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7-CHROMANYL ESTERS OF PHENOLS AND BENZOIC ACIDS HAVING RETINOID-LIKE ACTIVITY

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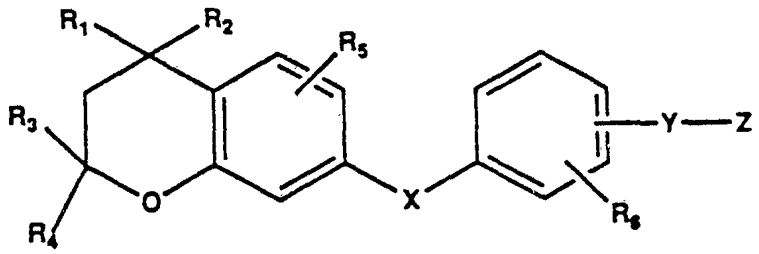
(71) Applicant(s)
ALLERGAN, INC.

(72) Inventor(s)
ROSHANTHA A.S. CHANDRARATNA

(74) Attorney or Agent
DAVIES COLLISON CAVE , GPO Box 3876, SYDNEY NSW 2001

(57) Claim

1. A compound of the formula



wherein

the R_1 - R_6 groups are independently H or straight chain or branched chain lower alkyl or cycloalkyl groups of 1 to 6 carbons;

X is -COO-, -COS-, -OOC- or -SOC-;

Y is cycloalkyl or branched chain alkyl group of 3 to 6 carbons, or is $(CH_2)_n$ where n is an integer between 0 to 6, and

Z is H, OH, OR', OCOR', -COOH or a pharmaceutically acceptable salt, $COOR_8$, $CONR_9R_{10}$, $-CH_2OH$, CH_2OR_{11}, CH_2OCOR_{11}, CHO, $CH(OR_{12})_2$, $CHOR_{13}O$, -COR', $COR'(OR_{12})_2$, or $CR'OR_{13}O$ where R' is an alkyl,

.../2

cycloalkyl or alkenyl group containing 1 to 5 carbons, R_8 is an alkyl group of 1-10 carbons, or a cycloalkyl group of 5-10 carbons, or R_8 is phenyl or lower alkylphenyl, R_9 and R_{10} independently are hydrogen, an alkyl group of 1-10 carbons, or a cycloalkyl group of 5-10 carbons or phenyl or lower alkyl phenyl, R_{11} is lower alkyl, R_{13} is divalent alkyl radical of 2 to 5 carbons.

13. A method for the treatment of skin disorders in a mammal which comprises administering to a mammal one or more compounds according to claim 1 optionally in association with a pharmaceutically acceptable carrier.

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(71) Applicant: ALLERGAN, INC. [US/US]; 2525 Dupont Drive, Post Office Box 19534, Irvine, CA 92713-9534 (US).

(72) Inventor: CHANDRARATNA, Roshantha, A., S. ; 23015 Ashwood, El Toro, CA 92630 (US).

(74) Agents: BARAN, Robert, J. et al.; Allergan, Inc., 2525 Dupont Drive, Post Office Box 19534, Irvine, CA 92713-9534 (US).

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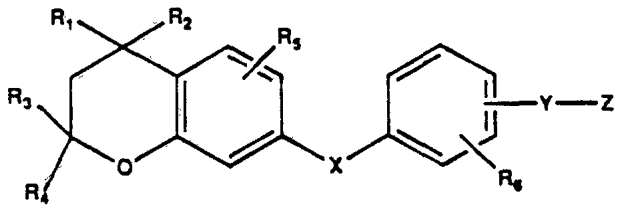


(I)

(57) Abstract

Retinoid like activity is exhibited by compounds of formula (I), wherein the R_1-R_6 groups are independently H or straight chain or branched chain lower alkyl or cycloalkyl of 1 to 6 carbons; X symbolizes an ester or thioester linkage, Y is lower branched chain alkyl having 2 to 6 carbons, cycloalkyl having 3 to 6 carbons or is $(CH_2)_n$ where n is an integer between 0 to 6 or is an alkenyl group of 2 to 6 carbons, and having 1 or 2 double bonds, or an alkynyl group of 2 to 6 carbons; and Z is H, OH, OR', OCOR', -COOH or a pharmaceutically acceptable salt, $COOR_8$, $COONR_9R_{10}$, $-CH_2OH$, CH_2OR_{11}, CH_2OCOR_{11}, CHO, $CH(OR_{12})$, $CHOR_{13}O$, -COR', $CR'(OR_{12})_2$, or $CR'OR_{13}O$; where R' is an alkyl, cycloalkyl or alkenyl group containing 1-5 carbons, R_8 is an alkyl group of 1-10 carbons, or a cycloalkyl group of 5-10 carbons, or R_8 is phenyl or lower alkylphenyl, R_9 and R_{10} independently are hydrogen, an alkyl group of 1-10 carbons, or a cycloalkyl group of 5-10 carbons or phenyl or lower alkyl phenyl, R_{11} is lower alkyl, and R_{13} is a divalent alkyl radical of 2-5 carbons.

7-CHROMANYL ESTERS OF PHENOLS AND BENZOIC ACIDS HAVING RETINOID-LIKE ACTIVITY

Background

This invention relates to novel compounds having retinoid-like activity. More specifically, the invention relates to compounds having a substituted chroman portion and a substituted phenyl portion linked to the 7-position of the chroman nucleus through an ester or thioester group.

Related Art

Carboxylic acid derivatives useful for inhibiting the degeneration of cartilage of the general formula 4-(2-(4,4-dimethyl-6-X)-2-methylvinyl)benzoic acid where X is tetrahydroquinolinyl, chromanyl or thiochromanyl are disclosed in European Patent Application 0133795 published January 9, 1985. European Patent Application 176034A published April 2, 1986 discloses tetrahydronaphthalene compounds having an ethynylbenzoic acid group. United States Patent No. 4,739,098 discloses compounds of retinoid-like activity where three olefinic units from the acid-containing moiety of retinoic acid are replaced by an ethynylphenyl functionality.

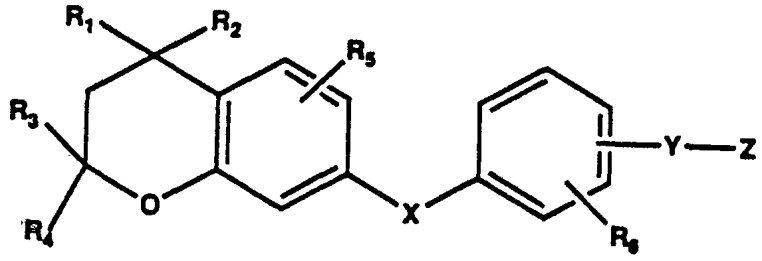
The publication by Sporn et. al. in J. Amer. Acad. Derm. 15:756-764 (1986) discloses the compound 4-(5,5,8,8-tetramethyl-5,6,7,8-tetrahydro-2-naphthoylamino)benzoic acid as a retinoid-like agent. Further compounds of background interest to the present invention are disclosed by Shudo et al. in Chem. Phar. Bull. 33:404-407 (1985).

A patent application of the present inventor, assigned to the same assignee as this application, describes compounds having a substituted chroman

portion and a substituted phenyl portion linked to the 6-position of the chroman nucleus through an ester or thioester group.

Summary of the Invention

This invention covers compounds of **Formula 1**



Formula 1

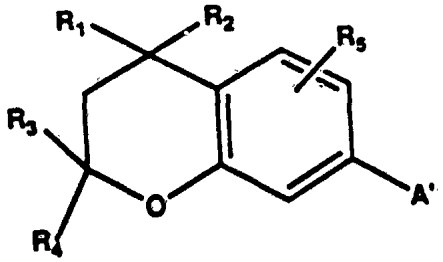
wherein the R_1 - R_6 groups are independently H or straight chain or branched chain lower alkyl or cycloalkyl of 1 to 6 carbons; **X** symbolizes an ester or thioester linkage, **Y** is lower branched chain alkyl having 2 to 6 carbons, cycloalkyl having 3 to 6 carbons or is $(CH_2)_n$ where **n** is an integer between 0 to 6 or is an alkenyl group of 2 to 6 carbons and having 1 or 2 double bonds, or an alkynyl group of 2 to 6 carbons; and **Z** is H, OH, OR', OCOR', -COOH or a pharmaceutically acceptable salt, $COOR_8$, $COONR_9R_{10}$, $-CH_2OH$, CH_2OR_{11}, CH_2OCOR_{11}, CHO, $CH(OR_{12})$, $CHOR_{13}O$, -COR', $CR'(OR_{12})_2$, or $CR'OR_{13}O$; where R' is an alkyl, cycloalkyl or alkenyl group containing 1-5 carbons, R_8 is an alkyl group of 1-10 carbons, or a cycloalkyl group of 5-10 carbons, or R_8 is phenyl or lower alkylphenyl, R_9 and R_{10} independently are hydrogen, an alkyl group of 1-10 carbons, or a cycloalkyl group of 5-10 carbons or

phenyl or lower alkyl phenyl, R_{11} is lower alkyl, R_{13} is divalent alkyl radical of 2-5 carbons.

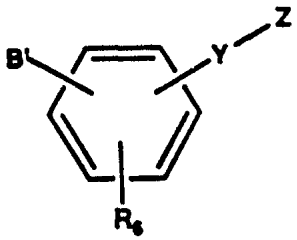
In a second aspect, this invention relates to the use of the compounds of **Formula 1** for treating dermatoses, such as acne, Darier's disease, psoriasis, icthyosis, eczema, atopic dermatitis and epithelial cancers. These compounds are also useful in the treatment of arthritic diseases and other immunological disorders (e.g. lupus erythematosus), in promoting wound healing, in treating dry eye syndrome and in reversing and preventing the effects of sun damage to skin.

This invention also relates to a pharmaceutical formulation comprising a compound of **Formula 1** in admixture with a pharmaceutically acceptable excipient.

In another aspect, this invention relates to the process for making a compound of **Formula 1** which process comprises reacting compounds of **Formula 2** with compounds of **Formula 3**,



Formula 2



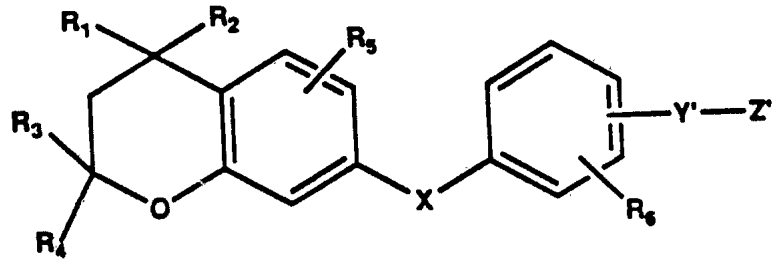
Formula 3

where R_1 - R_6, Y and Z are defined as above in connection with **Formula 1**, and wherein one of **A'** and **B'** is an OH or SH group, and the other is a carboxylic acid (COOH) or an appropriate derivative (such as an

acid chloride) suitable for forming an ester with a hydroxyl or thiol group, and where the reaction is conducted under conditions suitable for forming an ester or thioester bond between the chroman ring of the compound of **Formula 2** and the phenyl ring of the compound of **Formula 3**.

In the process of reacting compounds of **Formula 2** with the compounds of **Formula 3** to form the ester or thioester linkage **X** of **Formula 1**, when **Z** is an alcohol or acid function it is preferred that such alcohol or acid function be protected. When, in the esterification reaction **Z** is an aldehyde or ketone, it may not need to be protected depending on the precise nature of the compounds and the conditions of the esterification reaction.

