

## FUNGI ASSOCIATED WITH THE HAIR OF GOAT AND SHEEP FROM EL-BAHRAIN

By

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### الفطريات العالقة بشعر ماعز وخراف البحرين

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يهدف هذا البحث إلى دراسة الفلورا الفطرية في ٢٥ عينة من شعر الماعز والخراف والتي جمعت من البحرين باستخدام طريقتين للعزل عند ٢٥ م . تم عزل وتعريف ٧٠ نوعاً فطرياً بالإضافة إلى ٣ أصناف تنتمي إلى ٣١ جنساً من نوعي الشعر المختلفين . وقد وجد أن شعر الخراف أكثر تلوثاً بالفطريات بالمقارنة بشعر الماعز حيث انه سجل أعلى تعداد للأصناف والأجناس الفطرية . تم عزل نوعين من الفطريات الجلدية وهما ترايكوفيتون ريرم وترايكوفيتون تيرست . وتم عز العديد من الفطريات المحبة للكيراتين ولكن بنسب متفاوتة ومنها كريزوسبوريم انديكم ، كريزوسبوريم كيراتينوفيلم وكريزوسبوريم تروبيكم حيث انه أكثر شيوعاً . ووجد ان الفطريات التي تنتمي إلى أجناس اسبرجيلس ، بنسيليوم ، ايميرسيلا ، التيرناريا وكوشلوبولس كانت اكثر الفطريات الرمية شيوعاً من حيث تواجدها .

*Key Words:* Dermatophytes, Keratinophilic, Saprophytic fungi, Goats, Sheep

### ABSTRACT

The mycoflora on the hair in 25 samples of each of goats and sheep collected from El - Bahrain was analysed using two isolation methods at 25 °C. Seventy species and 3 varieties belonging to 31 genera were collected from the two substrates. The hairs of sheep were more polluted with fungi than the goat ones, containing higher total counts and number of genera and species. Two species of true dermatophytes were isolated namely: *Trichophyton rubrum* and *T. terrestre*. Several keratinophilic species were isolated, but with different frequency, of which *Chrysosporium indicum*, *C. keratinophilum* and *C. tropicum* were the most prevalent. The commonest saprophytes in order of frequency were members of the genera *Aspergillus*, *Penicillium*, *Emericella*, *Alternaria* and *Cochliobolus*.

### INTRODUCTION

Animals are known to carry dermatophytes and other keratinophilic fungi on their coats. These animals may act as a direct source of human and other animals infections for subjects in contact with them, or as an indirect source of infection by contaminating working areas and dwelling places [1]. Thus, studies on dermatophytes and keratinophilic fungi on healthy hairs of domestic animals are of considerable significance.

The presence of keratinophilic fungi on hairs of various animals has been briefly reviewed by numerous researches

in many parts of the world [2-16]. In El-Bahrain, information on the existence of such fungi are not available. Thus, this study has attempted to isolate dermatophytes and keratinophilic associated with the hair of two small animals (sheep and goats).

### MATERIALS AND METHODS

A total of 50 healthy hair samples of goats and sheep (25 each) were collected randomly from different localities in El-Bahrain. The samples were placed in clean plastic bags and transferred to the laboratory. For isolation of mycoflora associated with the animals hair, two methods were used:

### a. Hair-baiting technique

For isolation of dermatophytes and other keratinophilic fungi, the hair-baiting technique [17] was employed. Five fragments from each sample were scattered on the surface of moistened sterile soil (20-25% moisture content) in sterile plates (2 plates for each sample). The plates were incubated at 25°C for 10-12 weeks and the soil in plates was remoistened with sterile distilled water whenever necessary. The moulds which appear on the hair fragments were transferred to the surface of Sabouraud's dextrose agar medium [18]. The medium was supplemented with 0.5 g cycloheximide (actidione), 40 mg/ml streptomycin and 20 units/ml penicillin as bacteriostatic agents. The plates were incubated at 25°C for 2-4 weeks and the developing fungal colonies were counted, identified and calculated per 10 hair fragments for each sample. The relative importance value (RIV) was calculated [19,20] as follows:

- 1 - Species frequency in a sample (A-values) = number of hair fragments that yielded the species/total number of hair fragments transferred) \* 100.
- 2 - Mean frequency of the species in all samples (B-value)=(A-values) of the species in all samples / total number of samples.
- 3 - Relative mean frequency of the species in the samples (C-values) = (B-value) of the species/ (B-values) of all species isolated from the samples.
- 4 - Overall frequency of the species (D-values) = Number of samples from which the species was isolated / total number of samples.
- 5 - Relative importance value (RIV) = (C-value + D-value)\* 100

### b- The dilution-plate method

For estimation of saprophytic fungi associated with the hair, the dilution-plate method as described by Johnson and Curl (21) was used. Glucose-Czapek's agar medium was used in which rose-bengal (1/15000) and chloramphenicol (25 µg/ml) were added as bacteriostatic agents. Five plates were used for each sample and the plates were incubated at 25°C for 2-3 weeks. The developing fungi were counted, identified and calculated per g hair.

## RESULTS AND DISCUSSION

### a. Dermatophytic and keratinophilic fungi (using hair baiting technique at 25°C)

Eleven species belonging to 2 genera of dermatophytes and closely related fungi were isolated from goat (7 species and 2 genera) and sheep hairs (10 and 2). The most con-

taminated hairs were of sheep with the higher total counts (288 isolates/250 fragments) and wide spectrum of species (10 species) than goat ones (171 isolates and 7 species) as shown in table (1).

*Chrysosporium* was the most frequent genus and emerged in 92% and 96% of the samples comprising 91.2% and 87.8% of total isolates and have RIV of 183.2 and 193.8 of goat and sheep, respectively. This genus has also been isolated from cloven hooves and horns of goats and sheep, in Egypt, by Abdel-Hafez *et. al.* [22]. They observed that it was represented in 79% and 51% of the samples constituting 23.4% and 24.7% of total fungi of goat and sheep, respectively. Ali-Shtayeh *et. al.* (5) indicated that *Chrysosporium* was found in 9.3% of all keratinophilic fungi on goat hair from the West Bank of the Jordan. Also, they isolated the above genus from different animals hair in Jordan and it was represented in 13.7% of cow, 14.6% of donkey, 15.8% of rabbit, 25.0% of cat and 50.1% of dog hairs. It was represented by 9 species of which *C. indicum*, *C. keratinophilum* and *C. tropicum* were the most prevalent species. They occurred in 28%, 36% and 48% of goat and 40%, 68% and 48% of sheep hairs comprising 6.4% and 15.9%; 21.6% and 28.9%; and 30.4% and 21.2% of total isolates on the two substrates, respectively. These three species were also, predominant among fungi isolated from hairs of camel and goats [8] and cloven-hooves and horns of goats and sheep [22]. The above species were also isolated from mammals in Venezuela by Moraes *et al.* (23), Australia by Rees (15), India by Gugnani *et. al.* [23], Australia by Rees [15], India by Gugnani *et. al.* [11], Jordan by Ali-Shtayeh *et. al.* [6] and Egypt by Bagy [7].

One species namely *C. pannorum* and 1 unidentified *Chrysosporium* species were of low frequency of occurrence on goat hair but rare on sheep hairs. They constituted 16% and 12% of the samples matching 10.5% and 5.2%, and 14.6% and 7.3% of total isolates on goat, and sheep hairs, respectively. The previous identified species was found to be in 1.7% of goat hairs from Egypt [8].

Some species were isolated only from one substrate and not on the other such as *C. dermatitidis* (8% of the samples and 4.7% of total fungi) on goat; *C. asperatum* (4% and 2.7%), *C. carmichalii* (8% and 2.4%) and *C. queenslandicum* (4% and 1.7%) on sheep hairs. Other less common species recovered on the two substrates included: *C. xerophilum* (Table 1). Most of these fungi were recovered, with variable degrees and densities, from animal hair or natural soil baited with sterilized human or animal hair from Egypt [7, 8, 22, 24 - 28] as well as from other parts of the world [6, 19, 29, 39, 31].

