New Compounds

Terpene Compounds as Drugs. II. Terpenyl Derivatives of Barbituric Acids and Normeperidine

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In connection with our interest in the field of terpene chemistry we have introduced terpenyl groups into the 5 positions of barbituric acid to test the resulting compounds as hypnotics,[1] anticonvulsants,[2] and analgetics;[3,4] into the 5 position of 1,3-diphenylbarbituric acid for examination of antiinflammatory activity;[5] and into the 1 position of normeperidine for the study of analgetic activity.[3,4] None of the compounds showed activity in these tests.

Diethyl citronellylphenylmalonate [bp 155–160° (0.2 mm), 38%] was prepared similarly.

Anal. Calcd for $C_{23}H_{34}O_4$: C, 73.76; H, 9.15. Found: C, 73.58; H, 9.19.

Diethyl digeranylmalonate was prepared according to the same procedure, using diethyl malonate, geranyl bromide, and sodium in the molar proportions of 1:2:2. The thick oil obtained was purified by removal of the fractions distilling up to 170° (0.3 mm).

Anal. Calcd for $C_{27}H_{44}O_4$: C, 74.95; H, 10.25. Found: C, 74.80; H, 10.33.

Derivatives of barbituric acid and normeperidine are given in Table I. Examples of their methods of preparation are given below.

Method A. 5-Phenyl-5-farnesylbarbituric Acid (I).—Urea (0.75 g, 0.0175 mole) was added, under N_2, to a solution of sodium (0.23 g, 0.01 g-atom) in absolute methanol (5 ml), and then a solution of diethyl phenylfarnesylmalonate (2.2 g, 0.005 mole) in absolute methanol (3 ml) was dropped in, and the mixture was then refluxed for 16 hr. Finally, the solution was cooled and the solvent was evaporated *in vacuo* at low temperature, the residue was taken up in ether, water and ice were added, the two layers were separated, and the ethereal layer was extracted with 10% NaOH. The latter solution was combined with the previous aqueous alkaline layer and acidified with 10% HCl. A viscous oil separated and was extracted with ether, and the ethereal solution was washed with water until neutral. On distillation of the dried (Na_2SO_4) extract, a solid was obtained, which on crystallization from dilute ethanol gave colorless crystals, mp 139–140°.

TABLE I

DERIVATIVES OF BARBITURIC ACID AND NORMEPERIDINE

Compd	Name	Prepn method	Recrystn solvent[a]	Yield, %	Mp or bp (mm), °C	Formula	C, % Calcd	C, % Found	H, % Calcd	H, % Found	N, % Calcd	N, % Found
I	5-Phenyl-5-farnesylbarbituric acid	A	B	46[b]	139–140	$C_{25}H_{32}N_2O_3$	73.49	73.31	7.90	7.88	6.86	6.74
II	5-Phenyl-5-geranylbarbituric acid	A	B	53[b]	147–148	$C_{20}H_{24}N_2O_3$	70.56	70.84	7.11	7.16	8.23	8.19
III	5-Phenyl-5-citronellylbarbituric acid	A	B	48[b]	102–103	$C_{20}H_{28}N_2O_3$	70.15	70.81	7.65	7.67	8.18	8.18
IV	5,5-Digeranylbarbituric acid	B	C	46[b]	92	$C_{24}H_{36}N_2O_3$	71.96	71.90	9.06	9.08	6.99	6.99
V	1,3-Diphenyl-5-geranylbarbituric acid	C	A	38[b]	81–82	$C_{20}H_{28}N_2O_3$	74.97	74.88	6.78	6.74	6.73	6.71
VI	1,3-Diphenyl-5-farnesylbarbituric acid	C		25[c]		$C_{31}H_{36}N_2O_3$	76.83	76.88	7.49	7.45	5.78	5.60
VII	1,3-Diphenyl-5-citronellylbarbituric acid	C	B	32[b]	83–84	$C_{26}H_{30}N_2O_3$	74.61	74.66	7.23	7.23	6.69	6.64
VIII	1-Geranylnormeperidine	D		76[c]	166–168 (0.1)	$C_{24}H_{35}NO_2$	78.00	77.44	9.55	9.50	3.79	3.81
IX	1-Nerylnormeperidine	D		68[c]	162–165 (0.1)[d]	$C_{24}H_{35}NO_2$	78.00	78.02	9.55	9.60	3.79	3.84
X	1-Citronellylnormeperidine	D		34[c]	171–174 (0.2)	$C_{24}H_{37}NO_2$	77.58	76.78	10.04	10.15	3.77	3.72
XI	1-Farnesylnormeperidine	D		81[c]	187–189 (0.2)[e]	$C_{29}H_{43}NO_2$	79.58	79.47	9.90	9.92	3.20	3.21