In still another aspect, the present invention also relates to preparation of compounds of **Formula 1** by conversion of compounds having the structure of **Formula 4**.



Formula 4

In **Formula 4** the symbols R_1 - R_6 and **X** are defined as above in connection with **Formula 1**, and **Y'** - **Z'** symbolizes such precursors of the groups **Y** - **Z** which can be readily converted by reactions well known to

organic chemists, into the desired groups Y - Z. Thus, the present invention also relates to the above-noted processes involvings steps such as:

converting an acid of **Formula 4** to a salt; or

forming an acid addition salt;

converting an acid of **Formula 4** to an ester; or

converting an acid or ester of **Formula 4** to an amide; or

reducing an acid or ester of **Formula 4** to an alcohol or aldehyde; or

converting an alcohol of **Formula 4** to an ether or ester; or

oxidizing an alcohol of **Formula 4** to an aldehyde; or

converting an aldehyde of **Formula 4** to an acetal; or

converting a ketone of **Formula 4** to a ketal,

extending by homologation the length of the alkyl chain of a compound of **Formula 4**, where Y' is alkyl.

General Embodiments

Definitions

The term "ester" as used here refers to and covers any compound falling within the definition of that term as classically used in organic chemistry. The term "thioester" as used here refers to and covers any compound falling within the definition of that term as classically used in organic chemistry. With respect to the ester or thioester function symbolized by X in **Formula 1** linking the chroman and phenyl moieties of the compounds of the invention, the function includes an ester or thioester derived from a phenol or thiophenol and a 7-chromanoic acid derivative (when the carbonyl group is directly attached to the chroman

nucleus) and also an ester or thioester derived from a benzoic acid and 7-hydroxy-chroman or 7-thiohydroxy-chroman derivative (when the carbonyl group is directly attached to the phenyl nucleus).

Where Z (of **Formula 1**) is -COOH, the term "ester" covers the products derived from treatment of this function with alcohols. Where the ester is derived from compounds where Z is $-CH_2OH$, this term covers compounds of the formula $-CH_2OOCR$ where R is any substituted or unsubstituted aliphatic, aromatic or aliphatic-aromatic group.

Preferred esters are derived from the saturated aliphatic alcohols or acids of ten or fewer carbon atoms or the cyclic or saturated aliphatic cyclic alcohols and acids of 5 to 10 carbon atoms. Particularly preferred aliphatic esters are those derived from lower alkyl acids or alcohols. Here, and where ever else used, lower alkyl means having 1-6 carbon atoms and includes straight as well as branched chain alkyl groups. Also preferred are the phenyl or lower alkylphenyl esters.

Amide has the meaning classically accorded that term in organic chemistry. In this instance it includes the unsubstituted amides and all aliphatic and aromatic mono-and di-substituted amides. Preferred amides are the mono- and di-substituted amides derived from the saturated aliphatic radicals of ten or fewer carbon atoms or the cyclic or saturated aliphatic-cyclic radicals of 5 to 10 carbon atoms. Particularly preferred amides are those derived from lower alkyl amines. Also preferred are mono- and di-substituted amides derived from the phenyl or lower alkylphenyl amines. Unsubstituted amides are also preferred.

Acetals and ketals include the radicals of the formula -CK where K is $(-OR)_2$. Here, R is lower alkyl. Also, K may be $-OR_1O-$ where R_1 is lower alkyl of 2-5 carbon atoms, straight chain or branched.

A pharmaceutically acceptable salt may be prepared for any compound of this invention having a functionality capable of forming such salt, for example an acid or an amine functionality. A pharmaceutically acceptable salt may be any salt which retains the activity of the parent compound and does not impart any deleterious or untoward effect on the subject to which it is administered and in the context in which it is administered.

Such a salt may be derived from any organic or inorganic acid or base. The salt may be a mono or polyvalent ion. Of particular interest where the acid function is concerned are the inorganic ions, sodium, potassium, calcium, and magnesium. Organic amine salts may be made with amines, particularly ammonium salts such as mono-, di- and trialkyl amines or ethanol amines. Salts may also be formed with caffeine, tromethamine and similar molecules. Where there is a nitrogen sufficiently basic as to be capable of forming acid addition salts, such may be formed with any inorganic or organic acids or alkylating agent such as methyl iodide. Preferred salts are those formed with inorganic acids such as hydrochloric acid, sulfuric acid or phosphoric acid. Any of a number of simple organic acids such as mono-, di- or tri-acid may also be used.

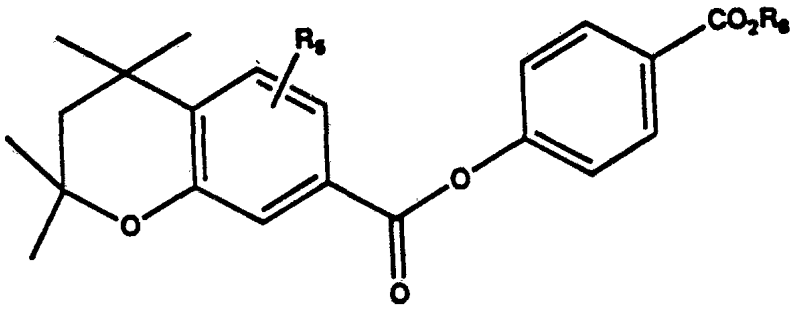
The preferred compounds of this invention are those where the X functionality of Formula 1 is COO-. In other words, preferred compounds of the invention

are phenyl ester derivatives of 7-carboxy chromans.

Within the above-noted preference, still more preferred are compounds where in the Y - Z functionality of **Formula 1** Y is $(CH_2)_n$ and **n** is zero, and **Z** is either COOH or $COOR_8$ (R_8 being lower alkyl, lower cycloalkyl, phenyl substituted lower alkyl, phenyl or lower alkyl substituted phenyl). In other words, still more preferred are esters of 7-carboxy chromans formed with hydroxy benzoic acids, or with hydroxy benzoic acid esters. Within this group, esters of substituted 7-carboxy chromans with 4-hydroxy benzoic acid and particularly with 4-hydroxy benzoic acid esters are still more preferred.

Even more preferred are compounds which, in addition to having the hydroxy-benzoic acid or hydroxy-benzoic acid ester residue, include substituents in the 2,2 and/or in the 4,4 and/or in the 6 position of the 7-chromanoic acid moiety. Within this group, derivatives of 2,2,4,4-tetramethyl-7-chromanoic acid are most preferred.

The most preferred specific compounds of the invention are shown in **Formula 5**, and are identified as follows:



Formula 5

Ethyl 4-(2,2,4,4-tetramethyl-7-chromanoyloxy) benzoate (**Compound 1, R_5=H and R_8=ethyl**);

Benzyl 4-(2,2,4,4,tetramethyl-7-chromanoyloxy)benzoate (**Compound 2**, R_5 = H and R_8 = benzyl); 4-(2,2,4,4-tetramethyl-7-chromanoyloxy) benzoic acid (**Compound 3**, R_5=H and R_8=H);

The compounds of this invention may be administered systemically or topically, depending on such considerations as the condition to be treated, need for site-specific treatment, quantity of drug to be administered, and similar considerations.

In the treatment of dermatoses, it will generally be preferred to administer the drug topically, though in certain cases such as treatment of severe cystic acne, oral administration may also be used. Any common topical formulation such as a solution, suspension, gel, ointment, or salve and the like may be used. Preparation of such topical formulations are well described in the art of pharmaceutical formulations as exemplified, for example, Remington's Pharmaceutical Science, Edition 17, Mack Publishing Company, Easton, Pennsylvania. For topical application, these compounds could also be administered as a powder or spray, particularly in aerosol form.

If the drug is to be administered systemically, it may be confected as a powder, pill, tablet or the like, or as a syrup or elixir for oral administration. For intravenous or intraperitoneal administration, the compound will be prepared as a solution or suspension capable of being administered by injection. In certain cases, it may be useful to formulate these compounds in suppository form or as an extended release formulation for deposit under the skin or intermuscular injection.

Other medicaments can be added to such topical formulation for such secondary purposes as treating

skin dryness, providing protection against light; other medications for treating dermatoses, preventing infection, reducing irritation, inflammation and the like.

Treatment of dermatoses or any other indications known or discovered to be susceptible to treatment by retinoic acid-like compounds will be effected by administration of the therapeutically effective dose of one or more compounds of the instant invention. A therapeutic concentration will be that concentration which effects reduction of the particular condition, or retards its expansion. In certain instances, the drug potentially could be used in a prophylactic manner to prevent onset of a particular condition. A given therapeutic concentration will vary from condition to condition and in certain instances may vary with the severity of the condition being treated and the patient's susceptibility to treatment. Accordingly, a given therapeutic concentration will be best determined at the time and place through routine experimentation. However, it is anticipated that in the treatment of, for example, acne, or other such dermatoses, that a formulation containing between 0.001 and 5 percent by weight, preferably about 0.01 to 1% will usually constitute a therapeutically effective concentration. If administered systemically, an amount between 0.01 and 100 mg per kg body weight per day, but preferably about 0.1 to 10 mg/kg, will effect a therapeutic result in most instances.

The retionic acid like activity of these compounds was confirmed through the classic measure of retionic acid activity involving the effects of retionic acid on ornithine decarboxylase. The original work on the

correlation between retinoic acid and decrease in cell proliferation was done by Verma & Boutwell, Cancer Research, 1977, 37, 2196-2201. That reference discloses that ornithine decarboxylase (ODC) activity increased precedent to polyamine biosynthesis. It has been established elsewhere that increases in polyamine synthesis can be correlated or associated with cellular proliferation. Thus, if ODC activity could be inhibited, cell hyperproliferation could be modulated. Although all causes for ODC activity increase are unknown, it is known that 12-0-tetradecanoyl-phorbol-13-acetate (TPA) induces ODC activity. Retinoic acid inhibits this induction of ODC activity by TPA. The compounds of this invention also inhibit TPA induction of ODC as demonstrated by an assay essentially following the procedure set out in Cancer Res., 35: 1662-1670, 1975.

