International Journal of Science and Research Archive
eISSN: 2582-8185
Cross Ref DOI: 10.30574/ijsra
Journal homepage: https://ijsra.net/

(REVIEW ARTICLE)

Check for updates

Polyherbal approaches to acne treatment: Natural solution

Sandhya Sahu [1], Janki Sahu [1] and Tiltoma Sahu [2, *]

[1] *Rungta Institute of Pharmaceutical Sciences and Research*
[2] *Rungta Institute of Pharmaceutical Sciences*

International Journal of Science and Research Archive, 2024, 13(02), 2821-2830

Publication history: Received on 30 October 2024; revised on 12 December 2024; accepted on 14 December 2024

Article DOI: https://doi.org/10.30574/ijsra.2024.13.2.2455

Abstract

Acne is a chronic inflammatory condition of the pilosebaceous unit caused by androgen-induced changes in keratinization, inflammation, and sebum production. It often affects the face, back, and chest due to clogged hair follicles from oil, dead skin cells, and bacterial colonization, primarily by *Propionibacterium acnes*. Hormonal changes during adolescence, family history, and possibly early *P. acnes* colonization contribute to its development. While dietary factors have been suggested, evidence remains inconclusive. Acne affects 9.4% of the global population and is particularly prevalent among teenagers, with over 85% experiencing some form. It can persist into adulthood, particularly in women, and is a common reason for dermatologist visits.Acne lesions are classified as inflammatory (papules, pustules, nodules, cysts) or non-inflammatory (open/black and closed/white comedones), both of which can lead to pigmentation and scarring. Variants include drug-induced acne, acne fulminans, and acne mechanica. Severe forms can cause permanent skin damage and social distress, particularly in adolescence when self-image is critical. Treatment options include topical agents like retinoids, benzoyl peroxide, and antibiotics, as well as systemic therapies such as oral antibiotics, hormonal therapy, and isotretinoin. Herbal remedies, using plants like neem and turmeric, are increasingly popular due to their minimal side effects. Advances in understanding acne's pathophysiology have led to new therapeutic combinations. Consistent care and treatment tailored to individual needs are essential to manage acne, prevent scarring, and improve quality of life.

Keywords: Acne; Chronic Inflammatory Condition; Pilosebaceous Unit; Androgen-Induced Changes; Keratinization

1. Introduction

Acne is a chronic inflammatory illness of the pilosebaceous unit that is brought on by androgen-induced changes in keratinization, inflammation, and sebum production. Propionibacterium acnes also colonizes hair follicles on the face, neck, chest, and back.[1] What causes acne and how treatment impacts the disease's progression are still unknown, despite the possibility that early Pacnes colonization and family history play significant roles in the condition. Dietary influences have also been suggested but not proved.[2] Around 20% of teenagers have acne-related facial scarring. Even as an adult, acne can still exist and negatively impact one's self-esteem.[3] Commonly referred to as acne vulgaris, acne is one of the most common skin conditions that afflict people of all ages, but it is especially common in adolescence.[4]

It is identified by mainly on the face, back, and shoulders, the formation of pimples, blackheads, cysts, and pustules.[5] Inflammation and infection result from oil buildup, dead skin cells, and occasionally bacteria clogging hair follicles, which causes acne.[6] Acne is most frequent during adolescence because of hormonal changes that boost oil production, although it can also appear later in life or last into adulthood People all over the world suffer from acne, sometimes referred to as acne vulgaris, a chronic, persistent inflammatory skin disorder of the pilosebaceous follicles.[7]

