ESJ Natural/Life/Medical Sciences Peer-reviewed

# Incorporation of a Non-Conventional Liana (*Tetracapidium conophorum*) Seed Oil Cake in Diets of Congolese Indigenous *Batéké* Chicks Raised Without Outdoor Access

***Adzona P. P.***
***Mopoundza P.***
***Ngouama Dandou A.***
National College of Agronomy and Forestry
University Marien Ngouabi Brazzaville, Congo
National Research Group in Local Biodiversity, Congo
***Bati J. B.***
National Institute for Research in Agriculture Avenue Des Premiers Jeux Africains. Face Stade Alphonse Massamba-Débat. Brazzaville, Congo
Research Group in Local Biodiversity, Congo
***Ntsoumou M. V.***
Research Group in Local Biodiversity, Congo
***Saya Ngouonomba H. J.***
***Bitsili B. T.***
***Akouango P.***
***Banga-Mboko H.***
National College of Agronomy and Forestry
University Marien Ngouabi Brazzaville, Congo
National Research Group in Local Biodiversity, Congo

Doi:10.19044/esj.2024.v20n24p67

Submitted: 07 May 2024
Accepted: 25 August 2024
Published: 31 August 2024



*Cite As:*
Adzona P. P., Mopoundza P., Ngouama Dandou A., Bati J. B., Ntsoumou M. V., Saya Ngouonomba H. J., Bitsili B. T., Akouango P. & Banga-Mboko H. (2024). *Incorporation of a Non-Conventional Liana (Tetracapidium conophorum) Seed Oil Cake in Diets of Congolese Indigenous Batéké Chicks Raised Without Outdoor Access.* European Scientific Journal, ESJ, 20 (24), 67. https://doi.org/10.19044/esj.2024.v20n24p67

## Abstract

The indigenous *Batéké* hen (*Gallus gallus*) has low productivity due to various constraints such as feeding sources. The aim of this study was to improve the productivity of the local hen using a new local protein source:

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

*Tetracarpidium conophorum* meal. A sample of ninety-six chicks 21-day old from the local population were randomized into 3 groups of 32 birds each (TC0, TC4 and TC6), with one replicate. In each group. *Tetracarpidium conophorum* oil cake was incorporated into groupsTC4 (4% *Tcconophorum* oil cake and 11% soya oil cake), TC6 (6% *T.conophorum* oil cake and 9% soya oil cake) whereas TC0 served as a control group (0% *T.conophorum* meal and 15% soya oilcake). The experiment started at 3 weeks and lasted at 20 weeks of age. Chickens were fed *ad libithum* and had free access to drinkers. The results indicated that mortality rate decreased (3.12 % versus 9.3), Also, the treatment improved significantly ($p < 0.05$) feed intake (56.8 vs 60.1g per day), feed conversion (6.5 vs 5.7), and carcass yield (65.8 % vs 71.3 %). The final body weight at 20 weeks of age has been improved groups (1.200g versus 1300g) .. This study indicated that *T.conophorum* oil cake may be useful in diets at 4% thus reducing soya oil cake from 15% to 11% of incorporation) in a small scale poultry farming in Congo.

**Keywords:** Indigenous Gallus gallus, feeding, growth performance, Conophorum nut Congo

## Introduction

According to the FAO (2011), avian genetic biodiversity (*Gallus gallus*) is constitute by experimental breeds, commercial lines and. In Africa, the local chicken population is raised in rural and peri-urban areas. Indigenous breeds plays an important role to food security by supplying meat, eggs, and cash to the rural population (Gondwe *et al.,* 2005 and Dinka *et al.,* 2010).

