Study of the distribution of *Malassezia* species in patients with pityriasis versicolor and healthy individuals in Tehran, Iran

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Abstract

**Background:** Pityriasis versicolor is a superficial infection of the stratum corneum which caused by a group of yeasts formerly named pityrosporium. The taxonomy of these lipophilic yeasts has recently been modified and includes seven species referred as *Malassezia*. The aim of this study is to compare the distribution of *Malassezia* species isolated from pityriasis versicolor lesions and those isolated from healthy skins.

**Methods:** Differentiation of all *malassezia* species performed using morphological features and physiological test including catalase reaction, Tween assimilation test and splitting of esculin.

**Results:** In pityriasis versicolor lesions, the most frequently isolated species was *M. globosa* (53.3%), followed by *M. furfur* (25.3%), *M. sympodialis* (9.3%), *M. obtusa* (8.1%) and *M. slooffiae* (4.0%). The most frequently isolated species in the skin of healthy individuals were *M. globosa*, *M. sympodialis*, *M. furfur*, *M. slooffiae* and *M. restricta* which respectively made up 41.7%, 25.0%, 23.3%, 6.7% and 3.3% of the isolated species.

**Conclusions:** According to our data, *M. globosa* was the most prevalent species in the skin of healthy individuals which recovered only in the yeast form. However, the Mycelial form of *M. globosa* was isolated as the dominant species from pityriasis versicolor lesions. Therefore, the role of predisposing factors in the conversion of this yeast to mycelium and its subsequent involvement in pityriasis versicolor pathogenicity should be considered.
Background
Yeasts of the genus *Malassezia* are known to be members of the skin microflora of human and other warm-blooded vertebrates [1,2]. These lipophilic yeasts are associated with various human diseases, especially pityriasis versicolor (PV), a chronic superficial scaling dermatomycosis [3]. This disease is common in late teens and young adults of both sex and characterized by well-demarcated scaling patches with variable pigmentation [4].

Although PV had been described at the beginning of nineteen century [5], until recently classification of its etiologic agent was a matter of debt. This controversy may be caused by various morphological features and fastidious growth requirements of *Malassezia* yeasts in vitro.

The genus of *Malassezia* has undergone several taxonomic revisions [1,6]. In the last reclassification by Gueho et al, seven distinct species were recognized within this genus, namely *M. furfur, M. pachydermatis, M. sympodialis, M. globosa, M. obtusa, M. restricta* and *M. slooffiae* [7]. Furthermore, recently three new species were included in this genus namely, *M. dermatitis, M. equi* and *M. nana* [8,9]. However, the acceptance of these new species is still under investigation. There is only scanty information about the epidemiology and ecology of *Malassezia* species available and the clinical significance of these species is not completely recognized. Therefore, the aim of this study is to establish whether there is any association between the various species of *Malassezia* and PV lesions as well as determining *Malassezia* species microflora of healthy individuals.

Methods
Subjects
Ninety four outpatients at Razi hospital and medical mycology unit in the school of public health were included in this study. 100 age- and sex-matched clinically healthy individuals (without any dermatosis) were also conducted as control. A questionnaire was used to getting informative data about history of each person.

Collection and culture of samples
Mycological examinations were performed to confirm the diagnosis of pityriasis versicolor. Specimens were taken by scraping the lesions with a scalpel. Moreover, in normal subjects and in cases which there were not sufficient scales, samples were taken by means of sellotape.

Direct microscopy with KOH 20% and methylene blue staining were carried out in the PV lesions as well as normal samples. All samples were also inoculated in plates containing modified Dixon medium. The plates were incubated at 31°C for two weeks and examined at frequent intervals for developing colonies.