* Corresponding author: Tiltoma Sahu

It is estimated that 9.4% of people worldwide suffer from acne, making it the eighth most common skin condition.[8] More than 85% of teenagers suffer from acne, which can last into adulthood. It typically affects women and is the reason for two-thirds of dermatologist appointments.[9] The distinct lesions can be classified as either inflammatory (papules, pustules, nodules, and cysts) or non-inflammatory (open/black and closed/white comedones). [10] Both types of lesions cause skin pigmentation and scarring, which calls for ongoing and consistent treatment, Lesions are usually seen on the chest, upper back, neck, and face, Acne can take many different forms, including drug-induced acne, acne in neonates and infants, acne conglobata, acne fulminans, acne mechanica, excoriated acne, and chloracne. Acne vulgaris is a prevalent skin condition that affects the face, back, and trunk, which have the largest oil glands.[11]

The pathophysiology of acne is significantly influenced by the anaerobic pathogen Propionibacterium acne.[12] By converting sebaceous triglycerides into fatty acids and activating antioxidants, it has also contributed to the development of inflammatory acne, chemotactic neutrophils.[13] One of the skin conditions that causes the most social discomfort is acne, especially for teenagers who must deal with a deformity that strikes right when their sexual maturation makes them most self-conscious of their appearance.[14] Furthermore, social misery lasts the entirety of adulthood when severe acne causes permanent skin scarring, Acne is altered and progresses because of aberrant keratinocyte growth and desquamation, which causes ductal blockage.[15] P. acne proliferates more when sebum production is stimulated by androgen. Overproduction of sebum causes irritation by clogging the pores, Acne1 is one of the most prevalent conditions affecting children, typically those between the ages of 18 and 25.[16] A skin condition of the pilosebaceous gland, acne vulgaris causes inflammatory lesions, seborrhea, comedone, and other symptoms.[17] Propionibacterium acnes causes the pus that forms in acne and causes irritation, There is a remarkable demand of herbal Formulations in the global market, Acne is A popular disorder among the teenagers Which make them feel unappealing to look At and also a sort of inferior feel.[18]

They take Many measures to avoid and cure acne. Plants are well known for their medicinal Dermatologists treat acne vulgaris, one of the most prevalent skin conditions.[19] It can manifest at any age, but it primarily affects adolescents.[20] New therapeutic modalities and different combinations have been developed in recent years as a result of a greater understanding of the pathophysiology of acne.[21] Topical medications, such as retinoids, antibiotics, and benzyl peroxide, constitute the cornerstone of care and can be administered in combination. [22]Although oral antibiotics, hormone therapy, and isotretinoin are all part of systemic therapy, the patient's needs must be taken into consideration when choosing one.[23]

2. Types

Conglobate, rosacea, fulminans, cosmetica, excoriee (picker's acne), medicamentosa, chloracne, and mechanica are some of the names for the various types of acne. Nevertheless, 99% of all occurrences of acne are of the most common type, acne vulgaris. It is distinguished by two kinds of lesions: in-inflammatory papules, pustules, nodules, and cysts, as well as non-inflammatory, open, and closed comedones. Two varieties of comedones exist: a closed comedone is called a whitehead, and an open comedone is called a blackhead.

- **Blackheads -** blackhead are non-inflammatory acne lesions that form on the skin when dead skin cells and excess oil block the hair shafts. The reason a blackhead is called an open comedo is because the skin surface is still visible and appears dark, like brown or black.

Figure 1 Blackheads

- **whiteheads -** Whiteheads are tiny pimples and a non-inflammatory acne lesion that appear on the skin when bacteria, oil, and skin cells obstruct the pores that open in hair follicles. Whiteheads are called closed

comedones because they are white and closed pimples. Although they can appear anywhere on the body, whiteheads are most common in the T-zone, which is the area that comprises the forehead, chin, and nose. on the face, arms, shoulders, neck, chest, and back.

Figure 2 Whiteheads

- **Papules -** Swelling, heat, redness, and discomfort are the symptoms of inflammation, which is the body's reaction to germs, excessive oil production, and androgen activity. Known as papules, these inflammatory lesions are thought to constitute a transitional stage between non-inflammatory and inflammatory lesions. Papules appear on the skin as a tiny, pink lump that is usually not pus-filled and less than 5 mm in diameter.

