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A COMPREHENSIVE REVIEW OF ACNE PREVENTION AND CONTROL WITH INDIAN HERBS

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ABSTRACT:
Acne is one of the most pervasive skin conditions influencing youngsters. It is a sickness of the pilosebaceous unit. Blockage of sebaceous organs and colonization with Proionobacterium acnes prompts acne. Evaluating the seriousness of acne assists with deciding the proper treatment. Treatment of acne should to be begun as soon as conceivable to limit the gamble of scarring and antagonistic mental impacts. It ought to be custom-made to the singular patient, the sort of acne, its seriousness, the patient's capacity to utilize the treatment, and the mental state. Skin specialists are the backbone for treatment of gentle acne. Moderate acne is treated with oral anti-bacterial. Protection from anti-toxins might be diminished by resulting utilization of non-antibiotic skin prescriptions. Extreme acne is treated with isotretinoin, and this can prompt super durable reduction. With better training and care given by clinical calling, acne treatment could be altogether moved along.

Keywords: Acne Vulgaris, Medicinal Plants, Herbal Plants, Infectious Diseases, Skin Diseases.

INTRODUCTION:

1.1 General

The comorbidity of constant skin conditions and psychological well-being problems has for some time been known among the arising gatherings of psych-somatic dermatology and neurodermatology. Acne vulgaris is a dermatological condition that occurs frequently and is frequently associated with depression, anxiety, and other psychological complications [1]. Acne is one of the most well-known multifactorial persistent incendiary illnesses of the pilosebaceous follicles including androgen instigated sebaceous hyperplasia, modified follicular keratinization, hormonal lopsidedness, insusceptible excessive touchiness, and bacterial (Propionibacterium acnes) colonization [2, 3]. Despite the fact that acne misses the mark on direness of a dangerous condition without impeding the general wellness, it creates long haul repercussions that can be pivotal thinking of cutaneous and close to home scars enduring lifetime [4]. It reduces self-esteem and alleviates emotional distress caused by perceived disfigurement, as well as causes physical, social, and psychological suffering [5,6].Acne's clinical signs and symptoms include seborrhea (excess grease), non-inflammatory lesions (open and closed pustules), inflammatory lesions (papules and pustules), and various degrees of scarring due to cyst formation are the clinical manifestations of acne [2]. The dispersion of acne compares to the most elevated thickness of pilosebaceous units; it is circulated over face, neck, upper chest, shoulders, and back. Acne can be divided into two categories based on the type of lesion: inflammatory acne (mild pimples, scarring pimples, and nodular) and

noninflammatory acne (purely pimples acne). Acne can be categorized as mild, moderate, or severe depending on its severity. Gentle acne involves open and shut pustules (<20), provocative injuries (<15) with all out sores not surpassing 30. Moreover, in moderate acne various papules and pustules are seen alongside (20-100), provocative sores (15-50) though complete injuries in the scope of 30-125. Serious acne is determined to have broad sores including knobs and scarring along with growths (>5), complete blackheads count (>100), all out incendiary count (>50) and all out number of injuries more than 125 [7, 8].

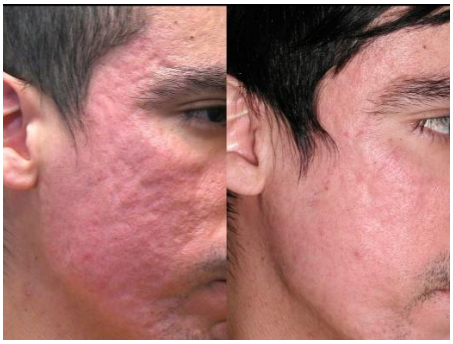

Figure 1: Acne Vulgaris

1.2. Epidemiology

Basically, no mortality is confirmed in this illness, however there is much of the time critical physical and mental grimness. On the expression of measurements, worldwide around 85% of youthful grown-ups matured 12-25 years of age, roughly 8% of grown-ups matured 25-34 years of age, and 3% of grown-ups matured 35-44 years of age experience specific level of acne [9]. On a normal 42.5% of men and 50.9% of ladies keep on experiencing the sickness in their twenties [5]. Acne can last throughout the entire fertile period in 30% of women, according to recent research [10]. Influencing 40 to 50 million individuals in USA each year, countless grown-ups keep on battling with acne even after their high school years. A population study conducted in Germany found that 64% of people aged 20 to 29 and 43% of people aged 30 to 39 had visible acne. One more review from Germany of in excess of 2000 grown-ups showed that 3% of men and 5% of ladies actually had clear gentle acne at 40 years old to 49 years [11]. In an investigation of 309 subjects in southern India, the shut pimples varied from open pimples by an element of 4.9 : 1. Grade 1 acne vulgaris affected 186 patients (60.2%), while grades 2, 3, and 4 affected 85 (27.5%), 8.6%), and 30 (9.7%), respectively [12]. As of late, it was noticed that heritability of acne is practically 80% in first degree family members and is more serious in those with a positive family ancestry. Acne was viewed as more incessant and extreme among smokers following a portion subordinate affiliation [13]. The weight of acne as far as cost to society was not very much delineated, however its transcendence supported the significant expenses presenting a significant monetary weight to the local area. In a new report in USA, the expense of acne is assessed to be 3 billion bucks each year as far as treatment and loss of efficiency [11].

1.3. Pathophysiology of Acne:

The multifactorial pathogenesis of acne prompts at the pilosebaceous unit that comprised of multilobulated sebaceous organs, an epithelial lined follicular channel, and a hair [14]. Pathophysiology of skin break out is credited to various prominent factors, for example, sebaceous organ hyperplasia with seborrhea, adjustment in the nature of sebum lipids, fiery cycles other than safe reaction, dysregulation of the chemical microenvironment, cooperation with neuropeptides, and follicular hyperkeratinisation followed by multiplication of Propionibacterium acnes inside the follicle [15, 16].The connection between androgen level and sebum creation in acne vulgaris has been preestablished. The androgen-induced hypertrophy of sebaceous glands with excessive sebum production is the first factor in the development of acne [17]. Steroid metabolizing enzymes are found in the sebaceous glands, which are responsible for converting DHEAS to DHT. Besides, two

subtypes of 5-α-reductase isozymes, that is to say, type 1 and type 2, communicated in the scalp, chest, sebaceous organs, genitourinary tissue, and dermal papillae as well as in hair follicles, convert testosterone to the more dynamic DHT [5]. Increased cell turnover in the follicular canal and occlusion of the pilosebaceous unit are both consequences of excessive sebum production. Additionally, in the second component of pathogenesis, pilosebaceous follicles are encircled by macrophages and fiery middle people communicating Toll like receptors (TLR2) on their surface. Interleukin-1 (IL-1), IL-8, and granulocyte

macrophage-colony stimulating factor (GM-CSF) are just a few of the cytokines that are produced when TLR2 is activated [18]. This process starts and spreads the inflammatory response, which further causes keratinocyte hyperproliferation. Maintenance of desquamated keratinocytes inside the pilosebaceous unit starts follicular stopping and impediment which triggers decimation of the ordinary design of the follicle and development of a dainty walled cystic injury that is the pimple. As the keratinocytes and sebum keep on gathering, the microcomedo wall in the long run bursts provoking irritation [19].

