AN APPROACH TO THE CHEMICAL COMPOSITION AND IN VITRO DIGESTIBILITY OF MULBERRY AND TRICHANTHERA LEAF MEALS FOR PIGS

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SUMMARY

Four representative samples from either mulberry (Morus alba) or trichanthera (Trichanthera gigantea) leaf meals were examined. The samples were obtained at random from periodical harvested foliages in plantations located at Maracay, Venezuela. Several indices related to foliage physico-chemical composition and in vitro, either by the pepsin/pancreatin or faecal incubation values, were determined in leaves plus petioles of the foliages after sun-dried and milled.

Water solubility and in vitro pepsin/pancreatin digestibility indices of several fractions from the examined samples were the best in mulberry leaf meal, as compared to trichanthera leaf meal. The results from this comparison were more obvious for N solubility (P<0.05) and in vitro pepsin/pancreatin N digestibility (P<0.001). Overall, faecal in vitro digestibility values of DM, organic matter and N were higher, approximately 10%, than that corresponding to pepsin/pancreatin in vitro digestibility. In vitro organic matter digestibility of mulberry and trichanthera leaf meal, as determined by pepsin/pancreatin incubation was 57.2 and 44.4% (P<0.01), and 61.1 and 45.5% (P<0.001) when the faecal inocculum was used.

It was confirmed that mulberry leaf meal shows a higher nutritive value for pigs as contrasted to trichanthera leaf meal, from the point of view of its N and organic matter content and utilization.

Key words: *trichantera, mulberry, tree foliage, nutritive value, pigs*

Short title:*:Nutritive value of trichanthera and mulberry foliage for pigs*

UNA APROXIMACIÓN A LA COMPOSICIÓN QUÌMICA Y LA DIGESTIBILIDAD IN VITRO DE FOLLAJE DE MORERA Y TRICANTERA PARA CERDOS

RESUMEN

Se examinaron cuatro muestras representativas de harina de follaje de morera (Morus alba) y tricantera (Trichanthera gigantea). Las muestras se obtuvieron al azar de follaje cosechado periódicamente en plantaciones localizados en Maracay, Venezuela. Varios índices relativos a la composición químico/física y a valores de incubación, fuera con pepsina/pncrati8na o con inóculo fecal, se determinaron en hojas y pecíolos del follaje después de ser secado al sol y molido.

Los índices de solubilidad en agua y de digestibilidad in vitro (pepsina/pancreatina) de las muestras examinadas fueron mejores en la harina de follaje de morera, en comparación con la de tricantera. Los resultados de esta comparación fueron más obvios en la solubilidad del N (P<0.05) in en la digestibilidad in vitro (pepsina/pancreatina) del N (P<0.001). En general, los valores de digestibilidad fecal para la MS, la materia orgánica y el N fueron superiores, aproximadamente 10%, de los correspondientes a los de digestibilidad in vitro con pepsina/pancreatina. La digestibilidad in vitro de la materia orgánica para las harinas de follaje de morera y tricantera fue de 57.2 y 44.4% (P<0.01) cuando se determinó con pepsina/pancreatina, y de 61.1 y 45.5% (P<0.001) cuando se usó inóculo fecal.

Se confirmó que la harina de follaje de morera posee un valor nutritivo más alto para los cerdos si se compara con el de la tricantera, desde el punto de vista de la utilización del N y la materia orgánica.

Palabras claves: *tricantera, morera, follaje arbóreo valor nutritivo, cerdos*

Título corto: *Valor nutritivo de follaje de tricantera y morera para cerdos*

INTRODUCTION

In contrast to legume trees, other types of tropical trees have shown a non negligible potential as source of protein for pigs. This feeding strategy can be done when rations low in fibre are given to the animals. This occurs in the tropical environment, when non conventional energy sources, as roots and tubercles are included in the diet. However, protein sources from trees can adversely influence the voluntary feed intake of pigs, due to its high content of fibre, or bulkiness (Wenk 2001).

Non leguminous trees such as mulberry (Morus alba) and trichanthera (Trichantera gigantea) offers the opportunity to provide an important amount of N for feeding pigs, as it has been assayed in several feeding trials (Gohl 1981; Sarría 2003; Ly 2004). In this connection, it has been claimed that more research should be necessary in order to further study the possibilities of use of tree tropical foliages for feeding pigs (Ly 2004). In the particular case of mulberry and trichanthera foliage, it has often found that a pronounced difference exists between the nutritive value and feeding value of mulberry and that of trichanthera foliage, according to data provided by experiments conducted with growing pigs (Ly et al 2001,2004; González et al 2006; Araque et al 2005; Ly 2006; Contino 2007).

