

Forage nutritive value: influence of drying time and storage method

L.F. Garcia¹, G.F.S. Congio¹, M.B. Chiavegato¹, S.C. da Silva¹

¹University of São Paulo, Piracicaba, São Paulo, Brazil, 13418-900. e-mail: larissagarcia@usp.br

Keywords NDF, ADF, chemical analysis, sward grazed stratum

Introduction The precise determination of nutritive value on consumed forage is essential to guide the decision making in production systems. Crude protein (CP), neutral detergent fiber (NDF) and acid detergent fiber (ADF) contents might affect, directly or indirectly, dry matter intake (Van Soest, 1994). Once the forage sample is collected in the field, plant respiration does not immediately stop, due to its high moisture content (approximately 80%). Therefore, stop cellular respiration is important to decrease dry matter losses and to maintain nutritional value. The objective of this study was to evaluate the effect of drying time and storage method on forage nutritional value determination.

Material and Methods The experiment was conducted in the Laboratory of Forage Plants, a partner of the EsalqLab, of the Animal Science Department at ESALQ/USP, in June 2017. Samples of rotationally grazed elephant grass cv. Cameroon (*Pennisetum purpureum* Schum.) were collected from the upper stratum (grazed stratum, above post-grazing height) and weighed to 200 g. The oven used was ventilated, set to 55°C and samples were dried to constant weight. The following treatments were tested: 1. samples were immediately dried in air forced oven after collection (Cont); 2. samples were stored in paper bags for 3 days at ambient temperature, and dried in air forced oven (PBag-3d); 3. samples were stored in paper bags for 6 days at ambient temperature, and dried in air forced oven (PBag-6d); 4. samples were frozen in plastic bags, stored at ambient temperature for 3 days and dried in air forced oven (Fre-3d); 5. samples were frozen in plastic bags, stored at ambient temperature for 6 days and dried in air forced oven (Fre-6d); 6. samples were dried immediately after collection in a microwave oven for 2 min, stored in paper bags for 3 days at ambient temperature, and dried in air forced oven (Mic-2min-3d); 7. samples were dried immediately after collection in a microwave oven for 2 min, stored in paper bags for 6 days at ambient temperature, and dried in air forced oven (Mic-2min-6d); 8. samples were dried immediately after collection in a microwave oven for 4 min, stored in paper bags for 3 days at ambient temperature, and dried in air forced oven (Mic-4min-3d); 9. samples were dried immediately after collection in a microwave oven for 4 min, stored in paper bags for 6 days at ambient temperature, and dried in air forced oven (Mic-4min-6d); 10. samples were dried immediately after collection in a microwave oven for 6 min, stored in paper bags for 3 days at ambient temperature, and dried in air forced oven (Mic-6min-3d); 11. samples were dried immediately after collection in a microwave oven for 6 min, stored in paper bags for 6 days at ambient temperature, and dried in air forced oven (Mic-6min-6d). Samples were ground in a Willey mill, with a 1 mm diameter sieve. Dry matter (DM), CP, NDF and ADF contents were analyzed using the Proximal Infrared Spectrophotometry (NIRS) method. Experimental design was completely randomized, with two replicates. The ANOVA was performed using SAS[®], means were separated by LSMEANS, with a 5% error probability.

Results and Discussion There were treatment effects on DM, CP, NDF and ADF contents ($P < 0.001$, $P < 0.001$, $P = 0.004$, and $P < 0.001$, respectively; Table 1). The Mic-6min-6d treatment was the only one similar to the control for DM content. Treatments PBag-6d and Fre-6d had lower CP content (16.48 and 17.30%, respectively) as compared to control (19.79%). The highest NDF content was recorded for PBag-3d treatment (61.96%) and lowest for treatments Mic-2min-6d and Mic-4min-6d (58.18 and 56.23%, respectively). Greater ADF values were observed for treatments PBag-6d, Fre-3d and Fre-6d (37.49, 34.84 and 35.07%, respectively).

