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News Release

Freising-Weihenstephan, December 12th, 2008

No Christmas mystery:

It is the elusive bitter substances that make cocoa so divine

Whether ginger bread men, cinnamon star cookies or Christmas flan – many Christmas goodies rely on that final pinch of cocoa to attain perfection. The brown powder's well-balanced bitterness and full-bodied aroma does the trick. But what concentration of which substances is responsible for those wonderful "hmmm" moments? Food chemist Prof. Thomas Hofmann at the Technische Universität München (TUM) is looking into the answers. His motivation: Good cocoa should not be a product of chance.

Every child knows cocoa. Yet, what is really behind its bittersweet taste and velvety feel on the tongue remains a mystery even to most chocolate aficionados. Not so for the food chemists of the TUM: Prof. Thomas Hofmann from the Department of Food Chemistry and Molecular Sensory Science has shed new light on the chemical backdrop of that distinctive cocoa taste we all know and love. Prof Hofmann and his team discovered that beside theobromine and caffeine, which until now were seen as the essential aromatic drivers of cocoa, 30 further substances contribute to the brown powder's well-balanced bitterness and velvety, full-bodied taste.

Prof. Hofmann and his team at the Center of Life and Food Sciences Weihenstephan at the TUM started by taking a very close look at cocoa. To pinpoint the decisive substances in roasted cocoa beans, they combined a variety of instrument-analytical procedures with different psychophysical testing methods, i.e. scientifically evaluated taste tests. The challenge facing the flavor researchers was to align the laboratory results with the sensory impressions of chocolate lovers. This is all the more important when you consider that the human tongue is yet to be matched by any kind of technical equipment.

To ensure that the sensory analysis was objective and reproducible, Prof. Hofmann turned to trained food tasters. Before tasting the cocoa, these experts train and standardize their sense of taste using purified reference specimens. But these tasting sessions have little in common with having a cozy mug of hot cocoa: the food chemists use cold water instead of hot milk and, based on the chemical compounds they have already identified, they gradually reconstruct the taste, until it is as close to the original as possible.

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The tasters sample the cold cocoa solutions using the so-called “half tongue test” to decide if they can already – or still – taste a given substance. The test works by applying two strips to an expert’s tongue: one is laced with the substance being tested for, while the other is a neutral-tasting placebo. A trained tongue can distinguish between left and right, and discern finest nuances in flavor. This “taste dilution analysis” developed by Prof. Hofmann makes it possible to identify bioactive substances. And these substances are crucial, since they define the flavor, even though they are often only present in very low concentrations.

Once the expert tasters have completed their task, the work moves on to the lab: using mass spectrometers and nuclear resonance spectrometers the researchers analyze the active flavors until the precise chemical structure of the key substances has been determined. With his novel approach of combining chemical and sensory analysis, Prof. Hofmann has now, for the first time, successfully identified 30 chemical compounds and respective concentrations that define the flavor of great-tasting cocoa. Armed with this knowledge, cocoa bean roasters will no longer need to leave anything to chance.

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Kakao_Hofmann.jpg: Food chemists at the Technische Universität München have identified the substances responsible for cocoa’s distinctive taste. (Picture: TUM / Thomas Hofmann)

Half-Tongue-Test_LauraEgger.jpg: The “half tongue test” makes sensory taste results scientifically reproducible. (Picture: Laura Egger)