# Ethyl 4-(3-hydroxy-6-methyl-4-oxo-4*H*-pyran-2-ylmethyl)piperazine-1-carboxylate

**Nazan Ocak,[a]\* Şamil Işık[a] and Mutlu Dilsiz Aytemir[b]**

[a]Department of Physics, Faculty of Arts and Sciences, Ondokuz Mayís University, TR-55139, Kurupelit-Samsun, Turkey, and [b]Department of Pharmaceutical Chemistry, Faculty of Pharmacy, Hacettepe University, TR-06100, Sıhhiye, Ankara, Turkey

Correspondence e-mail: nocak@omu.edu.tr

The title compound, $C_{14}H_{20}N_2O_5$, was synthesized as a Mannich base and characterized by IR, $^1$H NMR, GC mass spectra and elemental analysis. The piperazine ring displays a chair conformation, and the crystal structure is stabilized by O—H···O and C—H···O intra- and intermolecular hydrogen bonds.

## Comment

The title compound, (I), is being studied for its possible biological properties due to the presence in it of the allomaltol group.
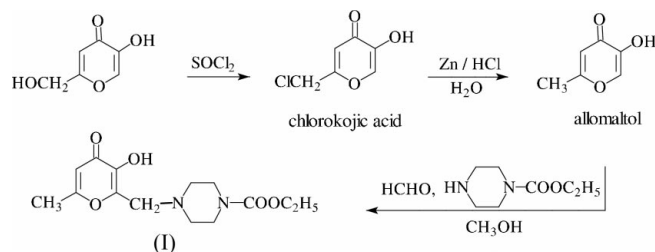


The title compound consists of 2-methyl-5-hydroxy-4*H*-pyran-4-one (allomaltol) and a piperazine ring, which is connected on one N side to the methylene bridge at the 2-position of the pyranone ring and on the other N side to the carboxylic acid ethyl ester group.

The bond lengths and angles observed in the allomaltol group are comparable to those found in maltol (3-hydroxy-2-methyl-4*H*-pyran-4-one; Burgess *et al.*, 1996).

In the piperazine ring, the bond lengths and angles conform to those found previously (Yogavel *et al.*, 2002; Thirumurugan *et al.*, 1998; Koysal *et al.*, 2003). The piperazine ring adopts a chair conformation, with a total puckering amplitude of $Q_T$ = 0.566 (2) Å (Cremer & Pople, 1975). The sums of the bond angles around atoms N1 and N2 are 337.1 and 359.8°, respectively, because atom N1 is 0.411 (1) Å out of the plane through atoms C6, C7 and C9, and atom N2 is 0.040 (2) Å out of the plane through atoms C8, C10 and C11, indicative that atom N1 is $sp^3$ while atom N2 is $sp^2\pi$-conjugated with the carboxy group. This is also shown by the values of the N1—C6 and N2—C11 bond distances. The plane through the C atoms of the piperazine ring makes a dihedral angle of 77.43 (4)° with the allomaltol group.

There are one intermolecular (O—H···O) and five intramolecular (O—H···O and C—H···O) hydrogen bonds. Atom O2 is involved as a donor in an inter- and intramolecular bifurcated hydrogen bond. The C—H···O intramolecular interactions, shown in Fig. 2, help to stabilize the structure.
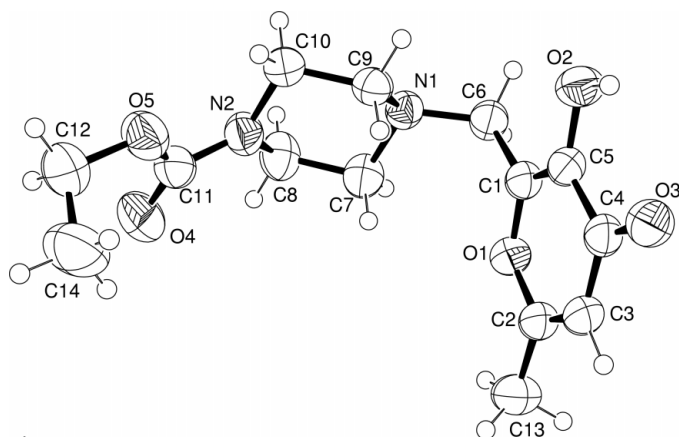
**Figure 1**
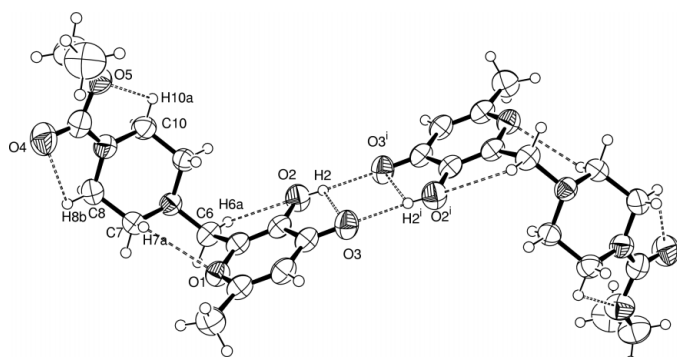A view of (I), with the atom-numbering scheme. Displacement ellipsoids of non-H atoms are drawn at the 50% probability level.



