Preservation And Cattle Acceptability Of Waterhyacinth Silage[1,2]

J. A. BALDWIN, J. F. HENTGES, JR., and
L. O. BAGNALL

Research Assistant, Professor and Animal Nutritionist,
Asst. Professor and Assistant Agricultural Engineer,
Institute of Food and Agricultural Sciences,
Univ. of Florida, Gainesville 32611

ABSTRACT

Waterhyacinth (*Eichhornia crassipes* (Mart.) Solms) press residue ensiled with three concentrations of preservatives, largely dried citrus pulp, was evaluated by physical, chemical and cattle acceptability measures. Favorable fermentation of waterhyacinths and preservatives was achieved and silage had a desired acidity, aroma and texture. Acceptability of most silage treatments by cattle was immediate. Although the plants ensiled in each of five experiments were harvested at different times of the year, different stages of plant growth, and at different locations, the results of preservative comparisons on chemical composition and cattle acceptability were consistent in all experiments. The most acceptable silages received a preservative level of 4 kg dried citrus pulp and 1 kg of standard cane molasses per 100 kg of pressed plant residue.

INTRODUCTION

Utilization of waterhyacinths as an animal feed has been suggested (3, 7, 8, 13, 16, 20, 21, 24). Cattle have been observed grazing floating waterhyacinths when the supply of nutrients from land forages was limited (14, 20). Dried waterhyacinth press residue was studied in controlled experiments as 33% of the organic matter in pelleted diets for steers (21, 24). Waterhyacinths vary in nutrient composition according to fertility of water at the harvest site, stage of plant growth and processing method (9, 10, 19, 22, 23, 25). The same is true for land forages. In order to utilize waterhyacinths as a feedstuff, they should be classified according to the international feed nomenclature (15). A classification proposed for waterhyacinths was used for descriptive purposes in this paper.[3]

In animal feeding experiments, problems were encountered with voluntary feed intake and acceptability of the processed plant products (16, 17, 21, 24). A com-

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mercially economical system has not been developed for drying waterhyacinth. The logical method of utilization of these plants for animal feeding is as silage for ruminants. A previous attempt was made to ensile unprocessed fresh waterhyacinths chopped pressed waterhyacinths and chopped pressed waterhyacinths with molasses added. This study was unsuccessful due to excessive spoilage and inadequate fermentation (17).

The objective of this study was to evaluate waterhyacinths ensiled with various preservatives. Criteria used were physical characteristics, chemical composition and cattle acceptability.

METHODS AND MATERIALS

Five experiments were conducted during a 6-month period. Barrel silos were constructed with a drainage tube to collect effluent (3). Plants were obtained from a fresh water lake (Lake Alice) and a sewage disposal plant lagoon located on the University of Florida campus (11). Dates of harvesting waterhyacinths from Lake Alice for Experiments I, II, III, and V were respectively: January 10-14, 1972; March 22-24, 1972; and June 27-30, 1972. Plants from the sewage disposal lagoons used in Experiment IV were harvested on August 3, 1972. Physical descriptions of plants harvested were: January, small with 80% float petioles; March, small with 30% float and 70% elongated petioles; June, medium mostly elongated petioles; August, large with elongated petioles, 70% flowering.

Preservative treatments utilized dried citrus pulp (DCP) as an absorbent and source of fermentable carbohydrates, standard cane molasses (SCM), dried waterhyacinth press residue (DWH) and yellow dent corn (YDC). The concentrations of DCP and SCM are grouped into three categories; High (H), Medium (M), and Low (L). The concentrations of SCP and SCM added to 100 kg chopped pressed waterhyacinths respectively were: High, 3.6 - 4.0 kg DCP and 0-1 kg SCM; Medium, 1.8 - 2.0 kg DCP and 0-1 kg SCM; Low, 0-1 kg SCM.

Sixty days elapsed before the barrel silos were opened during experiments I, II and V, and 21 days elapsed during experiments III and IV. Acidity was monitored using a Beckman ph meter by direct analysis of runoff liquid and by analysis of dried milled silage (4). Samples of original fresh chopped and pressed material along with the resulting silages were weighed, dried at 60 C, ground through a 1 mm screen of a Wiley mill, placed in sealed plastic bottles, and stored at room temperature for future laboratory analyses. Chemical analyses were done in duplicate according to A.O.A.C. (1).