By way of example of retinoic acid-like activity it is noted that in the assay conducted essentially in accordance with the method of Verma & Boutwell, ibid, the following examples of the preferred compounds of the present invention (**Compounds 1, 2 and 3**) elicited the following percent inhibition of TPA-induced ODC activity at the given calculations:

Compound	Dose (nmol)	% inhibition
1	30	100
2	300	84
3	30	86

Specific Embodiments

The compounds of this invention can be made by a number of different synthetic chemical pathways. To illustrate this invention, there is here outlined a series of steps which have been proven to provide the

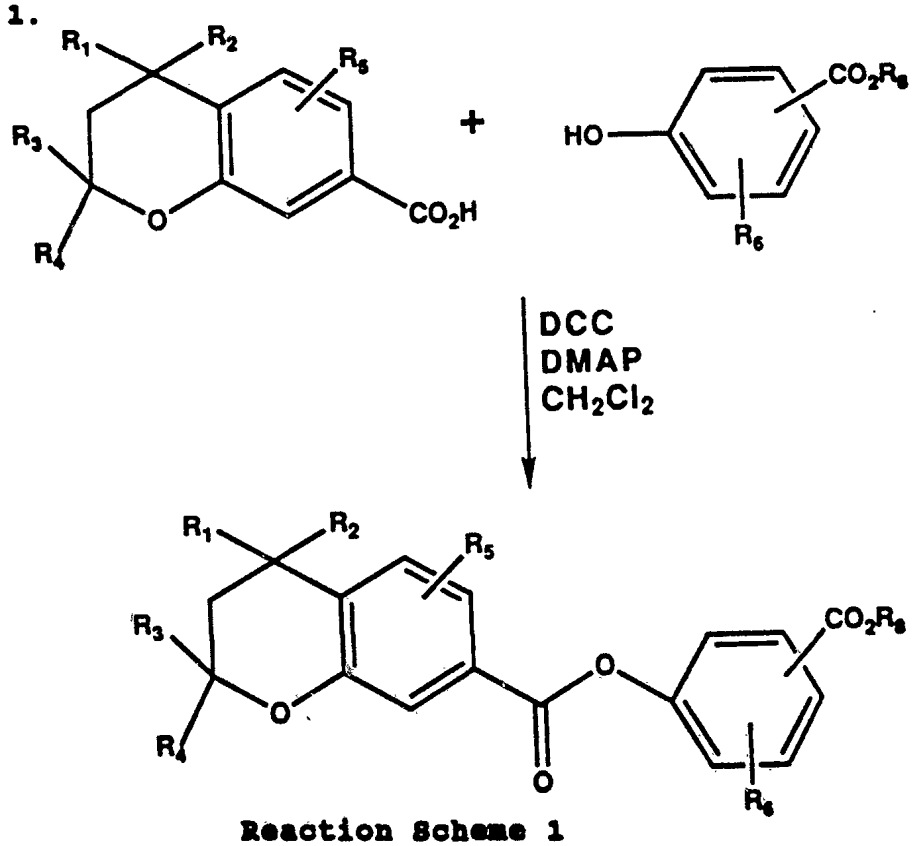
compounds of **Formula 1** when such synthesis is followed in fact and in spirit. The synthetic chemist will readily appreciate that the conditions set out here are specific embodiments which can be generalized to any and all of the compounds represented by **Formula 1**. Furthermore, the synthetic chemist will readily appreciate that the herein described synthetic steps may be varied and or adjusted by those skilled in the art without departing from the scope and spirit of the invention.

The compounds of the invention, in accordance with **Formula 1** are esters or thioesters containing a chroman moiety and a phenyl moiety. Accordingly, and speaking generally, the compounds of the invention can be made from the appropriate carboxylic acid or derivatized carboxylic acid precursors on the one hand and thiol or alcohol precursors on the other, by synthetic methods which per se are known in the art.

Specifically, the compounds of the invention (shown in **Formula 1**) can be made by reaction of the precursors shown in **Formula 2** and **Formula 3**. As is noted above, in these formulas either **A'** or **B'** is an OH or an SH group, and the other is a carboxylic acid (COOH) or a derivatized carboxylic acid (such as an acid chloride) which is capable of forming an ester or a thioester with the other group.

More specifically, and by way of example, preferred compounds of the invention comprise esters of substituted 7-carboxy chromans, i.e. esters derived from compounds of **Formula 2** where **A'** is COOH) with hydroxybenzoic acid esters (compounds of **Formula 3** where **Y** is $(CH_2)_n$ and n is zero, and **Z** is $COOR_8$, R_8 being an esterifying alkyl, lower alkylphenyl or phenyl

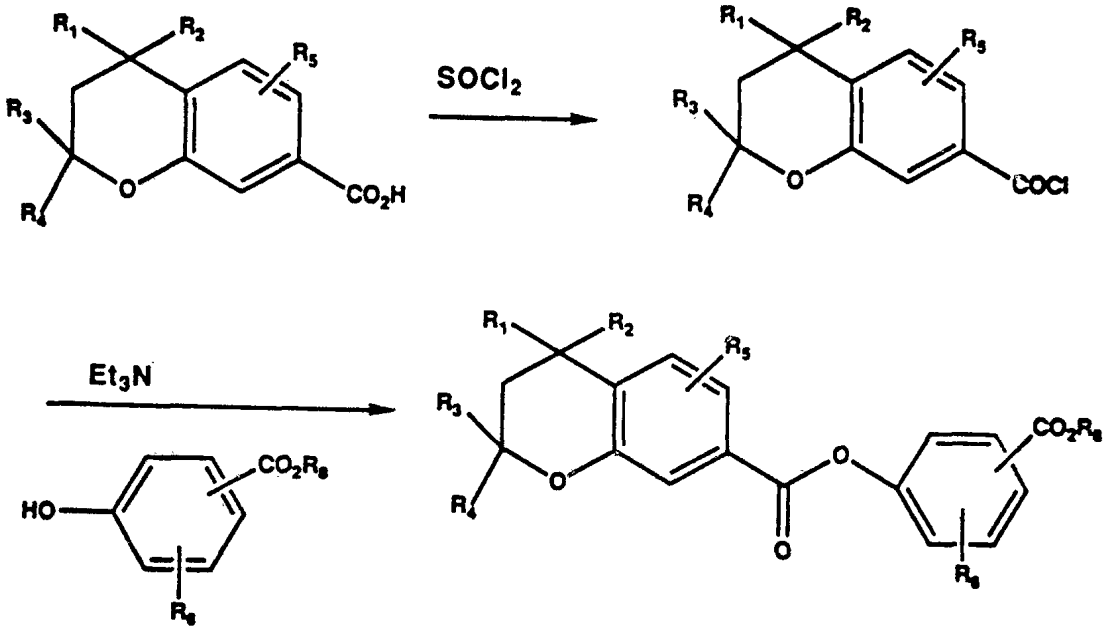
group). These compounds can be prepared in accordance with **Reaction Scheme 1.** In this reaction the free acid, a 7-carboxychroman derivative (compound of **Formula 2**) is reacted with the hydroxybenzoic acid ester (compound of **Formula 3**) in a suitable solvent such as methylene chloride (CH_2Cl_2) in the presence of dicyclohexyl carbodiimide (DCC) and dimethylaminopyridine (DMAP). In **Reaction Scheme 1** the symbols R_1 **through** R_6 have the same definition as in **Formula 1.**



Reaction Scheme 1

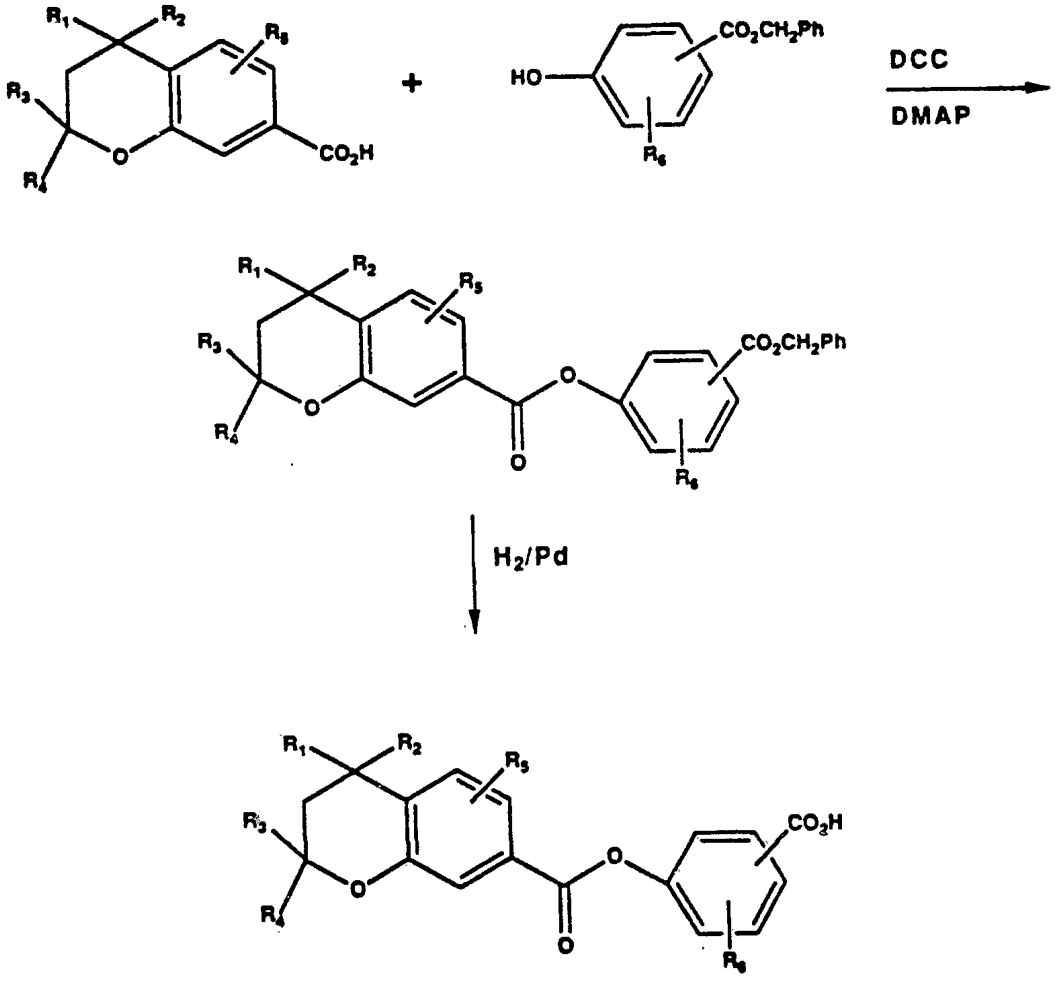
Reaction Scheme 2 shows an alternative process for synthezizing the compounds which are obtainable in **Reaction Scheme 1.** In accordance with this process, the substituted 7-carboxychroman derivatives are first converted to the corresponding acid chloride by treatment with a suitable reagent, for example, thionyl

chloride ($SOCl_2$). The corresponding acid chloride is thereafter reacted with a hydroxybenzoic acid ester in a suitable solvent and preferably in the presence of an acid acceptor, such as triethylamine.



Reaction Scheme 2

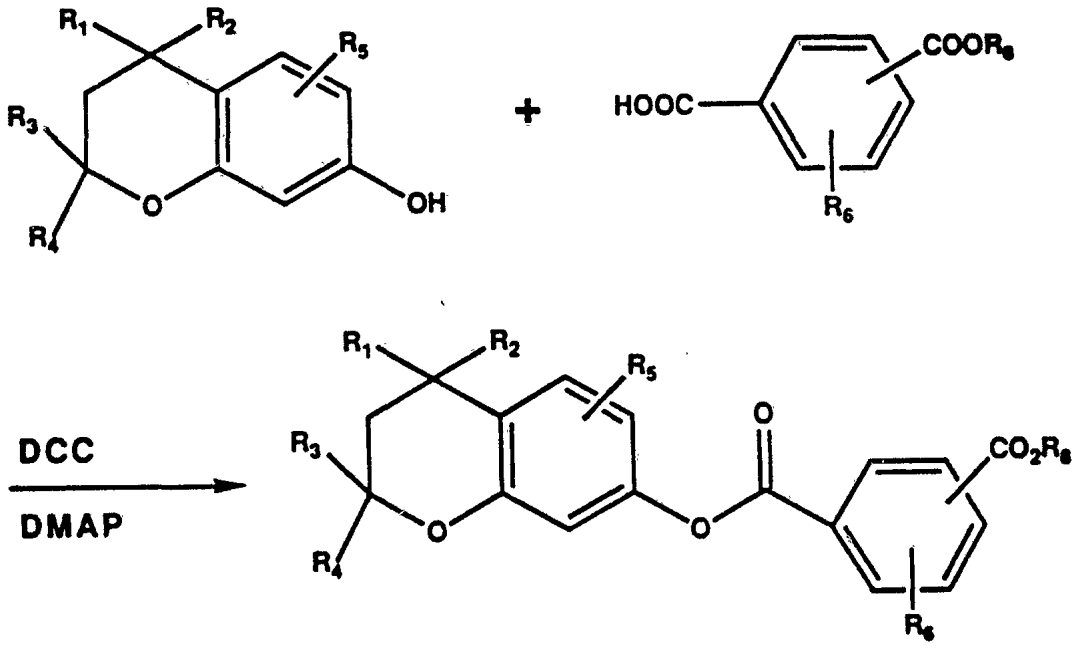
Reaction Scheme 3 shows a process for making esters of substituted 7-carboxychromans with hydroxy benzoic acid derivatives, where the desired products, (compounds of the invention) have a free carboxylic acid group. This process is similar to the condensation, in the presence of DCC and DMAP, shown in **Reaction Scheme 1**, except that a benzyl ester of the hydroxybenzoic acid is employed, and that in the last step of the process the benzyl ester function is selectively cleaved by hydrogenation over palladium (or other suitable catalyst), to provide the target compound having a free carboxylic acid group attached to the phenyl moiety.



