การศึกษาความสามารถในการย่อยได้ในกระเพาะรูเมนของอาหารสัตว์ในท้องถิ่นโดยวิธีถุงไนลอน

Study on ruminal degradability of local feeds using nylon bag technique

กัมปนาจ เภสัชชา[1] และ เมธา วรรณพัฒน์[1*]

Kampanat Phesatcha[1] and Metha Wanapat[1*]

บทคัดย่อ: การศึกษาความสามารถในการย่อยได้ของอาหารสัตว์ในท้องถิ่น วัดความสามารถในการย่อยได้ในกระเพาะรูเมนโดยใช้เทคนิคถุงไนลอน ใช้กระบือเพศผู้จำนวน 2 ตัวน้ำหนักเฉลี่ย 385 ± 21 กิโลกรัม ใช้ตัวอย่างอาหารสัตว์ทั้งหมด 16 ชนิด ได้แก่ ฟางข้าว ฟางข้าวหมักด้วย 3% ยูเรีย (รูปแบบแห้ง) ฟางข้าวหมักด้วย 2+2% ยูเรีย+แคลเซียมไฮดรอกไซด์ (รูปแบบแห้ง) ฟางข้าวหมักด้วย 3% ยูเรีย (รูปแบบสด) ฟางข้าวหมักด้วย 2+2% ยูเรีย+แคลเซียมไฮดรอกไซด์ (รูปแบบสด) มันเฮย์ เถามันเทศ ใบโสน ใบมะรุม ใบทองหลาง ใบผักตบชวา ยอดอ้อย หญ้าเนเปียร์ หญ้ารูซี่ หญ้าซิกแนล และหญ้ากินนีสีม่วง จากการศึกษาพบว่า ค่าสัมประสิทธิ์ของการย่อยได้ของวัตถุแห้ง อินทรียวัตถุ เยื่อใยที่ถูกละลายในสารละลายที่เป็นกลาง และโปรตีนหยาบ ของมันเฮย์ ใบมะรุม เถามันเทศ และใบโสน สูงกว่าอาหารสัตว์ชนิดอื่น (P<0.05) สำหรับกลุ่มฟางข้าวมีค่าสัมประสิทธ์ของการย่อยได้ต่ำที่สุด ผลจากการศึกษาสามารถนำไปใช้ในการจัดการให้อาหารสัตว์เคี้ยวเอื้อง

คำสำคัญ: การย่อยได้, เทคนิคถุงไนลอน, สัตว์เคี้ยวเอื้อง, อาหารสัตว์ในท้องถิ่น

ABSTRACT: Two, ruminally fistulated buffaloes of 385 ± 21 kg BW were used to evaluate the nutritive value of local feeds by using the *in sacco* nylon bag technique. The experiment was a randomized complete block design (RCBD) with sixteen treatments; T1 = untreated rice straw, T2 = 3% urea treated rice straw (dry form), T3 = 2+2% urea-lime treated rice straw (dry form), T4 = 3% urea treated rice straw (fresh form), T5 = 2+2% urea-lime treated rice straw (fresh form), T6 = cassava hay,T7 = sweet potato vine, T8 = sesbania leaf, T9 = horseradish tree, T10 = coral leaf, T11 = water hyacinth, T12 = sugarcane-top, T13 = napier grass, T14 = ruzi grass, T15 = signal grass, T16 = purple guinea. The results showed that ruminal OM degradation rate constants (c) of cassava hay, sesbania, sweet potato vine and horseradish tree were similar and were significantly higher (P<0.05) than that of other treatments. The rates of degradation of DM were highest in horseradish tree, sweet potato vine and sesbania leaf. The rate of degradation of NDF were significantly higher (P<0.05) in cassava hay, horseradish tree, sweet potato vine and sesbania leaf compared with other treatments. These findings provide useful information for feeding ruminants.

