A Comprehensive Analysis of The Effectiveness of Synthetic Shampoos and Crude Plant Extracts In Combating Dandruff

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Abstract

Dandruff, a common scalp issue causing flaking and itching, has led to the development of various treatments. Synthetic shampoos contain chemicals like ketoconazole, zinc pyrithione, selenium sulfide, and coal tar, targeting the root causes like Malassezia fungus. Yet, they may cause scalp irritation, dryness, and even dermatitis. Plant extracts like tea tree oil, neem, aloe vera, and coconut oil are gaining popularity for their natural properties. They offer antifungal, anti-inflammatory, and hydrating benefits, often with fewer side effects. Research on their effectiveness compared to synthetic shampoos shows mixed results, with both showing promise depending on individual preferences and sensitivities. However, synthetic shampoos tend to have more adverse reactions, such as coal tar causing discoloration and ketoconazole irritating sensitive scalps. Plant extracts, except for allergies, are generally well-tolerated. Considering long-term viability and ecological impact, synthetic shampoos pose environmental concerns due to their chemical contents, while plant extracts are biodegradable. Despite the availability and marketing of synthetic shampoos, the demand for eco-friendly plant-based alternatives is growing as people prioritize sustainability. Additionally, consumer preferences and cultural influences play a significant role in treatment uptake, with synthetic shampoos being widely available and familiar. However, as interest in sustainable products increases, so does the demand for plant-based alternatives. Moreover, it's essential to note that some synthetic shampoos have immediate and effective anti-fungal effects, while several plant extracts have shown equal efficacy over a longer period. Individual preferences and sensitivities may ultimately determine treatment options, with some preferring the convenience and familiarity of synthetic shampoos, while others opt for plant-based alternatives for their perceived natural and benign nature.

Keywords: Anti-dandruff, Dandruff, *Malassezia furfur,* Plant extract, Synthetic shampoo, zinc pyrithione,

DOI Number: 10.48047/nq.2022.20.9.nq44878 **NeuroQuantology 2022;20(9):7521-7536**

1. Introduction

Dandruff is a common scalp disorder characterized by the shedding of dead skin cells from the scalp (Silva et al., 2018). It is a common scalp disorder and also a major cosmetic problem as it leads to hair fall problems. It is estimated that dandruff affects approximately 50% of the global population (Gyedu-Akoto et al., 2015). Dandruff can cause itching, flaking, and irritation of the scalp, leading to discomfort and embarrassment for those affected. The etiology of dandruff appears to be dependent upon many factors: scalp gland secretions, head lice, microfloral metabolism, individual susceptibility and their interactions8-10, but the exact underlying cause of dandruff is unknown11. Fungi were one of the most suspected causative agents of scalp health problems worldwide12 (Imran et al 2016). The causes of dandruff are not fully understood, but factors such as excessive oil

production, fungal infection, and sensitivity to certain hair care products may contribute to its development (Nikam et al., 2022). Dealing with dandruff has been a top concern for people looking to keep their hair and scalp healthy. The traditional approach to treating dandruff has been the use of synthetic shampoos containing active ingredients such as zinc pyrithione, ketoconazole, coal tar, salicylic acid, and selenium sulfide. Synthetic shampoos are household staples designed to clean and nourish hair and scalp. These synthetic shampoos have shown varying degrees of effectiveness in reducing dandruff symptoms (Silva et al., 2018). However, concerns have been raised regarding the long-term use of synthetic shampoos due to their potential side effects (Gyedu-Akoto et al., 2015). Studies have shown that some synthetic shampoos can cause scalp irritation, dryness, and redness. Many contain active compounds like zinc pyrithione, selenium sulfide, ketoconazole, and coal tar, targeting the root causes of dandruff. For instance, zinc pyrithione fights the growth of Malassezia, a fungus linked to dandruff, while selenium sulfide reduces scalp cell turnover, reducing flaking. Ketoconazole, a potent antifungal, effectively treats fungal infections, including those responsible for dandruff. These chemicals disrupt the scalp's fungal or microbial environment, relieving dandruff symptoms. However, prolonged use of certain ingredients like selenium sulfide and coal tar may lead to scalp irritation, dryness, and hair discoloration. Concerns also arise about the environmental impact of synthetic chemicals in personal care products, prompting a shift toward more sustainable options.

On the other hand, crude plant extracts offer a natural approach to dandruff treatment, harnessing the therapeutic properties of botanicals. Traditional remedies include extracts from tea tree, neem, aloe vera, rosemary, and peppermint, known for their antibacterial, anti-inflammatory, and soothing effects, aiding scalp microbiome restoration and symptom relief. Tea tree oil, for example, extracted from the Australian Melaleuca alternifolia tree, boasts antifungal and antibacterial properties, effectively treating dandruff and seborrheic dermatitis. Neem, native to the Indian subcontinent, contains nimbidin and nimbin, with antifungal activity against Malassezia, making it valuable in anti-dandruff products. Crude plant extracts are often perceived as safer with fewer side effects compared to synthetics, though allergic reactions to certain botanicals are possible.

Malassezia furfur

Malassezia furfur is a lipophilic (fat-loving) fungus belonging to the genus Malassezia. This fungus is known to inhabit the skin of humans and other animals, where it can cause various skin conditions and diseases. *Malassezia furfur* is associated with a range of clinical manifestations, particularly dermatological disorders.

Varieties: *Malassezia furfur* can be further categorized into different varieties or subspecies based on genetic and biochemical differences. Varieties of Malassezia furfur include:

Malassezia furfur var. furfur

Malassezia furfur var. sub furfur

Association with Disease:

Malassezia furfur is implicated in various skin diseases and conditions, notably:

Pityriasis Versicolor: This is a common superficial fungal infection of the skin caused by Malassezia furfur. It is characterized by hypo- or hyper pigmented patches on the skin, often on the trunk.

Seborrheic Dermatitis: Malassezia furfur is believed to play a role in the pathogenesis of seborrheic dermatitis, a chronic inflammatory skin condition characterized by red, itchy, and flaky skin, commonly affecting the scalp and face.

Malassezia Folliculitis: This is a type of folliculitis caused by Malassezia species, including Malassezia furfur. It presents as itchy, acne-like papules and pustules.

Pathogenicity: Malassezia furfur is considered an opportunistic pathogen, meaning it usually resides harmlessly on the skin but can cause disease under certain conditions. Factors contributing to its pathogenicity include host susceptibility, environmental factors, and possibly changes in the local skin microenvironment.

