

Palatability of Alfalfa (*Medicago sativa* L.) and Orchard Grass (*Dactylis glomerata* L.) Silages

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Abstract The objective was to compare palatability with different methodologies for characterizing silages at Chapingo Autonomous University, México. Eight silages were used resulting from an experiment which evaluated effects of cutting time (08:00 and 14:00), time of wilting (0, 1 and 2 h) and use of lactic bacteria inoculant on properties of alfalfa (*Medicago sativa* L.) and orchard grass (*Dactylis glomerata* L.) silages. Organoleptic properties (odor, color, texture, moisture) were assessed by trained observers, using as categories: excellent, good, fair and poor. Dry matter content, CO₂ rate of production and pH were also measured. For the evaluation of palatability with ewes, the experiment encompassed 18 days of adaptation and 14 days of measurement. In each of the 14 days of evaluation, four combinations of silages were evaluated (three silages per combination), each one assigned to experimental units formed by three ewes allotted by means of ratified random; each experimental unit was housed during 2.5 h in a pen with three feeders. The silages to be evaluated daily by each experimental unit were allotted randomly to these feeders. Silages harvested at 14:00 achieved highest scores in organoleptic, preference and intake evaluations. Results of preference and intake were similar and the results of PCA ordering of treatments resembled those of odor and texture and were opposite to those of pH and in a lesser extent also to those of aerobic deterioration. The organoleptic evaluation resulted an easy and cheap method to characterize silages, which results were reliable predictors of preference and intake (and hence quality) of alfalfa and orchard grass silages.

Introduction

Low water-soluble carbohydrates content, high protein and organic acids contents, and concomitant high buffering capacity make Alfalfa forage difficult to ensile. To improve the characteristics of silage, forage can be harvested in the afternoon with prior wilting and with the addition of bacterial inoculants. Laboratory techniques can be used to assess silage quality, but at the field level, organoleptic properties are a very versatile and accurate way to evaluate the quality of silage (Ojeda 2000). Palatability is an indicator that triggers preference. Kirilov et al. (2006) stated that forage intake is related to palatability, being this a crucial indicator of forage quality. The evaluation of forage palatability is done by tests of intake, where the animals have simultaneous access to several forages placed in feeders. The results obtained in intake tests of different forages allow comparisons between the number of visits to each one of them, these results can be considered as relative indicators of their preference.

Based on the above stated, the objective was to evaluate the chemical and organoleptic characteristics and the palatability of eight alfalfa and orchard grass silages made with different treatments and to analyze the relationship between chemical properties, organoleptic indicators, and palatability.

Methods and Study Site

The study was conducted at Chapingo Autonomous University, Mexico (19° 29' N, 98° 54' W, 2240 m altitude) under a temperate subhumid climate with summer rains. The experimental animals were 21 Creole and Rideau ewes, with in average 32.9 kg live weight, distributed in seven experimental units of three ewes. Eight silages from the experiment reported by Améndola-Massiotti et al. (2018) were selected for contrasting organoleptic properties and used here. In the experiment from Améndola-Massiotti et al. (2018), treatments resulted from the factorial combination of: 1) harvesting at 8:00 or 14:00, 2) no wilting or wilting one or two hours and 3) with or without the use of bacterial inoculant (BIOTAL PLUS II®). Rainfall and evapotranspiration were recorded (Davis Instruments Vantage Pro2®, Hayward, California) during the six hours prior to ensiling. For the choice of the eight silages, a stratification based on organoleptic properties and pH was used as a criterion, which allowed them to be classified into three categories of silage quality: particularly good, good and regular.

The stages of the experiment comprised 18 days for an adaptation phase and 14 days for the evaluation phase by ewes. During the adaptation phase, to get the ewes acquainted to the silages to be evaluated, they were given free access on different days to a single silage of similar characteristics to each of the silages to be evaluated, each one of these adaptation silages was offered two days. For the presentation of results the labels consider time at harvest (8:00 or 14:00), inoculant with (1) or without (2) and wilting, no wilting (0) one hour (1) or two hours (2).

