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Effect of added sugar on preference and intake by sheep of hay cut in the morning versus the afternoon

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Abstract

Ruminants prefer hay cut in the afternoon to hay cut in the morning, presumably because hay cut in the afternoon contains higher concentrations of non-structural carbohydrates than hay cut in the morning. We determined if adding sugars (glucose and sucrose) to ground hay would account for differences in preference and affect intake of hay. Alfalfa hay cut either in the afternoon (PM) or the following morning (AM) was used in the trials. Glucose and sucrose were added to AM hay (AMS) to make its sugar content similar to PM hay. During the first trial, lambs received a choice of either: (1) AM and PM hay; (2) AMS and PM hay; or (3) AMS and AM hay. Lambs preferred PM to AMS or AM hay. We also studied how increasing the concentration of added sugars affected preference for hay. Lambs received a choice of AM hay and AM hay with either 1, 2, 3, or 4% added sugar. On the first day of the trial, lambs ate similar amounts of each hay type, regardless of the amount of sugar added. By the end of the trial, lambs preferred hay with 2, 3, or 4% added sugar compared with AM hay without added sugar. During the intake trial, lambs ate similar amounts of AM, AM hay with added starch and sugar (AMSS), and PM hay. After the intake trial, a final preference trial determined that prolonged exposure

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to AMSS hay increased preference for AMSS hay compared with AM hay. Our results indicate that preference for PM hay is likely related to increased levels of sugars, such as glucose and sucrose, and that lambs learn about the post-ingestive benefits of exogenous sugars added to hay.

Keywords: Sheep; Intake; Preference; Non-structural carbohydrates; Sugars

1. Introduction

Hay cut in the afternoon contains higher quantities of total non-structural carbohydrates (TNC) than hay cut in the morning. Though differences in TNC between morning and afternoon cut hay are small (generally less than 2%), numerous studies have demonstrated that ruminants (Fisher et al., 1999, 2002) and horses (MacKay et al., 2003) prefer hay cut in the afternoon to hay cut in the morning. Preference for hay cut in the afternoon may be due to the additional energy provided by these slight increases in TNC. Ruminants may reap additional benefits from TNC beyond the extra energy they receive because soluble carbohydrates, especially sugars, increase microbial protein synthesis from inorganic nitrogen in the rumen (Chamberlain et al., 1985).

Sheep form strong preferences for foods and flavors based on feedback from nutrients, such as energy and protein (Provenza, 1995; Villalba and Provenza, 1996, 1997a,b). Even small quantities of nutrients can condition preferences. For example sheep formed preferences for flavored straw when gavaged with a starch and water solution that provided only 2.5% of their daily energy requirement (Villalba and Provenza, 1997b).

To date, evidence supporting the hypothesis that higher levels of TNC in hay cut in the afternoon accounts for the increase in preference is purely correlative. We investigated whether adding small amounts of sugar and starch would cause sheep to increase their preference for hay cut in the morning. In addition, we determined if lambs would ingest more hay if it were cut in the afternoon rather than the morning or if it contained a larger proportion of sugars and starch.

2. Materials and methods

2.1. Animals and housing

Feeding trials were conducted at Utah State University's Green Canyon Ecology Center in Logan, UT, USA. We used 5-month-old white-faced lambs (commercial crossbreeds) in all trials. Lambs were weaned at 60 days and reared on alfalfa pellets, grass hay and barley. They were placed in individual pens prior to the onset of the trials.

2.2. Foods

Alfalfa hay was harvested at the Northwest Irrigation and Soils Research Laboratory in Kimberly, ID, USA, at sundown on June 16 (PM) and at sunup on June 17 (AM). Hay was field-dried and baled prior to shipment to Logan, UT, USA, for preference and intake trials.