

# Deactivation of tannins affects metabolizable protein profile of sainfoin (*Onobrychis vicifolia*)

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## Introduction

Sainfoin (*Onobrychis vicifolia* Scop) is a non-bloating member of the Fabaceae family (Leguminosae), which is widely grown in Europe and Asia, northern United States and southern Canada. It is a deep-rooted, tall-growing perennial with coarse stems, drought- and winterhardy, resistant to alfalfa weevil and a preferred forage for cattle, sheep, deer and elk (Graham 1941). Terry & Tilley (1964) found that Sainfoin stems were more digestible than those of alfalfa, whereas leaves and petioles were less digestible compared with alfalfa leaves and petioles. Sainfoin hay has lower crude protein (CP), crude fibre (CF) and ash than alfalfa hay harvested at the same maturity (Ditterline & Cooper 1975). Reports about Sainfoin CP and condensed tannin (CT) contents are very variable, from 102 to 285 and 25.2 to 100 g/kg dry matter (DM), respectively (Scharenberg et al. 2007). Differences in CT content are attributable to variety, stage of maturity, methods of CT analysis and ability to measure fibre- and protein-bound CT along with extractable CT. Although Sainfoin is a legume forage with high hay quality and its agronomic characteristics make it one of the most desired forages, especially in cold regions of Iran, data on the nutrient contents of Sainfoin and effects of condensed tannins on it are still quite scarce as investigations have mainly concentrated on the major forage plant species and their commercial cultivars.

## Objectives

Deactivation of tannins and evaluation of the effects on Metabolizable protein profile of sainfoin is the main objective of this study.

## Materials & Methods

Second cut forage was shade dried and chopped (3–5 cm length), and then exposed to solutions of KMnO<sub>4</sub> (0.03 M, pH 12.04), NaOH (0.05 M, pH 12.28) and water with forage to reagent ratio of 1:4 (W/V). Treatments were carried out in triplicate, at 25°C, for 20 min, with hand shaking. Condensed tannin (CT) concentration was determined using a Butanol-HCl reagent. Samples were analyzed for CP degradability using 3 ruminally fistulated Holstein cows, fed balanced rations with forage: concentrate ratio of 60:40. Samples were ground to pass a 2 mm screen and 5 g weighed in duplicate into nylon bags with 50 micron pore size and incubated in the ventral rumen up to 96 h. Effective degradability (ED) was calculated with NEWAY computer package. GLM PROC of SAS 9.1 and Duncan's Test were used for data analysis.

## Results

The CT concentration of the control forage was 21.3±0.4 g/kg dry matter. Treatments decreased CT more than 90 percent and increased degradability at all rumen incubation times. The rapidly degradable fraction increased with treatments, but NaOH was most effective. The slowly degradable fraction was not affected by treatments, but rate of degradation of this fraction was significantly increased by water and NaOH. Treatments improved ED at different rumen outflow rates. Sodium hydroxide increased RDP more. Treatments improved protein metabolizability of sainfoin. Also, digestible undegradable protein/undegradable protein ratio was improved by water and KMnO<sub>4</sub>.

## Conclusion

This study revealed that deactivation of CT can improve metabolizability of protein from tanniferous forages. Treatment of sainfoin with water, which is available on-farm and has no environmental hazard regarding its use, greatly improved protein metabolism characteristics of sainfoin.