In Congo, the native chicken called *Batélé* chicken is present at all socio-cultural events such as dowry, family party, Christmas or Easter party, guest reception, and healing sacrifice. Unlike to indigenous waterfowls, *Batéké* chicken meat or egg are not subjected to any taboos (Banga-Mboko *et al.,* 2007)

Morpho-metric studies carried out in Congo have shown that the local *Batéké* is backyard farming characterized by scavenging system with, enormous phenotypic variations, low in -put production namely poor housing and feeding (Akouango *et al.,* 2004, 2010 and Saya Ngouonimba *et al.,* 2019).The scavenging system as reported by many authors, suffer in dietary imbalance, combined with precarious sanitary conditions and management techniques, accentuates traditional chickens weakens their resistance to parasites and disease, increases flock mortality and consequently reduces the flock size. (Badubi *et al.,* 2006, Mugumaarhahama *et al.,* 2016). Also, it can noted a genetic erosion as *Batéké* chicken is uncontrollably crossed with commercial exotic strains.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Now a day, *Batéke* chicken meat is gaining more and more demand. In fact, it is observed a change in mentality, with traditional free-range rearing evolving towards confinement rearing in order to satisfy an ever-growing demand.

Unfortunately, such an option is hampered by a lack of feed from which Congolese poultry farming suffers. The binomial mays . -soybean is difficult to cover because national production of mays is low and soybean meal oil cake is imported because there is no national oil extraction industry. (Badubi *et al.,* 2006).

Faced with this difficulty, the use of local sources to meet nutritional needs in indigenous chicken is becoming a challenge (Adzona, 2019) since unconventional *Tetracarpidium* oil cake meal, rich in crude protein (43%), is produced in locally by cosmetic industry and which have the same content in crude proteins with oil cake soya (Mezanjoug Kenfack, 2010 , Sianard, 2010).

*T.conophorum* oil cake has been successfully tested in commercial broiler lines and improved growth performance in broiler (Londé Malanda, 2016 , Soki Kimpala, 2024) in the rates varying from 4 to 6 % of *T. Conophorum* oil cake.

Despite the century presence of *Batéké* chicken in Congo, all studies were carried on morphometric characteristics in the scavenging system with poor housing (Akouango *et al.,* 2004, 2010 ; Saya Ngouonimba *et al.,* 2019). Therefore, the study aimed to evaluate the effect of *Tetracarpidium conophorum* meal based –diet on the growth performance of *Batéké* chickens in close confinement.

## Material and methods

### Study area

The study was carried out in the experimental farm of the National Institute in Agronoic Recherch in Brazzaville, the Republic of Congo The climate of Brazzaville is tropical humid of Bas-Congolese type (Samba, 2014). Average annual temperatures is around 25ºC, with slight variations less than 5ºC.

The maximum temperature does not exceed 35ºC and the minimum remains above 20ºC (Samba 2014). It is characterized by two seasons: a rainy season from October to May, with a deep in January, and a dry season from June to September. Brazzaville is situated at an altitude of almost 301 m, with a latitude of 4º 15 '58" to the south and a longitude of 15º 16' 59 " to the east of the Republic.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

## Material

### Plant material

*Tetracarpidium conophorum* oil cake has been produced according to the procedure previously described by Mejazoug Kenfack (2010); Londé Malanda (2016) and (Ntsoumou et al., 2021, 2023). Briefly, the oilcake production process is illustrated in the figure 1.


**Figue 1:** Production of T. conophorum oil cake

## Methods

A flock of 30 native *Batéké* (5 males and 25 females) from local *Batéké* populations. Were raised on the ground on wood shavings (Figure 2). in a semi-open hen house. Eggs were collected daily, then artificially incubated.

**Figure 2:** Breeder nucleus of *Batéké* hens

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

**Production of experimental chicks**

One hundred and ten (110) fertile eggs from the *Batéké* flock were incubated in a French "Covatutto 120" electric incubator (figure 3a). A total of 96 *Batéké* chicks (various phenotypes) hatched, were obtained.

The 96 day-old chicks from different phenotypes. from weighed were kept in a brooder and fed with a starter feed.

**Chick rearing**

The chicks were reared on a sawdust litter , covered at a rate of 6kg per m².

The density was 5 chicks per m². They were heated under 100-watt bulbs. The room temperature was manually adjusted according to the chicks' behavior under the bulbs.