Laboratory Identification: Malassezia species, including Malassezia furfur, can be identified in the laboratory through specialized culture techniques. They require specific growth conditions such as lipid-enriched media due to their lipophilic nature.

2. MATERIALS AND METHOD

2.1 Materials

The materials used in this study were glassware, pipettes, dropers, inoculation loop, spreader, dry leaves of *Murraya koenigii, Azadirachta indica, Eucalyptus teriticornis, and juice of Citrus limon"*, Sabouraud dextrose agar (SDA), Chloramphenicol, Olive oil, Ethanol (70%), Nutrient Agar (NA), Lactophenol cotton blue for staining of fungi, Synthetic shampoos which are Dove, Sunsilk, Head & shoulder, Clinic plus, and herbal shampoo- Khadi Naturals Amla and Bhringraj, distilled water, dandruff sample, and instrumentation which included an autoclave which was used in the preparation of media, laminar airflow (LAF) which was used to culture fungi, microscope to observe the fungi, mortar & pestle for preparing fine powder of dried leaves, centrifuge which was used for obtaining the leaves extract supernatant, hot air oven for drying of leaves(Prabhamanju, and Shankar et al 2009).

2.2 Method

2.2.1 Sample collection

Samples were collected from the scalp of people suffering from dandruff using a blunt sterile scalpel. The scalp of the people suffering from dandruff was scraped by a scalpel to collect dandruff.

2.2.2 Media preparation

To grow and isolate fungi Sabouraud dextrose agar (SDA) media was used which was prepared from scratch in the laboratory. For preparing SDA media Dextrose (40gm/L), Peptone (10gm/L), and Agar (20gm/L) were weighed in the following quantity as shown in Table 1:

Table 1: Composition of Sabouraud dextrose agar (SDA) media prepared in the laboratory

S. No.	Components	Weight (in gms)
1.	Dextrose	10 grams
2.	Peptone	2.5 grams
3.	Agar	5 grams

The above-given composition was dissolved in 250 ml of distilled water. then it was cooked in an autoclave at 15 psi 122-degree Celsius temperature, after that, it was cooled down to room temperature, and a pinch of an antibiotic (Chloramphenicol) was added to the media, to avoid the growth of any other unwanted micro-organisms, inside LAF. Pouring and plating were done under sterile conditions 150 microliter sterilized olive oil was spread over media using a spreader.

2.2.3 Growth of *Malassezia furfur*

Dandruff samples were cultured in the olive oil-supplemented plates. It was done in two ways-In 10 plates streaking was done using a dry dandruff sample and in the other 10 plates, streaking was done using a diluted dandruff sample. These plates were incubated at less than 27 degrees for 3-5 days.

2.2.4 Preparation of Nutrient Agar plates

Plates of Nutrient Agar (NA) were made by dissolving 7 grams of Nutrient agar in 250 ml of distilled water and then autoclaved. An antibiotic (Chloramphenicol) was added to inhibit any other unwanted growth. Pouring and plating were done in a sterile environment. These plates were stored in the refrigerator for 4 days. Wells were made using ELISA double puncture. These plates were supplemented with olive oil.

2.2.5 Preparation of leaf extract

Leaves of Murraya koenigii, Azadirachta indica, and Eucalyptus globulus are collected from green plants. They are washed to remove any contaminants. The washed leaves are shade-dried for 10-15 days. After drying, the leaves are sterilized in the laboratory. This is done by washing them with distilled water seven times. Then, the leaves are dried in a hot air oven for 10 minutes. The sterilized leaves are crushed into fine powder using a mortar and pestle.

The powder obtained from each type of leaf is divided into two equal parts (5g each). One part (5g) of the powder from each type of leaf is separately diluted in distilled water. The other part (5g) of the powder from each type of leaf is separately diluted in ethanol. These

dilutions are mixed properly using a magnetic stirrer. Each dilution (distilled water and ethanol) is transferred into centrifugal tubes. The tubes are then centrifuged at 3000 rpm for 5 minutes. After centrifugation, the supernatant (liquid portion above the sediment) is collected. The supernatant obtained from each extract (distilled water and ethanol) is used for antifungal estimation(Deviha & Pavithram, 2015).

2.2.6 Preparation of lemon sample

Fresh lemon juice was squeezed and strained using a fine muslin cloth. The resulting juice was divided into two equal parts, each containing 5 ml. Subsequently, each part was diluted separately with distilled water and ethanol.

2.2.7 Preparation of shampoos for anti-fungal estimation

Synthetic shampoos Dove, Sunsilk, Head & shoulder, Clinic Plus, Khadi naturals Amla and bhringraj were taken at 10 ml each. Shampoos were then diluted in 10 ml distilled water.

2.2.8 Sample loading and culturing

All the prepared samples (plant extracts and shampoo) were loaded into pre-prepared NA plates as summarized in Table 2 (Ansari and Sharma, 2020).

Table 2: Samples and their culturing methods.

S. No.	Samples	Plates	Well 1	Well 2	Quantity (microliter)	Culturing
1.	Curry leaf	A	Distilled water extract	Ethanolic extract	150	Fungi
		B	Distilled water extract	Ethanolic extract	150	Dandruff
2.	Neem	A	Distilled water extract	Ethanolic extract	150	Fungi
		B	Distilled water extract	Ethanolic extract	150	Dandruff
3.	Eucalyptus	A	Distilled water extract	Ethanolic extract	150	Fungi
		B	Distilled water extract	Ethanolic extract	150	Dandruff
4.	Lemon	A	Distilled water extract	Ethanolic extract	150	Fungi
		B	Distilled water extract	Ethanolic extract	150	Dandruff
5.	Dove	A	Distilled water extract	Ethanolic extract	150	Fungi
		B	Distilled water extract	Ethanolic extract	150	Dandruff
6.	Sunsilk	A	Distilled water extract	Ethanolic extract	150	Fungi
		B	Distilled	Ethanolic	150	Dandruff

			water extract	extract		
7.	Head & shoulder	A	Distilled water extract	Ethanolic extract	150	Fungi
		B	Distilled water extract	Ethanolic extract	150	Dandruff
8.	Clinic plus	A	Distilled water extract	Ethanolic extract	150	Fungi
		B	Distilled water extract	Ethanolic extract	150	Dandruff
9.	Amla and Bhringraj	A	Distilled water extract	Ethanolic extract	150	Fungi
		B	Distilled water extract	Ethanolic extract	150	dandruff

3. RESULTS AND DISCUSSION

3.1 Raw material collection

The main raw material used for this project was dry leaves of *Murraya koenigii* [Fig.1(a)], *Azadirachta indica* [Fig.1(b)], *Eucalyptus teriticornis* [Fig.1 (c)], *and* juice of *Citrus limon* [Fig.1 (d)]" which were collected directly from trees present in the local area, Bindki, Fatehpur, Uttar Pradesh, shown in following figures below.