Table 1 Nutritive value of elephant grass cv. Cameroon samples submitted to different storage and drying methods

| Treatments ¹ | Item | | | |
|-------------------------|-----------------------|---------------------|---------------------|---------------------|
| | DM, % of fresh matter | CP, % of DM | NDF, % of DM | ADF, % of DM |
| Cont | 93.06 ^a | 19.79 ^a | 59.54 ^b | 32.97 ^{cd} |
| PBag-3d | 92.42 ^c | 19.56 ^a | 61.96 ^a | 34.20 ^b |
| PBag-6d | 92.42 ^c | 16.48 ^c | 60.94 ^{ab} | 37.49 ^a |
| Fre-3d | 91.85 ^d | 19.22 ^{ab} | 60.83 ^{ab} | 34.84 ^b |
| Fre-6d | 91.19 ^e | 17.30 ^c | 59.90 ^{ab} | 35.07 ^b |
| Mic-2min-3d | 92.41 ^c | 20.12 ^a | 59.70 ^{ab} | 32.90 ^{cd} |
| Mic-4-min-3d | 92.65 ^{bc} | 20.13 ^a | 60.42 ^{ab} | 32.15 ^d |
| Mic-6min-3d | 92.64 ^{bc} | 19.66 ^a | 59.52 ^b | 32.81 ^{cd} |
| Mic-2min-6d | 91.74 ^d | 18.57 ^b | 56.18 ^c | 33.54 ^c |
| Mic-4-min-6d | 92.56 ^c | 19.54 ^{ab} | 56.23 ^c | 33.07 ^{cd} |
| Mic-6min-6d | 92.96 ^{ab} | 19.48 ^{ab} | 59.39 ^b | 32.79 ^{cd} |
| SEM | 0.111 | 0.314 | 0.845 | 0.327 |

^{a-d}Values followed by the same letter in the column do not differ ($P > 0.05$).

¹Treatments: Cont = oven dried immediately after collection; PBag-3d = stored in paper bags for 3 days at ambient temperature, and oven dried; PBag-6d = stored in paper bags for 6 days at ambient temperature, and oven dried; Fre-3d = frozen in plastic bags, stored at ambient temperature for 3 days and oven dried; Fre-6d = frozen in plastic bags, stored at ambient temperature for 6 days and oven dried; Mic-2min-3d = dried immediately after collection in a microwave for 2 min, stored in paper bags for 3 days at ambient temperature, and oven dried; Mic-4min-3d = dried immediately after collection in a microwave for 4 min, stored in paper bags for 3 days at ambient temperature, and oven dried; Mic-6min-3d = dried immediately after collection in a microwave for 6 min, stored in paper bags for 3 days at ambient temperature, and oven dried; Mic-2min-6d = dried immediately after collection in a microwave for 2 min, stored in paper bags for 6 days at ambient temperature, and oven dried; Mic-4min-6d = dried immediately after collection in a microwave for 4 min, stored in paper bags for 6 days at ambient temperature, and oven dried; Mic-6min-6d = dried immediately after collection in a microwave for 6 min, stored in paper bags for 6 days at ambient temperature, and oven dried.

The Mic-6min-6d treatment did not differ from control. The differences observed among treatments were associated to cellular respiration. Hydrolytic and respiratory enzymes present in plant cells remain active at high moisture contents after cutting. Cellular respiration is interrupted with water content below 35-40% (Rees, 1982; Macdonald and Clark, 1987). The high moisture content also favored the appearance of fungi (mold) in forage samples from Fre-3d, Fre-6d, Mic-2min-6d and Mic-4min-6d treatments.

Conclusion, samples should be dried in microwave oven for 6 min immediately after collection, and stored in paper bags for up to 6 days at ambient temperature before oven drying and grinding to allow precise determination of forage nutritive value.