Creating pimple covers oily fittings containing combination of keratin, sebum, microorganisms, and the shallow layer of melanin which might show up as a zit or a white head. Due to the oxidation of tyrosine to melanin by tyrosinase, blisters that emerge through the skin's surface and have a central black appearance are referred to as "black heads" or open pimples. However, the formation of "white heads" or closed pimples, which remain beneath the skin surface as closed follicles, is caused by the impaction and distension of the follicle with improperly desquamated keratinocytes and sebum [3, 20]. Contingent on the seriousness of pathologic circumstances, these injuries address a papule, pustule, knob, and growth.

An anaerobic Gram-positive bacterium that produces propionic and acetic acid is Propionibacterium acnes. A lot of P. acnes are found in pimples follicular infundibulum because pimples contain a lipid substrate as a food source, making it an ideal habitat for anaerobes. Ultrastructural perception shows that P. acnes are 0.4 to 0.7 μm in width and 3 to 5 μm long, having a ribosome rich cytoplasm and a moderately thick cell wall made out of peptidoglycan [17]. P. acnes is engaged with the advancement of incendiary acne by initiating supplements and processing sebaceous fatty oils into unsaturated fats that aggravate the follicular wall and encompassing dermis. It additionally delivers exoenzymes and chemotactically draws in neutrophils [4]. P. acnes produces lipases, proteases, and hydrolases, adding to irritation and tissue annihilation; produces stress proteins that cause pimples to rupture; and also acts on TLR-2 to elicit an inflammatory response. This may cause follicular keratinocytes and macrophages to express cytokines like IL-6 and IL-8, which are thought to cause hyperkeratinisation, cell adhesion, follicular obstruction, and inflammation. The consecutive peculiarities lead to vascular and cell occasions of fiery reaction and cause follicular disturbance bringing about acneiform sores as papules, pustules, and knobs.

2. Plants Having Antiacne Potential

The undertaking for measures to battle skin break out keeps on being a significant innovative work drive in drug and individual consideration ventures [21]. The supported use of anti-microbials involves the gamble of arising safe microscopic organisms which is unnecessary to make reference to. The advancement of anti-infection opposition is multifactorial, including the particular idea of the relationship of microscopic organisms to anti-infection agents [22]. In this way, there are adequate purposes for looking through elective cures that work out and determine these issues. To conquer anti-toxin opposition as well as the high treatment cost, restorative plants have been read up as elective medicines for infections. As an elective methodology, various reports have demonstrated the chance of utilizing restoratively powerful plant actives to counter the development of the microbes and provocative reaction. Event of 250,000-500,000 plant species offers an extraordinary potential for screening phytotherapeutic specialists which can be used for skin break out

administration. Conventional natural medications give a fascinating and to a great extent neglected hotspot for the improvement of new medications. Conventional medications and regular items offer an extraordinary expectation in the recognizable proof of bioactive lead compounds and their improvement into drugs for the treatment of skin break out vulgaris [20]. An endeavor is likewise being made to specify the potential leads from conventional restorative framework for the treatment of skin inflammation with a continuous quest for novel naturally dynamic herbal specialists.

2.1 Plant Extracts

Plant removes are remedially wanted; therapeutically dynamic segments of restorative plants are isolated from dormant or latent parts utilizing particular solvents by standard extraction strategies like decoction, maceration, mixture, absorption, permeation, and soxhlet extraction. These are gotten as decoctions, mixtures, colors, semisolid, and powdered extricates. A portion of the dynamic plant separates with antiacne properties have been examined underneath.

1. Morus Alba (Mulberry):

Morus alba root extricate showed MIC values 15.6 µg/mL and 3.1 µg/mL against P. acnes and S. epidermidis, separately. Removes from *Phellodendron amurense*, *Albizzia julibrissin*, and *Poncirus trifoliate* additionally delivered amazingly low MIC values against both the microorganisms [23]. In like manner, *Anacardium pulsatilla* containing polyphenols and *Podocarpus nagi* containing flavonols are perceived to be compelling against P. acnes [24]. Another notable plant is *Angelica anomala* which had solid inhibitory impacts against P. acnes and S. epidermidis with MIC upsides of 15.6 µg/mL and 126 µg/mL, individually. *Mollugo pentaphylla*, *Matteuccia orientalis*, and *Orixa japonica* additionally hindered the development of the two microbes, alongside the decrease in P. acnes actuated emission of IL-8 and TNF-α in THP-1 cells [25]. *Caesalpinia sappan* and *Intsia palembanica* were noted as powerful antiacne plants in view of their antibacterial (MIC 0.13 mg/mL; MBC 0.25 mg/mL), lipase inhibitory, and antioxidative properties [26].

1.1 Properties of Morus Alba:

Morus alba, otherwise called white mulberry, is accepted to have against skin break out properties because of its different bioactive mixtures. These mixtures, like flavonoids, resveratrol, and quercetin, have shown cell reinforcement and mitigating impacts that might actually assist with overseeing skin inflammation. Nonetheless, logical exploration on Morus alba's immediate adequacy in treating skin inflammation is restricted, and more examinations are expected to comprehend its likely advantages for skin wellbeing completely.Continuously counsel a dermatologist or medical care proficient prior to involving any regular solutions for skincare concerns [26].

2. Indian Blackberry:

Syzygium cumini, an individual from the Myrtaceae family, is otherwise called Eugenia cumini and Syzygium jamunum. Different names for Indian blackberry incorporate Jambul, Dark Plum, Java Plum, Jamblang, and Jamun (Tewari et al.,2021) [27,28]. The tree just proves to be fruitful one time each year, and the flavor of the berries is sweetish-harsh. The ready organic products are used to create wine, squash, jams, and wellbeing refreshments. All parts of the tree, yet most altogether the seeds, are utilized to oversee diabetes mellitus regarding its dietary utilization. Jamun has cancer prevention agent, calming, hostile to HIV, an-tileishmanial and antifugal, nitric oxide rummaging, free revolutionary searching, anorexigenic, gastroprotective, against ulcerogenic, and redio-defensive impacts (Baliga et al., 2011) [29].