[a] Solvents: A = ethanol, B = dilute ethanol, C = hexane. [b] Crude product. [c] Pale yellow viscous oil, purified by chromatography. [d] Hydrochloride, mp 167–168° (from ethyl acetate). [e] Hydrochloride, mp 145–146° (from ethyl acetate).

Experimental Section[6]

Diethyl Farnesylphenylmalonate.—Diethyl phenylmalonate (17.4 g, 0.0739 mole) was added to a solution of sodium (1.7 g, 0.0739 g-atom) in absolute ethanol (70 ml). The solution was heated to boiling and farnesyl bromide (21.2 g, 0.0739 mole) was dropped in over 3 hr. After the addition, the mixture was refluxed for 3 hr. At the end of heating, the NaBr formed was filtered off, and the alcoholic solution was concentrated to dryness under reduced pressure. The residue was taken up in ether and the ethereal layer was washed with water, dried (Na_2SO_4), and evaporated *in vacuo*, giving a viscous oil, which was purified by removal of the fractions distilling up to 105° (0.2 mm) (16.2 g, 50%).

Anal. Calcd for $C_{28}H_{40}O_4$: C, 76.32; H, 9.15. Found: C, 75.94; H, 9.08.

Diethyl geranylphenylmalonate [bp 148–154° (0.1 mm), 54%] was obtained by the same procedure.

Anal. Calcd for $C_{23}H_{32}O_4$: C, 74.16; H, 8.66. Found: C, 74.51; H, 8.66.

Method B. 5,5-Digeranylbarbituric Acid (IV).—A solution of sodium (0.46 g, 0.02 g-atom) in absolute methanol (10 ml) was treated, under N_2, with urea (1.5 g, 0.025 mole), and a solution of diethyl 5,5-digeranylmalonate (4.32 g, 0.01 mole) in absolute methanol (5 ml) was then added dropwise, refluxing for 20 hr. At the end of refluxing the solution was cooled, the solvent was evaporated at low temperature, *in vacuo*, and the residue was taken up in ether, washing the ethereal layer with water until neutral.[7] On evaporation of the dried (Na_2SO_4) ethereal solution, an oily residue was obtained, which was purified by chromatography on a Kieselgel G (Merck) column, using benzene–acetic acid (95:5) as eluent. The solid after crystallization from hexane, gave colorless crystals, mp 92°.

Method C. 1,3-Diphenyl-5-geranylbarbituric Acid (V).—N,N′-Diphenylurea (17.2 g, 0.0813 mole) was added to a solution of geranylmalonic acid[8] (20 g, 0.0813 mole) in $CHCl_3$ (320 ml)

(1) E. F. Godefroi, P. A. J. Janssen, C. A. M. Van der Eycken, A. H. M. T. Van Heertum, and C. J. E. Niemegeers, *J. Med. Chem.*, **8**, 220 (1965).

(2) E. Marazzi-Uberti and C. Turba, *Arzneimittel-Forsch.*, **16**, 596 (1966).

(3) E. Adami and E. Marazzi-Uberti, *Arch. Intern. Pharmacodyn.*, **107**, 322 (1956).

(4) L. C. Hendershot and J. Forsaith, *J. Pharmacol. Exptl. Therap.*, **125**, 237 (1959).

(5) E. Arrigoni-Martelli and I. Conti, *Farmaco* (Pavia), *Ed. Prat.*, **19**, 135 (1964).