The objective of the present investigation was to determine the chemical composition and nutritive value of mulberry (Morus alba) and trichanthera (Trichanthera gigantea) leaf meals obtained from periodical cuts of tree plantations, and to explore some physico-chemical properties that can be linked to the voluntary feed intake of pigs.

MATERIALS AND METHODS

Four representative samples from either mulberry or trichanthera leaf meals were examined. The samples were obtained at random from periodical harvested foliages, at least every 60 days, in plantations located at the Experimental Farm of the Faculty of Agronomy, Maracay. Several indices related to foliage physico-chemical composition and in vitro, either by the pepsin/pancreatin (Dierick et al 1985) or faecal (Lowgreen 1992, as described by Allen and Ly 2007) incubation indices, simulating in vivo ileal and rectal digestibility, respectively, were determined in leaves plus petioles of the foliages after sun-dried and milled.

The analysis of DM, ash, crude fibre and N were conducted according to AOAC (1995) techniques, while NDF was carried out following Van Soest et al (1991) recommendations. In the case of water holding capacity of the foliage meals, the method of Kyriazakis and Emmans (1995) as referred by Pok Samkol et al (2004) was used. All chemical analyses of samples were conducted by duplicate whereas the in vitro procedures were repeated four times in every opportunity.

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Data were compared by the analysis of variance technique, according to a one-way classification (Steel et al 1997).

RESULTS AND DISCUSSION

The results related to some physico/chemical characteristics of the examined samples are listed in table 1. Mulberry leaf meal had significantly less ash (P<0.01), and therefore, more organic matter (P<0.01) content than trichanthera leaf meal. Similarly the crude protein content of mulberry leaf meal was significantly higher (P<0.05) than trichanthera leaf meal. A non significant trend (P<0.10) for higher values of NDF and crude fibre was noted in the trichanthera foliage, as compared to mulberry. There was no significant difference in water holding capacity between the two examined types of tree leaf meals, although mulberry leaves showed high values in this index.

Table 1. Physico-chemical characteristics of the tree leaf meals

	Tree leaf meals		
	Mulberry	**Trichanthera**	**SE ±**
Composition, % dry basis			
Ash	16.77	23.91	2.12**
Organic matter	83.23	76.09	2.21**
NDF	26.18	32.15	4.11+
Crude fibre	20.05	25.13	3.60
Nx6.25	20.38	15.63	2.14*
WHC, g H_2O/g DM[1]	8.19	7.72	0.50

[1] Water holding capacity determined by filtration
+ P<0.10; * P<0.05; ** P<0.01

Water solubility and in vitro pepsin/pancreatin digestibility indices of several fractions from the examined samples were the best in mulberry leaf meal, as compared to trichanthera leaf meal (table 2). The results from this comparison were more obvious for N solubility (P<0.05) and in vitro N digestibility (P<0.001). In this connection, in vitro (pepsin/pancreatin) digestibility of several Cuban cultivars of mulberry meal as conducted by Domínguez et al (2005) tends to support those corresponding indices found in the present investigation.

Table 2. In vitro (pepsin/pancreatin) digestibility and water solubility of the tree leaf meals

	Tree leaf meals		
	Mulberry	**Trichanthera**	**SE ±**
Water solubility, %			
Dry matter	42.22	43.49	3.33
N	46.78	37.80	2.50*
In vitro digestibility, %[1]			
Dry matter	55.21	40.21	4.62**
Organic matter	57.44	42.22	3.00**
N	59.10	46.34	2.63***

[1] In vitro N digestibility of casein used as standard was 98.53 ± 0.72 %
* P<0.05; ** P<0.01; *** P<0.001

Data corresponding to in vitro digestibility of the evaluated tree foliages when faecal inoccula was employed, are shown in table 3. Overall, faecal in vitro digestibility values of DM, organic matter and N were higher, approximately 10%, than that corresponding to pepsin/pancreatin in vitro digestibility (see table 2). On the other hand, organic matter digestibility was higher than DM digestibility. In this evaluation, disappearance of DM in incubations with faecal inocculum resulted to be significantly (P<0.01) higher in mulberry leaf meal as compared to trichanthera leaf meal. This finding is in accordance with in vivo digestibility trials conducted with pigs (Ly et al 2001).

