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Effect of soaking and toasting on the chemical composition, ingestion and *in vivo* digestibility of *Mucuna pruriens* (var *cochinchinensis*) seed powder in guinea pig

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ABSTRACT

Aim: The study was aimed to estimate soaking and toasting effects on the chemical composition, ingestion and *in vivo* digestibility of *Mucuna pruriens* (var *cochinchinensis*) seed powder in guinea pig.

Method and materials: Total 48 guinea pigs of local breed aged five months, 24 male and 24 female were used. It was divided into four batches of 6 males and 6 females each. To each lot was attributed a ration containing 0%, 20% of *Mucuna pruriens* be it raw, soaked or toasted.

Results: The chemical composition of the powder *Mucuna* seeds change from one treatment to another. The content of DM (96.33%, 93.33%), OM (92.67%DM, 91%DM), CF (13.00%DM, 11.62%DM) and CP (24.00%DM, 29%DM) of toasted seeds were higher than that of soaked seeds with the exception of crude protein where the reverse was observed with soaked seeds. The toasted seed intake of *M. pruriens cochinchinensis* was significantly higher ($p>0.05$) than that of soaked seeds, i.e. DM(78.49%, 74.54%), OM(69.82%DM, 66.60%DM), CF(23.96%DM, 22.88%DM) and CP(12.26%DM, 11.53%DM). Similarly, sex significantly affected ingestion, with males having better seed ingestion than females. Similarly, the digestibility of DM, OM, CP and CF of the different rations was comparable. However, males valued the RmtC ration more highly and females valued the R0, RmCC and RmTC rations more highly.

Conclusion: It was concluded that toasted *M. pruriens* seeds can be used in guinea pig feed as an alternative source of protein.

Keywords: *Cavia porcelus*, chemical composition, *cochinchinensis, in vivo* digestibility, *Mucuna pruriens*, treatment, ingestion.

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Introduction

Generally in Africa and particularly in Cameroon, the demand for meat is increasingly high, tending to exceed supply (Miégoué et al., 2018). Guinea pig is a monogastric herbivore whose interest lies in its prolificity, its lean meat rich in protein and its inexpensive diet (Cicogna 2000). However, feed remains one of the main handicaps to the development of its breeding. Indeed, in Cameroon, this animal feed mainly on kitchen waste, which could have quantitative and qualitative deficiency in proteins and minerals (Noumbissi et al., 2014).

Productivity improvement of guinea pigs can be achieved, among other things, by providing them with a balanced food ration taking into account their nutritional needs (Pamo et al., 2005). Solutions that can easily be envisaged include the useof unconventional protein such as *Mucuna Pruriens* seeds.

Mucuna Pruriens belongs to the Fabaceae family and is generally known as a cover plant. (Divya et al., 2017). It is a fast-growing annual climber with proven virtues in many areas (Razarfindahy, 2016). Relatively drought tolerant, it often produces a large amount of seeds with yields ranging from 2.9 to 6.9 tons/ha (Vissoh et al., 1998; Pugalenthi et al., 2007). Indeed, the seed, because of its interesting protein content (22-35%), (Costa et al., 2006) may be a good and cheap

proteins source. But the presence of anti-nutritional factors in this legume limits its use in animal feed. Those factors include tannins that form complexes with proteins, carbohydrates and digestive enzymes and interfere with digestion. They also include lectins or hemagglutinins that agglutinate blood cells and reduce the digestive efficiency of fats and starch (Andrianirina, 2015). The most important of these factors is L-Dopa (3,4 dihydroxy-L-phenylalanine). Indeed, L-Dopa limits the digestibility of proteins and starch (Tuleun et al., 2008), which causes psychic disorders (mental confusion), hallucinations, gastrointestinal disorders (nausea, vomiting and anorexia), dementia and severe depression. Therefore, detoxification methods such as physical and chemical treatments have been developed to control the negative effects of these anti-nutritional factors to a harmless threshold for use in animal feed. Dahouda et al, 2009 showed that once treated, the L-Dopa content in *Mucuna* seeds could be reduced up to 99%. Similarly, André et al. 2011 showed that treated *Mucuna* seeds used in broiler feed were comparable to the control ration without *Mucuna* seeds. However, very few studies on the ingestion and digestibility of rations associated with pruritic *Mucuna* seeds subjected to different treatments have been conducted so far in guinea pigs. Therefore, the present work was initiated in order to contribute to diversity of guinea pig diets through the valorization of locally available resources at low cost.

