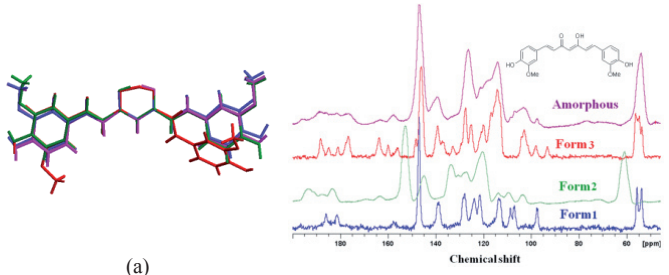
low bioavailability due to poor absorption. Curcumin decomposes upto 90% in pH 7.4 buffer solution within 30 minutes. Polymorphs and cocrystals were screened to improve stability and bioavailability of curcumin. The crystal structure of Stable form 1 (Z'=1) of Curcumin is reported in literature.[2] Single crystals of a new polymorph (form 2) were crystallized in the orthorhombic space group $Pca2_1$ (Z = 8, Z' = 2) upon attempted cocrystallization of curcumin with 4-hydroxypyridine in EtOH at room temperature. The same form 2 was obtained from DMSO at room temperature and also from a saturated solution of curcumin in EtOH. A third polymorph of Curcumin (form 3) was obtained with 4,6-dihydroxy-5-nitropyrimidine as the coformer, now in space group *Pbca* (Z = 8, Z'=1). Torsional flexibility[3] (Fig. 1a) along the seven carbon chain connecting two phenyl rings and also in phenolic –OH group orientation suggests conformational polymorphs of Curcumin. In the crystal structures, all the forms have similar O–H···O hydrogen bond between phenolic-OH and carbonyl group but differ in the C–H···O interaction. Curcumin amorphous form was also obtained by cooling of the melt phase. All the four forms are well characterized by IR, Raman and ss-NMR spectroscopy (Fig. 1b), DSC, HSM, XRPD and single crystal X-ray diffraction.[4] Metastable form 2 dissolves 3.1 times faster and is 1.8 times more soluble than commercial form 1 in 40% EtOH-water medium.



(a) (b)

Fig. 1 (a) Molecular overlay and (b) ss-NMR comparison of three polymorphs and one amorphous phase of Curcumin

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Keywords: polymorphism, solubility, x-ray diffraction

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A Novel Ternary Complex Involving Two Antitubercular Drugs

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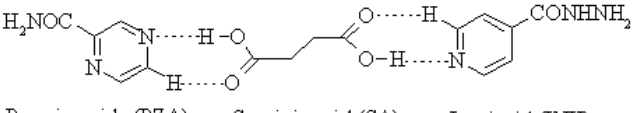
Pyrazinamide (PZA) and Isoniazid (INH) are the first-line antibacterial drugs used in monotherapy and also in combination to treat tuberculosis.[1] A fall in the bioavailability of Isoniazid and Rifampicin due to drug interactions in the fixed dose combination (FDC) drug formulation was reported in the literature.[1] Recently, the cocrystallization approach is under active research as a means of modulating the physicochemical properties of drugs in addition to its conferment of Intellectual Property Rights.[2] We report the usage of cocrystallization strategy for bringing combination drugs together in a crystal lattice through a GRAS (Generally Regarded As Safe) coformer. The pyridyl coformers were reported to form 2:1 binary cocrystals with homologous alkanedicarboxylic acids wherein the carboxylic acid groups on either side of the diacid hydrogen bond to each of the pyridyl moieties of two coformer molecules.[3] 2:1 binary cocrystals of INH with succinic acid and few other diacids were reported in literature[4,5] and we prepared a 2:1 cocrystal of PZA and succinic acid. We reasoned that PZA and INH can bind to the diacid groups of succinic acid on either side through acid–pyridine synthon to form a 1:1:1 ternary complex (Figure). As such, a 1:1:1 ternary complex of PZA and succinic acid and INH (PZA·SA·INH) was synthesized and characterized by x-ray powder diffraction (XRPD), differential scanning calorimetry (DSC), nuclear magnetic resonance (NMR) and Fourier transform infrared (FT–IR) spectroscopy. Whether this new supramolecular material is a cocrystal, eutectic or solid solution, is not fully established. The multicomponent adduct is found to be stable at ambient temperature and humidity and has superior intrinsic dissolution rate (IDR) than PZA and INH and their respective 2:1 binary cocrystals with succinic acid.



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Keywords: antibacterial, complex, supramolecular

MS53.P19

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Cocrystallization of GABA Adducts

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Pharmaceutical cocrystals are crystalline molecular complexes that contain therapeutically active molecules [1]. Polymorphs [2] and cocrystals, or other engineered multicomponent crystals [3] have been demonstrated to alter properties important to the bioavailability or processing of pharmaceutical solids. The structural elements (strong hydrogen bond donor, strong hydrogen bond acceptor, and nonpolar region) of γ-amino butyric acid, GABA, are typical of small drug molecules, and GABA is a major neurotransmitter inhibitor of the central nervous system. GABA and oxalic acid, OX, were cocrystallized as part of a study on formation of cocrystals of pharmaceutically interesting molecules via supramolecular bonding. 2:1 GABA/OX was prepared by both solution crystallization and solid-state grinding, and single crystal X-ray diffraction quality cocrystals were grown from ethanol solution by slow evaporation at room temperature. The single crystal X-ray structure of the resulting transparent colorless cocrystal shows it to be the oxalate salt of γ-amino butyric acid.