2.1 Nutritional Composition of Indian blackberries:

Table 1: Nutritional composition of Indian Blackberry [29]

Energy	60kcal
Carbohydrates	15.56 g
Fat	0.23 g
Protein	0.72 g
Water	83.13 g
Vitamin A	3 IU
Thiamine (vit. B1)	0.006 mg (1%)
Riboflavin (vit. B2)	0.012 mg (1%)
Pantothenic acid(B5)	0.260 mg (2%)
Vitamin B6	0.038 mg (3%)
Vitamin C	14.3 mg (17%)
Calcium	19 mg (2%)
Iron	0.19 mg (1%)
Magnesium	15 mg (4%)
Phosphorus	17 mg (2%)
Potassium	79 mg (2%)
Sodium	14 mg (1%)

2.2 Composition of Indian blackberry:

The natural product contains somewhere in the range of 83.70 and 85.80 grams of dampness, 0.70 and 0.13 grams of protein, 0.15 and 0.30 grams of unrefined fiber, 14 grams of starches, and 0.32 and 0.40 grams of debris. Per 100 g of consumable part, there are 8.30 to 15.00 mg of calcium, 35.00 mg of magnesium, 15.00 to 16.20 mg of phosphorus,1.20 to 1.62 mg of iron, 26.20 mg of sodium, 55.00 mg of potassium, 0.23 mg of copper, 13.00 mg of sulfur, 8I.U. of vitamin A, 0.01 to 0.03 mg of thiamine, 0.009 to 0.01 mg of vitamin b12, 0.20 mg to 29 mg of niacin (Chaudhuri et al., 1990) [30].

2.3 Chemical synthesis of Indian blackberry:

The phytochemicals malieic corrosive, oxalic corrosive, gallic corrosive, tannins, cynidin glycoside, oleanolic corrosive, flavonoids,medicinal ointments, and betulinic corrosive are available in Indian blackberry mash. Anthocyanins, delphinidin, petunidin,also, malvidin-diglucosides are tracked down in the jamun's mash. Glucose, fructose, citrus, malic, gallic, delphinidin-3-gentiobioside, malvidin-3-laminaribioside, petunidin-3-gentiobioside, and cyaniding diglycoside are all plentiful in natural products (Jagetia, 2007; Tewari et al., 2021) [27,28,31].

2.4 Medicinal Properties of Indian blackberry:

The jamun was basically broadcasted as a drug and conventional medication. The natural product is astringent, stomachic, carminative, antiscorbutic, and diuretic concerning medication. Furthermore, a natural product extricate cases to have antibacterial and cytotoxic properties and may be utilized to traditional antimicrobial medicines. Jamun had considerably higher cell reinforcement flavanol levels than other modern organic products. Organic products contain an assortment of against oxidant substances, like flavonoids, phenolics, carotenoids, and nutrients. These substances are all remembered to be really great for human wellbeing since they bring down the gamble of degenerative infections by decreasing oxidative stress and by repressing the action of macromolecular oxidation, which can be brought about by parts like anthocyanins, tannins, and flavanols (Giri et al., 1985) [32].

2.5 Uses of Indian blackberry:

Indian blackberries are very compelling in battling a few bacterial and viral sicknesses, which is credited to their high phytoestrogen, nutrient, and mineral substance. The ellagic acids present likewise help in its enemy of pathogenic properties. Consequently, blackberries help in supporting

the body's resistance and safeguard it from an assortment of microbial diseases (Ramteke et al., 2015) [33]. Indian blackberries incorporate various skin-molding components like L-ascorbic acid, A, K, and E that advance young looking skin. L-ascorbic acid keeps up with rigid, conditioned skin by sustaining and protecting the collagen from hurt. Blackberries contain vitamin E, which keeps skin brilliant and safeguards it from wrinkles and other oxidative harm. Furthermore, the tannins found in blackberry leaves can be applied to wounds as a characteristic astringent to help with blood coagulating (Sagrawat, 2006) [34].

3. Bael Leaves:

Bael, Aegle marmelos (L.) Corrêa, is one of the restoratively cherished tree species [35] out of the 250,000 living earthly plant species on the planet. Bael is otherwise called begal-quince, brilliant apple, and stone apple in India [36] and a holy tree where Hindus resides. Bael trees are generally established close to sanctuaries committed to Ruler Shiva and regularly revered by the fans [37]. Bael is one of the most valued plants utilized in ayurvedic medication by the Indian and other South Asian occupants in antiquated history [38]. As per the verifiable records, bael is utilized as a restorative and food thing beginning around 5000 B.C. [39] and known to people in any event, while composing the renowned Sanskrit epic-sonnet Ramayana [40]. Bael referenced in the prestigious book Charaka Samhita, an exhaustive gathering of all the fundamental ayurvedic data, which recognized bael as an essential thing in ayurvedic medication [40]. The tree is fragrant, and every one of the parts are restoratively significant [36]. Organic products, leaves, bark, roots, and seeds are utilized in ayurvedic and people medication frameworks to treat different afflictions [36,39].

3.1 Bael Leaves Properties:

Bael separates have shown antibacterial [41], antifungal [42], and antiviral [43,44] exercises. The antibacterial impact of Bael was found on pathogenic Shigella dysenteriae, and the inhibitory movement was accepted to be from coumarin intensifies present in the concentrate [45]. Antifungal exercises were additionally affirmed against Aspergillus and Candida spp. utilizing the plate dissemination measure [46]. The showed antimicrobial movement suggests that bael concentrates can be utilized to control the parasitic microbes in skin sicknesses and the pollution of food [46].

3.2 Bael Leaves use as antiacne:

Bael leaves are sometimes used for their anti-acne properties. They possess antibacterial and anti-inflammatory qualities that could help in managing acne. However, it's important to note that while natural remedies like Bael leaves might provide some benefits, consulting with a dermatologist for personalized advice is recommended for effective acne treatment [46].

