Available online at www.sciencedirect.com
SCIENCE DIRECT®
Animal Feed Science and Technology
122 (2005) 109–121
ANIMAL FEED SCIENCE AND TECHNOLOGY
www.elsevier.com/locate/anifeedsci

Attempts to deactivate tannins in fodder shrubs with physical and chemical treatments☆

H. Ben Salem[a,*], L. Saghrouni[a,b], A. Nefzaoui[a]

[a] *Institut National de la Recherche Agronomique de Tunisie, Laboratoire des Productions Animales et Fourragères, Rue Hédi Karray, 2049 Ariana, Tunisia*
[b] *Ecole Supérieure d'Agriculture de Mateur, 7030 Mateur, Tunisia*

Abstract

Chopping, water sprinkling, storage under aerobic and anaerobic conditions, urea, wood ash, activated charcoal and polyethylene glycol 4000 (PEG) treatments were evaluated for their efficiency in deactivating tannins in shrub foliage. In a first trial, fresh leaves of *Acacia cyanophylla* Lindl. (acacia) were stored after chopping or without chopping and spraying or without spraying with water under aerobic or anaerobic conditions. The plant material was stored for 1, 7 and 14 days and analysed thereafter for extractable total phenols (TP), extractable total tannins (TT) and extractable condensed tannins (CT) contents. Chopping and water spraying substantially decreased the levels of TP, TT and CT of acacia. The rate of tannin deactivation increased in acacia stored under anaerobic conditions. Acacia stored for 7 days exhibited lower TP, TT and CT contents than that stored for only 1 day. Compared to the 7-day storage period, there was a further non-significant decrease in the level of these phenolic compounds when the storage duration was extended to 14 days. The highest level of rumen degradation of crude protein (CP) in sheep rumen was obtained with chopped, water sprinkled acacia leaves stored under anaerobic conditions. The second trial investigated the effect of increasing levels of urea (0, 20, 40, 60 and 80 g/kg) and treatment duration (7, 14, 21 and 28 days) on CP, TP, TT and CT in acacia leaves. The 20 g/kg urea level was sufficient to totally deactivate tannins in acacia even with the shortest storage period, i.e. 7 days. However, urea treatment increased ash-free neutral

Abbreviations: CP, crude protein; CT, extractable condensed tannins; DM, dry matter; PEG, polyethylene glycol; NDF, neutral detergent fibre; NDFom, ash-free neutral detergent fibre; OM, organic matter; TP, total extractable phenols; TT, total extractable tannins; DMD, dry matter digestibility; CPD, crude protein digestibility

☆ This paper is part of the special issue entitled Predicting and Improving the Safety and Efficiency of Feeding Ruminants on Tanniniferous Tree Foliage, Guest Edited by Dr. Harinder P.S. Makkar.

* Corresponding author. Tel.: +216 71 230 024; fax: +216 71 231 592.
E-mail address: bensalem.hichem@iresa.agrinet.tn (H. Ben Salem).

0377-8401/$ – see front matter
doi:10.1016/j.anifeedsci.2005.04.009

detergent fibre content and did not improve in sacco acacia degradation. In the third trial air-dried 1 mm ground samples of acacia and kermes oak (*Quercus coccifera* L.) leaves were added to water (control), acacia wood ash, activated charcoal or PEG solutions (100 g/kg) at 1:10 (w/v) and shaken for 20 min. All these four treatments decreased TP, TT and CT contents and could be classified on the basis of their deactivation rate as wood ash = PEG > activated charcoal = water. In conclusion, the physical techniques tested in this study were found to be efficient in decreasing phenolic compounds in acacia leaves. The ideal treatment would be to spray water on the chopped leaves, which thereafter should be stored in sealed bags for at least 7 days. Although urea treatment deactivated these secondary compounds totally, it did not improve the nutritive value of acacia. Wood ash treatment seems to be a promising technique to deactivate tannins in shrub foliage and further studies on this inexpensive and locally available product should be encouraged.

Keywords: Shrubs; Tannin deactivation; Chopping; Storage; Urea; PEG; Wood ash; Activated charcoal; Nutritive value

1. Introduction

Phenolic compounds, mainly lignin and tannins, depress the nutritive value of many feedstuffs. Tannins are hydrosoluble polymers which form complexes, essentially with proteins. These complexes are broken under conditions of high acidity (pH <3.5) or high alkalinity (pH >7.5). Studies by several authors (Russel and Lolley, 1989; Makkar and Singh, 1993) showed that treatment of tanniniferous feed sources with alkalis (urea, sodium hydroxide, potassium hydroxide, etc.) and oxidizing agents (potassium dichromate, potassium permanganate, etc.) decreased their total extractable phenols and tannins and/or condensed tannins contents. However, the major disadvantage of these chemical treatments is the loss of soluble nutrients. Some other tannin deactivating techniques have been found to be promising. These include storage of lopped foliage, which was efficient in reducing tannin concentrations in *Quercus incana* (Makkar and Singh, 1993). Based on these findings, it seems that the benefits expected from the latter technique are derived from interactions of temperature, moisture and leaf chopping. Unfortunately, deactivating techniques, mainly senescence processes have been tested on a limited number of feed sources and it would be difficult to generalise their advantages and disadvantages on an array of tanniniferous feedstuffs. Along with earlier studies we (Ben Salem et al., 1997; Ben Salem, 1998) showed that the nutritive value of acacia and the resulting sheep and goat performance are low due to tannins and lignin. Attempts to deactivate tannins in acacia have so far focussed on the use of polyethylene glycol (PEG). Our earlier studies (Ben Salem et al., 1999a,b, 2000, 2002), have shown the significant improvement in the nutritive value of acacia, when PEG was administrated in different forms in the diets of sheep. Although encouraging, the cost and availability of PEG makes the use of this deactivating agent impractical and uneconomic. Therefore, cost-effective alternatives should be encouraged. The objectives of this study were to test the effect of (i) aerobic and anaerobic storage of *Acacia cyanophylla* leaves for various time periods, after chopping or without chopping and sprinkling or without sprinkling with water, and (ii) treatment with urea, wood ash, activated charcoal and PEG solutions of acacia leaves and or *Quercus coccifera* L. leaves, on their nutritive value with special focus on tannin contents and activity.