For the evaluation of palatability, the 56 combinations of 3 three silages taken out of the eight were considered. Each one of the 14 measuring days, four combinations were tested (three silages in each combination), each one of them assigned to an experimental unit. Each of the experimental units was housed in a pen, with three feeders per pen. The silages to be evaluated daily were randomly assigned to each of the feeders. Before offering the silages to the animals, their organoleptic properties were estimated by three trained observers, using the scale proposed by Ojeda (2000). The descriptive categories were transformed into numerical ones as follows 5.0 excellent, 3.3 good, 1.65 fair and 0.0 poor. Likewise, samples were taken to determine the DM content and pH. The quantity offered of each silage was 2.0 Kg fresh weight. At the end of the time (two and a half hours) of daily observation, the amount of residual silage was weighed. During measuring (09:30 a.m. to 12:00 p.m.), by direct observation, data on the behavior of the animals were taken individually every three minutes, recording the following activities: eating one of the three silages, drinking, eating salt or other. The number of visits to each silage were considered, as relative indicators of their preference and were used with data of intake derived from data on residuals.

With Microsoft Excel® using XLSTAT® (Addinsoft, New York, NY), two Principal Component Analysis were conducted, the first one based on the 72 samples from Améndola-Massiotti et al. (2018), was aimed at exploring the relationship among variables of wether, treatments and silage; and the second intended for studying the association between the eight silages chemical and organoleptic properties and their intake and preference.

Results and Discussion

The results shown in Figure 1 from results of Améndola-Massiotti et al.(2018), were the basis for selecting the eight silages used in the experiment. It is evident from the ordering of variables that in quadrat III the two variables that were clearly signs of low quality silages were pH, meaning that high pH is a negative sign of quality, and aerobic deterioration represented by CO₂, being even more negative and with a longer vector than pH, which indicates higher consistency of results; in quadrat IV also as a negative sign, silages are found that experienced a certain amount of rainfall in the six hours previous to ensiling. As opposite to those previous variables, variables in quadrats I and II are indicators of good quality of silages. In quadrat I the most clear and consistent is silage temperature, which is difficult to explain since lower silage temperatures are expected to be linked to higher silage quality. Wilting appeared to have a non-consistent effect, which can be explained by the fact that the nature of its effect is linked to the climatic conditions prior to ensiling, under rainy and low evapotranspiration conditions it is expected to be negative, and the opposite occurs under dry and high evapotranspiration conditions as shown by Coblenz and Muck (2012). Dry matter content of herbage prior to ensiling appeared to be, as expected, very closely related to the dry matter content of silage and appeared to be clear indicators of expected silage quality as stated by Kung (2010). The vectors of these two variables were close to that of evapotranspiration, this fact considered together with that of rainfall make clear that data on weather forecast are essential inputs of decision making about ensiling. Results shown on quadrat II show that outcomes of the four organoleptic properties were very consistent (long vectors) and clearly mutually connected, and their high values were closely related to data on high evapotranspiration and dry matter content of herbage which have already been stated as signs of silage good quality.

From results of PCA which variables include preference and intake (Figure 2), it is observed again that the four organoleptic properties deliver highly consistent results and as in Figure 1 are clearly opposed to results of pH and aerobic decay. Even though results of the four organoleptic properties are close to those of preference and intake, the results of smell reflect more closely those of the animal intake and preference. According to Provenza et al. (2007), animals acquire a preference for foods that meet their nutritional requirements, and hence it can be envisaged that preference for a given silage is a keen detector of its nutritional composition. Experiments involving the evaluation of preference of different silages are complex and expensive. On the other hand, evaluation of organoleptic properties, which in this study delivered results very close of the preference results, are easy to

implement and the only requirement is the training of observers. Organoleptic properties enabled the identification of the silages preferred and more ingested by the ewes, which in this study were those harvested during the afternoon, with no rain and high evapotranspiration and exposed to wilting. Opposed to results shown in Figure 1, in Figure 2 it is observed that most of the preferred silages were submitted to addition of inoculant.

