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Ashley

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(54) **USE METHODS OF TREATING ACNE AND TELANGIECTASIA**

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(60) Provisional application No. 60/281,916, filed on Apr. 5, 2001, provisional application No. 60/325,489, filed on Sep. 26, 2001.

(51) **Int. Cl.**
A61K 6/00 (2006.01)
A61K 9/20 (2006.01)
A61K 31/65 (2006.01)

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(58) **Field of Classification Search** 424/464, 424/465, 401, 468, 451, 457; 514/152
See application file for complete search history.

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(57) **ABSTRACT**

A method of treating telangiectasia in a human in need thereof comprising administering to said human a tetracycline compound in an amount that is effective to treat telangiectasia, but has substantially no antibiotic activity.

32 Claims, 1 Drawing Sheet

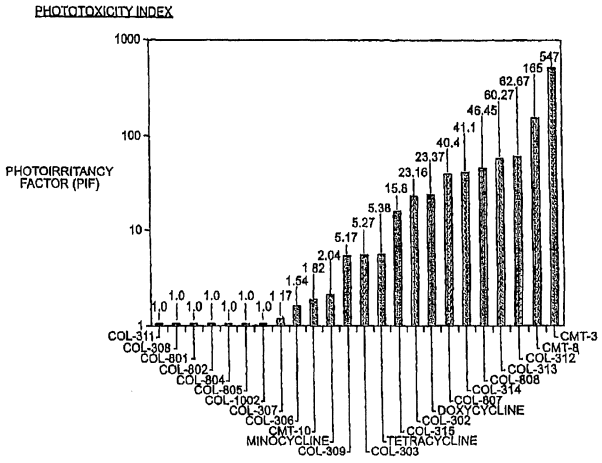

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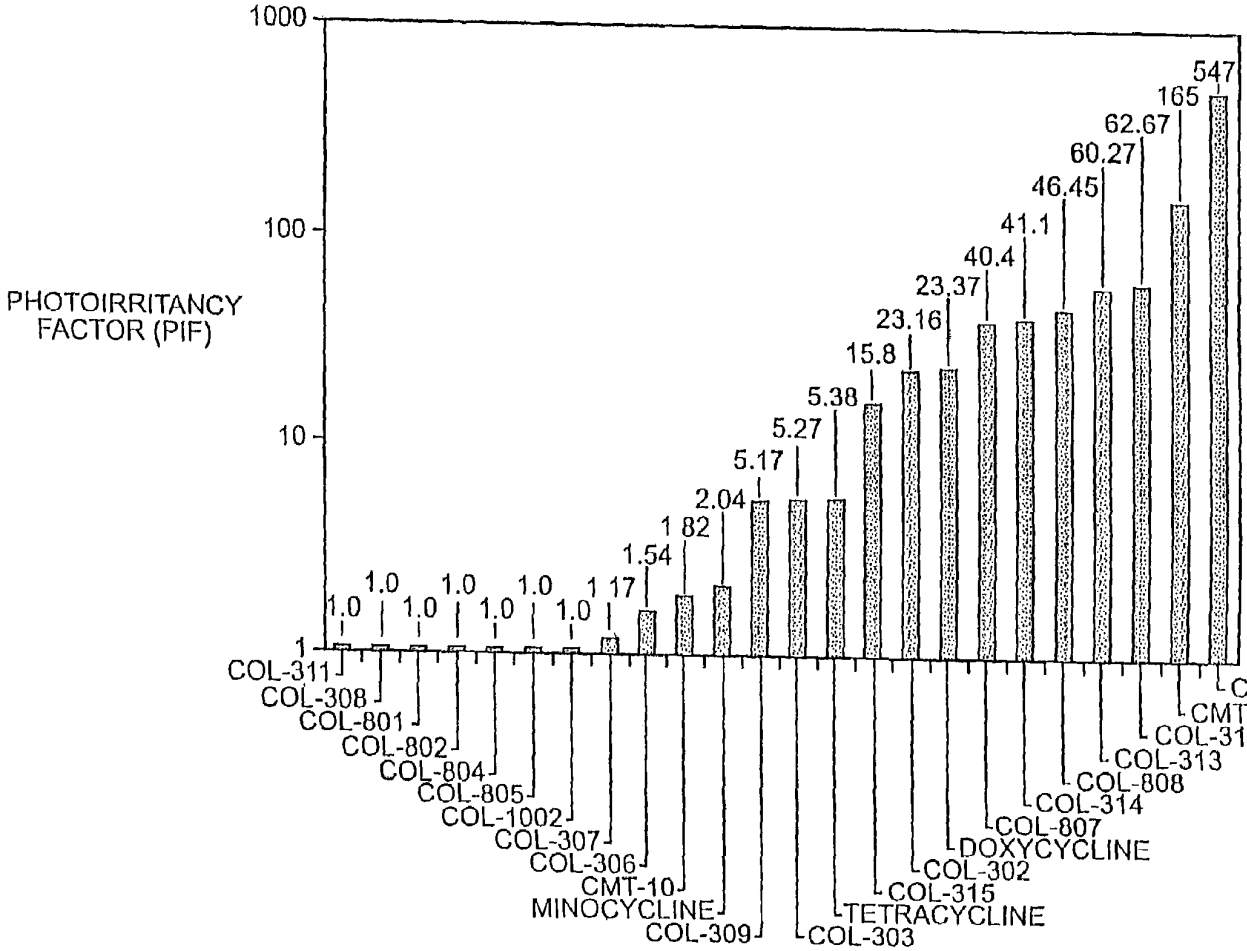
FIG. 1 PHOTOTOXICITY INDEX