4. Aloe Vera Gel:

Lately, there have been a rising number of drugs and beauty care products produced using aloe vera gel (AVG), the adhesive tissue in the focal point of the aloe vera leaf [47,48]. Its pharmacological capabilities incorporate antibacterial, mitigating impacts and wound mending advancement [49-51]. A past report recommended that AVG treatment in blend with tretinoin was successful in decreasing non-fiery and provocative skin break out sores. In any case, its unfavorable impacts were likewise seen in over 70% of treated patients, like scaling, consuming, and erythema [52]. Moreover, it has been accounted for that the high and low frequencies of ultrasound (US) waves play a part in disaggregating the horny layer and animating the retention of the dynamic mixtures [53]. This study was intended to assess the viability of AVG joined with US and outer use of delicate cover to offer an option in contrast to patients with gentle to extreme skin break out who look for skin medicines with gentle secondary effects and low anti-infection opposition rates.

4.1 Aloe Vera Gel Antimicrobial Properties:

Various examinations have been completed to assess the antimicrobial action of Aloe vera and its fundamental constituents. The greater part of these examinations are in vitro and center around the

antibacterial movement. One of the most concentrated on microscopic organisms are Staphylococcus aureus and Pseudomonas aeruginosa. Consequently, Aloe vera fluid concentrate diminished development and biofilm arrangement against methicillin safe Staphylococcus aureus [54]. Additionally, this microorganism has likewise been restrained by Aloe vera gel (half and 100 percent focuses), alongside other oral microorganisms acquired from patients with periapical and periodontal boil including Actinobacillus actinomycetemcomitans, Clostridium bacilli, and Streptococcus mutans utilizing plate dissemination, miniature weakening, and agar weakening strategies [55]. One of the mixtures credited to antibacterial action against Staphylococcus aureus is aloe-emodin which acts by repressing biofilm advancement and extracellular protein creation [56]. Pseudomonas aeruginosa development and biofilm arrangement hindrance has been likewise exhibited for Aloe vera inward gel. This Aloe vera internal gel likewise restrained other Gram-negative microorganisms (Helicobacter pylori and Escherichia coli) as well as the parasite Candida albicans [57]. In addition, in another review, Aloe vera hydroalcoholic remove showed antibacterial action against Enterococcus faecalis, a contaminating microorganism of the root waterways of teeth, with hindrance zones of 13 mm (soaked) and 9.6 mm (weakened) [58].

5. Turmeric (Curcuma Longa):

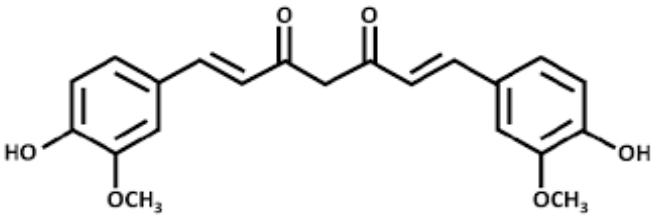

Figure 2: Structure of Turmeric

Curcumin (curcumin I, diferuloylmethane) is a dimeric subordinate of ferulic corrosive, made out of two o-methoxyphenol rings associated by a heptadienedione chain (Figure 2). It has a synthetic recipe of C21H20O6 and a sub-atomic load of 368.38 g/mol. This lipophilic polyphenol is a characteristic shade with a trademark yellow-orange tone, prevalently tracked down in the rhizomes of turmeric (Curcuma longa L.) from the ginger family, Zingiberaceae, local to tropical South Asia. Along with rejuvenating oils and other curcuminoids, curcumin is a primary bioactive compound of turmeric powder — an oriental flavor regularly got from this plant [59,60,61]. It is exceptionally well known in South Asian and Center Eastern foods, particularly for planning curry dishes. The utilization of C. longa as a culinary zest and in strict functions goes back almost 4000 years to the Vedic culture in India. This plant has been additionally notable in Ayurvedic and Unani frameworks, Customary Chinese Medication (TCM), and in the people medication of Pakistan, Bangladesh, and Afghanistan. Turmeric has been generally utilized as a sterile, antibacterial, mitigating, choleretic, and carminative specialist in the treatment of wounds and consumes, gastrointestinal and liver problems, respiratory framework sicknesses (e.g., asthma, hack, runny nose, sinusitis), anorexia, and stiffness [62,63]. These days, turmeric and curcumin (the code of E100) are generally used as food added substances with shading, enhancing, and additive properties (e.g., in mustard, margarine, spread, cheddar, pasta, and drinks) [59,62]. Generally, curcumin is frequently used to free numerous side effects from different gastrointestinal infections, like loose bowels, heartburn, efflux, and, surprisingly, gastric and duodenal ulcers [64]. It is additionally ready to lessen unfavorable impacts after medicine, i.e., through mucosal assurance from the gastric harm incited by non-steroidal calming drugs [65,66].

5.1 Turmeric Antimicrobial Property:

The antibacterial action of curcumin was first displayed in Nature in 1949 [67]. In 1974, scientists from our Foundation [68] distributed in the Planta Medica diary rich information on the impacts of

curcumin, an ethanol concentrate and natural balm of the rhizome of C. longa against 65 reference and clinical strains addressing 56 bacterial and contagious taxa. They reported a high in vitro viability of curcumin against Gram-positive cocci (Staphylococcus aureus, S. epidermidis, Streptococcus pyogenes, Micrococcus tetragenus, M. luteus), spore-shaping bacilli (Bacillus and Clostridium species), a few Gram-negative microorganisms (Acinetobacter lwoffii, Alcaligenes faecalis), and parasites (e.g., Candida stellatoidea, Cryptococcus neoformans, Microsporum gypseum, Saccharomyces cerevisiae, Scopulariopsis brevicaulis).

Current examinations have affirmed areas of strength for the capability of curcumin regardless of its unfortunate solvency in water, low bioavailability and pharmacokinetic profile [61]. Curcumin has been accounted for its antibiofilm movement through the hindrance of bacterial majority detecting (QS) frameworks and evacuation of currently shaped biofilms [69,70]. This plant particle was found to have a photodynamic activity by the cytotoxic receptive oxygen species (ROS) creation against both planktonic and biofilm types of microorganisms [71]. The writing information have likewise shown its valuable impacts against Gram-negative uropathogens (Escherichia coli, Pseudomonas aeruginosa, Proteus mirabilis, and Serratia marcescens [72]), and a preventive job in the development of struvite stones related with the urinary plot contaminations [73]. Besides, curcumin displayed a synergistic antimicrobial impact with anti-infection agents and antifungals against different microorganisms, including methicillin-safe S. aureus [74], Pseudomonas aeruginosa [75], enterotoxigenic Escherichia coli (ETEC) [76], and Candida albicans [77]. Curcumin, with its solid mitigating properties and against Helicobacter pylori movement, was additionally viewed as in the treatment of H. pylori-related gastritis, peptic ulcers, and gastric adenocarcinoma [64].

