

Garlic (*Allium sativum* L.) in ruminant nutrition: Chemical composition, antioxidant and antimicrobial activities and *in vitro* effect on digestion in sheep.

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Résumé

The chemical composition and the biological activities of a Tunisian variety of garlic (*Allium Sativum* L.) were evaluated. An *in vitro* study also was conducted to evaluate the effect of garlic powder supplementation on rumen fermentation. Two successive 24 h-incubations were practiced and at the end of each, gas production was measured. Growing doses of garlic powder were added to 500 mg of a diet composed of 50% of rye-grass hay and 50% of concentrate on dry matter (DM) basis. Liquid samplings for each dose were reserved to determine pH, ammonia nitrogen (NH₃-N) and true organic matter degradability (TOMD).

Results showed that garlic powder was low in ash (3.5 % DM), relatively high in CP (16.6% DM) and very lowly lignified (ADL content < 2.2 % DM). Colorimetric analysis revealed that the total phenols, flavonoids and tannins contents were respectively 0.37 mg AG.equ /g DM, 0.11 mg EC /g DM and 30.2 mg EC /g DM. The antioxidant activity was evaluated as a free radical-scavenging capacity and it was assessed by measuring the scavenging activity of garlic (DPPH). All aqueous extracts exhibited a high concentration dependent scavenging activity. The extract showed a higher DPPH scavenger (EC₅₀: 20.84 mg/ml). Antibacterial properties were tested on Gram negative bacteria (*Escherichia coli* (E.coli)) and Gram positive bacteria (*Staphylococcus aureus* and *Bacillus subtilis*). It was found that all extracts exhibited antibacterial activity against almost all bacteria, but ethanol extract was proven to be more efficient against the Gramnegative bacteria. The inhibition diameter of these extracts was checked at 13 mg/ml concentration level against *Staphylococcus aureus* and 7 mg/ml against E. coli. Results showed also that methanol extract had higher minimum activity against E. coli (inhibition diameter = 4 mg/ml). While it had a moderate activity against Gram negative bacteria.

After 24h of fermentation in the *in vitro* trial, results indicated that, garlic powder (GaP) increase significantly ($P < 0.001$) gas production for 32 mg (104,32 ml) and 64 mg (108,64 ml). Garlic had no effect on pH. An increase ($P < 0.0001$) in NH₃-N concentration was recorded with doses 4 and 8 mg compared with control, whereas adding 32 and 64 mg resulted in a NH₃-N concentration equivalent to control (averaged 39.25 mg/100 ml). The propionate proportion (C₃) increased with doses and the highest proportion was noted with the addition of 8 mg ($P < 0.001$). The TOMD was similar for all the doses except for 64 mg GaP, where a slight but significant ($P < 0.001$) increase was noted (77.7%). values of OMD did not differ among GaP doses, except for the 64 mg dose, in which the observed value (77.7%) was significantly ($P < 0.001$) higher than all the others (averaged 73.1%). It was concluded that garlic powder could present some feeding benefits related to its antioxidant and antimicrobial actions and could be considered as a natural alternative to

synthetic antioxidants. Also, it was found to modify positively rumen fermentation trends. *In vivo*, performance and meat quality measurements are necessary to confirm the eventual positive effects, considering the corresponding doses.

Keywords: Garlic, secondary compounds, antioxidant, antimicrobial activities, *in vitro* fermentation, sheep.