USE METHODS OF TREATING ACNE AND TELANGIECTASIA

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation of co-pending U.S. application Ser. No. 10/117,709, filed Apr. 5, 2002. This application claims benefit of U.S. Provisional Application No. 60/281,916, filed Apr. 5, 2001; and U.S. Provisional Application No. 60/325,489, filed Sep. 26, 2001, all of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

Acne is a common disease characterized by various types of lesions. The areas affected typically are areas of the skin where sebaceous glands are largest, most numerous, and most active. The lesions associated with acne are usually categorized as either non-inflammatory or inflammatory.

Non-inflammatory lesions include comedones. Comedones appear in two forms, open and closed. Comedones are thought to arise from abnormal follicular differentiation. Instead of undergoing shedding and discharge through the follicular orifice, abnormal desquamated cells (keratinocytes) become unusually cohesive, forming a microcomedo or a microscopic hyperkeratotic plug in the follicular canal. The progressive accumulation of these microcomedones lead to visible comedones.

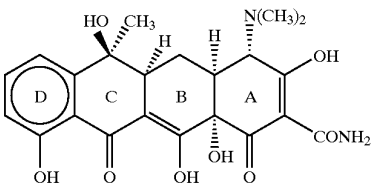
In its mildest form, acne is a more or less superficial disorder characterized by slight, spotty skin irritations. In such cases, ordinary skin hygiene is typically a satisfactory treatment. In the more inflammatory types of acne, however, pustules; infected cysts; and in extreme cases, canalizing, inflamed and infected sacs appear. Without effective treatment, these lesions may become extensive and leave permanent, disfiguring scars.

Microorganisms, especially *Propionibacterium acnes*, are strongly implicated in the pathogenesis of acne. The microorganisms are thought to release microbial mediators of inflammation into the dermis or trigger the release of cytokines from ductal keratinocytes.

Accordingly, the efficacy of antibiotics in treating acne is thought to be due, in significant part, to the direct inhibitory effect of the antibiotics on the growth and metabolism of these microorganisms. Systemically-administered tetracycline antibiotics, especially minocycline hydrochloride, are particularly effective in treating acne.

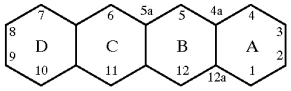
The tetracyclines are a class of compounds of which tetracycline is the parent compound. Tetracycline has the following general structure:

Structure A



The numbering system of the multiple ring nucleus is as follows:

Structure B



Tetracycline, as well as the 5-hydroxy (oxytetracycline, e.g. Terramycin) and 7-chloro (chlorotetracycline, e.g. Aureomycin) derivatives, exist in nature, and are all well known antibiotics. Semisynthetic derivatives such as 7-dimethylaminotetracycline (minocycline) and 6α-deoxy-5-hydroxytetracycline (doxycycline) are also known tetracycline antibiotics. Natural tetracyclines may be modified without losing their antibiotic properties, although certain elements of the structure must be retained to do so.