Fig.1 (a) ***Murraya koenigii (curry leaf***)

Fig.1 (b) ***Azadirachta indica*** **(Neem)**

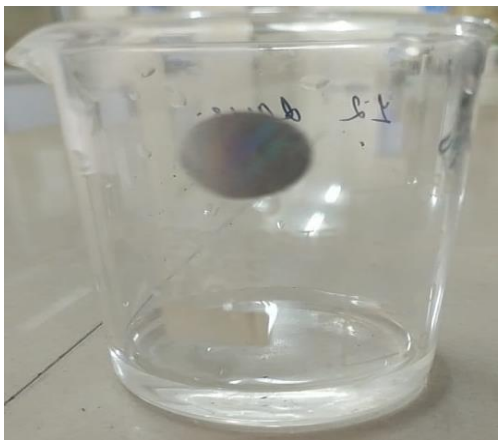


Fig.1 (c) *Eucalyptus teriticornis* (blue gum) **Fig.1 (d) *Citrus limon* (Lemon) juice**

3.2 Prepration of culturing plates

Sabouraud dextrose agar (SDA) plates were prepared by dissolving 17.5gm of raw media components into 250ml distilled water [Fig.4.2(a)], followed by autoclaving [Fig4.2(b)]. Addition of antibiotic was done after autoclaving of the media inside the LAF. Pouring and plating was done followed by spreading of olive oil into the plates [Fig.4.2(c)].

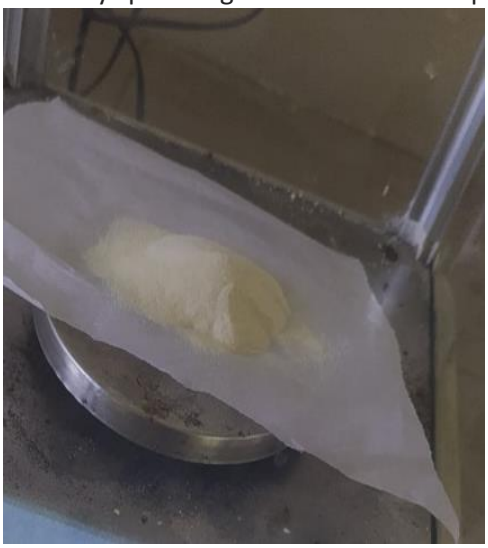
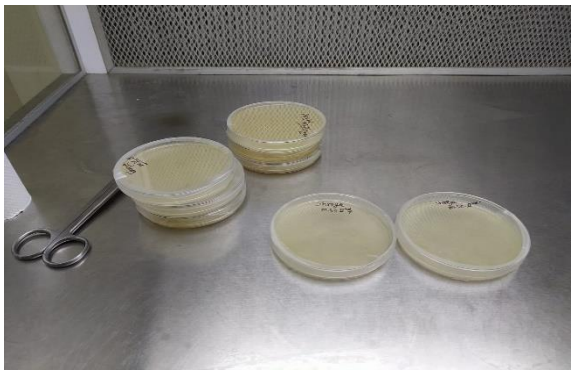


Fig.2(a) Raw media

Fig.2(b) Autoclaved Media



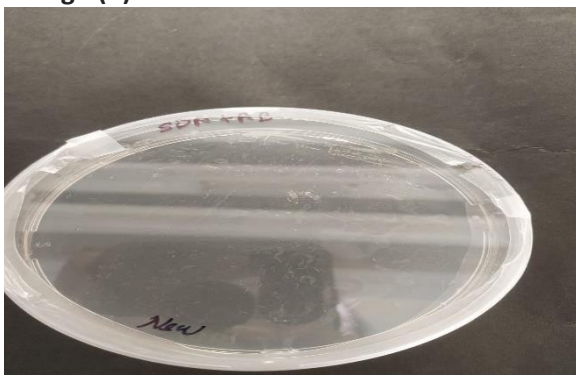
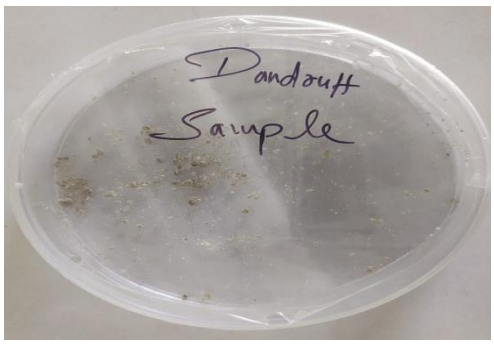


Fig.2(c) prepared plates

3.3 Growth of *Malassezia furfur*

streaking was done on the prepared SDA plates using dandruff sample[Fig.3(a)] and then they were incubated for 3-5 days in less than 27 degrees[Fig.3(b)]. Growth was observed after 5 days as creamy white colonies[Fig.3(c)].



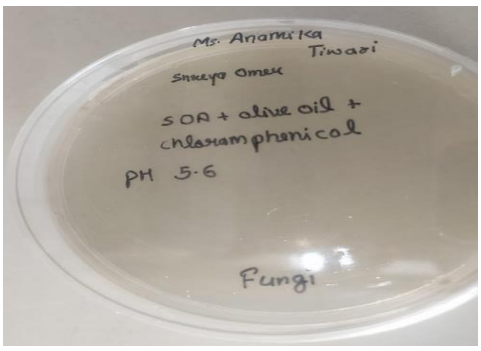


Fig.3(a) dandruff sample **Fig.3(b) cultured plate of *Malassezia furfur***
Fig.3(c) growth of *Malassezia furfur* after 5 days incubation period

3.4 Leaf extract preparation and shampoo preparation

For the leaf extract preparation, I took 10 grams of each leaf which were shade-dried for 10-15 days. Then crushed [Fig.4(a)] into fine powder, it was then dissolved equally into distilled water and ethanol separately [Fig.4(b)]. Solutions were then transferred into centrifugal tubes and centrifuged at 3000 rpm for 5 minutes [Fig.4(c)]. All the shampoos were dissolved in 10ml distilled water to form a solution[Fig.4(d)].

