Ethnobotanical Leaflets 13: 1373-81, 2009.

Herbal vs. Chemical Actives as Antidandruff Ingredients -Which Are More Effective in the Management of Dandruff?– An Overview

M Prabhamanju[1*], S Gokul Shankar[2] and K Babu[2]

[1]Mikasa, R&D Centre, Chennai, India

[2]R & D Center, Cholayil Private Ltd, Chennai, India
Corresponding author Email: mprabhamanju@yahoo.com

Issued November 01, 2009

Abstract

Dandruff, a clinical condition caused by *Malassezia (Pityrosporum)* species is of great cosmetic concern all over the world. Dandruff is known to be controlled by fungistatic ingredients in Anti-dandruff shampoos. A comparative study on the efficacy of chemical and herbal anti-dandruff ingredients on 'as is' basis and their performance in market shampoos was done *in vitro* against *Pityrosporum ovale* (MTCC 1374). Zinc pyrithione (ZnPTO), ketoconazole and other azole compounds recorded good anti-Pityrosporum activity among the chemical ingredients. Herbal ingredients like tea tree oil, rosemary oil, coleus oil, clove oil, pepper extract, neem extract, and basil extract also recorded anti-pityrosporum activity, but their MIC values are much higher than the synthetic ingredients. Shampoos containing ZnPTO and ketoconazole recorded higher
in vitro activities than the shampoos containing herbal AD ingredients.

Key Words : *Malassezia*, Pityrosporum, Dandruff, Anti-dandruff activity, Shampoos.

Introduction

Dandruff is a common scalp disorder affecting almost half of the post pubertal population of any ethnicity and both genders. The exact nature and etiology of dandruff has always been controversial since the time of the Greeks, through Sabouraud's era in late nineteenth century till to-date (Saint-Leger, 1990). Dandruff represents 25% of all scalp disorders (Herrera-Arellano et al 2004). It is present in an estimated 15-20% of the total population (Selden, 2005) and more than 50% of adult population (Ro and Dawson, 2005).

The pathogenesis of dandruff involves hyper proliferation, resulting in deregulation of keratinization. The corneocytes clump together, manifesting as large flakes of skin. Essentially keratolytic

agents, such as salicylic acid and sulfur, loosen the attachments between the corneocytes and allow them to be washed away with shampooing. Keratolytics soften, dissolve and release the adherent scale seen in dandruff, although the mechanism is not fully understood (Angela San Philippo, 2006).

The causative agents of dandruff belong to the group of scalp commensal lipophilic yeasts of the genus, *Malassezia.* Eradicating or controlling the abundance of yeasts appears to be the cleverest strategy for treating dandruff. Using various methods, different clinical and experimental protocols and distinct active ingredients, all indicate that applying antifungal based antidandruff shampoos lead to a stereotyped sequence of events. (Pierard-Franchimont *et al*, 2006)

Several fungi static compounds have been shown to improve dandruff condition. The main active ingredients include imidazole derivatives such as ketoconazole and other compounds such as selenium sulphide, zinc pyrithione (ZnPTO), piroctone olamine, cipropirox olamine, etc. The ultimate goals of antidandruff products are to remove scales, reduce *Malassezia (Pityrosporum)* spp adherence to corneocytes and inhibit the yeast growth. Besides the chemical actives, there is a wide range of herbal ingredients like pepper extract, basil extract, neem extract, rosemary oil, basil oil, clove oil, coleus oil, tea tree oil which have been documented to have good anti pityrosporum or antidandruff (AD) activity.

There are several independent studies on these chemical or herbal actives and their efficacy in AD shampoos. However, there is no comprehensive comparative *in vitro* study on the AD efficacy of the chemical and herbal actives on 'as is' basis or as a functional ingredient in the formulation (AD shampoo). Hence the present study was undertaken**.**

Materials and Methods

All natural and synthetic ingredients were procured from the local market. *P. ovale* MTCC 1374 culture was received from IMTECH, Chandigarh. The shampoos used in the study were popular brands in the Chennai market (names not disclosed to avoid any commercial implication). The base shampoo was prepared without any anti-dandruff ingredients

Minimum Inhibitory Concentration (MIC) (Krishnamoorthy *et al* (2006) and Takashi Sugita *et al* (2005):.

