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Sun-dried Stylo Hay (*Stylosanthes guianensis* CIAT 184) as Dietary Fibre Source in Rabbits

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ABSTRACT

Background: In West Africa, one of the main problem of rabbit production is the lack of fibre-balanced feeds available at remunerative price, as the supply of fibrous raw material remains difficult. Expensive fibrous raw materials imported from temperate countries are the most fibre source used in rabbit feed formulation. This study aimed to assess the nutritive value and the potential use of *Stylosanthes guianensis* CIAT 184, a local fodder, as dietary fibre source in rabbit feed.

Methods: Four diets containing an inclusion of *Stylo* hay: 0% (control, SH0), 15% (SH15), 30% (SH30) and 45% (SH45) as a substitute for the control diet (33.3 g NDF and 170 g CP/kg) were studied. Four groups of 12 rabbits, individually caged, were fed ad libitum the 4 diets, from weaning (35 days) to 78 days age.

Result: Replacing up to 45% the basal diet with Stylo hay reduced nutrients digestibility (P<0.001). The digestible protein (DP) contain of Stylo hay was 36±0.57 g/kg DM. The inclusion of Stylo up to 30% in the diet improved animals growth rate compared to the control diet. Health status and slaughter traits were not affected by Stylo incorporation. It was concluded that sun-dried Stylo hay could be considered as a good fibre source in the complete pellet feed for rabbits in West Africa.

Key words: Dietary fibre, Nutritive value, Rabbit, *Stylosanthes guianensis*.

INTRODUCTION

In West Africa, the lack of quality feed at affordable prices is one of the obstacles to the development of rabbit farming. Indeed, several raw materials used for rabbit feed production are imported. To produce fibre-balanced feed, various fibre source ingredients such as dehydrated alfalfa (*Medicago sativa),*wheat, sunflower and beet by-products are imported from temperate countries (Kadi *et al*., 2011). Importing these raw materials contributes to increase the cost of rabbit feed. Therefore, the search for local raw materials rich in fibre, is the only alternative to produce quality feed at a lower cost (Kimsé *et al*., 2017).

Stylosanthes guianensis is a legume forage native to Central and South America. It grows naturally in the tropical area of Africa. Also called “alfalfa of Brazil”, this forage legume is used as a cover plant for its ability to restore soil fertility. It is also a high-quality nutritive forage for most herbivorous animals such as rabbits. *Stylosanthes guianensis* is rich in fibre (54-60% NDF) and crude protein (14-20%) (Kambashi *et al*., 2014), with low levels of secondary metabolites (Pandey *et al*., 2013). In rabbit nutrition, its use in the form of green forage leads to interesting performance (Omole *et al*., 2007). The cultivar CIAT 184 of this fodder has been cultivated in Côte d’Ivoire for several years for ruminant feed. The main objective of the current study was to determine the nutritive value of *Stylosanthes guianensis* cv CIAT 184 and to assess its potential use as dietary fibre source in growing rabbits feed formulation.

MATERIALS AND METHODS

Experimental design and feeds

The study was carried out at the National Polytechnic Institute Félix HOUPHOUËT-BOIGNY of Yamoussoukro in Côte d’Ivoire. The district of Yamoussoukro is located between 6°15 and 7°35 North latitude and 4°40 and 5°40 West longitude. The farm was subjected to a natural atmosphere of lighting and ventilation. The average temperature was 27°C with a relative humidity of 81%. Forage of *Stylosanthes guianensis* CIAT 184 was harvested at vegetative stage after 5 months of cultivation, then sun dried. A basal mixture containing *Pennisetum purpureum* (elephant grass) hay, wheat bran, rice bran, corn grain, soybean meal, cottonseed meal and cane molasses was formulated to cover the nutritional needs of the growing rabbit according to the

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recommendations of De Blas and Mateos (2020). Four experimental diets containing an increasing rate of *Stylo* incorporation have been formulated by substituting the basal diet with 0, 15, 30 and 45% *Stylo* (SH0, SH15, SH30 and SH45, Table 1) without minerals and premix. Minerals and premix were added to all diets at a fixed amount of 2%. The mixtures were then pelleted (4 mm diameter, 9 mm length).