**Figure 2**
The hydrogen-bond network in (I).

## Experimental

All chemicals used in this study were supplied by Merck (Darmstadt, Germany) or Aldrich Chemical Co. (Steinheim, Germany). Compound (I) was prepared by the reaction of ethyl 1-piperazine-carboxylate (0.01 mol) and allomaltol (0.01 mol) in methanol (20 ml) with 37% formalin (1 ml). The mixture was stirred vigorously for 25 min. The resulting precipitate was collected by filtration and washed with cold methanol. Recrystallization from chloroform/petroleum ether (313–333 K) gave a white crystalline solid in 30% yield (m.p. 431–432 K). IR (cm$^{-1}$): 1700 (C=O, $s$), 1613 (C=O, $s$, pyranone), 1459 (C=C, $s$) and 1221 (C—O, $s$); $^1$H NMR (CDCl$_3$, 80 MHz, p.p.m.): 1.20 (3H, $t$, –CH$_3$), 2.30 (3H, $s$, 6 –CH$_3$), 2.50 (4H, $t$, $J = 4$ Hz, piperazine –CH$_2$–), 3.40 (4H, $t$, $J = 4$ Hz, piperazine –CH$_2$–), 3.85 (2H, $s$, –CH$_2$–), 4.10 (2H, $q$, –CH$_2$CH$_3$), 6.20 (1H, $s$, H$^5$); GC (MS) $m/e$: 116, 111, 85, 69, 56 (base peak). Analysis calculated for C$_{14}$H$_{20}$N$_2$O$_5$: C 56.74, H 6.80, N 9.45%; found: C 56.67, H 6.42, N 9.42%.

### Crystal data

| | |
|---|---|
| C$_{14}$H$_{20}$N$_2$O$_5$ | $D_x = 1.344$ Mg m$^{-3}$ |
| $M_r = 296.32$ | Mo $K\alpha$ radiation |
| Monoclinic, $C2/c$ | Cell parameters from 15 639 |
| $a = 24.069$ (3) Å | reflections |
| $b = 6.1796$ (4) Å | $\theta = 1.7$–29.6° |
| $c = 19.788$ (2) Å | $\mu = 0.10$ mm$^{-1}$ |
| $\beta = 95.513$ (8)° | $T = 293$ (2) K |
| $V = 2929.7$ (5) Å$^3$ | Prism, colourless |
| $Z = 8$ | $0.60 \times 0.55 \times 0.32$ mm |

### Data collection

| | |
|---|---|
| Stoe IPDS-II diffractometer | 2888 independent reflections |
| $\omega$ scans | 2388 reflections with $I > 2\sigma(I)$ |
| Absorption correction: by | $R_{int} = 0.074$ |
| integration (*X-RED*32; | $\theta_{max} = 26.0°$ |
| Stoe & Cie, 2002) | $h = -29 \rightarrow 29$ |
| $T_{min} = 0.937$, $T_{max} = 0.970$ | $k = -7 \rightarrow 7$ |
| 16 025 measured reflections | $l = -24 \rightarrow 24$ |

### Refinement

| | |
|---|---|
| Refinement on $F^2$ | $w = 1/[\sigma^2(F_o^2) + (0.0946P)^2$ |
| $R[F^2 > 2\sigma(F^2)] = 0.049$ | $+ 0.909P]$ |
| $wR(F^2) = 0.162$ | where $P = (F_o^2 + 2F_c^2)/3$ |
| $S = 1.10$ | $(\Delta/\sigma)_{max} < 0.001$ |
| 2888 reflections | $\Delta\rho_{max} = 0.37$ e Å$^{-3}$ |
| 191 parameters | $\Delta\rho_{min} = -0.33$ e Å$^{-3}$ |
| H-atom parameters constrained | Extinction correction: *SHELXL*97 |
| | Extinction coefficient: 0.0072 (13) |

