INTAKE, GROWTH AND FEED PREFERENCE BY STEERS FED COMBINATIONS OF ALFALFA AND ANNUAL RYEGRASS SILAGE

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ABSTRACT
Nutritive value and intake of legumes is generally considered superior to grasses when ensiled at similar digestibility. The objectives of this experiment were to determine the optimum combination of annual ryegrass (*Lolium multiflorum*) and alfalfa (*Medicago sativa*) silages to maximize growth rate of steers fed silage, determine chemical components which influenced performance, and to determine if steers selected the optimum mixture when given a choice. Both silages contained similar concentrations of dry matter, acid detergent fibre and organic acids, but alfalfa silage had higher concentrations of nitrogen (N), soluble N and ammonia N. Annual ryegrass contained more neutral detergent fibre. In a 12-wk growth trial, voluntary intake by steers was not influenced when the proportion of the two silages was changed from 0 to 1 in 0.25 increments. However, rate of gain increased linearly ($P<0.001$) as the proportion of ryegrass silage was increased. When conditioned to either of the two silages, steers showed a significant preference for ryegrass over alfalfa ($P<0.5$). However, when conditioned to a mixture of both silages no preference was elicited. The results suggested that extensive solubilization and deamination of protein in alfalfa silage nullified the expected intake and performance advantage to feeding a legume.

KEYWORDS
Legume, alfalfa, grass, annual ryegrass, silage, steer performance, feed preference, intake

INTRODUCTION
In Atlantic Canada, forages are the least expensive and most suitably adapted feed source for ruminants. However, animal performance from such crops is often disappointing, principally because forage quality is insufficient. This can be overcome by conserving crops at an earlier stage of maturity. For grasses, this is an acceptable approach. However, for legumes conserved at an earlier stage of maturity, crude protein (CP) levels are too high (NRC, 1984). This leads to poor CP utilization in the animal (Beever et al., 1987) and excessive loss of nitrogen (N) to the environment Broderick, 1995). Nevertheless, legumes are considered a superior animal feed to grasses due to higher intake and better utilization of digested nutrients (Thomson et al., 1991). To take advantage of legumes without having to deal with potential problems associated with high CP concentration, grasses and legumes can be fed in combination. While many are fed in combination as a result of being grown in combination (mixtures), relatively little work has been undertaken where the balance between the two species is controlled. Thus little is known about the optimum proportions of grasses and legumes which should be used in mixtures from the standpoint of animal utilization. Silages known to differ in voluntary intake characteristics may also have different feed preference characteristics. Exploiting the animal's innate sense of requirements may help us design forage mixtures which optimize utilization and performance. The objectives of this experiment were to determine the optimum combination of grass and legume silages to maximize growth rate, determine chemical components which were contributing to optimizing performance, and to determine if steers selected the optimum mixture when given a choice.

METHODS
Second-cut alfalfa (*Medicago sativa*) was harvested in September and ensiled in a bunker silo (289 g dry matter (DM)/kg) and third-cut annual ryegrass (*Lolium multiflorum*) was harvested in October and ensiled in a tower silo (330 g DM/kg).

Silages were fed in a growth trial lasting 12 wk using 40 steers (initial average body weight (BW) 330 kg) which were blocked according to BW and assigned to one of five treatments. These comprised solely of alfalfa and annual ryegrass silage mixtures except for a mineral mix which was top-dressed at 100 g/d. The proportion of alfalfa silage increased from 0 to 1 in 0.25 increments on a DM basis. Silage was fed once a day in the morning at a level sufficient to ensure 5% weighbacks. Uneaten silage was removed 1 h prior to feeding. Steers were weighed every 14 d prior to feeding with water being withheld overnight.

A further eight steers were used in a Latin square design trial to determine if steers preferred one silage over the other when given a choice. During weeks 1 to 3 of each period, steers were fed one of three silage combinations; all alfalfa, alfalfa/ryegrass mixture (50/50, DM basis) or all ryegrass. In week 4 all steers received an equal amount of alfalfa and ryegrass in adjacent feed troughs. Steers were free to choose from either trough, and the two silages were alternated between troughs each day. Rate of feed consumption over 8 h was recorded by weighing feed remaining every hour on the last 2 consecutive days of the week.

During the growth trial, samples of the two silages offered every day were taken and combined over 14 d for analysis of DM, organic matter (OM), acid detergent fibre (ADF), neutral detergent fibre (NDF), N, trichloroacetic acid (TCA) insoluble N, ammonia N, organic acids, alcohols and pH (Charmley et al., 1996). Samples of uneaten silage were taken once a week and analysed for DM, N and NDF.

The growth trial was statistically analysed as a randomized block design. The effect of increasing the proportion of alfalfa silage was assessed using polynomial regression analysis (Genstat V, Lawes Agricultural Trust, 1990). The feed preference trial was analysed as an incomplete Latin square. The effect of treatment imposed during weeks 1 to 3 in each period on consumption of alfalfa or ryegrass was assessed.