Materials and Methods

Study area

This study was conducted from March to April 2020 at the Teaching and research farm of the University of Dschang. It's located at the 15th degree of the East meridian, at latitude 5 ° 36'- 5 ° 44 'North and longitude 09 ° 85'-10 ° 06' East.

Animal and housing

Total 42 guinea pigs (21 males and 21 females) aged 5 months with an average weight of 450 ± 60g were produced at the LAPRONAN. Animals were placed in individual wire cages of 10.6 dm3 (76 cm x 46.5 cm x 30 cm), each equipped with a feeder trough and a drinker of 100 g each and a faeces collection device consisting of 1 mm mesh mosquito net and plastic paper. The various cages have been fitted with a fine-mesh cover to protect the animals from mice and other predators that may be present or enter the building.

Feeding

The different rations thus prepared were served to each animal on a daily basis and were made up as follows (Table 1):

Table 1: Percentage and chemical composition of the experimental rations for digestibility

	Rations			
Ingredients	R0	RmCC	RmTC	RmtC
Maize	21.5	22	24.5	22.5
Moulding	45 .5	31	31	30
Cotton seed cake	13	11.5	8	11
M. pruriens	0	20	20	20
Shell	1	1	1	1
P. purpureum	10	10	10	10
Palm oil	3.5	2	3	3
Iodizedsalt	0.5	0.5	0.5	0.5
Premix* 2%	2	2	2	2
Total	100	100	100	100
Dry matter (DM in %)	89.61	89.58	90.43	90.21
Organicmatter (%DM)	81.72	82.59	82.47	83.54
Crudeprotein (% DM)	18.63	18.55	18.84	18.94
Fat (% DM)	6.88	6.90	7.28	10.58
Crude fiber (% DM)	10.81	10.35	10.04	10.74
Ash (% DM)	6.57	6.26	6.79	6.01
EM (Kcal/KgDM)	2816.93	2876.37	2850.82	2806.01

*Premix 2% flesh: Vit. A=3000000 IU/kg, Vit. D3=600000 IU/kg, Vit. E=4000mg/kg, Vit. K3=500mg/kg, Vit. B1=200mg/kg, Vit. B2=1000mg/kg, Vit. B3=2400mg/kg, Biotin=10mg/kg, Vit. PP=7000mg/kg, Folic acid=200mg/kg, Choline chloride=10000mg/kg, ferrous sulphate=8000mg/kg, Copper (II) sulphate=2000mg/kg, Manganous oxide=1400mg/kg, Calcium iodate=200mg/kg, Basic cobalt carbonate=200mg/kg, Sodium selenite=20mg/kg, Methionine=20000mg/kg, Lysine=78000mg/kg, EM: Metabolizable energy, R0: Control ration, RmCC: Ration containing 20% raw *Mucuna pruriens*, RmTC: Ration containing 20% soaked*Mucuna pruriens*,RmtC: Ration containing 20% toasted*Mucuna pruriens*.

With,

- Lot 1: 60g of R0/animal/day (Control ration with 0% *Mucuna pruriens*)
- Lot 2: 60g of RmCC /animal/day (Ration containing 20% raw *Mucuna pruriens*)
- Lot 3: 60g of RmTC /animal/day (Ration containing 20% *Mucuna pruriens soaked*)
- Lot 4: 60g of RmtC /animal/day (Ration containing 20% toasted *Mucuna pruriens*)

Trying conduct

Treatment of grains: It's consisted of whole seeds of *Mucuna pruriens* variety *cochinchinnensis*. *Mucuna*

pruriens seeds were bought from North Cameroon. Underwent two different treatments including soaking (48h) at room temperature + boiling for 1h30 in a pressure cooker for one and toasting for 45min at 103°C. Then, these seeds were ground and the resulting powder was incorporated at a rate of 20% in the feed to make up the different experimental rations.