1. 24 hrs broth culture of the test organism was used for the study.
2. Doubling dilution of ingredients were done (5, 2.5, 1.25, 0.6 µg/ml) in the appropriate solvents.
3. The culture (10^4 cfu/ml) in the SDA broth with olive oil was used for inoculation of the tubes with the test ingredients and incubated at 30^0 C for 24 hrs.
4. After 24 hrs from the broth a loop full of culture was streaked on a SDA agar plate overlaid with olive oil to know the presence or absence of growth of *Malassezia.*
5. Agar dilution method was adapted for evaluation of shampoos. Different concentrations viz 2.5, 5, 7.5, 10, 25, 50, 75, 100, 125, 150 mg/ml of shampoos (containing active ingredients) were weighed separately in the petriplates and the molten SDA was poured and mixed thoroughly.
6. 20 µl of culture was spread over the agar.

7. The plates were incubated at 30^0 C for 3-5 days.
8. Experiments were done in triplicates with suitable controls.

Zone of Inhibition (ZOI) (Kumar GS *et al,* 2007)

1. 24 hrs broth culture was swabbed over the surface of Dixon agar
2. All the active ingredients and the shampoos were dissolved in their respective solvents at 10 mg/ml concentration.
3. A well of 7 mm diameter was cut at the centre of the agar and 100 µl of the above prepared samples were loaded on the well.
4. Plates were incubated at 30 ^{0} C for 3-5 days.
5. After incubation the zone was measured using zone measuring scale and recorded.

Results and Discussion:

The recorded results are presented in Tables 1 & 2, Fig 1 & 2.

1. Ketoconazole, Metronidazole and Fluconazole showed MIC of 2.5 µg/ml and ZOI of 25 mm.
2. ZnPTO and Octopirox showed MIC of 5 µg/ml and ZOI of 25 and 13 mm respectively.
3. Climbazole showed MIC of 20 µg/ml and ZOI of 30 mm.
4. Clove oil recorded good activity with a least MIC of 1000 µg/ml.
5. Coleus oil showed MIC at 25 mg/ml and ZOI of 8 mm, Basil oil recorded MIC at 10 mg/ml and ZOI of 5 mm, tea tree oil at 100 mg/ml and ZOI was nil and Rosemary oil at 200 mg/ml and ZOI was nil.
6. Propylene glycol extract of pepper showed MIC of 80 mg/ml, neem and Basil extracts showed inhibition at 100 mg/ml. No zones were observed.
7. Base shampoo (Control) showed MIC of 150 mg/ml and ZOI of 10 mm.
8. Shampoos A,B,C with 1% ZnPTO showed MIC at 5 mg/ml and ZOI of 27 mm dia., 1% ketoconazole showed MIC of 5 mg/ml and ZOI of 30 mm, 0.5 % climbazole showed MIC of 10 mg/ml and ZOI of 27 mm.
9. Herbal shampoo with 0.23% of Climbazole and tea tree oil, henna and lemon extract showed MIC at 25 mg/ml and ZOI of 23 mm.
10. Herbal shampoo with rosemary oil and tea tree oil showed MIC of 100 mg/ml and ZOI of 10 mm.

The lack of ZOI for the oils may be attributed to their inability to diffuse through the agar medium. Among the shampoos, those containing ZnPTO and Ketoconazole recorded higher activity levels. According to our survey in Chennai, India, most of the consumers with dandruff prefer to use shampoos with ZnPTO than any other actives.