These chicks were vaccinated against Newcastle disease and Bronchitis Infectious at day 7, with a booster on day 23, and against Gumboro disease on day 10. An anticoccidial (Amprolium) was administered in the drinking water on three consecutive days, and an internal dewormer (Levalape) was administered every three weeks (12 to 19 weeks), according to a well-defined prophylaxis program. Feed and water were provided *ad libitum* twice a day (at 9 am and 4 pm). . A starter feed containing 2762.75kcal of energy and 17% PB was given to the chicks prior to experimentation.

**Experimental stage**

From the 3rd week to 20 weeks of age , chicks were transferred and then placed in the 13 m2 experimental room, divided into 3 compartments, each measuring approximately 4m². .Each 4m$^2$ troom weas then dived in txwo parts as a replicate room, as schown in Table 1.

**Table 1 :** Expérimental design

| Age in week | Treatment groups | Number of subjects |
|---|---|---|
| 3-20 | Tc0 (0%) | 32 |
| | TcC4 (4%) | 32 |
| | TcC6 (6%) | 32 |

- Lot Tc0 (control):
- Group Tc4: feed containing 4% TTC;
- Lot Tc feed containing 6: 6% of the Tc.

**Diets**

Feed rations were designed according to the recommendations formulated for Dessi (Anjum. Khan, 2008) and Venda (Mbajiorgu, 2011) indigenous hens (Table 2).

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

**Table 2:** Diet formulations

| **Ingredients** | **Controls** | ***Tetracarpidium*-based feed *Conophorum*** | |
|---|---|---|---|
| | TC0 % | TC4 % | TC6 % |
| Corn | 45 | 40 | 43 |
| Wheat bran | 7 | 3 | 4 |
| Cassava bran | 10.5 | 7 | 10 |
| Brewer's grains | 8 | 11 | 8 |
| Palm oil | 5 | 5 | 1.5 |
| Soybean meal | **15** | **11** | **9** |
| Tc | **0** | **4** | **6** |
| Fish meal | 5 | 5 | 5 |
| Cowpea flour | 3 | 8.5 | 9 |
| lime | 1 | 5 | 4 |
| Na cl | 0.5 | 0.5 | 0.5 |
| Total | 100 | 100 | 100 |
| **Calculated nutritive values** | | | |
| Metabolisable energy/Kg de MS) | 2762.75 | 2864.35 | 2747.20 |
| Crude protein | 17.90 | 17.96 | 17.89 |
| Lysine | 1.72 | 2.46 | 2.04 |
| Methionine | 0.24 | 0.35 | 0.37 |
| Calcium | 0.55 | 0.58 | 0.59 |
| Phosphorus | 0.43 | 0.49 | 0.53 |
| **EM /PB (Kcal/g)** | 159.45 | 159.48 | 156. 3 |

The T. conophorum meal used in the present feed formula has a nutritional value of 2800kcal (Mezajoug Kenfack 2010); 43.75% PB. 3. 17%Ca. 0.85%P (Ntsoumou et al., 2023).

## Parameters measured

Body weight was recorded by weekly weighing of the subjects on an electronic scale, Voluntary I feed intake (VFI)

It was expressed in grams (g) and was calculated according to the following formula:

$$VIFC = \frac{QAD\ (g)/periode - QAR\ (g)/periode}{Duration\ of\ period\ (d)}$$

QAD: Quantity of feed distributed.
QAR: Quantity of feed refused
AverageDaily Gain (ADG)

Weekly measurements of animal weights were used to calculate the Average Daily Gain (ADG) by dividing the average weight gain during a period by the duration (in days) of the period. It was determined using the following formula :

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

$$ADG = \frac{Weight\ gain(g) during\ a\ period}{Length\ of\ period}$$

**Feed Conversion Ratio (FCR)**
**The feed conversion ratio (FCR) was determined as follows:**

$$FRC = \frac{Amount\ of\ feed\ consumed\ during\ a\ period(g)}{Weight\ gain\ during\ the\ same\ period(g)}$$

**Mortality rate (MR)**
**The mortality formula rate expressed as follows:**

$$MR = \frac{Number\ of\ animals\ that\ died\ during\ a\ period}{Number\ of\ animals\ at\ start\ of\ period}\ x\ 100$$

**Carcass yield (CY)**

At 20 weeks of age, 12 chickens (4 chickens/treatment) were randomly selected. They were subjected to a 24-hour diet. then weighed. bled. scalded. plucked and eviscerated as described by Onu *et al.*, (2010).