In spite of different examinations concerning the antibacterial and antifungal properties of curcumin, deficient information exist on its belongings against various types of microorganisms, particularly clinical disengages and multidrug-safe (MDR) ones. Moreover, the base inhibitory fixations (MICs) of this regular plant substance against planktonic types of numerous normal human microorganisms have not set in stone. Thus, this action of curcumin against such microorganisms as A. lwoffii [68], Proteus mirabilis [72,78], Serratia marcescens [68,72], Stenotrophomonas maltophilia [79], and Streptococcus agalactiae [78] has been inspected inconsistently. In the contemporary exploration, the in vitro capacity of curcumin to hinder microbial development has regularly been tried against a little (4-6) number of species addressing a little gathering of taxa, generally E. coli, P. aeruginosa, and S. aureus, and less frequently Bacillus subtilis and Enterococcus faecalis (e.g., [80-86]). A few works have revealed the base inhibitory focus (MIC) an incentive for only one animal types and a solitary, typically reference, strain (e.g., [87-90]). Once in a while, too low convergences of curcumin have been utilized to decide its antimicrobial movement, for example, at the greatest degrees of 64 µg/mL [38], 100 µg/mL [68], 128 µg/mL [81], 156 µg/mL [85], 256 µg/mL [91], 330 µg/mL [76], and 375 µg/mL [92]. Thus, there is as yet a requirement for broad exploration of the impacts of curcumin against an enormous number of microbial strains and species by a normalized strategy. The stock microdilution measure is a generally utilized technique that offers the chance to contrast got results and the writing information.

3.Conclusion:

In spite of the fact that there are various medication treatments for the treatment of acne (skin, fundamental retinoid, anti-microbials, and keratolytics), the premier test is the developing worries of rising anti-microbial opposition and dermal poison levels with existing meds. The creators acclaim regular cures as an option agains acne over these manufactured medications. These creating normal treatments cover normally got drugs from dynamic plant extricates, medicinal ointments, and phytomolecules which are talked about in the survey. In any case, there are sure issues unified to regular treatments, for instance; while considering plant separates, characterizing the quality and wellbeing of extracts is vital. Jamun has for quite some time been utilized to treat various sicknesses, especially diabetes, coronary illness, and its results. Jamun has antineoplastic activity,

consequently forestalling bosom cancer is additionally utilized. It is generally utilized for traditional treatment of looseness of the bowels, ulcers, irritation, and diabetes mellitus. It is a decent wellspring of anthocyanin, which is helpful against pain relieving attributes, and it has therapeutic advantages. Also, it has antineoplastic, radioprotective, and chemopreventive characteristics. It means quite a bit to investigate the chemopreventive impacts of jamun and its phytochemicals in other cancer-causing agent models, for example, those for synthetic, radiation, and viral carcinogenesis. It is vital to advance jamun makers in India's ancestral districts by advancing the wellbeing benefits of jamun crude and worth added items to metropolitan buyers. Mulberry remove shows guarantee as a possible treatment for skin break out because of its calming and cell reinforcement properties. In any case, further examination and clinical preliminaries are expected to lay out its viability, ideal dose, and long haul wellbeing before it tends to be suggested as a standard treatment for skin break out. It's fitting to talk with a clinical expert prior to integrating mulberry remove or some other elective medicines into a skin inflammation routine. Bael passes on offer likely advantages for acne treatment because of their antimicrobial and mitigating properties. While there is some customary information supporting their utilization, logical proof is right now restricted. Prior to considering bael leaves or any elective solutions for acne, counseling a dermatologist or medical services proficient is prescribed to guarantee protected and successful therapy. This study proposes that the new non-drug joined treatment essentially further developed skin inflammation, which gave exploratory proof and treatment direction for patients with gentle to serious acne, particularly patients with moderate acne. This new treatment may conceivably be a suitable strategy for patients who look for skin medicines with gentle secondary effects and low anti-microbial obstruction rates.

6. References:

1. 1. W. P. Bowe and A. C. Logan, “Acne vulgaris, probiotics and the gut-brain-skin axis—back to the future?” *Gut Pathogens,* vol. 3, no. 1, article 1, pp. 1–11, 2011.
2. H. C. Williams, R. P. Dellavalle, and S. Garner, “Acne vulgaris,” *The Lancet*, 2012: 379(9813):361–372.
3. T. Coenye, E. Peeters, and H. J. Nelis, “Biofilm formation by *Propionibacterium acnes* is associated with increased resistance to antimicrobial agents and increased production of putative virulence factors,” *Research in Microbiology*, 2007:158(4):386–392.
4. G. Webster, “Acne vulgaris,” *The British Medical Journal*, 2002:325(7362):475–479.
5. R. Nguyen and J. Su, “Treatment of acne vulgaris,” *Paediatrics and Child Health*, 2011:21(3):119–125.
6. C. C. Zouboulis, H. Seltmann, N. Hiroi et al., “Corticotropin-releasing hormone: an autocrine hormone that promotes lipogenesis in human sebocytes,” Proceedings of the National Academy of Sciences of the United States of America, 2002:99(10):7148–7153.
7. A. M. Layton, “Acne vulgaris and similar eruptions,” *Medicine*, 2005:33(1):44–48.
8. I. Truter, “Acne vulgaris,” *SA Pharmaceutical Journal*, 2009:76(3):12–19.
9. I. Brajac, L. Bilić-Zulle, M. Tkalčić, K. Lončarek, and F. Gruber, “Acne vulgaris: myths and misconceptions among patients and family physicians,” *Patient Education and Counseling*, 2004:54(1):21–25.
10. F. H. Sakamoto, L. Torezan, and R. R. Anderson, “Photodynamic therapy for acne vulgaris: a critical review from basics to clinical practice: Part II. Understanding parameters for acne treatment with photodynamic therapy,” *Journal of the American Academy of Dermatology*, 2010:63(2):195–211.
11. K. Bhate and H. C. Williams, “Epidemiology of acne vulgaris.,” *The British journal of dermatology*, 2013:168(3):474–485.
12. B. Adityan and D. M. Thappa, “Profile of acne vulgaris-A hospital-based study from South India,” *Indian Journal of Dermatology, Venereology and Leprology*, 2009:75(3):272–278.