Keywords: Degradation, *nylon bag* technique, ruminants, local feeds

[1] Tropical feed resources Research and Development Center (TROFREC), Department of Animal Science, Faculty of Agriculture, Khon Kaen University, Thailand

* Corresponding author: metha@kku.ac.th

Introduction

Ruminant diets in most developing countries are based on fibrous feeds and crop residues. These feeds are imbalanced and are particularly deficient in protein, minerals, vitamins, and are highly lignified (Wanapat, 1999). Local feed resources such as cassava root/hay/silage, leuceana leaves, mulberry leaves, moringa seed, have potential as ruminant feeds to improve and increase the efficiency of the production system (Promkot and Wanapat 2003). Limited information is available on characteristics of DM, OM, NDF and CP degradation in the rumen of feed resources locally used for livestock in the tropics with special reference to Thailand eg. sesbania (*Sesbania rostrata*) leaf, horseradish tree *(Moringa oleifera* Lam*)*, coral leaf (*Erithina variegate*), etc. These feeds can be used as supplements to improve rumen ecology. Therefore, the objective of this study was to determine DM, OM and CP degradation of tropical feeds of sixteen locally available feeds in Thailand on fermentation characteristics using the *in sacco* technique.

Materials and methods

Two, ruminally fistulated buffaloes of 385 ± 21 kg BW were used in the study. The experiment was a Randomized complete block design (RCBD) with sixteen treatments; T1 = untreated rice straw, T2 = 3% urea treated rice straw (dry form), T3 = 2+2% urea-lime treated rice straw (dry form), T4 = 3% urea treated rice straw (fresh form), T5 = 2+2% urea-lime treated rice straw (fresh form), T6 = cassava hay *(Manihot esculenta*, Crantz*)*, T7 = sweet potato vine *(Ipomoea batatas (L.)*, T8 = sesbania leaf (*Sesbania rostrata*), T9 = horseradish tree *(Moringa oleifera* Lam*)*, T10 = coral leaf *(Eritrina variegate)*, T11 = water hyacinth *(Eichhornia crassipes solms)*, T12 = sugarcane-top (*Saccharum officinarum Linn.),* T13 = napier grass *(Pennisetum purpureum)*, T14 = ruzi grass *(Brachiaria ruziziensis)*, T15 = signal grass *(Brachiaria decumbens),* T16= purple guinea *(Panicum maximum)*. Approximately 5 g of feed samples were weighed in to duplicate bags (38µm pore size). All the samples were incubate in the rumen at the same time which bags are withdrawn at intervals of 0, 2, 4, 6, 8, 12, 24, 48, 72 and 96 hours–post suspention. The DM, OM, and CP disappearances in the rumen were estimated for each feed sample using the nylon bag technique (Ørskov and McDonald 1979). The samples were analyzed for DM, Ash, and CP according to AOAC (1985). Neutral-detergent fiber (NDF) and acid-detergent fiber (ADF) were determined using the method of Van Soest et al. (1970). Data for ruminal disappearance characteristics of DM, OM, and CP were fitted to the exponential equation following the procedure described by Ørskov and McDonald (1979) and using the NEWAY program (Chen 1996). Data were analyzed by Analysis of variance (ANOVA) according to a RCBD. It was performed on the data of the same incubation time as a separate set following the ANOVA procedure of SAS (1998). Treatment means were compared using Duncan's New Multiple Range Test (Steel and Torrie 1980).

Results and discussion

The average ruminal pH and temperature were 6.9 and 38.1 ºC, respectively. There were no differences of these values among different times of suspention. The CP content ranged from 3.2 % in untreated rice straw to 27.0 % in horseradish tree (**Table 1**). The DM, OM, NDF, CP rumen degradation kinetics of experimental feedstuffs at various incubation times are shown in **Table 2**. The ruminal OM degradation rate constants (c) of cassava hay, sesbania leaf, sweet potato vine and horseradish tree were similar and were significantly higher ($P<0.05$) than that of other treatments. The rate of degradation of DM were highest in horseradish tree, sweet potato vine and sesbania. The rate of degradation of NDF were significantly higher ($P<0.05$) in cassava hay, horseradish tree, sweet potato vine and sesbania leaf compared with other treatments.