Data collection and study parameters

Evaluation of ingestion: A total of twelve (12) guinea pigs of which six (06) of each sex were used throughout this trial for each of the treatments. These animals were randomly assigned to individual cages, and food was served only once each day between 8 and 9 am. For intake assessment, the amounts of food served (60g) were recorded, and refusals were collected daily and weighed before further distribution. As a prophylactic measure, vitamin C was given daily to all animals in drinking water served at will to avoid any possible deficiency. Refusals were quantified in order to determine the quantities of food ingested. The ingestion or consumption of food was calculated according to the formula opposite:

Food ingestion = Daily amount of food served - Amount not consumed (refusal)

In vivo digestibility of rations: The digestibility test was preceded by a period of adaptation of the animals to the digestibility cage and the compound feed, which lasted 10 days. During this period, the quantities of compound food served were adjusted to the animal's consumption, estimated at 60 g/animal/day. During the data collection period which lasted 7 days, each morning before the distribution of the food, faeces were collected in batches, weighed and dried at 60°C in the laboratory in a ventilated oven. The animals were weighed individually during this collect period to assess their weekly gain. Subsequently, their dry matter (DM), organic matter (OM), crude protein (CP) and crude fibre (CF) content was analysed according to the method described by AOAC (2000). The apparent digestive utilization coefficients of Dry Matter (CUDaDM), Organic Matter (CUDaOM), Crude Protein (CUDaCP), and Crude Cellulose (CUDaCF) were calculated according to the formula of Roberge and Toutain (1999):

CUDaDM (%) = (DM ingested-FecalDM)/(DM ingested) ×100

CUDaOM (%) = (OM ingested-FecalOM)/(OM ingested) ×100

CUDaCP (%) = (CP ingested-FecalCP)/(CP ingested) ×100

CUDaCF (%) = (CF ingested-Fecal CF)/(CF ingested) ×100

Statistical analysis

Data on food intake and nutrient digestibility were subjected to one factor analysis of variance (ANOVA) (food ration) following the general linear model (GLM). When significant differences existed between treatments, the means were separated by the Waller Duncan test at the 5% significance level (Steel and Torrie 1980). SPSS 20.0 analysis software was used.

Results and Discussion

Soaking and toasting chemical composition of Mucuna Pruriens seeds

The different treatments carried out on *Mucuna pruriens* seeds have had a variable influence on its chemical composition (Fig 1). The DM content of toasted pruritic *Mucuna* seeds was significantly ($p<0.05$) high than that of the powder of pruritic *Mucuna* seeds and that of seeds soaked for 48 hours and boiled. The content of all nutrients in the powder of raw pruritic *Mucuna* seeds was significantly lower ($p<0.05$) than that of soaked or toasted seeds. As a result, the CP of the soaked *Mucuna pruriens* seeds that gave the best protein content compared to the whole and toasted seeds were significantly lower ($p<0.05$).

Effect of the inclusion of Mucuna pruriens powder in the ration on feed intake in guinea pigs

The intake of different experimental feed (R0, RmCC, RmTC, RmtC) was significantly ($p<0.05$) influenced by the *Mucuna pruriens* level of the ration (Fig 2).

It was presented effect of the inclusion of *Mucuna pruriens* powder in the ration on feed intake in guinea pigs (Table 2). It follows that, overall, the effect of the inclusion of Mucuna seed powder on feed intake in guinea pigs varies in a saw tooth pattern. Regardless of the lot, the inclusion of treated or untreated Mucuna powder had no significant effect ($p>0.05$) on DM, and OM ingestion in males. With respect to DM in females, the ingestion in animals from lot R0 was significantly ($p<0.05$) higher than in other lots. The same trend was observed regardless of sex. In females, the ingestion of OM in animals from lot R0 was significantly ($p<0.05$) higher than in other lots. Whereas, regardless of sex, the intake of OM in animals of lot R0 was comparable ($p>0.05$) to that of

animals of lot RmtC but significantly ($p<0.05$) higher than that of animals of lots RmCC and RmTC. However, the CP ingestion of the animals of lot R0 was significantly ($p<0.05$) higher than that of the other lots both in males and regardless of sex. In females, on the other hand, the CP intake of the animals of lot R0 was comparable ($p>0.05$) to that of the animals of lot RmCC but significantly ($p<0.05$) higher than that of the animals of lots RmTC and RmtC. In terms of CF, the ingestion of animals from lot RmCC was significantly ($p<0.05$) higher than that of animals from other lots both in males and regardless of sex; whereas in females, the CF ingestion of animals from lot R0 was comparable ($p>0.05$) to that of animals from all other lots.

