

MEASUREMENT OF PHYSIOLOGICALLY RESISTANT STARCH:
FOOD PROCESSING AFFECTS THE AMOUNT OF STARCH WHICH
ESCAPES DIGESTION IN VITRO.

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It is now clear that some starch escapes digestion in the small intestine and consequently is available for fermentation in the large bowel (Englyst and Cummings 1987). The amount of undigested starch reaching the colon depends on the type of food processing used (Cummings and Englyst 1987), for example starch may be physically inaccessible (partly milled), ungelatinized (uncooked) or retrograded (cooked and cooled). Colonic fermentation of undigested starch may have a number of health benefits (as with dietary fibre). It is therefore desirable to have an in vitro system to measure the amount of starch in carbohydrate foods which will escape digestion in the small intestine.

The aim of the following study was to develop an assay system to measure the amount of starch remaining undigested after different methods of food processing. This assay system attempted to mimic physiological conditions for starch digestion. The starch-containing foods were firstly chewed followed by treatment with pepsin (pH 1.5, 37 °C) and then a 6 hour incubation (pH 5, 37 °C) with a porcine pancreatic extract. The amount of starch surviving this procedure was called 'physiologically resistant starch'.

The results revealed that various food processing techniques produced different amounts of physiologically resistant starch. Some results are shown in the table. Results are expressed as mean \pm standard deviation. Uncooked foods produced the largest amount of undigested starch. Cooling food (overnight at 4 °C) after boiling also produced a significant ($P < 0.01$) increase in the amount of starch escaping digestion.

Potato (n=5)	Physiologically Resistant Starch (gm/100gm food as eaten)	Oats (n=4)	Physiologically Resistant Starch (gm/100gm food as eaten)
Uncooked	10.30 \pm 0.22	Uncooked	3.31 \pm 0.80
Boiled	0.78 \pm 0.12	Boiled	0.86 \pm 0.08
Boiled/cooled	2.26 \pm 0.13*	Ground/boiled	0.68 \pm 0.03
Instant	1.08 \pm 0.04	Ground/boiled/cooled	1.00 \pm 0.07*

*using t-test, boiled then cooled food was significantly different from boiled alone $P < 0.01$.

This assay system may be useful in predicting which starch-containing foods and processing techniques produce foods with high levels of physiologically resistant starch.

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