In addition to the direct antibiotic activity of tetracyclines, further activities of antibiotic tetracyclines have been investigated for possible therapeutic effects on acne. For example, a study by Elewski et al., *J. Amer. Acad. Dermatol.,* 8:807–812 (1983) suggests that acne therapy, consisting of orally-administered tetracycline at a total daily dose of 1000 mg, may have therapeutic anti-inflammatory effects in addition to antibiotic effects. In particular, it was found that the anti-inflammatory effect of tetracycline was, at least in part, due to inhibition of neutrophil chemotaxis induced by bacterial chemotactic factors.

A more recent study, performed by Eady et al., *J. Invest. Dermatol.,* 101:86–91 (1993), evaluated the effects of oral minocycline or tetracycline therapy on the cytokine and microflora content of open comedones in acne patients. The total daily dose of minocycline administered was 100 mg. The total daily dose of tetracycline administered was 1000 mg.

Eady et al. found that the therapies upregulated the production of bioactive IL-1α-like material and immunochemical IL-1β. IL-1 is considered to be a pro-inflammatory cytokine.

Accordingly to Eady et al., no overall decrease in the numbers of propionibacteria/mg of comedonal material was found. It is important to note, however, that the numbers of propionibacteria/mg of comedonal material are not expected to decrease in response to antibiotic therapy. Since the bacteria within comedones are encapsulated by the follicle, they are not susceptible to antibiotic treatment.

Another possible activity of tetracyclines in acne therapy was investigated by Bodokh, I., et al., *Acta. Derm. Venerol.,* 77:255–259 (1997). Their study was designed to evaluate the action of minocycline on sebaceous excretion in acne patients. A 100 mg daily dose of minocycline was administered. A subclinical increase in seborrhoea was reported. The authors propose that minocycline induces an increase in seborrhoea via a reduction in ductal obstruction. The mechanism by which the ductal obstruction is reduced is proposed to be a reduction in ductal irritation. The authors suggest that the reduction of ductal irritation is due to minocycline's direct effect on *P. acnes*, or minocycline's effect on the lipase produced by *P. acnes.*

Bodokh et al. also found that during treatment no correlation exists between seborrhoea intensity and clinical severity of acne. The authors state that the lack of correlation shows that seborrhoea is pathogenic because it is the "culture medium" of *P. acnes*. Thus, it can be concluded that the

authors consider the antibiotic activity of minocycline to be therapeutically significant with respect to acne.

Similarly, in a recent clinical study it was reported that tetracycline in sub-antibiotic doses had no clinical effect on acne. (Cunliffe et al., *J. Am. Acad. Dermatol.,* 16:591–9 (1987).) In particular, a 100 mg total daily dose of minocycline and a 1.0 g total daily dose of tetracycline were found to be necessary to successfully treat acne.

The antibiotic effects of antibiotics are generally directly proportional to the dose administered of the antibiotics. Accordingly, in moderate to severe (i.e. inflammatory) forms of acne, oral antibiotics are typically administered at high doses. For example, in conventional acne therapy, tetracycline is administered at an initial dose of 500 to 2,000 mg/day, followed by a maintenance dose of 250–500 mg/day.

Clearly, the state-of-the-art teaching is that the clinical efficacy of systemically-administered tetracyclines in the treatment of acne is due, at least in significant part, to the antibiotic effects of the tetracyclines. In addition to their antibiotic effects, it has been proposed that tetracyclines reduce the number of inflammatory lesions (papules, pustules and nodules) by a variety of non-antibiotic mechanisms. Such mechanisms include interfering with the chemotaxis of polymorphonuclear leukocytes (PMN) into the inflammatory lesion, inhibition of PMN derived collagenase, and by scavenging reactive oxidative species produced by resident inflammatory cells.

