

The use of principal component analysis to screen for high quality and low methane producing tropical plants (Anwendung der Methode der Hauptkomponentenanalyse zur Identifikation von tropischen Pflanzen mit hoher Qualität und niedrigem Methanbildungspotential). A. Jayanegara*, Carla R. Soliva, Elizabeth Wina, Svenja Marquardt, M. Kreuzer and F. Leiber – Zurich/Bogor

There is a need to screen tropical feed plants which are not only of good quality but also possess a low ruminal methane formation potential. These characteristics appear to be influenced by several factors simultaneously rather than by a single factor of influence. In the present study, a screening of such tropical feed plants was conducted by considering the multi-factorial view by using a multivariate statistical technique namely the principal component analysis (PCA).

Methods: Leaves from 27 plant species were obtained from the area of Bogor, Indonesia, and were analysed for their chemical composition (proximate and total phenolic contents) prior to incubation. The *in vitro* incubation of the plants was performed using the Hohenheim Gas Test method. Approximately 200 mg dry matter (DM) of each plant was incubated with 30 ml of ruminal fluid/buffer mixture (1:2; v/v) for 24 h at a constant temperature of 39 °C. Each plant was incubated four times, represented by two incubation units per experimental run. Variables measured were total gas production, methane (1), short chain fatty acid (SCFA) profiles, pH, ammonia, and bacterial and protozoal counts. Organic matter digestibility (OMD) was obtained by a calculation based on gas production and proximate composition. Relationships between variables were evaluated from the loading plot of PCA, and the score plot of PCA was used for screening the plants based on the desired characteristics. The PCA was performed using SPSS software version 17.0.

Results: There were five principal components (PC) with eigenvalues higher than 1 which contributed considerably to the total variation. The first principal component (PC1) and the second (PC2) explained 41.8% and 18.0% of the total variation, respectively, and they were biologically meaningful. The PC1 could be interpreted as the factor related to forage quality since the factor loading for OMD was as high as 0.81. Other variables positively assigned to forage quality (same direction as OMD) were ammonia, total SCFA, propionate, *iso*-SCFA (both *iso*-butyrate and *iso*-valerate) and crude protein content, whereas variables negatively assigned to forage quality (direction inverse to OMD) were acetate, neutral (NDF) and acid detergent fiber (ADF), acid detergent lignin and total phenols (TP). The PC2 could be interpreted as the factor related to *in vitro* ruminal methane formation since the factor loading for methane was 0.69. Variables positively correlated with methane formation were pH, butyrate, NDF and ADF, whereas variables negatively correlated with methane formation were ether extract (EE) and TP. To identify tropical plants possessing both high quality and low methane formation, selection was made based on the loading and the score plots of PCA. The plants coming closest to the desired properties were *Calliandra calothyrsus*, *Albizia falcataria*, *Leucaena leucocephala*, *Leucaena diversifolia*, *Swietenia mahagoni*, *Artocarpus heterophyllus* and *Clidemia hirta*. Particularly *S. mahagoni* decreased 47% of the methane in comparison to the average of all plants, while OMD was reduced in relation to the average by 12% only.

Conclusion: The PCA technique turned out to be a promising tool in identifying feed plants with characteristics desirable in ruminant nutrition, considering a multi-variate situation simultaneously. In this case, PCA was able to clearly separate quality-related variables and methane-related variables of tropical feed plants into different principal components which then allows, with adequate accuracy, the screening of plants favorable regarding both characteristics.

- (1) SOLIVA, C.R., HESS, H.D. (2007): Measuring methane emission of ruminants by *in vitro* and *in vivo* techniques. In: MAKKAR, H.P.S., VERCOE, P.E. (Eds.). Measuring methane production from ruminants. Springer, The Netherlands, pp. 15-31.

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