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Fungi Associated with the Hairs of Goat and Sheep in Libya

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The mycoflora on the hair in 25 samples of each of goats and sheep collected from Libya was analyzed 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 polluted with fungi than goat, contained high total counts and number of genera and species. Two species of true dermatophytes were isolated namely *Trichophyton rubrum* and *T. terrestre*. Several keratiophilic species were isolated 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*.

KEYWORDS : Goat, Hair fungi, Sheep

Animals are known to carry dermatophytes and other keratinophilic fungi on their hairs. These animals may act as a source of human and animal infections by direct contact or by contaminating working areas and dwelling places (Ripon, 1982). Therefore, studies on dematophytes and keratinophilic fungi present on hair of domestic animals are of considerable significance.

The presence of keratinophilic fungi on hairs of various animals has been briefly reviewed by numerous researchers in many parts of the world (Rees, 1967; Gugnani *et al*., 1975; Aho, 1980, 1983; Lopez-Martinez *et al*., 1984; Bagy and Abdel-Hafez, 1985; Bagy, 1986; Ali-Shtayeh *et al*., 1988a, b, 2000; Kubo *et al*., 1990; El-Said and Abdel-Hafez, 1995; El-Said, 1996, 2002; Rashid *et al*., 1996; Camin *et al*., 1998; Gugnani, 2000; Hubalek, 2000; Alghalibi, 2001; Moses and Sunday, 2001; Shukia *et al*., 2003; Periasamy *et al*., 2004; Dobrowolska *et al*., 2006; Ulfig, 2007; Thanaa *et al*., 2008 and others).

This study aimed to isolate dermatophytes and keratinophilic fungi associated with the hair of sheep and goats in Libya.

Materials and Methods

A total of 50 hair samples of goats and sheep (25 each) were collected randomly from different localities in Jifarah region. The samples were placed in clean plastic bags and transferred to the laboratory. For isolation of fungi associated with the animals hair, hair-baiting technique and dilution-plate method were used.

Hair-baiting technique. For isolation of dermatophytes and other keratinophilic fungi, the hair- baiting technique (Vanbreuseghem, 1952) 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 (Moss and McQuown, 1969). The medium was supplemented with 0.5 g cycloheximide (actidione), 40 $\mu g/ml$ 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 (Shearer and Webster, 1985; Ali-Shtayeh and Asa's Al-Sheikh, 1988).

The dilution-plate method. For estimation of saprophytic fungi associated with the hair, the dilution-plate method as described by Johnson and Curl (1972) was used. Glucose-Czapek's agar medium was used in which rose-bengal (0.1 mg/*ml*) and chloramphenicol (500 $\mu g/l$) were added as bacteriostatic agents. Five plates were used for each sample and the plates were incubated at 25ºC for 2-3 weeks. The developing fungi were counted, identified and calculated per g hair.

Results and Discussion

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 goats (7 species and 2 genera) and sheep hairs (10 and 2). The most contaminated hairs were those

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of sheep with the highest total counts (288 isolates/250 fragments) and wide spectrum of species (10 species) than goat's hair (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 the total isolates and have RIV of 183.2 and 183.8 of goats and sheep, respectively. This genus was also, isolated from cloven-hooves and horns of goats and sheep, in Egypt, as reported by Abdel-Hafez *et al*. (1990). They observed that it was represented in 79% and 51% of the samples constituting 23.4% and 24.7% of the total fungi of goats and sheep, respectively. Ali-Shatayeh *et al.* (1988a) indicated that *Chrysosporium* was found in 9.3% of all Keratinophilic fungi on goat's hair from the West Bank of 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's hair. 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 the total isolates on the two substrates, respectively. These three species were also, predominant among fungi isolated from hairs of camel and goats (Bagy and Abdel-Hafez, 1985) and cloven-hooves and horns of goats and sheep (Abdel-Hafez *et al*., 1990). The above species were also, isolated from mammals in Venezuela by Moraes *et al*. (1967), Austrailia by Rees (1967), India by Gugnani *et al.*(1975), Jordan by Ali-Shtayeh *et al*. (1988b) and Egypt by Bagy (1986).