Tween assimilation test
According to the method reported by Guillot et al. [10], ability to utilize different Tween compounds as a unique lipid supplement by *Malassezia* species was evaluated. Briefly, yeast suspension (at least 10^7 cfu/ml) was made in 2 ml sterilized distilled water and poured into plate containing Sabouraud dextrose agar at 45°C. The inoculum was then spread evenly. After solidification of each plate, four wells were made and filled with 30 µl of a Tween compound, i.e. Tween 20, 40, 60 and 80, respectively. These plates were incubated for a week at 31°C and the growth was assessed around the individual wells after 2, 4 and 7 days.

Catalase reaction
Presence of catalase was determined by using a drop of hydrogen peroxide (3% solution) and production of gas bubbles was considered as a positive reaction. Lack of catalase activity is a characteristic feature of *M. restricta* [10].

Splitting of esculin
The β-glucosidase activity of different *Malassezia* species was assayed using method described by Mayser et al. [11]. Briefly, a loop of fresh yeast was inoculated deeply in the esculin agar tube and incubated for 5 days at 32°C. The splitting of esculin is revealed by darkening of the medium. This test was used to distinguish *M. furfur, M. slooffiae* and *M. sympodialis* from other *Malassezia* species.

Statistical analysis
Quantitative data were analyzed by the group *t*-test. The data of the patient and healthy controls were analyzed using chi-square test. Correlation of predisposing factors with PV as well as the difference between isolates from patients and normal individuals was evaluated by Fisher exact test. Specificity and sensitivity of direct exam versus culture were computed. Besides, the effects of predisposing factors on culture results in both groups were eliminated by Mantel-Haenszel tests. A *P*-values of <0.05 were considered significant.

Results
From 94 patients with PV, 52.1% of the cases were female. The average and median ages of patients were 29.19 ± 11.14 and 27 years, respectively. The highest prevalence of
tinea versicolor was seen in patients with 20–30 years of age. Significant differences in the distribution of predisposing factors (i.e. allergy, hyperhydrosis, diabetes) were observed between patient groups (58.5%) and healthy control (30 %)(P < 0.001).

Direct examination of specimens was positive in 98.9% of PV lesions, in which hyphae were seen in 89.4% of positive cases together with budding yeasts. However, only 79.8% of the specimens yielded *Malassezia* in culture. Besides, culture positive cases were higher in patients than healthy controls and these differences was statistically significant (P < 0.05). Specificity and sensitivity of direct exam in comparison with culture were determined 62.8% and 99.4%, respectively.

Actual data related on predisposing factors and culture results were presented in tables 1, 2 and 3. Statistical analysis revealed that in both groups with and without predisposing factors (allergy, hyperhydrosis and diabetes), the rate of positive culture cases was higher in patients than controls. Regarding elimination the effects of predisposing factors by Mantel-Haenszel test, only hyperhydrosis could cause difference in the culture of samples in patients compared with those in healthy individuals.

In pityriasis versicolor lesions, the most commonly isolated species was *M. globosa* (53.3%), followed in frequency by *M. furfur* (25.3%), *M. sympodialis*(9.3%), *M. obtusa* (8.1%) and *M. slooffiae* (4.0%). However, the most frequently detected species in healthy individuals were *M. globosa*, *M. sympodialis*, *M. furfur*, *M. slooffiae*, and *M. restricta* which respectively made up 41.7%, 25.0%, 23.3%, 6.7% and 3.3% of the isolated *Malassezia* flora. Table 4 and 5, show the distribution of *Malassezia* species, based on the sites of sample collection. Overall, no differences in distribution of *Malassezia* were noted between patients group and healthy controls (P = 0.1).

### Table 1: Frequency of culture results and hyperhydrosis in patients with pityriasis versicolor compared with normal subjects.

| Group         | Patient | Normal |
|---------------|---------|--------|
| Culture results | Positive | Negative | Total | Positive | Negative | Total | statistical result |
| Hyperhydrosis | No | % | No | % | No | % | No | % | No | % |
| Positive      | 37 | 74.0 | 13 | 26.0 | 50 | 100.0 | 9 | 60.0 | 6 | 40.0 | 15 | 100.0 | f.p = 0.23 |
| Negative      | 67 | 72.8 | 25 | 27.2 | 92 | 100.0 | 51 | 60.0 | 34 | 40.0 | 85 | 100.0 | X² = 3.27 P = 0.07 |
| Total         | 104 | 73.2 | 38 | 26.8 | 142 | 100.0 | 60 | 60.0 | 40 | 40.0 | 100 | 100.0 | X²MH = 3.74 P = 0.053 |

f.p: fisher exact test p-value; X²: Chi square; P: P value; X²MH: Mantel-Haenszel Chi square No: Number; %: Percent.

