BROWSE COLLECTION AND PRESERVATION FOR WINTER IN A NORTHERN ZOO

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Abstract

Zoo nutritionists agree that herbivores need browse to maintain and improve their dental, gastrointestinal, and psychological health, and ideally browse should be offered throughout the year. Unfortunately, zoos in temperate climates such as Chicago's have difficulty providing browse for their animals in the colder months, and many zoos have limited available space for browse storage. The Chiago Zoological Society – Brookfield Zoo has had a relationship with the local utility company for 6 years, wherein the utility company provides browse from trimmings around power lines. Browse from this source is vacuum sealed and placed at -20ºC for storage. Browse stored in this manner has been palatable for animals even after 8 months. This procedure may be helpful for other institutions to store browse.

Introduction

Fresh leaves ("browse") are an important part of a healthy well-balanced diet for any herbivorous animal, and zoo nutritionists agree that more browse is needed for captive managed species. Adding browse to the diet is intended to increase fiber content and provides both physical and psychological health benefits. Unfortunately, browse is one of the hardest feeds to provide to captive animals year-round, especially those living in seasonally variable locations such as Chicago. Most zoo herbivores only receive a fraction of the browse they would normally be eating in the wild because most if not all browse is completely unavailable to temperate zoos during late fall, winter, and early spring, and certain species of browse may not be available year-round even for warm-climate zoos. Many zoos have plans to collect browse during the warm months and store it for winter, but this can be limited by a lack of long-term storage space.

Nutritionally, browse is the closest food item to the natural diet of herbivores, as neither hay nor commercial diets can replicate the hundreds of compounds found in fresh browse. Browse consumption can improve dental health by removing tartar, improve gastrointestinal health by stimulating gut motility, and improve nutrient digestibility by activating different microbacteria that aid in digestion. Campbell *et al.* (2001) investigated the effects of offering browse to sifaka species and found browse intake was around 35% of total consumption and that with increased browse, total digestible fiber and lignin consumption increased. Hatt *et al.* (2005) found that increasing browse for giraffes positively affected digestible energy intake and the amount of lignin in the diet; additionally, the giraffes tended to choose browse over hay, but only when they were fed a larger amount of browse. Dierenfeld *et al.* (2006) evaluated the chemical composition and digestibility of native browse species for the Sumatran rhino, finding that the digestibility of the native browse was higher than seen in captive species management

The inclusion of browse in an animal's diet is enriching and improves overall welfare by providing the animal with a means to exhibit natural behaviors. Browse procurement is engaging for the animal, causing more activity, more interactivity with the exhibit, fewer stereotypic behaviors, and

greater potential visitor interest in the exhibit and the species. For example, regurgitation and reingestion is abnormal in primates and can result from boredom, lack of space, or lack of control (Lukas, 1999); studies have shown that additional foraging opportunities and increased browse availability significantly decreased this behavior in great apes (Gould & Bres, 1986; Remis & Dierenfeld, 2004; Cassella *et al.*, 2012; Ryan *et al.*, 2012). Abnormal tongue-playing decreased in giraffes when browse was offered (Baxter & Plowman, 2001), and increased browse doubled foraging time and increased activity for elephants (Stoinski *et al.*, 2000).

Materials and Methods

For the pilot test, SpaceBags™ were used. A portion of a maple branch was divided into appropriately sized pieces and placed in six bags. Two bags were placed at room temperature, 4ºC, and -20ºC and left for 12 months. After 4 months and 1 year, the leaves were visually examined and sent for protein, fiber, and minerals.

An Amerivacs AVS-20 with 36" seal bar vacuum sealer was purchased from Vacuum Sealers Unlimited. Vacuum sealer bags (4 mil, 32" x 48") were purchased from Production Packaging Equipment (Deer Park, NY) and a 20 gallon air compressor (Husky, 1.5 hp) was purchased from Home Depot.