One species namely *C. pannorum* and an unidentified *Chrysosporium* species were of low frequency on goats hairs. They were encountered in 16% and 12% of the samples matching 10.5% and 5.2% and 14.6% and 7.3% of the total isolateds on goat, and sheep hairs, respectively. The previous identified species was found to be in 1.7% of goat hairs from Egypt (Bagy and Abdel-Hafez, 1985).

Some species were isolated only from one substrate and not from the other such as *C. dermatitidis* (8% of the samples and 4.7% of total fungi) from goat; *C. asperatum* (4% and 1.7%), *C. carmichalii* (8% and 2.4%) and *C. queenslandicum* (4% and 1.7%) from sheep hairs. Other less common fungi which were recovered from the two substrates included *C. xerophilum* (Table 1). Most of these fungi were recovered, with variable degrees and densities from animals hair or natural soil baited, with sterilized human or animals hair from Egypt (Bagy and Abdel-Hafez, 1985; Bagy, 1986; Abdel-Hafez, 1987; Moharram *et al*., 1988; Abdel-Gawad, 1989; Abdel-Hafez *et al*., 1989, 1990, 1991; Moharram and Abdel-Gawad, 1989; Abdel-Hafez and EL-Sharouny, 1990; El-Said, 1996, 2002; El-Said and Abdel-Hafez, 1995; Thanaa *et al*., 2008

Table 1. Total isolates (T I, 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 of each goats and sheep at 25°C

Genera & species	Goats			Sheep		
	TI	NCI&OR	RIV	TI	NCI&OR	RIV
Chrrysosporium	156	23H	183.2	253	24H	183.8
C.asperatium Carmichael	–	–	–	5	IR	5.7
C.carmichalii Van Oorschot	–	–	–	7	2R	10.4
C dermatitidis Carmichael	8	2R	12.6	–	–	–
C indicum (Rand. & Sand.) Gery	11	7M	34.4	46	10M	55.9
C. keratinophilum (Frey) Carmichael	37	9M	57.6	83	17H	96.8
C. pannorum (Link) Hughes	18	4L	26.5	15	3R	17.2
C.queenslandicum Apinis & Rees	–	–	–	5	1R	5.7
C. tropicum Carmichael	52	12M	78.4	61	12M	69.1
C. xerophilum Pitt	5	1R	6.9	10	2R	11.4
Chrysosporium sp.	25	4L	30.6	21	3R	19.3
Trichophyton	15	3R	20.7	35	6L	36.1
T. rubrum (castellani) Sabouraud	–	–	–	5	1R	5.7
T. terrestre Durie & Frey	5	2R	10.9	10	2R	11.4
Trichophyton 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	

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.

and others) as well as from other parts of the world (Filipello Marchisio, 1986; Ali-Shtayeh, 1988; Ali-Shtayeh and Asa`d AL-Sheikh, 1988; Ali-Shtayeh *et al.*, 1988a, b, 2000; Chabasse *et al.*, 1989; Kubo *et al.*, 1990; Rashid *et al.*, 1996; Camin *et al.*, 1998; Gugnani, 2000; Hubalek, 2000; Alghalibi, 2001; Moses and Sunday, 2001; Shukia *et al.*, 2003; Periasamy *et al.*, 2004; Dobrowolska *et al.*, 2006; Ulfig, 2006 and others).

