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A Preliminary Study on Ensiling Aspen Bark

CHARLES HELLELOID, JOHN KLOW, GARY PULLAR and JOHN VERANTH*

ABSTRACT — A preliminary study was conducted on the ensiling of aspen bark in laboratory silos for the production of animal food. Several types of silo, both with and without an enzyme preparation, were tested. Results of physical and chemical tests on the contents indicate that definite changes occur when bark is ensiled, and that these changes differ with ensiling conditions. Several of these changes suggest possibilities for future research.

Through a cooperative program of the Boise Cascade Corporation and International Falls High School spanning six years, qualified students have been given the opportunity to work on an industrial research project. Each year high school science teachers and members of the Boise Cascade research staff select a project which the students carry out from the planning stage through the final report writing, using facilities of the company's industrial research laboratory as needed. One such study was conducted on an ensiling process designed to convert wood bark into a digestable food for ruminant animals.

James Reddick of Bagley, Minnesota, has conducted an experimental feeding program in which sheep have subsisted on a diet of ensiled wood bark. He prepared pit silos, using a bulldozer to pack six-inch layers of aspen bark to an approximate depth of 10 feet. An enzyme was spread between the layers at a concentration of .025 per cent by weight of crude enzyme preparation. The bark was obtained from a nearby timber barking operation, and the enzyme was purchased from the Silak Corporation, Hospers, Iowa. The ensiling reaction was considered complete when the internal temperature of the silo reached 90°-110°F. This took from three days to two months, depending on the ambient temperatures. Very little quantitative data were available on Reddick's process. The student project was designed to obtain the information necessary for optimizing the bark ensiling process.

The aspen bark used in the study was obtained from the woodroom of the International Falls Paper Mill. The enzyme preparation, which is made from aspergillius oryzae mold, was donated by the Silak Corporation.

Several different types of silos were constructed in an effort to simulate the ensiling process used by Reddick at Bagley. To determine the effects of the enzyme, silos were constructed in pairs. Only one silo in each pair contained the enzyme.

Preparation

Silos 1 and 2, which were made from four inch diameter waxed cardboard tubes, were packed to a density of 33 lb./cu. ft. and then sealed. A wax coating was used to minimize moisture loss. Silos 3 and 4 were packed to a density of 26 lb./cu. ft. in 35 gallon metal barrels lined with polyethylene. Silos 1 through 4 were insulated, and thermocouples were inserted to follow temperature changes in the contents. Silos 5 and 6 were packed to a density of 16½ lb./cu. ft. in burlap bags and exposed to the air. Water was added periodically to compensate for moisture loss. Silos 7 and 8 were sealed plastic bags that had been packed to a density of 16½ lb./cu. ft. They were stored at 109° F. through the ensiling period. A small amount of soil was added to these silos to simulate the dirt walls of a pit silo.

During the course of this study, samples of the silage produced and a control sample which consisted of non-ensiled bark were tested for moisture content, pH, reducing sugar, optical density, and total titratable acid. The pH of each of the samples was determined by soaking the sample in distilled water for one half hour at room temperature. The pH of this extract was then determined. The moisture contents of the samples were determined by dividing the weight loss during oven drying at 320°F.

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for 12 hours, by the weight of the sample. Hot water extracts were prepared for the optical density, reducing sugar, and total titratable acid tests, using samples of silage and non-ensiled bark. The optical density of filtered extracts was measured in a Beckman Model B spectrophotometer set at a wave length of 400 millimicrons. The procedure for the reducing sugar test was modified from a standard test for blood sugar. The total acid content of the various extracts was determined by titration with sodium hydroxide. Phenolphthalein was used as an indicator.

Discussion

In each pair of silos, the one which contained the enzyme had both a lower mositure content and a lower total acid content than its counterpart. The difference in acid content was always relatively large, and it was nearly a factor of four in the case of silos 3 and 4.

Every silo had a lower sugar concentration than the non-ensiled bark, and those that were ensiled the longest had the lowest sugar concentration. However, sugar concentrations differed considerably in silos with equal ensiling times.

An increase in pH of the extracts was always accompanied by an increase in optical density. Differences in color, odor, and taste were noted when comparing ensiled bark to the non-ensiled bark. These changes may be useful indicators of reaction.

The temperature of the contents did not show any significant increase during the ensiling process. Although Reddick at Bagley considered the ensiling process to be complete when a peak silo temperature of 90°-110°F. was attained, the experimental analysis indicates that various changes can occur in the silo without a temperature increase. In the smaller laboratory silo, heat may have been dissipated almost as quickly as it was produced.

Suggestions for Follow-up

The results of the initial phase of this study suggest several possibilities for further research, and they will be considered for a Boise Cascade Corporation—International Falls High School Cooperative Program.

Quantitative tests designed specifically for use on wood and wood silage extracts should be conducted for other nutritive substances. A sealed silo should be constructed to study volatile silo products such as CO_2 and alcohol. The possibility of using standard animal feed tests in order to permit comparison of wood silage with more conventional feeds should be considered. After suitable testing procedures are developed, more data on laboratory silos should be obtained. The effects of silo variables such as size, density, and ensiling time should be determined. Samples of silage from pit silos should be obtained and tested for comparison with contents of laboratory silos.

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