



COMPARATIVE ANALYSIS OF SOLVENT EXTRACTION METHODS AND THEIR IMPACT ON THE ANTI-PSORIATIC ACTIVITY OF *MANGIFERA INDICA* FLOWER EXTRACTS

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Abstract

Mangifera indica (*M. indica*), commonly known as mango, is a widely recognized medicinal plant in Ayurvedic medicine and has traditionally been used for the management of various diseases and disorders. This study aimed to investigate the anti-psoriatic potential of *M. indica* flower extracts prepared using different solvents and to develop a topical spray formulation for psoriasis management.

Fresh *M. indica* flowers were collected from Multan Mango Farm and processed through maceration and grinding using n-hexane, ethanol, and olive oil as extraction solvents. The extracts were stored in airtight glass containers for seven days and subsequently filtered through double-layered muslin cloth. The obtained filtrates were concentrated using a rotary evaporator at 37 °C under reduced pressure and formulated into 5%, 10%, and 20% (w/v) concentrations using their respective solvents. These formulations were applied topically through spray bottles on Aldara (5% imiquimod)-induced psoriatic lesions in rabbits.

A total of 33 rabbits were included in the study, with 27 allocated to experimental treatments and the remaining animals assigned to positive and negative control groups. Corticosteroid ointment and distilled water were used as standard and placebo controls, respectively. Complete recovery from psoriatic symptoms was observed in rabbits treated with the olive oil-based *M. indica* flower extract, accounting for 33.33% of the experimental group. Statistical analyses of the collected data were performed using SPSS version 22.

The findings demonstrate the potential therapeutic value of *M. indica* flower extracts in reducing psoriasis-associated symptoms. Differences in treatment effectiveness among solvent-based extracts emphasize the critical role of solvent selection in enhancing the extraction and activity of bioactive compounds. These results highlight the potential of plant-based formulations as promising complementary alternatives to conventional therapies, which may be associated with undesirable side effects.

1. INTRODUCTION

About 1-3% of people worldwide suffer from psoriasis, an inflammatory skin condition that is chronic, genetically based, and immunologically related¹. The origin of the disease name is from the Greek word 'psora' which means 'itch'². It is believed to be a chronic skin illness characterized by red areas coated in white scales and an immune system issue that causes skin cells to

develop more quickly than normal. There are several types of psoriasis, and each one has its signs and symptoms. Psoriasis Vulgaris, often known as chronic plaque psoriasis, is the most typical form of the condition. However, the condition can also be divided into four separate subtypes, including inverse, postural, guttate, and erythrodermic psoriasis³. An injury to the skin, such as a cut, scrape, insect bite, or sunburn,



which triggers the Keener response, excessive alcohol use, smoking, stress, and hormonal fluctuations, especially in women, are common causes of psoriasis. A significant skin condition called psoriasis can have a negative impact on a person's social and professional life as well as other aspects of daily living. The physical and psychological symptoms of psoriasis are comparable to those of cancer, heart disease, diabetes, or depression. Epidermal hyperplasia (abnormal differentiation and inadequate maturation of keratinocytes), a thicker epidermis, and a diminished or nonexistent granular layer is the histological features. Fast epidermal keratinocyte hyperproliferation and differentiation, which require 7–10 days instead of 28–50 days for healthy skin.

Recent research on the immunologic causes of the condition has fundamentally altered psoriasis treatment and led to the development of novel medications. Biotechnological medications also referred to as biological drugs, are the new psoriasis treatments. Topical therapies could include Medications including corticosteroids, vitamin D analogues, and retinoids are frequently used in topical creams, ointments, and gels that are used to treat mild to moderate psoriasis. Although some people may acquire a tolerance to topical corticosteroids, chronic use of these drugs can thin the skin. A typical treatment for moderate to severe psoriasis is phototherapy, sometimes referred to as ultraviolet (UV) light therapy 4. UV light therapy may not be appropriate for people with a history of skin cancer or other skin problems since it can raise the chance of developing skin cancer 5-6.

Combination therapy: Combining different types of treatment can be more effective than using just one type. However, it can also increase the risk of side effects and drug interactions. Maintaining a healthy diet, avoiding smoking and alcohol, and managing stress can also be beneficial for managing psoriasis symptoms. However, lifestyle changes alone may not be effective in treating moderate to severe psoriasis

7. There are several plants and plant-based compounds that have been studied for their potential use in treating psoriasis. However, not all of these treatments are equally effective. Aloe Vera gel has been used traditionally to treat skin

conditions, including psoriasis 8.