Dermatophytes on goat and sheep hairs were represented only by the genus *Trichophyton*. It occurred in 12% and 24% of the animal hair samples examined representing 8.8% and 12.2% of the total isolates and have RIV of 20, 7 and 36, 1 on goats and sheep, respectively (Table 1). This result is in agreement with the finding of Bagy and Abdel-Hafez (1985) who reported that this genus was in low occurrence on large mammals. Also, Abdel-Hafez *et al.* (1990) isolated this genus in rare frequency from cloven-hooves and horns of goats and sheep. It was represent by 2 species and 1 unidentified species of which *T. terrestre* was isolated from the two substrates in rare occurrence. It emerged in 8% of the samples constituting 2.9% and 3.5% of the total isolates recovered on goats and sheep, respectively. Otcenasek and Dvorak (1962) reported that *T. terrestre* was probably only a skin contaminant of small mammals from South Eastern Moravia. Aho (1983) isolated *T. terrestre* from different animals including goats. The other identified species namely *T. rubrum* (1.7% of total isolates) was isolated in rare frequency from sheep hairs and was not encountered from different substrates as reported by several researchers from all over the world (Abdel-Hafez *et al.*, 1991; El-Said, 1996, 2002; El-Said and Abdel-Hafez, 1995; Ali-Shtayeh *et al.*, 1988a, b, 2000; Alghalibi, 2001; Moses and Sunday, 2001; Shukia *et al.*, 2003; Periasamy *et al.*, 2004; Dobrowolska *et al.*, 2006; Ulfig, 2006; Thanaa *et al.*, 2008 and others).

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 goats and sheep on glucose-Czapek's agar at 25°C

Genera	Goats			Sheep		
	NS	% C	%F	NS	% C	%F
Acremonium (1)	–	–	–	1	0.7	8
Alternaria (2)	2	5.7	64	1	1.2	20
Aspergillus (12 + 1 var.)	12+1	66.0	100	9	57.7	100
Botryotrichum (1)	1	0.3	4	1	0.2	4
Chaetomium (1)	1	0.4	4	1	0.4	8
Circinella (1)	–	–	–	1	1.3	16
Cladosporium (1)	1	0.7	8	–	–	–
Cochliobolus (5)	2	1.8	20	5	9.1	72
Curvularia (2)	–	–	–	2	2.1	40
Emericeela (2 + 2 var.)	2+2	6.8	56	1+2	4.0	52
Fusarum (1)	–	–	–	1	0.6	8
Gilmaniella (1)	–	–	–	1	0.7	12
Humicola (1)	–	–	–	1	0.5	8
Microascus (2)	1	0.3	4	1	0.3	4
Mucor (2)	2	1.0	12	2	2.1	36
Mycosphaerella (1)	1	1.4	12	1	0.4	8
Nectria (1)	–	–	–	1	0.4	8
Nigrospora (1)	–	–	–	1	0.2	4
Paecilomyces (1)	–	–	–	1	0.2	4
Papulaspora (1)	–	–	–	1	0.2	4
Penicillium (9)	7	12.1	80	8	10.3	80
Phoma (1)	1	0.3	4	–	–	–
Rhizopus (1)	1	0.6	8	1	1.6	24
Scopulariopsis (2)	–	–	–	2	1.9	28
Setosphaeria (1)	–	–	–	1	1.1	16
Stachybotrys (1)	1	0.3	4	–	–	–
Sterile mycelia (white & dark colour)	-	1.0	12	–	1.3	24
Torula (1)	1	0.4	4	1	0.6	12
Trichoderma (1)	–	–	–	1	0.3	4
Uloclad ium	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		

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 goats (38 species + 3 varieties and 16 genera) and sheep (48 + 2 and 26) on glucose-Czapek's agar at 25°C (Tables 2 and 3). Several saprobic and cycloheximide resistant fungi were encountered and the most prevalent species on the two substrates were members of *Alternaria*, *Aspergillus*, *Emericella* and *Penicillium*. These results are similar to those obtained by Aho (1980) who reported that members of *Penicillium*, *Cladosporium*, *Asperillus*, *Alternaria*, *Scopulariopsis*, *Trichoderma* and *Trichothecium* were the most common in order of frequency saprophytic fungi from hairs of domestic and laboratory animals in Finland.