Figure 3 Papules

- **Pustules** – Small lumps and an inflammatory lesion called pustules develop on the skin when dead skin cells and excess oil block the pores. Inflammatory lesions called pustules have pus or fluid in the middle. They frequently appear as white zits encircled by red, inflamed skin. Although pustules can develop anywhere on the body, they are most common on the underarms, pubic area, shoulders, chest, back, face, neck, and hairline.

Figure 4 Pustules

- **Nodules** – A severe type of inflammatory acne known as acne nodules appears when bacteria, extra oil, and dead skin cells block the pores. This combination typically results in blackhead or whitehead comedones, but if

the infection spreads beneath the skin's surface and affects the pores, the surrounding area may also become swollen and red, giving the appearance of a little bump. Over-the-counter drugs alone cannot treat acne nodules, which can persist for weeks or months. Nodular acne resembles papule acne, but it is larger than 5 to 10 mm in diameter and usually appears on the chin or jawline of the face.

Figure 5 Nodules

- **Cysts** - Oil, dry skin cells, and bacteria buildup clog pores, causing cystic acne, a severe form of inflammatory acne, to develop beneath the surface.People of all ages who have oily skin are most impacted. A cyst usually manifests as huge, painful, pus-filled lesions that are white or red and can occasionally leave scars. While cystic acne can develop anywhere on the body, the face, arms, shoulders, back, chest, and neck are the areas most commonly affected. The majority of individuals with cystic acne have both inflammatory and non-inflammatory acne symptoms.

3. Etiology

- Increased sebum production, ductal cornification, bacterial colonization of the pilosebaceous ducts, and inflammation are all factors that contribute to the development of acne, Because acne does not follow the traditional Mendelian inheritance pattern, its genetic predisposition is polygenic.Polymorphisms in CYP1A1, Interleukin-1 alpha, and tumor necrosis factor-alpha are among the several potential genes linked to acne.

Figure 6 Etiology

3.1. Environment

comprises a number of elements, such as high humidity, prolonged perspiration, increased skin hydration, and exposure to specific chemicals, such as petroleum compounds, or dirt or liquid cooking oil.

3.2. Psychological

Research indicates that higher stress levels are linked to more severe acne. According to the National Institutes of Health (USA), stress can exacerbate acne. A study conducted on teenagers in Singapore found a favorable relationship between stress levels and the severity of acne.

3.3. Diet

Although a high-glycemic diet is linked to worsening acne, the exact association between diet and acne is yet unknown. Increases in the prevalence of acne are positively correlated with milk consumption. According to reports, eating chocolate and salt is not linked to the onset of acne. Chocolate has a high glycemic load due to its high sugar content. It's probable that obesity and insulin metabolism are related to acne.

3.4. Nutrition

Growth factors that affect the keratinocytes and sebaceous glands lining the pilary canal are also responsible for acne. Sebaceous gland function is driven by 5α-reduced steroid hormones and other steroid precursors of DHT found in dairy products. Milk consumption raises blood sugar and serum insulin levels disproportionately, which in turn raises IGF-1. Foods with a high glycemic load also raise DHT through IGF-1.IGF-1 levels during adolescence closely correlate with acne activity and probably work in concert with steroid hormones. According to population-based studies, the prevalence of acne rises as diets become more westernized. The research demonstrate the links between specific food consumption patterns and acne.

3.5. Hormonal

Acne can also be brought on by puberty and menstruation.Follicle glands grow and sebum production rises as a result of an increase in testosterone levels throughout puberty. Anabolic steroids have a comparable effect. Acne is associated with a number of hormones, including insulin-like growth factor 1 (IGF-I), the androgens testosterone, dihydrotestosterone, and dehydroepiandrosterone sulfate. While the formation of acne vulgaris is rare in later life, the frequency of rosacea, which presents with comparable symptoms in older age groups, will rise. In adult women, hirsutism, Cushing's disease, pregnancy, or polycystic ovary syndrome are some of the underlying conditions that can cause acne vulgaris.

