

Thesis Title Solid State Degradation and Stabilization of Calcium Pantothenate

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ABSTRACT

The degradation characteristics of multivitamin tablet preparations were studied. It was found that overage was a normal practice in multivitamin products. Certain vitamins, e.g. B₁₂, C and calcium pantothenate (CP) seemed to be unstable at high temperature and humidity. Strong mutual interaction was anticipated between C and CP. This anticipation was confirmed by conducting the study in powder blends. One powder blend contained all the interesting vitamins, i.e., B₁, B₂, B₆, B₁₂, C, CP, folic acid (FA), and niacinamide (NA). One vitamin of different kind was omitted from each formulation. The study indicated the possibility of mutual interactions among these vitamins, especially between C and CP. Several compounds were evaluated for the stabilizing activity for CP. The granulation of calcium pantothenate and calcium lactate (CL), CP-CL, exhibited good stability and the optimal ratio of CP to CL would be 7:3. The stabilization and mutual interaction of CP were studied in the presence of vitamin C.

The characteristics of CP-CL were elucidated. It was found that the CP-CL was non-hygroscopic. At 80% RH, and 25 °C, the moisture content was only 1.12%. This property could be responsible for the stabilization of CP. FTIR revealed that the

interaction between CP and CL was possible since there were new peaks occurring and also peaks shifted. DSC/TGA indicated that the CP-CL containing water of crystallization. X-ray diffraction was also employed. It was concluded that CP-CL exhibited crystalline properties. Photomicrograph showed that the surface texture and shape of CP-CL were totally different from those of CP and CL. Both CP and CP-CL were subject to accelerated stability study. CP-CL was stable even at 50 °C and 75% RH, the degradation rate constant and order could not be determined. CP, on the other hand, showed first-order kinetic of degradation. The activation energy was 19.08 kcal/mole.

Four direct compression fillers, i.e., microcrystalline cellulose, anhydrous lactose, lactose, and spray dried rice starch (SDRS) were evaluated for their potential use in direct compression multivitamin tablets. SDRS was found to be the most suitable filler. Further study on the stability of tablets was carried out, CP and CP-CL were compared in tablet formulation employing SDRS. CP-CL yielded stable dosage form, compared with CP. CP-CL was so stable that at 50 °C and 75% RH the magnitude of decomposition was too low to be of any use for the determination of rate constant and order of reaction.

The CP-CL is a stabilized form of CP. It is not only stable but it can also protect the others from the mutual interactions. It hopefully replaces the regular form of CP in the future.