

Effect of polyethylene glycol on gas production parameters and nitrogen disappearance of some tree forages

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Abstract

The nine tree forages *Carissa spinarum*, *Ficus roxburghii*, *Hippophae rhamnoides*, *Leucaena leucocephala*, *Melia azedarach*, *Quercus incana*, *Robinia pseudoacacia*, *Zizyphus jujuba*, *Zizyphus nummularia*, and the three conventional forages paddy straw, wheat straw and mixed grass hay were analysed for chemical composition, phenolics, protein precipitation capacity (PPC), polyethylene glycol binding capacity (PEGBC) and rumen fermentation characteristics. The rumen degradability characteristics with and without polyethylene glycol (PEG) were studied in vitro by gas production. The crude protein content was more than 200 g/kg dry matter (DM) in *H. rhamnoides*, *L. leucocephala*, *M. azedarach*, *R. pseudoacacia* and *Z. jujuba*. The ash content (g/kg DM) was high in *F. roxburghii* (217) and paddy straw (178) while *R. pseudoacacia* and *C. spinarum* contained higher neutral detergent insoluble N and non-structural carbohydrates, respectively. Total phenolics (g/kg DM) ranged from six in paddy straw to 122 in *H. rhamnoides*, concurrent with the highest total tannin phenols (103) and hydrolysable tannins (89). The condensed tannins ranged from 0.2 in wheat straw to 56 in *C. spinarum* and *H. rhamnoides*, and *C. spinarum* had the highest PPC (0.593) and PEGBC (42.3%). In vitro gas production (ml/g) to 24 h ranged from 48.5 in *Q. incana* to 218.3 in *M. azedarach*. Addition of PEG increased gas volume and in vitro disappearing N, and decreased the partitioning factor in *C.*

Abbreviations: ADF, acid detergent fiber; ADIN, acid detergent insoluble N; CP, crude protein; CT, condensed tannins; DM, dry matter; FBCT, fiber-bound condensed tannins; HT, hydrolysable tannins; IVTDDM, in vitro true degradability of DM; IVDN, in vitro disappearing N; iNDF, isolated NDF; NDF, neutral detergent fiber; NDIN, neutral detergent insoluble N; NDS, neutral detergent solubles; ND, neutral detergent; NSC, non-structural carbohydrates; NTP, non-tannin phenolics; OM, organic matter; PF, partitioning factor; PEG, polyethylene glycol; PEGBC, PEG binding capacity of tannins; PPC, protein precipitation capacity of tannins; TP, total phenols; TTP, total tannin phenolics

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spinarum, *H. rhamnoides*, *Q. incana*, *Z. jujuba* and *Z. nummularia*. The in vitro true degradability of DM ranged from 0.337 in local grass hay to 0.820 in *M. azedarach*, which increased upon addition of PEG, except for *M. azedarach* and the conventional forages. Degradability values were negatively correlated with neutral detergent fiber, acid detergent fiber and lignin. Among the tree forages, the nutritional value of *M. azedarach*, *L. leucocephala* and *Z. jujuba* were ranked as very good on the basis of these parameters. Values of the in vitro gas production parameters determined in the presence or absence of PEG indicate the relative effects of tannins in these forages on substrate degradability and nutrient partitioning.

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1. Introduction

Trees and shrubs have been introduced into cropping and grazing systems to provide protein rich fodder to supplement low protein feeds, and their use as components of ruminant diets is a widespread practice in many tropical countries (Leng, 1997). Tree forages are also a source of digestible energy, rumen degraded and undegraded protein, vitamins and minerals, thereby reducing requirements for concentrates and reducing feeding costs. However, these feeds are generally high in secondary compounds, particularly tannins. Tannins released from one dietary component may react with nutrients in others (Mangan, 1988). Since the demand for tree fodders in feeding systems generally arise due to the poor quality of available basal forages, tree forage supplementation strategies should be such that they promote intake and digestibility of basal forages. Since tannins in tree forages have a wide range of effects on animals, the absence of adequate information on the tannin content of tree forages, and their influences on rumen digestion, development of appropriate supplementation strategies with them cannot be precise (Makkar, 2003a).

Polyethylene glycol (PEG), a tannin complexing agent, has potential to assess phenolic-related anti-nutritive effects in browse plants. Therefore, nutritional evaluation of tree forages in terms of phenolics, in vitro gas production, substrate fermentability, the partitioning factor (PF) and N disappearance in the presence of PEG was undertaken to quantify adverse effects of tannins, and the usefulness of these forages, in feeding ruminants.

2. Materials and methods

2.1. Trees and shrubs

Nine species of tree forages from the hilly regions of India (i.e., the north-west and mid-hill Himalaya) being *Carissa spinarum*, *Ficus roxburghii*, *Hippophae rhamnoides*, *Leucaena leucocephala*, *Melia azedarach*, *Quercus incana*, *Robinia pseudoacacia*, *Zizyphus jujuba* and *Zizyphus nummularia*, as well as the three conventional forages mixed grass hay, rice straw and wheat straw were selected. The leaf samples were collected, dried in

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