1. METHODOLOGY

The study was conducted according to the rules of Institute of Laboratory, Commission of Life Sciences, Natural research council (Murray et al., 1999) and approved by The Ethical Committee of Muhammad Institute of Medical and Allied sciences Multan, Pakistan via letter number EC/MIMAS-PK- 1812 dated 18th of June 2023. Participants were randomly assigned into groups for evaluation of anti- psoriatic activity of *Mangifera indica* (*M. indica*) fresh flower extract in a different solvent. Different reagents, solvents, inducer and the standard drug required for experimental procedures were of highest purity.

The flowers of *M. indica* was collected from Multan Mango Farm, it's also called Achari/Desi Aam (Raw Mango) in local areas of Pakistan that have tangy taste and identified by a Botanist from Bahauddin University Multan (BZU). *M. indica* flowers extract was prepared by macerated grinding of 350grams of

M. indica flowers with 500 mL of each solvent (n hexane, ethanol and olive oil). The evaporation of crude extract was done through rotary evaporator at 37°C under very low pressure to get stock solution from all solvents separately. Stock solutions were prepared by dilution method of (5%, 10% and 20%) W/V with their concerned solvents and stored at 4 °C in sprayer bottles⁹ as elaborated in Figure.1.

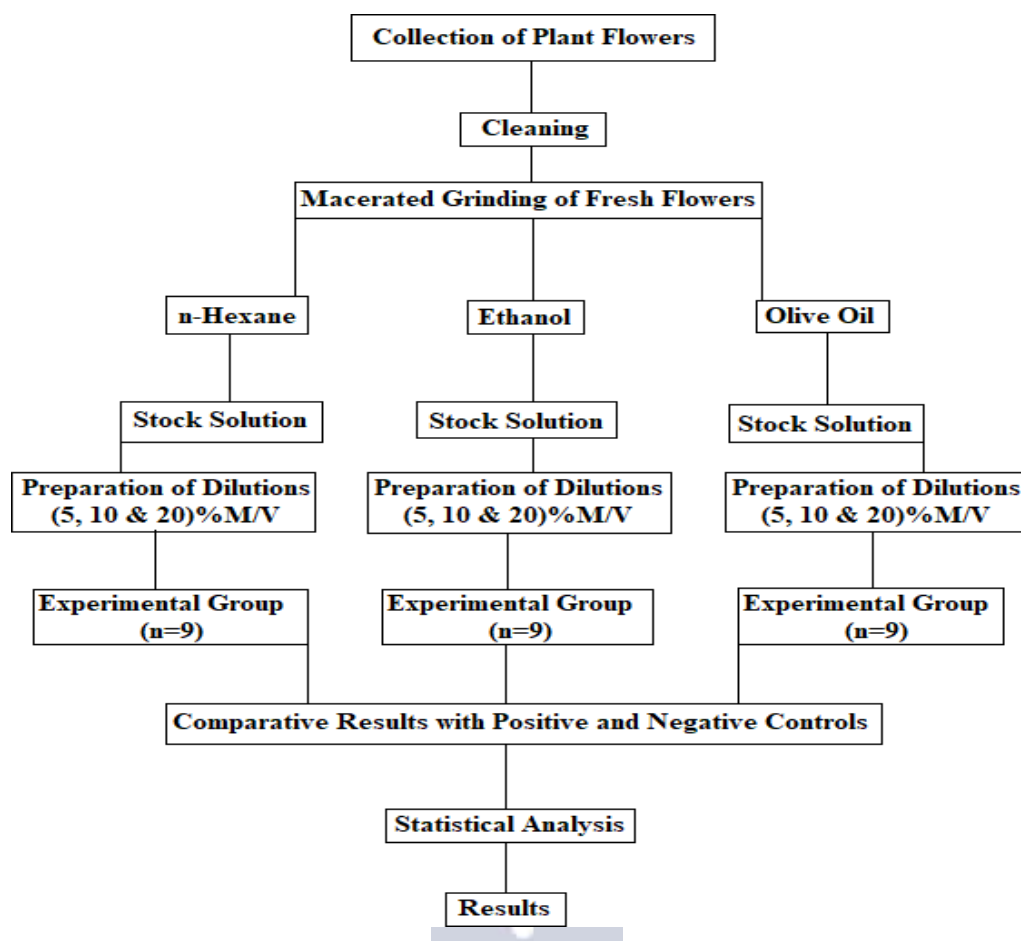


Figure 1. "Methodological Overview: M. Indica Flower Extract Production via Maceration and Evaporation"

