Potential Nutritive Value of Field Binweed (*Convolvulus arvensis* L.) Hay Harvested at Three Different Maturity Stages

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**INTRODUCTION**

It is well established that forages play an important role for ruminant animals since forages provide energy, protein and minerals. Forages also provide fiber to ruminants for chewing and rumination. Field bindweed

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Field bindweed hay samples (0.200 g DM) milled through a 1 mm sieve were incubated in vitro with diluted rumen fluid (10 ml rumen fluid + 20 ml culture medium) in triplicate calibrated glass syringes of 100 ml following the procedures of Menke et al.11. Rumen fluid was obtained from cows fed a daily ration containing maize silage and concentrates. The cows (4 years old and 600 kg live weight) had free access to water throughout the experiment. Rumen fluid was obtained using stomach tube from two lactating and pregnant cows fed a daily ration containing 20 kg maize silage and 8 kg concentrates (18% CP and 2750 Kcal ME kg⁻¹). Rumen samples was collected before the morning meal in the thermos flaks and taken immediately to the laboratory where it was strained through 4 layers of cheesecloth and kept at 39°C. The rumen fluid was flushed with CO₂. The rumen fluid was added to buffered mineral solution in the ratio of 1:2 respectively. The syringes were prewarmed at 39°C before the injection of 30 mL rumen fluid-buffer mixture into each syringe followed by incubation in a water bath at 39°C. Gas production was recorded at 3, 6, 12, 24, 48, 72 and 96 h after incubation and corrected for blank incubation. Cumulative gas production data were fitted to non-linear exponential model as:

\[ Y = A \left(1 - \exp^{-ct}\right) \]

Where \( Y \) is gas production at time \( t' \), \( A \) is the potential gas production (ml/200 mg DM), \( c \) is the gas production rate constant (h⁻¹) and \( t \) is the incubation time (h).

Time (h) to produce 50 and 95% of potential gas production using the equation suggested by Şahin et al.12.

\[ t_{50} = 0.693/c \]
\[ t_{95} = 2.996/c \]

ME (MJ/kg DM) content of field bindweed was calculated using equation of Menke et al.11 as follows:

\[ \text{ME (MJ/kg DM)} = 2.20 + 0.136 \text{ GP} + 0.057 \text{ CP} \]

where \( \text{GP} = 24 \text{ h net gas production (ml/200 mg DM)} \)
\( \text{CP} = \text{Crude protein} \)

Organic matter digestibility (%) of field bindweed was calculated using equation of Menke et al.11 as follows:

\[ \text{OMD (％)} = 14.88 + 0.889 \text{GP} + 0.45 \text{CP} + 0.0651 \text{XA} \]

where \( \text{XA}: \text{ash content (％)} \).

One-way analysis of variance (ANOVA) was used to determine the effect of maturity stage on the chemical composition, gas production kinetics, and some estimated parameters such as ME and OMD of field bind-weed hay using SPSS 13. Significance between individual means was identified using the Tukey’s multiple range tests. Mean differences were considered significant at (P<0.05) 14.
The effect of maturity stage on the chemical composition of field bindweed hay is presented in Table 1. The maturity stage has significant effect on the chemical composition of field bindweed hay. Dry matter (DM), NDF, ADF and ADL of field bindweed hay increased whereas CP, ash and EE content decreased with maturity. Dry matter (DM), CP, ash, EE, NDF, ADF, ADL, CT of field bindweed hay ranged from 21.34 to 30.40, 16.63 to 23.83, 3.47 to 7.97, 2.41 to 4.92, 34.00 to 54.04, 28.76 to 40.34, 5.26 to 12.18 and 0.57 to 0.84% respectively.

The effect of maturity stage on gas production at different time intervals is presented in Fig. 1. At all incubation times, gas production at pre-flowering stage was significantly higher than those of flowering and seeding stages.

The effect of maturity stage on gas production kinetics, ME, OMD of field bindweed hay is represented in Table 2.

The maturity had a significant effect on the gas production kinetics (c, A, t50 and t95) and estimated parameters such as ME and OMD. The gas production kinetics and estimated parameters such as ME and OMD of

<table>
<thead>
<tr>
<th>Nutrients (%)</th>
<th>Maturity Stages</th>
<th>SEM</th>
<th>Sig.</th>
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<tbody>
<tr>
<td></td>
<td>Pre-flowering</td>
<td>Flowering</td>
<td>Seeding</td>
</tr>
<tr>
<td>DM</td>
<td>21.34&lt;sup&gt;a&lt;/sup&gt;</td>
<td>23.39&lt;sup&gt;b&lt;/sup&gt;</td>
<td>30.40&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>CP</td>
<td>23.83&lt;sup&gt;a&lt;/sup&gt;</td>
<td>20.71&lt;sup&gt;b&lt;/sup&gt;</td>
<td>16.63&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Ash</td>
<td>7.97&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.13&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.47&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>EE</td>
<td>4.92&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.70&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.41&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>NDF</td>
<td>34.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>40.35&lt;sup&gt;b&lt;/sup&gt;</td>
<td>54.04&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>ADF</td>
<td>28.76&lt;sup&gt;a&lt;/sup&gt;</td>
<td>34.23&lt;sup&gt;b&lt;/sup&gt;</td>
<td>40.34&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>ADL</td>
<td>5.26&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.39&lt;sup&gt;b&lt;/sup&gt;</td>
<td>12.18&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>CT</td>
<td>0.84</td>
<td>0.72</td>
<td>0.57</td>
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**a, b, c:** Row means with common superscripts do not differ (P>0.05); s.e.m.: standard error mean; Sig.: significance level; DM: Dry matter %, CP: Crude protein, EE: Ether extract, NDF: Neutral detergent fiber, ADF: Acid detergent fiber, ADL: Acid detergent lignin, CT: Condensed tannin, NS: Non-significant; *** (P<0.001)
field bindweed hay decreased with increasing maturity.

