LIPE® MARKER FOR ESTIMATING TOTAL FAECAL PRODUCTION AND DRY MATTER APPARENT DIGESTIBILITY IN GROWING RABBITS

PEREIRA R. A. N.[1], SALIBA E. O. S.[2] , MOTTA W. F.[2], BERTECHINI A. G.[1], DONATO D. C. Z.[1], DUARTE M. R.[1], CHAVES, M. L.[1]

[1]Departamento de Zootecnia. Universidade Federal de Lavras (UFLA). C.P. 37. Campus. Lavras. MG. 37200000.Brasil.
rapocalypse@bol.com.br
[2]Departamento de Zootecnia. Escola de Veterinária da Universidade Federal de Minas Gerais (UFMG). C. P. 567, Campus da UFMG, CEP 30123-970. Belo Horizonte, MG Brasil.

ABSTRACT

LIPE®, a purified lignin, was used as external marker in growing rabbit diets containing different levels (0, 8, 16, 24 or 32%) of dried citrus pulp (DCP). The reference diet was formulated to meet the nutritional requirements of growing rabbits and was isometricaly substituted by one of four levels of DCP. Also, 0.77% of vitamin-mineral premix and salt was added to all diets. During four days, thirty five animals have received orally one mL of LIPE® solution. Lignin was measured in the faeces and in the ingredients using the infrared spectrophotometer. The dried matter (DM) faecal production and the digestibility coefficient (CD) of DM using LIPE® were obtained by a formula and compared to the total faeces collection. The LIPE® has resulted in similar values of total collection, except for 24% DCP diet, which has shown overstimed values of faecal production using the marker. However, significant differences were detected for CD of DM values. In the highest levels (16, 24 and 32%), the use of LIPE® underestimated the values compared to total collection method values. LIPE® was efficient as external marker in growing rabbits diets using reduced levels of DCP (0 and 8%).

Key words: lignin, digestibility marker.

INTRODUCTION

The external marker is used to save labor, as in the total faecal collection in digestion trials. The external marker needs to be recoverable, indigestible, and no adsorbed. Additionally, it should have no effect on the animal or on digestibility and also, not occur in the diet or soil (VAN SOEST, 1994).

Lignin, a indigestible substance, is commonly used as internal marker but lack of recovery that can occur difficulting its analyses. The use of lignin as internal marker for horses underestimated the digestibly values compared to total faeces collection (ARAÚJO, 1999).

Rare-earth metals (lanthanide family) and mordanced chromium have been used as transit markers in rabbits (GIDENNE and LAPANOUSE, 1997), but the purified lignin as external marker has not been performed in rabbits. The Federal University of Minas Gerais has been working in a product that can be used as external marker, but animal validation is still necessary.

The objective of this study was to compare LIPE® marker to the total faecal collection method for estimating the total faecal production and dry matter digestibility in growing rabbit diets.

MATERIAL AND METHODS

A reference diet was formulated to meet the nutritional requirements of growing rabbits and was isometricaly substituted by one of four levels (8, 16, 24 or 32% in NM basis) of dried citrus pulp (DCP). A level of 0.77% of vitamin-mineral premix and iodine salt was added to all five experimental diets, avoiding possible deficiency in highest levels of substitution. The diets (Table 1) were offered *ad libitum* and after an adaptation period of seven days, food intake and total faecal output recorded individually and frozen over a 4-day period. Caecotrophy was not prevented, according to EGRAN (PÉREZ *et al.,* 1995) procedures.

A total of thirty-five New Zealand growing (1.09 $\pm$ 0.12 kg LW) rabbits were individually housed in metabolism cages at the Rabbit Division of Lavras Federal University, a non acclimatized building, and they have received orally one mL of LIPE® solution (concentration of solution was 0,01%) during four days.

Chemical analyses were carried out on diets and faeces (oven dried). DM, crude protein (CP), ashes analysis were performed according to AOAC (1984). Acid-detergent fiber (ADF) and neutral-detergent fiber (NDF) sequential method was performed according to VAN SOEST *et al.* (1991). Gross energy (GE) determined with an adiabatic bomb calorimeter (Parr 1261 model).

The lignin was purified in the Animal Nutrition Laboratory of Animal Science Department in the Veterinary School at UFMG. Infrared spectrophotometer (Vatson Galaxy IVFT model) measured the waves of phenolic compounds, present in LIPE®. Ingredients were also measured to quantify lignin from raw materials. Then, the faecal production and the CD of DM were determined by a formulae (Saliba 1998), using DM intake values. The equations were:

$$\textbf{Digestibility (\%)} = \frac{\textbf{DM intake – DM faecal}}{\text{DM intake}} \times 100$$

$$\textbf{Faecal output (g/d)} = \frac{\textbf{marker intake (g)– marker faecal (g)}}{\textbf{DM faecal (g)}}$$

Faecal production and CD of DM were subjected to variance analysis according to a general linear mode (GLM) procedure of the Statistical Analysis System Institute (SAS, 1996).

