

# How digesting bread and pasta could be affecting our brains

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## New research reveals the molecules released when real samples of bread and pasta are digested in vitro

By Lucy Goodchild van Hilten    Posted on 2 July 2015

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Bread and pasta are cast as the villains in many diets; the Paleo Diet, the Atkins Diet and the South Beach Diet are well-known carb-cutters (and just three of more than [100 diets listed by WebMD](#)). One of the big talking points when it comes to carbs is gluten, the cause of celiac disease, irritable bowel syndrome and the more recently discovered non-celiac gluten sensitivity.

Research has focused on how pure gluten is broken down into disease-causing molecules that potentially have drug-like effects. However, until now, no studies have shown how digesting real bread and pasta can produce these molecules. A new study published in the journal *Food Research International* shows for the first time that these biologically active molecules are released by digesting bread and pasta. It also shows how they could survive digestion and pass through the gut lining into the blood.

“Previous lab tests have been done on pure gluten, but for the first time we have simulated digestion using real bread and pasta bought from the supermarket to see if these molecules are produced,” said lead author Dr. [Milda Stuknytė](#), a postdoctoral fellow in the [Department of Food, Environmental and Nutritional Sciences \(DeFENS\) at the University of Milan](#).

Milda Stuknytė, PhD

Until now there had been no evidence showing that the molecules are produced during digestion of real foods. The new research reveals that two of these molecules – called exorphins A5 and C5 – are released during digestion of real bread and pasta, and that they can survive digestion and pass through an *in vitro* model of the intestinal lining.

The researchers bought two kinds of sliced bread and four kinds of dried spaghetti to digest, from a commercial market. They cooked the spaghetti according to manufacturers' guidelines, and then digested each sample using a simulated digestion system in the lab.

The levels of the two molecules following digestion were quite different, with twice as much C5 being produced compared to A5; up to 1 milligram of C5 was produced from the *in vitro* digestion of a single serving size of pasta. Dr. Stuknytė said:



*We were surprised to find such a high amount of C5 in some of the pasta samples. We still don't know what effect this amount could have, but it's plausible that it could have a potential opioid effect in humans.*

## Looking at the mechanisms behind gluten sensitivity

More recently, there has been growing interest in the involvement of the molecules produced during gluten digestion in [gluten intolerance and sensitivity](#). An [estimated 1 percent of the population](#) suffers with celiac disease or wheat allergy. Non-celiac gluten sensitivity affects around six times more people than celiac disease, [according to the National Foundation of Celiac Awareness](#), yet relatively little is known about the mechanisms that cause it.

“We chose to study bread and pasta because they represent such a significant part of our diet, especially in Italy,” said Dr. Stuknytė. “While we know quite a lot about the mechanisms of celiac disease and how it’s connected to gluten, we still know relatively little about non-celiac gluten sensitivity. It’s just as important, and our research provides further insight into the proteins and the derived peptides that could be involved.”

The researchers now plan to investigate the mechanisms behind these molecules being transported through the intestine lining, potentially reaching the blood circulation.

“Our research is just *in vitro* at this stage, we have a long way to go in terms of discussing the potential biological effects of these molecules, especially in humans,” said Dr. Stuknytė.

## Can eating bread and pasta worsen neurological diseases?

The exorphins that are produced during gluten digestion have also been found in the spinal fluid of people with schizophrenia and autism. A [review in \*Clinical Nutrition\*](#) points out that in children with autistic spectrum disorder (ASD), these molecules can pass through the gut lining more easily: “Increased intestinal permeability ... allows these peptides to cross the intestinal membrane, enter the blood, and cross the blood-brain barrier.”

However, the review also notes that the role of non-celiac gluten sensitivity in diseases affecting the nervous system is still controversial, and there is more research to be done. While the new research does not explain the role these molecules play in neurological diseases, it does point to how they could end up in the spinal fluid. “We show that not only are these molecules produced during digestion, but they can also pass through the gut lining, suggesting that they could indeed have a biological effect,” said Dr. Stuknytė.