Table1. Effects of treatments on protein ruminal degradability

Incubation time	Control	Water	KMnO <sub>4</sub>	NaOH	SEM
4	24.65 <sup>b</sup>	43.95 <sup>a</sup>	44.60 <sup>a</sup>	44.47 <sup>a</sup>	1.52
8	30.29 <sup>c</sup>	53.94 <sup>a</sup>	48.38 <sup>b</sup>	53.64 <sup>a</sup>	1.26
12	35.04 <sup>c</sup>	61.59 <sup>a</sup>	51.65 <sup>b</sup>	60.74 <sup>a</sup>	1.31
24	45.36 <sup>c</sup>	75.40 <sup>a</sup>	59.13 <sup>b</sup>	73.84 <sup>a</sup>	1.38
48	55.63 <sup>c</sup>	84.63 <sup>a</sup>	67.38 <sup>b</sup>	82.89 <sup>a</sup>	1.13
72	59.74 <sup>c</sup>	86.67 <sup>a</sup>	71.12 <sup>b</sup>	84.94 <sup>a</sup>	1.02
96	61.49 <sup>c</sup>	87.15 <sup>a</sup>	72.89 <sup>b</sup>	85.42 <sup>a</sup>	1.04
Degradability Parameters					
a (%)	17.06 <sup>c</sup>	39.53 <sup>a</sup>	31.7 <sup>b</sup>	40.04 <sup>a</sup>	
b (%)	45.92 <sup>ab</sup>	47.87 <sup>a</sup>	42.95 <sup>b</sup>	45.53 <sup>ab</sup>	1.18
c (h <sup>-1</sup> )	0.041 <sup>ab</sup>	0.066 <sup>a</sup>	0.034 <sup>b</sup>	0.063 <sup>a</sup>	0.03
P(k=0.02)	47.63 <sup>c</sup>	74.23 <sup>a</sup>	62.33 <sup>b</sup>	72.97 <sup>a</sup>	0.81
P(k=0.05)	37.87 <sup>c</sup>	63.33 <sup>a</sup>	56.03 <sup>b</sup>	62.57 <sup>a</sup>	0.96
P(k=0.08)	33.07 <sup>c</sup>	57.10 <sup>a</sup>	53.13 <sup>b</sup>	56.63 <sup>a</sup>	1.06

Different superscripts in each row show statistical differences (p≤0.05).

Table2. Effects of treatments on MP system profile of sainfoin protein

Treatments	QDP	SDP	RDP	ERDP	UDP	DUP	MP	DUP/UDP
Control	17.06 <sup>c</sup>	21.15 <sup>a</sup>	38.21 <sup>c</sup>	34.80 <sup>c</sup>	61.79 <sup>a</sup>	27.78 <sup>b</sup>	49.97 <sup>b</sup>	44.96 <sup>b</sup>
Water	39.53 <sup>a</sup>	26.53 <sup>b</sup>	66.39 <sup>a</sup>	58.16 <sup>a</sup>	33.61 <sup>c</sup>	21.42 <sup>c</sup>	58.49 <sup>a</sup>	63.04 <sup>a</sup>
KMnO <sub>4</sub>	31.78 <sup>b</sup>	16.72 <sup>b</sup>	48.49 <sup>b</sup>	42.14 <sup>b</sup>	51.51 <sup>b</sup>	32.66 <sup>a</sup>	59.51 <sup>a</sup>	63.33 <sup>a</sup>
NaOH	40.04 <sup>a</sup>	25.26 <sup>a</sup>	65.30 <sup>a</sup>	56.97 <sup>a</sup>	34.70 <sup>c</sup>	12.39 <sup>d</sup>	48.90 <sup>b</sup>	35.77 <sup>c</sup>
SEM	1.44	1.49	1.43	1.43	1.46	1.29	0.38	1.29

Different superscripts in each column show statistical differences (p≤0.05).

Table3. Effects of treatments on CNCPS protein fraction of sainfoin

Treatments	A	B1	B2	B3	C
Control	16.85 <sup>b</sup>	9.67 <sup>a</sup>	28.65 <sup>b</sup>	13.92 <sup>c</sup>	30.91 <sup>a</sup>
Water	34.22 <sup>a</sup>	1.29 <sup>c</sup>	37.19 <sup>a</sup>	17.10 <sup>b</sup>	10.21 <sup>d</sup>
KMnO <sub>4</sub>	30.09 <sup>a</sup>	9.68 <sup>a</sup>	27.60 <sup>b</sup>	17.30 <sup>b</sup>	15.23 <sup>c</sup>
NaOH	11.02 <sup>c</sup>	7.48 <sup>b</sup>	36.52 <sup>a</sup>	24.03 <sup>a</sup>	20.97 <sup>b</sup>
SEM	1.53	0.45	2.11	0.95	1.05

Values of percentage of protein.

Different superscripts in each row show statistical differences (p≤0.05).

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