Differences in N disappearance between the in vitro simulation of ileal and rectal digestibility, could be a consequence of microbial activity on cell walls contained in the examined tree leaves, which could be considered a result of digesta disappearance in caecum and colon of pigs. In this connection, it has been suggested that large intestinal disappearance of organic matter would provide energy materials arising from microbial fermentation (Shi and Noblet 1993). When the digestion of the N fraction is considered, the possible microbial action on N linked to cell wall could result in an increase in N availability for the host. Most of the N linked to either FAD or FDN fraction can not be hydrolyzed in the large intestine due to the nature of this type of linkage (Licitra et al 1996). However, it has been shown that digestion of N in the large intestine of pigs does not provide any advantage to the host, due to the fact that ammonia and probably amine compounds, and not amino acids, are absorbed from the large intestine of pigs (Zebrowska 1973).

Table 3. In vitro (faecal) digestibility of the tree leaf meals

	Tree leaf meals		
	Mulberry	**Trichanthera**	**SE ±**
In vitro digestibility, %[1]			
Dry matter	62.11	38.55	3.33**
Organic matter	65.12	41.53	2.00**
N	50.00	40.66	3.63**

[1] In vitro organic matter digestibility of cellulose used as standard was 35.55 ± 4.55 %
** P<0.01; *** P<0.001

Simulation of digestive processes by in vitro methods as that described in the current investigation, and claimed elsewhere (Ly and Lemus 2007), might perform rapid and cheap screening procedures of energy and N availability from the two main digestive areas of pigs. Breeding differences for fibrous materials utilization by pigs (Ly et al 2003) should be taken into account too (Kyriazakis 2011). The interdependence between digestive indices in pigs fed tree foliages and its acceptability should be considered. In this connection, it has been found that fresh consumption of fresh mulberry leaf by different pig breeds may be different (Lawton and Pok Samkol 2011).

It was confirmed that mulberry leaf meal shows a higher nutritive value for pigs as contrasted to trichanthera leaf meal, from the point of view of its N content and utilization. Nevertheless, the high water holding capacity of both leaf meals, with mulberry leaf meal with values over 8 g H_2O/g DM, merits further research, to establish the influence of bulkiness of these tree foliages on the voluntary feed intake of pigs, and perhaps on the retention time of digesta in the alimentary canal of the animals.

REFERENCES

Allen, J. and Ly, J. 2007. Una aproximación a la predicción del valor nutritivo del follaje de leucaena para cerdos determinado por procedimientos in situ e in vitro. Revista Computadorizada de Producción Porcina, 14:65-69

AOAC. 2000. Official Methods of Analysis. Association of Official Analytical Chemists (K. Helrick, editor). Arlington, pp
.

Araque, H., González, C., Pok Samkol and Ly, J. 2005.Performance traits of finishing pigs fed sweet potatoes and graded levels of trichanthera leaf meal. Revista Científica de la Facultad de Medicina Veterinaria, Universidad del Zulia (FMZ/LUZ), 15:517-522

Contino, Y. 2007. Estudio de la inclusión del follaje fresco de Morus alba L. variedad acorazonada en dietas porcinas. MSci Thesis. Estación Experimental de Pastos y Forrajes "Indio Hatuey". El Perico, pp 36

Dierick, N., Vervaeke, I., Decupeyre, J. and Henderickx, H. 1985. Protein digestion in pigs measured in vivo and in vitro. In: Digestive Physiology in the Pig (A. Just, H. Jorgensen and J.A. Fernández, editors). 580 Beretning fra Statens Husdybrugsforsøg. Copenhagen, p 329-332

Domínguez, H., Díaz, C., Martín, G. and Ly, J. 2005. Estudios de digestibilidad in vitro (pepsina/pancreatina) de follajes de cuatro variedades de morera cultivada para cerdos. Revista Computadorizada de Producción Porcina, 12:210-213

Göhl, B. 1981. Feed Information. Summaries and Nutritive Values. FAO Animal Production and Health Series Nº 12. Rome, pp 529

