

Winter Meeting – Joint meeting between the Nutrition Society and the Royal Society of Medicine, 11–12 December 2012, Dietary Strategies for the Management of Cardiovascular Risk

Binding of hydrothermally processed starch to α -amylase and its relation to the kinetics of enzyme digestion

H. Patel, P. Ellis and P. Butterworth

School of Medicine, King's College London, London, SE1 9NH, UK

Starch is the main source of digestible carbohydrates and contributes significantly to the total food energy intake in the human diet. Many researchers have been interested in starch digestion due to the marked increase in postprandial blood glucose and insulin concentrations following a starch-rich meal⁽¹⁾. Starches which have been heated and stored are digested at a much slower rate compared to starches which have been heated and immediately used due to the process of retrogradation⁽²⁾. The purpose of this mechanistic research project is to produce kinetic data (K_m and k_{cat}/K_m) that provides an improved understanding of the initial interaction between α -amylase and retrograded starch.

Native, gelatinised (heated at 90°C) and retrograded (stored over a time period of 24–96 h at room temperature) wheat, potato and pea starch forms were digested with α -amylase to produce digestibility curves ($n = 4$). The K_m and k_{cat}/K_m were then determined from these digestibility plots, with the K_m representing the α -amylase affinity and k_{cat}/K_m indicating the catalytic efficiency⁽²⁾. Following hydrothermal treatment of the starch samples, the k_{cat}/K_m increased drastically compared to the native samples, as shown in Figure 1. The sharp rise in k_{cat}/K_m is most probably due to the loss of the ordered α -glucan structure and the corresponding increase in the quantity of amorphous material. For retrograded wheat and potato samples, the k_{cat}/K_m reduced relative to no cooling. However k_{cat}/K_m for pea starch only starts to reduce after 72 h suggesting retrogradation begins later compared to wheat and potato starch. Surprisingly, the binding of α -amylase to starch does not change over 96 h; as indicated by the K_m values (Figure 2). These results suggest retrograded starch may act as a competitive inhibitor due to the constant K_m and reducing k_{cat}/K_m ⁽³⁾. No change in K_m suggests α -amylase still binds to retrograded starch but the hydrolysis step does not occur hence the decrease in k_{cat}/K_m . These results highlight the potential relevance of resistant and slowly-digestible starch in health and disease (e.g. management of type 2 diabetes).

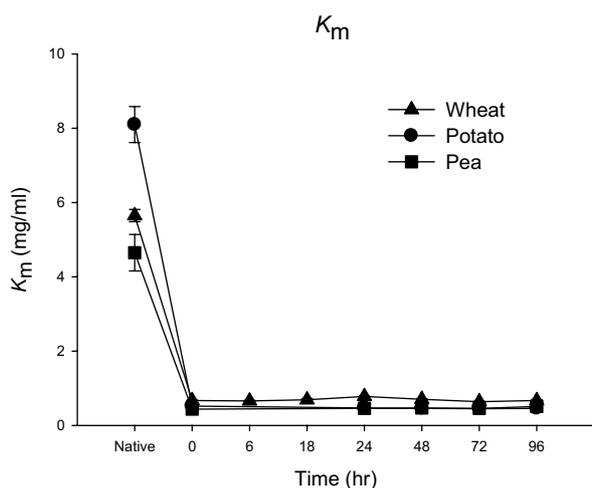


Fig. 1. K_m for the digestion of wheat, potato and pea starch.

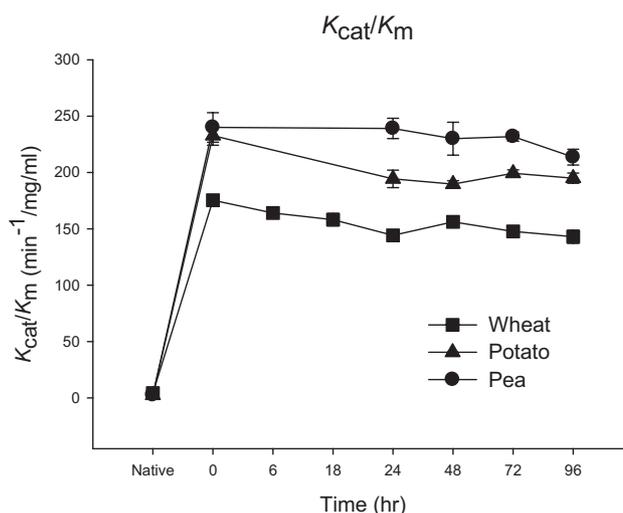


Fig. 2. k_{cat}/K_m for the digestion of wheat, potato and pea starch.

1. Butterworth P, Warren F, Grassby T *et al.* (2012) *Carbohydr Polym* **87**, 2189–2197.
2. Slaughter S, Ellis P & Butterworth P (2000) *Carbohydr Polym* **1525**, 29–36.
3. Bustos M, Barrera G, Perez G *et al.* (2012) *Int J Food Sci tech* **47**, 2134–2140.