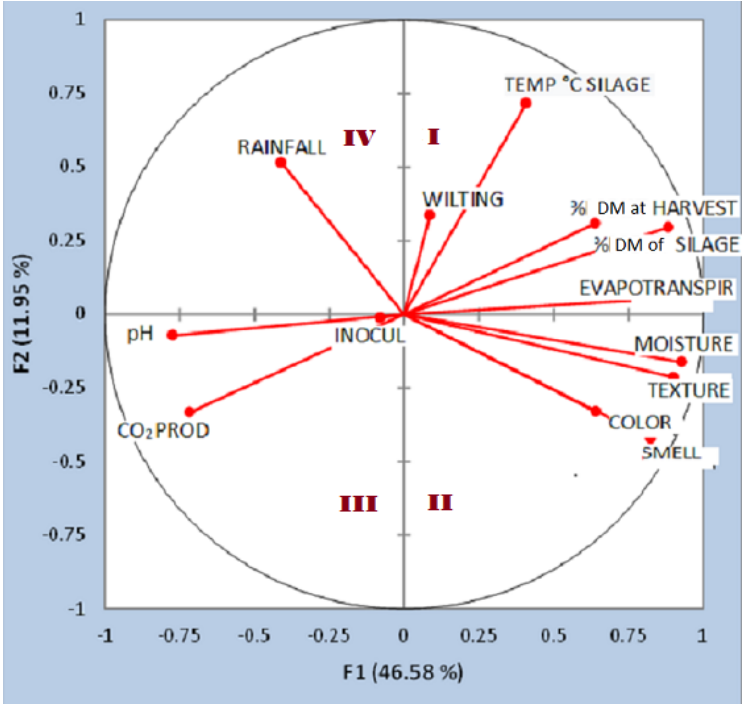


Figure 1: PCA ordering variables related to silage quality.

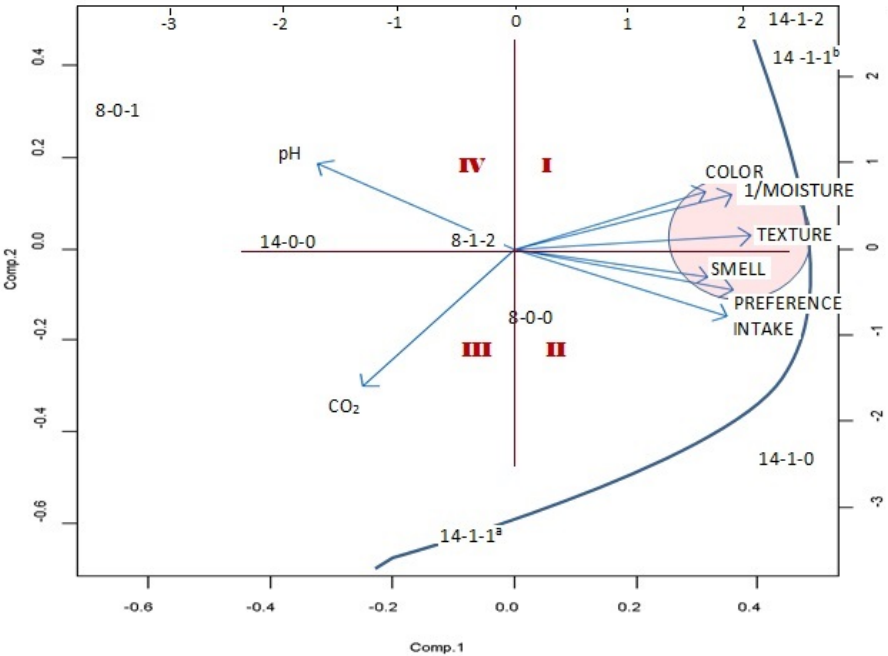


Figure 2. PCA ordering Treatments, chemical and organoleptic properties and preference for alfalfa and orchard grass silage.

Conclusions

Reliable weather forecasts are needed to efficaciously ensile alfalfa forage, because rainfall and evapotranspiration are key determinants of the success of the process. Silages harvested at 14:00 achieved highest scores in organoleptic, preference and intake evaluations. Results of preference and intake were correlated those of odor and texture and were opposite to those of pH and in a lesser extent also to those of aerobic deterioration. The organoleptic evaluation resulted an easy and cheap method to characterize silages, which results were reliable predictors of preference and intake (and hence quality) of alfalfa and orchard grass silages.

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