Reaction Scheme 3

Reaction Scheme 4 shows an examplary process for the preparation of compounds of the invention derived from substituted 7-hydroxy chromans and terephtalic acid half esters, that is, compounds where, with reference to **Formula 1**, **X** is COO with the carbonyl group attached to the phenyl moiety, Y is $(CH_2)_n$ and **n** is zero. The condensation shown in this reaction is

performed in the presence of DCC and DMAP. It should be understood however, that several variations of this process are possible, for example the terephtalic acid half ester can be converted into an acid chloride (or some other activated derivative of the carboxylic acid) and the acid chloride (or other active derivative) can be reacted with the 7-hydroxy-chroman derivative in a suitable solvent and in the presence of an acid acceptor, in analogy to the reaction sequence shown in **Reaction Scheme 2**. Utilizing the benzyl half ester of terephtalic acid (or of a substituted terephtalic acid) in analogy with **Reaction Scheme 3**, permits selective cleavage of the benzyl ester function by hydrogenation, and synthesis of the corresponding 7-hydroxy-chroman derivative esterified with terephatalic acid and bearing, attached to the phenyl, group a free carboxylic acid function.



Reaction Scheme 4

The synthetic procedures outlined in an examplary manner in connection with **Reaction Schemes 1 - 4**, can also be adapted for the preparation of the thioester compounds of the present invention.

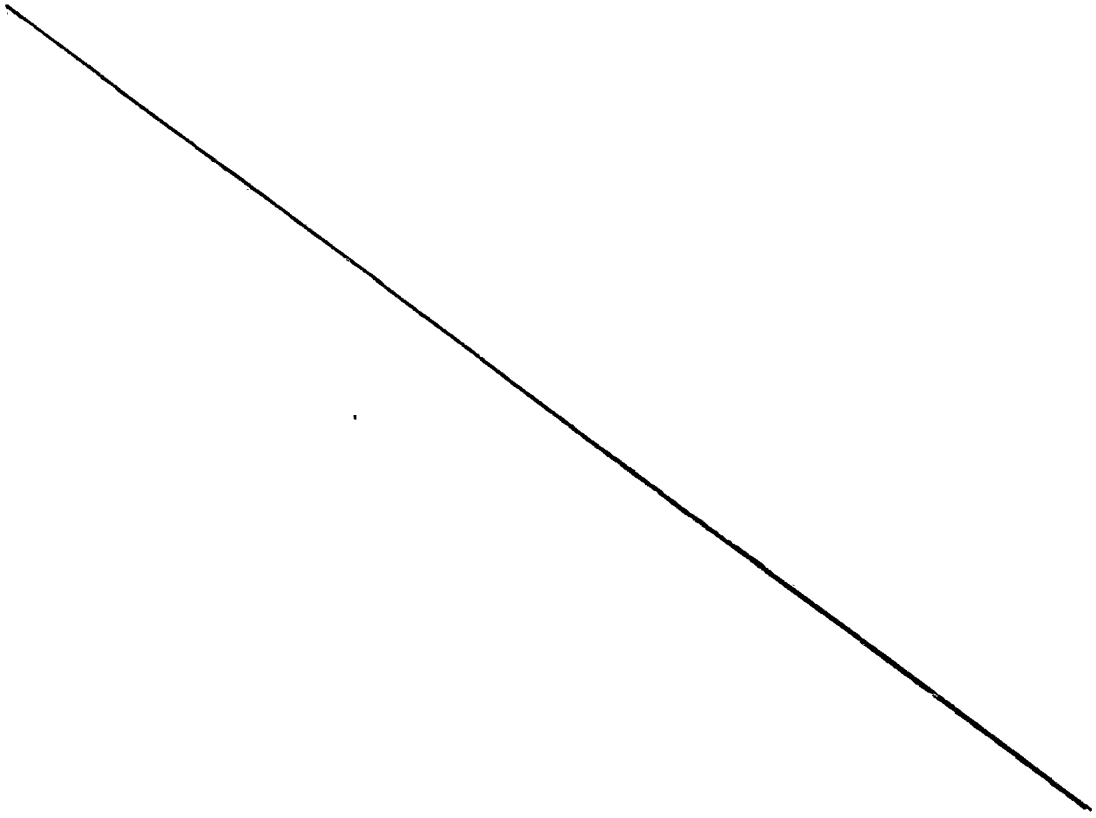
As is noted above in connection with **Formula 4**, compounds of the invention (**Formula 1**) may also be prepared by performing certain synthetic steps on compounds which are either already embraced by **Formula 1**, or are such precursors shown in **Formula 4**, which readily lend themselves to synthetic steps leading to compounds of the invention. In this regard free carboxylic acids of **Formula 4**, that is compounds possessing the "chroman to phenyl" ester linkage but having a free or appropriately protected carboxylic group on the phenyl moiety, can be converted to salts, esterified, converted to an amide, reduced to an aldehyde or an alcohol. The corresponding alcohols and aldehydes can be esterified or converted to acetals, as applicable. Alternatively the carbon chain of **Y - Z** of **Formula 1** may be subjected to chain elongation by homologation. As it will be recognized by those skilled in synthetic organic chemistry, the foregoing conversions can be performed by adapting generally known synthetic procedures to the compounds of the invention. In performing some of the above-noted synthetic steps on compounds of **Formula 1** or of **Formula 4**, care may need to be exercised not to saponify or otherwise destroy the ester linkage between the chroman and phenyl moieties.

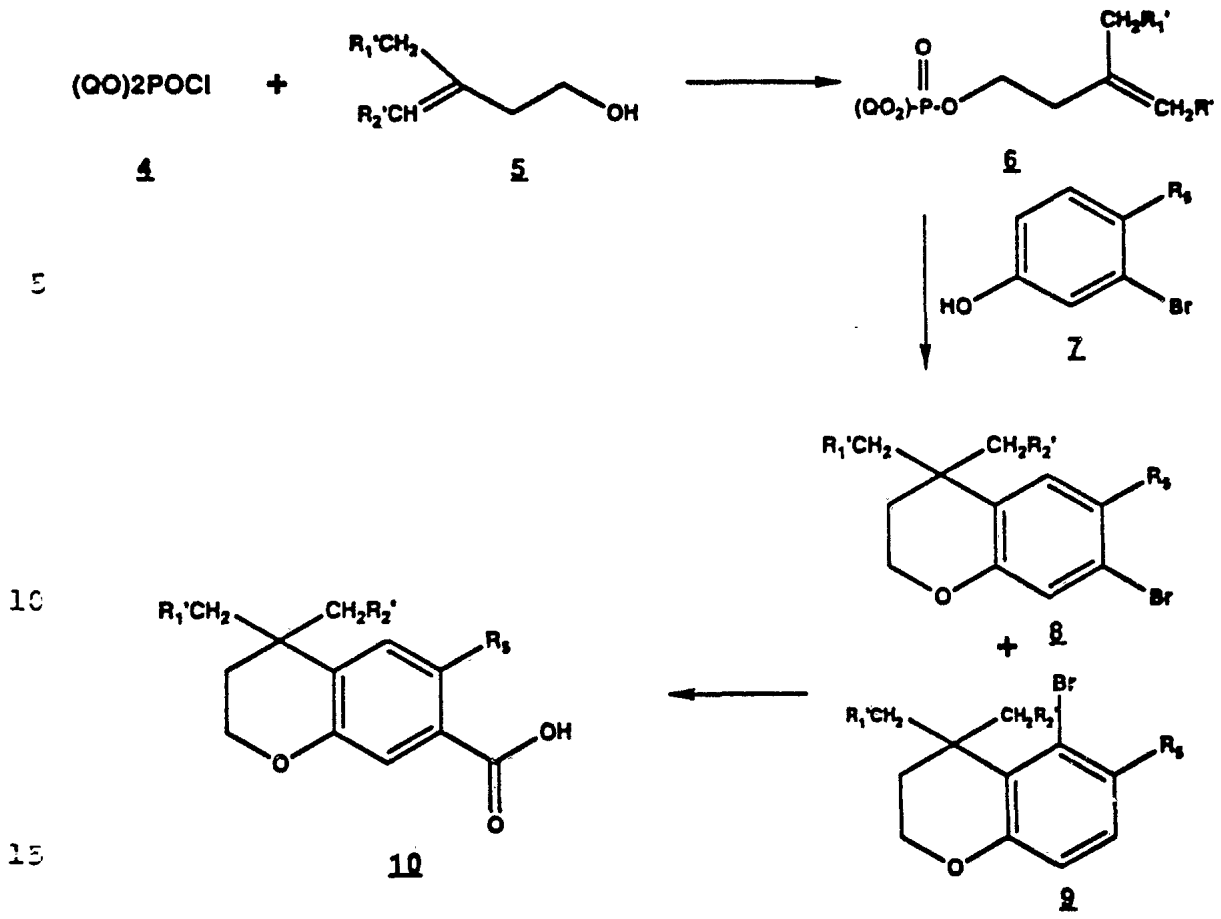
The compounds of **Formula 3** which comprise starting materials or intermediates to the compounds of the present invention, are either available commercially, or are readily synthesized by known synthetic methods

within the skill of ordinary artisan in the field. For example, 4-hydroxy benzoic acid is commerically available, and can be esterified to provide, for example, ethyl 4-hydroxy benzoate which is an important intermediate for the synthesis of certain specific examples of the compounds of the present invention. The mono ethyl ester of terephtalic acid, another intermediate in accordance with **Formula 3**, is also available commercially or is readily synthesized by known methods.

Intermediates of **Formula 2** where **A'** is COOH, can be synthesized by the reaction sequences described below.

