The influence of the inside diameter of the coring probe on the chemical composition of lucerne hay samples

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Abstract

The obtaining of a representative sample is crucial for the application of an accurate and uniform lucerne hay grading system in South Africa. There is currently limited data available on the effect of the inside diameter of the coring probe on the chemical composition of the lucerne hay samples. A study was therefore undertaken to determine the influence of the inside diameter of a coring probe on the chemical composition of unground lucerne hay samples using the Near Infrared Reflectance Spectroscopy (NIRS) technique. Ten lucerne bales (total 40), randomly chosen from four different grades (Prime, Grade 1, 2 and 3 according to the National Lucerne Trust quality and grading system), were sampled with both a large probe (35 mm inside diameter and 520 mm long) and a small probe (12 mm inside diameter and 450 mm long). The samples with each probe were taken at approximately the same location in the bale. The samples were analysed with the NIRS for crude protein (CP), acid detergent fibre (ADF), neutral detergent fibre (NDF), ash and lignin. The model to calculate the new lucerne quality index (NLQI) from the ADF, ash and lignin, according to the National Lucerne Trust quality and grading scheme was used. Regression analysis revealed a significant relationship (r^2) between the results of the large and small probe namely CP = 0.77, ADF = 0.95, NDF = 0.94, ash = 0.92, lignin = 0.87 and NLQI = 0.97. Sampling of lucerne hay with a large and small probe was irrelevant as resulted in similar chemical composition results.

Introduction

One of the best ways of preserving forage for use or sell later on, is in the form of baled hay. Lucerne hay has then been particularly successful for supplementing diets (McWilliams *et al.*, 2008). Lucerne hay is one of the forage species with the highest quality (Cash & Bowman, 1993). Unfortunately, the composition of a hay bale is generally not uniform, as it is made up of leaves and stems. The leaves and stems have a different chemical composition and the leaf and stem distribution are then affected by the process of baling (Undersander *et al.*, 2005). Abovementioned facts thus make it difficult to obtain a good representative sample from a hay bale, as well as the entire freight of hay arriving on the farm.

The best measure of hay quality is generally the quantity and availability of the hay nutrients (McWilliams *et al.*, 2008). Originally factors such as leafiness of the hay, colour, foreign material, contamination, stem coarseness and other visual parameters were used to determine the quality of lucerne hay. These visual properties are, however, subjective and not very good indicators of animal performance and the feed quality. In many cases the nutritional value of similar looking hay may differ substantially. With the passing of time hay standards have been updated to enable a more accurate and standardized grading system worldwide (McWilliams *et al.*, 2008). Traditional wet chemistry, as well as NIRS, is techniques used for forage analysis, with the NIRS being a non-invasive technique that generates faster results than the traditional wet chemistry. The forage is then graded according to the analysis results (Marsalis *et al.*, 2009).

Establishing set standards for lucerne hay grading will result in more specific and accurate grading of the lucerne hay sample. This grading may then encourage producers to produce better quality lucerne hay, resulting in higher prices because the hay with higher quality has a higher apparent nutrient value (McWilliams *et al.*, 2008).

To successfully analyse and ultimately determine in this case lucerne forage quality, it is essential that forage samples taken on the farm are representative of the entire hay harvest. If the forage sample is not representative of the forage that is being fed to the animals, the laboratory analyses will be of little worth (Undersander *et al.*, 2005). Forage sampling will then enable easy and representative determination of protein, fibre and other nutrient components of the hay. These values are then helpful to buyers and sellers to decide on an acceptable forage price and to also provide animals with the right forage type to satisfy the nutritional needs.

One of the most important components in the accurate testing of forage is choosing a suitable hay probe or sampler. The chosen probe should be able to take at least 20 samples per stack of hay bales at a 90º angle, at the ends of the bale (Putnam *et al.*, 2013). It should also be able to sample at least 325 mm into the bale to represent the variation occurring in the bales (Van der Merwe & Scholtz, 2011). To ensure that the probe provides a representative sample, the sample taken should consist of the same leaf : stem ratio of the stack, as well as the same amount of weed and other foreign material (Kinder & Shewmaker, 2011). The tip of the probe should be sharp and when the probe is removed from the inside of the bale after taking a sample, none of the sample should be lost (Putnam *et al.*, 2013).

Generally extremely small inside diameter probes may not represent an accurate leaf : stem ratio, while a probe with a very large inside diameter may result in a too large sample (Putnam *et al.*, 2013). If the sample is too large, a smaller representative sample of the large original sample will have to be taken for analysis, which further contributes to sampling error. There is currently limited data available on the effect of the inside diameter of a coring probe on the chemical composition of lucerne hay samples. The aim of this study was thus to determine the influence of the inside diameter of a coring probe on the chemical composition of lucerne hay samples.

