# 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 (R5’ = 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.

[1] Zencirci, N., Gelbrich, T., Kahlenberg, V. & Griesser, U. J. (2009). *Crystal Growth & Design* **9**, 3444.

[2] Gelbrich, T., Braun, D. E. & Griesser, U. J. (2016). *Chem. Cent. J.* **10**.

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

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