Effect of the inclusion of Mucuna pruriens powder white variety in the ration on the apparent digestive use coefficients (CUDa) of nutrients in guinea pigs

It was showed the effect of including *Mucuna pruriens* powder in the ration on the apparent digestive use coefficients (CUDa) of nutrients in guinea pigs (Table 3). It follows that overall, the inclusion of *Mucuna pruriens* seed powder significantly ($P<0.05$) affected CUDa in guinea pigs.

In males, the CUDaDM of animals from lots RmCC, RmTC were comparable ($P>0.05$) but significantly ($P<0.05$) higher than those of animals from lots R0 and RmtC. The same trend was observed for CUDaOM in males. While in females, the CUDaDM of the animals in the RmtC lots was significantly (p 0.05) higher than that of the other lots. The same trend was observed for CUDaOM, CUDaCP and CUDaCF in females. Regardless of sex, the CUDaDM of animals in lots RmCC, RmTC and RmtC was comparable ($P>0.05$) but significantly ($P<0.05$) higher than that of animals in lot R0. The same trend was observed for CUDaOM and CUDaCF regardless of sex. As for CUDaCP in males, it was comparable ($P>0.05$) in animals from lots RmCC, RmTC and RmtC but significantly ($P< 0.05$) higher than animals from lot R0. The same trend was observed for CUDaCF in males.

For CUDaDM compared between the two sexes, males significantly ($P<0.05$) valued the RmCC and RmTC rations better while the reverse was observed for R0 and RmtC rations. CUDaOM was comparable ($P>0.05$) in animals of both sexes for the control ration. In contrast, males significantly ($P<0.05$) gave better value to the RmCC and RmTC rations and females gave better value to the RmtC ration. The same trend was observed for CUDaCF. Nevertheless, for CPs, males significantly ($P<0.05$) better valued R0, RmCC and RmTC rations while the opposite effect was observed for RmtC rations (Fig 3).