### Table 2: Frequency of culture results and allergy in patients with pityriasis versicolor compared with normal subjects.

| Group         | Patient | Normal |
|---------------|---------|--------|
| Culture results | Positive | Negative | Total | Positive | Negative | Total | statistical result |
| Allergy       | No | % | No | % | No | % | No | % | No | % |
| Positive      | 19 | 63.3 | 11 | 36.7 | 30 | 100.0 | 6 | 45.5 | 5 | 45.5 | 11 | 100.0 | f.p = 0.44 |
| Negative      | 85 | 75.9 | 27 | 24.1 | 112 | 100.0 | 54 | 60.7 | 35 | 39.3 | 89 | 100.0 | X² = 5.38 P = 0.02 |
| Total         | 104 | 73.2 | 38 | 26.8 | 142 | 100.0 | 60 | 60.0 | 40 | 40.0 | 100 | 100.0 | X²MH = 4.77 P = 0.03 |

f.p: fisher exact test p-value; X²: Chi square; P: P value; X²MH: Mantel-Haenszel Chi square No: Number; %: Percent.

### Discussion

Although pityriasis versicolor has worldwide occurrence, its frequency is variable and depends on different climatic, occupational and socio-economic conditions [12,13]. This disease is prevalent in Iran, in which almost 6% of all dermatosis and approximately 30% of dermatomycoses are due to these lipophilic yeasts [14,15].

Similar to other investigations [1,3,16,17], the highest prevalence of PV in present study was observed in 20–30 year-old group, suggesting that the peak of the infection is coincided with ages when the sebum production is in the highest level. Although 60% of patients in age range of 10–20 years were female, this proportion was reversed in
the age group 20–30. Lower maturity age in female compared with male can be considered as the possible reason of this dissimilarity.

Pityriasis versicolor is uncommon in children [3]. We just found one case of PV in a child with the age less than 10 years. Moreover it is only rarely found in the elderly [1], as we have only two cases of PV over 50s.

The role of sex in propensity to development of PV is still unclear. Some studies found that PV is more common in men than women [18,19]. While others indicated that the incidence of this infection is higher in women [20-22], which may be due to extra attention of women to beauty and skin hygiene. However, similar to many reports [3,4,17], we found no differences in development of PV among both sexes.

Table 3: Frequency of culture results and diabetes in patients with pityriasis versicolor compared with normal subjects.

| Group | Positive | Negative | Total | Positive | Negative | Total | statistical result |
|-------|----------|----------|-------|----------|----------|-------|-------------------|
| Diabetes | No | % | No | % | No | % | No | % | No | % | No | % |
| Positive | 2 | 66.7 | 1 | 33.3 | 3 | 100.0 | 2 | 50.0 | 2 | 50.0 | 4 | 100.0 | f.p = 0.6 |
| Negative | 102 | 73.4 | 37 | 26.6 | 139 | 100.0 | 58 | 60.4 | 38 | 39.6 | 96 | 100.0 | $X^2 = 4.39$ P = 0.04 |
| Total | 104 | 73.2 | 38 | 26.8 | 142 | 100.0 | 60 | 60.0 | 40 | 40.0 | 100 | 100.0 | $X^2_{MH} = 3.97$ P = 0.046 |

f.p: fisher exact test p-value; $X^2$: Chi square; P: P value; $X^2_{MH}$: Mantel-Haenszel Chi square No: Number; %: Percent.