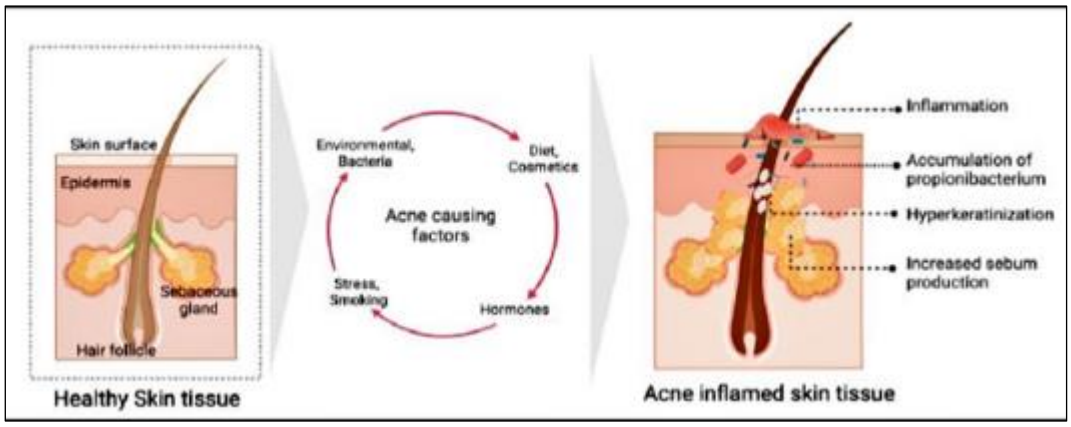

Figure 7 Acne Inflamed Skin

4. Treatment of acne

Additionally, menstruation and puberty can cause acne. As testosterone levels rise throughout puberty, follicle glands enlarge and sebum production increases. It is similar to anabolic steroids. The androgens testosterone, dihydrotestosterone, and dehydroepiandrosterone sulfate, as well as insulin-like growth factor 1 (IGF-I), are among the hormones linked to acne. Rosacea, which exhibits similar symptoms in older age groups, will become more common in later life, but acne vulgaris is uncommon. Cushing's disease, hirsutism, pregnancy, and polycystic ovary syndrome are a few underlying disorders that can lead to acne vulgaris in adult women.

4.1. Allopathic treatment

The most popular treatment is allopathic medicine, which treats acne using techniques supported by science. It covers sophisticated therapies, oral medicines, and topical treatments.

4.1.1. Tropical treatment

- **benzoyl peroxide -** An antibacterial agent that helps to destroy P. acnes bacteria and reduce oil production. frequently found in over-the-counter goods.

- **salicylic Acid** - A beta-hydroxy acid (BHA) that aids in pore clearing and skin exfoliation.
- **azelaic acid -** It helps lighten post-acne pigmentation and has antibacterial and anti-inflammatory properties.
- **Oral medicine –** Tetracycline, Minocycline, and Doxycycline are examples of oral antibiotics, Reduce inflammation and P. acnes bacteria.
- **Oral contraceptive –** Certain birth control tablets assist balance hormones and lower sebum production in cases of hormonal acne, particularly in women.
- **Spironolactone -** An anti-androgenic medication that works well for hormonal acne, particularly in females.
- **Isotretinoin -** A strong oral retinoid that works well for severe acne. It has long-term effects and decreases sebaceous gland activity.

4.2. Ayurvedic treatment

Ayurveda is a comprehensive medical approach that takes into account the body's dosha balance (Pitta, Kapha, and Vata) and emphasizes diet, lifestyle, and natural therapies to bring the doshas back into balance. Purifying the body and detoxifying the skin are common goals of ayurvedic acne remedies.