13. T. Schäfer, A. Nienhaus, D. Vieluf, J. Berger, and J. Ring, "Epidemiology of acne in the general population: the risk of smoking," *British Journal of Dermatology*, 2001:145(1):100–104.
14. A. N. Feneran, W. S. Kaufman, T. S. Dabade, and S. R. Feldman, "Retinoid plus antimicrobial combination treatments for acne," *Clinical, Cosmetic and Investigational Dermatology*, 2011:145(4):79–92.
15. H. Gollnick, W. Cunliffe, D. Berson et al., "Management of acne: a report from a global alliance to improve outcomes in acne," *Journal of the American Academy of Dermatology*, 2003:49(1):S1–S37.
16. E. Makrantonaki, R. Ganceviciene, and C. Zouboulis, "An update on the role of the sebaceous gland in the pathogenesis of acne," *Dermato-Endocrinology*, 2011:3(1):41-49.
17. M. Toyoda and M. Morohashi, "Pathogenesis of acne," *Medical Electron Microscopy*, 2001:34(1):29-40.
18. I. Kurokawa, F. W. Danby, Q. Ju et al., "New developments in our understanding of acne pathogenesis and treatment," *Experimental Dermatology*, 2009:18(10):821-832.
19. E. C. Davis and V. D. Callender, "A review of acne in ethnic skin: pathogenesis, clinical manifestations, and management strategies," *Journal of Clinical and Aesthetic Dermatology*, 2010:3(4):24-38.
20. V. K. Ghosh, D. H. Nagore, K. P. Kadbhane, and M. J. Patil, "Different approaches of alternative medicines in acne vulgaris treatment," *Oriental Pharmacy and Experimental Medicine*, 2011:11(1):1-9.
21. C. C. Zouboulis, "Sebaceous gland receptors," *Dermato-Endocrinology*, 2009:1(2):77-80.
22. R. Ganceviciene, V. Graziene, S. Fimmel, and C. C. Zouboulis, "Involvement of the corticotropin-releasing hormone system in the pathogenesis of acne vulgaris," British Journal of Dermatology, 2009:160(2):345-352.
23. B. C. Melnik and G. Schmitz, "Role of insulin, insulin-like growth factor-1, hyperglycaemic food and milk consumption in the pathogenesis of acne vulgaris," *Experimental Dermatology*, 2009:18(10):833–841.
24. M. Cappel, D. Mauger, and D. Thiboutot, "Correlation between serum levels of insulin-like growth factor 1, dehydroepiandrosterone sulfate, and dihydrotestosterone and acne lesion counts in adult women," *Archives of Dermatology*, 2005:141(3):333–338.
25. B. C. Melnik, "Role of FGFR2-signaling in the pathogenesis of acne," *Dermato-Endocrinology*, 2009:1(3):141–156.
26. B. C. Melnik, G. Schmitz, and C. C. Zouboulis, "Anti-acne agents attenuate FGFR2 signal transduction in acne," *Journal of Investigative Dermatology*, 2009:129(8): 1868–1877.
27. Tewari S, David J, Gautam A. Physicochemical analysis of probiotic functional Kulfi by using Indian blackberry (Syzygium cumini L.). Journal of Pharmacognosy and Phytochemistry, 2021:10(5):236-246.
28. Tewari S, David J, Gautam A. Sensory analysis of probiotic functional kulfi by using Indian blackberry (Syzygium cumini L.). The Pharma Innovation Journal, 2021:10(9):1421-1426.
29. Baliga MS, Bhat HP, Baliga BRV, Wilson R, Palatty PL. Phytochemistry, traditional uses and pharmacology of Eugenia jambolana Lam. (black plum): a review. Food Research International, 2011:44(7):1776-1789.
30. Chaudhuri AN, Pal S, Gomes A, Bhattacharya S. Anti-inflammatory and related actions of Syzygium cuminii seed extract. Phytotherapy research, 1990:4(1):5-10.
31. Jagetia GC. Radioprotective potential of plants and herbs against the effects of ionizing radiation. Journal of clinical biochemistry and nutrition, 2007:40(2):74-81.
32. Giri J, Sathidevi T, Dushyanth N. Effect of jamun seed extract on alloxan induced diabetes in rats. Journal of the Diabetic Association of India, 1985:25(4):115-119.
33. Ramteke V, Kurrey V, Kar S. Jamun: A traditional fruit and medicine. Popular Kheti, 2015:3(3):188-190.