The supramolecular structure contains extensive O–H···O, N–H···O and C–H···O interactions leading to an elaborate three-dimensional hydrogen bonded network. The ammonium cation participates in three separate O···H–N–H···O motifs (half of the $R_4^2(8)$ synthon [3]), but the $R_4^2(8)$ synthon itself is not found. Notable features in the structure include an $S_3^3(10)$ string containing a serpentine carboxylic acid-

carboxylate motif alternating with the ammonium motif. Additional strings and other concerted hydrogen bond motifs are also present. *Crystal data*: $2(C_4H_{10}NO_2^+):(C_2O_4^{2-})$, M_w = 296.28 Daltons; monoclinic, $P2_1/c$; a = 7.4153(9), b = 10.2052(13), c = 9.7584(12) A, β = 108.396(3)°, V = 700.72(15) A^3; Z = 2; T = 298 K; θ_{max} = 26.4°; R_1 = 0.0482 for 939 reflns, $I_o > 2\sigma(I_o)$, ρ_{max} = 0.18 e A^{-3}.

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Keywords: cocrystals, organic phamaceutical, GABA

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A new polymorph of halothane: An *in-situ* cryo-crystallographic study

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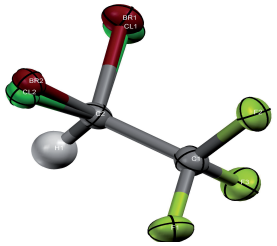
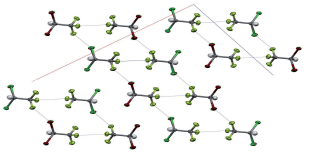
In-situ cryo-crystallographic techniques have been successfully applied to the determination of the crystal structures of compounds which are liquids at room temperature. It has become possible, using this approach to analyze intermolecular interactions of molecular species without the involvement of solvent either as a promoter for crystal growth or as incorporated solvatomorph [1]. 2-bromo-2-chloro-1,1,1-trifluoroethane (Halothane) is a clinically used anesthetic, which has been studied earlier by in situ pressure frozen method using a diamond anvil setup. The crystals were found to belong to triclinic (space group *P*-1) system [2]. The crystals generated in our experiment belong to a monoclinic system (space group *C*2/*c*) with *a* = 18.6626(1) Å, *b* = 4.5759(1) Å, *c* = 12.4030(2) Å, *β* =91.85°, and *V*=1058.59(12) Å^3, thus generates a new polymorphic form. In this structure the bromine and chlorine atoms are substitutionally disordered similar to that found in the in situ pressure frozen polymorph and the occupancies of bromine and chlorine at each site refine to 52:48 ratio. The packing is through several F….F and Cl/Br….F contacts resulting in tetrameric units as shown below.



Halothane structure
(50% Thermal ellipsoid)



Packing shows the tetramer formation in Halothane

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Keywords: cryo-crystallography, polymorphism, disorder

MS53.P21

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Supramolecular chemistry of Anti-HIV nucleoside drugs: Toward smart crystal phases and self-assembled DNA-mimicries

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Multicomponent molecular crystals have been widely screened for several classes of APIs, including the anti-HIV drugs. Lamivudine (β-L-2',3'-dideoxy-3'-thiacytidine, 3TC) and didanosine (2',3'-dideoxyinosine, ddI) are two of the most used NTRIs in anti-HIV therapy. Here, we used a rational strategy to design a $P2_12_12_1$ orthorhombic structure of lamivudine with maleic acid on the basis of lamivudine saccharinate [1]. Likewise, based on the capability of pairing between neutral and protonated lamivudine in the cocrystal of the drug with 3,5-dinitrosalicylate [2], a helical structure in which lamivudine is self-assembled into a DNA-like duplex without phosphodiester linkages was prepared. Crystals of ddI were also prepared using solvothermal techniques and the solid state structure of this drug was solved for the first time.

Chemical aspects of salt formers and crystal assembly features were taken into account for selection of maleic acid in order to assemble into a predicted $P2_12_12_1$ orthorhombic structure with lamivudine. Acid-ionization constant, arrangement of hydrogen bonding functionalities and conformational features were considered for selection of the salt former. A rationally designed crystal preparation and the establishment of structure-property relationships were some advantages of this strategy.

The assembly of the lamivudine double helix structure consists of an interesting example of spontaneous molecular self-organization. Stacking and hydrogen bonding interactions between the cytosine bases of lamivudine were the decisive forces responsible for this structural organization in which alternating neutral and protonated lamivudine conformers are placed into each helical strand. Other contacts such as hydrogen bonds involving duplex-duplex, duplex-anions (chloride and maleate) and duplex-water interactions were also important for the molecular assembly.

Concerning ddI, the pharmaceutical solid state form of the drug has a structure equal to that of the solvothermally prepared ddI crystals described here, while they do not exhibit an identical chemical composition due to different water fraction occupying hydrophobic channels assembled within the crystals. The two crystallographic ddI conformers were in agreement with previous structural elucidation based on solid state NMR techniques [7].

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Keywords: polymorphism, lamivudine, didanosine

MS53.P22

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Probing gels as a media for the growth of co-crystals

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