SUMMARY

Starches from tubers of seven *Dioscorea* species (*D. cayenensis*, *D. rotundata*, *D. alata*, *D. polygonoides*, *D. esculenta*, *D. trifida* and *D. bulbifera*) were extracted, characterized and used as binder at 2.5 % and 10 % concentration in the formulation of paracetamol granules for reconstitution.

The starch content of the yam tubers ranged from 332.03 ± 0.15 to 855.94 ± 0.30 g/kg with Blackwiss yellow yam having the highest and Yampie the lowest. The amylose content was found to vary significantly ($p<0.05$) from one yam variety to another, ranging from 111.44 ± 0.03 to 240.20 ± 0.20 g/kg, with Chinese yam having the lowest and Roundleaf yellow yam the highest. The granules obtained were of three crystalline types. Starches from *D. cayenensis*, *D. rotundata*, *D. alata* and *D. bulbifera* assumed the open hydrated hexagonal crystallites (type-B), *D. polygonoides* (Bitter yam) starch had the staggered monoclinic packing (type-A) while *D. trifida* (Yampie) and *D. esculenta* (Chinese yam) starches had the intermediate (type-C) form. The granule size varied between 5.4 µm for Chinese yam and 34.5µm for Roundleaf yellow yam. The granule shapes were either round, triangular, polyhedral or ellipsoidal. Particle size distribution plots of all the yam starches studied displayed a Gaussian or even distribution except for Pum pum yam, Mozella, Bitter yam, Renta yam and Sweet yam which were positively skewed. Significant variations in digestibility of the granules were also observed; where raw starches from Chinese yam and Bitter yam were the most susceptible to α -amylase digestion with 21.27 ± 0.01 % and 18.11 ± 0.02 % degradation, respectively, while Roundleaf yellow yam starch was the least susceptible with 13.74 ± 0.03 % enzymatic

degradation. The temperature of gelatinization was also found to vary significantly among the yam varieties studied ranging from 67.74 °C for Roundleaf yellow yam to 78.85 °C for Chinese yam.

A comparative investigation of the fundamental and derived properties of starches from all the yam (*Dioscorea spp.*) varieties studied was carried out with a view to establish their suitability as binders in granule formulations. Chinese yam and Bitter yam were found to possess the highest specific surface area (625.91 m^2/kg and 258.76 m^2/kg respectively) while Roundleaf yellow yam had the lowest (117. 4 m^2/kg). Chinese yam had the lowest granular volume (6.00 μm^3), surface area (5.67 μm^2) and granule surface-mean diameter (6.74 μm), while Roundleaf yellow yam had the largest mean granular diameter, highest granular volume (35.2 μm^3), surface area (34.8 μm^2) and granule surface-mean diameter (35.88 μm). The swelling power and hydration capacity also varied among the starches. Chinese yam was found to be the most susceptible to water, having the highest swelling power at 95 °C and the highest water binding capacity at 30 °C. The densities of the yam starches also varied with Bitter yam being the least dense and Blackwiss yellow yam the most dense. However, Chinese yam was found to be the bulkiest (lowest bulk density) material and possessed the highest intra-granular porosity. The starches studied were found to be cohesive as the values obtained for the compressibility index and angle of repose were above 30.

Paracetamol granules were formulated with the different yam starches using 2.5 % and 10 % starch as binders. The rate of paracetamol dissolution was found to be dependent on a

number of factors, such as starch surface tension, viscosity, swelling power, amylose content, starch powder micromeritics and density properties. The rate of paracetamol dissolution was found to be highest in granules formulated with Chinese yam and Bitter yam starch with T_{80} of 2.200 ± 0.081 min and 2.600 ± 0.083 min respectively at 2.5 % binder concentration, and slowest in granules formulated with *D. cayenensis* starch (4.300 ± 0.112 to 4.600 ± 0.106 min). Significant variations in the rate of dissolution were observed with binder concentrations, as the rate of paracetamol release was slower when the concentration was increased to 10 % binder. It was also observed that all the yam starches studied except Blackwiss yellow yam produced granules with faster dissolution rate than corn starch when used as binder at 2.5 %.

The observed species-specific differences in the fundamental and derived properties of starch powders and the effect they have on interaction with other components of formulation, processing, physical stability and drug product performance suggest that they can contribute significantly to the performance in their formulated products.

This study shows that Chinese yam and Bitter yam are better suited for use as binders in the formulation of paracetamol granules for reconstitution at binder concentrations ranging from 2.5 % to 10 % than the traditionally used corn starch. It also reveals that yam starches can be utilized in the food industry and could possibly be utilized in the formulation of diets for diabetics and other health conscious individuals.