Conclusions

The ruminal disappearance characteristics of the sixteen feeds differed among feeds. The ruminal OM degradation rate constants (c) was highest in cassava hay, sesbania leaf, sweet potato vine and horseradish tree as compared to the other treatments, and therefore it could have lower gut fill hence possible higher intake and ruminant production obtained. These findings provide useful information for feeding ruminants.

References

AOAC. 1985. Official methods of Analysis, Association of Official Analytic Chemists, Washington, DC.

Chen, X. B. 1996 An Excel Application Program for processing Feed Degradability Data. User Manual, Rowett Research Institute, Buckburn, Aberdeen,UK.

Goering, H.K. and P. J. Van Soest. 1970. Forage Fiber Analysis. Agr. Handbook No. 379, Agricultural Research Service, USDA, Washington, D.C. 20 p.

Ørskov, E. R., and I. McDonald. 1979. The estimation of protein degradability in the rumen from incubation measurements weighted according to rate of passage. Journal of Agricultural Science, Cambridge. 92: pp. 499-503.

Promkot, C., and M. Wanapat. 2003. Ruminal degradation and intestinal digestion of crude protein of tropical protein resources using nylon bag technique and three-step in vitro procedure in dairy cattle; Livestock Research for Rural Development (15) 11 Retrieved , from http://www.lrrd.org/lrrd15/11/prom1511.htm

SAS. 1998 User's Guide: Statistic, Version 6.12th Edition. SAS Inst. Inc., Cary, NC,

Steel R. G. D., and J. H. Torrie. 1980. Principles and Procedures of Statistics. A Biometrical Approch. McGraw-Hill, New York, USA.

Table 1 Chemical composition of feedstuffs

Treatment		DM %	Ash	OM	NDF	ADF	CP
			---------------- % of dry matter				-------------
T1	Untreated rice straw	92.9	9.1	90.9	73.2	63.6	3.2
T2	3% urea treated rice straw (dry form)	93.2	9.1	90.9	75.2	54.1	5.8
T3	2+2% urea-lime treated rice straw (dry form)	92.0	8.7	91.3	77.1	55.8	5.4
T4	3% urea treated rice straw (fresh form)	51.4	9.1	89.9	70.2	56.4	5.9
T5	2+2% urea-lime treated rice straw (fresh form)	54.5	9.8	90.2	71.5	59.4	5.6
T6	Cassava hay *(Manihot esculenta (L.) Crantz)*	92.0	7.2	92.8	50.9	32.4	25.5
T7	Sweet potato vine *(Ipomoea batatas (L.))*	91.5	10.3	89.7	28.9	12.3	22.2
T8	Sesbania leaf (*Sesbania rostrata*)	92.5	6.8	93.2	27.1	13.5	19.4
T9	Horseradish tree *(Moringa oleifera Lam)*	92.3	10.3	89.7	36.7	19.8	27.0
T10	Coral leaf *(Eritrina variegate)*	90.6	10.4	89.6	33.7	30.9	13.0
T11	Water hyacinth *(Eichhornia crassipes Solms)*	90.6	12.9	87.1	66.4	38.4	7.2
T12	Sugarcane-top (Saccharum officinarum Linn.)	92.4	5.7	94.3	78.5	43.6	9.3
T13	Napier grass *(Pennisetum purpureum)*	92.3	11.1	88.9	60.6	30.3	15.4
T14	Ruzi grass *(Brachiaria ruziziensis)*	91.9	7.9	92.1	72.8	43.5	13.3
T15	Signal grass *(Brachiaria decumbens)*	91.6	7.6	92.4	68.9	33.5	12.5
T16	Purple guinea *(Panicum maximum)*	92.1	10.7	89.3	76.1	34.4	15.2