Animals and measurements

Forty-eight (48) local rabbits, weaned at 35 days old (mean body weight: 628 g), were used for this study. They were divided into four batches of 12 rabbits and individually housed in wire cages (70×60×55 cm), for digestibility measurement. The weight and the origin of the litter were taken into account to constitute homogeneous lots. Animals in each batch were randomly assigned to one of the four experimental diets from 35 to 78 days.

During the experiment, the rabbits were given the feeds and water ad libitum. Feed intake was measured daily and growth once a week. In addition, the rabbits' health was monitored by daily morbidity and mortality control as recommended for feeding experiments in rabbits (Fernández-Carmona *et al*., 2005).

After an adaptation period of 10 days (at 45 days old), 10 rabbits per group were selected for digestibility study, according the European reference method EGRAN (European Group on Rabbit Nutrition) described by Pérez *et al*. (1995). The cages were equipped under the floor with a drawer with a grid to collect faeces over a 5 days period. Faeces were collected daily in plastic bags and stored at -20°C until chemical analysis.

Slaughter and carcass characteristics measurement

At the end of the trial, eight rabbits per diet were selected and slaughtered in controlled conditions, according the recommendations of the World Rabbit Science Association (WRSA) described by Blasco and Ouhayoun (1996). On each rabbit slaughtered, the weights of the full digestive tract, the hot carcass including the head, all the organs of the neck (thymus, trachea, esophagus), the rib cage (lung and heart), organs (liver and kidneys) and abdominal fat, were recorded. Liver, kidneys and perirenal fat were collected and recorded. Dressing percentage was determined by ratioing the weight of hot carcasses to the live weight at slaughter.

Chemical analyses

Samples of *Stylo*, feed and animals faeces were analysed according to harmonised European procedures (EGRAN, 2001). Dry matter was determined in the oven for 24 h at 103°C, crude protein according to the Kjeldahl method (N×6.25) and crude ash in a muffle furnace at 550°C for 8 h. The fibres (NDF, ADF and ADL) were determined according to the sequential procedure of Van Soest *et al.* (1991).

Statistical analysis

The analyses were performed with R software (R Development Core Team, 2021). The data obtained were

Table1: Ingredients and chemical composition of Stylo and experimental feeds.

Ingredients (g/kg as fed)	Stylo	SH0	SH15	SH30	SH45
Stylo		0	150.0	300.0	450.0
Pennisetum purpureum (leaves)		119.4	101.2	82.8	64.4
Wheat bran		250.0	211.6	173.6	135.2
Rice bran		300.0	254.0	208.0	162.4
Corn grain		85.2	72.0	59.2	46.0
Soybean meal		94.6	80.4	65.6	51.2
Cottonseed meal		110.8	94.0	76.8	60.0
Cane molasses		20.0	16.8	14.0	10.8
Salt (NaCl)		5.0	5.0	5.0	5.0
Oyster shells		10.0	10.0	10.0	10.0
Vitamin/mineral premix[1] 0.5%		5.0	5.0	5.0	5.0
Chemical composition (g/kg as fed)					
Dry matter	903	908	917	911	908
Crude ash	50	97	95	94	92
Crude protein (CP, N×6.25)	105	170	163	157	148
Neutral detergent fibre (NDF)	538	333	363	393	422
Acid detergent fibre (ADF)	425	165	204	242	280
Acid detergent lignin (ADL)	96	35	44	53	62

[1]Vitamins and minerals: A: 1,000,000 IU/kg; D3: 100,000 IU/kg; E: 3,000 mg/kg; K3: 200 mg/kg, B1: 200 mg/kg; B2: 500 mg/kg; B5: 1000 mg/kg; B6: 200 mg/kg; B12: 1.14 mg/kg; PP: 2500 mg/kg; Choline chloride: 12000 mg/kg, Biotin: 5 mg/kg, Folic acid: 200 mg/kg, Calcium: 187 g/kg, NaCl (Salt): 400 g/kg, Sodium (Na): 154 g/kg, Magnesium (Mg): 21198 mg/kg, Copper (Cu): 1051 mg/kg, Iron (Fe): 9515 mg/kg, Zinc (Zn): 8020 mg/kg, Manganese (Mn): 3144 mg/kg, Iodine (I): 30 mg/kg, Selenium: 9 mg/kg, Cobalt (Co): 13 mg/kg; (Support: calcium carbonate).

subjected to one-way ANOVA with the regime as the source of variation. Means were compared using the Tukey test (5%). The linear effect of *Stylo* incorporation on nutrient content and dry matter intake of the experimental feeds, as well as on animal growth, was analyzed using REG procedure from RCMDR package. The protein value of *Stylo* was determined according to the method described by Villamide *et al.* (2001).

