

Effects of flavouring agents on intake of silage by feedlot steers

M. J. Corkum¹, L. A. Bate¹, A. Lirette², and T. Tennessen²

¹Department of Anatomy and Physiology, University of Prince Edward Island, Charlottetown, Prince Edward Island, Canada C1A 4P3; and ²Department of Animal Science, Nova Scotia Agriculture College, Truro, Nova Scotia, Canada B2N 5E3. Received 18 August 1993, accepted 7 February 1994.

Corkum, M. J., Bate, L. A., Lirette, A. and Tennessen, T. 1994. **Effects of flavouring agents on intake of silage by feedlot steers.** *Can. J. Anim. Sci.* **74**: 387–389. Thirty-five yearling Hereford steers with an average weight of 358 ± 32 kg were randomly assigned to one of five groups of seven animals to determine the effect of adding flavouring agents to grass-legume silage at feeding time. The trial was designed as a 5×5 Latin square with each group receiving each of the 5 treatments for a 12-d period. The flavouring agents chosen represented major taste groups: sweet (aspartame (Asp) at 0.025% as fed), acid (hydrochloric acid (HCl) at 0.625% as fed), salt (sodium chloride (NaCl) at 0.6% as fed), and monosodium glutamate (MSG) at 1% as fed. Daily intakes were measured. Monosodium glutamate increased silage intake ($P < 0.05$). The results suggest that addition of MSG may be of possible practical use as a silage additive to increase silage intake by yearling steers.

Key words: Steer, aspartame, monosodium glutamate, intake, flavour, silage

Corkum, M. J., Bate, L. A., Lirette, A. et Tennessen, T. 1995. **Effets des agents de sapidité sur l'ingestion d'ensilage par des bouvillons à l'engraissement.** *Can. J. Anim. Sci.* **74**: 387–389. Trente-cinq bouvillons Hereford d'un an, pesant en moyenne 358 ± 32 kg, ont été répartis au hasard en cinq groupes de sept pour déterminer l'effet de l'adjonction d'agents de sapidité à un ensilage graminée-légumineuse au moment de la distribution. L'essai était disposé en carré latin 5×5 , chaque groupe recevant chacun de 5 traitements pendant une période de 12 jours. Les agents de sapidité retenus représentaient les grands groupes de saveur: sucrée (aspartame à raison de 0,025%), acide (HCl à raison de 0,625%), salée (NaCl à 0,6%) et glutamate de sodium (MSG à 1%). Toutes ces concentrations étaient mesurées à la distribution. Le MSG accroissait l'ingestion journalière d'ensilage ($P < 0,05$), ce qui porte à conclure que ce produit pourrait être utilisé dans l'ensilage, pour accroître la consommation par les bouvillons d'un an.

Mots clés: Bouvillons, aspartame, glutamate de sodium, ingestion, saveur, ensilage

Palatability is the sum of factors that operate to determine to what degree a food is attractive to animals relative to other available feeds. The effect of palatability on intake is as important as that of digestibility. Changing the palatability without changing digestibility has shown a dramatic effect on intake (Greenhalgh and Reid 1967). A major component of palatability is taste, which is very important in food acceptance. To be productive, feedlot animals need to eat diets in excess of their maintenance requirements. Numerous studies have shown that addition of flavouring agents to feed increases the amount of dry matter intake, so flavouring agents are often incorporated in commercially produced concentrate and starter rations (Waldren and VanDyk 1971). Flavouring agents like monosodium glutamate (MSG) have been shown to increase the intake of starter rations by calves and the intake of roughage by sheep (Waldren and VanDyk 1971; Grovum and Chapman 1988). In monogastric animals, MSG's components have been associated with depressed food intake, while its sweetening effects have been associated with increased appetite (Blundell and Hill 1986). Animals in a sodium-deficient situation have been shown to have an increased desire for the taste of salt (Goatcher and Church

1970a), but little work has been done on effect of the palatability of salt on an animal that is not in a salt-deficit situation. Comparative studies have shown that goats, lambs and calves differ in their responses to acidic tastes and that cattle seem to be the most sensitive to acidic tastes (Goatcher and Church 1970b). There is very little information on the use of flavouring agents and their effects when added to silage. The objective of this research was to obtain information about the effects of the addition of flavouring agents on the intake of silage.