® PI0304736-9 *saliba@vet.ufmg.br*

Table 1. Ingredients (%) of the reference and experimental diets.

Ingredients	Reference diets	Dried Citrus Pulp level				
		0	**8**	**16**	**24**	**32**
Reference diet		99.23	91.23	83.23	75.23	67.23
DCP		0	8.0	16.0	24.0	32.0
DGSMEC[1]	15.00					
Wheat bran	13.91					
Soybean meal	16.41					
Alfalfa hay	26.98					
Corn meal	8.13					
Bean straw	15.00					
Molasses	2.00					
Dicalcium phosphate	0.16					
L-lysine	0.04					
DL metionin	0.10					
Iodine salt	0.47	0.47	0.47	0.47	0.47	0.47
Vaccinar[2]	0.30	0.30	0.30	0.30	0.30	0.30

[1]Dried ground snapped mature earn corn [2] 0.3 kg/ 100 kg Vitamin-mineral premix: 100 mg folic acid, 3000 mg panthothenic acid, 100 mg avilamicin, 1.0% BHT, 9 mg calcium, 200 mg cobalt, 4000 mg copper, 10000 mg cholin, 20000 mg iron, 140 mg iodine, 4000 mg manganese, 6000 mg niacin, 19.8 mg selenium, 2000000 UI vit. A, 400 mg vit. B1, 2000 mcg vit. B2, 1000 mg vit. B2, 600 mg vit. B6, 200000 UI vit.D3, 4000 mg vit. E, 722 mg vit.K, 14000 mg zinc

RESULTS AND DISCUSSION

Faecal production values using LIPE® were not significativally (P> 0.05) different from those of total faecal collection, except when 24% DCP diet was used (<0.005). In this case, the use of marker overestimated the values (Table 2).

At lower levels (0 and 8%) of DCP, the CD of DM values were not significative different (P>0.05) between methods. However, when 16, 24 or 32% of DCP were included, the CD of DM calculated by LIPE® were underestimated (Table 3). The lowest DM intake (60.10 g) and faecal excretion was observed when 32% of DCP was included. This fact, can help to explain the results, since DM intake is used for lignin calculation.

For high dietary DCP levels, the use of LIPE® overestimated the faecal production values and underestimated the CD values, compared to total collection method.

Table 2. Faecal production values using marker (FPm) and total collection (FPc), g DM/day, of growing rabbits fed with different levels (0, 8, 16, 24 or 32%) of dried citrus pulp (DCP).

DCP level	FPm	FPc	n[1]	SEM[2]	*P*-value
0	27.50	28.20	8	1.97	0.70
8	27.10	28.19	8	4.99	0.70
16	24.89	22.97	5	0.47	0.08
24	30.74	25.84	8	0.46	<0.005
32	19.40	15.70	6	2.70	0.14

[1]number of rabbits [2]Standard Error Mean

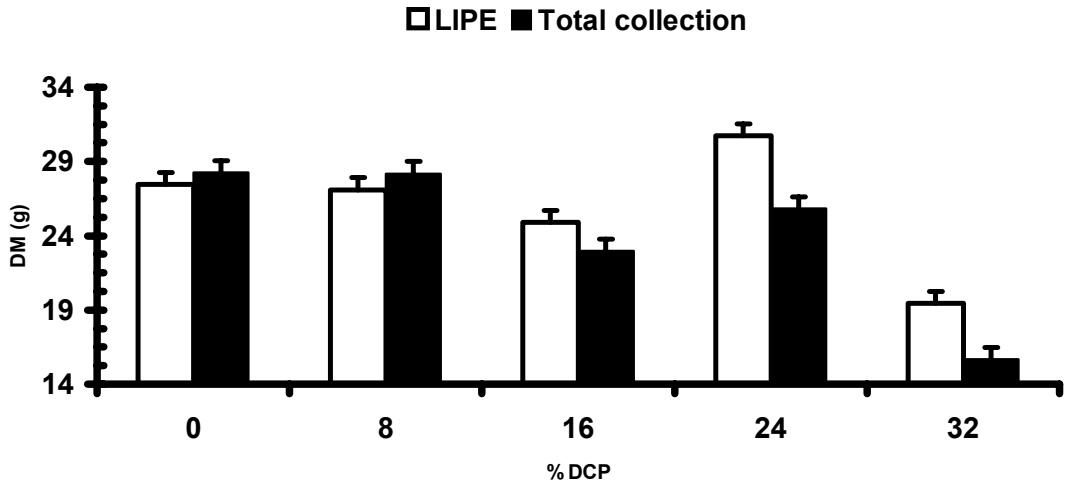

Figure 1. Faecal production (gDM/day) calculated by LIPE® or total collection method to growing rabbits fed different levels (0, 8, 16, 24 or 32%) of dried citrus pulp diets. Interaction treatment*method *P*=0.0005, SEM= 0.8

Table 3. Digestible apparent coefficient (DC) of dry matter (DM) using marker (DCm) or total collection (DCc), of growing rabbits fed with different levels (0, 8, 16, 24 or 32%) of dried citrus pulp (DCP).

