, the difference between the black truffle type (*P. juniperi*) and the study area was found to be statistically (p<0.05). 11.6% of the black type was found in the Malatya Province, whereas 88.4% was seen in the Elazığ province. All the (100.0%) red, pink, reddish brown (*T. boudieri*) and brown, brownish (*P. lefebvrei*) types could be found during the fieldwork in the Elazığ and Malatya provinces. However, it was determined that the rate of occurrence of the white type in these localities was 60.4% and the rate of occurrence of the black type was 30.0% (Table 7). As indicated in studies conducted at different parts of the world [5, 8, 10-13, 15, 22, 26-27, 29-30, 34-36], truffle mushroom types only grow during a certain period of time and for a limited time, they appear at certain locations, and different or similar types can grow together in these areas.

Table 7. *The types of truffles based on the study areas*

Truffle types	**Malatya**		**Elazığ**		**Total**		χ^2	***p*-value**
	N	**%**	**N**	**%**	**N**	**%**		
Red, reddish brown, pink	78	33.9	152	66.1	230	100.0	**	**
Yellowish white, whitish	45	32.4	94	67.6	139	60.4	**0.371**	**0.571**
Brown -brownish	78	33.9	152	66.1	230	100.0	**	**
Black *	8	11.6	61	88.4	69	30.0	**21.908**	**0.000***

*: $p<0.05$, **: the chi-square test was not applied to these species as they are found at all locations
Red, reddish brown, pink (*T. boudieri* and *T. claveryi*), brown , brownish (*P. lefebvrei*), yellowish white, whitish type (*T. olbiensis*), black (*P. juniperi*)

Table 8. *The time periods when truffles are detected*

Truffle types	**1-15 March**		**15-30 March**		**1-15 April**		**15-30 April**		**1-15 May**		**15-31 May**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Red, reddish brown **	37	16.1	98	42.6	230	100	230	100	97	42.2	33	14.3
Yellowish white, whitish	7	3.0	33	14.3	117	50.9	132	57.4	23	10.0	5	2.2
χ^2 value	**1.592**		**9.426**		**55.234**		**90.502**		**13.739**		**3.795**	
***p*-value**	**0.307**		**0.002***		**0.000***		**0.000***		**0.000***		**0.073**	
Brown, brownish **	100	43.5	180	78.3	230	100	230	100	63	27.4	21	9.1
Black	6	2.6	23	10.0	47	20.4	62	27.0	38	16.5	15	6.5
χ^2 value	**16.694**		**69.247**		**160.063**		**230.000**		**223.347**		**43.481**	
***p*-value**	**0.000***		**0.000***		**0.000***		**0.000***		**0.000***		**0.000***	

*: $p<0.05$,
**: the chi-square test was not applied to these species as they are found at all locations
Red, reddish brown, pink (*T. boudieri* and *T. claveryi*), brown -brownish (*P. lefebvrei*), yellowish white, whitish type (*T. olbiensis*), black (*P. juniperi*)

It was determined that truffle mushrooms usually appear in the months from March to May (rarely in June), red, reddish-pink and brown, brownish types exist throughout March (100%), however their rate of occurrence drop (14.3% and 9.1% respectively) after 15 May and they diminish (Table 8). It was seen that the yellowish white, whitish type (*T. olbiensis*) was mostly seen in the month of April (1-15 April (50.9%) and 15-30 April (57.4%), but the rate of occurrence drop to 2.2% after 15 May (Table 8). The apperance of the white type between 1 and 15 March, and bewteen 15 and 31 May were not found statistically meaningful ($p>0.05$). It was observed that the black type was the least seen type in the period between 1 and 15 March (2.6%), and these were mostly seen during the month of April (Table 8). The apperance of the black type during all periods was found to be statistically meaningful ($p<0.05$). As a result, it can be said that the earliest appearing types are the brown (*P. lefebvrei*), red-pink (*T. boudieri*, *T. claveryi*), white (*T. olbiensis*) and black types (*P. juniperi*), and the earliest types to disappear are white, black, brown and red-pink types, respectively (Table 8). It was determined that the time of appreance of different or similar species observed at different georgraphical locations can vary based on the species and the environment they grow in [5, 8, 10-13, 15, 22, 26-27, 30, 34-36].

In conclusion, arid - semi arid truffles are edible hypogeous mushrooms, which are highly appreciated by the inhabitants of semi arid and arid setlements. The locals use truffle as a natural food source, for commerce, and for increasing fertility or for fatigue. This research has shown that truffle collectors actively consume mushroom as a hobby, to continue traditions, for daily income, for nutrition (easy digestion, natural source of food), and for health (as an aphrodisiac, for satiety, and for energy). It is important to take drastic measures to protect the habitats of these species in order to allow future generations to also exploit these, as these areas are in danger of being used for intensive farming and settlement.

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CONFLICTS OF INTEREST

No conflict of interest was declared by the authors.

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