Table 4: Distribution of Malassezia species based on the body sites in Pityriasis Versicolor

| Anatomic site (%) | Species | Neck | Chest | Abdomen | Back | Limbs | Groin | Total |
|-------------------|---------|------|-------|---------|------|-------|-------|-------|
| M. globosa        | 13 (61.9) | 7 (41.2) | 2 (25.0) | 14 (63.6) | 2 (66.7) | 2 (50.0) | 40 (53.3) |
| M. furfur         | 3 (14.3) | 7 (41.2) | 2 (25.0) | 6 (27.4) | 1 (33.3) | 0 (0.0) | 19 (25.3) |
| M. sympodialis    | 1 (4.8) | 1 (5.9) | 2 (25.0) | 1 (4.5) | 0 (0.0) | 2 (50.0) | 7 (9.3) |
| M. obtusa         | 4 (19.0) | 1 (5.9) | 1 (12.5) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 6 (8.1) |
| M. slooffiae      | 0 (0.0) | 1 (5.8) | 1 (12.5) | 1 (4.5) | 0 (0.0) | 0 (0.0) | 3 (4.0) |
| Total             | 21 (100.0) | 17 (100.0) | 8 (100.0) | 22 (100.0) | 3 (100.0) | 4 (100.0) | 75 (100.0) |

Table 5: Distribution of Malassezia species based on the body sites in healthy individuals

| Anatomic site (%) | Species | Scalp | Chest | Back | Total |
|-------------------|---------|-------|-------|------|-------|
| M. globosa        | 8 (28.6) | 6 (42.9) | 11 (61.1) | 25 (41.7) |
| M. furfur         | 9 (32.1) | 3 (21.4) | 2 (11.1) | 14 (23.3) |
| M. sympodialis    | 8 (28.6) | 3 (21.4) | 4 (22.2) | 15 (25.0) |
| M. slooffiae      | 1 (3.6) | 2 (14.3) | 1 (5.6) | 4 (6.7) |
| M. restricta      | 2 (7.1) | 0 (0.0) | 0 (0.0) | 2 (3.3) |
| Total             | 28 (100.0) | 14 (100.0) | 18 (100.0) | 60 (100.0) |
well established [1,25]. In this regard, no significant differences were observed in culture results of patients in comparison with controls after elimination the effects of endogenous factors such as hyperhydrosis by statistical tests. Similar to other investigations [3,26], our results strongly support that hyperhydrosis can be considered as the endogenous factors in mediating the development of this infection.

In this survey, the most affected areas were the trunk and neck, which is concordant with the majority of studies worldwide [3,21,27]. The distribution of Malassezia species on back and chest is parallel with the density and activity of pilosebaceous glands in these areas. However, there are few reports indicated that PV lesions can occur in unusual location such as the nipple, genital areas and groin [28-30]. Similar to previous studies [27], we found no statistical difference in the distribution of Malassezia species on various body sites.

Diagnosis of PV is generally simple and lies on the clinical manifestations and microscopic examinations of the lesions [13,23]. In the direct examination 98% of PV samples yielded positive results which is the same as the results reported by Erchiga et al [31]. Two patients with negative results in this study had also been received topical antifungal treatment.

In 89.4% of positive cases of PV, classical feature so-called "spaghetti and meatball" were seen. Our results are consistent with those previously published and confirm the significance of the yeast-mycelium conversion in pathogenesis of this infection [23,31]. Regarding high sensitivity and acceptable specificity of direct exam, diagnosis of PV is based on observation of short hyphae and yeast in the scales. However, in cases that only hyphae were presented in the scales, direct examination of samples with KOH especially by unskilled technicians, may fail to reveal the infection. Hence, we suggest staining the scales prior to performing light microscopic examination to avoid false-negative results.