**Carcass yield** was determined using the following formula:

$$CY = \frac{Carcass\ weight\ (g)}{Live\ weight\ at\ slaughter(g)} \times 100$$

**Statistical analysis**

Data were recorded Microsoft Excel 2013 and then transferred in R software (R Core Team, 2022). The effect of the treatment on parameters was assessed by using analysis of variance (one way) followed by comparison of means using t student Nieman Keul. Two means were different when p value was lower than 0.05.

**Results and discussion**

No data ;is available in the literature on the use of *T. conophorum* meal in diets of indigenous hens (*Gallus gallus*). So, after presenting the results, the discussion will focus in comparison with other strains experimented with local agro-resources.

**Effect of *Tetracarpidium conophorum* oil cake meal on final body live weight of *Batéké* chicken**

Figure 3 illustrates the effect of *Tetracarpidium conophorum* on weight development.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

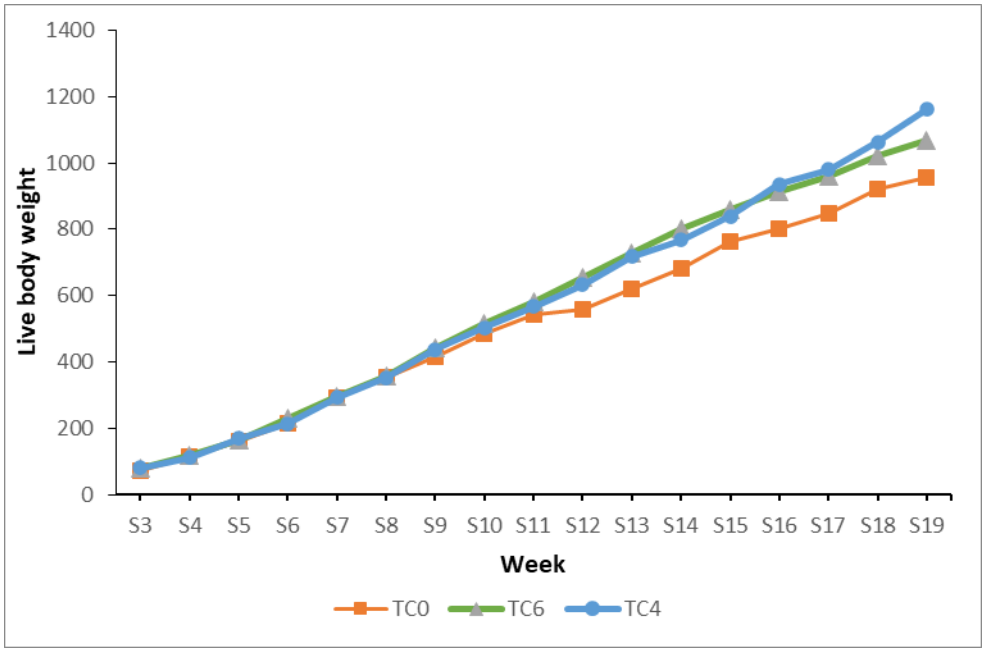


**Figure 3:** Evolution of body live weight

**The effect of *Tetracarpidium conophorum* oil cake on weekly growth rate**

It can be seen that from week3 until the end of the experiment there was a significant difference between treatment groups and the control (P-value=0.002). These results are higher to those of Akouango *et al.*, (2010), who recorded live weights of 993,43 ± 99g in colored fawn-Hermine phenotype Batéké chickens reared in Brazzaville. These results are lower than those found by Moula *et al.*, (2009) respectively after 17 weeks of age in the Fayoumi breed from Egypt and the Kabylie hen from Algeria chicken (1531 g)., Badubi *et al.*,., (2006) recorded 1.9kg in males and 1.5kg in females) , whereas Gondwe *et al.*, (2005,) reported 1.5kg .In another way ,by using crossbred (Isa brown x indigenous);) Ouedraogo *et al.*,., (2015 ) were aware of 1,689g at 4 month of age.