There is no disclosure in the prior art of using either a sub-antibiotic dose of an antibiotic tetracycline compound, or of using a non-antibiotic tetracycline compound for the treatment of acne.

The use of tetracycline antibiotics, however, can lead to undesirable side effects. For example, the long term administration of antibiotic tetracyclines can reduce or eliminate healthy microbial flora, such as intestinal flora, and can lead to the production of antibiotic resistant organisms or the overgrowth of yeast and fungi.

Accordingly, there is a need for an effective treatment of acne which causes fewer undesirable side effects produced by the systemically-administered antibiotics used in conventional acne therapy.

SUMMARY OF INVENTION

The present invention provides a method of treating acne in a human in need thereof. The method comprises administering systemically to the human a tetracycline compound in an amount that is effective to treat acne but has substantially no antibiotic activity (i.e. substantially no antimicrobial activity), without administering a bisphosphonate compound.

Additionally, the present invention provides methods for reducing the number of comedones, inhibiting oxidation of melanin, and/or inhibiting lipid-associated abnormal follicular differentiation in a human in need thereof. These methods comprise administering systemically to the human a tetracycline compound in an amount that is effective for its purpose, e.g., to reduce the number of comedones, to inhibit oxidation of melanin, and/or to inhibit lipid-associated abnormal follicular differentiation, but has substantially no antibiotic activity.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows the photoirritancy factor (PIF) for some tetracycline compounds. For structure K, the compounds indicated are as follows:

COL	R7	R8	R9
308	hydrogen	hydrogen	amino
311	hydrogen	hydrogen	palmitamide
306	hydrogen	hydrogen	dimethylamino

For structures L, M, N or O the compounds indicated are as follows:

COL	R7	R8	R9
801	hydrogen	hydrogen	acetamido
802	hydrogen	hydrogen	dimethylaminoacetamido
804	hydrogen	hydrogen	nitro
805	hydrogen	hydrogen	amino

For structure P, R8 is hydrogen and R9 is nitro.

DETAILED DESCRIPTION

The present invention provides methods of treating acne. As used herein, the term "acne" is a disorder of the skin characterized by papules, pustules, cysts, nodules, comedones, and other blemishes or skin lesions. These blemishes and lesions are often accompanied by inflammation of the skin glands and pilosebaceous follicles, as well as, microbial, especially bacterial, infection.

For the purposes of this specification, acne includes all known types of acne. Some types of acne include, for example, acne vulgaris, cystic acne, acne atrophica, bromide acne, chlorine acne, acne conglobata, acne cosmetica, acne detergicans, epidemic acne, acne estivalis, acne fulminans, halogen acne, acne indurata, iodide acne, acne keloid, acne mechanica, acne papulosa, pomade acne, premenstral acne, acne pustulosa, acne scorbutica, acne scrofulosorum, acne urticata, acne varioliformis, acne venenata, propionic acne, acne excoriee, gram negative acne, steroid acne, nodulocystic acne and acne rosacea. Acne rosacea is characterized by inflammatory lesions (erythema) and telangiectasia.

Telangiectasia is abnormally and permanently dilated blood vessels associated with a number of diseases. For example, facial telangiectasia is associated with age, acne rosacea, sun exposure, and alcohol use. Other diseases associated with telangiectasia include, for example, scleroderma, hereditary hemorrhagic telangiectasia (Olser-Rendu syndrome), Ataxia-Telangiectasia, spider angioma, cutis marmorata telangiectasia congenita, Bloom syndrome, Klippel-Trenaunay-Weber syndrome, Sturge-Weber disease, Xeroderma pigmentosa and Nevus flammeus.

Telangietcasia can develop anywhere within the body, but can be easily seen in the skin, mucous membranes and whites of the eyes. Some forms of telangiectasia may be asymptomatic, however, some forms of telangiectasia bleed readily and cause significant problems. For example, telangiectasia can occur in the brain and cause problems from bleeding.

The present invention is effective in treating telangiectasia caused by any disease or condition. The method comprises the administration of a tetracycline compound, to a human, in an amount which is effective for the treatment of telangiectasia, but which has substantially no antibiotic activity.

The present invention is particularly effective in treating comedones, e.g., reducing the number of comedones. Both

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