Culture is necessary to distinguish the Malassezia species by morphological and physiological methods. In the present study, the recovery rate of Malassezia species from the PV lesions was 87%, which was most comparable to recent study by Nakabayashi et al [19]. But, our result is higher than some previous studies [27,32-34]. The difference may be due to this fact that margin of the PV lesions might be used to collect specimens. However as it shown by Erchiga et al [23], unlike other dermatomycosis, center of the PV lesions yields more viable materials for culture. Hence we scraped center of the lesions instead of the borders to increase recovery rate and avoid isolation of surrounding commensal species. Besides, more recovery rate which was reported by Gupta et al [21] may reflect the difference in culture media and sampling method. Although Leeming & Notman agar which used by them enhances recovery of Malassezia spp., modified Dixon agar provides features of colonies [1,33].

Based on many studies, more than one species can be recovered from each sample [21]. On the other hand, providing a pure culture and discriminating a species from mixed sample is too difficult. This might be due to this point that fast growing species usually cover other species in the culture. Besides, because of hydrophobic characteristic of Malassezia yeast, preparing homogenous suspension is very difficult to separate them by culture [1]. Moreover, some Malassezia species may loss their viability after several subcultures [7]. That's why we selected single separated colony in each species for analyzing.

As we mentioned above, Malassezia species are members of the normal skin flora and can be recovered from different sites of the body especially the sebaceous-rich areas. In healthy skin, we found Malassezia species by direct examination and culture with the frequency of 62% and 60%, respectively. These rates of positive results in our study are lower than those from recent study of Gupta et al [21] and may suggest the difference in sampling method and culture medium. Similar to the majority of other investigations [19,34,35], we found M. globosa as the most frequent species in healthy skin. By contrast, M. sympodialis was the main isolated species in some other investigations [17,22,36,37].

In this survey, the most common isolated species in PV lesions was M. globosa, which is concordant with the majority of studies worldwide [19,31,32,38]. This was contrary to observation of Makimura et al, which isolated M. furfur and M. sympodialis as the predominant species in PV lesions [37]. Although Gupta et al, were also found M. sympodialis as the predominant agent of PV in temperate climate, they reported M. globosa as the main agent in tropical regions [27]. Moreover, M. furfur was the second most frequent species isolated from PV lesions in the present study which was similar to the report of Dutta [32]. However they failed to isolate M. slooffiae from PV lesions.

Conclusions
Collectively, M. globosa was also the most prevalent species in healthy individuals and recovered from healthy skin only in yeast form. Furthermore, our results suggested that M. globosa especially in the mycelial form, is the main agent of PV and M. furfur is the second agent in importance. This hypothesis gained strength because of the fact that M. globosa is a species with high levels of esterase and lipase enzymes with probable importance in
pathogenicity [38]. It remains an open question, if there are any differences in enzyme components of its mycelial phase with yeast form.

Competing interests
None declared.

Authors' contributions
All authors contributed equally in the study design, literature search, data analysis and manuscript preparation. All authors read and approved the final manuscript.

