Science now helping to develop better chocolate

Description

Fat bloom on a Lindt bunny. Image by Achates, CC BY-SA 3.0

Scientists have used X-ray to peer into the sweet brown heart of chocolate to discover what causes it to turn white.

Have you ever rejected a piece of chocolate because of its surface had turned an unappetising dusty white? Youâ€™re not alone: that bloom is the reason many turn away from what is arguably the worldâ€™s most beloved sweet indulgence, even though itâ€™s still safe to eat.

In an attempt to help reveal the process of the bloom, and thereby figure out a means of preventing it, scientists at German national research centre Deutsches Elektronen-Synchrotron (DESY), the Hamburg University of Technology (TUHH), and NestlÃ© (which funded the research) have turned a powerful X-ray to chocolate.

â€œAlthough fat blooming is perfectly harmless, it causes millions in damage to the food industry as a result of rejects and customer complaints,â€• said study main author Svenja Reinke of TUHH. â€œDespite this well-known quality issue, comparatively little has been known until now about its root causes.â€•

Implying DESYâ€™s PETRA III is just an ordinary X-ray machine would be doing it a huge disservice. Itâ€™s hugely powerful â€” the most powerful light source of its kind, and the most brilliant storage-ring

-based X-ray radiation source in the world. The 2.3-kilometre particle accelerator is particularly useful for examining very small samples.

Real-Time Chocolate Bloom

It is through the use of PETRA III that the researchers were able to study the underlying processes of chocolate bloom in real-time. The powerful machine was able to show the chocolate down to a scale of just a few nanometres, revealing that the bloom is caused by the migration of liquid fats (such as cocoa butter) to the surface, where it crystallises.

â€œThis can happen when liquid chocolate cools down in an uncontrolled manner and unstable crystals form, for example,â€• Reinke said. â€œBut even at room temperature, a quarter of the lipids [fat molecules] contained are already in a liquid state.â€•

The team first ground it to a fine powder, in order to investigate the behaviour of different mixes of the components: cocoa, sugar, milk powder and cocoa butter. Powderising it speeds up the blooming processes.

Then a few drops of sunflower oil were placed on each of the samples, which sped up the fat migration process. The oil penetrated the chocolate very quickly, even to the smallest pores, altering the chocolateâ€™s internal structure. Over a few hours, the liquid fat dissolved the chocolateâ€™s lipid structures, making the entire chocolate structure softer, which in turn increases lipid migration.

This study will help the industry develop solutions for the prevention of chocolate bloom.

â€œOne consequence might, for example, be to reduce the porosity of the chocolate during manufacture, so that the fat migrates more slowly,â€• Reinke said. â€œAnother approach is to limit the amount of fat that is present in a liquid form by storing the product in cool, but not too cold, conditions. 18 degrees Celsius [65 degrees Farenheit] is ideal.â€•

Michelle Starr

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1. Factual
2. Information
3. News

Tags

1. Bloom
2. Chocolate
3. DESY
4. Fats
5. Liquid
6. Petra III
7. Science

Date Created

May 11, 2015
Author
sephra