(6) Boiling points are uncorrected. Melting points are corrected and were taken on a Büchi capillary melting point apparatus.

(7) IV is insoluble in aqueous alkaline media.

(8) D. W. Dicker and M. C. Whiting, *J. Chem. Soc.*, 1994 (1958).

and then a solution of acetic anhydride (20.7 g, 0.2033 mole) in $CHCl_3$ (25 ml) was added dropwise over 30 min. The suspension was heated to boiling and refluxed for 10 hr under N_2. Finally the mixture was cooled to room temperature, the suspended solid, consisting of unreacted N,N'-diphenylurea, was filtered off, and the $CHCl_3$ solution was washed several times with 1% $NaHCO_3$ solution and then with water, until neutral. The organic layer was dried (Na_2SO_4) and evaporated *in vacuo* to give a residue consisting of a mixture of oil and solid product which was extracted several times with petroleum ether. A solid fraction was separated from the petroleum ether on standing, after filtration of the solid remaining in suspension. This solid fraction, filtered from the petroleum ether, was extracted with methanol; the insoluble portion consisting of N,N'-diphenylurea was removed, and the residue obtained by evaporation of the methanol solution was purified by chromatography on a Kieselgel G (Merck) column, using benzene–acetone (97:3) as eluent, giving an additional fraction of pure product. The product was further purified by crystallization from ethanol and gave colorless crystals (mp 81–82°).

Method D. 1-Geranylnormeperidine (VIII).—Normeperidine carbonate[9,10] (26.4 g) followed by geranyl bromide (21.7 g) was added to a sodium ethoxide solution prepared from sodium (2.3 g) and ethanol (230 ml). The mixture was stirred and refluxed for 1 hr under nitrogen, the solvent was evaporated under reduced pressure, and the residue was extracted with ether. The ethereal solution was treated with CO_2 to remove traces of unreacted normeperidine and filtered, and the ether was evaporated. The crude residue was then purified by chromatography on a Kieselgel G (Merck, 180 g) column, eluting with a 9:1 mixture of benzene and acetone to obtain the required product. A sample of the free base was distilled, bp 166–168° (0.1 mm), yielding a viscous oil. The pure hydrochloride, mp 143–144°, was obtained by treatment with HCl and subsequent crystallization from ethyl acetate.

(9) R. H. Thorp and E. Walton, *J. Chem. Soc.*, 559 (1948).

(10) J. Weijlard, P. D. Orabovats, A. P. Sullivan, Jr., G. Purdue, F. K. Heath, and K. Pfister, *J. Am. Chem. Soc.*, **78**, 2342 (1956), indicated that this material is the carbamate derived from 2 molecules of normeperidine.

Terpenes as Drugs. I. 1-Terpenyl-3-arylsulfonylureas

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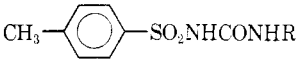
It is well known that in the hypoglycemic 1-alkyl-3-arylsulfonylureas the nature of the group in position 1 can be fairly widely varied without loss of activity;[1] compounds in which the above substituent was a cyclic terpene group have also been reported.[2] Our interest in the terpene field led us to synthesize three sulfonylureas of formula I, in which R is an acyclic terpene radical.



I

In order to draw a correlation of some significance, we have chosen a monoterpene radical (*i.e.*, geranyl), a partially saturated monoterpene radical (*i.e.*, citronellyl), and a sesquiterpene radical (*i.e.*, farnesyl), keeping the aryl component unchanged. Hypoglycemic tests have shown that only 1-citronellyl-3-*p*-tolylsulfonylurea is active, even though its action was found to be rather fleeting. As the citronellyl radical is more similar, than the other two, to a saturated alkyl group, the conclusion may be drawn that in hypoglycemic arylsulfonylureas the introduction of a markedly terpene-type radical in position 1 leads to inactive products.

(1) K. Gerzon, E. V. Krumkalns, R. L. Brindle, F. J. Marshall, and M. A. Root, *J. Med. Chem.*, **6**, 760 (1963).

(2) J. A. Aeschlimann and A. Stempel, U. S. Patent 2,928,871 (1960).