Aspergillus was the most frequent saprophytic fungus emerging in all samples constituting 66.0% and 57.7% of total isolates on goats and sheep, respectively. From this genus 12 species and one variety were identified of which *A. flavus*, *A. fumigatus*, *A. niger*, *A. ochraceus* and *A. terreus* were the most predominant species. They occurred in 32~100% and 24~100% of the hairs examined comprising 2.8~16.8% and 1.2~27.8% of total fungi on the two types of substrates, respectively. *A. candidus*, *A. carneus*, *A. terreus* var. *africanus* and *A. wentii* were isolated only from goat hair but were not encountered on sheep hairs. The remaining *Aspergillus* species were less common (Table 3). Bagy and Abdel-Hafez (1985) 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. Also, Moharram *et al.* (1988) they found noticed that *Aspergillus* (10 species +1 variety) was the first most dominant fungi on human hairs in Egypt.

Penicillium (9 species) was the second most predominant genus and occurred in 80% of the animal tested contributing 12.1% and 10.3% of the total moulds on the goats and sheep, respectively. *P. chrysogenum*, *P. citrinum* and *P. puberulum* were prevalent on the two substrates. They emerged in 20~40% and 20~56% of the samples having 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 3 species of *Penicillium* were encountered on the two substrates in rare or low frequencies of occurrence (Table 3). Also, members of *Penicillium* were among the most common fungi on the hair of

Table 3. Average total count (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 goats and sheep on glucose-Czapek's agar at 25°C

Genera & species	Goats		Sheep	
	ATC	NCI & OR	ATC	NCI & OR
Acremonium	–	–	118	2R
A. strictun W. Gams	–	–	81	2R
Acremonium sp.	–	–	37	1R
Alternaria	525	12H	193	5L
A. alternata (Fries) Keissler	475	16H	193	5L
A. tenuissima (Kunse : Pers.) Wiltshire	50	2R	–	–
Aspergillus	6064	25H	9303	25H
A. aureolatus Munt. Cvet. & Bata	87	3R	37	2R
A. candidus Link	31	1R	–	–
A. carneus (V. Tiegh.) Blochwitz	43	2R	–	–
A. flavus Link	1525	24H	4475	25H
A. fumigatus Fresenius	1475	25H	1912	24H
A. niger Van Tieghem	1542	25H	2250	25H
A. ochraceus Wilhelm	812	19H	312	8M
A. sydowii (Bain. & Sart.) Thon & Church	75	3R	62	2R
A. terreus Thom	256	8M	193	6L
A. terreus var. *africanus* Fennell & Raper	118	4L	–	–
A. ustus Fennell & Raper	37	1R	31	1R
A. versicolor (Vuill.) Tiraboschi	31	1R	31	1R
A. wentii Wehmer	31	1R	–	–
Botryotrichum atrogriseum Van Beyma	31	1R	31	1R
Chactomium glabosum kunze	37	1R	68	2R
Circinella muscae (Sorok) Berl. & Detoli	–	–	206	4L
Cladosporium Cladosporioides (Fres.) de Vries	62	2R	–	–
Cohliobolus	162	5L	1460	18H
C. hawaiiansis Alcorn	131	4L	324	4L