Materials & Methods

Five lucerne hay bales, each of four different grades (Prime, Grade 1, Grade 2 and Grade 3 - according to the National Lucerne Trust quality and grading system (Van der Merwe & Scholtz, 2011) were randomly chosen. Each bale was first sampled once at two different ends with a large probe (L; 35 mm inside diameter and 520 mm long) and then 20 samples with a small probe (S; 12 mm inside diameter and 450 mm long) were taken, 10 around each hole left by the large probe. The samples of each bale were pooled so that each pooled sample contained either two large probe samples or 20 small probe samples. The large- and the small probe pooled samples were analysed with the use of the NIRS for CP, ADF, NDF, ash and lignin according to the prescribed procedures in the lucerne grading manual of the National Lucerne Trust (Van der Merwe & Scholtz, 2011). The model to calculate New Lucerne Quality Index (NLQI) from the ADF, ash and lignin according to the National Lucerne Trust quality and grading scheme was used (Scholtz *et al.*, 2009). The results were statistically analysed using a 2 x 4 factorial experimental design.

Results and Discussion

The results (%CP, ADF, NDF, ash and lignin and NLQI) of the 20 samples collected with both the small probe and large probe are illustrated in Figure 1.

This graph clearly shows that NLQI score of the samples taken with the small probe was very similar to the samples taken using the large probe and that their chemical composition was very similar. Reed & DePeters (1995) reported similar results when using different size forage probes to determine whether there would be a difference in chemical composition of lucerne hay samples taken. They concluded that the sampling probe did not influence the accuracy of analyses results if an adequate number of lucerne hay bales were sampled.

The coefficient of determination (r^2) between the large probe and the small probe sample analyses for ADF, NDF, ash, lignin, protein and NLQI are set out in Table 1.

Table 1 The coefficient of determination (r^2) between the large probe and small probe for ADF, NDF, ash, lignin, protein analyses and New Lucerne Quality Index (NLQI) of lucerne hay samples

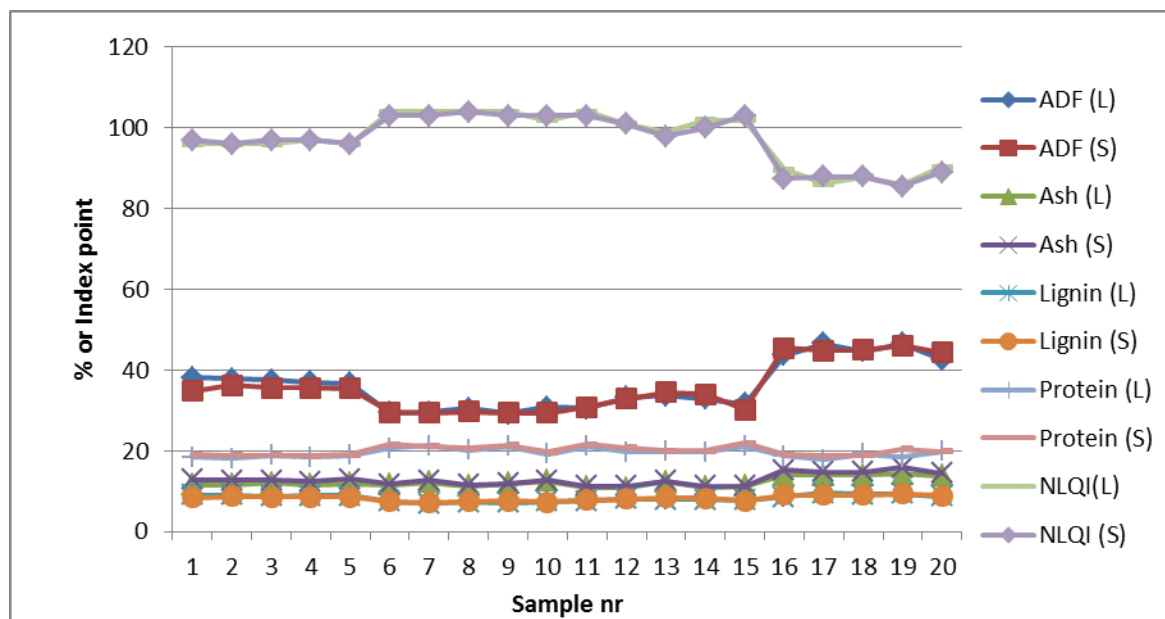|	ADF	NDF	Ash	Lignin	Protein	NLQI
r^2	0.95	0.94	0.92	0.87	0.77	0.97

Figure 1 Percentage of CP, ADF, NDF, ash and lignin and New Lucerne Quality Index (NLQI) scores of samples taken with the small probe (S) or large probe (L).

The results (r^2) indicated a high correlation between the analyses results of the samples taken with the large and small probe.

Conclusion

No significant differences in the chemical composition of lucerne samples taken with the two different probe sizes were recorded. Using the small probe to sample lucerne hay is, however, recommended, as it is less labour intensive and a more practical way to sample stacks of lucerne hay.

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