A Calorimetric Study of Erythritol

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Erythritol is a naturally occurring polyol present in various fruits and fermented foods as well as in tissues and body fluids of humans and animals. It has found increasingly numerous applications in the food and pharmaceutical industries, being particularly used as a bulk sweetener in the widespread market of "light" and "reduced calories" products. Moreover as it meets most of the criteria that make an ideal excipient for formulating pharmaceutical preparations, it became a promissory new ingredient for the pharmaceutical industry.

Thus, the knowledge of its structure plays an important role in the interpretation of various systems and in the expansion of its applied field. It also gives a valuable contribution to the understanding of the structure of higher molecular weight polyols.

The present paper is dedicated to the calorimetric study of erythritol and its main objective is to infer from the calorimetric properties information on the structures exhibited by this compound. The techniques used in this research are the differential scanning calorimetry (DSC) and polarized light thermal microscopy (PLTM).

The study was performed on commercial erythritol 99 mole per cent pure and on solids prepared by cooling the melt. The structures were characterized by the characteristic parameters of the respective fusion curves. The fusion curves recorded by DSC are decomposed into the overlapped components by fitting analysis using an asymmetric Gaussian function. The values got for T_{peak} were grouped into clusters identified as distinct polymorphic forms. Four polymorphs were identified for erythritol:

118.5 ± 0.6 (IV); 119.8 ± 0.3 (III); 121.7 ± 0.5 (II); 123.1 ± 0.3 (I)

The original material is a mixture of polymorphs, IV, III and II whilst the values obtained from the melt are commonly binary mixtures of III/II or II/I structural forms. In both solids polymorph III was always the dominant component.

The values (38.9 ± 0.4) kJ mol^{-1} (n = 5) and (38.7 ± 0.3) kJ mol^{-1} (n = 16) obtained for the enthalpy of fusion of the original and frozen melt, respectively, show that the structural difference between polymorphs must be small.

The phase transformations occurring during the heating and cooling processes were studied by PLTM.

On cooling the melt crystallization and glass formation were observed. Increasing the cooling rate decreases the crystalline solid mass and increases that of the glass. In any case perfect crystalline forms were never obtained upon cooling but a considerable increase of the crystallinity was always observed on heating.