Thirty-five Hereford steers with an average weight of 358 ± 32 kg were randomly assigned to one of five groups of seven animals. The trial was divided into five 12-d periods. Animals were individually fed and given continuous access to ad libitum grass/legume silage through Calan Broadbent® gates. All animals were trained to use the gates, and had used them for 1 yr prior to the trial. Water was available ad libitum. Fresh silage was offered every day at 08:30 h and flavouring agents representing major taste groups — aspartame (Asp), hydrochloric acid (HCl), salt (NaCl), and MSG — were added to the silage immediately prior to feeding and mixed with the silage for a 5 min minimum using a Calan

Broadbent Data RangerTM. The additives were Fisher laboratory-grade chemicals, with the exception of MSG and Asp, which were commercial grades supplied by Ajinomoto (Japan) and Nutrasweet (Deerfield, IL), respectively. Silage for the different groups contained either Asp at 0.025% as fed, HCl at 0.625% as fed, NaCl at 0.6% as fed, or MSG at 1% as fed; silage alone served as a control.

The silage was a 50:50 grass/legume silage made from perennial rye grass and alfalfa that met National Research Council (1984) nutritional requirements for steers at this stage of growth. The silage composition and pH were analyzed twice during the trial by the Plant Industry Branch of the Nova Scotia Department of Agriculture and Marketing. Trace-mineral salt blocks (Co-Op; 99% NaCl, 7 mg iodine kg⁻¹, 40 mg cobalt kg⁻¹) were continuously available to all animals.

Silage was fed in excess of 15%, and feed not consumed was weighed back daily just prior to the next feeding. There was no obvious sorting of the silage observed, and orts were assumed to have a composition similar to that of the initially fed silage.

The animals used in this experiment were cared for under guidelines comparable to those stated in the guide to the care and use of experimental animals provided by the Canadian Council on Animal Care.

The study was designed as a 5 × 5 Latin square. The statistical analysis for all parameters was performed using general linear models with a Duncan's multiple-range test to distinguish treatment differences. The analysis was performed using SAS Institute, Inc. (1985) software. All results are reported with mean ± SE of the mean.

Silage intake was increased by the application of MSG ($P < 0.05$). The steers consuming Asp-treated silage tended to have the lowest intake of all treatments, but this was not different from the HCl-treated silage or control ($P > 0.05$) (Table 1).

The increase in silage intake that resulted from the application of MSG could be due to an increased palatability and (or) substrate effects. Sheep fed coarsely chopped straw showed quadrupled intakes when the straw was sprayed with MSG at 2% (Grovm and Chapman 1988). Dairy calves increased their intakes of concentrate when 2 g MSG kg⁻¹ was added to starter rations (Waldren and VanDyk 1971). The increased intake of silage containing MSG was most likely due to the combination of factors that include the flavour enhancement of the silage by the glutamate tastes. MSG can modify flavour; thus, MSG is used in the food industry as a flavour enhancer.

Intake of salty and sour material represented by NaCl and HCl, respectively, was not different ($P > 0.05$) from the control; this may be due to the effect of the continuously available salt blocks. Sham-fed sheep given pelleted alfalfa containing 50–200 g NaCl kg⁻¹ had increased intakes (Grovm and Chapman 1988). These results could be due to the need for NaCl after it is lost in the saliva: oesophageal-fistulated animals lose sodium in saliva that leaks through the fistulas. The results of the silage analysis demonstrated that the NaCl-treated silage dry matter contained $0.65 \pm 0.11\%$ NaCl ($n = 3$), which was significantly more sodium than in the

Table 1. Average daily intake of steers fed silage with different flavouring agents

Flavouring agent	Average daily intake (kg d ⁻¹)	
	Mean	SE
Flavouring agent		
Monosodium glutamate	24.1a	0.43
Sodium chloride	22.8bc	0.46
Control	22.6bcd	0.50
Hydrochloric acid	22.3bcd	0.52
Aspartame	22.0d	0.51

a–d Means followed by the same letter within a column are not different from each other ($P > 0.05$).

control and the HCl- and Asp-treated silage, which all contained <0.05% sodium ($n=8$). The amount of sodium found in the MSG-treated silage ($n=3$) was substantially but not significantly lower ($0.48 \pm 0.08\%$) than in the NaCl-treated silage. The animals in this trial did not appear to be craving the taste of salt, as they had a consistent supply via the salt block; the addition of salt to the diet had no effect on silage intake compared with the control. It was concluded from this that the increased intake of silage containing MSG was not due to the appetite for sodium.

