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Critical role for fibre gelation in regulation of glucose uptake: implications for diabetes management

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Gastric emptying and the extent and speed of small intestinal nutrient degradation, exposure and absorption are important determinants of postprandial glycaemia[1,2,3]. Alginate is an algal polysaccharide that forms a gel matrix in the presence of divalent cations. Ingestion of a gelling alginate composition has the potential to modulate postprandial glycaemia by delayed gastric emptying and nutrient entrapment[4].

Fifty-two healthy male volunteers (BMI range 18.6–39.4 kg/m^2; age range 18–62 years) were recruited to take part in this randomised single-blinded controlled parallel trial. The modulatory effects of preprandial ingestion of a preload on postprandial glycaemia were examined. Following an overnight fast, controlled breakfast and controlled study morning volunteers were randomly allocated to one of three preload treatments: a strong (ionic)-gelling alginate beverage (SA); a weaker (acid)-gelling excipient-free control (EF); a commercially-available slimming aid (Slim.Fast, Unilever Plc, Port Sunlight, Cheshire, UK; SF). SA, containing sodium alginate, calcium carbonate ($CaCO_3$) and buffering agents, is specifically formulated to undergo enhanced intragastric gelation on ingestion. The EF control is identical in composition to the SA minus the $CaCO_3$. SF contains a range of soluble and insoluble fibres.

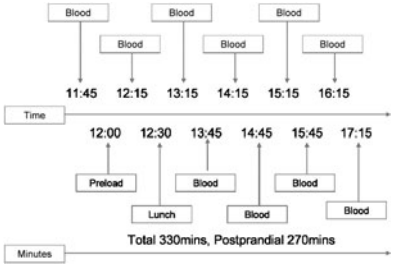
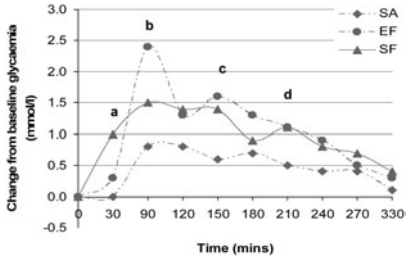


Fig. 1. Laboratory protocol.

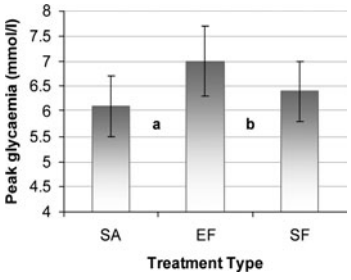
Volunteers ingested a controlled set lunch (pasta and sauce) 30 min post-preload treatment. Ten capillary blood samples were taken to determine blood glucose up to 330 min from baseline (270 min postprandially; Fig. 1). Blood measures were converted to area under the curve (AUC) using the trapezoid rule with subtraction of basal values for statistical analysis.

Following ingestion of the SA preload, mean AUC glycaemia was significantly reduced by 52% when compared with the EF preload ($P = 0.036$) and non-significantly by 50% when compared with the SF preload. In addition, mean glycaemia was significantly reduced following SA at 90, 150 and 210 min from baseline compared with EF (Fig. 2). Peak postprandial glycaemia was significantly reduced following SA compared with EF ($P = 0.001$) and following SF compared with EF ($P = 0.032$; Fig. 3).



Effect of treatment at 30 min (SA *v.* SF; $P<0.0005$; EF *v.* SF; $P=0.009$); b, effect of treatment at 90 min (SA *v.* EF; $P<0.0005$); c, effect of treatment at 150 min (SA *v.* EF; $P=0.011$); d, effect of treatment at 210 min (SA *v.* SF; $P=0.045$).

Fig. 2. AUC glycaemia.



Peak glycaemia was significantly reduced following SA compared with EF ($P=0.001$); b, peak glycaemia was significantly reduced following SF compared with EF ($P=0.032$).

Fig. 3. Peak glycaemia.

A strong-gelling alginate beverage, specifically designed to undergo enhanced intragastric ionic gelation, significantly attenuated glycaemic response to a test meal compared with a weaker-gelling control. It is proposed that this inhibitory effect resulted from reduced exposure of nutrients to intestinal receptors following delayed gastric emptying and/or nutrient entrapment. Therapeutic interventions that lower acute (2 h) postprandial glycaemia may reduce diabetic complications[5]. These data suggest a role for a strong-gelling alginate beverage in the prevention and management of type 2 diabetes.

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