Dermatophytes on goat and sheep hairs were represented only by one genus *Trichophyton*. It occurred in 12% and 24% of the animals examined comprising 8.8% and 12.2% of total isolates and have RIV of 20.7 and 36.1 on goat and sheep, respectively (Table 1). This result is in agreement with the finding of Bagy & Abdel-Hafez [8] who reported

that this genus was in low occurrence on large mammals. Also, Abdel-Hafez *et. al.* [22] isolated this genus rarely from cloven-hooves and horns of goat and sheep. It was represented by 2 species and 1 unidentified species of which *T. terrestre* was isolated from the two substrates rarely. It was found in 8% of the samples constituting 2.9% and 3.5% of total isolates recovered on goat and sheep, respectively. Otcenasek & Dvorak [32] reported that *T. terrestre* was a skin contaminant of small mammals from South Eastern Moravia. Aho [3] isolated *T. terrestre* from different animals including goats. The other identified species namely *T. rubrum* (1.7% of total isolates) was isolated rarely from sheep hairs and not encountered from goat hairs. Also these species were isolated from different substrates as reported by several researches all over the world.

#### b - Saprophytic fungi (on glucose-Czapek's agar at 25°C)

Fifty-nine species and 3 varieties appertaining to 29 genera were collected from 25 hair samples of each of goat (38 species + 3 varieties and 16 genera) and sheep (48 + 2 and 26) on glucose-Czapek's agar at 25°C (Tables 2,3). Several saprobic and cycloheximide - resistant fungi were encountered. The most prevalent species on the two substrates were members of *Alternaria*, *Aspergillus*, *Emergicella* and *Penicillium*. This result was greatly similar to those obtained by Aho (4) who reported that members of *Penicillium*, *Cladosporium*, *Aspergillus*, *Alternaria*, *Scopulariopsis*, *Trichoderma* and *Trichothecium* were the most common in order of frequency of saprophytic fungi from hairs of domestic and laboratory animals in Finland.

Table I

Total isolates (TI, calculated per 250 hair fragments), number of cases of isolation (NCI, out of 25 samples), occurrence remarks (OR) and relative importance values (RIV) of dermatophytic and keratinophilic fungi recovered from hairs of 25 animals and keratinophilic fungi recovered from hairs of 25 animals of each of goat and sheep at 25°C.

Genera & species	Goat			Sheep		
	TI	NCI & OR	RIV	TI	NCI & OR	RIV
<i>Chrysosporium</i>	156	23 H	183.2	253	24H	183.8
<i>C. asperatum</i> Carmichael	-	-	-	5	2.R	5.7
<i>C. carmichaelii</i> Van Oorschot	-	-	-	7	2R	10.4
<i>C. dermatitidis</i> Carmichael	8	2R	12.6	-	-	-
<i>C. indicum</i> (Rand. & Sand.) Gary	11	7M	34.4	46	10M	55.9
<i>C. keratinophilum</i> (Frey) Carmichael	37	9M	57.6	83	17H	96.8
<i>C. pannorum</i> (Link) Hughes	18	4L	26.5	15	3R	17.2
<i>C. queensland</i> Apinis & Rees	-	-	-	5	1R	5.7
<i>C. tropicum</i> Carmichael	52	12M	78.4	61	12M	69.1
<i>C. xerophilum</i> Pitt	5	1R	6.9	10	2R	11.4
<i>Chrysosporium</i> sp.	25	4L	30.6	21	3R	19.3
<i>Trichophyton</i>	15	3R	20.7	35	6L	36.1
<i>T. rubrum</i> (Castellani) Sabouraud	-	-	-	5	1R	5.7
<i>T. terrestre</i> Durie & Frey	5	2R	10.9	10	2R	11.4
<i>Trichophyton</i> sp.	10	2R	13.8	20	4L	22.9
Total isolates	171			288		
Number of genera = 2	2			2		
Number of species = 11	7			10		

Table 2

Number of species (NS), percentage count (%C, calculated per total fungi) and percentage frequency (%F, calculated per 25 samples) of various fungal genera recovered from hairs of 25 animals of each of goat and sheep on glucose-Czapek's agar at 25°C.