Total 33 rabbits with age 34.62 ± 5.11 months were trialed in this study who were divided in positive control group (G1), negative control group (G2) each containing rabbits (n=3) while experimental group (G3) contained rabbits (n=27) who were equally divided into three groups each containing rabbits (n=9) for each solvent who are further subdivided into subgroups each containing three rabbits for each concentration of extract in same solvent. About 3cm² dorsal skin areas of rabbits was shaved, 62.5gm of inducer (Aldara cream containing 5 % imiquimod) was topically applied once on daily basis for 7days on shaved skin that induced lesions on skin of rabbits exactly resembling the plaques of psoriasis following a previous study. Scaling, redness and skin thickening were the three parameters that made up the severity score

based on some previous research studies, which was graded on a scale of 0-4 (absent=0, mild=1, moderate=2, severe=3, and very severe=4) were measured before trial, after a week and at the end of trial¹⁰

¹¹. At the end of this trial, 3 healthy rabbits were shaved to find cytotoxicity or any other harmful effects on skin of rabbits by these flowers extracts in all three solvents.

All rabbits were kept free of any other oral or topical medications against psoriasis two weeks before trial and two weeks during trial. Standard drug corticosteroid ointment¹² were applied 0.5g/square inch¹³ topically once a day on psoriasis skin on dorsal area of participants group of G1 (positive control), while distilled water (10mL) was used for topical application of group G2 (negative control) for two weeks.



Extract concentration of 5%W/V, 10% W/V and 20% W/V was topically applied by squeezing the sprayer bottle (3.5mL/squeez) to cover whole psoriasis affected skin area once a day for two

weeks in experimental group (G3) against each solvent accordingly as mentioned in Table 1. Statistical analysis was done with SPSS version-22, based on obtained data during research trial.

Table 1. Proposed dosing Trial of all rabbits for two weeks

Severity Score Absent=0, Severe=3 Verysevere	Per Gram	Positive Control (n=3)	Negative Control (n=3)	Experimental Group (n=27)								
				n-Hexane (n=9)			Ethanol (n=9)			Olive Oil (n=9)		
				w/v%			w/v%			w/v%		
	0.5	10		5	10	20	5	10	20	5	10	20
Before Trial												
7 th Day												
14 th Day												

2. RESULTS

Thirty-three rabbits were included in this study with mean age 34.62 ± 5 11 months. There were (42.2%) male rabbits and (57.57%) female rabbits. In our study, 33.33% rabbits were partially recovered, 33.33% were fully recovered which were 100% to be recovered with flowers

extract in olive oil and 33.33% rabbits were not recovered. (Figure. 2). No evidence of any adverse effects on rabbit's skin by flowers extract in olive oil was found during this research study. The mean age of the participants who had recovered was greater than the partially and fully recovered rabbits.

Table 2. Dosing trial of all rabbits for two weeks

Severity Score Absent=0, Severe=3 Verysevere	Per Gram	Positive Control (n=3)	Negative Control (n=3)	Experimental Group (n=27)								
				n-Hexane (n=11)			Ethanol (n=11)			Olive Oil (n=11)		
				w/v%			w/v%			w/v%		
	0.5	10		5	10	20	5	10	20	5	10	20
Before Trial	4	4	4	4	4	4	4	4	4	4	4	4
7 th Day	3	4	4	4	3	3	4	3	3	3	2	1
14 th Day	2	4	4	3	3	2	3	2	2	0	0	0

