EVALUATING THE STABILITY OF NUTRIENTS OF CUT *EUCALYPTUS SIDEROXYLON* BROWSE FOR KOALAS

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ABSTRACT

The objective of this study was to evaluate the stability of leaf nutrient contents in *Eucalyptus sideroxylon* browse branches over the course of one week. Twelve branches were cut and transported to the koala barn within 1 h. These branches were kept in a walk-in cooler and three branches were sampled 1.5, 45, 93, and 141 h post-harvest. The branches were weighed and the leaves and petioles removed and freeze-dried to a constant weight. The freeze-dried samples were ground and sent to two commercial laboratories for vitamin E, CP, ADF, NDF, sugar, fat, and ash analysis. Non-fiber carbohydrates were calculated. Leaves sampled after 93 and 141h post-harvest had 9.4 and 11.7% (6 percentage units) lower ($P < 0.05$) NFC than leaves sampled 1.5 h post-harvest, respectively. Leaves sampled after 141 h post-harvest tended to have 19.7% (2 percentage units) greater ($P < 0.10$) crude fat than after 1.5 h post-harvest. Additional research is needed with a larger sample size to determine the crucial storage length of *Eucalyptus* post-harvest without impacting nutrients provided to the animal.

INTRODUCTION

The koala (*Phascolarctos cinereus*) is a hind-gut fermenter that feeds primarily on the genus *Eucalyptus* (Lee and Martin, 1984). The extent to which koalas rely on *Eucalyptus* and the number of *Eucalyptus* species koalas regularly consume can vary significantly (Moore and Foley, 2000). This is relevant to our understanding of the range of nutritional challenges that koalas face and are able to meet. In their natural habitat, koalas are able to forage on multiple species of *Eucalyptus* and each of these species varies in nutrient compositions. In zoos, koalas are more restricted to limited species of *Eucalyptus* and normally consume *Eucalyptus* that has been stored for some period of time. The San Diego Zoo (SDZ) has the largest group of Northern Queensland Koalas in captivity outside of Australia, and sends koalas on loan to other zoos or accredited institutions in North America and Europe. Thirty-five species of *Eucalyptus* are grown at the San Diego Zoo, the San Diego Zoo Safari Park and at a 4 ha (10 ac) plantation to feed the koalas. Information is lacking on how long *Eucalyptus* browse should be stored without loss of nutrients. Therefore, the objective of this study was to determine nutrient stability of *Eucalyptus sideroxylon* browse 1 week post-harvest.

MATERIALS AND METHODS

On day 1, 12 *E. sideroxylon* branches were harvested at 1200 and transported to the off-exhibit koala facility by 1300. The branches were placed in a plastic garbage can (filled one-third with water) and stored inside a walk-cooler for the entire week. The temperature of the cooler was set at 7.5° C (45° F) and the water in the garbage can was replaced as needed. Horticulture staff would periodically mist the *Eucalyptus* in the cooler to keep it moist.

On day 1 (at 1330), and on days 3, 5, and 7 at 0900, three branches were randomly selected from the cooler and transported to the Nutrition Laboratory. The date the branches were collected was recorded, along with the total wet branch weight (mean 221.86 g), branch base diameter (mean 9.21 mm) and branch length (mean 49.90 cm). Leaves and petioles on the branch were stripped, weighed (mean 138.06 g/branch), and freeze-dried (Labconco FreeZone 6, Freeze Dryer System, Kansas City, MO 64132) to a constant dry weight. Tubes containing leaf samples were covered with trash bags to avoid direct sunlight, as the leaf samples were to be analyzed for vitamin E once dried. Dried leaf samples were put individually into labeled bags, placed inside a cabinet to prevent nutrient degradation, and ground to 0.8 mm (Thomas Wiley® Mill, Thomas Scientific, Swedesboro, NJ 08085). Ground samples were sent to a commercial laboratory to determine vitamin E (alpha-tocopherol) (Michigan State University, Diagnostic Center for Population and Animal Health, Lansing, MI 48910), crude fat, crude protein (CP), fiber (ADF and NDF), ash, and sugar content (Dairy One, Ithaca, New York 14850). Non-fiber carbohydrates (NFC) were calculated as 100% - (CP% + NDF% + Fat% + Ash%) (Mertens, 2011). Post-harvest changes in leaf nutrients were analyzed by one-way ANOVA with means separated by Tukey test (JMP rel. 5.0.1.2, SAS Institute, Inc., Cary, NC 27513).

RESULTS AND DISCUSSION

Through the post-harvest duration, there was a trend in dry matter (DM) loss ($P < 0.15$) from 1.5 to 141 h (Table 1), but the amount of water sprayed on the browse while in the cooler is not known and the exterior of the leaves were not dried before freeze drying. There were no significant differences in CP, ADF, NDF, sugar, ash, or vitamin E concentrations with time post-harvest. However, there was a change in NFC ($P < 0.05$), and crude fat ($P < 0.10$) through the post-harvest duration.

Leaves sampled after 93 and 141 h post-harvest had 9.4 and 11.7% (6 percentage units) lower NFC than leaves sampled 1.5 h post-harvest, respectively. Although not significantly different, leaf sugar content decreased 13.8% (3 percentage units) from 1.5 to 141 h post-harvest. Other components of NFC which were not measured in this study, that could have also decreased post-harvest, include starches, organic acids, and pectins. Leaves sampled after 141 h post-harvest increased 19.7% (2 percentage units) in crude fat.

The main post-harvest loss of nutrients in *E. sideroxylon* appears to be from NFC. Although, koalas have the ability to ferment cellulose in their hind-gut, it is not known what portion of the energy requirement is supplied by NFC. Additional research with a larger sample size is needed to determine the critical storage length of *Eucalyptus* post-harvest without impacting nutrients provided to the animal.

ACKNOWLEDGMENTS

The authors would like to thank the koala keepers (SDZ Collection Husbandry Science Department) for their help during this project. The authors would also like to thank M. Edith Galindo for her help in grinding the *Eucalyptus* samples, and the SDZ Horticulture Department for harvesting the *Eucalyptus*.

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Table 1. Nutrient concentrations (% of dry matter) of *Eucalyptus sideroxylon* with time post-harvest

	Hours post-harvest				
Nutrients	1.5	45	93	141	SEM[1]
DM, % as-fed	37.24	35.12	35.78	34.55	0.786
CP, % of DM	10.07	10.57	10.83	11.03	0.719
ADF, % of DM	17.10	18.57	19.07	18.07	0.522
NDF, % of DM	23.27	25.53	25.07	25.77	0.976
Sugar, % of DM[2]	18.13	16.73	17.27	15.63	0.821
NFC, % of DM[3]	50.53[a]	46.70[ab]	45.77[b]	44.60[b]	0.916
Crude fat, % of DM	11.47[y]	12.37[xy]	13.73[x]	13.73[x]	0.567
Ash, %	4.66	4.91	4.62	4.88	0.209
Alpha-tocopherol, mg/kg	202.9	207.4	247.1	215.3	25.50

[1]Standard error of the means.
[2]Non-fiber carbohydrates calculated as 100% - (CP% + NDF% + Fat% + Ash%).
[3]Ethanol soluble carbohydrates.
[ab]Within a row, means without a common superscript differ ($P < 0.05$).
[xy]Within a row, means without a common superscript differ ($P < 0.10$).