Genera & species	Goat			Sheep		
	NS	%C	%F	NS	%C	%F
<i>Acremonium</i> (1)	-	-	-	1	0.7	8
<i>Alternaria</i> (2)	2	5.7	64	1	1.2	20
<i>Aspergillus</i> (12+1 var)	12+1	66.0	100	9	57.7	100
<i>Botryotrichum</i> (1)	1	0.3	4	1	0.2	4
<i>Chaetomium</i> (1)	1	0.4	4	1	0.4	8
<i>Circinella</i> (1)	-	-	-	1	1.3	16
<i>Cladosporium</i> (1)	1	0.7	8	-	-	-
<i>Cochliobolus</i> (5)	2	1.8	20	5	9.1	72
<i>Curvularia</i> (2)	-	-	-	2	2.1	40
<i>Emericella</i> (2 +2 var)	2+2	6.8	56	1+2	4.0	52
<i>Fusarium</i> (1)	-	-	-	1	0.6	8
<i>Gilmaniella</i> (1)	-	-	-	1	0.7	12
<i>Humicola</i> (1)	-	-	-	1	0.5	8
<i>Microascus</i> (2)	1	0.3	4	1	0.3	4
<i>Mucor</i> (2)	2	1.0	12	2	2.1	36
<i>Mycosphaerella</i> (1)	1	1.4	12	1	0.4	8
<i>Nectria</i> (1)	-	-	-	1	0.4	8
<i>Nigrospora</i> (1)	-	-	-	1	0.2	4
<i>Paecilomyces</i> (1)	-	-	-	1	0.2	4
<i>Papulaspora</i> (1)	-	-	-	1	0.2	4
<i>Penicillium</i> (9)	7	12.1	80	8	10.3	80
<i>Phoma</i> (1)	1	0.3	4	-	-	-
<i>Rhizopus</i> (1)	1	0.6	8	1	1.6	24
<i>Scopulariopsis</i> (2)	-	-	-	2	1.9	28
<i>Setosphaeria</i> (1)	-	-	-	1	1.1	16
<i>Stachybotrys</i> (1)	1	0.3	4	-	-	-
Sterile mycelia (white & dark colour)	1	1.0	12	-	1.3	24
<i>Torula</i> (1)	1	0.4	4	1	0.6	12
<i>Trichoderma</i> (1)	-	-	-	1	0.3	4
<i>Ulocladium</i> (2)	2	0.9	8	1	0.6	12
Number of genera = 29	16			26		
Number of species = 59 + 3 var.	38 +3 var			48 + 2 var.		

*Aspergillus* was the most frequent saprophytic fungus found in all samples constituting 66.0% and 57.7% of total isolates on goat and sheep, respectively. From the genus 12 species and one variety were isolated of which *A. flavus*, *A. fumigatus*, *A. niger*, *A. ochraceus* and *A. terreus* were the predominant species. They occurred in 32-100% and 24-100% of the hairs examined comprising 2.8-16% and 1.2-27.8% of total fungi on the two substrates, respectively. *A. candidus*, *A. carneus*, *A. terreus* var *africanus* and *A. wentii* were isolated only from goat hairs and not encountered on sheep hairs. The remaining *Aspergillus* species were less common (Table 3). Bagy & Abdel-Hafez [8] reported that *Aspergillus* species was the second most frequent genus on the hairs of goat and camel from Al-Arish in Egypt. They noticed that *A. niger*, *A. flavus*, *A. sydowii*, *A. fumigatus* and *A. nidulans* were the most common species.

*Penicillium* (9 species) was the second most predominant genus which occurred in 80% of the animals test-

ed, contributing 12.1% and 10.3% of total fungi on goat and sheep, respectively. *P. chrysogenum*, *p. citrinum* and *P. puberulum* were prevalent on the two substrates. They were found in 20-40% and 20-56% of the samples, comprising 1.8-3.5% and 1.3-3.1% of total fungi, respectively. *P. duclauxii*, was isolated only from goat hairs while *P.aurantiogriseum* and *P. waksmanii* from sheep hairs. The remaining *Penicillium* 3 species were encountered on the two substrates in rare or low frequency (Table 3). Also, members of *Penicillium* were among the most common fungi on the hair of different animals from West Bank of the Jordan (5,6) and Al-Arish of Egypt [8].

