

Dairy cows fed botanicals-supplemented diets use energy more efficiently

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Researcher Leoni Martins, doctoral student in the Department of Animal Science, led a 10-week experiment that included 48 Holstein cows. He is pictured here with a cow in the Penn State Dairy Barns. Credit: Penn State

Supplementing the feed of high-producing dairy cows with the botanical extract capsicum oleoresin, obtained from chili peppers, or a combination of that extract and clove oil resulted in the animals using feed energy more efficiently and emitting less methane from their largest stomach, according to a new study conducted by Penn State researchers.

Adding those substances, sometimes referred to as [essential oils](#), to the cattle's rations resulted in improved efficiency of energy utilization in peak-lactation dairy cows. According to Alex Hristov, distinguished professor of dairy nutrition, corresponding author of the study, the cattle would use the available energy for body weight gain rather than milk yield or milk components.

The [findings](#), recently published in the *Journal of Dairy Science*, suggest a potential positive physiological and environmental effect of supplementation with this combination of botanicals. From previous studies, the researchers knew that botanicals have the potential to modify fermentation in the dairy cow's largest stomach, called the rumen, Hristov explained, adding that he has become increasingly interested in post-ruminal, physiological effects of botanicals.

Hristov's research group in the College of Agricultural Sciences has experimented with supplementing the feed of high-performing dairy cows, with additives ranging from seaweed to garlic and oregano oils to synthetic additives, in a nearly two-decades-long effort to improve milk production and reduce environmental emissions from dairy farms.

Methane—a potent greenhouse gas released into the atmosphere by the cows belching—results from fermentation occurring in the cow's rumen. That process allows the animal to consume and utilize fibrous feeds and byproducts that cannot be digested by humans or other simple-stomach farm animals.

Although methane mitigation was not an objective of this research project, the researchers reported that the yield and intensity of methane from cows in the study were decreased by 11% by the combination of capsicum oleoresin and clove oil. The effect was particularly pronounced in first-lactation cows.

"We concluded that capsicum oleoresin may affect energy and nitrogen utilization of the cows, whereas the ruminal fermentation and methane-mitigation effects likely were triggered by an associative effect of capsicum oleoresin and clove oil or clove oil alone," Hristov said.

Botanicals—plant-derived bio-active compounds also called phytonutrients—have shown a wide range of anti-microbial properties against bacteria, protozoa and fungi, and have been investigated as potential rumen modifiers in ruminants, Hristov pointed out. Studies with non-ruminant species have shown that phytonutrients can trigger, at low doses, specific responses related to gastrointestinal health and immunity in animals.

Various botanicals, with active ingredients such as eugenol, cinnamaldehyde, allicin and capsaicin, can trigger immune responses, reduce oxidative stress and influence insulin secretion and activity, Hristov noted. Other studies have shown that botanicals can regulate pro- or anti-inflammatory responses by increasing or decreasing inflammatory proteins involved in the immune system, white blood cells and oxidative stress in nonruminants and, potentially, in ruminants.

In this 10-week experiment conducted at the Penn State Dairy Barns, led by Leoni Martins, doctoral degree candidate in animal science, 48 Holstein cows were randomly assigned to one of three dietary treatments. The rations of 16 were supplemented with 300 milligrams per cow each day of capsicum oleoresin; 16 received a diet supplemented with 300 milligrams per cow each day of a combination of

capsicum oleoresin and clove oil; and a 16-cow control group was fed a diet without supplements.

Throughout the experiment, body weight increased in cows supplemented with capsicum oleoresin and a combination of capsicum oleoresin and clove oil, by 850 and 660 grams per day respectively, compared to a negligible 10 grams per day for the unsupplemented control group. Cows fed diets supplemented by the botanicals also exhibited higher efficiency of energy utilization, revealed by several metabolic measurements.

"The use of rumen-protected capsicum—which partially passes through the rumen without affecting fermentation, but still can be digested in the cow's intestine—represents an interesting approach to improve metabolic status of [dairy](#) cows during the transition period of three weeks before and three weeks after giving birth, and early lactation," Hristov said. "But the mechanism underlying this response remains unclear."

More information: L.F. Martins et al, Lactational performance, enteric methane emission, and nutrient utilization of dairy cows supplemented with botanicals, *Journal of Dairy Science* (2024). [DOI: 10.3168/jds.2023-23719](https://doi.org/10.3168/jds.2023-23719)

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