Specifically, compounds of **Formula 2** where R_3 **and** R_4 are hydrogen, and **A'** is COOH are synthesized according to **Reaction Scheme 5.**





Reaction Scheme 5

In **Reaction Scheme 5** Q is phenyl and R_1', R_2'' and R_5 are hydrogen or lower alkyl having 1 to 5 carbons. The reaction sequence is hereinafter further described generally but with emphasis to the preferred case where R'_1 and R_2' both are hydrogen, i.e. for the synthesis of a 4,4-dimethyl-7-carboxy chroman (**Compound 10**). The phosphate (**Compound 6**) is prepared from the corresponding diphenyl chlorophosphate (**Compound 4**) and 3-methyl-3-butene-1-ol (**Compound 5**, R_1' and R_2' are both H) which is available from Aldrich, Chemical Company, or is prepared by means known in the art. It

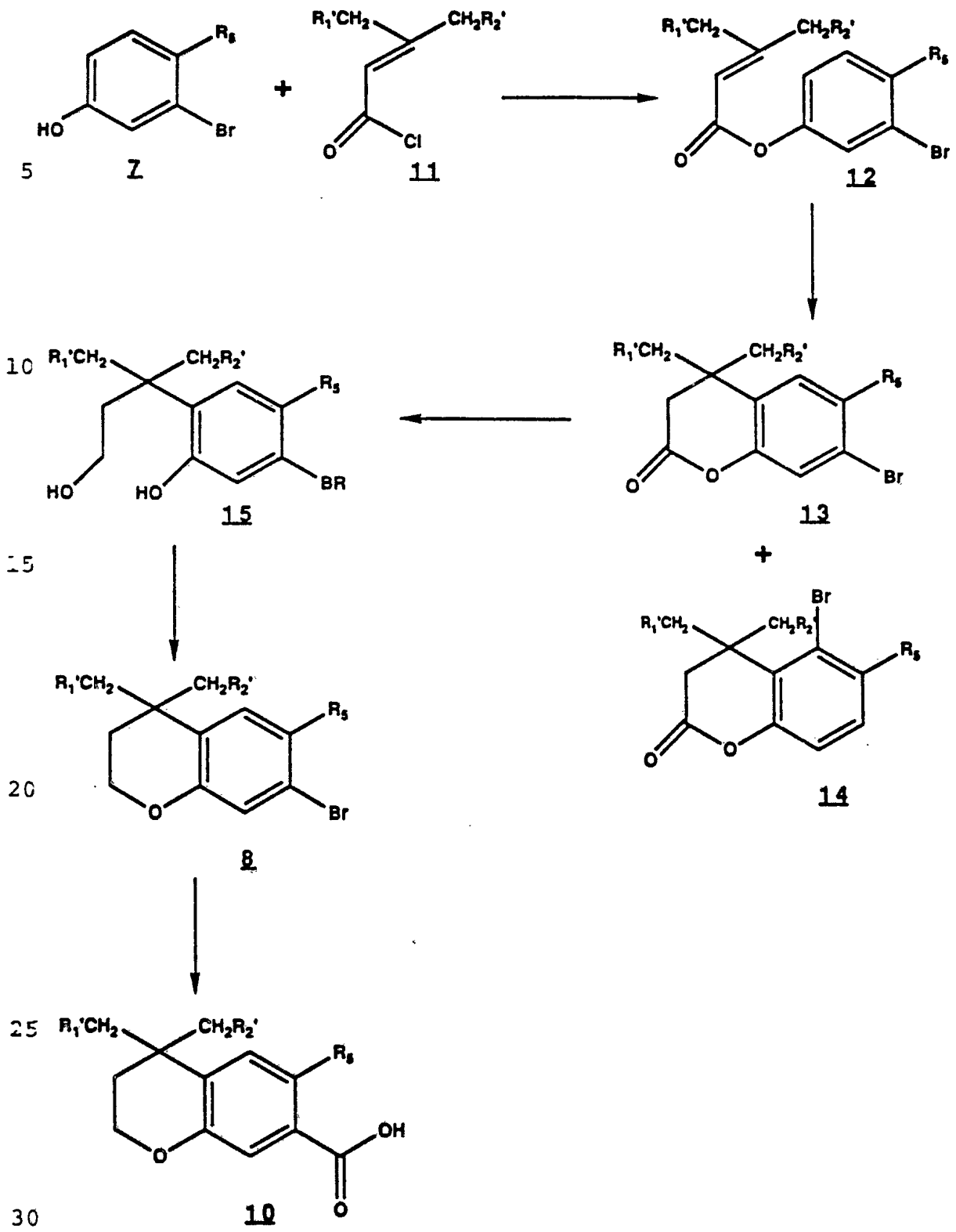
is preferred to prepare **Compound 6** by dissolving the alcohol (**Compound 5**) in about a 10% excess of pyridine (or like solvent) under an inert atmosphere cooled to approximately -10 degrees C. This solution is then added drop-wise, under an inert atmosphere, to a solution of diphenyl chlorophospate (**Compound 4**), in about an equal amount of reaction solvent. About a 2-5% molar excess of diphenyl chlorophosphate (**Compound 4**) relative to the alcohol (**Compound 5**) is employed. The mixture is heated at reflux for 1 to 5 hours, preferably about 3, to affect the reaction. The product is then recovered by conventional means. The diphenyl phosphate ester (**Compound 6**) is then reacted with the 3-bromo phenol derivative (**Compound 7**) to affect formation of an isomeric mixture of chromans (**Compound 8** and **Compound 9**). For example, 3-bromo-phenol (**Compound 7**, R_5=H) is added to a flask already containing stannic chloride under argon which has been cooled to -10 degrees to 10 degrees C. After thorough mixing of this combination for about 15 minutes to an hour at the reduced temperature, the phosphate (**Compound 6**) is added. When the addition of the phosphate (**Compound 6**) is completed, the mixture is stirred at about ambient temperature for up to 24 hours. Then the reaction is quenched with a dilute solution of aqueous alkali metal base or the like. The isomeric mixture is then separated by conventional means to give the desired 7-bromo-chroman (**Compound 8**).

Alternatively, the desired 7-substituted chromans can be separated from their potential regio-isomeric impurities at the carboxylic acid stage or at the final coupling stage.

The carboxylic acid function is then introduced

into the 7-position of the 4,4-disubstituted bromochroman by metal halogen exchange. The bromochroman (**Compound 8**) is treated with tert-butyl-lithium (or other appropriate metal halogen exchange reagents) followed by carbon dioxide quench. Subsequent acidification gives the 4,4-dialkyl-7-carboxy chroman derivative which contains the desired R_1', R_2', R_3, R_4 and R_5 substituents (**Compound 10**).

Reaction Scheme 6 illustrates an alternative method for preparing compounds of **Formula 2** where R_1 - R_5 are as previously described in **Reaction Scheme 5**.

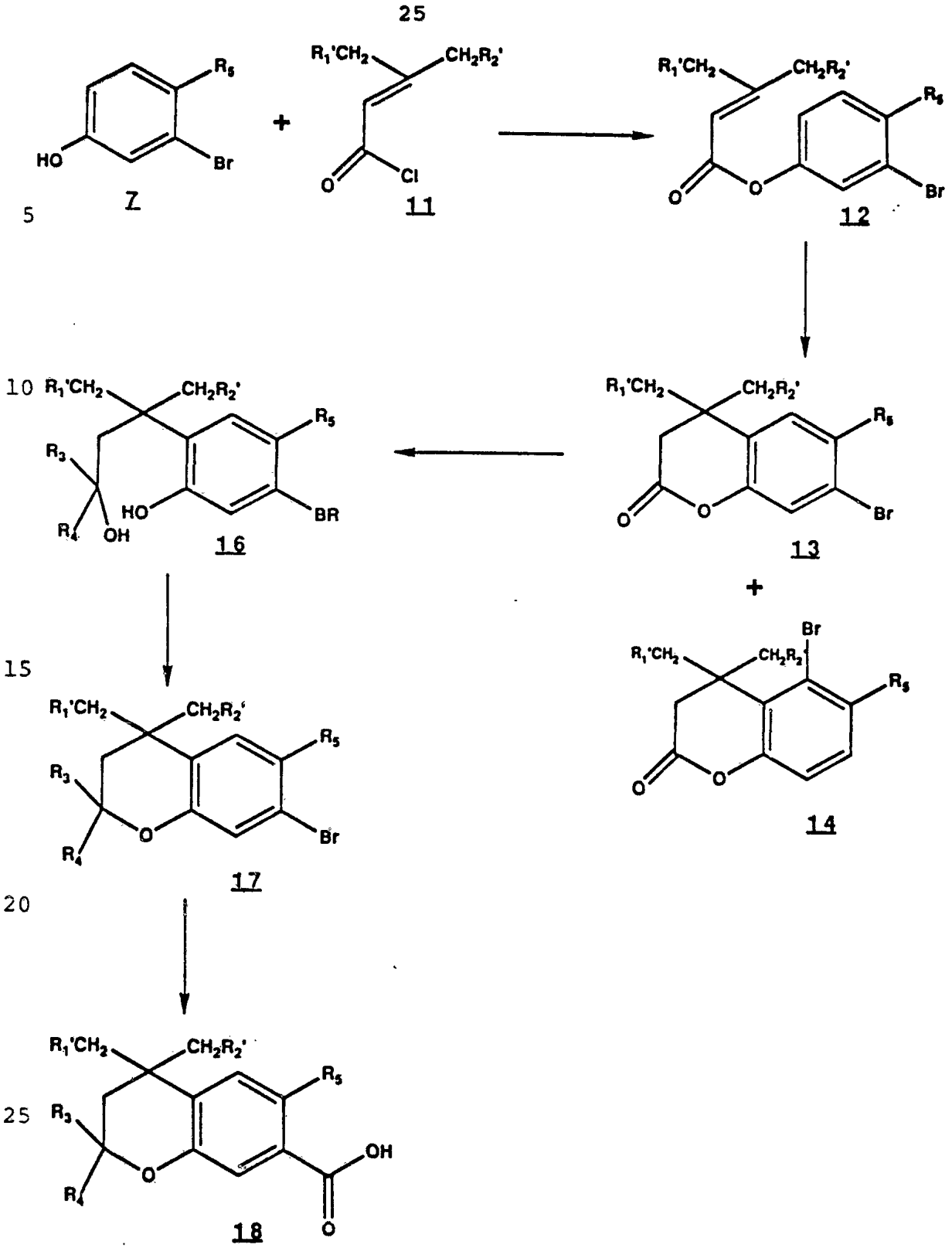


Reaction Scheme 6

Thus, in accordance with **Reaction Scheme 6**, 3-bromo phenol, or a 3-bromo phenol substituted in the 4 (para) position by an alkyl substituent (**Compound 7**) is acylated with an acylating agent, such as the acid chloride (**Compound 11**) derived from 3,3-dimethylacrylic acid or from another appropriately substituted acrylic acid (R_1' and R_2' is either H or lower alkyl). The acylation of the 3-bromo-phenol (**Compound 7**) with the acid chloride (**Compound 11**) is preferably conducted in the presence of a strong base (e.g. sodium hydride) in an inert solvent (such as tetrahydrofuran). The resulting phenyl-acrylate (**Compound 12**) is ring closed under Friedel-Crafts type reaction conditions (e.g. $AlCl_3$ catalyst, in an inert solvent such as methylene chloride) to provide two positional isomers (**Compound 13**) and (**Compound 14**) of the 2-oxo-chroman derivative, each of which bears, in the 4-position, the CH_2R_1' and CH_2R_2' substituents and where R_5 is hydrogen or lower alkyl. As described previously for **Reaction Scheme 5**, the mixture is then separated by conventional means to obtain the desired 7-bromo-2-oxo-chroman (**Compound 13**). It should be noted that as also described previously in connection with **Reaction Scheme 5** the 7-bromo-2-oxo chroman (**Compound 13**) can be separated from the potential regio-isomeric impurities at the carboxylic acid stage or at the final coupling stage. The 2-oxo-7-bromo-chroman (**Compound 13**) is thereafter reduced with lithium aluminum hydride or an appropriate reducing agent to provide the 7-bromo-diol (**Compound 15**). The diol (**Compound 15**) is then mono-mesylated at the primary alcohol position followed by intramolecular nucleophilic displacement of a mesyl leaving group, to give the 7-bromo-chroman (**Compound 8**) which bears the

desired CH_2-R_1', CH_2R_2' and R_5 substituents. The carboxylic acid function is introduced into the 7-position in the same manner as described previously in **Reaction Scheme 5** to give the 7-carboxy chroman (**Compound 10**).