*Alternaria* (2 species), *Cochliobolus* [5] and *Emericella* (2+2 varieties) were also prevalent and isolated in high or low frequency from the two substrates. They were found in 20-64% and 20-72% of the samples tested comprising 1.8-6% and 20-72% total isolates on goat and sheep, respectively. From the above genera *A. alternata*, *C. haw-*

Table 3

Average total (ATC, calculated per g hair in all samples), number of cases of isolation (NCI, out of 25 samples) and occurrence remarks (OR) of fungal genera and species recovered from hairs of 25 animals of each of goat and sheep on glucose-Czapek's agar at 25°C

Genera & species	Goats		Sheep	
	ATC	NCI& OR	ATC	NCI & OR
<i>Acremonium</i>	-	-	118	2R
<i>A. strictum</i> W. Gams	-	-	81	2R
<i>Acremonium</i> sp	-	-	37	1R
<i>Alternaria</i>	525	16H	193	5L
<i>A. alternata</i> (fries) Keissler	475	16H	193	5L
<i>A. tenuissima</i> (Kunze: Pers.) Wiltshire	50	2R	-	-
<i>Aspergillus</i>	6064	25H	9303	25H
<i>A. aureolans</i> Munt. Cvet & Bata	87	3R	37	2R
<i>A. candidus</i> Link	31	1R	-	-
<i>A. carneus</i> (v. Tieghem)	43	2R	-	-
<i>A. flavus</i> Link	1525	24H	4475	25H
<i>A. fumigatus</i> Fresenius	1475	25H	1912	24H
<i>A. niger</i> Van Tieghem	1542	25H	2250	25H
<i>A. ochraceus</i> Wilhelm	812	19H	312	8M
<i>A. sydowii</i> (Bain. & Sart.) Thom & Church	75	3R	62	2R
<i>A. terreus</i> Thom	256	8M	193	6L
<i>A. terreus</i> var. <i>africanus</i> Fennell & Raper	118	4L	-	-
<i>A. ustus</i> Fennell & Raper	37	1R	31	1R
<i>A. versicolor</i> (Vuill.) Tiraboschi	31	1R	31	1R
<i>A. wentii</i> Wehmer	31	1R	-	-
<i>Botryotrichum atrogriseum</i> Van Beyma	31	1R	31	1R
<i>Chaetomium globosum</i> Kunze	37	1R	68	2R
<i>Circinella muscae</i> (Sorok.) Berl. & Detoni	-	-	206	4L
<i>Cladosporium cladosporioides</i> (Fres.) de Vries	62	2R	-	-
<i>Coeliobolus</i>	162	5L	1460	18H
<i>C. hawaiiensis</i> Alcorn	131	4L	324	4L
<i>C. intermedius</i> Nelson	-	-	162	3R
<i>C. lunatus</i> Nelson & Haasis	-	-	425	10M
<i>C. spicifer</i> Nelson	31	1R	206	6L
<i>C. tuberculatus</i> Jain	-	-	343	6L
<i>Curvularia</i>	-	-	342	6L
<i>C. clavata</i> Jain	-	-	193	3R
<i>C. pallescens</i> Boedijn	-	-	106	3R
<i>Curvularia</i> sp.	-	-	43	1R
<i>Emericella</i>	623	14H	643	13H
<i>E. nidulans</i> (Eidam) Vuillemin	237	7M	175	6L
<i>E. nidulans</i> var. <i>dentata</i> Sandhu & Sandhu	218	6L	181	4L
<i>E. nidulans</i> var. <i>lata</i> (Thom & Raper) Subram.	81	2R	287	7M
<i>E. rugulosa</i> (Thom & Raper) Benjamin	87	2R	-	-
<i>Fusarium oxysporum</i> Shelecht.	-	-	93	2R
<i>Gilmaniella humicola</i> Barron	-	-	118	3R
<i>Humicola grisea</i> Traaen	-	-	75	2R
<i>Microascus</i>	31	1R	43	1R
<i>M. cinereus</i> (Emile-Weil ex Gaudin) Curzi	31	1R	-	-
<i>M. trigonosporus</i> Emmons & Dodge	-	-	43	1R
<i>Mucor</i>	93	3R	336	6L

Table 3, Contd.