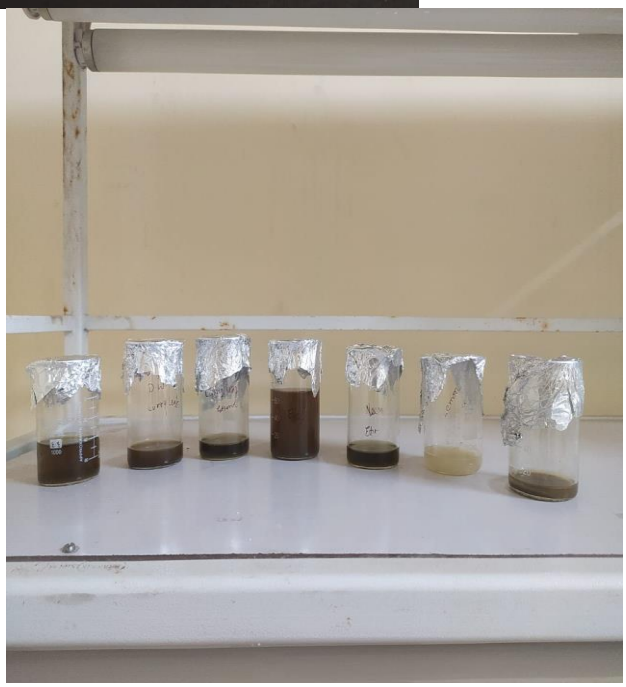


Fig.4(a) crushing process **Fig.4(b) Prepared solutions**

Fig.4(c) Centrifused extract

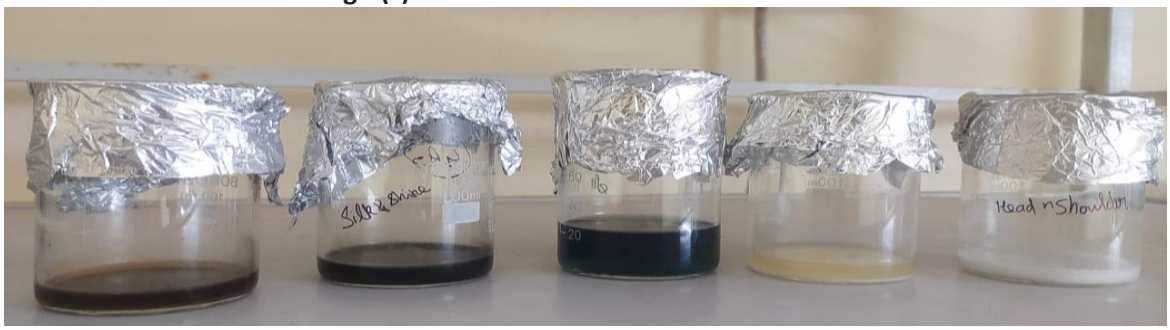


Fig.4(d) Shampoo solutions

3.5 Preparation of Nutrient Agar plates

The nutrient agar (NA) plates were prepared by dissolving 7gm of NA into 250ml distilled water followed by autoclaving. The prepared media was poured into plates and punctured using ELISA double puncture[Fig.5].

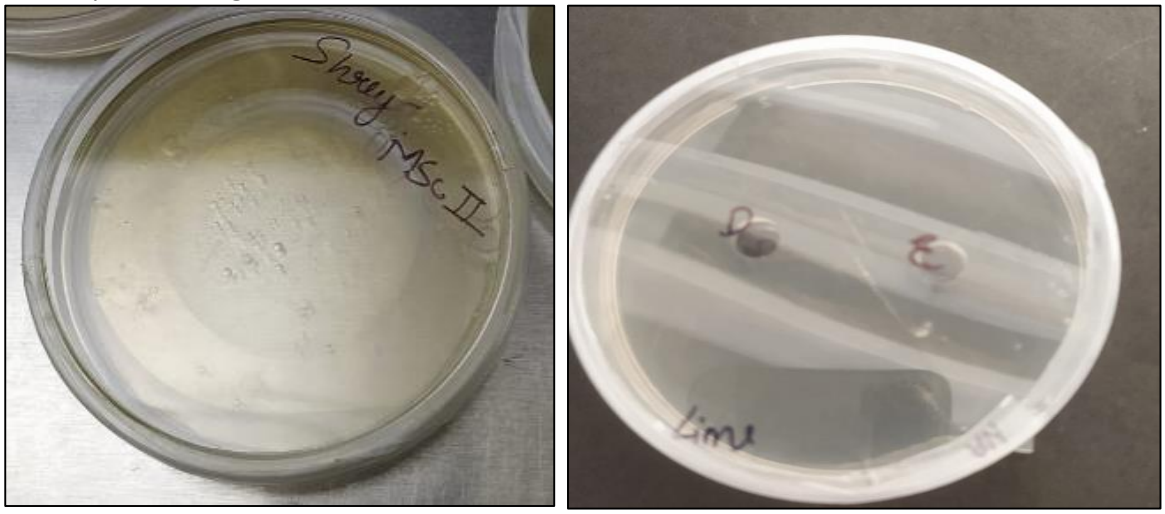


Fig.5 NA plates before and after puncture

3.6 Sample loading and culturing

For the antifungal assay of plants and shampoos, all the samples were loaded into punctured NA plates and incubated for 3-5 days and the following results were obtained:

3.6.1 *Azadirachta indica* (Neem)

Two plates of Nutrient Agar were loaded with *Azadirachta indica* (Neem) samples plate A was cultured with dandruff sample and plate B was cultured with fungal sample. In plate A less growth

was observed in both ethanolic and aqueous extract[Fig.6.1.a] while in plate B more growth was observed in aqueous extract than ethanolic extract[Fig.6.1.b]. The fungal sample showed more growth than the dandruff sample.

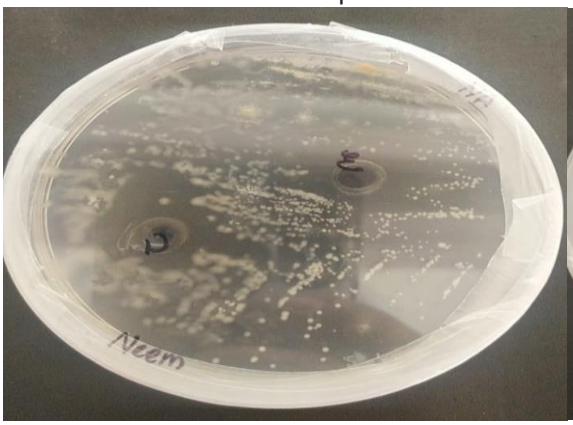


Fig.6.1.a *Azadirachta indica* (Neem) Plate B

Fig.6.1.b *Azadirachta indica* (Neem) Plate B

3.6.2 *Murraya Koenigii* (Curry leaf)

Two plates of Nutrient Agar were loaded with *Murraya Koenigii (Curry leaf)* samples plate A was cultured with dandruff sample and plate B was cultured with fungal sample. In plate A less growth was observed in both ethanolic and aqueous extract [Fig.6.2. a] while in plate B more growth was observed in aqueous extract than ethanolic extract[Fig.6.2.b]. The fungal sample showed more growth than the dandruff sample.