4.2.1. Herbal remedies

Neem (Azadirachta indica)

Renowned for having anti-inflammatory, antifungal, and antibacterial qualities. Inflammation is decreased and acne is treated with neem oil or lotions containing neem.

Turmeric (Curcuma longa)

A strong antibacterial and anti-inflammatory plant. It is frequently used to cure acne and avoid scarring in masks, lotions, and even internally as a supplement.

Aloe vera

Aloe vera gel is applied topically to soothe inflamed skin because of its well-known calming and restorative qualities.

Manjistha (Rubia cordifolia)

Used to enhance skin health and cleanse the blood. It is frequently used to treat acne in Ayurvedic formulations.

Tulsi (Holy basil) It has antibacterial and anti-inflammatory qualities; it's frequently utilized in topical ointments or face masks .

4.3. Ayurvedic formulation

- **Chandanasav:** A herbal tonic that balances the Pitta dosha, which is thought to be the cause of acne flare-ups, and cools the body.
- **Triphala:** A herbal medicine that is well-known for its ability to detoxify the body and aid in digestive system cleansing, which may indirectly enhance skin health
- **Brahmi (Bacopa monnieri):** An herb that can help with stress management, as stress is a contributing factor to acne. Brahmi is often consumed in supplement form to calm the mind and improve skin health.

4.4. Homeopathic Treatment

Homeopathy is customized, meaning that remedies are chosen according to a person's general constitution and particular symptoms. It is founded on the idea of treating "like with like." The goal of homeopathic treatments for acne is to promote the body's natural healing mechanisms in order to improve skin health.

4.5. Common Homeopathic Remedies for Acne

- **Sulphur:** frequently recommended for acne that is worsened by heat and exhibits burning, itching, or inflammation. A typical treatment for greasy, itchy, or inflammatory skin is sulfur.
- **Hepar Sulphuris Calcareum:** Used for painful, pus-filled pimples, particularly those that are prone to abscessing or infection
- **Calcium Carbonicum:** prescribed to people who are at risk of developing scarring, deep, cystic acne. People who have a slow metabolism and feel cold are treated with it.

- **Natrum Muriaticum:** It is advised for acne that develops on the cheeks, forehead, or mouth, particularly when it is connected to emotional or stress-related problems. Those with dry, sensitive skin frequently utilize this treatment.
- **Kali Bromatum**: Used for facial acne, especially on the cheeks, which is frequently linked to deep cystic acne or hormonal problems.
- **Pulsatilla:** frequently used to treat female acne, especially when emotional causes (such as crying or mood swings) or premenstrual acne exacerbate.

Table 1 Patents

S. NO.	Tittle	Authors	Publication	Submission Date	Publication Date
1.	Methods and compositions for treatment of skin	Jan de Rijk	US9499419B2	2006-08-04	2016-11-22
2.	Permeation enhancers and methods of cryotherapy	JoelN.JimenezLozano, GeorgeFrangineas, Jr., Like Zeng, Leonard C. DeBenedictis	US20170326346A1	2017-04-27	2017-11-16
3.	Method and apparatus for dermal delivery of a substance.	Richard Rox Anderson, William A. Farinelli, Gerard Van Hamel Platerink	AU2016202383B2	2016-04-14	2018-03-16
4.	Dermal delivery	Jonathan Edelson, Timothy Kotyla, Boke Zhang	EP2310000B1	2009-06-26	2019-09-18
5.	Compositions for the improved treatment of acne and related disorders	Dov Tamarkin, Elana Gazal, RitaKEYNAN, Meir Eini, David Schuz	US20210077509A1	2020-09-18	2021-03-18
6.	Skin freezing systems for treating acne and skin conditions	Leonard C. DeBenedictis, Joel N. Jimenez Lozano, Like Zeng, George Frangineas, Jr., Linda Pham	US20240164938A1	2023-08-29	2024-05-23

4.6. Future prospects

Thanks to developments in science, technology, and a better understanding of the pathophysiology of acne, the future of acne formulations seems bright. In the upcoming years, a number of significant developments and trends are anticipated to influence the creation of more potent acne therapies.