González, C., Tepper, R. and Ly, J. 2006 . An approach to the study of the nutritive value of mulberry leaf and palm oil in growing pigs. Revista Científica de la Facultad de Medicina Veterinaria, Universidad del Zulia (FMZ/LUZ), 16:406-413

Kyriazakis, I. 2011. Opportunities to improve nutrient efficiency in pigs and poultry through breeding. Animal, 5/6:821-832

Kyriazakis, I. and Emmans, G.C. 1995. The voluntary feed intake of pigs given feeds based on wheat bran, dried citrus pulp and grass meal, in relation to measurements of feed bulk. British Journal of Nutrition, 73:191-207

Lawton, M. and Pok Samkol, 2011. A note on acceptability studies of mulberry leaf meal in young Mong Cai pigs. Revista Computadorizada de Producción Porcina, 18:118-121

Licitra, G., Hernández, T.M. and Van Soest, P.J. 1996. Standardization of procedures for nitrogen fractionation in ruminant feed. Animal Feed Science and Technology, 57:347-358

Löwgren, W. 1992. An in vitro method for studying digestion of dietary components and the energy value of pig feeds. PhD Thesis. Swedish University of Agricultural Sciences. Uppsala, pp 102

Ly, J. 2004. Arboles tropicales para alimentar cerdos. Ventajas y desventajas. Revista Computadorizada de Producción Porcina, 11:5-27

Ly, J. 2006. Procesos digestivos en cerdos alimentados con follaje arbóreo. Revista Computadorizada de Producción Porcina, 13(suplemento 1):13-21

Ly, J., Chhay Ty, Chiev Phiny and Preston T.R. 2001. Some aspects of the nutritive value of leaf meals of Trichanthera gigantea and Morus alba for Mong Cai pigs. Livestock Research for Rural Development, electronic version available in: http://www.cipav.org.col/lrrd/lrrd13/3/ly133.html

Ly, J., Chhay Ty and Pok Samkol, 2003. N balance studies in young Mong Cai and Large White pigs fed high fibre diets based on wheat bran. Livestock Research for Rural Development, 15(1): electronic version available in: http://www/lrrd/org/lrrd15/1/ly151.htm

Ly, J. and Lemus, C. 2007. Las pruebas de digestibilidad en la evaluación de nuevos recursos alimentarios para cerdos. In: IX Encuentro de Nutrición y Producción en Animales Monogástricos. Uiversidad de la República. Montevideo, p 41-45

Ly, J., Pok Samkol and Chiev Phiny. 2004 . An approach to N balance in pigs fed high levels of triochanthera and mulberry leaf meal. In: Los Arboles y Arbustos en la Ganadería. VI Taller Internacional Silvopastoril. Holguín (Cuba). Versión electrónica disponible en disco compacto ISBN 959 16 0285 1

Minitab 2009. Minitab 15 Statistical Software. Minitab In Company. State College (Pennsilvania). Versión electrónica disponible in: http://www.minitab.com

Pok Samkol, Bun Y, Díaz, C., Macías, M. and Ly J. 2004. The nutritive value for monogastrics animals of tropical tree leaves may be a response of its physico-chemical properties. Revista Computadoriza de Producción Porcina, 11 (suplemento 1):30-32

Sarría, P. 2003. Forrajes arbóreos en la alimentación de monogástricos. In: Agroforestería para la Producción Animal en América Latina – II (M.D. Sánchez y M. Rosales, editores). Estudios FAO de Producción y Sanidad Animal Nº 155. Roma, p 213-216

Shi, X.S. and Noblet, J. 1993. Contribution of the hind gut to digestión of diets in growing and adult sows: effect of diet composition. Livestock Production Science, 34:237-252

Steel, R.G.D., Torrie, J.H. and Dickey, M. 1997. Principles and Procedures of Statistics. A Biometrical Approach. McGraw and Hill Book Company In Company (second edition). New York, pp 666

Van Soest, P.J., Robertson, J.B. and Lewis, B.A. 1991. Methods for dietary fiber, neutral detergent fiber and non starch polysaccharides in relation to animal nutrition. Journal of Dairy Science, 74:3583-3593

Wenk, C. 2001. The role of dietary fibre in the digestive physiology of the pig. Animal Feed Science and Technology, 151:197:210

Zebowska, T. 1973. Digestion and absorption of nitrogenous compounds in the large intestine of pigs. Roczniki Nauk Rolnicky, B95:85-90