Total phenolic and tannins contents of some Algerian shrubs and browse species

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ABSTRACT
The objective was to evaluate levels of phenolics and tannins antinutritive factors of various Algerian shrubs and browse species (*Arthrocnemum macrostachyum*, *Atriplex canescens*, *Artemesia herba-alba*, *Astragalus gombo*, *Calobota saharae Ceratonia siliqua* (Pods), *Gleditschia triacanthos* (Pods), *Hedysarum coronarium*, *Medicago sativa, Ononis natrix* L, *Hordeum vulgare* (Straw) and *Stipa tenacissima* L.) grown in arid and semi-arid areas. Phenolic compounds were extracted following the procedures described by Makkar (2003) and determined using the Folin-Ciocalteau reagent and tannic acid as standard.The Total extractable phenols (TEP) content varied widely from 3.02 $g.kg^{-1}$ DM in S. *tenacissima* to 85.30 $g.kg^{-1}$ DM in G. *triacanthos*, whereas the content of Total extractable tannins (TET) ranged from 12.80 $g.kg^{-1}$ DM in C. *Saharae* to 69.92 $g.kg^{-1}$ DM in A. *macrostachyum*. The Free condensed tannins FCT varied widely from 4.6 $g.kg^{-1}$ DM in A. *herba-alba* to 525.0 $g.kg^{-1}$ DM in C. *siliqua* pods. Total condensed tannins TCT varied widely among species, being highest in C. *siliqua* and lowest in H. *vulgare*. The analysis of specific tannins gives an indication of the presence of some anti-nutritive factors in browse. Except for some few species (C. *siliqua* pods, G. *triacanthos* pods and H.*coronarium*, the plants material investigated in this study had low tannin contents, particularly in M.*sativa*, A. *macrostachyum* and c. *saharae* which would be of little significance in their effects on digestion of nutrients by ruminants. Low tannin contents may be beneficial to ruminants due their effect in reducing rumen degradation of forage proteins, which can be digested post-ruminally. However, high tannin contents in nutritionally important forage trees, shrubs, legumes, cereals and grains often limits their utilization as feeds tuffs.
Key Words: Phenolic compounds, Shrubs, Tannins

RESUME
L'objectif était d'évaluer les niveaux de facteurs antinutritifs phénoliques et tanins de différents arbustes et espèces fourragères algériennes (*Arthrocnemum macrostachyum, Atriplex canescens, Artemisia herba-alba*), *Medicago sativa, Ononis natrix L, Hordeum vulgare* (Straw) et *Stipa tenacissima* L.) prélevées dans des zones arides et semi-arides. Les composés phénoliques ont été extraits suivant les procédures décrites par Makkar (2003) et déterminés en utilisant le réactif de Folin-Ciocalteau et l'acide tannique comme standard. La teneur en phénols totaux extractibles variait considérablement de 3,02 g.kg-1 MS chez S. *tenacissima* à 85,30 g. kg-1 MS chez G. *triacanthos*, alors que la teneur en tanins totaux extractibles allait de 12,80 g.kg-1 MS chez C. *Saharae* à 69,92 g.kg-1 MS chez A. *macrostachyum*. La teneur en tanins condensés libres variait considérablement, allant de 4,6 g.kg-1 MS chez A. *herba-alba* à 525,0 g.kg-1 MS dans les gousses de C. *siliqu*a. Les tanins condensés totaux ont varié considérablement parmi les espèces, étant les plus élevés chez C. *siliqua* et les plus faibles chez H. *vulgare*. L'analyse de tanins spécifiques donne une indication de la présence de certains facteurs anti-nutritifs dans les plantes fourragères. À l'exception de quelques espèces (gousses C.*siliqua*, G. *triacanthos* et H. *coronarium*), le matériel végétal étudié dans cette étude avait une faible teneur en tanins, en particulier chez M.*sativa*, A. *macrostachyum* et C.*saharae*, ce qui peut être bénéfique pour les ruminants en raison de son effet réducteur sur la dégradation par le rumen des protéines fourragères, qui peuvent être digérées en aval des pré estomacs, mais des teneurs

élevées en tanin dans les espèces fourragers et les arbustes, légumineuses, céréales limite souvent leur utilisation en tant qu'aliment pour animaux.
Mots-clés: Composés phénoliques, arbustes, tanins

1. INTRODUCTION

Livestock, especially ruminants, an important component of many farming system play an important role in the food and nutritional security of millions of rural people especially in the arid and semi-arid regions in Algeria. They are valued for their meat, milk, manure and, in many cases, as sources of traction power. Traditionally, they graze natural pastures, fallow lands, crop re-growth and residues (Medjekal et al., 2018). Plants synthesize a vast range of secondary metabolites with a significant portion consisting of phenolic compounds and flavonoid compounds. These phytochemicals are structurally diverse, and many are distributed among a very limited number of species within the plant kingdom. Tanniniferous shrubs and browse species are of importance in animal production because they can provide significant protein supplements, but unfortunately the amounts of tannins that they contain vary widely and largely unpredictably, and their effects on animals range from beneficial to toxicity and death. The anti-nutritive effects of tannins are associated with their ability to combine with dietary proteins, polymers such as cellulose, hemicellulose and pectin, and minerals thus retarding their digestion (McSweeney et al., 2001). The objective was to evaluate levels of phenolic compounds and tannins antinutritive factors of various Algerian shrubs and browse species grown in arid and semi-arid areas.

