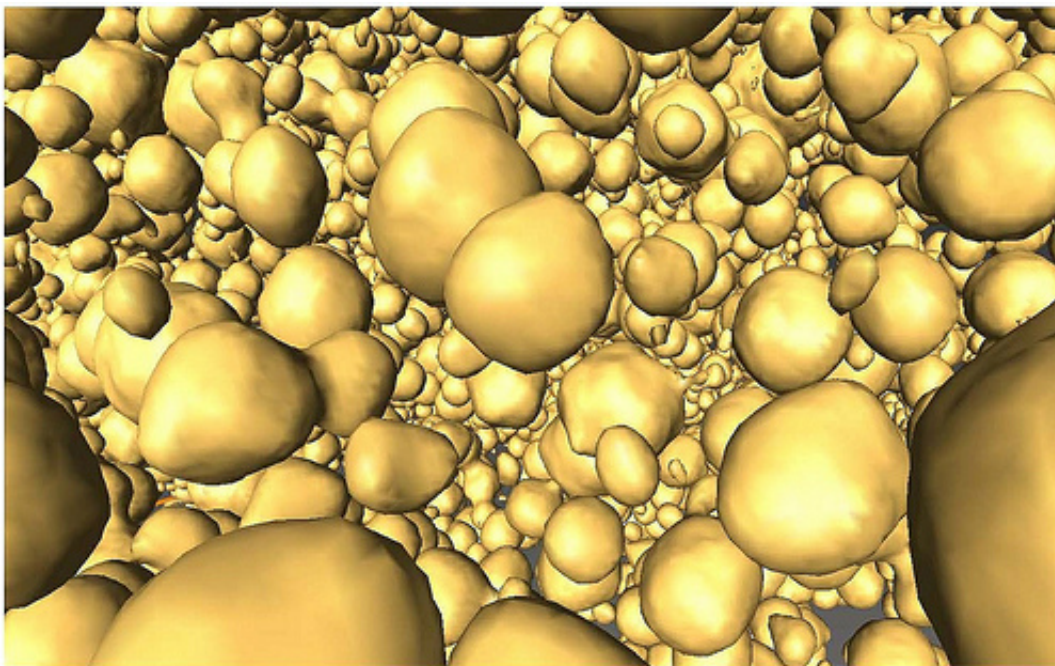


Fine bubble structure of bread dough visualized for the first time using CLS synchrotron

April 19 2013



University of Manitoba Food Scientist Martin Scanlon and PhD Candidate Filiz Koksel work with CLS scientists George Belev and Adam Webb to visualize the bubble formations in bread dough using powerful X-rays on the Biomedical Imaging and Therapy (BMIT) beamline. The research will help bakers create more consistent, healthy and gluten free loaves.

Baking the perfect loaf of bread is both a science and an art, so researchers are using Canada's only synchrotron to look at the way

bubbles form in bread dough to understand what makes the perfect loaf and how gluten-free products might better resemble traditional bread.

Researchers from the University of Manitoba (U of M) alongside scientists at the Canadian Light Source (CLS) synchrotron used powerful [X-rays](#) on the Biomedical Imaging and Therapy (BMIT) [beamline](#) to look carefully at the fine details of dough.

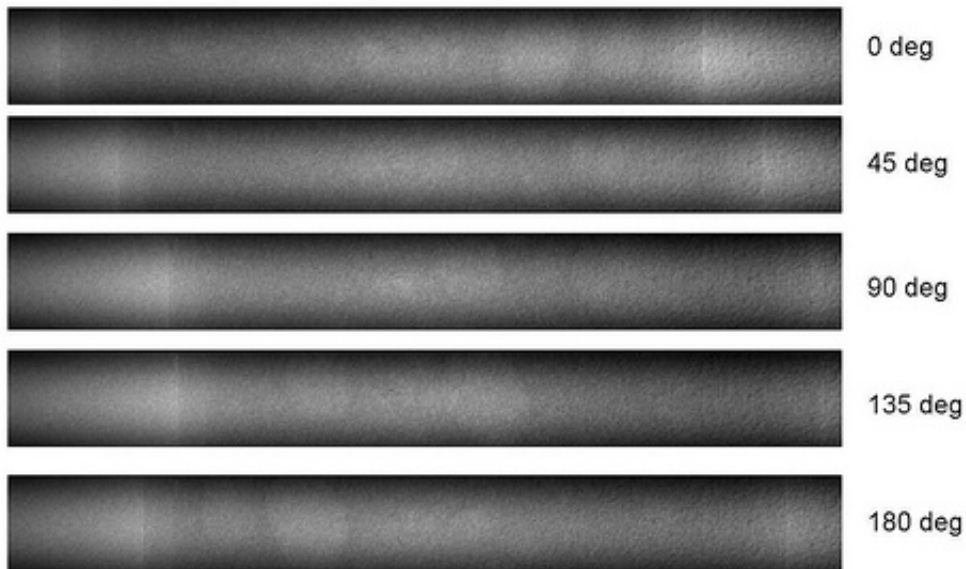
This is the first time that scientists have been able to see the very small [bubbles](#) that form within bread dough during the mixing process.