## Investigating the alternatives

With the increasing interest in gluten-free diets, research reveals new information about wheat alternatives, suggesting that replacing wheat might provide better nutritional value and even ensure food security.

A [recent paper published in \*LWT – Food Science and Technology\*](#) shows that replacing wheat flour with quinoa flour in bread increases its nutritional value, boosting its fiber, calcium, iron and zinc content. While the bread was nutritionally better, however, it suffered in quality, with consumers reporting it was not as tasty as bread made with wheat flour. This is important when developing new foods, as consumers will simply not eat food they don't enjoy.

A different [study published in \*Food Chemistry\*](#) looked at alternatives to wheat in pasta, conducting sensory tests to determine the best recipe. The researchers used flour made from sorghum, rice, corn, and potato starch in place of wheat flour to make gluten free pasta, and they looked at different qualities of the pasta, such as density, appearance and color. They found that spaghetti made using a mix of sorghum, rice and potato flours (at 40:20:40), performed best in the cooking quality tests.

In both cases, the alternatives to wheat could also support efforts to ensure food security. Quinoa is very adaptable to different soils, so growing and eating more of it could be an important way to ensure good nutrition and tackle hunger globally. Similarly, sorghum – a crop used to make biofuel, animal feed and food in many developing countries – provides an important alternative to wheat.

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## Milda Stuknytė, PhD

Dr. Milda Stuknytė is a postdoctoral fellow in Food Science at the Department of Food, Environmental and Nutritional Sciences (DeFENS) of the University of Milan in Italy. She graduated in Molecular Biology (BSc) and Microbiology (MSc) at the University of Vilnius, Lithuania. In 2009 she joined the team of Professor Ivano De Noni at DeFENS and received her PhD in Biotechnologies of Food. Her research activities concern quality and technological functionality of raw materials and food products, characterization of bioactive molecules from food and those of microbial origin, *in vitro* evaluation of bioactivity and digestibility of foods.

## Read the research papers featured in this story

[Release of wheat gluten exorphins A5 and C5 during \*in vitro\* gastrointestinal digestion of bread and pasta and their absorption through an \*in vitro\* model of intestinal epithelium](#) by Milda Stuknytė, Margherita Maggioni, Stefano Cattaneo, Paola De Luca, Amelia Fiorilli, Anita Ferraretto and Ivano De Noni at the University of Milan. Published in [Food Research International](#) (June 2015)

[Bread with whole quinoa flour and bifidobacterial phytases increases dietary mineral intake and bioavailability](#) by Esther Iglesias-Puig, Vicente Monedero and Monika Haros at the Institute of Agrochemistry and Food Technology (IATA-CSIC), Valencia, Spain. Published in [LWT – Food Science and Technology](#) (January 2015)

[Utilization of sorghum, rice, corn flours with potato starch for the preparation of gluten-free pasta](#), by Sila Mary Rodrigues Ferreira, Ana Paula de Mello, Mônica de Caldas Rosa dos Anjos, Cláudia Carneiro Hecke Krüger, Patrícia Moreira Azoubel and Márcia Aurelina de Oliveira Alves, from Universidade Federal do Paraná and Universidade Federal de Pernambuco, Brazil. Published in [Food Chemistry](#) (April 2015)

[Non coeliac gluten sensitivity – A new disease with gluten intolerance](#), by Grażyna Czaja-Bulsa from the Pomeranian Medical University and Zdroje Hospital in Szczecin, Poland. Published open access in [Clinical Nutrition](#) (April 2015)

Lucy Goodchild-van Hilten

After a few accidents, Lucy Goodchild van Hilten discovered that she's a much better writer than a scientist. Following an MSc in the History of Science, Medicine and Technology at [Imperial College London](#), she became Assistant Editor of *Microbiology Today*. A stint in the press office at Imperial saw her stories on the front pages, and she moved to Amsterdam to work at Elsevier as Senior Marketing Communications Manager for Life Sciences. She's now a freelance writer at [Tell Lucy](#). Tweet her [@LucyGoodchild](#).



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