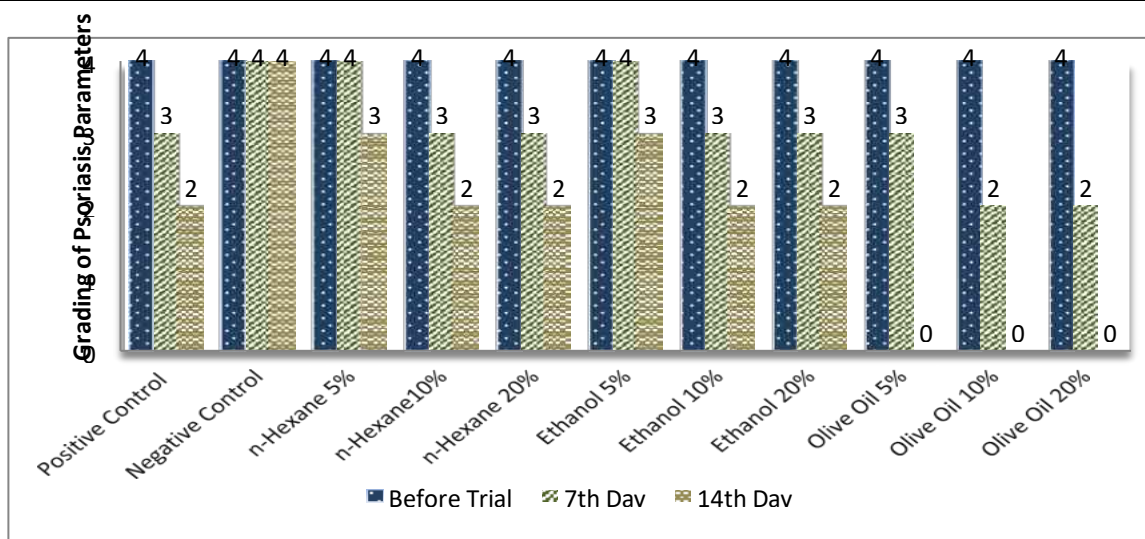


Figure 2. Effect of *M. indica* flowers extract in different solvents on psoriasis parameters in two weeks



Figure 3. Outcome visualization: Before and After Treatment Images

3. DISCUSSION

Psoriasis affects people of all ages and ethnic backgrounds and is a common ailment throughout the world¹⁴. While psoriasis prevalence varies by population, it is estimated that 2-3% of people worldwide suffer from the condition¹⁵. Because of its obvious symptoms and possible complications, it can significantly affect one's quality of life. Even though psoriasis presents problems, effective management options such as medication, lifestyle modifications, and psychological support can help individuals with the illness enjoy satisfying lives. In this study we have evaluated the anti-psoriatic activity of *Mangifera Indica* flower extract in different solvents. Our study on mangiferin's anti-psoriatic properties in different solvents provides important information about the drug's potential for treating psoriasis. Different solvents can affect mangiferin's pharmacological efficacy by changing its solubility, stability, and bioavailability. Scaling, redness and skin thickening were the three parameters which form the basis of evaluation of mangiferin's anti-psoriatic activity. We found that mangiferin extract in olive oil at concentration of 5%W/V, 10% W/V and 20% W/V when topically applied by squeezing the sprayer bottle (3.5mL/squeeze) to cover whole psoriasis affected skin area once a day for two weeks showed more profound results in decreasing redness, scaling and increasing the skin thickness as compared to mangiferin applied with different extracts.

Mangiferin can be effectively delivered by olive oil, which also improves its ability to dissolve,

stability, skin penetration, and synergistic effects¹⁶. The effectiveness of mangiferin in treating psoriasis can be greatly increased by adding it to formulations based on olive oil, which presents a viable method for the creation of new treatment approaches. A number of bioactive substances found in olive oil, including squalene, polyphenols, and oleic acid, have been demonstrated to have anti-inflammatory, antioxidant, and immunomodulatory qualities¹⁷. These substances may work in concert with mangiferin to increase the formulation's overall anti-psoriatic efficacy. Increased treatment efficacy and better results in the treatment of psoriasis may result from this combination. Oxidation, heat, and light are some of the conditions that might cause bioactive molecules like mangiferin to break down over time. Tocopherols and phenolic compounds, which are found naturally in olive oil¹⁸, can help shield mangiferin from deterioration and preserve its stability while it is being stored and transported.

It has been demonstrated that mangiferin prevents immune cells and keratinocytes¹⁹ from producing pro-inflammatory cytokines such as tumor necrosis factor- α (TNF- α), interleukin-6 (IL-6), and interleukin-1 beta (IL-1 β). Mangiferin helps reduce the irritation, swelling, and itching that come with psoriatic lesions by inhibiting inflammation.⁷ Mangiferin stimulates keratinocyte migration and proliferation, augments extracellular matrix component formation, and regulates inflammatory responses during the healing process to enhance wound



healing. Mangiferin's ability to heal wounds may aid in the restoration of damaged skin and enhance the therapeutic results of psoriasis treatments^{19,20}.

