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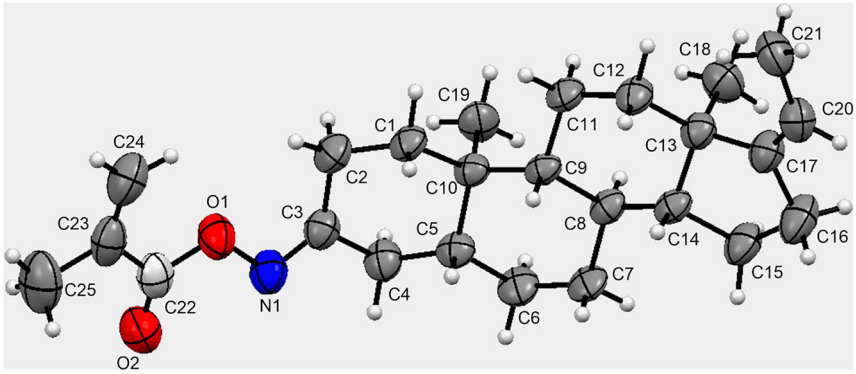
Synthesis and crystal structure of (3*E*,5*S*,10*S*,13*S*,14*S*,17*Z*)-17-ethylidene-10,13-dimethylhexadecahydro-3*H*-cyclopenta[*α*]phenanthren-3-one *O*-(methacryloyl) oxime, $C_{50}H_{74}N_2O_4$



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Abstract

$C_{50}H_{74}N_2O_4$, orthorhombic, *P*1 (no. 1), a = 7.3320(3) Å, b = 11.8132(4) Å, c = 13.1604(5) Å, α = 99.1910(10)°, β = 95.039(1)°, γ = 95.8560(10)°, V = 1113.06(7) Å^3, Z = 1, $R_{gt}(F)$ = 0.0662, $wR_{ref}(F^2)$ = 0.1655, T = 273(2) K.

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The molecular structure is shown in the figure. Table 1 contains crystallographic data and Table 2 contains the list of the atoms including atomic coordinates and displacement parameters.

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Table 1: Data collection and handling.

Crystal:	Colourless nubbly
Size:	0.22 × 0.21 × 0.19 mm
Wavelength:	Mo *K*α radiation (0.71073 Å)
μ:	0.07 mm^{-1}
Diffractometer, scan mode:	Bruker APEX-II, φ and ω
θ_{max}, completeness:	34.6°, 99 %
$N(hkl)_{measured}$, $N(hkl)_{unique}$, R_{int}:	38,222, 18,292, 0.054
Criterion for I_{obs}, $N(hkl)_{gt}$:	$I_{obs} > 2\sigma(I_{obs})$, 7800
$N(param)_{refined}$:	512
Programs:	Olex2 [1], Bruker [2], SHELX [3], Diamond [4]

1 Source of material

(3*E*,5*S*,10*S*,13*S*,14*S*,17*Z*)-17-ethylidene-10,13-dimethylhexadecahydro-3*H*-cyclopenta[*α*]phenanthren-3-one oxime (1.2 mmol) was dissolved in 10 ml of benzene and stirred at room temperature. After the addition of 1.5 mmol of triethylamine, we added a benzene solution containing 1.5 mmol methacryloyl chloride slowly, after keeping stirring at room temperature for 3 h. The reaction mixture was terminated with water and extracted with ethyl acetate, then merged with organic phase. This product was dried by anhydrous Na_2SO_4,

Table 2: Fractional atomic coordinates and isotropic or equivalent isotropic displacement parameters (Å^2).