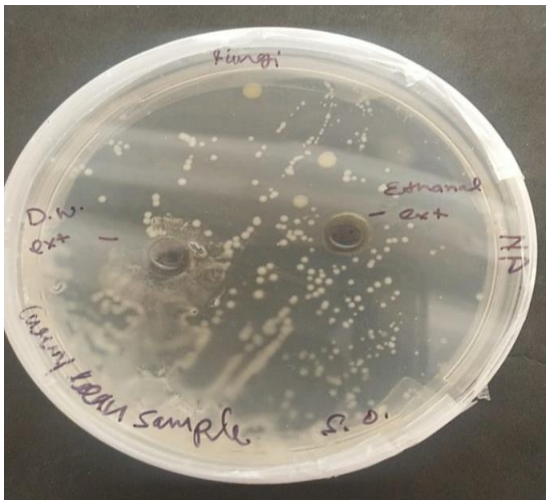


Fig 6.2.a *Murraya Koenigii* (Curry leaf) Plate A

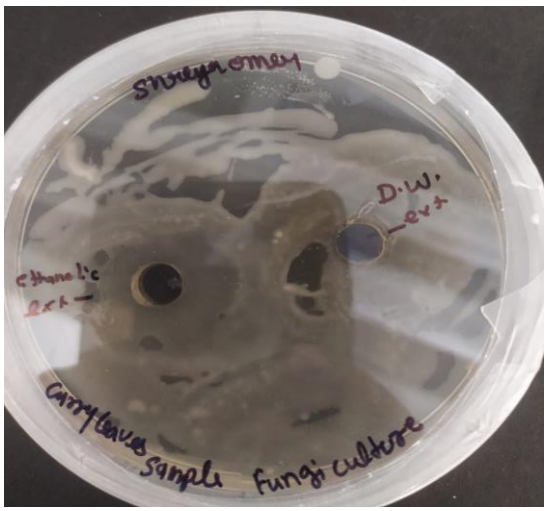


Fig 6.2.b *Murraya Koenigii* (Curry leaf) Plate B

3.6.3 *Eucalyptus globolus* (Eucalyptus)

Two plates of Nutrient Agar were loaded with *Eucalyptus globolus*(Eucalyptus) samples plate A was cultured with dandruff sample and plate B was cultured with fungal sample. In plate A less growth was observed in both ethanolic and aqueous extract [Fig.6.3.a] while in plate B more growth was observed in aqueous extract than ethanolic extract[Fig.6.3.b]. The fungal sample showed more growth than the dandruff sample.

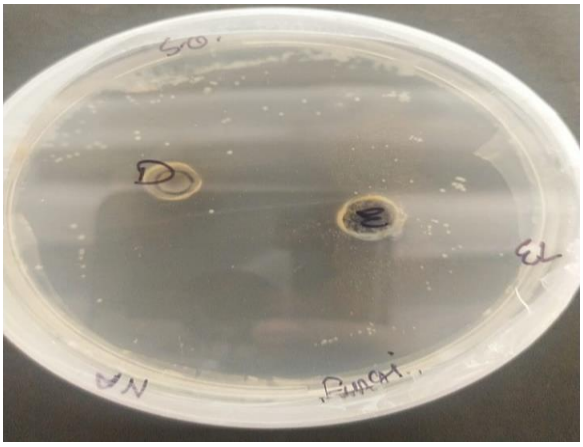


Fig.6.3.a *Eucalyptus globolus* (Eucalyptus) plate A

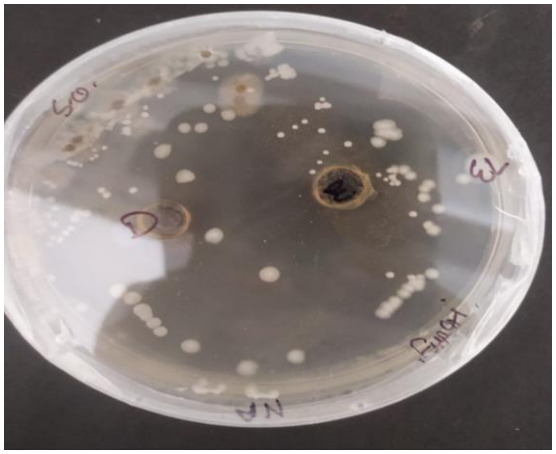


Fig.6.3.b *Eucalyptus globolus* (Eucalyptus) plate

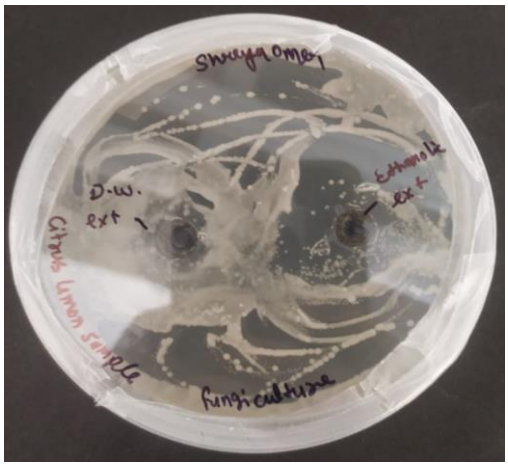
3.6.4 *Citrus limon* (lemon)

Two plates of Nutrient Agar were loaded with *Citrus limon* (lemon)samples plate A was cultured with dandruff sample and plate B was cultured with fungal sample. In plate A less growth was observed in both ethanolic and aqueous extract [Fig.6.4.a] while in plate B maximum growth was observed in both aqueous extract and ethanolic extract[Fig.6.4.b]. The fungal sample showed more growth than the dandruff sample.

Fig.6.4.a *Citrus limon* (lemon) plate **Fig.6.4.b *Citrus limon*(lemon) plate B**

3.6.5 Head & Shoulder, Sunsilk, and Clinicplus shampoo

Two plates of Nutrient Agar were loaded with Head & Shoulder, Sunsilk, and Clinicplus samples plate



A was cultured with dandruff sample and plate B was cultured with fungal sample. In plate A no growth was observed in samples [Fig.6.5.a] while in plate B minimum growth was observed in samples [Fig.6.5.b]. Only fungal samples showed growth in shampoo samples.