Browse was delivered to the zoo by the local utility company and a portion of the browse was set aside for storage. Appropriately sized branches were cut and placed in the vacuum sealer bags. Maple, mulberry, willow, and honey locust were used. After vacuum sealing, the bags were stored at -20ºC for up to 9 months.

For feeding, the bags were thawed at room temperature, then offered to the animals.

Results

The results from the pilot study showed that the leaves stored at -20ºC maintained their color and integrity. The leaves kept at room temperature were discolored by 4 months and further discolored and drier at 1 year; they were visually unappealing. The leaves at 4ºC maintained their color and integrity at 4 months, but were discolored by 1 year. The analyses for these leaves are in Table 1. There were no significant differences between any of the variables.

The browse that was frozen in the large bags were stored in the freezer in 4' x 4' x 4' boxes. They were removed on a scheduled basis and delivered to animal buildings. All animals consumed the thawed browse.

Discussion

There is little argument that browse is important for animals on both a physiological and psychological level. Being able to store browse effectively and efficiently is beneficial for all temperate climate zoos. Freezing vacuum sealed browse seems to be an option that works.

Although there was no baseline browse to compare to, there seemed to be little difference in storage effects on nutrient concentrations measured. It must be considered though that since the measurement of protein is based off nitrogen, and the nitrogen does not disappear over time, the protein concentrations are probably an overestimate of actual protein content. The other

inorganic minerals also do not disintegrate over time, so it was expected that there wouldn't be a difference in their concentrations over time.

The browse program itself has been a great success as we have a good working relationship with the local utility company (ComEd). ComEd agrees to cut primarily from around transmissions towers to reduce the possibility of pesticides and/or pollution affecting the browse. The company has a certified arborist who oversees the tree trimmings, and he has a list of approved browse species. The arborist is on-site and chooses the areas and species to trim and also is present as the browse is off-loaded at the zoo. A twice-weekly schedule from May to October occurs at no cost to us. The ComEd team trims trees on Monday and Thursdays and delivers approximately 50 cubic yards of browse to us first thing Tuesday and Friday mornings. The volume of browse allows it to be offered daily throughout the season. Once the browse is delivered, a team of keepers load the branches onto flatbed trucks and delivers it to animal buildings throughout the zoo. The importance of providing browse is not lost on the entire animal care team in that all departments (even our Marine Mammal department) send keeper staff to help distribute it.

Additionally, the vacuum sealing and freezing of the browse has been very successful. The act of vacuum sealing is straightforward and the equipment is user-friendly. Two keepers can easily make 8 – 10 bags of browse in an hour. In our first full year of doing the vacuum sealing we made 170 bags. That allowed us to give out browse to eight different species every other week for the entire winter. All species which were offered the browse consumed it, this included giraffe, okapi, colobus, hyrax, gerenuk, and orangutan.

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Table 1: Protein, fiber, and mineral analyses (DMB) of browse stored for 4 or 12 months at room temperature, 4ºC, or -20ºC.

	4 months			12 months		
	RT	4ºC	-20ºC	RT	4ºC	-20ºC
Dry matter (%)	55.1	50.1	51.2	60.3	48.9	50.1
Crude protein (%)	15.9	14.3	14.2	14.8	14.2	14.2
ADF (%)	19.4	23.6	21.8	25.1	24.2	26.3
NDF (%)	24.8	37.7	22.2	--	--	--
TDN (%)	80.4	75.7	77.7	73.9	75.0	72.6
Ca (%)	1.32	1.56	1.36	1.44	1.47	1.33
P (%)	0.36	0.30	0.31	0.32	0.32	0.31
Mg (%)	0.41	0.39	0.34	0.40	0.41	0.33
K (%)	0.93	1.00	1.09	1.16	1.04	1.17
Fe (ppm)	117	202	149	117	128	122
Cu (ppm)	16	13	13	13	16	14
Zn (ppm)	55	58	62	58	74	61
Mn (ppm)	72	74	68	75	78	70