DCP level	DCm	DCc	n[1]	SEM[2]	*P*-value
0	64.70	64.00	8	0.40	0.40
8	63.63	62.69	8	0.75	0.50
16	65.72	68.38	5	0.37	<0.05
24	59.20	65.80	8	0.95	<0.005
32	65.90	73.00	6	0.47	<0.05

[1]number of rabbits [2]Standard Error Mean

Interaction between treatment (level of DCP) and method (LIPE®) was then observed. Increasing the DCP levels, also increased the difference between the faecal production

and CD of DM values calculated by marker and obtained by total collection (Figures 1 and 2).

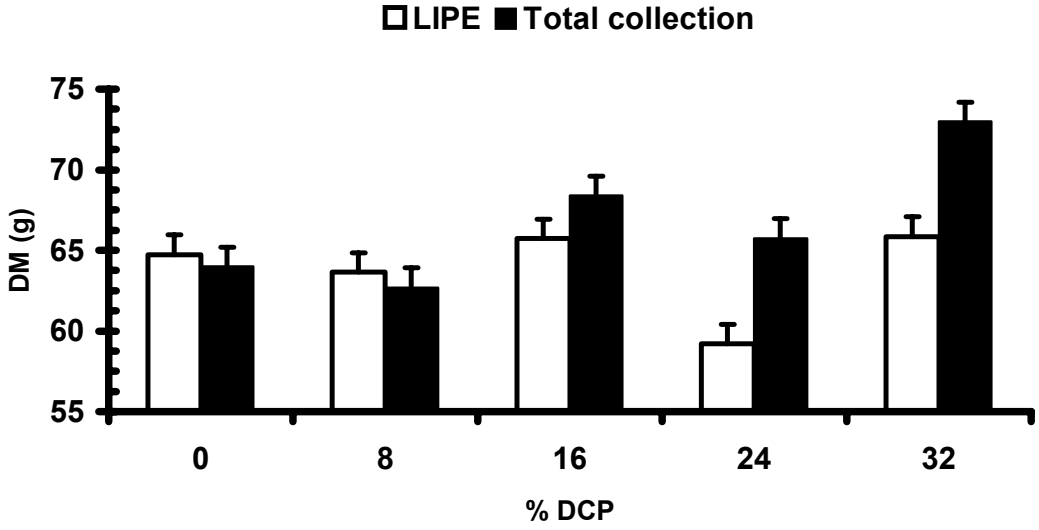

Figure 2. Digestible coefficient of dry matter (%) calculated by LIPE® or total collection method to growing rabbits fed different levels (0, 8, 16, 24 or 32%) of dried citrus pulp diets. Interaction treatment*method *P*<0.0005, SEM= 1.22

CONCLUSIONS

LIPE® was efficient external marker for estimating the faecal production and dry matter apparent digestibility in diets to growing rabbits containing low levels (0 and 8%) of DCP. However, when higher levels (16, 24 or 32%) were included, faecal production were overestimated and dry matter digestibility underestimated, not been recommended its use.

REFERENCES

ARAÚJO K. V. 1999. Métodos para determinação da digestibilidade aparente dos nutrientes em eqüinos. *Tesis*. Universidade Federal de Lavras, MG. Brazil.

ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTS – AOAC. 1984. *Official methods of analysis*. 14ed. Washington. 1141 p.

GIDENNE T. & LAPANOUSE A. 1997. Rate of passage in the rabbit digestive tract: influence of marker dosing time, ileal cannulation and marker type. *World Rabbit Sci*. 5 (1): 27-32.

SALIBA E. O. S. 1998. Características química e microscópica das ligninas dos resíduos de milho e de soja expostas à degradação ruminal e seu efeito sobre

digestibilidade dos carbohidratos estruturais. *Tesis*. Universidade Federal de Minas Gerais, MG. Brazil.

SAS. 1996. SAS/STAT User's guide. (Release: 6.12.4) SAS Institute Inc., Cary NC. USA.

PÉREZ J. M., LEBAS F., GIDENNE T., MAERTENS L., XICCATO G., PARIGI-BINI R., DALLE ZOTTE A., COSSU M. E. 1995. European reference method for *in vivo* determination of diet digestibility in rabbits. *World Rabbit Sci*. 3 (1): 41-43.

VAN SOEST P. J., ROBERTSON J. B., LEWIS B. A. 1991. Methods for dietary fiber, neutral detergent fiber, and nonstarch polyssacharides in relation to animal nutrition. *Journal of Dairy Science*, 74 (10): 3583 –3597.

VAN SOEST P. J. 1994. *Lignin*. 2 ed. London: Cornell University, pp.189-190.