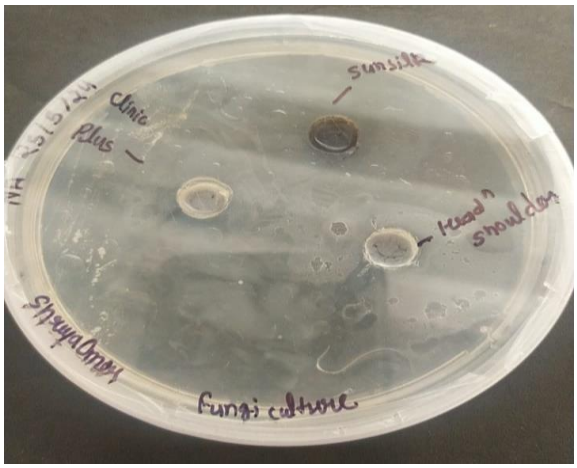


Fig.6.5.a Head & Shoulder, Sunsilk, Clinic plus plate A

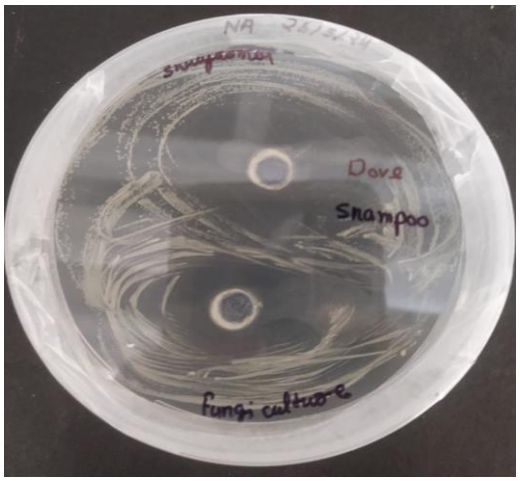
Fig.6.5.b Head & Shoulder, Sunsilk, Clinic plus plate B

3.6.6 Dove shampoo

Two plates of Nutrient Agar were loaded with Dove shampoo samples plate A was cultured with dandruff sample and plate B was cultured with fungal sample. In both plates- Plate A [Fig.6.6.a] and in Plate B[Fig.6.6.b] same growth was observed.

Fig.6.6.a Dove plate A

Fig.6.6.b Dove plate B



3.6.7 Amla and Bhringraj shampoo

Two plates of Nutrient Agar were loaded with Amla and Bhringraj shampoo samples plate A was cultured with dandruff sample and plate B was cultured with fungal sample. In both plates- Plate A [Fig.6.7.a] and in Plate B[Fig.6.7.b] same growth was observed.

Fig.6.7.a Amla & Bhringraj Shampoo Plate A

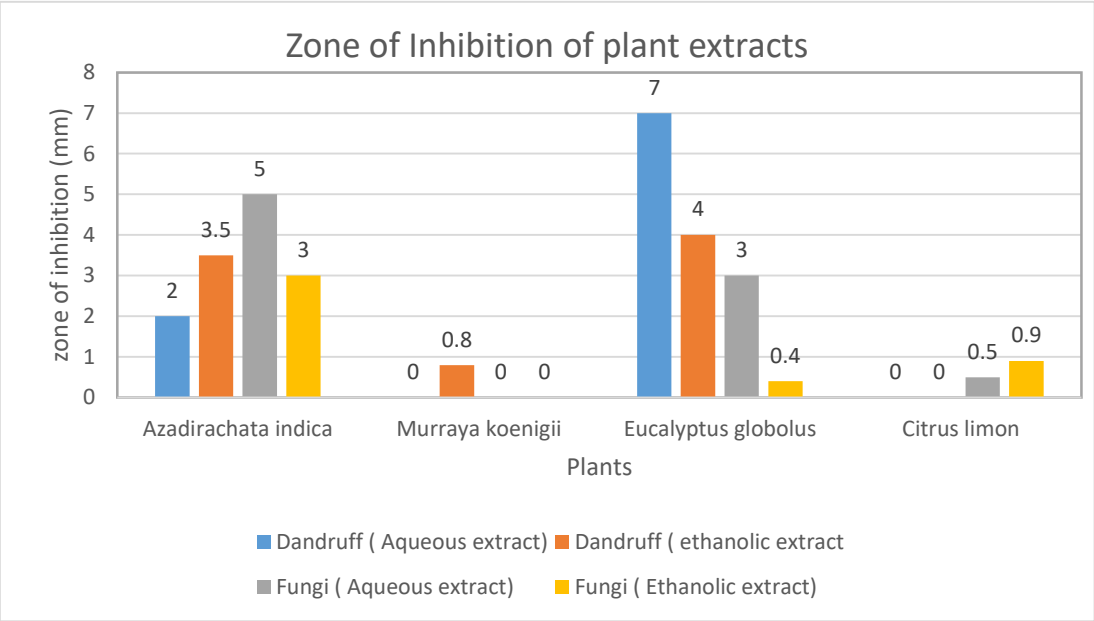
Fig.6.7.b. Amla &Bhringraj Shampoo Plate B

3.7 Zone of inhibition

The activity of plant extract crude showed significant inhibition in the colony diameter of fungi. Showed the variation of inhibition zones based on plant species, and the type of extract: the aqueous extract, the ethanolic extract, and the sample of fungi used, summarized in Table 3 and Graph 1.

Table 3: Plant extracts and their Zone of inhibition

S. No.	Plant	Type of sample extract	Type of fungi samples	Zone of inhibition (mm)
1.	*Azadirachta indica* (Neem)	Aqueous extract	Dandruff sample	2 mm
		Ethanolic extract		3.5mm
2.	*Azadirachta indica* (Neem)	Aqueous extract	Fungi	5 mm
		Ethanolic extract		3 mm
3.	*Murraya koenigii* (curry leaf)	Aqueous extract	Dandruff sample	NIL
		Ethanolic extract		0.8mm
4.	*Murraya koenigii* (curry leaf)	Aqueous extract	Fungi	NIL
		Ethanolic extract		NIL
5.	*Eucalyptus globolus* (Eucalyptus)	Aqueous extract	Dandruff sample	7mm
		Ethanolic extract		4mm
6.	*Eucalyptus globolus* (Eucalyptus)	Aqueous extract	Fungi	3mm
		Ethanolic extract		0.4mm
7.	*Citrus limon* (Lemon)	Aqueous extract	Dandruff sample	NIL
		Ethanolic extract		NIL
8.	*Citrus limon* (Lemon)	Aqueous extract	Fungi	0.5mm
		Ethanolic extract		0.9mm

