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Evaluation of the nutritional value of Cajanus cajan (L.) Millsp for use in breeding in the Republic of Congo

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Abstract
General objective: *In the search for the resolution of the animal feed problem, in particular on its production cost, the cultivation of legumes must be considered. To achieve this, a study on the determination of the food values of the leaves and seeds of Cajanus cajan has just been carried out in the Republic of Congo.*
Methodology: *The study concerned a cultivar and a variety of Cajanus cajan (RDC and ICP7035), sown on the same date and under the same environmental conditions. Leaf cutting took place at the flowering stage and seed harvesting at the end of the crop cycle. The leaves and seeds were dried in the sun for 2 days and then sent to the laboratory for analysis.*
Results: *The analyzes focused on the determination of humidity, mineral matter or crude ash, crude protein (CP), fat (MG), crude cellulose (CB), Poultry Metabolizable Energy (EMV) , Gross Energy (EB), Lysine, Methionine and mineral elements including calcium and phosphorus. The results obtained report the leaves and seeds containing respectively 23.15 and 29.20% of crude protein for the cultivar RDC against 22.35 and 31.90% for ICP7035. The Metabolizable Energy is respectively 1352.50 kcal /kg (cultivar RDC) and 1064.40 kcal/kg (variety ICP7035) in the leaves and in the seeds it varies from 2661.25 kcal/kg for the cultivar RDC and 2743.00 kcal/kg for the variety ICP7035.*
Conclusion: *The results on the evaluation of the nutritive value of Cajanus cajan (L.) Millsp for the use in breeding in the Republic of Congo show that the leaves and the seeds of Cajanus cajan can be incorporated into animal feed breeding to reduce production costs.*
Keywords: *Cajanus cajan – nutritional value – breeding – Congo.*

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I. Introduction

In animal production, feed is one of the most important limiting factors. Indeed, it represents 60-80% of the cost of production in poultry farming essentially based on conventional raw materials which are mostly imported (Doumbia, 2002). Conventional sources of protein such as soybean meal, groundnut meal and fishmeal are rare and expensive in developing countries (Dahouda *et al*., 2009; Hêdji *et al.*, 2014). This results in their low incorporation into the food rations of small livestock farmers (Ayssiwede *et al.*, 2012). However, the diversity of local plant resources in most African countries provides agrifood science with many unconventional food resources that can be used in animal feed (Dahouda *et al.*, 2009).

Among the different species of legumes whose food values are high we can cite *Cajanus cajan* (L.) Millsp. It abounds in Congolese lands in all seasons and is of interest for both human and animal nutrition. Indeed, its seed contains 20 to 30% protein (Saxena *et al.*, 2002) and the fresh or preserved leaves are rich in protein (21-25% DM) and fiber (30-35% DM) according to Grimaud (1988) cited by Ido (2016).

In the Republic of Congo, it has been pointed out by Diamouangana (2000), that with the increase in the price of certain raw materials used in the manufacture of animal feed, special attention should be paid to the leaves and seeds of *Cajanus cajan* very cultivated in the Niari valley. This legume has very satisfactory levels of certain mineral elements. Thus, the use of leaves and seeds of *Cajanus cajan* could then contribute to reducing the cost of animal feed. This is why it seemed to us interesting to undertake the present study. Its objective is to determine the nutritional values of leaves and seeds of *Cajanus cajan* (L.) Millsp with a view to its use as ingredients of food rations in breeding.

II. Materialand Methods

2. 1. Experimental site

The study was conducted precisely in the experimental plots of the Group for the Study and Conservation of Biodiversity for Development (GECOBIDE) in Loutété in the Republic of Congo from January 2020 to September 2020. This area is characterized by a humid tropical climate.

2.2. Plant material

The plant material of the present study consists of the leaves and seeds of *Cajanus cajan*. Leaf harvesting took place at the flowering stage and seed harvesting at the end of the crop cycle.

2.3. Methods

After harvest, the leaves and seeds were dried in the sun for 2 days. Sun drying allows not only to have dry leaves and seeds but also to reduce or eliminate possible thermolabile toxic factors of the leaves such as mimosine

(Ayssiwede et al., 2012).

To determine the food values of *Cajanus cajan*, the analyzes concerned the leaves and seeds of the ICP7035 variety and the RDC cultivar which were previously sown on the same date and under the same environmental conditions.

The dry leaves and seeds are put in paper bags and taken to the laboratory for analysis. They were carried out at the Animal Food and Nutrition Laboratory (LANA) of the Inter-State School of Veterinary Sciences and Medicine (EISMV) in Dakar, Senegal and focused on the determination of humidity, mineral matter or crude ash, crude protein (CP), fat (MG), crude fiber (CB), Poultry Metabolizable Energy (VME), Gross Energy (EB), Lysine, Methionine and mineral elements including calcium and phosphorus.