RESULTS AND DISCUSSION
For the alfalfa and ryegrass silages, respectively, the DM was 299 and 302 g/kg, and of the DM (g/kg DM) OM was 937 and 930, N was 36 and 31 g/kg, TCA soluble N was 17.9 and 11.8, ammonia N was 7.8 and 5.4, ADF was 311 and 303, NDF was 389 and 484, lactic acid was 32 and 33, volatile fatty acids were 20.4 and 18.2, alcohols were 10.8 and 4.8, and pH was 5.54 and 4.94. Alfalfa silage differed from ryegrass silage having higher total N (15% higher), soluble N (50% higher) and ammonia N (44% higher) concentrations. The pH of alfalfa silage was also higher, this being attributed to a higher buffering capacity. Although ADF concentrations were similar between silages, as expected alfalfa contained approximately 25% less NDF than ryegrass.

Voluntary intake was not influenced by changing the proportions of alfalfa and ryegrass in the diet (Table 1). This observation was unexpected since most literature indicates that intake of legumes is greater than grasses when ensiled at similar digestibility (Cook and Wilkins, 1981; Thompson et al., 1991; Wilman and Williams, 1993). However, ensiling can have a modifying effect on voluntary intake. Factors known to reduce voluntary intake of silages include ammonia (Cushnahan et al., 1995) certain VFA (Buchanan-Smith and Phillip, 1986) and the amount of soluble N (Charmley et al. 1995). Soluble N and ammonia N concentrations differed between the silages, being some 40 to 50% higher for the alfalfa when expressed on a DM basis. In the absence of other fermentation differences between the silages, it is concluded that soluble N and ammonia may have

contributed to the absence of an intake response to the legume silage. Intake of NDF increased from 2.9 to 3.8 kg/d as the proportion of ryegrass in the diet was increased suggesting that NDF was not a primary regulator of voluntary intake. Similar results were reported by Thompson et al. (1991).

Although voluntary intake was not influenced by altering the proportion of alfalfa and ryegrass silages in the diet, rate of gain increased linearly with the proportion of ryegrass silage (Table 1). Thus feed conversion efficiency was higher for ryegrass silage than alfalfa silage. Both silages were of similar ADF concentration, suggesting similar digestibility, however, this detail remains to be confirmed. Currently, it has to be assumed that the response in gain was due to improved efficiency of protein utilization. Charmley et al. (1995) demonstrated a similar effect when protein solubility is altered by the use of silage additives. Alternately, increased digesta load in steers on ryegrass diets may have increased total BW gain but not empty body gain (Thomson et al., 1991).

Results of the preference study (Table 2) showed that although there was not a marked difference in voluntary intake of the two silages, steers showed a definite preference for ryegrass over alfalfa. Steers that had been conditioned to alfalfa during the 3-wk conditioning phase of each period, showed a marked preference for ryegrass as evidenced by consumption of the two silages. Steers conditioned to ryegrass still showed a preference for ryegrass, although this was not as pronounced. Only steers that had been conditioned to a mixture of the silages showed no significant preference for one silage over another. These results suggest that preference testing could be a relatively simple means whereby nutritive value of silages could be judged.

The objective of this trial was to determine an optimum combination of legume and grass in the diet in order to determine optimum combinations of legumes and grasses in mixed swards for silage. However, the results indicated that pure ryegrass was superior to any combination of ryegrass and alfalfa. This was contrary to expectation and suggests an over-riding influence of silage fermentation quality, specifically the higher concentrations of soluble protein and ammonia N concentration in alfalfa silage. The preference study suggests that these factors are potent influences determining preference for one silage over another.

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Table 1
Intake and performance of steers fed alfalfa and ryegrass silages in various proportions

	Proportion of alfalfa/annual ryegrass silage in diet						
	1/0	0.75/0.25	0.5/0.5	0.25/0.75	0/1	SEM	Linear effect
DM intake (kg/d)	7.61	7.55	7.68	7.69	7.88	0.26	NS
DM intake (g/kg BW)	21.8	21.7	21.4	21.7	22.1	0.46	NS
NDF intake (g/d)	2.96	3.11	3.35	3.53	3.81	-	-
BW gain (kg/d)	0.577	0.724	0.794	0.841	0.905	0.079	<0.001
Feed to gain ratio	14.6	11.2	10.1	9.7	9.6	1.24	<0.001

Table 2
Amounts of alfalfa and ryegrass silages remaining (%) after feeding when offered separately to steers that had been conditioned to eating either alfalfa silage, ryegrass silage or a mixture of the two

Previous conditioning treatment	Alfalfa		Mixture		Ryegrass		
	Alfalfa	Ryegrass	Alfalfa	Ryegrass	Alfalfa	Ryegrass	SEM
% remaining after							
1 h	91	71**	86	83	98	63***	4.8
4 h	85	49**	68	67	92	35***	7.2
6 h	68	34*	53	46	79	14***	9.5
8 h	55	19^{+}	43	39	67	8***	8.9

Superscripts denote a significant difference in feed remaining within previous conditioning treatment;
$^{+}$P<0.10, *P<0.05, **P<0.01, ***P<0.001.