In the survey conducted in Chennai population (consisting of both sexes) of 324 consumers only 138 were using AD shampoos of which 114 were users of shampoos with ZnPTO (82.6%), 8 were users of shampoo with ketoconazole, 8 were users of herbal shampoos and another 8 were using shampoos with climbazole. A large population (n= 186) were using shampoos with no specific antidandruff ingredients

despite having dandruff problem. This could be due to the lack of awareness regarding use of anti-dandruff shampoos or that their dandruff condition may be in the range of mild to moderate which would have been managed by regular hair washing with an ordinary shampoo. The preference to ZnPTO based shampoos by the consumers is mainly because of the better management of dandruff by these shampoos (data not included). The results of the present *in vitro* studies also justify this stand. ZnPTO besides controlling the proliferation of the causative agent may also heal the scalp by normalizing epithelial keratinization, sebum production, or both. Some of the earlier studies have also shown a significant reduction in the numbers of yeast organisms after the application of zinc pyrithione. Ketoconazole is a broad spectrum antimycotic agent that is active against *P. ovale* (Angela San Philippo, 2006). Ketoconazole, an imidazole derivative, is effective against many fungi both
in vivo and *in vitro* (Heel *et al*, 1982). It is effective in many dermatomycoses, including pityriasis versicolor (Faergamann *et al, 1982)*. However the lower preference to the ketoconazole based shampoos by the consumers may be attributed to the relatively higher costs. However, the people (n=8) who have turned to ketoconazole based shampoos in the present study had extensive dandruff and they have been prescribed to use the shampoos by their dermatologists. Further, even though Metronidazole, Fluconazole have also recorded significant anti-Pityrosporum activity *in vitro* (MIC and ZOI), their usage (oral/ topical drugs) may be limited to severe manifestations of *Malassezia* as in conditions like seborrheic dermatitis and pityriasis versicolor.

Among the herbal ingredients tea tree oil recorded significant anti-fungal activity. Tea tree oil is the essential oil of the leaves of the Australian *Melaleuca alternifolia* tree. It is a mixture of hydrocarbons and terpenes, consisting of almost 100 substances. The antimicrobial property is attributed primarily to the major component, terpinen-4-ol. Tea tree oil represents a sound alternative for patients with dandruff who prefer a natural product and who are willing to shampoo their hair daily (Angela San Philippo, 2006). In our current study, basil oil and coleus oil recorded the highest activity among the herbal ingredients.

Table 1: MIC and ZOI for all synthetic and Herbal ingredients

S.No	Sample	MIC	ZOI (dia in mm)
Synthetic Ingredients			
1.	Ketoconazole	2.5 µg/ml	25
2.	Metronidazole	2.5 µg/ml	25
3.	Fluconazole	2.5 µg/ml	25
4.	ZnPTO	5 µg/ml	25
5.	Octopirox	5 µg/ml	13
6.	Climbazole	20 µg/ml	30
Herbal Ingredients			
1.	Clove oil	1000 µg/ml	20
2.	Coleus oil	25 mg/ml	8
3.	Basil oil	10 mg/ml	5

4.	Tea tree oil	100 mg/ml	Nil
5.	Rosemary oil	200 mg/ml	Nil
6.	Pepper Extract	80 mg/ml	Nil
7.	Neem extract	100 mg/ml	Nil
8.	Basil extract	100 mg/ml	Nil

Table 2 : Anti dandruff activity of Shampoos with synthetic and herbal active ingredients

S.No	Shampoo with Actives	MIC	ZOI(dia in mm)
1	Base shampoo	150 mg/ml	10
2	1% ketoconazole	5 mg/ml	30
3	Shampoo A with 1 % ZnPTO	5 mg/ml	27
4	Shmapoo B with 1 % ZnPTO	5 mg/ml	27
5	Shampoo C wih 1 % ZnPTO	5 mg/ml	27
	0.5 % Climbazole	10 mg/ml	25
6	0.23 % Climbazole	25 mg/ml	23
7	0.15 % Tea tree oil, Rosemary oil	100 mg/ml	10

Figure 1: ZOI of different active ingredients against *P.ovale* 1374.

Figure 2: ZOI for Shampoos with different active ingredients against *P.ovale* 1374.

