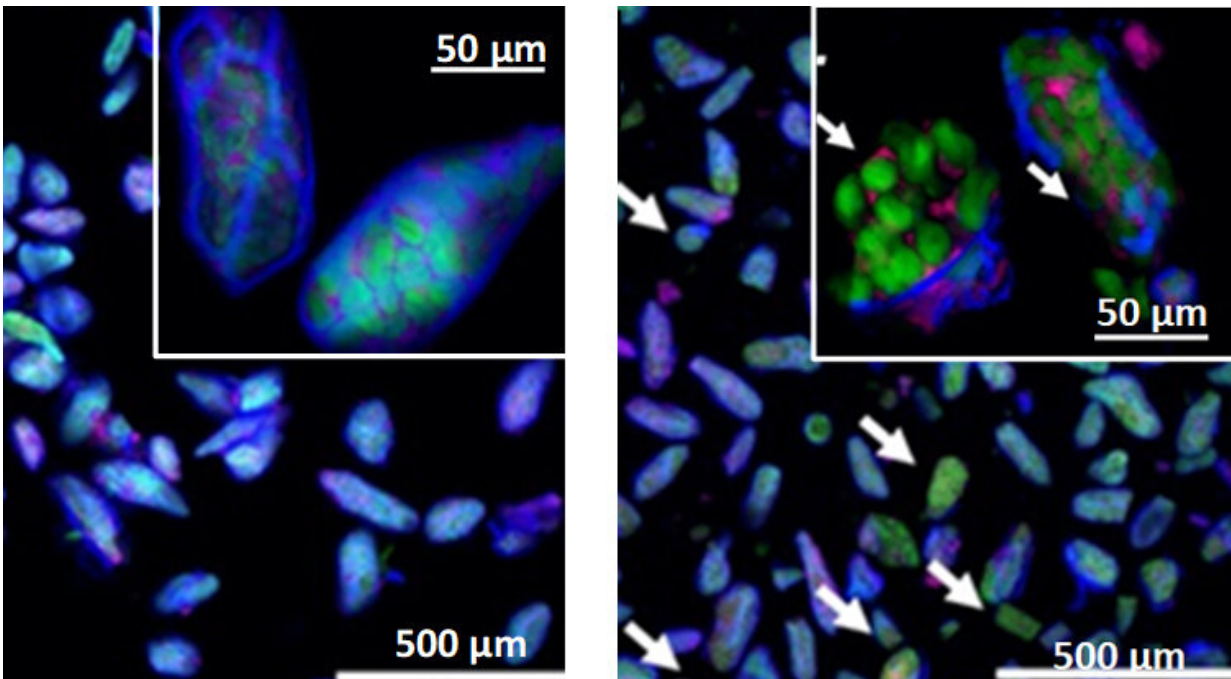


Health benefits of replacing wheat flour with chickpea flour

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Left: PulseON flour, looked at under the microscope, shows the starch (green) remains inside the plant cell wall (blue), which protects it from digestion. Right: In normal milling and processing, many plant cells rupture, exposing the starch and making it much more digestible. Credit: Quadram Institute

Researchers from the Quadram Institute and King's College London have shown that replacing wheat flour with a new ingredient derived from chickpeas improved the glycaemic response of people eating white

bread.

The ingredient uses specially developed milling and drying processes that preserves cellular structure, making its starch more resistant to digestion. Developing food products that contain more of this [resistant starch](#) would help to control [blood glucose levels](#) and reduce risk of type 2 diabetes.

Starch from wheat is a major source of dietary carbohydrate, but in [bread](#) and many other [processed foods](#) it is quickly digested to [glucose](#) in the body, causing a large spike in blood glucose levels. There is a large body of evidence that links long-term consumption of foods that provoke high glycaemic responses to the development of Type II diabetes. With this condition on the rise, along with obesity and other metabolic disorders, providing foods and ingredients that help consumers better manage blood glucose could help combat these challenges to health.

Many pulses, such as chickpeas, peas, beans and lentils naturally contain high amounts of resistant starch, which is digested slowly and avoids potentially damaging blood glucose spikes. But most of this beneficial resistance is lost, rendering the starch highly digestible, when these crops are milled to flour and processed into a [food product](#).