Table 3. Continued

Genera & species	Goats		Sheep	
	ATC	NCI & OR	ATC	NCI & OR
C. intermedius Nelson	–	–	162	3R
C. lunatus Nelson & Haasis	–	–	425	10M
C. Spicifer Nelson	31	1R	206	6L
C. tuberculatus Jain	–	–	343	6L
Curvlaria	–	–	342	6L
C. clavata Jain	–	–	193	3R
C. Pallescens Boedijn	–	–	106	3R
Curvularia sp.	–	–	43	1R
Emericella	623	14H	643	13H
E. nidulans (Eidam) Vuillemin	237	7M	175	6L
E. nidulans var. *dentata* Sandhu & Sandhu	218	6L	181	4L
E. nidulans var. *lata* (Thom & Raper) Subram	81	2R	287	7M
E. rugulosa (Thom & Raper) Benjamin	87	2R	–	–
Fusarium oxysporum Shelecht	–	–	93	2R
Gilmaniella humicola Barron	–	–	118	3R
Humicola grisea Traaen	–	–	75	2R
Microascus	31	1R	43	1R
M. cinereus (Emile - Weil ex Gaudin) Curzi	31	1R	–	–
M. trigonosporus Emmons & Dodge	–	–	43	1R
Mucor	93	3R	336	6L
M. circinelloides van Tieghem	62	2R	268	5L
M. hiemalis Wehmer	31	1R	68	2R
Mycosphaerella tassiana (Albertini & Schweinitz) Ditmer ex Steudel	131	3R	62	2R
Nectria haematococca Berkeley & brown	–	–	68	2R
Nigrospora sphaerica (Sacc.) Mason	–	–	37	1R
Paecilomyces lilacinus (Thom) Samson	–	–	31	1R
Papulaspora immerse Hotson	–	–	37	1R
Penicillium	1110	20H	1661	20H
P. aurantiogriseum Dierckx	–	–	150	4L
P. chrysogenun Thom	325	10M	506	14H
P. citrinum Thom	168	5L	212	7M
P. corylophilum Dierckx	150	5L	125	4L
P. dudauxii Delacroix	62	2R	–	–
P. funiculoum Thom	68	2R	56	2R
P. oxalicum currie & Thom	112	4L	181	5L
P. puderulum Bainier	225	8M	306	10M
P. waksmanii Zaleski	–	–	125	4L
Phoma glonerata (Crda) Woll. & Hochabfel	31	1R	–	–
Rhizopus stolonifer (Ehrenb.) Lindt	56	2R	256	6L
Scopulariopsis	–	–	300	6L
S. brevicaulis (Sacc.) Bainier	–	–	225	6L
S. cundida (Gueguen) Vuillemin	–	–	75	2R
Setosphaeria rostrata Leonard	–	–	175	4L
Stachibotrys Chartarum (Ehrenb : Lindt) Heghes	31	1R	–	–
Sterile mycelia (white & dark colour)	87	3R	212	6L
Torula herbarum (Pers.) Link	37	1R	106	3R
Trichoderma hamatum (Bonord.) Bain.	–	–	43	1R
Ulocladium	80	2R	100	3R
U. botrytis Preuss	43	1R	100	3R
U. tuberculatum Simmons	37	1R	–	–
Gross total count	9191		16117	
Number of genera	16		26	
Number of species = 59 + 3 var.	83 + 3 var.		48 + 2 var.	

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

different animals from West Bank of Jordan (Ali-Shtayeh *et al*., 1988 a, b), AL-Arish of Egypt (Bagy and Abdel-Hafez, 1985) and El-Bahrin (El-Said, 1996).

Alternaria (2 species), *Cochliobolus* (5) and *Emericella* (2 + 2 varieties) were also prevalent and isolated in high occurrence from one or two substrates. They were found in 20~64% and 20~72% of the samples tested comprising 1.8~6.8% and 1.2~9.1% of total isolates on goats and sheep, respectively. From the above genera, *A. alternata*, *C. hawaiiensis*, *C. lunatus*, *E. nidulans*, *E. nidulans* var. *dentata* and *E. nidulans* var. *lata* were common. Other species of the preceding genera were less frequent (Table 3). The three genera were isolated from the skin of dogs and cats (Bone and Hackson, 1971), cloven-hooves and horns of goats and sheep (Abdel-Hafez *et al*., 1990), hairs or goats, cows, donkeys and cats (Ali-Shtayeh *et al*., 1988a, b) and camel and goats hairs (Bagy and Abdel-Hafez, 1985).

The remaining genera were isolated in rare or low frequencies of occurrence and were encountered collectively in 7.6% and 18.7% of the total moulds on goat sheep hairs, respectively (Table 3).

In conclusion, analysis of the mycoflora of goat and sheep hairs indicated that there are several keratinophilic and saprophytic fungi on the animal hairs. The hairs of sheep were contaminated more than goat hairs. This may be due to the increasing of organic in sheep hair than goat hair. The amount of organic matter fluctuated between 0.340~0.899% in sheep and 0.191~0.694% in 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. Several investigators, in many parts of the world isolated the saprophytic fungi which were recovered in the present work from various substrates including foodstuffs; seeds; grains; root and leaf surface of numerous plants; hairs, claws, cloven-hooves and horns of domestic and wild animals; soils; muds and air.

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