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Title:

Particle size of combinatorial protein- and carbohydrate-rich foods modulates gastric emptying

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Abstract: (Your abstract must use **Normal style** and must fit in this box. Your abstract should be no longer than 300 words. The box will 'expand' over 2 pages as you add text into it.)

Preparation of Your Abstract

1. The title should be as brief as possible but long enough to indicate clearly the nature of the study. Capitalise the first letter of the first word **ONLY** (place names excluded). No full stop at the end.

2. Abstracts should state briefly and clearly the purpose, methods, results and conclusions of the work.

Introduction: Clearly state the purpose of the abstract

Methods: Describe your selection of observations or experimental subjects clearly

Results: Present your results in a logical sequence

Discussion: Emphasize new and important aspects of the study and conclusions that are drawn from them

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Digestion behaviour of food has been previously studied mostly in isolated or individual forms. However, most meals are composed of multiple foods eaten in combination. Food structure also plays a crucial role in determining digestion behaviour. This study aimed to investigate the gastric emptying rate of the meal components (dry matter, starch, and protein) of food combinations with varying particle sizes: Haloumi ($128 \pm 15 \text{ mm}^2$) and pasta ($342 \pm 66 \text{ mm}^2$) represented protein- and carbohydrate-rich foods with larger particle sizes, whereas spirulina ($0.31 \pm 0.23 \text{ mm}^2$) and semolina ($<0.01 \text{ mm}^2$), represented smaller particle sizes.

Pigs ($n = 132$) were fed with one of six diets that contained either 150g carbohydrate and 75g protein for carbohydrate+protein diet, or 150g protein for protein only diet (dry matter basis): haloumi, spirulina, haloumi+pasta, haloumi+semolina, spirulina+pasta, or spirulina+semolina. After 30, 60, 120, or 240 minutes, gastric contents were collected, and dry matter, starch, and protein emptying were estimated using a modified power exponential function to determine emptying half-time ($t_{1/2}$). Four-to-six pigs per dietary treatment and time combination were used.

Particle size influenced gastric emptying. Diets with larger particles, such as haloumi and haloumi+pasta, were emptied more slowly ($t_{1/2, \text{DM}}$ of 1,270 and 411 minutes, respectively) than diets with smaller particles, such as spirulina and spirulina+semolina ($t_{1/2, \text{DM}}$ of 72 and 26 minutes, respectively). The diet particle size impacted protein and starch $t_{1/2}$. In diets containing small protein particles (e.g., spirulina+pasta), protein emptied faster ($t_{1/2, \text{protein}}=80$ minutes) than the carbohydrate component ($t_{1/2, \text{starch}}=584$ minutes). However, diets with small carbohydrate particles (e.g., haloumi+semolina), carbohydrate emptied faster ($t_{1/2, \text{starch}}=0.2$ minutes) than protein ($t_{1/2, \text{protein}}=195$ minutes).

These results show the influence of particle size on gastric emptying. This study can provide a basis for the development of food products with targeted digestion behaviour and controlled gastric emptying rates.