Ketoconazole and ZnPTO based shampoos (OTC products) are used more by the consumers for common dandruff problems. The shampoos with ZnPTO are preferred by majority of the consumers not only as the shampoo brands with ZnPTO (AD ingredient) are cheaper but also provide the desired functional benefit However, in very severe cases of dandruff , ketoconazole based shampoos are preferred despite their relatively higher costs.

Herbal ingredients like tea tree oil, rosemary oil, coleus oil, clove oil, pepper extract, neem extract, and basil extract also recorded anti-pityrosporum activity, but their MIC are much higher than the synthetic ingredients. These ingredients can be exploited for its AD activity individually or in combination in AD shampoos. The commercial shampoos with tea tree oil, rosemary oil, henna, lemon also recorded good anti-

pityrosporum activity *in vitro* but not better than shampoos with synthetic ingredients in both MIC and ZOI assays. But for regular usage even shampoos with herbal AD ingredients may suffice the purpose.

Acknowledgements

Sincere thanks to Mr. Ketan, Managing Director, Ms. Neetha, Manager HR and Mr. Ganesh, GM – R & D of Mikasa cosmetics Ltd. I also thank my friends and colleagues for their help and co-operation

References

Angela San philippo, M.D. and Joseph C.English III,MD. 2006. An overview of Medicated shampoos used in Dandruff treatment. *P&T* 31(7): 396-400.

Faergemann, J., and Djirv, L. 1982. Tinea versicolor: treatment and prophylaxis with ketoconazole. *Cutis* 30:542-550.

Heel, R. C., Brogden, R. N., Carmin,L., Morley, P. A., Speight, T. M. and Avery, G. S. 1982. Ketoconazole: a review of its therapeutic efficacy in superficial and systemic fungal infections. *Drugs* 23:1-36.

Herrera-Arellano, A., Jimenez-Ferrer, E., Vega-Pimentel, A.M., Martinez- Revera Mde, L., Hernandez-Hernandez, M., Zamilpa, A. et al. 2004. Clinical and mycological evaluation of therapeutic effectiveness of Solanum chrysotrichum standardized extract on patients with Pityriasis capitis (dandruff). A double blind and randomized clinical trial controlled with ketoconazole. *Planta Med* 70: 483-8

Krishnamoorthy, J.R., Ranganathan, S., Gokul Shankar, S., Ranjith, M.S. 2006. Dano : A herbal solution for Dandruff. *African J. Biotechnol* Vol.5(10), 960-962.

Kumar GS., Jayaveera, KN., Ashok kumar CK., Umachigi P Sanjay., BM Vrushabendra Swamy, DV Kishore Kumar. 2007. Antimicrobial effects of Indian medicinal plants against acne-inducing bacteria. *Tropical Journal of Pharmaceutical research.* Vol 6 (2) : 717-723.

Pierard-Franchimont, C., Xhauflaire-Uhoda, E. and Pierard,G.E. 2006. Revisiting Dandruff. *International Journal of cosmetic Science* 28. 311-318

Ro, B.I. and Dawson, T.L. 2005. The role of sebaceous gland activity and scalp microfloral metabolism in the etiology of seborrhoeic dermatitis and dandruff. *J Investig Dermatol Symp Proc* 10: 194-7.

Saint-Leger, D. 1990. The history of dandruff and dandruff in history. A homage to Raymond Sabouraud. *Ann Dermatol Venereol* 117: 23-7.

Selden S. Seborrhoic dermatitis. In: Travers R, Vinson RP, Meffert J, Quirk C, James WD, (edi). eMedicine world library. 2005 Sep 23 [cited 2006 Nov 30]. Available from: URL: http://www.emedicine.com/derm/topic396.htm

Takashi Sugita, Mami Tajima, Tomonobu Ito, Masuyoshi saito, Ryoji Tsuboi, and Akemi Nishikawa. 2005. Antifungal activites of Tacrolimus and Azole agents against the eleven currently accepted *Malassezia* Sp.

Journal of Clin. Microbiol 2824-2829.