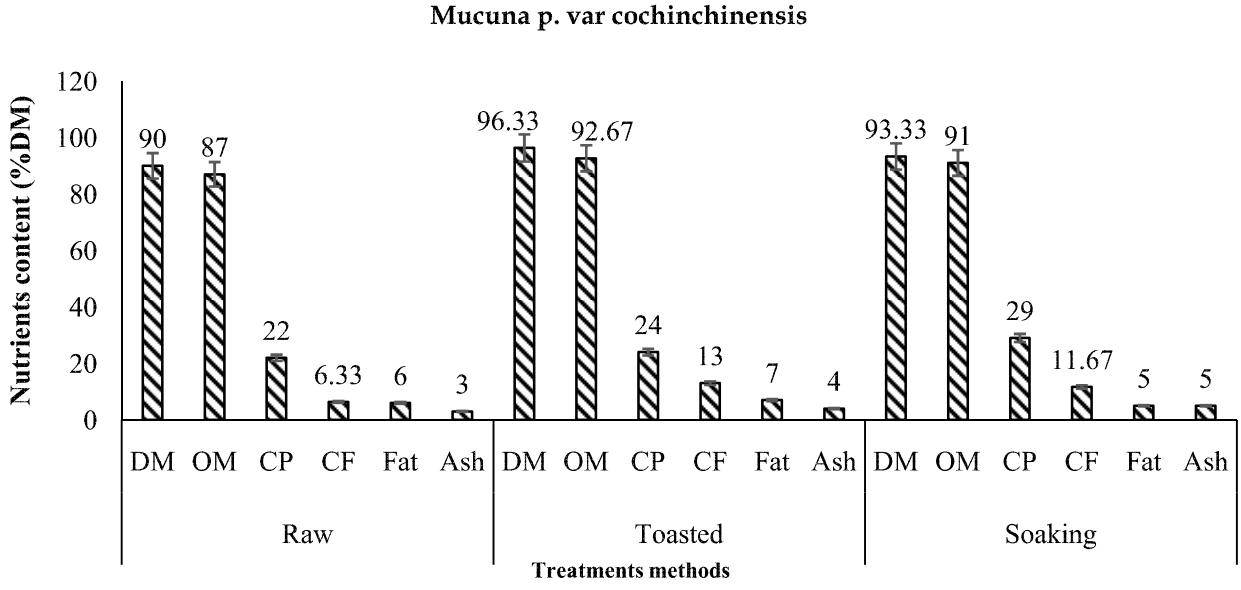

Fig 1: Chemical composition of the seeds

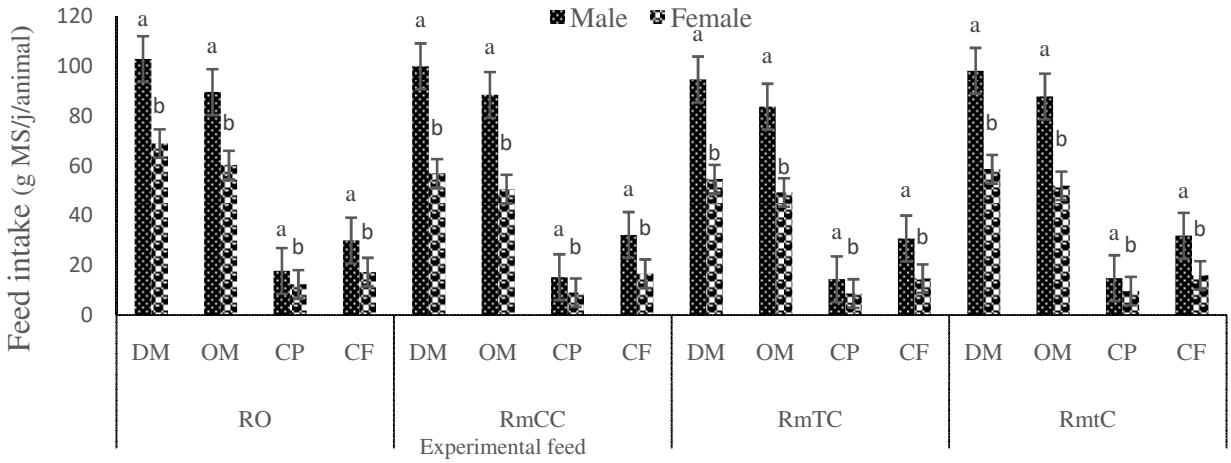

Fig 2: Feed intake between male and female

Table 2: Ingestion of granulated compound feed with inclusion of pruritic Mucuna seeds subjected to different treatments in guinea pigs

Ingestions (g MS/j/animal)		**Ration**		***ESM***	***P***		
		R0	RmCC	RmTC	RmtC		
Dry Matter (DM)	♂ (6)	103,00^{a}	100,08^{a}	94,79^{a}	98,29^{a}	1,06	0,36
	♀ (6)	69,00^{a}	57,00^{b}	54,67^{b}	58,67^{b}	1,73	0,00
	♂♀ (12)	85,87^{a}	78,48^{b}	74,54^{b}	78,49^{b}	1,51	0,00
OrganicMatter (OM)	♂ (6)	89,68^{a}	88,54^{a}	83,87^{a}	87,94^{a}	1,28	0,46
	♀ (6)	60,33^{a}	50,67^{b}	49,33^{b}	52,00^{b}	1,35	0,00
	♂♀ (12)	75,12^{a}	69,54^{b}	66,60^{b}	69,82^{ab}	1,15	0,03
CrudeProtein (CP)	♂ (6)	17,77^{a}	15,27^{b}	14,44^{b}	14,86^{b}	0,47	0,02
	♀ (6)	12,33^{a}	9,00^{ab}	8,67^{c}	9,67^{b}	0,45	0,00
	♂♀ (12)	15,12^{a}	12,18^{b}	11,53^{b}	12,26^{b}	0,45	0,00
Crude Fiber (CF)	♂ (6)	29,97^{b}	32,25^{a}	30,82^{ab}	31,89^{a}	0,33	0,02
	♀ (6)	17,33^{a}	16,67^{a}	14,67^{b}	16,00^{ab}	0,38	0,04
	♂♀ (12)	23,53^{ab}	24,51^{a}	22,88^{b}	23,96^{ab}	0,25	0,03

a, b, c: Means with the same letters on the same line are not significantly different at the 5% threshold; ESM: Standard Error on the Mean; P: Probability; R: Rations. mCC: Raw mucuna cochinchinensis; mTC: mucuna Soaked cochinchinensis; mtC: mucuna toasted cochinchinensis