DM = dry matter, OM = organic matter, CP = crude protein, NDF = neutral- detergent fiber, ADF = acid- detergent fiber

Table 2 The DM, OM, NDF, CP rumen degradation kinetics of experimental feedstuffs at various incubation times in swamp buffaloes

	Treatment																
Parameters	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	SEM
a, %	8.5^{a}	8.0^{a}	9.6^{a}	9.4^{a}	9.1^{a}	33.4^{b}	51.9^{c}	39.5^{d}	38.4^{d}	28.1^{b}	25.5^{b}	17.2^{e}	29.8^{b}	31.8^{b}	29.3^{b}	28.4^{b}	0.75
b,%	34.0^{a}	51.0^{b}	50.4^{b}	66.4^{c}	57.4^{d}	63.8^{c}	42.3^{e}	53.9^{b}	56.1^{d}	36.0^{a}	34.8^{a}	47.3^{b}	53.9^{b}	52.8^{b}	46.3^{b}	52.4^{b}	1.04
c, h^{-1}	0.012^{a}	0.012^{a}	0.011^{a}	0.020^{a}	0.020^{a}	0.041^{a}	0.071^{b}	0.102^{b}	0.068^{b}	0.027^{a}	0.010^{a}	0.022^{a}	0.038^{a}	0.028^{a}	0.025^{a}	0.030^{a}	0.11
a + b, %	42.5^{a}	58.9^{b}	60.0^{b}	75.9^{c}	66.5^{d}	97.2^{e}	94.2^{e}	93.4^{e}	94.5^{e}	64.1^{b}	60.4^{b}	64.5^{b}	83.8^{c}	84.6^{c}	75.6^{c}	80.8^{c}	0.64
*EDDM,%	21.4^{a}	27.1^{a}	27.7^{a}	42.7^{b}	38.1^{b}	76.3^{c}	84.9^{c}	84.5^{c}	81.8^{c}	48.9^{b}	37.2^{b}	42.0^{b}	65.1^{c}	62.8^{c}	55.1^{bc}	59.8^{c}	1.54
a, %	3.5^{a}	7.3^{a}	7.1^{a}	9.1^{a}	8.8^{a}	35.6^{b}	48.1^{b}	36.3^{b}	39.0^{b}	29.6^{c}	23.3^{c}	16.7^{ac}	26.6^{c}	34.9^{bc}	31.8^{c}	21.4^{c}	1.24
b,%	36.8^{a}	32.6^{a}	33.4^{a}	37.3^{a}	37.9^{a}	52.5^{b}	45.3^{ab}	56.5^{c}	55.3^{c}	23.8^{ad}	45.9^{c}	44.3^{ab}	55.6^{c}	57.9^{c}	45.8^{ab}	56.0^{c}	0.57
c, h^{-1}	0.027^{a}	0.035^{a}	0.034^{a}	0.036^{a}	0.035^{a}	0.060^{b}	0.075^{b}	0.107^{b}	0.061^{b}	0.055^{ab}	0.021^{a}	0.024^{a}	0.039^{a}	0.026^{a}	0.020^{a}	0.030^{a}	0.03
a + b, %	40.3^{a}	39.9^{a}	40.5^{a}	46.4^{a}	46.6^{a}	88.1^{b}	93.4^{b}	92.8^{b}	94.3^{b}	53.4^{ac}	69.2^{c}	61.0^{ac}	82.2^{b}	92.9^{b}	77.6^{bc}	77.5^{bc}	0.51
*EDOM,%	24.8^{a}	28.1^{a}	28.2^{a}	33.1^{a}	32.9^{a}	74.9^{b}	83.9^{b}	83.9^{b}	80.7^{b}	47.0^{c}	47.0^{c}	40.9^{c}	63.3^{d}	67.4^{d}	54.7^{cd}	55.0^{cd}	0.62