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References
1. Midgley G, Gueho E, Guillot J: Disease caused by Malassezia species. In Topley and Wilson's Microbiology and microbial infections Volume 4. 9th edition. Edited by: Ajello L, Hay RJ. London: Arnold; 1998:201-211.
2. Leeming JP, Notman FH, Holland KT: The distribution and ecology of Malassezia furfur and cutaneous bacteria on human skin. J Appl Bacteriol 1989, 67(1):47-52.
3. Gupta AK, Bluhm R, Summerbell R: Pilzbildung in der Pityriasis versicolor. Fröfip Neue Notizen aus dem Gebeite der Naturkunde Heilkunde 1846, 39:270.
4. Ingham E, Cunningham AC: Malassezia furfur. Med Mycol 1993, 31:265-288.
5. Gueho E, Midgley, Guillot J: The genus Malassezia with description of four new species. Antonie Leeuwenhoek 1996, 69:337-355.
6. Gupta AK, Kohli Y, Summber RC, Faergemann J: Mycelial analysis of Malassezia species from different body sites of individuals with or without dermatoses. Med Mycol 2001, 39(3):243-51.
7. Burke RC: Tinea versicolor: socioeconomic and clinico- mycologic study in India. Int J Dermatol 1991, 30:600.
8. Rudolph RI, Holzwarth JM: Inverse tinea versicolor. Arch Dermatol 1975, 111:1213.
9. Ashbee HR, Evans EG: Immunology of diseases associated with Malassezia species. Clin Microbiol Rev 2002, 15(1):21-37.
10. Boardman CR, Malkinson FD: Unilateral areolar and periareolar tinea versicolor. Int J Dermatol 1991, 30:623-4.
11. Midgley G: The lipophilic yeasts: state of the art and prospects. Med Mycol 2000, 38(Suppl 1):9-16.
12. Mosher P, Haze P, Papavasillis C, Pickel M, Gruender K, Gueho E: Differentiation of Malassezia species: selectivity of Cremophor EL, castor oil and rincicoleic acid for M. furfur. Br J Dermatol 1997, 137:208-213.
13. Borelli D, Jacobs PH, Nall L: Tinea versicolor: epidemiologic, clinical, and therapeutic aspects. J Am Acad Dermatol 1991, 25:300-5.
14. Sunenshine PJ, Schwartz RA, Janniger CK: Tinea versicolor. Int J Dermatol 1998, 37(9):648-55.
15. Jalali AMH: Study the prevalence of superficial fungal diseases, Rasht, Iran [in Persian]. J Faculty Medicine Guilan Univ Med Sci. 1991, 10(4):245-252.
16. Burke RC: Tinea versicolor: susceptibility factors and experimental infections in human beings. J Invest Dermatol 1961, 36:389-402.
17. Crespo Erchiga V, Ojeda Martos A, Vera Casano A, Crespo Erchiga A, Sanchez Fajardo F, Gueho E: Mycology of pityriasis versicolor. J Mycol Med 1999, 9:143-148.
18. Belec L, Testa J, Bourre P: Pityriasis versicolor in the Central African Republic: a randomized study of 144 cases. J Med Vet Med 1991, 29:323-329.
19. Nakabayashi A, Sei Y, Guillot J: Identification of Malassezia species isolated from patients with seborrhoeic dermatitis, atopic dermatitis, pityriasis versicolor and normal subjects. Med Mycol 2000, 38:337-341.
20. Nikpoo N, Leppard B: Fungal disease in shiraz. Pahlavi Med J 1978, 901:27-49.
21. Gupta AK, Kohli Y, Summerbell RC, Faergemann J: Quantitative culture of Malassezia species from different body sites of individuals with or without dermatoses. Med Mycol 2001, 39(3):243-51.
22. Crespo Erchiga V, Ojeda Martos A, Vera Casano A, Crespo Erchiga A, Sanchez Fajardo F: Malassezia globosa as the causative agent of pityriasis versicolor. Br J Dermatol 2000, 143:799-803.
23. Dutta S, Bajaj AK, Basu S, Dikshit A: Pityriasis versicolor: socio-economic and clinico- mycologic study in India. Int J Dermatol 2002, 41(11):823-4.
24. Ashbee HR, Evans EG: Immunology of diseases associated with Malassezia species. Clin Microbiol Rev 2002, 15(1):21-37.
25. Boardman CR, Malkinson FD: Unilateral areolar and periareolar tinea versicolor. Int J Dermatol 1991, 30:600.