The intermediate chroman derivatives of **Formula 2** where R_1 - R_4 are lower alkyl, R_5 is H or lower alkyl, and **A'** is COOH may be prepared in accordance with the synthetic steps illustrated in **Reaction Scheme 7**.

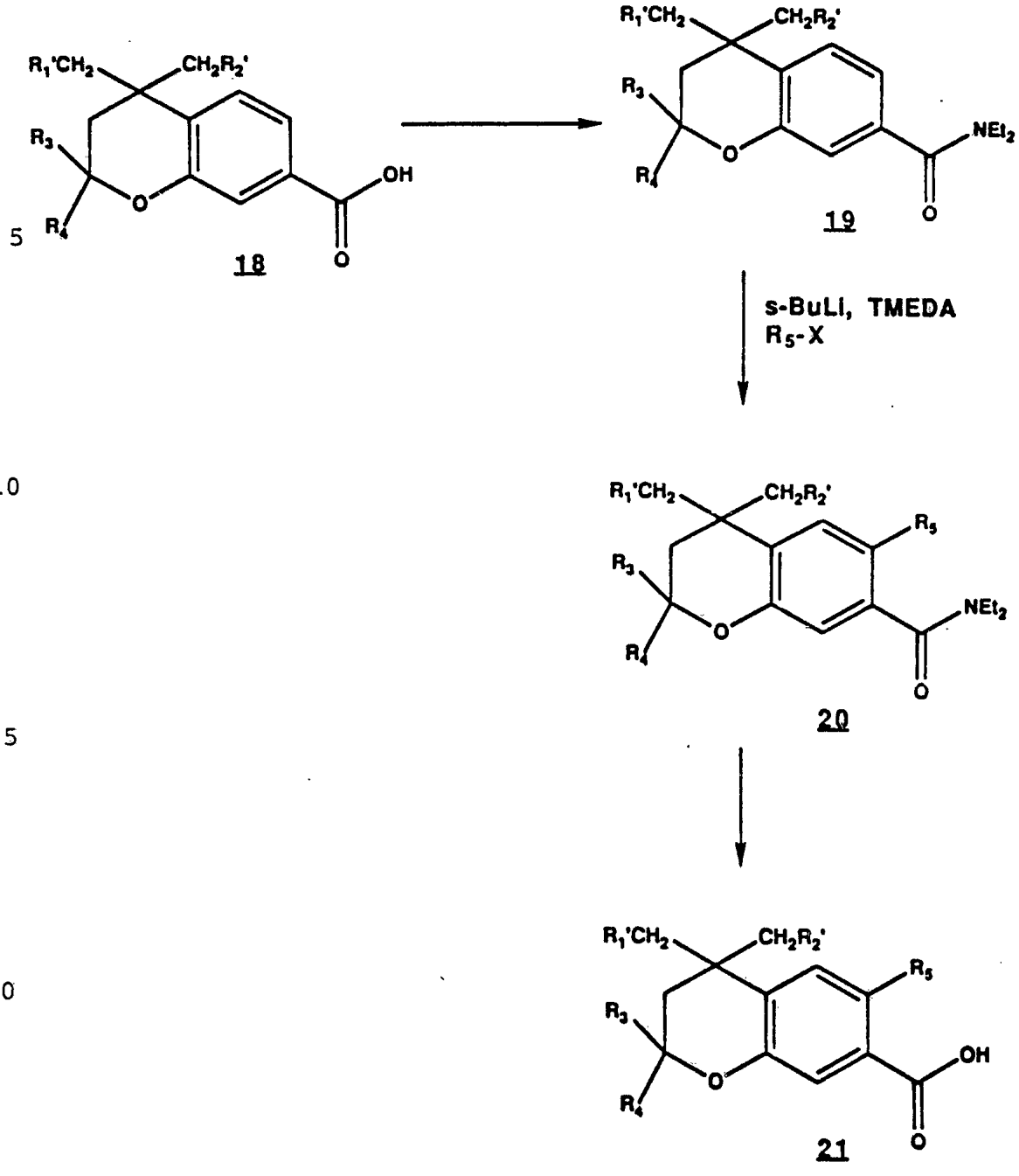


Reaction Scheme 7

With reference to **Reaction Scheme 7**, the 3-bromo-phenol derivative, where R_5 is hydrogen or lower alkyl, (**Compound 7**) is acylated with an acylating agent, such as acid chloride (**Compound 11**) derived from 3,3-dimethyl acrylic acid or from another appropriately substituted acrylic acid. (R_1' and R_2' are hydrogen or lower alkyl). As previously described cyclization of **Compound 12** under Friedel-Crafts type reaction conditions results in the formation of positional isomers, (**Compounds 13 and 14**), where the bromo substituent of the meta (3) position of the phenol **Compound 7** becomes, in the target chroman compounds the substituent either at the 5-position or the 7-position of the chroman nucleus. Thus, with specific reference to **Reaction Scheme 7**, the acylation of the bromo phenol (**Compound 7**) with the acid chloride (**Compound 11**) is preferably conducted in the presence of a strong base in an inert solvent, analogus to the conditions described for **Reaction Scheme 6**. The phenyl-acrylate (**Compund 12**) is ring closed under Friedel Craftes type reaction conditions as described for **Reaction Scheme 6** to provide a mixture of two isomers. (**Compound 13** and **Compound 14**) each of which bears, in the 4-position, the CH_2R_1 and CH_2R_2 substituents. The isomers are then separated as described previously for **Reaction Schemes 5 and 6**. The 2-oxo-7-bromo derivative (**Compound 13**) is thereafter treated with a Grignard reagent to introduce the R_3 and R_4 substituents. In the preferred embodiments, R_3 and R_4 are identical, for example both are methyl or ethyl. When R_3 and R_4 are methyl, the Grignard reagent is preferably methylmagnesium chloride (dissolved in tetrahydrofuran). To carry out the Grignard reaction a solution of **Compound 13** in a suitable

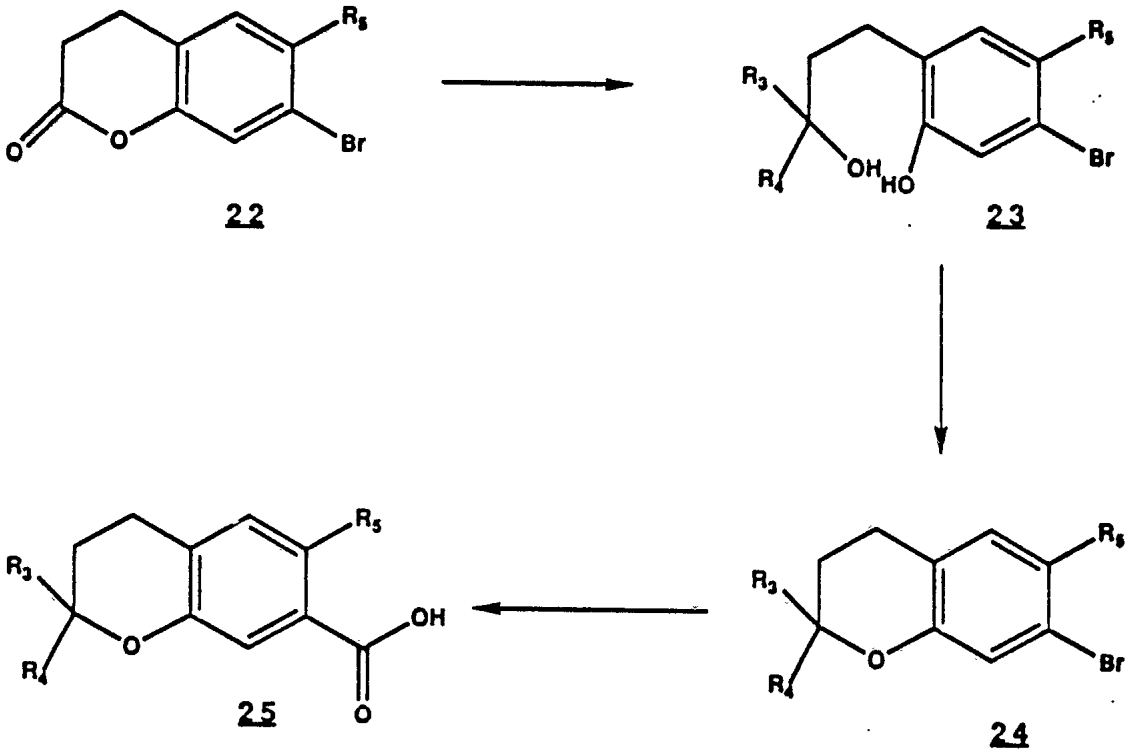
solvent (for example in dry diethylether) is added to this Grignard reagent. The resulting tertiary phenol that has undergone ring opening is shown as **Compound 16** in **Reaction Scheme 7**.

Compound 16 which already has the desired R_1, R_2, R_3, R_4 and R_5 substituents, is ring closed under acidic conditions, (e.g. by heating in aqueous sulfuric acid) to provide the chroman derivative (**Compound 17**). The carboxylic acid moiety is introduced by metal halogen exchange followed by reaction with carbon dioxide, as described previously, to give the desired 7-carboxy chroman (**Compound 18**).