Table 3: Apparent digestive utilization coefficients (CUDa) of nutrients in guinea pigs fed *M. pruriens*

CUDa (%)		**Rations**			***ESM***	**p**	
		R0	RmCC	RmTC	RmtC		
CUDaDM	♂ (6)	80,42^{b}	96,70^{a}	96,79^{a}	94,20^{b}	2,15	0,00
	♀ (6)	89,00^{c}	93,00^{b}	93,33^{b}	97,33^{a}	0,92	0,00
	♂♀ (12)	84,70^{b}	94,83^{a}	95,15^{a}	95,79^{a}	1,41	0,00
CUDaOM	♂ (6)	85,01^{b}	96,79^{a}	96,92^{a}	94,29^{b}	1,56	0,00
	♀ (6)	89,00^{c}	93,33^{b}	94,00^{b}	97,33^{a}	0,91	0,00
	♂♀ (12)	86,97^{b}	94,97^{a}	95,36^{a}	95,86^{a}	1,14	0,00
CUDaCP	♂ (6)	98,29^{b}	99,66^{a}	99,81^{a}	99,58^{a}	0,19	0,00
	♀ (6)	95,67^{c}	97,00^{b}	99,00^{a}	100,00^{a}	0,52	0,00
	♂♀ (12)	96,98^{c}	98,49^{b}	99,23^{ab}	99,70^{a}	0,32	0,00
CUDaCF	♂ (6)	88,60^{b}	97,65^{a}	97,59^{a}	96,25^{a}	1,22	0,00
	♀ (6)	91,33^{c}	94,33^{b}	94,67^{c}	98,00^{a}	0,72	0,00
	♂♀ (12)	89,96^{b}	96,05^{a}	96,11^{a}	97,13^{a}	0,88	0,00

$^{a, b, c:}$ Means with the same letters on the same line are not significantly different at the 5% threshold; ESM: Standard Error on the Mean; P: Probability; R: Rations. mCC: Raw mucuna cochinchinensis; mTC: mucuna Soaked cochinchinensis; mtC: mucuna toasted cochinchinensis .

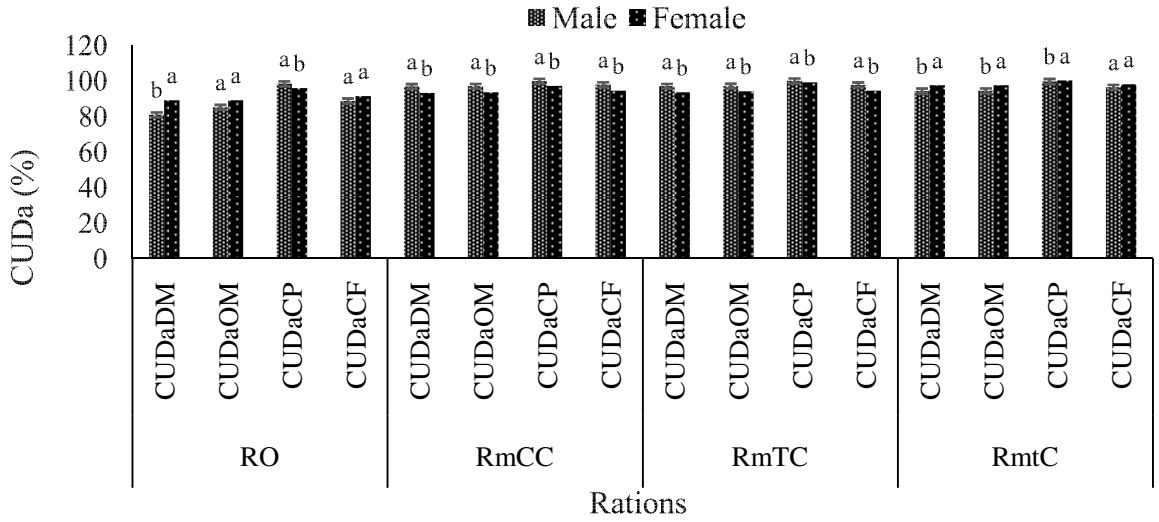

Fig 3: Apparent digestive utilization coefficients (CUDa) between male and female

Mucuna pruriens cultivation is not yet intensified in Cameroon. However, *Mucuna pruriens* is available in some regions and is inexpensive locally. The quantity to be used as a protein source is highly available if the population is more interested in it. Also, this use is quite possible because it is one of the most productive legumes in the world 2.9 to 6.9 t/ha (Pugalenthi and Vadivel, 2007).