26. Rudolph RI, Holzwarth JM: Inverse tinea versicolor. Arch Dermatol 1975, 111:1213.
27. Crespo Erchiga V, Ojeda Martos A, Vera Casano A, Crespo Erchiga A, Sanchez Fajardo F: Malassezia globosa as the causative agent of pityriasis versicolor. Br J Dermatol 2000, 143:799-803.
28. Ashbee HR, Evans EG: Immunology of diseases associated with Malassezia species. Clin Microbiol Rev 2002, 15(1):21-37.
29. Boardman CR, Malkinson FD: Unilateral areolar and periareolar tinea versicolor. Int J Dermatol 1991, 30:600.
30. Rudolph RI, Holzwarth JM: Inverse tinea versicolor. Arch Dermatol 1975, 111:1213.
31. Crespo Erchiga V, Ojeda Martos A, Vera Casano A, Crespo Erchiga A, Sanchez Fajardo F: Malassezia globosa as the causative agent of pityriasis versicolor. Br J Dermatol 2000, 143:799-803.
32. Dutta S, Bajaj AK, Basu S, Dikshit A: Pityriasis versicolor: socio-economic and clinico- mycologic study in India. Int J Dermatol 2002, 41(11):823-4.
33. Midgley G: The lipophilic yeasts: state of the art and prospects. Med Mycol 2000, 38(Suppl 1):9-16.
34. Mosher P, Haze P, Papavasillis C, Pickel M, Gruender K, Gueho E: Differentiation of Malassezia species: selectivity of Cremophor EL, castor oil and ricinoleic acid for M. furfur. Br J Dermatol 1997, 137:208-213.
35. Borelli D, Jacobs PH, Nall L: Tinea versicolor: epidemiologic, clinical, and therapeutic aspects. J Am Acad Dermatol 1991, 25:300-5.
36. Sunenshine PJ, Schwartz RA, Janniger CK: Tinea versicolor. Int J Dermatol 1998, 37(9):648-55.
37. Jalali AMH: Study the prevalence of superficial fungal diseases, Rasht, Iran [in Persian]. J Faculty Medicine Guilan Univ Med Sci. 1991, 10(4):245-252.
38. Moghadami M: Identification of Malassezia species isolated from patients with seborrhoeic dermatitis, atopic dermatitis, pityriasis versicolor and normal subjects. Med Mycol 2000, 38:337-341.
39. Nakabayashi A, Sei Y, Guillot J: Identification of Malassezia species isolated from patients with seborrhoeic dermatitis, atopic dermatitis, pityriasis versicolor and normal subjects. Med Mycol 2000, 38:337-341.
40. Nikpoo N, Leppard B: Fungal disease in shiraz. Pahlavi Med J 1978, 901:27-49.
41. Gupta AK, Kohli Y, Summerbell RC, Faergemann J: Quantitative culture of Malassezia species from different body sites of individuals with or without dermatoses. Med Mycol 2001, 39(3):243-51.
42. Crespo Erchiga V, Ojeda Martos A, Vera Casano A, Crespo Erchiga A, Sanchez Fajardo F: Malassezia globosa as the causative agent of pityriasis versicolor. Br J Dermatol 2000, 143:799-803.
43. Dutta S, Bajaj AK, Basu S, Dikshit A: Pityriasis versicolor: socio-economic and clinico- mycologic study in India. Int J Dermatol 2002, 41(11):823-4.
44. Midgley G: The lipophilic yeasts: state of the art and prospects. Med Mycol 2000, 38(Suppl 1):9-16.
45. Mosher P, Haze P, Papavasillis C, Pickel M, Gruender K, Gueho E: Differentiation of Malassezia species: selectivity of Cremophor EL, castor oil and ricinoleic acid for M. furfur. Br J Dermatol 1997, 137:208-213.
46. Borelli D, Jacobs PH, Nall L: Tinea versicolor: epidemiologic, clinical, and therapeutic aspects. J Am Acad Dermatol 1991, 25:300-5.
47. Sunenshine PJ, Schwartz RA, Janniger CK: Tinea versicolor. Int J Dermatol 1998, 37(9):648-55.
48. Jalali AMH: Study the prevalence of superficial fungal diseases, Rasht, Iran [in Persian]. J Faculty Medicine Guilan Univ Med Sci. 1991, 10(4):245-252.
49. Moghadami M: Identification of Malassezia species [in Persian]. J Faculty Medicine Shohid Beheshti Univ Med Sci 1998, 3–4;102-107.
50. Burke RC: Tinea versicolor: susceptibility factors and experimental infections in human beings. J Invest Dermatol 1961, 36:389-402.