Compared with commercial broiler lines, our results were lower to those reported by Londé Malanda (2016 ) 880g at 4 weeks of age and Soki Kimpala (2024) 1.8kg at 8 weeks

**Effect of *T. conophorum* meal on mortality, feed intake, Daily Gain Weight , Feed Conversion Ratio and Carcass yield**

Results on the effect of *T. conophorum* meal on growth performance are given in Table 3.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

**Table 3:** Effect of T. conophorum meal on mortality, feed intake, Daily Gain Weight , Feed Conversion Ratio and Carcass yield

| Parameters | Treatment groups | | |
|---|---|---|---|
| | TC0 | TC4 | TC6 |
| **Mortality (%)** | 9.37 | 3.12 | 3.12 |
| **Feed intake (g/day)** | 56.72±7.90$^{b}$ | 60.08±8.11$^{a}$ | 63.80±8.21$^{c}$ |
| **Daily Gain Weight (g/day)** | 11.79±7.29$^{a}$ | 11.83±4.553$^{a}$ | 10.56±4.64$^{a}$ |
| **Feed conversion ratio** | 6.53±2.9434$^{b}$ | 5.7217±3.005$^{a}$ | 7.3992±4.3037$^{c}$ |
| **Carcass weight (g)** | 818.75±51.40$^{a}$ | 912.5±21.118$^{b}$ | 861.25±63.15$^{a}$ |
| **Carcass yield (%)** | 65.80±4.5$^{a}$ | 71.23±5.908$^{b}$ | 66.10±1.51$^{a}$ |

Values on the same line with the same superscript letter are not significantly different ($P > 0.05$)

**Effect of T*etracarpidium conophorum* meal on local chicken mortality**

Table 3 shows that the incorporation of *Tetracarpidium conophorum* meal into the ration of local chickens had no adverse effects on the treatment.

Our results are lower than those reported by Ouedraogo *et al.,* (2015**)** who recorded 8% in the crossed bred Isa brown x indigenous chick in Burkinafaso.

On the other hand, they are not better than those of Londé Malanda (2016) and Ntsoumou. (2023) who recorded no mortality among broilers and layers fed with *T. conophorum*. This difference can be attributed to experimental conditions, which vary from one experimental setting to another.

**Effect of T*etracarpidium conophorum* meal on voluntary feed intake**

*T. conophorum* meal incorporated at 4% and 6% in diets of local *Batéké* chickens improved feed consumption voluntary feed consumption ($p < 0.05$). Similar results have been found by Londé Malanda (2016) and Soki kimpala (2024) at 5% in Cobb 500 strain broilers . This could be explained by the presence of alkaloids and amino acids in *T. conophorum*. Recent studies have shown that alkaloids can increase food consumption (Onu *et al.,* 2010). By contrast, the improvement in consumption at 4% incorporation in local chickens disagree with those of Ntsoumou *et al.,* (2021) who observed a slight decrease in consumption in laying hens fed *T. conophorum* at the fourth week. This decrease may be due to the presence of certain anti-nutritional factors that escaped cooking and roasting despite the heat treatment applied, and to the fact that the latter used high rates of TTC as a substitute for soybean meal (12%).

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

**Effect of T*etracarpidium conophorum* meal on DGW**

With regard to DGW, the incorporation of *T. conophorum* meal did not induce any significant effect.These results are lower to those of Ouedraogo *et al.* (2015) cross local chicken x Isa Brown bred in confined condition (27**g/d),** Londé Malanda (2016), who found 12.65 g/d and Soki kimpala (2024) who recorded 42g/day in commercially broiler line fed with *T.conoplhorum* oil cake. This discrepancy can be explained by the fact that this parameter was assessed at different strains and ages.

**Effect of T*etracarpidium conophorum* meal on feed conversion**

The use of 4% *T. conophorum* in the diets of local *Batéké* hens showed the positive impact on reducing the feed conversion rate. Data in the present study was higher than those reported by Ouedraogo *et al.,* (2015) Londé Malanda and Soki kimpala (2024) who found 2.3, 3.2 and 2.1 respectively in commercial broiler strains

**Effect of *tetracarpidium conophorum* meal on carcass yield.**

Treatment at 4% improved carcass weight and carcass yield ($p < 0.05$). Data obtained in the present data are similar to the work of many studies in broiler where carcass yield represents more than 65 % **(Akouango** *et al.,* 2010, Onu *et al.,* 2010, Soki Kimpala (2024).

