Preliminary study on the use of near infrared spectroscopy for determination of plasma deuterium oxide in dairy cattle

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Information of body composition (fat and protein) in living animal is important to determine the nutrients requirement. Deuterium oxide (D2O) dilution techniques, as one of isotope dilution techniques have been useful for the prediction of body composition. However, the determination of D2O concentration is time consuming and complicated. Therefore this study was conducted to develop a new method to predict D2O concentration in plasma using near infrared spectroscopy technique (NIRS). Four dairy cows in early lactation were used. They were fed total mixed ration containing conr silage, timothy hay, and concentrates to make 17.0 %CP and 14.0 MJDE/kgDM. Dosing D2O was at week 1, 3 and 5 after parturition. After dosing D2O, the blood was collected from hour 0 to 72. Blood samples were then centrifuge at 3,000 rpm for 10 minutes to obtain plasma. D2O concentration was analyzed by gas chromatograph (deuterium oxide analyzable system, HK102, Shokotsusyou) after extracted from plasma by liophilization. Plasma sample was scanned by NIRS using Pacific Scientific (Neotec) model 6500 (Perstorp Analytical, Silver Spring, MD) in the range of wavelength from 1100 to 2500 nm. Calibration equation was developed using multiple linear regression. Sample from one animal (cow #550; n: 74) was used for developing the calibration while the rest three animals were used for validating the equation. The range, R and SEC of the calibration set samples were 135-925 ppm, 0.93 and 48.1 ppm, respectively. Validation of the calibration equation for three individual cows was done and the average of NIR predicted value of D2O at each collection time from three weeks injection showed a high correlation. The range, r and SE of plasma from cow #474 were 322-840 ppm, 0.93 and 53.1; cow #478 were 146-951 ppm, 0.95 and 39.8; cow #942 were 313-885 ppm, 0.95 and 37.2, respectively. Judgement of accuracy based on ratio of standard deviation and standard error in validation set samples (RPD) for cow #474, #478 and #942 were 2.2, 4.3 and 3.4, respectively. The error in application due to the variation between individual was considered smaller than the bias from collection period, however, this prediction can be overcome with correction of standard zero-minute concentration of blood. The results of this preliminary study on the use of NIRS for determination of D2O in plasma showed very promising as shown by a convenient and satisfy accuracy. Further study on various physiological stage of animal should be done.

Key word: near infrared spectroscopy, plasma, deuterium oxide