In treating psoriasis many drugs have been used and many researches have been done highlighting the use of these drugs at the same time many researches have been done highlighting the side effects of these drugs¹⁴. For mild to moderate cases of psoriasis, topical corticosteroids are frequently recommended²¹. Their effectiveness in lowering the scaling, itching, and inflammation linked to psoriatic plaques has been shown by research. Corticosteroids can, however, have negative side effects over time, including telangiectasia, skin thinning, and adrenal suppression²². Studies have demonstrated the efficacy of calcipotriene and topical tazarotene in the treatment of psoriasis lesions, especially when combined with corticosteroids. Itching, burning, and skin irritation are possible side effects due to their use²³.

Methotrexate is useful in treating moderate-to-severe psoriasis and psoriatic arthritis, according to research. On the other hand, chronic use may cause gastrointestinal adverse effects, bone marrow suppression, and hepatotoxicity²⁴. To reduce toxicity, research has concentrated on improving dosage schedules and monitoring techniques.

A systemic immunosuppressant, cyclosporine lowers inflammation and prevents T-cell activation. Studies have indicated that it is effective in treating serious cases of psoriasis and has a quick start of action. On the other hand, prolonged use may result in hypertension, nephrotoxicity, and an elevated risk of infections²⁵.

The main goals of our research is to minimize long-term negative effects of these drugs and find alternate therapy approaches which are easy to use, less expensive, have less side effects, increases patients compliance and maximize efficacy by refining treatment regimens and formulations. *M. indica* fresh flowers extract in olive found a promising candidate with no side effects on rabbits skin even after its topical application for two weeks.

In summary, the use of mangiferin to the

treatment of psoriasis is a fresh and creative approach that may help with the intricate pathogenesis of the condition. In the realm of dermatology and autoimmune illnesses, the use of mangiferin to treat psoriasis is a new and promising strategy. Furthermore, to completely understand its therapeutic benefits, ideal dose schedules, and long-term safety profile in psoriasis patients, more investigation—including clinical trials—is necessary.

4. CONCLUSION

In conclusion, the study investigated the anti-psoriatic activity of *Mangifera indica* flower extract in various solvents. The findings suggest that the flowers extract in olive oil possesses significant potential in mitigating psoriasis-related symptoms. The diverse solvents used for extraction demonstrated variations in efficacy, emphasizing the importance of solvent selection in extracting bioactive compounds.

5. REFERENCES

- Dhanabal, S.; Priyanka Dwarampudi, L.; Muruganatham, N.; Vadivelan, R., Evaluation of the antipsoriatic activity of Aloe vera leaf extract using a mouse tail model of psoriasis. *Phytotherapy research* 2012, 26 (4), 617-619.
- Raut, G.; Waikar, S., Management of psoriasis with nutraceuticals: An update. *Complementary therapies in clinical practice* 2018, 31, 25-30.
- Schmitt, J.; Rosumeck, S.; Thomaschewski, G.; Sporbeck, B.; Haufe, E.; Nast, A., Efficacy and safety of systemic treatments for moderate-to-severe psoriasis: meta-analysis of randomized controlled trials. *British Journal of Dermatology* 2014, 170 (2), 274-303.
- Cui, L.; Chen, R.; Subedi, S.; Yu, Q.; Gong, Y.; Chen, Z.; Shi, Y., Efficacy and safety of biologics targeting IL-17 and IL-23 in the treatment of moderate-to-severe plaque psoriasis: a systematic review and meta-analysis of randomized controlled trials. *International immunopharmacology* 2018, 62, 46-58.



