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CHEMICAL COMPOSITION OF SOME RAW MATERIALS AVAILABLE FOR RABBIT FEEDING IN BENIN

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ABSTRACT

During the past ten years various chemical analyses of 25 raw materials used in Benin for rabbit feeding were performed. The aim of the present paper is to make this information available for a maximum of potential users. The studied products were 9 sun dried forages (*Albizia chevalierii* foliage, *Bidens pilosa* whole plant, *Cajanus cajan* foliage, *Desmodium scorpiurus* vines, *Leucaena leucocephala* foliage, *Manihot esculenta* foliage, *Puerearia phaseolides* whole plant, *Samanea saman* foliage, *Sida acuta* foliage), 7 energy sources (cashew industry by-product, maize germ, maize grain (white), cassava peels, cassava root chips, wheat bran and maize bran), 3 industrial fiber sources (cassava distillery by-product, rice hulls and teak wood sawdust) and 6 protein sources (local fish meal, local toasted soybean seeds, local cottonseed meal, local palm kernel meal, imported soybean meal and local brewers grain). The nutrients analyzed were dry mater (DM), crude protein (CP), ash, crude fiber, ether extract, neutral detergent fiber (NDF), acid detergent fiber (ADF), lignin (ADL) and gross energy. In addition for 8 forages and 5 other raw materials mineral composition was determined for calcium, phosphorus, magnesium, sodium and potassium. All were expressed as percentage of DM. It should be noticed that, if as expected the studied forages could be interesting fiber sources for rabbit feeding (ADF = 21 to 39% DM, ADL= 6.5 to 24.6% DM)), their CP content is also high enough (15 to 29% DM) to provide a noticeable proportion of rabbits total protein requirement. Nevertheless their high level of potassium (1.4 to 3.9% DM) may limit their incorporation level in rabbit feeds. Determination of residual trypsin inhibitor activity indicated that traditional soybean seeds toasting was efficient since the residual activity was only 5.8 TUI/mg. Then with their high protein level (44.2% DM), local toasted soybean seeds should be considered as an interesting source of protein for rabbits.

Keywords : Rabbit feeding, raw material, analytical composition.

INTRODUCTION

Rabbit production in Benin as in most of the West African countries is based on a mix of small and medium scale rabbitries (Djago *et al.*, 2010). Because of urbanisation and of enlargement of the production unit's dimension, more and more units have recourse to compound feeds, employed in addition to fresh forages or used as only feed with water. To support the development of this increasing activity, the new rabbit feed industry uses only locally available raw materials. For production around big cities such as Cotonou, the raw materials available are mainly the agro-industry by-products (tropical oil meals, bran) and products for which commercial activity is important (cereals, soybean meal, …). For production fare from the big cities like in the "Département des Collines", around Savalou, list of local raw materials is partially different and includes dried forages and agricultural by-products such as cassava peels produced by traditional "gari" production.

During the past ten years various chemical analyses of 25 of these raw materials were performed. The aim of the present paper is to make this information available for a maximum of potential users.

MATERIALS AND METHODS

Origin of products

All raw materials included in this study were used in commercial or experimental rabbit feeds production and used thereafter in rabbit feeding without any specific trouble. These raw materials were employed in one or both of 2 rabbit feed factories: 1 - the semi-industrial factory depending of the CECURI experimental and extension service in the Abomey-Calavi University campus, and 2- the small cooperative unit established in the village of Miniki (Benin Hill's Department, 250 km north from Cotonou).

All initially fresh products such forages, distillers by-products or cassava products were sun dried. For forages the term "foliage" corresponds to the raw power obtained after grinding in a cutting mill of sun dried small branches and attached leaves of the corresponding forage. It should be also noticed that locally, rice hulls (3.7% crude protein, Feedipedia, 2012), corresponding to the rice grain dehulling, *i.e.* the first treatment of the grain after separation of grain and straw, are commercialized with the name "rice bran" (14.2% crude protein, Feedipedia, 2012), situation which could be source of some confusions.

Chemical analyses

All products were analysed with the classical methods employed in France in the feed industry or nutrition laboratories.

Dry matter (DM) was determined after 24 hours at 103°C according to the standard methodology adopted by the European Group on Rabbit Nutrition in Lisboa (EGRAN, 2001). Ash was estimated after a DM determination, by treatment of the sample at 250°C during 1 hour followed by 6 hours at 550°C.