The gas production rate (c), potential gas production (A), time to produce 50 and 95% of potential gas production ranged from 0.08 to 0.099, 61.59 to 71.77 ml, 6.96 to 8.68 h and 30.13 to 37.54 h. On the other hand, ME and OMD of field bindweed hay ranged from 9.31 to 11.71 MJ /kg DM and 63.19 to 79.17% respectively.

**DISCUSSION**

There was marked changes in the chemical composition of field bindweed with increasing maturity. The crude protein content of field bindweed hay is in excess of that proposed as the minimum requirements for lactation (12% of DM) and growth (11.3% of DM) in ruminants. High crude protein levels suggests field bindweed hay with potential as N supplements to ruminants fed low quality forages during dry season. The concentration of field bindweed hay harvested at seeding stage was comparable with that reported by Kazemi et al. who found that field bindweed contained 17.41% crude protein. It was well established that CP content of plants decreases with increasing maturity. This decrease in CP contents results from decrease in CP in leaves, while stems, which had a lower protein concentration, represented a larger proportion of the available herbage in more mature forages. Several researchers estimated the daily reduction in CP contents of plant using the difference between CP of hay obtained at pre-flowering and seeding stages, divided by the time (days) required to reach from flowering to seeding stage. In the current study, the reduction in CP content of field bindweed hay was 3.01 g/kg/day. This reduction was considerably higher than those reported by Minson, Kamalak and Canbolat and Kamalak et al. who reported that the average decline in crude protein concentration with advancing maturity averaged 1.082 and 2.34 g/kg/day respectively. It is well known that high level of CT in forages may adversely affect of the microbial and enzyme activities. However, in this experiment, the condensed tannin levels of field bindweed hay harvested at three maturity stages were lower than those considered detrimental to ruminant animals.

There was also marked changes in the gas production and estimated parameters of field bindweed with increasing maturity. The decline in gas production and estimated parameters is possibly associated with increase in cell wall contents (NDF, ADF and ADL) of field bindweed with maturity. It is well known that cell wall contents are more indigestible fractions of plant. Blummel and Orskov suggested that gas production is associated with volatile fatty acid (VFA) production following fermentation of substrate so the more fermentation of a substrate the greater the gas production, although the fermentation end products do influence more closely with gas production. As a result, there was reduced gas production from the indigestible fractions with increasing maturity. The reduction in CP concentration and gas production resulted in OMD and ME concentration of field bindweed also decreased with increasing maturity. These results obtained in the current study are consistent with findings of Kamalak, Kamalak and Canbolat and Kamalak et al. Even if there is a reduction in ME content of field bindweed with maturity, the ME content of field bindweed obtained at pre-flowering was similar to that of maize silage which is commonly regarded as a very high energy forage with a typical ME concentration of 11.7 MJ kg⁻¹ DM. Thus it is suggested that field bindweed could be used not only as a basic forage in the ruminant ration, but also as a high energy feed.

In conclusion, although there was a marked decline in nutritive value of the forage of field bindweed hay with advancing maturity, even at the seeding stage, the forage had high CP content and was quite digestible. Field bindweed hay showed promising potential for

<table>
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<th>Estimated Parameters</th>
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<tr>
<td></td>
<td>Pre-flowering</td>
<td>Flowering</td>
<td>Seeding</td>
</tr>
<tr>
<td>c</td>
<td>0.099ᵃ</td>
<td>0.079ᵇ</td>
<td>0.080ᵇ</td>
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<tr>
<td>A</td>
<td>71.77ᵃ</td>
<td>68.51ᵇ</td>
<td>61.59ᵇ</td>
</tr>
<tr>
<td>t₅₀</td>
<td>6.96ᵃ</td>
<td>8.67ᵇ</td>
<td>8.68ᵇ</td>
</tr>
<tr>
<td>t₉₀</td>
<td>30.13ᵇ</td>
<td>37.5₁ᵃ</td>
<td>37.54ᵃ</td>
</tr>
<tr>
<td>ME</td>
<td>11.71ᵃ</td>
<td>10.5⁰ᵇ</td>
<td>9.3¹ᶜ</td>
</tr>
<tr>
<td>OMD</td>
<td>79.17ᵃ</td>
<td>71.1₁ᵇ</td>
<td>63.1⁰ᵇ</td>
</tr>
</tbody>
</table>

ᵃᵇᶜ Row means with common superscripts do not differ (P>0.05); s.e.m.: standard error mean; Sig.: significance level; NS: Non-significant, c: gas production rate (%); A: potential gas production (mL); ME: Metabolisable energy (MJ /Kg DM); OMD: Organic matter digestibility %; ** P < 0.01; *** P<0.001
ruminant animals. However, further studies especially on animal responses, is required to confirm the nutritional characteristics indicated in the current study.

REFERENCES