- Antiga, E.; Bonciolini, V.; Volpi, W.; Del Bianco, E.; Caproni, M., Oral curcumin (Meriva) is effective as an adjuvant treatment and is able to reduce IL-22 serum levels in patients with psoriasis vulgaris. *BioMed research international* **2015**, 2015.
- Chaudhari, S.; Leon, A.; Thakur, A.; Koo, J. In *Review of Curcumin, Indigo Naturalis, and Aloe Vera in Psoriasis Treatment*, Psoriasis Forum, SAGE Publications Sage CA: Los Angeles, CA: 2015; pp 2-8.
- Inamadar, A. C.; Palit, A., Acute skin failure: concept, causes, consequences and care. *Indian journal of dermatology, venereology and leprology* **2005**, 71, 379.
- Bahmani, M.; Shirzad, H.; Rafieian, S.; Rafieian-Kopaei, M., Silybum marianum: beyond hepatoprotection. *Journal of evidence-based complementary & alternative medicine* **2015**, 20 (4), 292-301.
- Horváth, S.; Komlódi, R.; Perkecz, A.; Pintér, E.; Gyulai, R.; Kemény, Á., Methodological refinement of Aldara-induced psoriasiform dermatitis model in mice. *Scientific reports* **2019**, 9 (1), 3685.
- Jabeen, M.; Boisgard, A.-S.; Danoy, A.; El Kholi, N.; Salvi, J.-P.; Boulieu, R.; Fromy, B.; Verrier, B.; Lamrayah, M., Advanced characterization of imiquimod-induced psoriasis-like mouse model. *Pharmaceutics* **2020**, 12 (9), 789.
- Abeje, B. A.; Bekele, T.; Getahun, K. A.; Asrie, A. B., Evaluation of wound healing activity of 80% hydromethanolic crude extract and solvent fractions of the leaves of urtica simensis in mice. *Journal of Experimental Pharmacology* **2022**, 221-241.
- Horn, E.; Domm, S.; Katz, H.; Lebwohl, M.; Mrowietz, U.; Kragballe, K.; Council, I. P., Topical corticosteroids in psoriasis: strategies for improving safety. *Journal of the European Academy of Dermatology and Venereology* **2010**, 24 (2), 119-124.
- Bewley, A.; Group, D. W., Expert consensus: time for a change in the way we advise our patients to use topical corticosteroids. *British Journal of Dermatology* **2008**, 158 (5), 917-920.
- Raharja, A.; Mahil, S. K.; Barker, J. N., Psoriasis: a brief overview. *Clinical Medicine* **2021**, 21 (3), 170.
- Armstrong, A. W.; Mehta, M. D.; Schupp, C. W.; Gondo, G. C.; Bell, S. J.; Griffiths, C. E., Psoriasis prevalence in adults in the United States. *JAMA dermatology* **2021**, 157 (8), 940-946.
- Borate, S.; Mundada, A. S., Herbal cosmeceuticals-intensifies health and beauty of the skin. *J Med Pharm Allied Sci* **2021**, 11, 40-46.
- Jimenez-Lopez, C.; Carpena, M.; Lourenço-Lopes, C.; Gallardo-Gomez, M.; Lorenzo, J. M.; Barba, F. J.; Prieto, M. A.; Simal-Gandara, J., Bioactive compounds and quality of extra virgin olive oil. *Foods* **2020**, 9 (8), 1014.
- Dugo, L.; Russo, M.; Cacciola, F.; Mandolino, F.; Salafia, F.; Vilmercati, A.; Fanali, C.; Casale, M.; De Gara, L.; Dugo, P., Determination of the phenol and tocopherol content in Italian high-quality extra-virgin olive oils by using LC-MS and multivariate data analysis. *Food Analytical Methods* **2020**, 13, 1027-1041.
- Das, P.; Mounika, P.; Yellurkar, M. L.; Prasanna, V. S.; Sarkar, S.; Velayutham, R.; Arumugam, S., Keratinocytes: an enigmatic factor in atopic dermatitis. *Cells* **2022**, 11 (10), 1683.
- Swain, B.; Maddi, S., Molecular Interaction Analysis of Phytochemicals as the Prospective Potential Multi-Target Inhibitors Related to Psoriasis and Other Autoimmune Disorders. *Journal of Drug Design and Medicinal Chemistry* **2024**, 10 (1), 16-30.
- Reid, C.; Griffiths, C. E., Psoriasis and treatment: past, present and future aspects. *Acta dermato-venereologica* **2020**, 100 (3), 69-79.
- Jinagal, J.; Gupta, P. C.; Piloni, R. K.; Ram, J., Systemic toxicity of topical corticosteroids. *Indian journal of ophthalmology* **2019**, 67 (4), 559-561.



- Chat, V. S.; Kearns, D. G.; Uppal, S. K.; Han, G.; Wu, J. J., Management of psoriasis with topicals: Applying the 2020 AAD-NPF guidelines of care to clinical practice. *Cutis* **2022**, *110* (2 Suppl), 8-14.
- Solomon, D. H.; Glynn, R. J.; Karlson, E. W.; Lu, F.; Corrigan, C.; Colls, J.; Xu, C.; MacFadyen, J.; Barbhaiya, M.; Berliner, N., Adverse effects of low-dose methotrexate: a randomized trial. *Annals of internal medicine* **2020**, *172* (6), 369-380.
- Patocka, J.; Nepovimova, E.; Kuca, K.; Wu, W., Cyclosporine A: chemistry and toxicity-a review. *Current medicinal chemistry* **2021**, *28* (20), 3925-3934.