Reaction Scheme 8

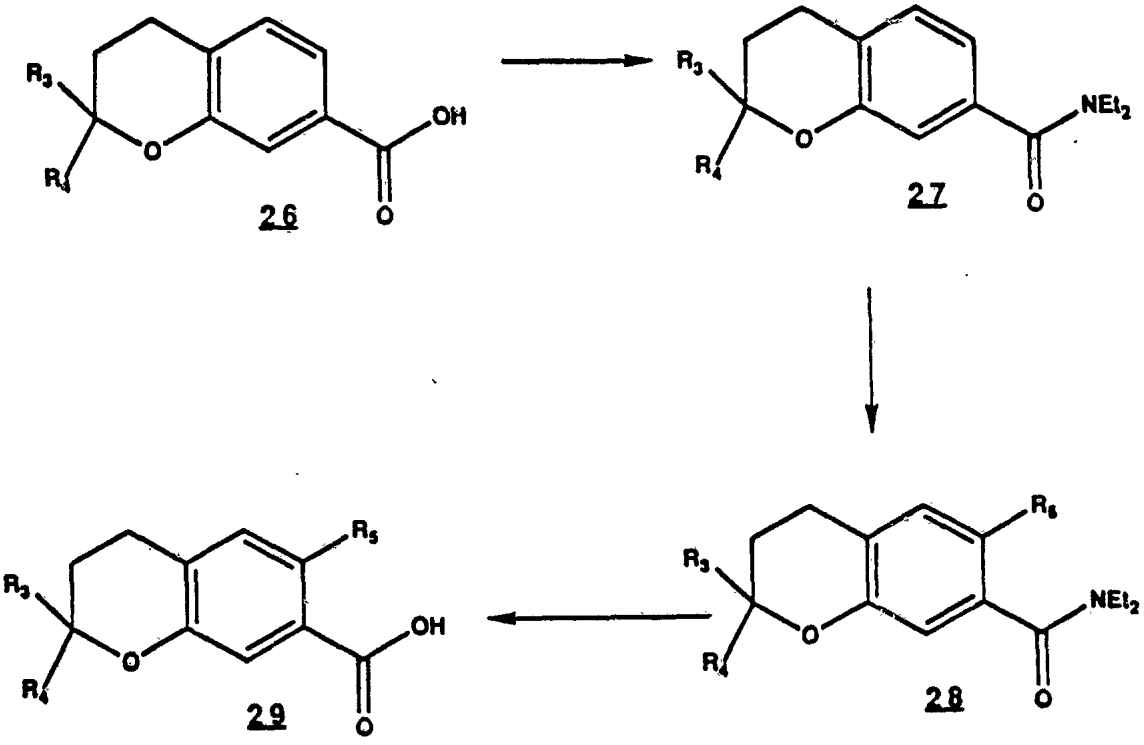
An alternative route for synthesizing compounds of Formula 2 where R_3 and R_4 are hydrogen or lower alkyl, R_5 is lower alkyl and **A'** is COOH, is shown in **Reaction Scheme 8**. This scheme serves as an illustrative example for the synthesis of compounds of the invention having substituents in the 4,4 and 6 positions or in the 2,2,4,4 and 6 positions of the chroman nucleus. In this scheme, the 7-carboxy-chromans (**Compound 18**) where R_3 and R_4 are hydrogen or lower alkyl serve as starting materials. **Compound 18** is obtained in accordance with **Reaction Scheme 5, 6** when R_3 and R_4 = H and in accordance with **Reaction Scheme 7** (when R_3 and R_4 = CH_3). **Compound 18** is converted to the corresponding acid chloride, and thereafter to the corresponding diethylamide (**Compound 19**) through treatment with thionyl chloride and subsequently by treatment with diethylamine. The lower alkyl substituent at the 6 position of the chroman nucleus is introduced by alkylation of **Compound 19** with an alkyl halide (R_5 - X), after treating **Compound 19** with secondary butyl lithium in tetramethylethylenediamine (TMEDA). The resulting 6-substituted diethylamide (**Compound 20**) is thereafter converted into the corresponding 4,4,6 substituted or 2,2,4,4,6 substituted 7-carboxy chroman (**Compound 21**) by hydrolysis, for example under appropriate acidic or basic conditions.



Reaction Scheme 9

The synthetic sequence which provides 7-carboxychroman intermediates unsubstituted in the 4 position, and substituted or unsubstituted in the 6-position, is shown in **Reaction Scheme 9**. The 7-bromo-2-oxo-chroman, also known as dihydrocoumarin (**Compound 22**) can be obtained, for example, by the steps outlined in **Reaction Scheme 7** using acrylic acid chloride (R_1, R_2 = H in **Compound 11**) and 3-bromo phenol derivative (R_5 = H or lower alkyl in **Compound 7**). Dihydro coumarin (**Compound 22**) is subjected to the reaction sequence outlined in **Reaction Scheme 9** to yield, through the intermediate compounds **23** and **24**, the 2,2 disubstituted 7-carboxychroman (**Compound 25**). **Compound 25** then can be reacted with an appropriate compound of Formula 3 to provide the esters of the invention, in accordance with **Formula 1**. Alterna-

tively, the 2,2 disubstituted 7-carboxy chroman (**Compound 25**) where R_5 is hydrogen may be alkylated in the 6- position of the chroman nucleus in accordance with the synthetic sequence described above in **Reaction Scheme 8** in connection with the analogous alkylation of 4,4 disubstituted and 2,2,4,4 tetrasubstituted 7-carboxy chromans (**Compound 18**). Thus, with specific reference now to **Reaction Scheme 10**, **Compound 26** is first converted to the corresponding diethylamide (**Compound 27**). The diethylamide (**Compound 27**) is alkylated with an alkyl halide (R_5X) in the presence of secondary butyl lithium in tetramethylethylene diamine. The resulting 6-substituted diethylamide (**Compound 28**) is thereafter converted into the corresponding 2,2,6-substituted 7-carboxy chroman (**Compound 29**) for example by hydrolysis with base or acid.



Reaction Scheme 10

It should be noted that in accordance with **Formula 2** the R_5 substituent may be attached to the 6-position, which has been described and is preferred, but also to the 5 position or 8-position of the chroman nucleus.

In addition, although the bromo substituted phenols are described and preferred, the iodo, chloro and other appropriately halogenated phenols can also be used in the above described synthetic steps leading to the compounds of the present invention.

The following examples of specific compounds of the invention, and specific examples of the synthetic steps in which the compounds and certain intermediates are made, are set out to illustrate the invention, not to limit its scope.

Specific Examples

5-Bromophenyl 3,3-dimethyl acrylate **(Compound 30)**

To an ice-cooled suspension of 4g (100 mmol) of sodium hydride (60% in mineral oil) in 50 ml of dry THF was added dropwise a solution of 15.7 g(90.7 mmol) of 3-bromo phenol in 25 ml of dry THF. The mixture was stirred at 0 degrees C for 0.5 hours and then treated with a solution of 10.65 g (90.0 mmol) of dimethyl acryloyl chloride in 30 ml of dry THF. The mixture was allowed to warm to room temperature and stirred for 24 hours. The reaction mixture was poured onto 200 ml of ice water containing 3 ml of glacial acetic acid. The mixture was extracted with 2 x 250 ml ether and the combined ether extracts were washed with 200 ml of water and 100 ml saturated NaCl solution and dried ($MgSO_4$). The solvent was removed in vacuo and the residue purified by kugelrohr distillation to give the title compound as a clear oil.

PMR ($CDCl_3$): & 2.02 (3H, s), 2.28 (3H, s), 5.94

(1H, broad s), 7.06 - 7.12 (1H, m), 7.28 (1H, t, J - 8.0 Hz), 7.34 (1H, t, J - 2.0 Hz), 7.37 - 7.42 (1H, m).

3-Bromo-2-(1,1,3-trimethyl-3-hydroxybutyl)phenol (**Compound 32**)

To a stirred, ice-cooled suspension of 21 g (158 mmol) of aluminum chloride in 200 ml of methylene chloride was added slowly a solution of 23.74 g (93.1 mmol) of 5-bromophenyl-3,3-dimethyl acrylate (**Compound 30**) in 100 ml of methylene chloride. The mixture was warmed to room temperature and stirred for 52 hours. The mixture was poured into a mixture of ice and brine and the organic layer was separated. The aqueous layer was extracted with 2 X 100 ml ether. The organic extracts were combined and washed with 2 X 250 ml of water and 50 ml of saturated NaCl solution and dried ($MgSO_4$). The solvent was removed in vacuo and the residue was partially purified by flash column chromatography, (silica; 5% ethyl acetate/hexane) to give impure 4,4-dimethyl-7-bromo-2-oxochroman (**Compound 31**) as a yellow oil which was used in the next step without further purification. To an ice-cooled solution of 10 g of this impure 4,4,dimethyl-7-bromo-2-oxo-chroman (**Compound 31**) in 200 ml of dry THF was added under argon 39.2 ml of 3.0 M Methyl Magnesium Chloride (117.6 mmol) in THF. The reaction mixture was allowed to warm to room temperature and stirred for 5 hours. The reaction mixture was then poured into ice water containing 2 ml of sulfuric acid and the organic layer was separated. The aqueous layer was extracted with 200 ml of ether. The organic extracts were combined and washed with 200 ml of water and 200 ml of brine and dried ($MgSO_4$). The solvent was removed in vacuo and the residue purified by flash column

chromatography (silica; 10% ethylacetate/hexanes) to give the title compound as a pale yellow oil.

PMR ($CDCl_3$): & 0.98 (6H, s), 1.36 (6H, s), 2.15 (2H, s), 6.82 (1H, d, J - 1.9 Hz), 6.86 (1H dd, J - 8.3 Hz, 1.9 Hz), 7.04 (1H, d, J - 8.3 Hz).

2,2,4,4-tetramethyl-7-bromochroman (**Compound 33**)

A mixture of 5.42 (18.9 mmol) of 3-bromo-2(1,1,3 trimethyl-3-hydroxy-butyl) phenol (**Compound 32**) and 50 ml of 20 percent aqueous sulfuric acid was heated at reflux for 24 hours. The reaction mixture was cooled to room temperature and treated with 100 ml of ether. The organic layer was separated and the aqueous layer was extracted with 50 ml of ether. The ether extracts were combined and washed with 100 ml of water and 100 ml saturated NaCl solution and dried ($MgSO_4$). The solvent was removed in vacuo and the residue was purified by Kugelrohr distillation to give the impure title compound as a pale yellow oil.

PMR ($CDCl_3$): & 1.22 (6H, s), 1.24 (6H, s), 1.72 (2H, s), 6.87 (1H, d, J - 2.0 Hz), 6.92 (1H, dd, J - 8.3 Hz, 2.0 Hz), 7.02 (1H, d, J - 8.3 Hz).

2,2,4,4-Tetramethyl-7-carboxychroman (**Compound 34**)

A solution of 1.78g (6.6 mmol) of 2,2,4,4-Tetramethyl-7-bromochroman (**Compound 33**) in 10 ml of ether was cooled to -78 degrees C under Argon and treated dropwise with 7.76 ml (13.19 mmol) of 1.7M t-Butyl Lithium solution. The mixture was stirred at -78 degrees C for 5 hours. A rapid stream of carbon dioxide gas was then bubbled through the mixture for 1 hour while warming to room temperature. The mixture was then taken up with water and ether and the layers were separated. The ether layer was extracted with water and the combined aqueous extracts were washed

with ether and then acidified with 1N HCl until a white precipitate formed. The acidified mixture was cooled overnight and then extracted with ether. The organic layer was then washed with water and with saturated sodium chloride solution and dried ($MgSO_4$). The solvent was removed in vacuo to give the title compound as a white solid.

PMR ($CDCl_3$): & 1.36 (6H, s), 1.38 (6H, s), 1.87 (2H, s), 7.38 (1H, d, J - 1.8 Hz), 7.56 (1H, d J - 1.8 Hz) 7.65 (1H, dd, J - 8.1 Hz, 1.8 Hz).

Ethyl-4-(2,2,4,4-Tetramethyl-7-chromanoyl-oxy)benzoate (**Compound 1**)

A solution of 450 mg (1.923 mmol) of 2,2,4,4-Tetramethyl-7-carboxychroman (**Compound 34**) and 320 mg (1.926 mmol) of Ethyl-4-hydroxy benzoate in 15 ml of methylene chloride was treated sequentially with 397 mg (1.924 mmol) of Dicyclohexylcarbodiimide and 58 mg (.475 mmol) of 4-Dimethyl-aminopyridine. The mixture was stirred for 18 hours and then filtered. The filtrate was concentrated in-vacuo and the resulting residue was purified by flash chromatography (silica: 10% ethyl acetate in hexanes) to give the title compound as a white solid.

PMR ($CDCl_3$): & 1.34 - 1.45 (15 H, m), 4.39 (2H, q, J - 7.0 Hz), 7.28 (2H, a, J - 8.7 Hz), 7.42 (1H, d, J - 8.2 Hz), 7.65 (1H, d, J - 1.8 Hz), 7.73 (1H, dd, J - 8.2 Hz, 1.8 Hz), 8.12 (2H, d, J - 8.7 Hz).