34. Sagrawat H. Pharmacological potential of Eugenia jambolana: A review. Pharmacogn Mag, 2006:2(6):96- 105.
35. R. Chanda, "Phytochemical and pharmacological activity of *Aegle marmelos* as a potential medicinal plant: an overview," *The Internet Journal of Pharmacology*, 2008:6(1):3.
36. S. E. Kintzios, "Terrestrial plant-derived anticancer agents and plant species used in anticancer research," *Critical Reviews in Plant Sciences*, 2006:25(1):79-113.
37. V. K. Singhal, A. Salwan, P. Kumar, and J. Kaur, "Phenology, pollination and breeding system of *Aegle marmelos* (Linn.) correa (Rutaceae) from India," *New Forest*, 2011:42(1):85-100.
38. G. C. Jagetia and M. S. Baliga, "The evaluation of nitric oxide scavenging activity of certain Indian medicinal plants in vitro: a preliminary study," *Journal of Medicinal Food*, 2004:7(3):343-348.
39. M. S. Baliga, H. P. Bhat, N. Joseph, and F. Fazal, "Phytochemistry and medicinal uses of the bael fruit (*Aegle marmelos* Correa): a concise review," *Food Research International*, 2011:44(7):1768-1775.
40. S. K. Roy and R. N. Sing, "Bael fruit (*Aegle marmelos*): a potential fruit for processing," *Economic Botany*, 1979:33(2):203-212.
41. P. Rani and N. Khullar, "Antimicrobial evaluation of some medicinal plants for their anti-enteric potential against multi-drug resistant *Salmonella typhi*," *Phytotherapy Research*, 2004:18(2):670-673.
42. B. K. Rana, U. P. Singh, and V. Taneja, "Antifungal activity and kinetics of inhibition by essential oil isolated from leaves of *Aegle marmelos*," *Journal of Ethnopharmacology*, (1997)57:29-34.
43. G. Balasubramanian, M. Sarathi, R. S. Kumar, and A. S. S. Hameed, "Screening the antiviral activity of Indian medicinal plants against white spot syndrome virus in shrimp," *Aquaculture*, (2007)263:15-19.
44. T. Citarasu, V. Sivaram, G. Immanuel, N. Rout, and V. Murugan, "Influence of selected Indian immunostimulant herbs against white spot syndrome virus (WSSV) infection in black tiger shrimp, Penaeusmonodon with reference to haematological, biochemical and immunological changes," *Fish and Shellfish Immunology*, (2006)21:372-384.
45. S. B. Raja, M. R. Murali, and S. N. Devaraj, "Differential expression of *ompC* and *ompF* in multidrug-resistant *Shigella dysenteriae* and *Shigella flexneri* by aqueous extract of *Aegle marmelos*, altering its susceptibility toward *β*-lactam antibiotics," *Diagnostic Microbiology and Infectious Disease*, (2008)61:321-328.
46. F. G. Shoba and M. Thomas, "Study of antidiarrhoeal activity of four medicinal plants in castor-oil induced diarrhea," *Journal of Ethnopharmacology*, (2001)76:73-76.
47. Grindlay D, Reynolds T. The aloe vera phenomenon: a review of the properties and modern uses of the leaf parenchyma gel. *J Ethnopharmacol.* (1986) 16:117–51.
48. Triantafyllidi A, Xanthos T, Papalois A, Triantafillidis JK. Herbal and plant therapy in patients with inflammatory bowel disease. *Ann Gastroenterol.* (2015) 28:210–20.
49. Jain S, Rathod N, Nagi R, Sur J, Laheji A, Gupta N. Antibacterial effect of aloe vera gel against oral pathogens: an in-vitro study. *J Clin Diagn Res.* (2016) 10:41–4.
50. Reuter J, Jocher A, Stump J, Grossjohann B, Franke G, Schempp CM. Investigation of the anti-inflammatory potential of aloe vera gel (97.5%) in the ultraviolet erythema test. *Skin Pharmacol Physiol.* (2008) 21:106–10.
51. Norman G, Christie J, Liu Z, Westby MJ, Jefferies JM, Hudson T, et al.. Antiseptics for burns. *Cochrane Database Syst Rev.* (2017) 7:CD011821.
52. Hajheydari Z, Saeedi M, Morteza-Semnani K, Soltani A. Effect of aloe vera topical gel combined with tretinoin in treatment of mild and moderate acne vulgaris: a randomized, double-blind, prospective trial. *J Dermatolog Treat.* (2014) 25:123–9.
53. Juhász M, Korta D, Mesinkovska NA. A review of the use of ultrasound for skin tightening, body contouring, and cellulite reduction in dermatology. *Dermatolog Surg.* (2018) 44:949–63.

54. Saddiq A.A., Al-Ghamdi H. *Aloe vera* extract: A novel antimicrobial and antibiofilm against methicillin resistant Staphylococcus aureus strains. *Pak. J. Pharm. Sci. (2018)*31:2123–2130.
55. Jain S., Rathod N., Nagi R., Sur J., Laheji A., Gupta N., Prasad S. Antibacterial Effect of *Aloe vera* Gel against Oral Pathogens: An In-vitro Study. *J. Clin. Diagn. Res.* (2016)10:41–44.
56. Xiang H., Cao F., Ming D., Zheng Y., Dong X., Zhong X., Wang L. Aloe-emodin inhibits Staphylococcus aureus biofilms and extracellular protein production at the initial adhesion stage of biofilm development. *Appl. Microbiol. Biotechnol.* (2017)101:6671–6681.
57. Cataldi V., Di Bartolomeo S., Di Campli E., Nostro A., Cellini L., Di Giulio M. In vitro activity of *Aloe vera* inner gel against microorganisms grown in planktonic and sessile phases. *Int. J. Immunopathol. Pharmacol.* (2015)28:595–602.
58. Karkare S.R., Ahire N.P., Khedkar S.U. Comparative evaluation of antimicrobial activity of hydroalcoholic extract of *Aloe vera*, garlic, and 5% sodium hypochlorite as root canal irrigants against Enterococcus faecalis: An in vitro study. *J. Indian Soc. Pedod. Prev. Dent.* (2015)33:274–278.
59. Basnet P., Skalko-Basnet N. Curcumin: An anti-inflammatory molecule from a curry spice on the path to cancer treatment. *Molecules.* (2011)16:4567–4598.
60. Siviero A., Gallo E., Maggini V., Gori L., Mugelli A., Firenzuoli F., Vannacci A. Curcumin, a golden spice with a low bioavailability. *J. Herb. Med.* 2015;5:57–70.
61. Kotha R.R., Luthria D.L. Curcumin: Biological, pharmaceutical, nutraceutical, and analytical aspects. *Molecules.* (2019)24:2930.
62. Prasad S., Aggarwal B.B. Turmeric, the golden spice. In: Benzie I.F.F., Wachtel-Galor S., editors. *Herbal Medicine: Biomolecular and Clinical Aspects.* 2nd ed. CRC Press/Taylor & Francis; Boca Raton, FL, USA: (2011)24:263–288.
63. Nair K.P. *Turmeric (Curcuma longa L.) and Ginger (Zingiber officinale Rosc.)—World's Invaluable Medicinal Spices. The Agronomy and Economy of Turmeric and Ginger.* 1st ed. Springer Nature; Cham, Switzerland: (2019)24:1–243.
64. Kwiecien S., Magierowski M., Majka J., Ptak-Belowska A., Wojcik D., Sliwowski Z., Magierowska K., Brzozowski T. Curcumin: A potent protectant against esophageal and gastric disorders. *Int. J. Mol. Sci.* (2019)20:1477.
65. Cheng Y.T., Lu C.C., Yen G.C. Phytochemicals enhance antioxidant enzyme expression to protect against NSAID-induced oxidative damage of the gastrointestinal mucosa. *Mol. Nutr. Food Res.* (2017)61:1460.
66. Singh D.P., Borse S.P., Rana R., Nivsarkar M. Curcumin, a component of turmeric, efficiently prevents diclofenac sodium-induced gastroenteropathic damage in rats: A step towards translational medicine. *Food Chem. Toxicol.* (2017)108:43–52.
67. Schraufstätter E., Bernt H. Antibacterial action of curcumin and related compounds. *Nature.* (1949)164:456–457.
68. Lutomski J., Kędzia B., Dębska W. Wirkung des Äthanolextraktes und aktiver Substanzen aus *Curcuma longa* auf Bakterien und Pilze (Effect of the ethanol extract and active substances from *Curcuma longa* on bacteria and fungi) *Planta Med.* (1974)26:9–19.
69. Loo C.Y., Rohanizadeh R., Young P.M., Traini D., Cavaliere R., Whitchurch C.B., Lee W.H. Combination of silver nanoparticles and curcumin nanoparticles for enhanced anti-biofilm activities. *J. Agric. Food Chem.* (2016)64:2513–2522.
70. Shukla A., Parmar P., Rao P., Goswami D., Saraf M. Twin peaks: Presenting the antagonistic molecular interplay of curcumin with LasR and LuxR quorum sensing pathways. *Curr. Microbiol.* (2020)30:101676.
71. Abdulrahman H., Misba L., Ahmad S., Khan A.U. Curcumin induced photodynamic therapy mediated suppression of quorum sensing pathway of *Pseudomonas aeruginosa*: An approach to inhibit biofilm *in vitro*. *Photodiagn. Photodyn. Ther.* (2020)30:101645.
72. Packiavathy I.A., Priya S., Pandian S.K., Ravi A.V. Inhibition of biofilm development of uropathogens by curcumin—An anti-quorum sensing agent from *Curcuma longa*. *Food Chem.* (2014)148:453–460.