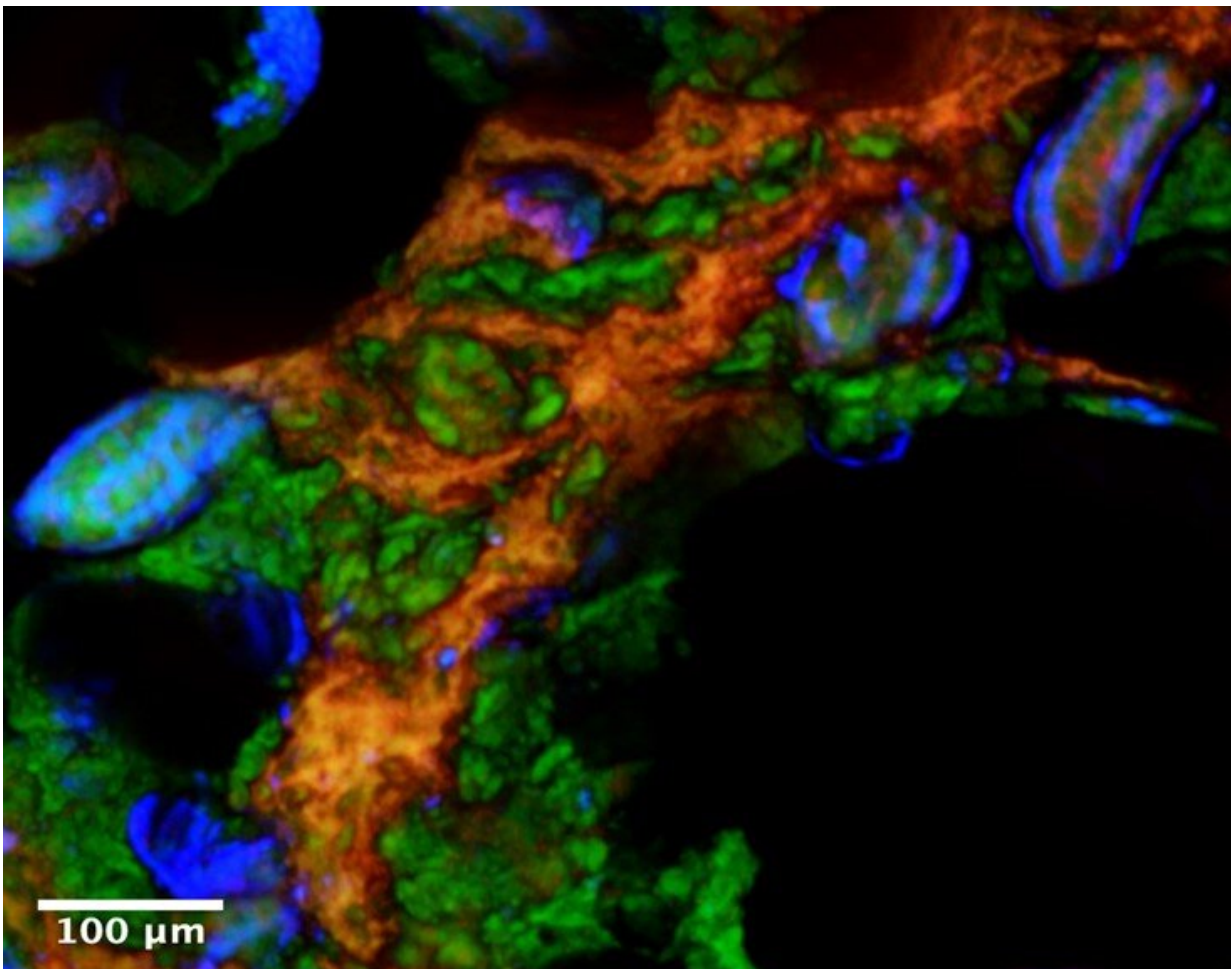
For this reason, the scientists invented an alternative milling process, which preserves the plant cell wall structures (dietary fiber) that surround the starch. This 'Type 1' resistant starch is the same as that found in wholefoods, but this new ingredient can be used in a form that potentially allows it to be incorporated into a wider range of foods.

Funding from the Biotechnology and Biological Sciences Research Council (BBSRC), part of UKRI, was used to develop the commercial potential of this novel ingredient, referred to as PulseON, and expands

the possibilities for including large amounts of resistant starch in processed foods to improve nutritional quality.

And now, in a new study published in the journal *Food Hydrocolloids*, the research team shows for the first time that the resistant property of the starch is retained during bread making, and that people who ate bread rolls where some [wheat flour](#) was replaced by PulseON had lower blood glucose responses.

In a double blind randomized cross over study, the scientists replaced 0%, 30% or 60% of the wheat flour in a standard white wheat bread recipe with PulseON.



PulseON-enriched bread under the microscope. Entact plant cells from PulseON flour (blue) mixed with gluten (orange) and wheat starch (green) in the structure of bread. After simulated upper gut digestion, only the plant cells remained.

Credit: Quadram Institute

Healthy human participants consumed each type of bread roll type for breakfast in random order on separate days, with no knowledge of which type of roll they were eating. Their glucose levels were recorded using continuous glucose monitors.

Blood glucose responses to the PulseON enriched breads were on average 40% lower than after eating the control breads. All bread rolls contained similar amounts of starch and wheat protein (gluten) per serving, so the different blood glucose responses reflect the carbohydrate quality.

These results raise the possibility of using such foods for improving the dietary management of diabetes, which needs to be evaluated in future studies.

The digestion of starch in each bread type was also studied in a laboratory using biochemical and microscopy techniques. These experiments showed that after two hours of digestion, the wheat starch had been digested, but the type-1-resistant starch remained. This confirms that the lower glucose response to PulseON enriched breads was due to the resistant starch enclosed in the chickpea ingredient not being digested.

"Incorporating our new type of flour into bread and other staple foods

provides an opportunity to develop the next generation of low glycaemic food products to support public health measures to improve health through better diets" said Dr. Cathrina Edwards from the Quadram Institute.

"Consumers replacing wheat bread with PulseON enriched bread would benefit not only from the type 1 resistant starch, but also from the higher fiber and protein content."

For widespread acceptance, the qualities of the products such as their taste, texture and appearance need to match those that are so popular with consumers.

Participants gave the PulseON enriched breads similar scores for texture and taste as the white bread. Quality tests indicated that any effects on bread quality (texture, appearance) were subtle and most noticeable when large amounts of PulseON were used. The sensory properties need to be confirmed with a broader consumer group in a non-clinical setting, but are very encouraging for efforts to produce healthier [white bread](#) without adverse effect on product quality.

The technology is patent-protected and the group are looking at commercial exploitation. Previous research from the same group has shown that the same milling process may be applied to other beans, lentils and pulses, resulting in cellular powders high in resistant [starch](#), but with different colors and flavors. The researchers are now exploring ingredient applications in a broader range of [food](#) products, and planning further trials involving those with prediabetes and type 2 diabetes.

More information: Balazs H. Bajka et al. The impact of replacing wheat flour with cellular legume powder on starch bioaccessibility, glycaemic response and bread roll quality: A double-blind randomised controlled trial in healthy participants, *Food Hydrocolloids* (2020). [DOI:](#)

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Provided by Quadram Institute

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