The humidity and raw ash contents of our different samples were determined according to the standard of the French Association for Normalization (AFNOR, 1977). The determination of the crude protein and fat content followed the same standard based respectively on the Kjeldhal assay method and the method of extraction under reflux by ethyl ether or petroleum using the Soxhlet apparatus. As for the crude cellulose content, it was determined according to the Wende method of the AFNOR standard, (1993). Calcium was assayed using the photometric atomic absorption method of the AFNOR standard, (1984), while the total phosphorus assay was performed using the spectrophotometric method at 430 nm described by the AFNOR standard, (1980). Lysine and methionine were estimated according to the methodology described by Sauvant *et al.*, (2004).

Metabolizable energy (ME) and gross energy were calculated from the regression equation (ME = 3951 + (54.4 x %MG) – (40.8 x %MM – 88.7 x % CB) following the INRA method,(1984) and Sauvant *et al*., (2004).

III. RESULTS

3.1 Nutritive values of leaves and seeds of *Cajanus cajan*

The nutritional values obtained after analysis of the leaves and seeds of the variety ICP7035 and the cultivar RDC are listed in Table 1. These values reveal a slightly high crude protein level in the leaves of the cultivar RDC (23.15%) compared to in the leaves of the ICP7035 variety (22.35%) on the other hand, this rate is higher in the seeds of the ICP7035 variety (31.9%) against 29.20% for the seeds of the cultivar RDC. The Metabolizable Energy is higher in the leaves of the cultivar RDC than in the leaves of the variety ICP7035. However, it is more important in the seeds of the variety ICP7035 compared to the seeds of the cultivar RDC. It is respectively 1352.50 kcal/kg (cultivar RDC) and 1064.40 kcal/kg (variety ICP7035) in the leaves and in the seeds it varies from 2661.25 kcal/kg for the cultivar RDC and from 2743, 00 kcal/kg for variety ICP7035.

Table 1: Nutritive values of leaves and seeds of *Cajanus cajan*

DETERMINED COMPONENTS	Samples analyzed			
	Leaves *RDC*	Leaves *ICP7035*	Seeds *RDC*	Seeds *ICP7035*
Humidity (%)	8.40	9.30	9.53	9.84
Crude mineral materials (%)	6.20	6.28	4.50	4.79
Crude protein (%)	23.15	22.35	29.20	31.90
Fatmaterials (%)	2.90	3.36	1.10	6.72
Cellulose or crude fiber (%)	24.49	27.55	8.90	11.15

Calcium (%)	0.40	0.80	0.35	0.32
Phosphorus (%)	0.24	0.23	0.20	0.25
Poultry metabolizable energy (kcal/kg)	1352.50	1064.40	2661.25	2743.00
Gross Energy (kcal/kg)	4228.8	4223.2	4127.0	4460.0
Lysine (%)	1.62	1.56	2.04	2.23
Méthionine (%)	0.24	0.23	0.31	0.33

IV. DISCUSSION

4.1 Nutritive values of leaves and seeds of *Cajanus cajan*

The results of the bromatological analysis of the leaves and seeds of *Cajanus cajan* from the present study reveal a slightly elevated crude protein level in the leaves of the cultivar RDC (23.15%) compared to the leaves of the variety ICP7035 (22. 35%) on the other hand, this rate is higher in the seeds of the ICP7035 variety (31.9%) against 29.20% for the seeds of the cultivar RDC. Similarly, the Metabolizable Energy is greater in the leaves of the cultivar RDC compared to the leaves of the variety ICP7035. However, it is more important in the seeds of the variety ICP7035 compared to the seeds of the cultivar RDC. It is respectively 1352.50 kcal/kg (cultivar RDC) and 1064.40 kcal/kg (variety ICP7035) in the leaves and in the seeds it varies from 2661.25 kcal/kg for the cultivar RDC and from 2743, 00 kcal/kg for variety ICP7035.

On the other hand, Diamouangana (2000) in his work on the mineral content of fodder from the plain of Dihesse (Congo-Brazzaville) reported average values of 5 cultivars of *Cajanus cajan*. His study was carried out in the same study area as ours. These results indicate rates of 18.8%; 29.3%; 5.6%; 0.95% and 0.28% respectively for crude protein, crude fibre, total mineral matter, calcium and phosphorus in the leaves.

At the level of the seeds, he found respectively for the same chemical constituents the following values: 21.8%; 7.7%; 3.8%; 0.32% and 0.38%. For the leaves, the phosphorus value (0.28%) he found did not differ from those of the variety ICP7035 (0.23%) and the cultivar RDC (0.24%) studied.

Our results indicate a leaf mineral value of 6.20% and 6.28% respectively for cultivar RDC and variety ICP7035; and in the seeds 4.50% and 4.79% respectively for the cultivar RDC and the variety ICP7035. These values are higher than the values obtained by Diamouangana, (2000) who found 5.6% in the leaves and 3.8% in seeds. This difference could be explained by the conditions of soil fertility.

For calcium, the value found by this author (0.95%) in the leaves is close to that of the ICP7035 variety (0.80%) obtained in the leaves, however, they are higher than the value obtained for the cultivar DRC (0.40%). However, the crude fiber content he mentioned (29.3%) in the leaves is close to the value obtained in the leaves for the variety ICP7035 (27.55%) and higher than that of the cultivar RDC (24. 49%).