In this study, the protein and fat contents of raw or whole *Mucuna Pruriens*seeds and toasted seeds were comparable and significantly lower than those of soaked seeds. This could be attributed to the soaking and then boiling of the seeds which resulted in the decomplexing of the proteins by anti-nutritional factors. Indeed, L-dopa is the main anti-nutritional factor that limits protein digestibility in *Mucuna Pruriens* seeds and is most often concentrated in large quantities in the pulp compared to the pulped seed, and soaking and increasing temperature significantly reduces the levels of L-dopamine, as well as condensed tannins and total phenols (Dahouda et al., 2009). However, this decrease was most pronounced in *Mucuna pruriens*seeds soaked for 48 hours and boiled. This result is consistent with work by Pugalenthi and Vadivel, (2007) who showed that toasting, soaking and cooking reduced the levels of condensed tannins, flavonoids and phytates in pruritic Mucuna seeds. In addition, Divya et al (2017) also reported a decrease in tannins, phytates and phenols in legume seeds after soaking in water for 24 hours.

The daily feed intake of crude protein (CP), crude cellulose (CB) and organic matter (OM) increased significantly ($P<0.05$) with different treatments of *Mucuna pruriens* seeds, although soaked seeds showed better results with protein levels comparable to those of Majcher's work (2016) which showed that soaking neutralizes the enzyme inhibitors present in the seeds in order to improve the digestion of certain molecules. To this end, *Mucuna pruriens* seeds after soaking and boiling can be used in Guinea pig feed as an alternative source of protein by improving its zoo technical performance. In the same vein, Wauffo et al (2020) showed that soaked *Moringa oleifera* seeds improve feed intake compared to whole seeds and therefore the digestive utilization of protein is better.

Conclusion

At the end of this study on the effect of the inclusion of *Mucuna pruriens* powder as a protein source in the ration on the ingestion and digestibility of guinea pigs. The results show that:

- The different treatments carried out on the seeds of *M. pruriens* significantly influenced the chemical composition. The nutrient content of soaked Mucuna seeds was significantly higher than that of toasted seeds. Whereas with raw and toasted seeds, the opposite effect was observed. Soaked Mucuna seeds have the best intake in any ration;
- The inclusion of *Mucuna* seeds had no significant effect on nutrient CUDa regardless of treatment. Males had better intakes and value of rations regardless of treatment.

In view of the above, it can be concluded that the seeds of *M. pruriens* variety *cochinchinensis* soaked have given the best results and can therefore be used as alternative source of protein in guinea pig food.

Reference

Aboh AB, Mensah EP, Atchade GT, et MENSAH GA (2011). Ponderal perfomance and characteristics of carcasses guinea fowlfeeding with feeding ration made from Mucuna pruriens. Int. J. Biol. Chem. Sci. 5(6): 2306-2316.

Andrianirina J (2015). Nutritional and anti-nutritional characterisation of vegetables grains consumed in Androy. Research programme from DEA in Biochimemistry applied to sciences of feeding and of Nutrition, University of Antananarivo.

AOAC Association of Official Analytical Chemists (1990). The official Method of Analysis. 15th edition. Association of Official Analyses chemistry. Washington SD.C.

Cicogna M (2000). Technical guide of elavation n°4 on guinea pig.Office for exchange and the distribution of information Mini-elavation (B.E.D.I.M), 8p.

Costa GEA, Queiroz MKS, Machado RSMP, Oliveira AC (2006). Chemical composition, dietary fiber and resistant starch contents of raw and cooked pea, common bean, chickpea and lentil legumes. *Food Chem*., 94: 327-330.

Dahouda M, Toléba SS, Senou M, Youssao AKI, Hambuckers A, Hornick JL (2009). The non-convenable resources feeding utilised for the production in Africa : nutritionalvalue and contraints ; *Danisco AnimalNutrition.*

Divya BJ, Suman B, Venkataswamy M and Thyagaraju K (2017). The Traditional uses and Pharmacological Activities of Mucuna Pruriens (L) Dc: A Comprehensive Review. Indo American Journal of Pharmaceutical Research. 7(01): 7516-7525.

