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In vitro gas production and its relationship to in situ disappearance and chemical composition of some Mediterranean browse species

Aziza Gasmi-Boubaker[a,*], C. Kayouli[a], A. Buldgen[b]

[a] *Cité Mahrajène INAT, Tunis 1082, Tunisia*
[b] *Faculté des sciences agronomiques, Gembloux, Belgium*

Abstract

In vitro gas production of seven species (i.e., *Arbutus unedo*, *Calycotum villosa*, *Erica arborea*, *Phillyrea angustifolia*, *Pistacia lentiscus*, *Myrtus communis*, *Quercus sube*r) that are widely browsed by goats were measured through 120 h and related to in situ dry matter disappearance (DMD) and chemical composition. Three goats fitted with ruminal cannulae were used for the in vitro and in situ studies. Browses varied in their crude protein (CP: 55–221 g/kg DM) and neutral detergent fibre (360–551 g/kg DM) contents. High levels of total condensed tannins (TCT) were observed in *Pistacia lentiscus*, and the lowest levels were in *Calycotum villosa* and *Phillyrea angustifolia*. The browses varied widely in potential (145.7–224.0 ml/g DM) and fractional rates (0.038–0.075/h) of gas production, and there were differences among species in DMD ($P < 0.05$). Gas production at 24 h was positively correlated ($P < 0.05$) with in situ DM disappearance and CP content, but negatively correlated ($P < 0.05$) to acid detergent lignin (ADL), free condensed tannins (FCT) and TCT contents. The fractional rate of fermentation (μ) was negatively related ($P < 0.05$) to FCT ($r = -0.81$) and TCT ($r = -0.83$), whereas DMD was only related to acid detergent fibre and ADL content. Results

Abbreviations: A, potential gas production; ADF, acid detergent fibre; ADL, acid detergent lignin; BCT, bound condensed tannins; CP, crude protein; DM, dry matter; DMD, in situ dry matter disappearance; FCT, free condensed tannins; G24, cumulative gas production at 24 h; L, lag time; μ, fractional rate of gas production; NDF, neutral detergent fibre; S.E.D., standard errors of differences; TCT, total condensed tannins

* Corresponding author. Tel.: +216 71287110; fax: +216 71799391.
E-mail address: azizaboubaker@yahoo.com (A. Gasmi-Boubaker).

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support combined use of gas production and in situ techniques to determine the nutritive value of feeds containing phenolic compounds.

Keywords: Gas production; In situ disappearance; Shrubs; Tannins

1. Introduction

The hill areas of northern Tunisia have traditionally been used to browse goats, which can consume substantial amounts of shrubs to meet their nutrient requirements. Despite their potential as feeds, little research has been completed to determine their nutritive value. While in vivo evaluation may best estimate a feed's nutritional value, this technique is very laborious and difficult to standardize with browsing goats.

The in situ rumen disappearance and in vitro gas production techniques are useful for rapid screening of feeds to assess their potential as energy sources for ruminants (Preston, 1995). However, the gas production technique has proved to be more effective than the in situ nylon bag technique for determining the nutritive value of feeds containing inhibitory compounds, such as tannins. Khazaal et al. (1994) showed that while physical binding of tannins to substrate could be detected in a nylon bag incubated in the rumen, effects such as toxicity to microbes and binding to enzymes would be diluted and difficult to detect. In contrast, the in vitro gas production technique, being a closed system with a limited supply of rumen fluid, may be more reliable in detecting effects of inhibitory compounds in feeds on their digestion.

Ruminal in situ disappearance and in vitro gas production from shrubs are frequently evaluated with confined animals receiving a standard diet, which is generally quite different from the browsed shrubs. Although this minimizes variability in feed intake, and consequently rumen microbial activity, the microbial population sustained by the standard diets need not be similar to those with the browsed shrubs. There has been little research to compare in situ bag technique results with in vitro gas production determined with grazing animals adapted to feeds high in inhibitory compounds.

Several ruminal micro-organisms have been identified that can tolerate relatively high concentrations of tannins in feeds (O'Donovan and Brooker, 2001). Adaptative strategies involve production of a thick glycocalyx of glycoprotein that has a high binding affinity for tannins, as well as the tendency to form glycocalyx-enclosed microcolonies (McSweeny et al., 2001).

Objectives were to evaluate the nutritive value of various shrub species and to compare in situ dry matter disappearance (DMD) of these forages with gas production parameters determined with goats browsing shrubs.

2. Materials and methods

2.1. Shrub species and preparation

Samples consisted of leaves and twigs (diameter < 2 mm) of seven indigenous browses, being *Arbutus unedo*, *Calycotum villosa*, *Erica arborea*, *Phillyrea angustifolia*, *Pistacia*