Atom	*x*	*y*	*z*	U_{iso}*/U_{eq}
O1	0.3076 (3)	0.48271 (18)	0.6422 (2)	0.0675 (6)
N1	0.4993 (3)	0.5295 (2)	0.6593 (2)	0.0606 (7)
C1	0.3809 (3)	0.8208 (2)	0.7111 (2)	0.0520 (7)
H1A	0.292743	0.869706	0.688183	0.062*
H1AB	0.347456	0.801068	0.776359	0.062*
O2	0.4011 (4)	0.3068 (2)	0.6349 (2)	0.0805 (7)
C2	0.3648 (4)	0.7094 (3)	0.6312 (3)	0.0614 (8)
H2A	0.245517	0.665624	0.631266	0.074*
H2AB	0.372620	0.728993	0.562778	0.074*
C4	0.7055 (4)	0.6990 (3)	0.6767 (3)	0.0561 (8)
H4A	0.746502	0.720881	0.613673	0.067*
H4AB	0.788780	0.647887	0.700918	0.067*
C3	0.5133 (4)	0.6367 (3)	0.6541 (2)	0.0527 (7)
C5	0.7111 (3)	0.8066 (2)	0.7586 (2)	0.0475 (7)
H5	0.671801	0.779577	0.820808	0.057*
C8	0.7779 (3)	1.0504 (2)	0.8596 (2)	0.0444 (6)
H8	0.818219	1.090298	0.804140	0.053*
C7	0.9133 (3)	0.9640 (3)	0.8790 (3)	0.0573 (7)
H7A	1.037201	1.004449	0.893175	0.069*
H7AB	0.884736	0.931824	0.939870	0.069*
C6	0.9079 (3)	0.8667 (3)	0.7886 (3)	0.0585 (8)
H6A	0.988278	0.811188	0.807051	0.070*
H6AB	0.952464	0.897109	0.729916	0.070*
C9	0.5813 (3)	0.9881 (2)	0.8245 (2)	0.0417 (6)
H9	0.546469	0.949829	0.881953	0.050*
C10	0.5731 (3)	0.8899 (2)	0.7298 (2)	0.0426 (6)
C11	0.4431 (4)	1.0755 (3)	0.8138 (2)	0.0532 (7)
H11A	0.319779	1.034225	0.799556	0.064*
H11B	0.467328	1.112394	0.754830	0.064*
C12	0.4485 (4)	1.1693 (3)	0.9095 (3)	0.0541 (7)
H12A	0.365131	1.224670	0.894726	0.065*
H12B	0.406714	1.134332	0.966527	0.065*
C14	0.7723 (3)	1.1396 (2)	0.9547 (2)	0.0465 (7)
H14	0.722171	1.097156	1.006147	0.056*
C13	0.6433 (4)	1.2321 (2)	0.9412 (2)	0.0485 (7)
C15	0.9522 (4)	1.2087 (3)	1.0082 (3)	0.0622 (8)
H15A	1.026090	1.160881	1.044325	0.075*
H15B	1.023827	1.240667	0.958754	0.075*
C16	0.8874 (4)	1.3040 (3)	1.0841 (3)	0.0749 (10)
H16A	0.960152	1.377333	1.083962	0.090*
H16B	0.899361	1.286393	1.153676	0.090*
C17	0.6847 (4)	1.3095 (3)	1.0475 (2)	0.0563 (7)
C18	0.6989 (5)	1.3059 (3)	0.8598 (3)	0.0664 (9)
H18A	0.688906	1.257551	0.793067	0.100*
H18B	0.823810	1.341055	0.878103	0.100*
H18C	0.618535	1.364875	0.857390	0.100*
C19	0.6158 (4)	0.9385 (3)	0.6321 (2)	0.0585 (8)
H19A	0.606749	0.876323	0.574544	0.088*
H19B	0.738313	0.978630	0.642583	0.088*
H19C	0.528881	0.991037	0.618050	0.088*
C20	0.5793 (4)	1.3752 (3)	1.1019 (3)	0.0583 (8)
H20	0.635488	1.415849	1.165167	0.070*
C21	0.3842 (4)	1.3930 (3)	1.0763 (3)	0.0672 (8)
H21A	0.376791	1.439348	1.022811	0.101*
H21B	0.337919	1.431597	1.136896	0.101*
H21C	0.311842	1.319567	1.052740	0.101*
C22	0.2793 (5)	0.3679 (3)	0.6380 (2)	0.0595 (8)