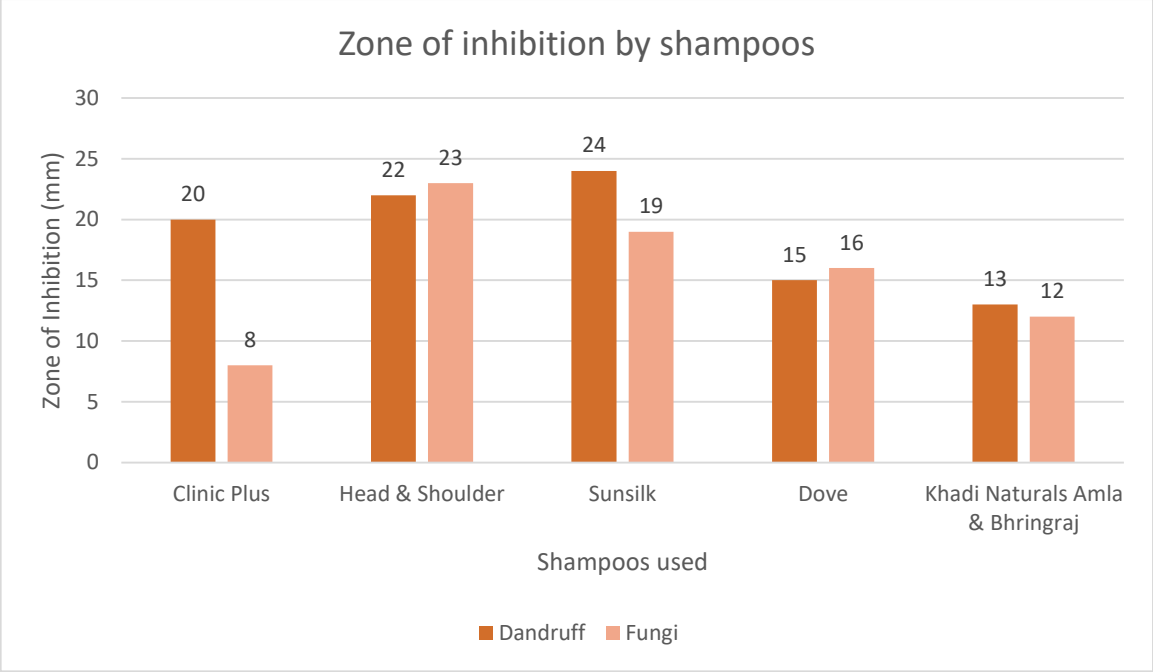


Graph 1: Showing antifungal activity of different plant extracts

The activity of shampoo showed significant inhibition in the colony diameter of fungi. Showed the variation of inhibition zones based on shampoos used, and the sample of fungi used, summarized in Table 4 and Graph 1.

Table 4: Shampoos and their Zone of inhibition.

S. No.	Shampoo	Type of fungi samples	Zone of inhibition (mm)
1.	Clinic plus	Dandruff	20mm
		Fungi	8mm
2.	Head & Shoulder	Dandruff	22mm
		Fungi	23mm
3.	Sunsilk	Dandruff	24mm
		Fungi	19mm
4.	Dove	Dandruff	15mm
		Fungi	16mm
5.	Khadi Naturals Amla & Bhringraj	Dandruff	13mm
		Fungi	12mm



Graph 2: Showing antifungal activity of different anti-dandruff shampoos

The antifungal activity of *Azardichata indica and Murraya koenigii* was reported as 1.71 mm and 0mm respectively against *Malssezia furfur* in a study (Gebremedhin, Tesfay, et al 2020) (Raju KS 2019). Whereas in our study, aqueous extract of *Azadrichata indica* showed more inhibition zone of 2 mm and *Murraya koenigii* showed less inhibition zone of 0.8mm.

The antifungal activity of *Eucalyptus globolus* and *Citrus limon* was reported as 0.3mm and 18mm respectively (Rathi, Murarkar et al 2019). Whereas in our study aqueous extract of *Eucalyptus globolus* showed maximum zone of inhibition of 7mm and *Citrus limon* showed less zone of inhibitiob of 0.5mm.

Tha antifungal activity of Clinic Plus, Head & Shoulder, Sunsilk, Dove were reported with highest zone of inhibition 8-20mm, 22-23mm, 19-24mm, 15-16mm, 13-12mm respectively in our study.

Conclusion

To summarize, the fight against dandruff has long been a scientific and natural endeavor, with synthetic shampoos and crude plant extracts emerging as two major contestants in the search for an effective remedy. A thorough examination reveals that both treatments provide distinct benefits and problems, each giving a nuanced perspective on managing this prevalent scalp ailment. Synthetic shampoos, designed with precision and supported by substantial research, provide a uniform and predictable treatment to dandruff. These shampoos, which contain active chemicals such as zinc pyrithione, ketoconazole, and selenium sulfide, effectively address the underlying causes of dandruff, such as fungal overgrowth or excessive sebum production. Their controlled formulations offer constant outcomes, giving them a dependable option for many people suffering from chronic flakes and itching. Furthermore, synthetic shampoos frequently include extra characteristics such as moisturizing ingredients, scents, and conditioning agents, which improve the whole hair-care experience. These goods' simplicity and accessibility contribute to their widespread popularity, since consumers can easily find them on shelves in supermarkets and pharmacies around the world. Furthermore, the clinical testing and regulatory control associated with synthetic formulations provide consumers confidence in their safety and efficacy, which adds to their appeal.

However, despite their efficiency, synthetic shampoos have downsides. Some people may have negative reactions to particular compounds, such as scalp irritation or allergic reactions, emphasizing the significance of patch testing and cautious ingredient selection. Furthermore, repeated use of

certain synthetic chemicals may result in the development of resistance in dandruff-causing bacteria, necessitating product rotation or alternate treatment options. In contrast, crude plant extracts tap into nature's pharmacy, providing a holistic approach to dandruff treatment that appeals to natural remedy advocates. Plant extracts, which are high in bioactive substances like polyphenols, terpenoids, and flavonoids, have a wide range of antibacterial, anti-inflammatory, and antioxidant characteristics that can effectively tackle the underlying causes of dandruff while also nourishing the scalp and hair follicles.

In conclusion, both synthetic shampoos and basic plant extracts are effective approaches to dandruff treatment, each with their own set of benefits and drawbacks. Individuals can make informed decisions that are suited to their own requirements and preferences by knowing the mechanisms of action, safety concerns, and consumer preferences connected with these approaches. Finally, the search for a successful dandruff treatment continues, fueled by breakthroughs in scientific research, technological innovation, and a greater awareness for nature's varied array of cures.