RESULTS AND DISCUSSION

Nutritive value of Stylo and impact on the experimental diets

The fibre content of the experimental diets increased with the incorporation level of *Stylo* while the protein content decreased. The NDF content increased by 0.2 points per point of *Stylo* incorporated. Furthermore, the ADF content was positively correlated (R^2=1, P<0.001) by the *Stylo* level since it increased by 11% from SH0 to SH45. Unlike fibre, the protein content of the diets decreased by 1 point with the incorporation of *Stylo*, leading to a 2.2% decrease between SH0 and SH45 (R^2=0.99, P<0.01).

Stylo was harvested at vegetative stage in the present study has a high fibre content. Its ADF and NDF contents (42.5% and 53.8% respectively) are similar to those of *Stylo* hay reported by Akpensuen *et al.* (2019). However, these values are low than those obtained by Kambashi *et al.* (2014) (NDF=58.3%; ADF=50.5%). Its protein content, 10.5%, is 3 to 6 units lower than those obtained by (Ntsafack *et al.*, 2020).

Feed intake, growth and health of the rabbits

Feed intake and rabbits growth are shown in Table 2. Over the whole rearing period (35-78 days) the daily growth remained lower for the SH0 and SH45 diets and better for the SH30 diet. The feed conversion rate increased with the inclusion level of *Stylo*. The feed intake increased by 31% between the SH0 and SH45 diets. Furthermore, the animals showed good health during the experiment. No cases of illness or mortality have been observed for all diets.

According to De Blas and Mateos (2020), the crude protein (CP) requirements for rabbit fattening are in the range of 14.2% and 16%. The rabbits receiving the SH0 diet containing 17% CP recorded a lower growth rate (-22%) than lot SH30 with 15.7% CP. This difference in weight gain seems to be the consequence of a low level of ingestion of the SH0 diet (-33 g/d compared to SH30) and possibly the presence of oxalates in *P. purpureum* leaves that alter the palatability and digestion of the SH0 diet (Rahman *et al.*, 2020).

The increase of feed intake by 31% from SH0 to SH45 diets could be attributed to a decrease in the energy concentration, due to the increase in fibres content of the diets. Indeed, the rabbit fed *ad libitum* regulates its ingestion in order to adjust its consumption of digestible energy (Gidenne *et al.*, 2015).

Nutrients digestibility

Dry matter digestibility decreased linearly (-25%, P<0.001) between the diets SH0 and SH45. *Stylo* incorporation reduced the amount of digestible protein by 40%, (P<0.001), between the SH0 and SH45 diets. Also, the digestibility coefficient for CP decreased linearly from SH0 to SH45 (P<0.001; Table 3). The digestible protein (DP) content of the diets consequently decreased from 122 to 72 g/kg DM. When using linear regression, the DP content of Stylo was estimated at 32 g/kg of crude product. In comparison, the DP content of *Pueraria* is

Table 2: Effect of stylo inclusion level on feed intake and rabbit growth.