Genera & species	Goat		Sheep	
	ATC	NCI & OR	ATC	NCI & OR
<i>M. circinelloides</i> Van Tighem	62	2R	268	5L
<i>M. hiemalis</i> Wehmer	31	1R	68	2R
<i>Mycosphaerella tassiana</i> (Albertini: Schweinitz)				
<i>Ditmir</i> ex Steudel	131	3R	62	2R
<i>Nectria haematococca</i> Berkeley & Brown	-	-	68	2R
<i>Nigrospora sphaerica</i> (sacc.) Mason	-	-	37	1R
<i>Paecilomyces lilacinus</i> (Thom) Samson	-	-	31	1R
<i>Papulaspora immersa</i> Hotson	-	-	37	1R
<i>Penicillium</i>	1110	20H	1661	20H
<i>P. aurantiogriseum</i> Dierckx	-	-	150	4L
<i>P. chrysogenum</i> Thom	325	10M	506	14H
<i>P. citrinum</i> Thom	168	5L	212	7M
<i>P. corylophilum</i> Dierckx	150	5L	125	4L
<i>P. duclauxii</i> Delacroix	62	2R	-	-
<i>P. funiculosom</i> Thom	68	2R	56	2R
<i>P. oxalicum</i> Currie & Thom	112	4L	181	5L
<i>P. puberulum</i> Bainier	225	8M	306	10M
<i>P. waksmanii</i> Zaleski	-	-	125	4L
<i>Phoma glomerata</i> (Corda) Woll. & Hochapfel	31	1R	-	-
<i>Rhizopus stolonifer</i> (Ehrenb.) Lindt	56	2R	256	6L
<i>Scopulariopsis</i>	-	-	300	6L
<i>S. brevicaulis</i> (Sacc.) Bainier	-	-	225	6L
<i>S. candida</i> (Guegen) Vuillemin	-	-	75	2R
<i>Seiosphaeria rostrata</i> Leonard	-	-	175	4L
<i>Stachybotrys chartarum</i> (ehrenb: Lindt) Hughes	31	1R	-	-
<i>Sterile mycelia</i> (white & dark colour)	87	3R	212	6L
<i>Torula herbarum</i> (Pers.) Link	37	1R	106	3R
<i>Trichoderma hamatum</i> (Bonord.) Bain	-	-	43	1R
<i>Ulocladium</i>	80	2R	100	3R
<i>U. botrytis</i> Preuss	43	1R	100	3R
<i>U. tuberculatum</i> Simmons	37	1R	-	-
Gross total count	9191		16117	
Number of genera = 29	16		26	
Number of species = 59 + 3	38 + 3		48 + 2	

Occurrence remarks (OR) : H = high occurrence, between 13-25 (out of 25); M = moderate occurrence, from 7-12 cases; L = low occurrence, from 4-6 cases; R = rare occurrence, from 1-3 cases.

*aiiensis*, *C. lunatus*, *E. nidulans* var. *dentata* and *E. nidulans* var. *lata* were common. The other species of the preceding genera were less frequent (Table 3). These three genera were isolated from the skin of dogs and cats [9], cloven-hooves and horns of goats and sheep [22], hair of goats, cows, donkeys and cats [5,6] and camel and goat hairs [8].

The remaining genera were isolated in rare or low frequency and encountered collectively in 7.6% and 18.7% of total fungi on goat and sheep hair, respectively (Table 3).

In conclusion, the mycofloral analysis of goat and sheep hairs indicated that there are several keratinophilic and sap-

rophytic fungi on the animal hairs. The hairs of sheep were more contaminated than goat hairs. Some species were predominant on one substrate and less on the other. Eleven species were encountered only from goat but not from sheep hairs. On the contrary, 23 species were isolated from sheep and not from goat hairs. Probably, natural fats on the two hairs are different in type and proportion, and are responsible for these variations and this is the objective of future work

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