Declaration

This submitted article contains all of the data generated or analyzed during this investigation.

Competing interest

The author has no relevant direct or indirect, financial or non-financial interest to disclose.

Funding

The author declares that no funds, grants, or other support were received during the preparation of this manuscript.

Authors contribution

SO wrote the manuscript. AT planned this work and thoroughly checked and reviewed

Acknowledgment

SO would like to thank to the Department of Biotechnology, Faculty of Engineering and Technology, Rama University, Kanpur for providing the necessary facilities during their study to complete this manuscript.

Ethical approval

The author has followed ethical guidelines while preparing the manuscript. The author has no potential conflicts to disclose. No human or animal participants were involved in this research.

Conflict of interest

The author declares that they do not have any conflict of interest in this publication.

Consent to participate

The author has given consent to participate as per the journal guidelines and policies.

Consent to publish

The author has given consent to publish as per the journal guidelines and policy.

REFERENCES

1. Al-Bader, S. M., & Moqbel, F. S. (2017). Effect of Selected Plant Extracts on Malssezia Furfur in Culture. *Eurasian Journal of Science and Engineering*, *3*(1), 38-43.
2. Ansari, S. P. M. M., Sharma, M. N., & Panicker, S. (2020). ANTI-DANDRUFF ACTIVITY OF COMBINATIONS OF CRUDE PLANT EXTRACTS ON DANDRUFF CAUSING FUNGAL ISOLATE.
3. Da Silva, B. J. M., Hage, A. A. P., Silva, E. O., & Rodrigues, A. P. D. (2018). Medicinal plants from the Brazilian Amazonian region and their antileishmanial activity: a review. *Journal of Integrative Medicine*, *16*(4), 211-222.
4. Dahal, P., Bista, G., & Dahal, P. (2021) Phytochemical screening, antioxidant, antibacterial, and antidandruff activities of leaf extract of Artemisia indica *Journal of Reports in Pharmaceutical Sciences*, *10*, 231-239
5. Deviha, M. S., & Pavithram, K. S. (2015). Antifungal activity by ethanolic extracts of medicinal plants against Malasseziafurfur: A potential application in the treatment of

Dandruff. *Int J Pharmtech Res*, *8*(3), 440-444.

6. Gebremedhin, G., Tesfay, T., Chaithanya, K. K., Kamalakararao, K., & Kamalakararao, K. (2020). Phytochemical screening and in vitro anti-dandruff activities of bark extracts of neem (Azadirachta indica). *Drug. Invent. Today*, *13*, 707-713.
7. González-Molina, E., Domínguez-Perles, R., Moreno, D. A., & García-Viguera, C. (2010). Natural bioactive compounds of Citrus limon for food and health. *Journal of pharmaceutical and biomedical analysis*, *51*(2), 327-345.
8. Gyedu-Akoto, E., Yabani, D., Sefa, J., & Owusu, D. (2015). Natural skin-care products: The case of soap made from cocoa pod husk potash. *Advances in Research*, *4*(6), 365-370.
9. Hayat, U., Jilani, M. I., Rehman, R., & Nadeem, F. (2015). A Review on Eucalyptus globulus: A new perspective in therapeutics. *Int. J. Chem. Biochem. Sci*, *8*, 85-91.
10. Imran, Z. K., Wtwt, S. M. A., & Hussein, O. K. (2016). Molecular typing of dandruff pathogens and evaluated the antifungal activity of plant extracts. *International J. Pharm Tech Research*, *9*(12), 669-679.
11. Kumar, A. (2021) Developing Anti-dandruff Shampoo Formulations using different Indian plant Herbs-An Eco-friendly Hair care Cosmetic.
12. Mishra, R. C., Kumari, R., & Yadav, J. P. (2022). Comparative antidandruff efficacy of plant extracts prepared from conventional and supercritical fluid extraction method and chemical profiling using GCMS. *Journal of Dermatological Treatment*, *33*(2), 989-995.
13. Nikam, N. R., & Kolekar, Y. M. (2022) Formulation and Evaluation of Herbal Shampoo: A Comparative Study By DoE/QbD Approach.
14. Obasi Chinelo, J., Obasi Innocent, S., Okafor Ugochukwu, C., & Uzoka, I. S.(2018) Comparison of Anti-Dandruff Activity of Synthetic Shampoos and Crude Plant Extracts On Dandruff Causing Isolates.
15. Patidar, K. (2018). Polyherbal anti-dandruff shampoo: Basic concept, benefits, and challenges. *Asian Journal of Pharmaceutics (AJP)*, *12*(03).
16. Prabhamanju, M., Shankar, S. G., & Babu, K. (2009). Herbal vs. Chemical Actives as Antidandruff Ingredients-Which Are More Effective in the Management of Dandruff?–An Overview. *Ethnobotanical leaflets*, *2009*(11), 5.
17. Raju, K S (2019) Comparison of antifungal activity of plant extracts and shampoos against dandruff-causing organism Malassezia Species Int *J Adv Res*, *5*, 1008-1013
18. Rathi, S., Murarkar, K., & Chandak, A. (2019). Antimicrobial activity of natural herbal products against dandruff causing fungus and bacteria. *World Journal of Pharmaceutical Research*, *8*(1), 1460-1467.
19. Revansiddappa, M, Sharadha, R, & Abbulu, K (2018) Formulation and evaluation of herbal Anti-dandruff shampoo *Journal of Pharmacognosy and Phytochemistry*, *7*(4), 764-767
20. Sahraie-Rad, M, Izadyari, A, Rakizadeh, S, & Sharifi-Rad, J (2015) Preparation of strong antidandruff shampoo using medicinal plant extracts: a clinical trial and chronic dandruff treatment *Jundishapur Journal of Natural Pharmaceutical Products*, *10*(4)
21. Sathishkumar, P, Preethi, J, Vijayan, R, Yusoff, A R M, Ameen, F, Suresh, S, & Palvannan, T (2016) Anti-acne, anti-dandruff and anti-breast cancer efficacy of green synthesized silver nanoparticles using Coriandrum sativum leaf extract *Journal of Photochemistry and Photobiology B: Biology*, *163*, 69-76
22. Zoya, M., Bhikhu, M., & Gaurav, S. (2016). Anti-dandruff activity of synthetic and herbal shampoos on dandruff causing isolate: Malassezia. *Int J Appl Res*, *2*, 80-5