THE EFFECT OF THERMAL DEHYDRATION ON THE COMPRESSIONAL PROPERTIES OF DEXTROSE MONOHYDRATE

N. Anthony Armstrong and Anil Patel, Welsh School of Pharmacy, UWIST, Cardiff.

Granular materials produced by a wet granulation technique must be dried before they can be compressed into tablets, and solids used in a direct compression process will almost certainly have been subjected to drying at some stage of their production. It has been suggested (Lerk et al., 1984) that upon thermal dehydration, the binding capacity of dextrose monohydrate increases to an extent governed by the temperature used for dehydration, compact strength increasing markedly after drying at temperatures in excess of 100°C.

The aim of this investigation was to evaluate the effects of thermal dehydration and consequent changes in water content upon both consolidation and tablet tensile strength of dextrose monohydrate.

Sieved fractions of 180-250 μm α-dextrose monohydrate were dehydrated under vaccum at 52°C. to a range of moisture levels by varying the drying time. Moisture was determined using Karl Fischer reagent. The powders were compressed on a Manesty F3 excentric press using 12.5 mm. diameter punches over a range of forces. The values of the compaction parameters at 19 kN were determined by interpolation. Tablet strength was measured on a CT40 strength tester.

Tablet consolidation and its variation with moisture content was assessed by tablet porosity obtained after ejection and by the yield force derived from Heckel plots. Consolidation was progressively reduced as thermal dehydration proceeded, since tablet porosity increases (Fig.1[□]) and the yield forces obtained both during consolidation (Fig.1[•]) and after tablet ejection increase (Fig.1[○]). Reduced consolidation is attributed to the gradual conversion of dextrose monohydrate to the anhydrous form. This was confirmed using scanning electron microscopy. The crystal structure of dextrose monohydrate was observed to be progressively lost and replaced by loose aggregates of particles characteristic of the anhydrous form.

An increase in tablet tensile strength was also obtained upon thermal dehydration, down to 2.7% w/w moisture level (Fig.2[○]). This was attributed to the creation of fresh surfaces made available for bonding as the crystal structure was progressively destroyed. Reduction in tensile strength at moisture levels below 2.7% w/w appears to be due to the greatly increased elastic recovery at the lower moisture levels (Fig.2[•]) (Armstrong et al., in press).

In conclusion, thermal dehydration of dextrose monohydrate results in reduced consolidation, and hence increased tablet porosity. This affects tablet strength and possibly other properties related to porosity. Thus it is essential that the drying treatment of a solid, either as powder or granulate, is kept constant if tablet properties are to be maintained.

Fig 1

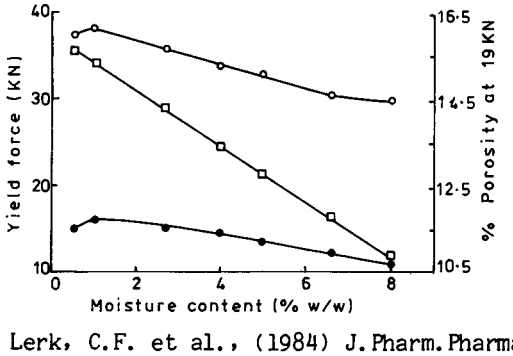
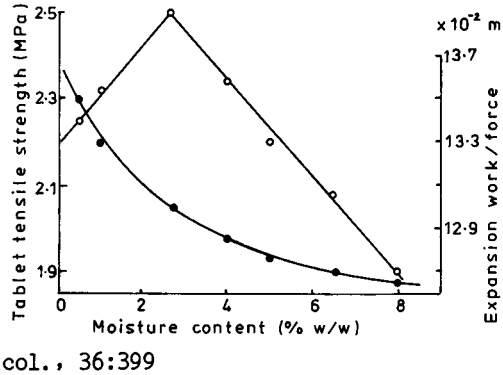


Fig 2



Lerk, C.F. et al., (1984) J. Pharm. Pharmacol., 36:399
Armstrong, N.A. et al., (1986) Drug Dev. Ind. Pharm. (in press).