2. MATERIALS AND METHODS

Twelve plant samples were used in this study: ten dicots plants nalemy *Arthrocnemum macrostachyum* (A. *macrostachyum*)., *Atriplex canescens* (A. *canescens*)., *Artemesia herba-alba*Asso (A. *herba-alba*)., *Astragalus gombo* Bunge (A. *gombo*)., *Calobota saharae* (Coss. &Durieu) Boatwr. & B.-E.vanWyk (C. *saharae*)., *Ceratonia siliqua* (C. *siliqua*)., *Gleditschia triacanthos* (G. *triacanthos*)., *Hedysarum coronarium* (H. *coronarium*)., *Medicago sativa* (M. *sativa*) and *Ononis natrix* L (*O. natrix*)., and two monocots plants namely *Hordeum vulgare* (*H. vulgare*) and *Stipa tenacissima* L. (*S. tenacissima*). Selection of the species was based on the available information on their consumption by grazing small ruminants, and on their relative abundance.The freeze dried samples were ground in a Willey Mill to pass through 1mm sieve for the determination of phenolic compounds tannins contents following the procedures described by Makkar (2003). Phenolic compounds were extracted following the procedures described by Makkar and determined using the Folin-Ciocalteau reagent and tannic acid as standard.

Table 1. Phenolic compounds and tannin contents (g kg^{-1} DM, standard equivalent)

Plant family	Plant species	Total extractable phenols	Total extractable tannins	Free condensed tannins	Total condensed tannins
Dicotyledons					
Chenopodiaceae	A. *macrostachyum*	8.34	70.93	7.6	28.6
	A. *canescens*	8.26	60,21	6.4	38.05
Asteraceae	A. *herba-alba*	3.46	17.54	3.5	44.6
Fabaceae-	A. *gombo*	10.64	67.41	7.6	36.8
Leguminosae	C. *saharae*	6.03	10,85	6.8	28.0
	C. *siliqua*	64.16	34,52	525	723.4
	G. *triacanthos*	84.35	60,92	251.8	455.5
	H.*coronarium*	50.81	27,08	258.3	512
	M. *Sativa*	4.72	33,24	9.4	25.7
	O. *natrix L.*	12.89	88,06	10.8	45.3
Monocotyledons	H. *vulgare*	1.98	19,34	6.6	25.0
Poaceae- Gramineae	S. *tenacissima L.*	62.44	37,60	7	29.7

Samples were collected in June 2010, when plants were at flowering (A. gombo and C. saharae) or at a mature stage (final stage of biological function for the rest of the species). Pods from (C. siliqua and G. triacanthos trees) were picked in November (2010) from the ground and H. vulgare was used as straw.

3. RESULTS AND DISCUSSION

The Total extractable phenols content varied widely from 1.98 $g.kg^{-1}$ DM in S. *tenacissima* to 84.35 $g.kg^{-1}$ DM in G. *triacanthos*, whereas the content of Total extractable tannins ranged from 10.85 $g.kg^{-1}$ DM in C. *Saharae* to 70.93 $g.kg^{-1}$ DM in A. *macrostachyum* (Table 1). The Free condensed tannins varied widely from 3.5 $g.kg^{-1}$ DM in A. *herba-alba* to 512$g.kg^{-1}$ DM in C. *siliqua* pods. Total condensed tannins varied widely among species, being highest in C. *siliqua* and lowest in H. *vulgare*. The analysis of specific tannins gives an indication of the presence of some anti-nutritive factors in browse. Except for some few species (C.*siliqua*, G.*triacanthos* and H.*coronarium*), the plants material investigated in this study had low tannin contents, particularly in M.*sativa*, A. *macrostachyum*and C.*saharae* which would be of little significance in their effects on digestion of nutrients by ruminants. Low level tannin (2-3% of DM) may have beneficial effect since the level of tannin in diets prevents the CP from extensive degradation through formation of protein-tannin complexes. On the other hand, high tannin level (5% of DM) in diets may result in the increased indigested CP due to excessive formation of tannin-protein complexes. Thus, low tannin contents may be beneficial to ruminants due their effect in reducing rumen degradation of forage proteins, which can be digested post-ruminally. However, high tannin contents in nutritionally important forage trees, shrubs, legumes, cereals and grains often limits their utilization as feedstuffs (Kumar and Vaithiyanathan, 1990).

4. CONCLUSION

Low tannin contents may be beneficial to ruminants due their effect in reducing rumen degradation of forage proteins, which can be digested post-ruminally. However, high tannin contents in nutritionally important forage trees, shrubs, legumes, cereals and grains often limits their utilisation as feedstuffs. Therefore, under farmers' conditions, optimal utilization of browse could be achieved through feeding a mixture of tanniferous browse with other feeds especially high in nitrogen to dilute tannin antinutritive activity.

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