Majchers N (2016). The reasons to wet vegetables. http:/docteurbonnebouffe.com.

Metre KT (2012). Possibilities of ameliorations to feed guinea pig (*Cavia porcellus L.*) to south of Kivu, to the East of the Républic of Democatic of Congo (research). 67p.

Miégoué E, Tendonkeng F, Lemoufouet J, Mweugang Ngouopo N, Noumbissi MNB, Fongang M D, Zougou Tovignon G, Matumuini Ndzani Essie F, Mboko AV, Boukila B and Pamo Tedonkeng E (2016). Ingestion et digestibilité de *Pennisetum purpureum* associé à une légumineuse (*Arachis glabrata*, *Calliandra calothyrsus*ou *Desmodium intortum*) comme source de protéines chez le cobaye. *Livestock Research for Rural Development. Volume 28, Article #12.* Retrieved January 5, 2020, from http://www.lrrd.org/lrrd28/1/mieg28012.htm

Miégoué E, Tendonkeng F, Mweugang NN, Lemoufouet J, Tatang MV, Ntsafack P, Mouchili M and Pamo TE (2018). Effect of inclusion level of *Arachis glabrata* in the diet on the ingestion and *in vivo* digestibility of *Panicum maximum* in guinea pigs (*Cavia porcellus*). International Journal of Veterinary Science and Technology. 3 (1): 026-032.

Noumbissi MNB, Tendonkeng F, Zougou TG and Pamo TE (2014). Effect of different level of supplémentation of leaves of *Tithonia diversifolia* (Hemsl) A Gray on ingestion digestibility *in vivo* de *Pennisetum purpureum* K. Schum.to guinea pig(*Cavia porcellus L.*). *Tropicultural,* 32 : 3138-146.

Pamo TE, Boukila B, Fonteh FA, Tendonkeng F and Kana JR (2005). Composition of chimicals and of supplementation with*Calliandra calothyrsus and Leucaena leucocephala* on the production milky and nutrition of short horses of Guinea. *Livestock Research for Rural Development, p17.* http://www.cipav.org.co/lrrd/lrrd17/03/tedo17034

Pugalenthi M and Vadivel V (2007). Agro biodiversity of eleven accessions of Mucuna pruriens (L.) DC. var. utilis (Wall. ex Wight) Baker ex Burck (velvet bean) collected from four districts of South India. Gen. Res. Crop Evol, 54 : 1117-1124.

Razafindahy BMJ (2016). Effects of the treatment of physico-chimistry on nutritional treatment and on the holding en l-dopa du *Mucuna pruriens*, var utilis black, August2016

Roberge G, et Toutain (1999). Cultures fourragères tropicales. CIRAD, pp 19 – 51.

Steele RG and Torrie JH (1980). Principles and procedures of statistics. McGraws Hill Book C, New York, 633 p.

Tuleun CD, Carew SN and Aji I (2008). Feeding

value of velvet beans (*Mucuna utilis*) for laying hens. *Livestock Research for Rural Development, 20.* http://www.cipav.org.co/lrrd/lrrd20/5/tule20081.htm.

Vadivel V and Pugalenthi M (2007). Biological value and protein quality of raw and processed seeds of *Mucuna pruriens* var. *utilis*. Livestock Research for Rural Development, 19: n97

Versteeg MN and Koudokpon V (1993). Participative farmer testing of four low external input technologies, to address soil fertility decline in Mono Province (Benin). *Agric. Syst,* 42: 265-276.

Vissoh P, Manyong VM, Carsky JR, Osei-Bonsu P and Galiba M (1998). Experiences with*Mucuna* in Occindental Africa. *In* Cover Crops in West Africa: contributing to sustainable agriculture. Ed by D. Buckles, Eteka, Osiname, Galiba and Galiano. IDRC/IIT*NSG2000.* Ottawa, Canada.

Wauffo DF, Tendonkeng F, Miégoué E, Tobou FGD, Sawa C, Mouchili M and Jiope GA (2020) Ingestion and In Vivo Digestibility of a Concentrated Granulated Feed Containing Seeds of Moringa oleifera Associated with Pennisetum purpureum in Guinea Pigs. Open J. Anim. Sci., 10: 782-791.

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