Silages from the barrel silos used in cattle tests were stored at 5 C in metal cans lined with polyethylene. Experimental cattle used in the five acceptability tests ranged in age from 2 to 3 years and in weight from 230 to 370 kg. Six to eight head were used for each test and none had been previously exposed to silage. They were offered each silage *ad libitum* in individual fiberglass boxes with free-choice access to all boxes. Any silage treatment which was not consumed after 24 hr was replaced with fresh silage.

RESULTS AND DISCUSSION

Change in pH indicated that fermentation occurred in the first 21 days after sealing each silo. Previous research has shown that increase in acidity is indicative of a source of fermentable carbohydrates in silage (4, 19). Changes due to processing the fresh harvested plants are illustrated in Table 1. Losses of nutrients in press juice were noted previously (2, 12).

Although waterhyacinths for each experiment were harvested at different times of the year, different stages of growth, and from different locations, the effects of preservative concentrations on chemical composition and acceptability were consistent for all experiments. The change in chemical composition for the (H), (M), and (L) concentrations of preservatives averaged for all experiments were as follows: pH (4.4, 4.8, 5.4); organic matter (85.3%, 79.9%, 72.7%); ash (14.7%, 20.1%, 27.3%); crude protein (10.0%, 9.5%, 7.9%).

The most acceptable silage treatments had the (H) level of preservatives (3.6 to 4 kg DCP and 0 to 1 kg. SCM), lowest pH, highest % organic matter and lowest % ash, upon removal from the barrel silos. Ratings of acceptability of silages by cattle and the quantity of each treatment voluntarily consumed by cattle are presented in Tables 2 and 3. Cattle showed an immediate preference for the most acceptable silage, and there was a definite order of acceptance in each experiment.

The correlation between preservative level, pH, and ash as they affect acceptability are shown in Table 4. As the acceptability of a silage treatment increased, there was an increase in preservative level, and a decrease in acidity and ash.

In one experiment, dried waterhyacinth (DWH) press residue was compared with DCP as a silage preservative at a concentration of 3.6 kg per 100 kg of chopped pressed waterhyacinths. The DWH treatments had a lower rate of fermentation as evidenced by a higher pH 5.2, as com-

TABLE 1. EFFECTIVE PROCESSING METHOD ON CHEMICAL COMPOSITION.

Process	Dry matter %	Percent of dry weight						
		Organic matter	Ash	Crude protein	Ca	P	Mg	K
Chopped	3.46	77.58	22.42	15.82	1.71	0.88	0.68	8.71
One Pressing	6.83	83.32	16.68	13.90	1.74	0.60	0.51	5.83
Two Pressings	9.37	84.27	15.73	13.11	1.80	0.53	0.47	4.93

TABLE 2. RATING OF ACCEPTABILITY BY CATTLE OF SILAGE ACCORDING TO PRESERVATIVE CONCENTRATION AND EXPERIMENT.

Preservative concentration	Experiment number I	II	III	IV	V
High	(1, 2, 3, 4)[a]	(1, 4, 6)	(1, 2)	(1, 4)	(1, 3)
Medium	(5, 6)	(2, 3, 5, 8, 9)	(3, 4, 5)	(2, 3, 5)	(2, 4, 5)
Low	(7, 8, 9)	(7, 10, 11, 12)	———	———	

[a]Rated in order of preference with 1 being most preferred.

TABLE 3. PERCENTAGE OF SILAGE CONSUMED ACCORDING TO PRESERVATIVE CONCENTRATION AND EXPERIMENT NUMBER.

Preservative concentration	Experiment number[a] I	II	III	IV	V
High	97	92	91	100	66
Medium	80	69	49	100	28
Low	42	14	—	—	—

[a]Values indicate silage consumed as a percentage of that actually offered. They are averages over all treatments in each experiment.

TABLE 4. CORRELATION OF SILAGE ACCEPTABILITY BY CATTLE WITH SILAGE ASH, ACIDITY, AND PRESERVATIVE CONCENTRATION.

Silage acceptability ranking[a]	Preservative concentration	Acidity, pH	Ash, % of dry matter
1	High	4.4	14.7
2	Medium	4.8	20.1
3	Low	5.4	27.3

[a]Ranked in order of preference with 1 being most preferred.

pared to 3.7, and was not consumed by cattle in an acceptability test.

In one experiment, yellow dent corn (YDC) was compared to DCP as a silage preservative for waterhyacinth press residue at two levels, 2 and 4 kg per 100 kg of chopped pressed waterhyacinths. Acceptability by cattle and chemical composition of these silage treatments were similar. Both treatments with the high preservative concentration were more acceptable than the low concentration.

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