5. Personalized and Targeted Treatments

5.1. Genetic and Microbiome Research

The use of customized acne treatments will increase as studies into the skin microbiota and genetics advance. Treatments could be more accurate and successful if products were customized to a person's unique skin microbiota makeup and genetic predisposition.

5.2. Biomarker-Driven Solutions

Developments in biomarker identification may result in more specialized and effective treatments that address the underlying causes of acne, including inflammation, sebum production, and bacterial imbalances.

5.3. Advanced Topical Therapies

- **Nanotechnology**: By facilitating deeper penetration and improved efficacy with fewer side effects, nanoparticles can enhance the delivery of active substances. More effective therapies with less irritability or systemic effects may result from this.
- **New Retinoids:** One important field of research is the creation of next-generation retinoids that reduce acne lesions while being less irritating. For individuals who encounter adverse effects from conventional retinoid therapy, they can provide an alternative.
- **Anti-inflammatory Agents:** New formulations that explicitly target inflammation, including cytokine-targeting medicines or IL-1 inhibitors, may lessen the inflammatory response that causes acne, resulting in fewer adverse effects and quicker recovery.

5.4. Oral Medications and Systemic Therapies

- **Microbiome-Based Drugs:** Microbiome-Based Drugs: Research is being done on medications that alter the skin microbiota to either decrease acne-causing bacteria or increase good bacteria. In contrast to conventional antibiotics, these might provide a more long-term and side-effect-free solution.
- **Advanced Hormonal Therapies:** More focused hormonal treatments (such as selective anti-androgens or cutting-edge birth control techniques) are being investigated for those with hormonally driven acne in order to better control hormone fluctuations without the negative effects of existing treatments.

5.5. Laser and Light Therapies

- **Photoholdmic Therapy (PDT):** PDT is a non-invasive, efficient treatment for acne that may become more widely used as a result of advancements in the technique, which employs light to target acne germs and reduce inflammation.
- **Blue and Red Light:** With a better understanding of their mechanics, these therapies—which have been popular for treating acne—may continue to advance, resulting in combination treatments, wavelengths, and durations that are optimized for quicker and more long-lasting outcomes.
- **AI and Digital Health:** AI for Monitoring Diagnosis and Treatment Dermatologists may be able to better monitor treatment outcomes and customize treatment regimens with the use of AI-powered tools, such as platforms or applications that examine photos of acne.
- **Telemedicine:** Remote monitoring of acne treatment regimens and dermatologist consultations will be more accessible to patients as telemedicine grows in popularity.

Combination Therapies: Future therapies will probably incorporate several different modes of action into a single formulation, such as keratolytic, antibacterial, and anti-inflammatory drugs. This could improve patient compliance by increasing efficacy and lowering the demand for numerous medicines.

Sustainability and Natural Ingredients: Acne treatments that use sustainable, natural, and less chemically intense components are becoming more popular as clean beauty gains popularity. Probiotics, botanical extracts, and other plant-based substances may start to appear more frequently in acne treatment solutions.

5.6. Long-Term Solutions

- **Preventive Strategies:** Beyond therapy, acne formulations may incorporate preventive measures, like skincare routines that support long-term skin health and reduce the likelihood of acne recurrence, especially in those with chronic acne.
- **Vaccines**: A long-term cure may eventually be provided by research into creating vaccinations that can lessen the bacterial overgrowth or inflammatory processes that cause acne, however this is still a long way off.

6. Conclusion

One of the prevalent skin conditions that affects a lot of people's lives is acne vulgaris. To obtain the desired results, an integrated therapeutic approach is necessary, taking into account a number of important factors for acne treatment. Numerous clinical studies have demonstrated the extremely promising effects of our traditional herbs in treating acne.