a, %	16.6^{a}	15.7^{a}	16.9^{a}	19.4^{a}	23.9^{a}	42.4^{b}	38.0^{b}	37.4^{b}	36.4^{b}	41.0^{b}	34.2^{b}	35.6^{b}	37.4^{b}	39.2^{b}	35.9^{b}	40.5^{b}	0.80
b,%	35.4^{a}	65.1^{b}	44.6^{ab}	58.6^{b}	44.7^{ab}	45.7^{ab}	52.0^{b}	49.6^{ab}	51.0^{b}	38.0^{a}	37.5^{a}	41.0^{a}	48.1^{ab}	46.1^{ab}	45.8^{ab}	44.2^{aa}	1.04
c, h^{-1}	0.020^{a}	0.030^{a}	0.034^{a}	0.047^{a}	0.041^{a}	0.070^{b}	0.067^{b}	0.061^{b}	0.066^{b}	0.050^{ab}	0.051^{ab}	0.054^{ab}	0.038^{a}	0.039^{a}	0.040^{a}	0.040^{a}	0.06
a + b, %	52.0^{a}	80.8^{b}	61.6^{a}	78.0^{b}	68.6^{a}	88.1^{b}	90.0^{b}	87.0^{b}	87.4^{b}	79.0^{b}	71.7^{ab}	76.6^{ab}	85.5^{b}	85.3^{b}	81.7^{b}	84.7^{b}	1.18
*EDNDF,%	34.5^{a}	54.6^{b}	44.9^{c}	60.5^{b}	53.8^{b}	77.9^{d}	78.0^{d}	74.8^{d}	75.5^{d}	68.1^{bd}	61.1^{bd}	65.5^{bd}	68.9^{bd}	69.7^{bd}	66.4^{bd}	69.9^{bd}	0.58
a, %	3.1^{a}	5.8^{a}	7.5^{a}	30.2^{b}	35.3^{b}	10.5^{a}	18.8^{ab}	16.7^{ab}	11.3^{a}	24.8^{ab}	11.4^{a}	16.8^{ab}	20.3^{ab}	24.5^{b}	23.2^{b}	27.3^{b}	0.52
b,%	44.7^{a}	50.9^{a}	53.7^{a}	29.5^{b}	18.3^{b}	74.5^{c}	65.9^{c}	64.0^{c}	73.0^{c}	45.9^{a}	42.8^{a}	63.2^{c}	61.0^{c}	54.6^{a}	64.1^{c}	65.7^{c}	0.96
c, h^{-1}	0.020^{a}	0.020^{a}	0.029^{a}	0.024^{a}	0.022^{a}	0.073^{b}	0.040^{a}	0.035^{a}	0.062^{ab}	0.033^{a}	0.044^{a}	0.021^{a}	0.039^{a}	0.044^{a}	0.029^{a}	0.024^{a}	0.08
a + b, %	47.8^{a}	56.7^{a}	61.1^{a}	59.7^{a}	53.6^{a}	85.0^{b}	84.8^{b}	80.7^{b}	84.2^{b}	70.8^{b}	54.2^{a}	80.0^{b}	81.3^{a}	79.1^{a}	87.3^{a}	92.9^{a}	1.07
*EDCP,%	25.2^{a}	31.4^{ab}	39.4^{b}	46.1^{b}	44.9^{b}	69.0^{c}	62.6^{c}	57.4^{c}	66.5^{c}	53.4^{bc}	40.7^{b}	49.2^{bc}	60.5^{c}	61.9^{c}	61.1^{c}	63.0^{c}	0.64

^{a,b,c} Means within rows not sharing common superscripts are different at $P<0.05$, * Effective degradability in the rumen (assuming rate of passage of 0.05/h), SEM: standard error of the mean; EDDM: effective degradability of dry matter, EDOM: effective degradability of organic matter, EDNDF: effective degradability of neutral detergent fiber, EDCP: effective degradability of crude protein