Crude protein content (CP) was calculated (N x 6.25) after determination of total nitrogen according the Dumas methodology with a Leco-FP428 apparatus. Crude fibre content was estimated according to the Weende method corresponding to an acid followed by a basic treatment, using a Fibetec apparatus (Foss-Tecator). Neutral detergent fiber (NDF), acid detergent fiber (ADF) and lignin (ADL) were determined also using a Fibetec apparatus but according to the sequential procedure initially proposed by Van Soest (1963) and mainly improved by Robertson and Van Soest (1977) and Giger *et al*. (1979). The ether extract was estimated with a Soxtec® (Tecator) equipment according to the methodology proposed by Alstin and Nilsson (1990) and corresponding to an acid hydrolysis pre-treatment followed by a petroleum ether extraction. Gross energy of samples was determined with an adiabatic calorimeter Parr-1281. Mineral composition for calcium, phosphorus, magnesium sodium and potassium, and the residual anti-trypsic activity of toasted soybean seeds were analysed in the Lareal Company (56006, Vannes, France). Minerals were determined by plasma emission spectrometry with a Varian Vista spectrometer, and the residual trypsin inhibitor activity of toasted soybean grains was determined according to recommendation of the AOAC (1983) without previous defatting.

The DM indicated in tables was the value determined on samples received at INRA laboratory. It may be somewhat different from the practical value of the product when it was introduced in the feed making process. All other nutrients were expressed as percentage of the dry matter of samples.

RESULTS AND DISCUSSION

The main analyses of the 25 raw material are summarized on Table 1, and the mineral composition of 13 of them is presented on the Table 2.

It should be noticed that if as expected the studied forages could be interesting fiber sources for rabbit feeding, their crude protein content is also high enough to provide a noticeable proportion of rabbits total protein requirement. Particular attention should be paid to the cassava foliage (*Manihot esculenta*) with its 28.9% of CP on dry matter basis. A special attention should also be paid to toasted

Table 1: Chemical composition of 25 raw materials available in Benin for rabbit feeding.

Raw material	n	Dry matter	Ash	Crude Protein	Ether extract	Crude fiber	NDF	ADF	ADL	Gross energy
		%	%DM	%DM	%DM	%DM	%DM	%DM	%DM	MJ/kg DM
Forages										
Albizia chevalierii foliage	2	91.93	7.09	26.50	2.63	28.14	62.61	38.84	22.07	20.15
Bidens pilosa whole plant	1	92.16	18.24	14.95	2.48	20.57	38.54	35.32	24.63	16.51
Cajanus cajan foliage	1	92.46	7.13	18.32	2.70	26.38	54.16	33.63	16.65	20.34
Desmodium scorpiurus vines	1	91.81	12.05	14.50	2.05	28.44	46.08	32.71	31.43	17.40
Leucaena leucocephala foliage	1	92.18	10.94	19.74	6.10	20.96	36.29	21.21	11.93	19.87
Manihot esculenta foliage	1	92.49	8.12	28.89	4.94	17.20	34.90	31.88	27.82	20.47
Puerearia phaseolides whole plant	1	90.86	17.20	17.60	nd	35.16	43.05	30.84	6.45	19.40
Samanea saman foliage	1	93.86	6.08	18.70	6.48	37.62	51.90	35.36	21.19	21.73
Sida acuta foliage	1	91.94	10.68	17.20	4.24	23.50	44.56	30.92	12.91	18.40
Energy sources										
Cashew industry by-product	2	95.68	4.13	14.72	nd	15.48	40.92	15.86	7.15	24.20
Maize germ	1	89.82	7.36	15.01	nd	7.66	nd	nd	nd	22.60
Maize grain (white)	5	89.62	1.35	8.74	5.06	3.47	24.68	4.22	2.11	18.77
Cassava peels	2	91.67	7.50	2.93	2.33	9.46	23.05	17.97	12.23	16.43
Cassava root chips	1	90.40	8.85	3.75	1.44	3.11	11.10	6.39	4.20	16.40
Wheat bran	3	87.78	7.94	18.01	nd	10.80	49.05	13.91	4.71	18.99
Maize bran (maize offals)	1	88.27	4.02	9.06	nd	12.21	nd	nd	nd	19.63
Industrial fiber sources										
Cassava distillery by-product	1	91.62	3.84	12.99	nd	22.36	60.76	32.99	32.30	nd
Rice hulls	6	91.02	19.89	4.62	3.37	35.07	63.58	40.62	18.59	16.83
Teak wood sawdust	2	85.16	2.07	1.41	nd	70.82	90.03	75.48	25.13	20.33
Protein sources										
Local fish meal	2	89.11	37.88	46.60	nd	0.76	nd	nd	nd	15.93
Local soybean seeds, toasted	2	92.24	5.88	44.20	20.34	10.35	31.92	14.54	1.39	23.45
Local cottonseed meal	4	91.32	8.05	39.26	nd	13.33	38.24	22.77	5.92	20.46
Local palm kernel meal	4	91.16	6.20	17.76	nd	15.97	62.06	32.46	6.64	21.05
Imported soybean meal	1	86.35	6.84	48.31	nd	6.89	16.39	8.31	0.29	20.84
Local brewers grain	5	89.75	10.74	24.40	nd	13.48	61.53	20.45	4.43	19.18

n = number of analyzed samples – Ether extract : only one sample when analyzed

soybean seeds. Their protein content (44.2% DM) was above the variation range based on more than 2400 samples (36.9-42.0% DM) and reported in the Feedipedia data base (2012) for toasted soybean seeds. Nevertheless it is comparable to the 44.9% value reported by Houndonougbo *et al.* (2009) for soybean seeds collected in north or south parts of Benin. The complementary determination of residual trypsin inhibitor activity indicated that traditional soybean seeds toasting was efficient since the residual activity was only 5.8 TUI/mg.

