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Section 3 : Environment (PE1)

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PF1-8

Prediction of Protein Fraction of Tropical grass by Near Infrared Reflectance Spectroscopy

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Indrtduction

The nutritive value of feed protein for the ruminant varies inversely with the extent of solubility and degradability of protein in the rumen. Because of ruminal microbes do not provide enough protein for maximum milk production, it is necessary to provide escape ruminal degradation protein(Chalupa,1996). Therefore, feeding for high levels of milk production must consider the protein fraction. Since, there are few reports of protein fraction in Japan, this investigation was done. Meanwhile near infrared reflectance spectroscopy(NIRS) was been used as analytical method in the field due to the rapid, accurate and no loborious methods. that provides rapid determination of feed composition. Prediction of protein fraction by NIRS will be useful to estimate nutritive value of feed protein for supporting high producing dairy cow.

The object of this study was to examine the possibility of NIRS to determine protein fraction of tropical grass which was widely cultivated in southwest of Japan.

Materials and methods

The experimental grass were guineagrass(Panicum maximum Jacq.var. maxmam.), rhodes grass (Chloris gayana Kunth.) and sudangrass(Sorghum sudanense Stapf.). All 53 samples of tropical grass dried forced-air oven at 60 ℃ for 24h followed by milling through a 1mm screen. Grass samples for this suudy were collected in form of fresh cutting, hay and silage. These processed samples were chemical analized to determine crude protein(CP), soluble intake protein(SIP), Degradable intake protein(DIP) and binding protein(BP) that is acid detergent insoluble protein(Licitra,1996). Near infrared spectra were collected using spectrophotometer(NIRECO 6500). The samples were scanned over the range 1100-2500nm. The spectral data were collected at wavelength intervals of 2 nm, and the second derivative of these values were used to derive relationships with the protein fraction. Thirty-one samples chosen randomly from the 53 samples above were then used as a standard sample to develop a NIRS calibration equation. This equation was used to predict the nitrogen fraction of the remaining 17 samples. The calibration was done with a maximum of four wavelengths.

Results and Discussion

The means(min.-max.) of CP, SIP, DIP and BP for the standard samples are 11.4(5.2-15.8), 4.0 (0.8-7.2), 8.2(3.5-11.3) and 1.0(0.6-1.4) respectively, and these for prediction samples are 11.1(6.3-15.1), 4.5(3.0-6.4), 8.2(4.8-11.4) and 1.1(0.5-1.8) respectively. Regarding the range of protein fraction, values of the standard samples were slightly wider than those of the prediction samples except BP.

Wavelengths observed for calibration of standard samples are shown in Table 1. With respect to CP, SIP and DIP, the 1st to 4th absorbance wavelengths were found at 1234, 2326, 1980 and 2296nm respectively. The first absorbance was close to 1215nm which is thought to be hemicellulose. The 2nd wavelength was in the 2305nm and 2326nm region, considered to be cellulose. The 3rd and 4th

wavelength was thought to be crude protein. Meanwhile the 1st to 4th absorbance wavelengths of BP were 1358,1684,1820 and 2148nm. The 1st wavelength was 1358nm which is close to hemicellulose. The 2nd wavelength was close to 1685nm, aromatic structure which thought to be lignin. The 3rd wavelength was 1820nm which is thought to be cellulose. The 4th wavelength was close to 2050nm which is thought to be protein.

Table 1. Wavelength used and correlation coefficients of each constituent of standard and prediction of unknown of tropical grass.

Constituent	Wavelength				Standard		Prediction	
	1st	2nd	3rd	4th	R	SeC	r	SeP
C P	1234	2326	1980	2296	0.93	1.02	0.92	0.86
SIP	1234	2326	1980	2296	0.82	0.64	0.92	0.38
DIP	1234	2326	1980	2296	0.95	0.66	0.93	0.60
BP	1358	1684	1820	2148	0.74	0.14	0.84	0.11

R: Multiple correlation coefficient.
r : Simple correlation coefficient
SeC:Standard error of standard.
SeP:Standard error of Prediction
C P:Crude protein.
SIP:Soluble intake protein.
DIP:Degradable intake protein.
BP:Binding protein.

Correlation coefficients(R) between the values obtained by chemical analysis and those obtained by NIRS for protein fraction in the standard samples were observed to be more than 0.90 except SIP and BP. The prediction equation obtained from the standard samples was used to determine the protein fraction of 22 prediction samples. The simple correlation coefficient(r) and standard errors(SeP) of BP were lower than those of the standard samples.

The wavelengths appropriate for BP were somewhat different from that observed for CP, SIP and DIP. The 2nd and 3rd wavelengths observed here shows that BP was closely related to fiber. Meanwhile Abrams(1988) reported that accuracy was higher in the measurement of nitrogen solubility when it was expressed as insoluble nitrogen rather than soluble nitrogen. If nitrogen fraction of tropical grass were expressed as soluble nitrogen, it may increase accuracy .

It is concluded from this experiment that there is potential for NIRS to evaluate protein fraction of tropical grass, Although it is considered that additional research is necessary in BP.

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