C23	0.0804 (5)	0.3277 (3)	0.6348 (3)	0.0648 (9)
C24	−0.0497 (5)	0.4004 (4)	0.6359 (3)	0.0813 (11)
H24A	−0.173053	0.372282	0.635229	0.098*
H24B	−0.016137	0.478777	0.637379	0.098*
C25	0.0395 (6)	0.2019 (3)	0.6325 (4)	0.0984 (14)
H25A	−0.091441	0.181610	0.627928	0.148*
H25B	0.096676	0.181830	0.694568	0.148*
H25C	0.086847	0.160757	0.573442	0.148*
C1_1	0.2814 (3)	0.1946 (2)	0.2668 (2)	0.0479 (7)
H1A_1	0.312986	0.218213	0.202694	0.058*
H1AB_1	0.157906	0.153467	0.253907	0.058*
N1_1	0.4932 (3)	0.4702 (2)	0.3680 (2)	0.0622 (7)
O1_1	0.6881 (3)	0.51335 (19)	0.38858 (19)	0.0678 (6)
C2_1	0.2813 (4)	0.3030 (3)	0.3489 (3)	0.0617 (9)
H2A_1	0.201821	0.354561	0.322063	0.074*
H2AB_1	0.232685	0.280963	0.410097	0.074*
O2_1	0.6053 (4)	0.6930 (2)	0.4071 (2)	0.0768 (7)
C3_1	0.4724 (4)	0.3644 (3)	0.3777 (2)	0.0554 (8)
C4_1	0.6150 (4)	0.2901 (3)	0.4078 (2)	0.0574 (8)
H4A_1	0.591807	0.266798	0.473293	0.069*
H4AB_1	0.736150	0.334089	0.416583	0.069*
C5_1	0.6109 (3)	0.1826 (2)	0.3248 (2)	0.0463 (7)
H5_1	0.641231	0.210687	0.261450	0.056*
C6_1	0.7593 (4)	0.1080 (3)	0.3508 (2)	0.0585 (7)
H6A_1	0.732745	0.075394	0.411809	0.070*
H6AB_1	0.877730	0.155257	0.366355	0.070*
C7_1	0.7686 (4)	0.0111 (2)	0.2611 (2)	0.0562 (7)
H7A_1	0.858452	−0.038172	0.281324	0.067*
H7AB_1	0.810083	0.043994	0.202901	0.067*
C8_1	0.5816 (3)	−0.0621 (2)	0.2271 (2)	0.0450 (6)
H8_1	0.547259	−0.102343	0.283520	0.054*
C9_1	0.4320 (3)	0.0168 (2)	0.2042 (2)	0.0411 (6)
H9_1	0.474951	0.057789	0.150000	0.049*
C10_1	0.4171 (3)	0.1116 (2)	0.2983 (2)	0.0438 (6)
C11_1	0.2478 (3)	−0.0537 (3)	0.1574 (2)	0.0521 (7)
H11A_1	0.193745	−0.089604	0.210766	0.062*
H11B_1	0.164456	−0.001475	0.135415	0.062*
C12_1	0.2637 (4)	−0.1477 (2)	0.0651 (2)	0.0507 (7)
H12A_1	0.301042	−0.111988	0.007571	0.061*
H12B_1	0.144169	−0.192367	0.043479	0.061*
C13_1	0.4048 (4)	−0.2285 (2)	0.0930 (2)	0.0454 (6)
C14_1	0.5885 (3)	−0.1510 (2)	0.1312 (2)	0.0462 (6)
H14_1	0.613763	−0.106927	0.075883	0.055*
C15_1	0.7320 (4)	−0.2361 (3)	0.1306 (2)	0.0594 (8)
H15A_1	0.855134	−0.197698	0.129796	0.071*
H15B_1	0.729508	−0.275115	0.190021	0.071*
C16_1	0.6697 (4)	−0.3198 (3)	0.0302 (2)	0.0623 (8)
H16A_1	0.692165	−0.397544	0.038241	0.075*
H16B_1	0.736370	−0.297723	−0.025392	0.075*
C17_1	0.4638 (4)	−0.3141 (2)	0.0062 (2)	0.0518 (7)
C18_1	0.3353 (4)	−0.2971 (3)	0.1754 (2)	0.0592 (8)
H18A_1	0.221958	−0.344249	0.147738	0.089*
H18B_1	0.314756	−0.244236	0.235617	0.089*
H18C_1	0.426003	−0.345323	0.194178	0.089*