Among the studied forages only pigeon pea foliage (*Cajanus cajan*) and cassava foliage (*Manihot esculenta*) were from plants cultivated by farmers; all the others were collected in the wild. Nevertheless the potassium level for all of them was high to very high and this could be a limitation to a too large use of theses foliages because a maximum of 1.5-1.8 % of potassium in the final complete diets as fed is recommended (Lebas, 2004). The potassium level of *Bidens pilosa* (3.9% DM) as that of *Desmodium scorpiurus* (3.4% DM) limited the incorporation level to 20 to 30% maximum depending from the potassium content of other diet's components.

A last remark should be done about the dry matter content of the teak wood sawdust. It was raw sawdust corresponding to the first cut of teak trees to make boards. The tree trunks were not completely dry. Then some problems of conservation could be observed if the relatively wet sawdust (about 15% humidity) was not immediately incorporated in rabbits feed or dried before conservation (sun dried or oven dried).

Table 2: Mineral composition of 13 raw materials available in Benin for rabbit feeding (1 sample analysed per raw material).

Raw material	**Dry matter** %	**Calcium** %DM	**Phosphorus** %DM	**Magnesium** %DM	**Sodium** %DM	**Potassium** %DM
Forages						
Albizia chevalierii foliage	93.19	1.009	0.161	0.451	0.009	1.416
Bidens pilosa whole plant	92.16	1.188	0.518	0.421	0.007	3.855
Cajanus cajan foliage	92.46	1.057	0.227	0.259	0.005	1.446
Desmodium scorpiurus vines	91.81	1.254	0.411	0.324	0.008	3.405
Leucaena leucocephala foliage	92.18	2.001	0.141	0.325	0.004	1.495
Manihot esculenta foliage	92.49	0.956	0.301	0.430	0.009	1.826
Samanea saman foliage	93.86	0.967	0.138	0.138	0.008	1.424
Sida acuta foliage	91.94	1.554	0.413	0.370	0.007	1.804
Other ingredients						
Maize grain (white)	89.36	0.014	0.225	0.109	0.001	0.326
Cassava peels	90.44	0.499	0.144	0.133	0.005	1.343
Cassava root chips	90.40	0.178	0.097	0.091	0.060	0.566
Rice hulls	92.36	0.086	0.479	0.272	0.006	0.403
Local soybean seeds, toasted	94.07	0.434	0.445	0.265	0.001	1.801

REFERENCES

Alstin F., Nilsson M., 1990. Le système d'hydrolyse Soxtec® améliore les méthodes officielles de dosage des matières grasses totales. *Ind. Alim. Agric., 107 (12), 1271-1274.*

AOAC (1983) Official Methods of Analysis. *Association of Official Agricultural Chemists, Washington, D.C.*

Djago A.Y., Kpodekon M., Lebas F., 2010. Le guide pratique de l'éleveur de lapins sous les tropiques 2ème édition. *Cecuri éd., Abomey-Calavi (Bénin) 116 pages*

E.G.R.A.N. 2001. Technical note: Attempts to harmonize chemical analyses of feeds and faeces for rabbits feed evaluation. *World Rabbit Sci., 9, 57-64.*

Feedipedia, 2012. Soybean seeds, Rice hulls and Rice bran Tables. *On line* Animal Feed Resources Information System Inra-Cirad-Afz-Fao http://www.trc.zootechnie.fr/node/42 (accessed 12 May 2012)

Giger S., Sauvant D., Dorleans M., Morand-Fehr P., 1979. Détermination semi-automatique des constituants membranaires des aliments concentrés par la méthode de Van Soest. *30th Annual Meeting of the European Association for Animal Production, Harrogate, England, 23-26 July 1979.*

Houndonougbo F. M., Chwalibog A., Chrysostome C. A.. A. M. 2009: Is the nutritional value of grains in broiler chickens' diets affected by environmental factors of soybean (*Glycine max*) growing and the variety of maize (*Zea maize*) in Benin ? *Livestock Research for Rural Development. Volume 21, Article #22.* Retrieved February 17, 2009, from http://www.lrrd.org/lrrd21/2/houn21022.htm

Lebas F., 2004. Reflections on rabbit nutrition with a special emphasis on feed ingredients utilization. *Proc 8th World Rabbit Congress, Puebla Mexico,* 686-736.

Robertson J.B., Van Soest P.J., 1977. Dietary fiber estimation in concentrate feedstuffs. *J. Anim. Sci. 45 Suppl., 1, 254.*

Van Soest P.J., 1963. Use of detergents in the analysis of fibrous feeds. II. A rapid method for the determination of fibre and lignin. *J. Assoc.Off. Anal. Chem., 46, 829-835.*