Even though there are many different types of medications available, plants are a natural source of medications that are useful in treating acne and have negligible or no negative side effects. As a result, they can be frequently utilized as substitutes for synthetic acne medications. Most often affecting adults, acne is a common inflammatory skin disorder that frequently results in social shame and sadness. The four main pathogenic variables stated above are the causes of the development of acne; researchers can use this pathological process to produce a variety of acne management therapies. To optimize the efficacy of current and novel treatments, a comprehensive knowledge of the irritants responsible for microcomedone development and the conversion of non-inflammatory lesions into inflammatory lesions is crucial.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Cawar, I. N., Rajput, R. R., Vaghani, S. S., & Katara, B. V. (2017). Formulation and evaluation of topical spray containing anti acne agent. Glob Pure Appl Sci, 5(24), 14-28.

[2] Roy, S., Bose, S., Sarkar, D., Mandal, S., Sarkar, S., & Mandal, S. K. (2020). Formulation and evaluation of anti-acne gel containing Murraya koenigii extract.

[3] Vasam, M., Korutla, S., & Bohara, R. A. (2023). Acne vulgaris: A review of the pathophysiology, treatment, and recent nanotechnology based advances.

[4] Kameswararao, K., Sujani, C., Koteswararao, N. V. N., Rajarao, A., & Satyanarayanamma, P. N. S. (2019). A Brief Review on Acne Vulgaris.Research Journal of Pharmacology and Pharmacodynamics.

[5] Reddy, D. M., & Jain, V. (2019). Overview on medicinal plants for the treatment of acne. *Research Journal of Pharmacology and Pharmacodynamics.

[6] BROWN, Sonya K.; SHALITA, Alan R. Acne vulgaris. The Lancet, 1998, 351.9119: 1871-1876.

[7] WILLIAMS, Hywel C.; DELLAVALLE, Robert P.; GARNER, Sarah. Acne vulgaris. The Lancet, 2012, 379.9813: 361-372.

[8] CUNLIFFE, W. J.; SHUSTER, Sam. Pathogenesis of acne. The Lancet, 1969, 293.7597: 685-687.

[9] Asai, Y., Baibergenova, A., Dutil, M., Humphrey, S., Hull, P., Lynde, C., ... & Zip, C. (2016). Management of acne: Canadian clinical practice guideline. Cmaj, 188(2), 118-126.

[10] HAIDER, Aamir; SHAW, James C. Treatment of acne vulgaris. Jama, 2004, 292.6: 726-735.

[11] KRAFT, John; FREIMAN, Anatoli. Management of acne. Cmaj, 2011, 183.7: E430-E435.

[12] Kraft, John, and Anatoli Freiman. "Management of acne." Cmaj 183.7 (2011): E430-E435.

[13] LEYDEN, James J.; SHALITA, Alan R. Rational therapy for acne vulgaris: an update on topical treatment. Journal of the American Academy of Dermatology, 1986, 15.4: 907-915.

[14] Leyden, James J., and Alan R. Shalita. "Rational therapy for acne vulgaris: an update on topical treatment." Journal of the American Academy of Dermatology 15.4 (1986): 907-915.

[15] FELDMAN, Steven, et al. Diagnosis and treatment of acne. American Family Physician, 2004, 69.9: 2123-2130.

[16] HABESHIAN, Kaiane A.; COHEN, Bernard A. Current issues in the treatment of acne vulgaris. Pediatrics, 2020, 145.Supplement_2: S225-S230.

[17] AK, Mohiuddin. A comprehensive review of acne vulgaris. J. Clin. Pharm, 2019, 1.1: 17-45.

[18] LEHMANN, Harold P., et al. Acne therapy: a methodologic review. Journal of the American Academy of Dermatology, 2002, 47.2: 231-240.