**Table 1**
Selected geometric parameters (Å, °).

| | | | |
|---|---|---|---|
| O1—C2 | 1.351 (2) | C9—C10 | 1.511 (2) |
| O1—C1 | 1.376 (2) | N2—C11 | 1.340 (2) |
| C4—O3 | 1.235 (2) | N2—C8 | 1.446 (2) |
| C4—C3 | 1.427 (3) | N2—C10 | 1.459 (2) |
| C4—C5 | 1.457 (2) | C3—C2 | 1.342 (3) |
| C5—C1 | 1.338 (2) | O4—C11 | 1.213 (2) |
| C5—O2 | 1.357 (2) | C8—C7 | 1.519 (3) |
| C9—N1 | 1.452 (2) | | |
| | | | |
| N1—C9—C10 | 110.40 (14) | N2—C8—C7 | 109.25 (14) |
| C11—N2—C8 | 121.14 (16) | N1—C7—C8 | 109.62 (15) |
| C11—N2—C10 | 125.39 (17) | C9—N1—C7 | 111.21 (13) |
| C8—N2—C10 | 113.23 (15) | C9—N1—C6 | 112.41 (13) |
| N2—C10—C9 | 110.17 (14) | C7—N1—C6 | 113.51 (14) |

**Table 2**
Hydrogen-bonding geometry (Å, °).

| $D$—H$\cdots A$ | $D$—H | H$\cdots A$ | $D\cdots A$ | $D$—H$\cdots A$ |
|---|---|---|---|---|
| O2—H2$\cdots$O3$^i$ | 0.82 | 1.97 | 2.6941 (18) | 147 |
| O2—H2$\cdots$O3 | 0.82 | 2.33 | 2.7527 (18) | 113 |
| C6—H6$A\cdots$O2 | 0.97 | 2.53 | 2.909 (2) | 103 |
| C7—H7$A\cdots$O1 | 0.97 | 2.54 | 3.060 (2) | 114 |
| C8—H8$B\cdots$O4 | 0.97 | 2.39 | 2.784 (3) | 104 |
| C10—H10$A\cdots$O5 | 0.97 | 2.27 | 2.696 (2) | 106 |

Symmetry code: (i) $\frac{1}{2} - x, \frac{3}{2} - y, -z$.

H atoms were included in calculated positions and treated using a riding model [C—H(aromatic) = 0.93 Å and C—H(CH$_2$) = 0.97 Å, with $U_{iso}$(H) = 1.2$U_{eq}$(parent C atom); C—H(CH$_3$) = 0.96 Å and O—H = 0.82 Å, with $U_{iso}$(H) = 1.5$U_{eq}$(parent C,O atom)].

## References

Burgess, J., Fawcett, J., Russell, D. R., Hider, R. C Hossain, M. B., Stoner, C. R. & Helm, D. van der (1996). *Acta Cryst.* C**52**, 2917–2920.

Burnett, M. N. & Johnson, C. K. (1996). *ORTEP*III. Report ORNL-6895. Oak Ridge National Laboratory, Tennessee, USA.

Cremer, D. & Pople, J. A. (1975). *J. Am. Chem. Soc.* **97**, 1354–1358.

Farrugia, L. J. (1999). *J. Appl. Cryst.* **32**, 837–838.

Koysal, Y., Işık, Ş., Köksal, M., Erdoan, H. & Gökhan, N. (2003). *Acta Cryst.* E**59**, o1975–o1976.

Nardelli, M. (1995). *J. Appl. Cryst.* **28**, 659.

Sheldrick, G. M. (1997). *SHELXS*97 and *SHELXL*97. University of Göttingen, Germany.

Stoe & Cie (2002). *X-AREA* (Version 1.18) and *X-RED*32 (Version 1.04). Stoe & Cie, Darmstadt, Germany.

Thirumurugan, R., Sundura Raj, S. S., Shanmugam, G., Fun, H.-K. Chinnakali, K., Chantrapromma, S. & Marappan, M. (1998). *Acta Cryst.* C**54**, 780–781.

Yogavel, M., Selvanayagam, S., Velmurugan, D., Shanmuga Sundara Raj, S., Fun, H.-K., Marappan, M. & Kandaswamy, M. (2003). *Acta Cryst.* E**59**, o83–o85.