73. Das P., Gupta G., Velu V., Awasthi R., Dua K., Malipeddi H. Formation of struvite urinary stones and approaches towards the inhibition—A review. *Biomed. Pharmacother.* (2017)96:361–370.
74. Teow S.Y., Liew K., Ali S.A., Khoo A.S.B., Peh S.C. Antibacterial action of curcumin against *Staphylococcus aureus*: A brief review. *J. Trop. Med.* (2016)96;2853045.
75. Bahari S., Zeighami H., Mirshahabi H., Roudashti S., Haghi F. Inhibition of *Pseudomonas aeruginosa* quorum sensing by subinhibitory concentrations of curcumin with gentamicin and azithromycin. *J. Glob. Antimicrob. Resist.* (2017)10:21–28.
76. Rangel-Castañeda I.A., Cruz-Lozano J.R., Zermeño-Ruiz M., Cortes-Zarate R., Hernández-Hernández L., Tapia-Pastrana G., Castillo-Romero A. Drug susceptibility testing and synergistic antibacterial activity of curcumin with antibiotics against enterotoxigenic *Escherichia coli*. *Antibiotics.* (2019)8:43.
77. Sharma M., Manoharlal R., Negi A.S., Prasad R. Synergistic anticandidal activity of pure polyphenol curcumin I in combination with azoles and polyenes generates reactive oxygen species leading to apoptosis. *FEMS Yeast Res.* (2010)10:570–578.
78. Lawhavinit O., Kongkathip N., Kongkathip B. Antimicrobial activity of curcuminoids from *Curcuma longa* L. on pathogenic bacteria of shrimp and chicken. *Kasetsart J. Nat. Sci.* (2010)44:364–371.
79. Betts J.W., Sharili A.S., La Ragione R.M., Wareham D.W. *In vitro* antibacterial activity of curcumin-polymyxin B combinations against multidrug-resistant bacteria associated with traumatic wound infections. *J. Nat. Prod.* (2016)79:1702–1706.
80. Sasidharan N.K., Sreekala S.R., Jacob J., Nambisan B. *In vitro* synergistic effect of curcumin in combination with third generation cephalosporins against bacteria associated with infectious diarrhea. *Biomed. Res. Int.* (2014)561456.
81. Wang Y., Yan M., Ma R., Ma S. Synthesis and antibacterial activity of novel 4-bromo-1*H*-indazole derivatives as FtsZ inhibitors. *Arch. Pharm. Chem. Life Sci.* (2015)348:266–274.
82. Gunes H., Gulen D., Mutlu R., Gumus A., Tas T., Topkaya A.E. Antibacterial effects of curcumin: An *in vitro* minimum inhibitory concentration study. *Toxicol. Ind. Health.* (2016)32:246–250.
83. Silva A.C.D., Santos P.D.F., Palazzi N.C., Leimann F.V., Fuchs R.H.B., Bracht L., Gonçalves O.H. Production and characterization of curcumin microcrystals and evaluation of the antimicrobial and sensory aspects in minimally processed carrots. *Food Funct.* (2017)8:1851–1858.
84. Khan M., Ali M., Shah W., Shah A., Yasinzai M.M. Curcumin-loaded self-emulsifying drug delivery system (cu-SEDDS): A promising approach for the control of primary pathogen and secondary bacterial infections in cutaneous leishmaniasis. *Appl. Microbiol. Biotechnol.* (2019)103:7481–7490.
85. Polaquini C.R., Morão L.G., Nazaré A.C., Torrezan G.S., Dilarri G., Cavalca L.B., Campos D.L., Silva I.C., Pereira J.A., Scheffers D.J., et al. Antibacterial activity of 3,3′-dihydroxycurcumin (DHC) is associated with membrane perturbation. *Bioorg. Chem.* (2019)90:103031.
86. Srivastava P., Shukla M., Kaul G., Chopra S., Patra A.K. Rationally designed curcumin based ruthenium(II) antimicrobials effective against drug-resistant *Staphylococcus aureus*. *Dalton Trans.* (2019)48:11822–11828.
87. Neelakantan P., Subbarao C., Sharma S., Subbarao C.V., Garcia-Godoy F., Gutmann J.L. Effectiveness of curcumin against *Enterococcus faecalis* biofilm. *Acta Odontol. Scand.* (2013)71:1453–1457.
88. Marickar R.F., Geetha R.V., Neelakantan P. Efficacy of contemporary and novel intracanal medicaments against *Enterococcus faecalis*. *J. Clin. Pediatr. Dent.* (2014)39:47–50.
89. Yun D.G., Lee D.G. Antibacterial activity of curcumin via apoptosis-like response in *Escherichia coli*. *Appl. Microbiol. Biotechnol.* (2016)100:5505–5514.

90. Raorane C.J., Lee J.H., Kim Y.G., Rajasekharan S.K., García-Contreras R., Lee J. Antibiofilm and antivirulence efficacies of flavonoids and curcumin against *Acinetobacter baumannii*. *Front. Microbiol.* (2019)10:990.
91. Betts J.W., Wareham D.W. *In vitro* activity of curcumin in combination with epigallocatechin gallate (EGCG) versus multidrug-resistant *Acinetobacter baumannii*. *BMC Microbiol.* (2014)14:172.
92. Tajbakhsh S., Mohammadi K., Deilami I., Zandi K., Fouladvand M., Ramedani E., Asayesh G. Antibacterial activity of indium curcumin and indium diacetylcurcumin. *Afr. J. Biotechnol.* (2008)7:3832–3835.