SCIENTISTS PUBLISH NEW STUDY ANALYZING HOW BREAD AROMAS AND TASTES INTERACT TO PRODUCE FLAVOR

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Psychologists rank the enjoyment of eating and drinking among the key criteria used to measure quality of life. For food scientists, chefs and gourmets, the pleasures of food derive in part from the aromatic odorants, also known as "volatile organic compounds," impacting taste buds in the mouth and olfactory sensors in the nasal canal, where the combination of taste and aroma becomes flavor.

A team of French researchers[1] are exploring the alchemy of aroma and taste, focusing their attention on bread. Specifically, these scientists recently studied how bread's crumb-and-crust structure lends itself to the release of aroma molecules into the human nose, and the impact of those aromas on the taste buds and tactile sensors in the mouth, to result in a consumer's appreciation for the flavors of food and drink.

The importance of aromatics to consumption is well none. Oenophiles have focused on a wine's "nose" for millennia. Similarly, every foodie at some point dreams of that quintessential experience of walking into the small, family-operated boulangère, inhaling deeply, and becoming one with the classic French baguette.

Working from that premise, French food scientists authored a study published recently in the *Journal of Agricultural and Food Chemistry* entitled **Effect of Bread Crumb and Crust Structure on the in Vivo Release of Volatiles and the Dynamics of Aroma Perception.**[2] Behind the scientific title is a straightforward premise: defining and calibrating the interactions between touch, taste and smell can directly enhance the experience of flavor.

To test their hypothesis, the research team assembled a selection of forty baguettes from three sources; some were purchased from a traditional boulangère bakery, while others came from a commercial supermarket, and still others were partially based in the laboratory. They next analyzed the loaves with

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[2] *J. Agric. Food Chem.*, **DOI:** 10.1021/acs.jafc.7b00287 Publication Date (Web): April 10, 2017.

laboratory equipment that identified and measured each loaf's volatile compounds. According to the study's authors, "Bread is a good tool to study the impact of structure on [volatile organic compound] release because of its structural complexity: it is composed of a porous crumb surrounded by a rigid crust."

The scientists then selected nine loaves for a human test: five from three local bakeries, one from a supermarket, and three partially baked (mostly baked, but not fully crusted) in the lab. They fed the bread to eight volunteers, each of whom was fitted with a special detector, whose receiver consisted of two stainless steel nostril plugs attached to a pair of eyeglasses "so that the participants could eat relatively normally."

Under the testing protocol, each participant received a sample of one of the bread types, took a bite of the bread, and exhaled through the nose into the machine. The researchers measured each exhalation to identify which volatile compounds in what quantifiable levels were released through the eating and exposed to the consumer. The researchers also measured each subject's chewing behavior and the resulting bolus[3] at the moment of swallowing, again measuring the impact on the release of volatile compounds.

Finally, the researchers had each subject characterize what each sample smelled like using a multiple choice selection. For the bread crumb-only samples from the non-crusted bread, there were four descriptive odorant options: "wet flour", "fermented", "wheat", and "butter." For the crumb-and-crust samples, there were seven different odorant descriptors to choose from: "wet flour", "fermented", "wheat", "roasted cereals", "cardboard", "toasted", and "grilled." These data were analyzed to identify "crust markers" for qualifying and quantifying the intensity of the taste experience.

The baking of bread is a chemistry all its own. A range of variables influence everything from size, weight and texture to color, moisture and aroma. For true bakers, crumb and crust are no accident.

Breads with denser, more rigid crumb structures generally received high marks for releasing aromatic odorant compounds, and crusts measurably released more aromatics than did the crumbs. The scientists hypothesized that a more rigid or crunchier texture might enhance the aroma-flavor connection because "during consumption, the crust is probably broken down more rapidly than the crumb due to its placement on the bread's surface and its brittle structure, thus leading to a faster release of crust markers." They also found that "greater muscular activity" while chewing "appears to release greater amounts" of the volatile molecules.

According to the abstract of the published article:

> The objective of this study was to investigate for the first time the influence of bread structure, volatile compounds, and oral processing on aroma perception. 3 types of French baguette were created using the same raw ingredients but different bread-making processes; they consequently varied in their crumb and crust structures. We characterized the initial volatile profiles of two bread structural subtypes—namely bread crumb and bread crumb with crust—using proton transfer reaction–mass spectrometry (PTR–MS) headspace analysis. Three types of bread were characterized by thirty-nine ion fragments from m/z 45 to 139. We then conducted a study in which 8 participants

[3] A bolus is a small, rounded mass of a substance, especially of chewed food.

> scored aroma attribute intensities for the different bread types and subtypes at 3 key stages of oral processing (10, 40, and 100% of individual swallowing time). At these 3 time points, we collected boli from the participants and characterized their volatile profiles using PTR–MS headspace analysis. The results suggest saliva addition dilutes volatile compounds, reducing volatile release during oral processing. Thus, a bread with high porosity and high hydration capacity was characterized by a low volatile release above boli. We examined the relationships between 4 aroma attributes of bread crumb with crust and 24 discriminatory fragment ions found in boli headspace. This study demonstrated for the first time that the perceived aroma of crumb with crust was influenced more by volatile profiles than by crumb texture. It thus contributes to our understanding of aroma perception dynamics and the mechanisms driving volatile release during oral processing in bread.[4]

The bottom line results of this study?

1. Sensory and chemical analyses were conducted on three structurally distinct breads and their boli.

2. Volatile profiles above bread boli, analyzed with Proton Transfer Reaction - Mass Spectrometry (PTR-MS)[5] varied highly across oral processing.

3. Whatever the crumb structure, the crust brought high variability in volatile profiles and aroma.

4. The study originality was to quantify the variations of perceived aroma across bread consumption.

5. Perceived aroma of crumb with crust was influenced more by volatile profiles than by food texture.

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[4] *Publication: Gaining deeper insight into aroma perception: An integrative study of the oral processing of breads with different structures*. Available from: https://www.researchgate.net/publication/312412353_Gaining_deeper_insight_into_aroma_perception_An_integrative_study_of_the_oral_processing_of_breads_with_different_structures [accessed Apr 15, 2017].

[5] Proton Transfer Reaction – Mass Spectrometry (PTR-MS) is the benchmark method for simultaneous real-time monitoring of volatile (organic) compounds without sample preparation in very low concentrations. The process is analytical chemistry technique that uses gas phase hydronium ions as ion source reagents. PTR-MS is used for online monitoring of volatile organic compounds in ambient air. *See,* Andrew M. Ellis; Christopher A. Mayhew, *Proton Transfer Reaction Mass Spectrometry: Principles and Applications*. (Wiley 2013) at pp. 15–17 (ISBN 978-1-118-68412-2).

The scientists conducting this experiment acknowledge that their recently published paper is the result of a single study with a relatively small sample size. However, the researchers have established a premise based on scientific method to highlight the importance of bread texture in taste perception, and for developing new bread types.

Of broader interest to the food and beverage sciences, this study further defines the complex interactions between aroma and taste that helps us all better account for the joys of flavor.

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