

More intense roasting of cocoa beans lessens bitterness, boosts chocolate liking

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Confection makers who want to develop products containing 100% chocolate and no sugar for health-conscious consumers can reduce bitterness and optimize flavor acceptance by roasting cocoa beans longer and at higher temperatures.

That's the conclusion of a team of researchers who conducted a new

study in Penn State's Sensory Evaluation Center in the Department of Food Science. The study involved 27 100%-[chocolate](#) preparations made from cocoa beans roasted at various intensities and 145 people who came to the center on five consecutive days, evaluating five different samples each day.

The research confirmed that bitterness and astringency are negatively correlated to consumer liking, and demonstrated that those qualities in chocolate can be reduced through optimizing roasting, according to research team member Helene Hopfer, Rasmussen Career Development Professor in Food Science in the College of Agricultural Sciences.

"More and more people these days are eating darker chocolates with less sugar and more cacao because they are trying to cut down on sugar intake or they want to take advantage of perceived health benefits," she said. "Dark chocolate is particularly high in flavonoids, particularly a subtype called flavan-3-ols and their oligomers, which are all considered functional ingredients due to their associated health effects."

However, unsweetened chocolate is too bitter for most people to enjoy, so researchers experimented with roasting treatments to modify the flavor—investigating more than basic tastes such as sour and bitter—making it more acceptable for consumers, Hopfer explained.

For the study, research team member Alan McClure, founder of craft chocolate company Patric Chocolate and related consultancy Patric Food & Beverage Development, partnered with Hopfer and Penn State to characterize the flavor and acceptability of the chocolates.

Part of his doctoral degree dissertation research, McClure chose cocoa beans from three origins—Madagascar, Ghana and Peru, harvested in 2018 and 2019. He roasted and ground all samples into cocoa liquor at his factory in Columbia, Missouri, and then shipped the solidified 100%

chocolate to Penn State, where he and Hopfer remelted and portioned out the chocolates into small disks for sensory evaluation.

McClure found the reaction of study participants to his 27 100% chocolate preparations especially interesting, and he suggested that what he learned from this research will guide him, and roasting staff at other chocolate manufacturing companies, in creating future products through an increased scientific understanding of the complex changes resulting from cocoa roasting.

In findings published in *Current Research in Food Science*, the researchers reported that more intense roasting conditions—such as 20 minutes at 340 degrees Fahrenheit, 80 min at 275 F, and 54 min at 304 F—all led to chocolate consumers finding unsweetened chocolate the most acceptable. Conversely, research participants did not find 100% chocolate acceptable when made from raw or lightly roasted cacao, such as beans roasted 11 minutes at 221 F, or 55 minutes at 147 F.

Hopfer noted that scientists' understanding of the variation of cacao-related bitterness has historically come from instrumental investigation of the bitter compounds found in [cocoa beans](#), but the Penn State research is novel because of its use of human sensory evaluation to quantify such variation.

"Our research was intended to learn about bitterness perception and the liking of chocolate made from cacao roasted with a variety of roasting profiles to see if wide consumer acceptability of 100% chocolate is possible," she said.

"A chocolate maker doesn't have many other options to influence the flavor quality of 100% chocolate except to vary how he or she roasts the beans, and our results show optimal roasting can adequately reduce bitterness."

More information: Alan P. McClure et al, Optimizing consumer acceptability of 100% chocolate through roasting treatments and effects on bitterness and other important sensory characteristics, *Current Research in Food Science* (2022). [DOI: 10.1016/j.crfs.2022.01.005](https://doi.org/10.1016/j.crfs.2022.01.005)

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