Table 2: (continued)

Atom	x	y	z	U_{iso}*/U_{eq}
C19_1	0.3526 (4)	0.0592 (3)	0.3907 (2)	0.0590 (8)
H19A_1	0.226005	0.026459	0.374859	0.088*
H19B_1	0.364297	0.118472	0.450755	0.088*
H19C_1	0.427301	−0.000047	0.404119	0.088*
C20_1	0.3653 (5)	−0.3800 (3)	−0.0742 (3)	0.0627 (8)
H20_1	0.431760	−0.423687	−0.119543	0.075*
C21_1	0.1619 (5)	−0.3942 (3)	−0.1024 (3)	0.0791 (10)
H21A_1	0.135456	−0.371039	−0.168308	0.119*
H21B_1	0.105236	−0.347100	−0.050707	0.119*
H21C_1	0.113962	−0.473732	−0.106475	0.119*
C22_1	0.7215 (5)	0.6293 (3)	0.3996 (2)	0.0550 (7)
C23_1	0.9228 (5)	0.6663 (3)	0.4031 (3)	0.0622 (8)
C24_1	0.9810 (6)	0.7840 (3)	0.4306 (3)	0.0861 (12)
H24A_1	1.105324	0.811036	0.433449	0.103*
H24B_1	0.895680	0.835524	0.446142	0.103*
C25_1	1.0443 (5)	0.5837 (4)	0.3786 (4)	0.0930 (13)
H25A_1	0.976036	0.508170	0.361947	0.139*
H25B_1	1.105879	0.600143	0.320320	0.139*
H25C_1	1.133874	0.586363	0.436994	0.139*

concentrated under reduced pressure, purified by silica gel chromatography. Colorless crystals were obtained. 78 % yield. Elemental analysis calcd. (%) for $C_{50}H_{74}N_2O_4$: C, 78.28; H, 9.72; N, 3.65; O, 8.34.

2 Experimental details

2.1 Comment

Pregnane alkaloids are the main chemical constituents of *Sarcococca* [5, 6]. Our research group previously has carried out a systematic study on the chemical constituents of *Sarcococca ruscifolia* and *Sarcococca hookeriana*, obtaining some steroidal alkaloids with novel structures and significant anti-tumor and anti-senile dementia activities [7–9]. However, the structural diversity of naturally occurring alkaloids is very limited. We used epiandrosterone as raw material to introduce an allyl group at the C17 position through the Wittig reaction, a ketone group at the C3 position through the Corey reaction, and a series of pregnane alkaloids were obtained by the reaction of carbonyl compounds with hydroxylamine hydrochloride [10–14]. In order to find high-efficiency, low-toxicity and safe prestanane alkaloid derivatives, we introduced methacryloyl chloride and obtained a new compound.

The title compound contains four rings, including three six-membered rings, one five-membered ring, four methyl groups, one ester group, two carbon-carbon double bonds, and one carbon-nitrogen double bond. There are two molecules in the asymmetric unit. *d*(O1–C22) = 1.342(4) Å, *d*(O2–C22) = 1.204(4) Å, *d*(O1–N1) = 1.441(3) Å, *d*(N1–C3) = 1.274(4) Å, *d*(C17–C20) = 1.325(4) Å. The five-and six-membered rings show molecular interaction only through van der Waals force.

Author contributions: All the authors have accepted responsibility for the entire content of this submitted manuscript and approved submission.

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Conflict of interest statement: The authors declare no conflicts of interest regarding this article.

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