Feeding saponin-containing Yucca schidigera and Quillaja saponaria to decrease enteric methane production in dairy cows

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Abstract

An experiment was conducted in vitro to determine whether the addition of saponin-containing Yucca schidigera or Quillaja saponaria reduces methane production without impairing ruminal fermentation or fiber digestion. A slightly lower dose of saponin was then fed to lactating dairy cows to evaluate effects on ruminal fermentation, methane production, total-tract nutrient digestibility, and milk production and composition. A 24-h batch culture in vitro incubation was conducted in a completely randomized design with a control (no additive, CON) and 3 doses of either saponin source [15, 30, and 45 g/kg of substrate dry matter (DM)] using buffered ruminal fluid from 3 dairy cows. The in vivo study was conducted as a crossover design with 2 groups of cows, 3 treatments, and three 28-d periods. Six ruminally cannulated cows were used in group 1 and 6 intact cows in group 2 (627 +/- 55 kg of body weight and 155 +/- 28 d in milk). The treatments were 1) early lactation total mixed ration, no additive (control; CON); 2) CON diet supplemented with whole-plant Y. schidigera powder at 10 g/kg of DM (YS); and 3) CON diet supplemented with whole-plant Q. saponaria powder at 10 g/kg of DM (QS). Methane production was measured in environmental chambers and with the sulfur hexafluoride (SF(6)) tracer technique. In vitro, increasing levels of both saponin sources decreased methane concentration in the headspace and increased the proportion of propionate in the buffered rumen fluid. Concentration of ammonia-N, acetate proportion, and the acetate:propionate ratio in the buffered rumen fluid as well as 24-h digestible neutral detergent fiber were reduced compared with the CON treatment. Medium and high saponin levels decreased DM digestibility compared with the CON treatment. A lower feeding rate of both saponin sources (10 g/kg of DM) was used in vivo in an attempt to avoid potentially negative effects of higher saponin levels on feed digestibility. Feeding saponin did not affect milk production, total-tract nutrient digestibility, rumen fermentation, or methane production. However, DM intake was greater for cows fed YS and QS than for CON cows, with a tendency for greater DM intake for cows fed YS compared with those fed QS. Consequently, efficiency of milk production (kg of milk/kg of DM intake) was lower for cows fed saponin compared with controls. The results show that although saponin from Y. schidigera and Q. saponaria lowered methane production in vitro, the reduction was largely due to reduced ruminal fermentation and feed digestion. Feeding a lower dose of saponin to lactating dairy cows avoided potentially negative effects on ruminal fermentation and feed digestion, but methane production was not reduced. Lower efficiency of milk production of cows fed saponin, and potential reductions in feed digestion at high supplementation rates may make saponin supplements an unattractive option for lowering methane production in vivo.