[19] HENG, Anna Hwee Sing; CHEW, Fook Tim. Systematic review of the epidemiology of acne vulgaris. Scientific reports, 2020, 10.1: 5754.

[20] TAN, Jerry KL; BHATE, Ketaki. A global perspective on the epidemiology of acne. British Journal of Dermatology, 2015, 172.S1: 3-12.

[21] Ak, Mohiuddin. "A comprehensive review of acne vulgaris." J. Clin. Pharm 1.1 (2019): 17-45.

[22] Heng, Anna Hwee Sing, and Fook Tim Chew. "Systematic review of the epidemiology of acne vulgaris." Scientific reports 10.1 (2020): 5754.

[23] Tan, Jerry KL, and Ketaki Bhate. "A global perspective on the epidemiology of acne." British Journal of Dermatology 172.S1 (2015): 3-12.

[24] Eichenfield, D. Z., Sprague, J., & Eichenfield, L. F. (2021). Management of acne vulgaris: a review. Jama, 326(20), 2055-2067.

[25] SUH, D. H.; KWON, H. H. What's new in the physiopathology of acne?. British Journal of Dermatology, 2015, 172: 13-19.

[26] BARRATT, H., et al. Outcome measures in acne vulgaris: systematic review. British Journal of Dermatology, 2009, 160.1: 132-136.

[27] EICHENFIELD, Dawn Z.; SPRAGUE, Jessica; EICHENFIELD, Lawrence F. Management of acne vulgaris: a review. Jama, 2021, 326.20: 2055-2067.

[28] BHATE, K.; WILLIAMS, H. C. What's new in acne? An analysis of systematic reviews published in 2011–2012. Clinical and experimental dermatology, 2014, 39.3: 273-278.

[29] FIEDLER, Friederike, et al. Acne and nutrition: a systematic review. Acta dermato-venereologica, 2017, 97.1: 7-9.

[30] Dall'Oglio, F., Nasca, M. R., Fiorentini, F., & Micali, G. (2021). Diet and acne: review of the evidence from 2009 to 2020. International journal of dermatology, 60(6), 672-685.

[31] Bhate, K., & Williams, H. C. (2014). What's new in acne? An analysis of systematic reviews published in 2011–2012. Clinical and experimental dermatology, 39(3), 273-278.

[32] Fiedler, F., Stangl, G. I., Fiedler, E., & Taube, K. M. (2017). Acne and nutrition: a systematic review. Acta dermato-venereologica, 97(1), 7-9.

[33] LEHMANN, Harold P., et al. Acne therapy: a methodologic review. Journal of the American Academy of Dermatology, 2002, 47.2: 231-240.

[34] DE VRIES, F. M. C., et al. The efficacy and safety of non-pharmacological therapies for the treatment of acne vulgaris: A systematic review and best-evidence synthesis. Journal of the European Academy of Dermatology and Venereology, 2018, 32.7: 1195-1203.

[35] VAN ZUUREN, E. J., et al. Identifying and appraising patient-reported outcome measures on treatment satisfaction in acne: a systematic review. British Journal of Dermatology, 2021, 185.1: 36-51

[36] YUAN, Yi, et al. Topical, light-based, and complementary interventions for acne: an overview of systematic reviews. Cochrane Database of Systematic Reviews, 2024, 10.

[37] SANCLEMENTE, Gloria, et al. Clinical practice guidelines for treatment of acne vulgaris: a critical appraisal using the AGREE II instrument. Archives of dermatological research, 2014, 306: 269-277.

[38] SCOTT, Anna Mae, et al. Blue-light therapy for acne vulgaris: a systematic review and meta-analysis. The Annals of Family Medicine, 2019, 17.6: 545-553.

[39] THIBOUTOT, D. M., et al. Assessing effectiveness in acne clinical trials: steps towards a core outcome measure set. British Journal of Dermatology, 2019, 181.4: 700-706.