Addition of HCl at 25 g kg⁻¹ of feed has been shown to increase intakes of pelleted alfalfa in sham-fed sheep (Grovm and Chapman 1988). In this study HCl did not have any effect on intakes compared with the control, probably as a result of masking of flavour by the already acidic silage and dilution of HCl by the high moisture content of the silage. The silage in the control, MSG, NaCl and Asp groups had a pH of 4.04 ± 0.09 ($n=9$) and in the HCl-treated group had a pH of 3.9 ± 0.0 ($n=2$). Adding 0.018% HCl to water resulted in increased intakes of water in sheep but had no effect when added to food (Goatcher and Church 1970b). It was hypothesized that this may be due to a masking of the flavour of the food. Sheep with oesophageal fistulas decreased their intake when HCl was offered at 5% in their food (Grovm and Chapman 1988).

Cattle have no electrophysiological taste sensation from Asp (Hard and Hellekant 1989), and it has been suggested that Asp is not a good sweetener for ruminants or swine but may play a role in the stimulation of intake in some species. It is possible that the effects of Asp in this trial may have been post-ingestive. Asp may affect intake because it is a methyl ester of a dipeptide aspartylphenylalanine, and phenylalanine stimulates the release of cholecystokinin, a gut peptide that is associated with satiety (Blundell and Hill 1986). Rogers et al. (1990) provided clear evidence of the post-ingestive inhibitory action of Asp on appetite. When human volunteers consumed a small dose (162 mg) of Asp in capsules, they had reduced food intakes and less motivation to eat.

Flavouring agents with negligible nutritional values can alter silage intake by steers. The results from this study suggest that Asp and HCl are not intake stimulants for cattle. Cattle that are not sodium deficient most likely do not have an increased appetite for salt. This study has dealt with short-term (12-d) measurement of silage intake. The results indicate that addition of MSG may be of practical use as a silage additive to increase silage intake by feedlot steers.

The financial support of the Atlantic Canada Livestock Feed Initiative program is gratefully acknowledged. We wish to thank Gary Wallace and Peter MacIntyre for their technical assistance in data collection.

- Blundell, J. E. and Hill, A. J. 1986.** Paradoxical effects of an intense sweetener (aspartame) on appetite. *Lancet* **1**: 1092–1093.
- Goatcher, W. D. and Church, D. C. 1970a.** Taste responses in ruminants. III. Reaction of pygmy goats, normal goats, sheep and cattle to sucrose and sodium chloride. *J. Anim. Sci.* **31**: 364–372.
- Goatcher, W. D. and Church, D. C. 1970b.** Taste responses in ruminants. IV. Taste responses of pygmy goats, sheep and cattle to acid and quinine hydrochloride. *J. Anim. Sci.* **31**: 373–382.
- Greenhalgh, J. F. D. and Reid, G. W. 1967.** Separating the effect of digestibility and palatability on food intake in ruminant animals. *Nature (London)* **214**: 744.
- Grovum, W. L. 1984.** Controls over the intake of straw by sheep: effects of form of diet and intake stimulants on sham feeding. *Can. J. Anim. Sci.* **64**(Suppl.): 150–151.

Grovum, W. L. and Chapman, H. W. 1988. Factors affecting the voluntary intake of food by sheep. 4. The effect of additives representing the primary tastes on sham intakes by oesophageal fistulated sheep. *Br. J. Nutr.* **59**: 63–72.

Hard, C. and Hellekant, G. 1989. The sweet taste in the calf. I. Chorda tympani proper nerve responses to taste stimulation of the tongue. *Physiol. Behav.* **45**: 633–638.

National Research Council. 1984. Nutrient requirements of beef cattle. 6th ed. NRC, Washington, DC.

Rogers, P. J., Pleming, H. C. and Blundell, J. E. 1990. Aspartame ingested without tasting inhibits hunger and food intake. *Physiol. Behav.* **47**: 1239–1243.

Statistical Analysis System Institute, Inc. 1985. Statistical methods. SAS Institute, Inc., Cary, NC.

Waldren, D. E. and VanDyk, R. D. 1971. Effect of monosodium glutamate in starter rations on feed consumption and performance of early weaned calves. *J. Dairy Sci.* **54**: 262–265.