Benzyl-4(2,2,4,4-tetramethyl-7-chromanoyloxy)benzoate (**Compound 2**)

A solution of 450 mg (1.923 mmol) of 2,2,4,4 Tetramethyl-7-carboxychroman (**Compound 34**) and 440 mg (1.930) of Benzyl-4-hydroxy benzoate in 15 ml of methylene chloride was treated sequentially with 400 mg

(1.940) of 1,3-Dicyclohexyilcarbodiimide and 58 mg (.475 mmol) of Dimethylaminopyridine. The mixture was stirred for 18 hours and filtered. The filtrate was concentrated in-vacuo and the residue was purified by flash chromatography (silica; 10% ethylacetate in hexanes) to give the title compound as a white solid.

PMR ($CDCl_3$): & 1.39 (6H, s), 1.40 (6H, s), 1.89 (2H, s), 5.38 (2H, s), 7.29 (2H, d, J - 8.3 Hz), 7.34 - 7.49 (6H, m), 7.66 (1H, d, J - 1.8 Hz), 7.73 (1H, dd, J - 8.1 Hz, 1.8 Hz), 8.16 (2H, d, J - 8.3 Hz).

By substituting, for example, methyl or propyl 4-hydroxybenzoate for benzyl 4-hydroxybenzoate or for ethyl 4-hydroxybenzoate as in the immediately preceding two specific examples, methyl 4-(2,2,4,4,tetramethyl-7-chromanoyloxy benzoate and propyl 4-(2,2,4,4-tetramethyl-7-chromanoyloxy) benzoate can be obtained, respectively.

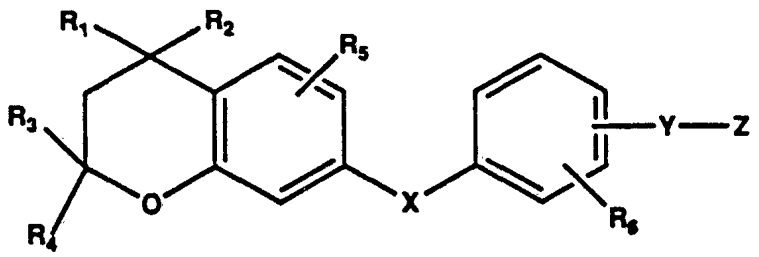
4-(2,2,4,4-tetramethyl-7-chromanoyloxy) benzoic acid (**Compound 3**)

To a degassed solution of 400 mg (.9 mmol) of Benzyl 4-(2,2,4,4-tetramethyl-7-chromanoyloxy) benzoate (**Compound 2**) in 15 ml of Ethylacetate, under argon was added 130 mg of 10% Palladium on carbon. The mixture was placed under a hydrogen atmosphere at 5 PSI and hydrogenated for 3 hours. The mixture was then filtered through celite and the filtrate was concentrated in-vacuo to give the title compound as a white solid.

PMR ($CDCl_3$): & 1.39 (6H, s), 1.40 (6H, s), 1.90 (2H, s), 7.34 (2H, d, J - 8.7 Hz), 7.43 (1H, d, J - 8.1 Hz), 7.67 (1H, d, J - 1.6 Hz), 7.74 (1H, dd, J - 8.1 Hz, 1.6 Hz), 8.21 (2H, d, J - 8.7 Hz).

WHAT IS CLAIMED IS:

1. A compound of the formula



wherein

the R_1 - R_6 groups are independently H or straight chain or branched chain lower alkyl or cycloalkyl groups of 1 to 6 carbons;

X is -COO-, -COS-, -OOC- or -SOC-;

Y is cycloalkyl or branched chain alkyl group of 3 to 6 carbons, or is $(CH_2)_n$ where n is an integer between 0 to 6, and

Z is H, OH, OR', OCOR', -COOH or a pharmaceutically acceptable salt, $COOR_8$, $CONR_9R_{10}$, $-CH_2OH$, CH_2OR_{11}, CH_2OCOR_{11}, CHO, $CH(OR_{12})_2$, $CHOR_{13}O$, -COR', $COR'(OR_{12})_2$, or $CR'OR_{13}O$ where R' is an alkyl, cycloalkyl or alkenyl group containing 1 to 5 carbons, R_8 is an alkyl group of 1-10 carbons, or a cycloalkyl group of 5-10 carbons, or R_8 is phenyl or lower alkylphenyl, R_9 and R_{10} independently are hydrogen, an alkyl group of 1-10 carbons, or a cycloalkyl group of 5-10 carbons or phenyl or lower alkyl phenyl, R_{11} is lower alkyl, R_{13} is divalent alkyl radical of 2 to 5 carbons.

2. A compound of Claim 1 where X is -COO-.

3. A compound of Claim 2 where Y is $(CH_2)_n$ and n

is zero.

4. A compound of claim 3 where Z is $COOR_8$ wherein R_8 is H, lower alkyl.

5. A compound of claim 4 where R_8 is hydrogen or lower alkyl.

6. A compound of claim 2 where in R_1 and R_2 are methyl, R_3, R_4 and R_5 are hydrogen.

7. A compound of claim 6 wherein R_5 is attached to the 6-position of the chroman nucleus.

8. A compound of claim 2 wherein R_3 and R_4 are methyl, R_1, R_2 and R_5 are hydrogen.

9. A compound of claim 8 wherein R_5 is attached to the 6-position of the chroman nucleus.

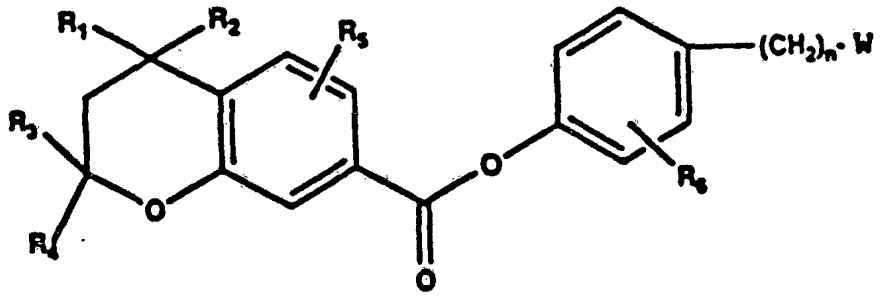
10. A compound of claim 2 wherein R_1, R_2 and R_3, R_4 all are methyl.

11. A compound of claim 10 wherein R_5 is attached to the 6-position of the chroman nucleus.

12. A pharmaceutical composition comprising one or more compounds set forth in claim 1 and a pharmaceutically acceptable excipient.

13. A method for the treatment of skin disorders in a mammal which comprises administering to a mammal one or more compounds according to claim 1 optionally in association with a pharmaceutically acceptable carrier.

14. A compound of the formula



wherein

the R_1 - R_6 groups are independently H or straight chain or branched chain

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lower alkyl or cycloalkyl groups of up to 6 carbons;

n is an integer between 0 to 6;

W is $COOR_8$ and R_8 is H, or lower alkyl, or W is $CONR_9R_{10}$ where R_9 and R_{10} independently are H or lower alkyl or phenyl.

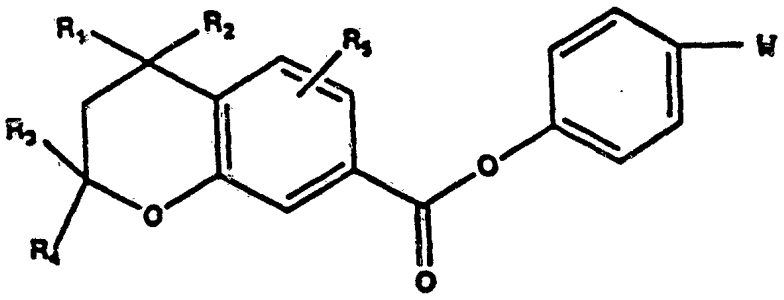
15. A compound of claim 14 wherein n is zero.

16. A compound of claim 14 wherein R_1 - R_4 groups are independently H or CH_3.

17. A pharmaceutical composition comprising one or more compounds set forth in claim 14 and a pharmaceutically acceptable excipient.

18. A method for the treatment of skin disorders in a mammal which comprises administering to a mammal one or more compounds according to claim 14 optionally in association with a pharmaceutically acceptable carrier.

19. A compound of the formula



wherein

R_1 - R_4 are independently H or CH_3, R_5 is H or lower alkyl of 1 - 6 carbons;

W is $COOR_8$ and R_8 is H, lower alkyl, phenyl or benzyl, or W is $CONR_9R_{10}$ where R_9 and R_{10} independently are H or lower alkyl or a pharmaceutically acceptable salt thereof.

20. A compound of claim 19 wherein R_1 - R_4 all are methyl.

21. A compound of claim 20 wherein R_5 is H or methyl, W is $COOR_8$ and R_8 is H, lower alkyl or benzyl.

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~~21. Amended) A compound of Claim 20 wherein R_5 is H or methyl, W is $COOR_8$ and R_8 is H, lower alkyl or benzyl.~~

22. A compound of Claim 21 wherein R_5 is H.

23. The compound of Claim 22 wherein R_8 is ethyl.

24. The compound of Claim 22 wherein R_8 is hydrogen, and pharmaceutically acceptable salts thereof.

25. The compound of Claim 22 where R_8 is benzyl.

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INTERNATIONAL SEARCH REPORT

International Application No PCT/US 92/02346

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl.5 C 07 D 311/58 A 61 K 31/335

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl.5	C 07 D

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
A	EP,A,0337689 (ALLERGAN) 18 October 1989, see page 2 ---	1,12-14,19
A	LU,A, 86259 (CENTRE INTERNATIONAL DE RECHERCHES DERMATOLOGIQUES) 3 September 1987, see page 1 ---	1,12-14,19
P,X	US,A,5006550 (R.A.S. CHANDRARATNA) 9 April 1991, see column 1 -----	1-6,8,10,12-25

° Special categories of cited documents :[10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
02-07-1992	05. 10. 92
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	Natalie Weinberg

Form PCT/ISA/210 (second sheet) (January 1985)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US92/02346

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

see attached sheet

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searches without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Claims searched completely: 1-6,8,10,12-25

Claims not searched: 7,9,11

Claims 7,9,11:

Since the variable R_6 is not defined in claim 1 as being attached to the chroman nucleus, these claims are meaningless.

Claims 1-16:

There is a discrepancy between the claims and the description, namely in claim 1 one of the values for Z is given as $CONR_9R_{10}$, whilst this value is absent from the list of values for Z given on page 2 of the description.
The latter list includes $COONR_9R_{10}$, which is absent from the list in the claims.
However, claims 14 and 19 also include $COONR_9R_{10}$ as a value for Z.
The search has been carried out to include all compounds with either possibility.

Claim 25:

Benzyl is not a possibility as a value for the variable R_8 in claim 22, on which claim 25 is dependent.

Claim 25 has been searched on the assumption that benzyl is included in claim 22.

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. US 9202346 SA 59622

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 16/09/92
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A- 0337689	18-10-89	AU-A- 3258589	12-10-89
		JP-A- 2006437	10-01-90
		US-A- 5130335	14-07-92
LU-A- 86259	03-09-87	None	
US-A- 5006550	09-04-91	AU-A- 6828790	04-07-91
		EP-A- 0435681	03-07-91
		JP-A- 4139178	13-05-92