The crude protein value (18.8%) found in the leaves by this author is lower than that obtained during our study which is 23.15% and 22.35% respectively for the cultivar RDC and the variety ICP7035. For the seeds, we find that the mineral content; calcium and phosphorus found by the said author are of the same order of magnitude as those obtained during our study. Similarly, the crude fiber content (7.7%) found by this author is close to that of the cultivar RDC (8.90%), but is lower than that of the variety ICP7035 (11.15%).

The value of crude protein in the seeds (21.8%) reported by Diamouangana (2000) is lower than that of our results which is 29.20% and 31.90% respectively for the cultivar RDC and the variety ICP7035.

Amaefule and Nwagbara., (2004) also determined for the seeds of Cajanus cajan, the values of 26.2%; 5.0% and 3829 kcal/kg respectively for crude protein, crude fiber and metabolizable energy. The value in metabolizable energy (3829 kcal/kg) that they found is higher than that of the cultivar RDC (2661.25 kcal/kg) and the variety ICP7035 (2743.00 kcal/kg) studied, whereas the values in crude protein (26.2%) and crude cellulose (5.0%) found by these authors are lower than those of our results which are respectively 29.20% and 8.9% for the cultivar RDC and 31 .90% and 11.15% for the ICP7035 variety.

We observe a certain variability of the values of the different chemical constituents at the level of the varieties of *Cajanus cajan*. This difference in content could be due, on the one hand, to the variety or cultivar, to the organ considered and, on the other hand, to the climate and the soil. Some work has demonstrated the relationship between macro-invertebrates and the restoration of soil fertility where certain legumes grow. They highlighted the direct contribution of macro-invertebrates to the nutritional value of crops through soil fertility (Mboukou, 1997; N'Klo *et al.,* 1997). Through the literature, it appears that the contents of various nutrients vary over time. Indeed, a decrease in mineral matter from leafing to fruiting and an increase in organic matter and cell walls over time has been observed (Kiema, 1991). Myriam,(2017), reported that leaves, twigs and pods contain high total nitrogenous matter and higher cellulose content. Grasses lose 75% of their protein content during the period from the growth phase to that of seed formation, compared to only 40% in woody fodder (Myriam, 2017). However, the amount of nitrogen compounds in woody forages varies according to season, species, age of the plant and stage of development.

In comparison with other legumes, chemical analysis of Azolla pinnata leaves dried in the sun for 3 days showed that it contains 25.46% crude protein; 14.80% crude cellulose; 2.25% calcium and 0.40% phosphorus (Alalade and Iyayi, 2006). The calculated metabolic energy value of dried Azolla is 1807 kcal/kg (Shamna, 2013). The protein content of Azolla is close to that of soy (Hêdji et al., 2014). As for the leaves of Moringa oleifera, they are an excellent source of protein whose average content varies between 19-35% DM (Richter et al., 2003; Tchiégang and Aissatou, 2004; Pamo et al., 2005; Adeyinka et al., 2008; Olugbemi et al., 2010). These various authors have found that mature leaves contain less protein than young leaves due to their high fiber content, in particular crude cellulose ranging from 9.13-28.2% DM. On the other hand, the leaves of Leucaena leucocephala contain 25.8% crude protein 9.9% crude cellulose; 1.02% calcium; 0.24% phosphorus and 1876 kcal/kg metabolic energy (Dhar *et al.,* 2007). Tuleun *et al.,* (2008) reported for the seeds of the Mucuna utilis variety 32.4% crude protein; 6.1% crude fiber and 3490 kcal/kg of metabolizable energy. However, Agbede and Aletor, (2005) reported for Mucuna pruriens seeds the following values: 27.5% crude protein, 7.1% crude fiber and 4617 kcal/kg metabolic energy.

The crude protein values of the leaves and seeds of these different legumes are close to those of the leaves and seeds of the variety ICP7035 and the cultivar RDC studied.

We can say that *Cajanus cajan* has a double advantage, it is exploited both for its leaves and for its protein-rich seeds. This richness makes *Cajanus cajan* a good food supplement for animals.

V. CONCLUSION

This study provides good information that can help solve the thorny problem of the high costs of conventional resources, which are mostly imported to tropical countries, in particular the Republic of Congo. However, the results of the present study indicate good nutritional values of *Cajanus cajan* which is available in all seasons and widely cultivated in the Niari Valley in the Republic of Congo. It could thus constitute a choice alternative to the costs of conventional feed used in animal production.

The contents of the different elements in the leaves and seeds of *Cajanus cajan* studied are quite satisfactory and can be well substituted for conventional resources.

In conclusion, we address our recommendations:

- To the public authorities, with regard to the good nutritional values of *Cajanus cajan*, to promote the use of leaves and seeds of *Cajanus cajan* in breeding by raising awareness through NGOs;
- Researchers in animal production to carry out more in-depth research in order to study the rates of incorporation of leaves and seeds of *Cajanus cajan* in the food rations of farmed animals.

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