Filiz Koksel, a PhD student at the U of M, said that studying the makeup of the bubbles will help bakers create more consistent loaves of bread.

"During the mixing process, bits of the dough flop over and trap air in the dough," said Koksel. "The [air bubbles](#) get smaller and smaller during mixing and they make up around 10 per cent of the volume of the dough – it's a significant ingredient."

The amount and the size of the bubbles in the dough changes based on the ingredients and the amount of mixing that takes place. Changes to either the mixing process or the ingredients can have drastic effects on the outcome of the dough.

Projection images are acquired through 180 degree rotation



Dough experiment: 600 projection images are collected over 180 degree rotation. The scan is completed for 1 min/. Data set is about 1.5 GB.

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"For example, using less salt often results in more air that can ruin your dough, giving you bread with big keyholes," added Koxsel.

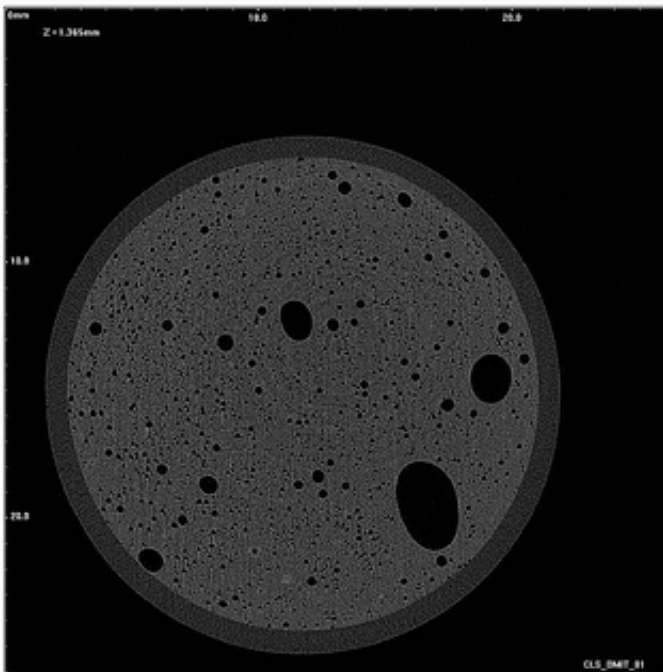
Visualizing the structure of the dough is something BMIT scientist George Belev said was a unique experiment for him.

"The [3D visualization](#) of the bubbles in the dough requires a very fast, high-resolution computed tomography (CT) experiment which is only possible with high-intensity synchrotron X-ray sources like the ones

available on the [Biomedical imaging](#) and Therapy beamline at the CLS," said Belev. "We take 600 images in less than a minute as the sample rotates over 180 degrees to obtain a [3D image](#) of the bubbles in the dough sample.

"By repeating the one-minute long CT scan, we can obtain important information about the bubble number, size, shape and volume, along with the evolution and changes to the bubble population over time as the dough ages."

Each sinogram is then backprojected to form one slice image of the dough sample. The slice image represents section of the dough that is 8.75 microns thick. Each pixel in the image has physical size 8.75 x 8.75 microns.



The walls of the cylindrical container can be clearly seen (dark gray). The air in the image appears black. So, the air bubbles in the dough are the dark circular and elliptical regions that are clearly seen in the light gray dough matrix.

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After processing the data, Belev said that one small sample of dough (about 83 mm³) contained over 24,000 tiny bubbles.

"The data clearly proves the air bubble population in the dough sample is very complex."

There are health benefits to the research as well that could allow bakers to cut back on the amount of salt (sodium) in the dough and still allow for a good crumb structure.

Koksel also hopes the results will translate into better crumb textures for gluten-free products.

"Gluten is great at holding onto gas. When you remove the gluten, there is difficulty with the gas holding properties of the dough, so our research will help us understand how to make better gluten-free products."

Provided by Canadian Light Source

Citation: Fine bubble structure of bread dough visualized for the first time using CLS synchrotron (2013, April 19) retrieved 26 April 2024 from <https://phys.org/news/2013-04-fine-bread-dough-visualized-cls.html>

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