	Experimental diets				Standard	P value
	SH0	SH15	SH30	SH45	error	
No.[1]	12	12	12	12		
Period 35-57 d						
Body weight at 35 days (g)	628	627	628	628	29.68	0.05
Body weight at 57 days (g)	1195^a	1267^{ab}	1335^b	1187^a	38.68	0.032
Daily weight gain (g)	25.8^a	29.1^b	32.1^c	25.2^a	0.74	<0.001
Daily feed intake (g)	65.1^a	78.1^b	90.4^c	94.7^c	3.66	<0.001
Feed conversion rate (g/g)	2.51^a	2.69^a	2.81^a	3.77^b	0.11	<0.001
Period 57-78 d						
Body weight at 78 days (g)	1693^a	1841^b	1994^c	1705^a	42.80	<0.001
Daily weight gain (g)	23.7^a	27.3^b	31.4^c	24.6^a	0.65	<0.001
Daily feed intake (g)	80.8^a	92.5^b	106.6^c	117.4^d	3.05	<0.001
Feed conversion rate (g/g)	3.41^a	3.41^a	3.39^a	4.79^b	0.12	<0.001
Period 35-78 d						
Daily weight gain (g)	24.8^a	28.2^b	31.8^c	24.9^a	0.59	<0.001
Daily feed intake (g)	72.8^a	85.1^b	98.3^c	105.8^c	3.04	<0.001
Feed conversion rate (g/g)	2.93^a	3.02^a	3.09^a	4.25^b	0.09	<0.001

No[1]: Number of rabbits at the end of the experiment.

$^{a, b, c, d}$: Averages with different letters on the same line differ significantly (*P<0.05*).

Table 3: Effect of stylo inclusion level on faecal digestibility and digestible protein content of experimental diets (between 45 and 50 days old).

	Experimental diets				Standard error	P value
	SH0	SH15	SH30	SH45		
No.[1]	10	10	10	10		
Digestibility (%)						
Dry matter	74.6[a]	65.0[b]	58.2[c]	54.5[c]	1.40	<0.001
Organic matter	71.3[a]	62,5[b]	57.4[c]	49.6[d]	0.51	<0.001
Crude protein	69.2[a]	65.2[b]	60.9[c]	52.6[d]	0.41	<0.001
Digestible protein (g/kg DM)	122[a]	107[b]	91[c]	72[d]	0.03	<0.001

[1]No: number of rabbits at the end of the experiment.

[a, b, c,] d: Averages with different letters on the same line differ significantly (*P<0.05*).

Table 4: Effect of Stylo inclusion level on rabbit carcass characteristics.

	Experimental feeds				Standard error	P value
	SH0	SH15	SH30	SH45		
No	8	8	8	8		
Body weight (g)	1841[a]	1956[b]	2101[c]	1825[a]	38.04	<0.001
Full digestive tract (g)	26.57	25.10	26.34	25.46	0.39	0.052
Cold carcass (g)	1011[a]	1093[b]	1187[c]	1006[a]	20.82	<0.001
Liver (g)	63.56	60.07	67.75	64.79	2.58	0.239
Kidneys (g)	16.42[a]	16.12[a]	19.35[b]	15.59[a]	0.66	<0.001
Dressing yield[*] (%)	54.92	55.88	56.46	55.21	0.60	0.296

[+] Slaughter of rabbits at 11 weeks of age; No. : number of rabbits slaughtered per diet.

[*] Carcass yield (%) = Ratio of hot carcass to live weight x 100.

[a, b,c]: Averages with different letters on the same line differ significantly (*P<0,05*).

16% higher (Akoutey *et al.*, 2012) and that of *Hedysarum flexuosum* 74% higher (Kadi *et al.*, 2011).

Characteristics of the carcass

The slaughter weights of the rabbits fed the SH30 diet were higher (*P*<0.001), compared to the others lots (Table 4). Cold carcass weights followed the same trend. However, the weight of the full digestive tract and dressing percentage were not affected by the different levels of *Stylo* inclusion.

The carcass weights obtained in this study are better than those reported by Ojebiyi *et al.* (2013) who obtained lower weight at slaughter despite an older age (105 days). Carcass yields in the present study are similar to those reported with rabbits of hybrid breeds in West Africa (Oloruntola *et al.*, 2019).

CONCLUSION

The aim of this study was to determine if the variety of *Stylosanthes guianensis* cultivated in Côte d'Ivoire could be used as a source of fibre in the complete pelleted feed for rabbits. This work revealed that *Stylosanthes guianensis* cv CIAT 184 (*Stylo*) can be considered a moderate source of nutrients with a low digestible protein content (32 g/kg of raw product), but a good source of fibre. Based on these results, sun-dried Stylo hay could thus be used as a good fibre source for rabbit nutrition in West Africa. But forage should be harvested at a younger age (4 months) for better crude protein content.

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