Experimental Section

1-Citronellyl-3-*p*-tolylsulfonylurea.—A solution of citronellylamine[3] (6 g, 0.0368 mole) and ethyl N-(*p*-tolylsulfonyl)carbamate (10.6 g, 0.0435 mole) in anhydrous toluene (120 ml) was refluxed for 5 hr. The solvent was removed *in vacuo*, and the residue was repeatedly washed with formamide and then extracted with ether; after washing with water, the ethereal solution was dried (Na_2SO_4). The solvent was then evaporated to give a viscous oil (9.8 g, 72% yield).

Anal. Calcd for $C_{18}H_{28}N_2O_3S$: C, 61.33; H, 8.00; N, 7.95; S, 9.09. Found: C, 61.48; H, 8.08; N, 7.82; S, 9.01.

1-Geranyl-3-*p*-tolylsulfonylurea.—A solution of geranylamine[4] (3 g, 0.0196 mole) and ethyl N-(*p*-tolylsulfonyl)carbamate (5.3 g, 0.0219 mole) in anhydrous toluene (60 ml) was refluxed as above. The solvent was removed and the residue was triturated with ether to give a colorless solid (5.7 g, 82% yield). An analytical sample, obtained by recrystallization from ethanol, melted at 89–90° (uncor).

Anal. Calcd for $C_{18}H_{26}N_2O_3S$: C, 61.68; H, 7.48; N, 7.99; S, 9.14. Found: C, 61.71; H, 7.50; N, 8.04; S, 9.12.

1-Farnesyl-3-*p*-tolylsulfonylurea.—A solution of farnesylamine[5] (6.5 g, 0.0294 mole) and ethyl N-(*p*-tolylsulfonyl)carbamate (8 g, 0.0328 mole) in anhydrous toluene (100 ml) was refluxed as above and worked up. The product was obtained as a viscous oil (8.6 g, 70% yield).

Anal. Calcd for $C_{23}H_{34}N_2O_3S$: C, 65.99; H, 8.19; N, 6.69; S, 7.66. Found: C, 65.83; H, 8.23; N, 6.70; S, 7.54.

(3) D. Arigoni and O. Jeger, *Helv. Chim. Acta*, **37**, 881 (1954).

(4) M. S. Kharasch, W. Nudenberg, and E. K. Fields, *J. Am. Chem. Soc.*, **66**, 1276 (1944).

(5) Hoffmann-La Roche & Co., A.-G., Belgian Patent 617,175 (1962).

Potential Antimalarial Substances. Amides of *o*-Ethoxy- and *p*-Isopropylbenzoic Acids[1]

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Preliminary antimalarial screening results suggested that the dicyclohexylamide of *o*-ethoxybenzoic acid (**8**) (Table I) and the diethylamide of *p*-isopropylbenzoic acid (**9**) (Table II) had some activity against *Plasmodium berghei* in mice.[2] Therefore, authentic samples of **8** and **9** were synthesized together with several analogs (Tables I and II). None of the amides described herein was active against *P. berghei* in the mouse when administered in a single subcutaneous dose of 640 mg/kg.[2]

Experimental Section[3]

Acid Chlorides.—The acid (0.12 mole) and 50 ml of $SOCl_2$ were heated for 5 hr on a steam bath. The mixture was cooled to room temperature and the excess $SOCl_2$ was removed *in vacuo* yielding the crude acid chloride as a liquid.

Amides.—To a cooled solution of 0.15 mole of the crude acid chloride in 150 ml of benzene, 0.3 mole of the amine was added. After the addition of amine, an additional 50 ml of benzene was added and the mixture was allowed to warm to room temperature. The mixture was stirred overnight and the solid which formed was removed by filtration. The solid was triturated with water to remove amine hydrochloride, and any residual material was removed by filtration and recrystallized. The benzene

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(2) The antimalarial screening was carried out by Dr. Leo Rane of the University of Miami, and test results were supplied through the courtesy of Dr. David P. Jacobus of the Walter Reed Army Institute of Research.

(3) Melting points (corrected) were taken in open capillary tubes in a Thomas-Hoover capillary melting point apparatus.