Desmotropy, polymorphism and packing relationships of 5-monosubstituted derivatives of barbituric acid

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5,5-Disubstituted derivatives of barbituric acid are model systems for the study of polymorphic behaviour, isostructural relationships and competing H-bonded structures [1]. These compounds display a 2,4,6-pyrimidinetrione unit whose two NH and three carbonyl groups can serve as H-bond donor (D_{N1}, D_{N3}) and acceptor sites (A_{O2}, A_{O4}, A_{O6}), respectively (Fig. 1). All of the approximately 50 known crystal structures of this group share the characteristic that each donor function (D_{N1}, D_{N3}) is employed in exactly one intermolecular N–H···O=C interaction. The number of accepted H bonds per barbiturate molecule, averaged over *Z*' independent formula units, is therefore always two, whereas the H-bond multiplicity of the individual carbonyl acceptor sites (A_{O2}, A_{O4}, A_{O6}) varies between 0 and 2. These constraints on H-bond connectivity and the rigid geometry of the 2,4,6-pyrimidinetrione unit impose severe restrictions on possible H-bonded architectures. So far, thirteen distinct chain, layer and frameworks types have been identified. Of these, two chain types, each containing exclusively two-point H-bond connections between molecules, are observed frequently [2], whilst complex layer and framework structures were found in 5,5-dihalogen species [3].

The apparent influence of the substituents at C5 on the resulting H-bond architecture motivated us to investigate 5-monosubstituted analogues ($R^{5'}$ = H). These compounds can exist in enol and keto tautomeric forms and therefore form desmotropes [4]. Only the keto form of each species matches exactly the H-bond capabilities of the 5,5-disubstituted analogues. Six 5-monosubstituted derivatives were investigated and the crystal structures of seven keto tautomers and three enol crystal forms were determined. We describe and classify their H-bonded structures and analyse packing relationships with other barbiturates.

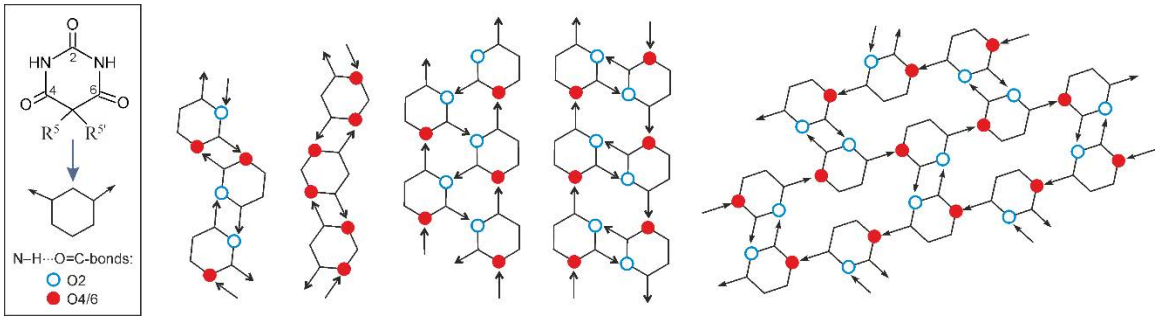

Figure 1. Schematic representation of a barbituric acid molecule (left) and examples of N–H···O=C bonded chain and layer structures.

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[3] Gelbrich, T., Rossi, D., Häfele, C. A. & Griesser, U. J. (2011). *Crystengcomm* **13**, 5502.

[4] Elguero, J. (2011) *Cryst. Growth Des.* **11**, 4731.