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Olive biochar supplementation in small ruminant feeding: Contrasting methane mitigation and productivity in lactating goats

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Abstract

Mediterranean agriculture is under increasing strain due to resource scarcity, inefficient waste management, and climate change. Circular economy strategies offer a promising pathway toward sustainable agro-ecosystems by transforming waste streams from one sector into valuable inputs for another. This study investigated the conversion of solid waste from olive mills into biochar enriched with olive phenolic compounds, intended for use as a dietary supplement in small ruminants. The objective was to enhance integration between the economically important olive and small ruminant sectors while mitigating methane emissions from the latter. Two trials were conducted, each involving two groups of lactating goats: a control group receiving a standard diet and a treatment group receiving the same diet supplemented with polyphenol-enriched olive biochar at 2 % of the total mixed ration.

Individual data on milk production and methane emissions were collected over a 5-week period in both trials, while body weight was recorded at the beginning and end of each trial. Additionally, feed intake and milk composition were monitored weekly during the 5-week period in Trial 1. Data were statistically analysed using SPSS, applying the general linear model for repeated measures, with data from the first week used as a covariate. The biochar treatment did not have a significant effect on animal weight, feed intake (Trial 1), milk production, nor milk composition (Trial 1). In contrast, methane emissions, measured using a handheld laser methane detector, were lower in the biochar-supplemented groups in both trials, with a statistically significant reduction observed in Trial 2 ($p < 0.05$). These findings support the safety of biochar supplementation and highlight its potential for methane mitigation in small ruminant feeding systems. However, the overall sustainability of this approach requires further evaluation, particularly with respect to the environmental and economic costs associated with the production and application of olive waste-derived biochar.

Keywords: Circular economy, lactating goat, methane emission, olive waste