**Conclusion**

The aim of this study was to evaluate the effect of *T.conophorum* oil cake on the growth performance of the indigenous *Batéké* chicken.

- *Tetracarpidium conophorum* meal did not cause any adverse effects on the chickens' health status;
- the final body live weight has been slowly improved
- the feed conversion was higher
- Feed intake was improved at 4% in diets
- The study suggested to incorporate *T. con*ophorum oil cake at 4% and reducing soya oil cake from 15 to 11 %.in a small scale poultry farming
- Additional investigation are needed on the nutritive value of *T conophorum*
- Also, genetic selection trials are recommended in order to perform *Batéké* chickens, especially in broiler strains or in laying hens strains as a tool for a small scale poultry farming.in Congo.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

**Acknowledgements:** The authors are grateful to the National Institute for Agriculture Research for agreeing to carry out this study and to Mrs Diane Mavoungou for the technical assistance.

**Conflicts of interest**: The authors declare that they have no conflict of interest.

**Data Availability:** All data are included in the content of the paper.

**Funding Statement:** The authors did not obtain any funding for this research.

**Ethical Statement:** This study has been approved by the Ethical Committee at the University Marien Ngouabi, Congo Brazzaville. The ethical guidelines for animal research outlined by the Ministry of research on animal Heath and production were followed.

**References:**

1. Adzona, P.P. (2019). Influence de quatre tourteaux locaux non conventionnels en alimentation mélangée, fractionnée et séquentielle chez la volaille en milieu tropical. Thèse en vue d'obtention du diplôme de doctorat unique. Dept. Scie. Bio, Univ. Marien Ngouabi, FST, Congo, Brazzaville. 133 P.
2. Akouango, P., F. Mouangou, et G. Ganongo (2004). Phénotypes et performances d'élevage chez des populations loales de volailles du genre *Gallus gallus* au Congo Brazzaville. Cah. Agric.. 13 : 257-262.
3. Akouango, P., P. Bandtaba, et C. Ngokaka (2010). Croissance pondérale et productivité de la poule locale *Gallus domesticus* en élevage fermier au Congo. Anim. Genet. Resour. 46: 61-65.
4. Anjum, M.S. and S.H. Khan (2008). Effects of different energy protein ratio on the performance of Desi native chickens during growing phase. Asian Journal Poultry Science 2:42–47.
5. Badubi, S.S., M. Rakereng and M. Marumo (2006). Morphological characteristics and feed resources available for indigenous chickens in Botswana. Livest. Res. Rural Dev. 18 (3). http://www.lrrd.org/lrrd18/1/badu18003.htm.
6. Banga-Mboko, H., D. Maes, and P.L. Leroy (2007). Indigenous Muscovy ducks in Congo-Brazzaville. A survey of indigenous Muscovy duck management in households in Dolisie City. Trop. Anim. Health Prod. 39, 115–122. https://doi.org/10.1007/s11250-007-4234-1
7. Dinka, H., R. Chala, F. Dawo, S. Leta and E. Bekana (2010) Socio-economic importance and management of village chicken production

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

in rift valley of Oromia. Ethiopia. Livest. Res. Rural Dev. 22 (11). http://www.lrrd.org/lrrd22/11/cont2211.htm.

8. FAO (2011).World livestock:livestock in food security.Rome FAO 115p.
9. Gondwe, T.N., C.B.A Wollny and W. Kaumbata (2005). Marketing system and channels for scavenging local chickens in Lilongwe. Malawi. Livest. Res. Rural Dev. 17 (24). http://www.lrrd.org/lrrd17/3/gond17024.htm.
10. Londé Malanda, L.J. (2016). Effet de l'incorporation du tourteau *Tetracarpidium conophorum* (Mull-Arg) Hutch et Dalziel) dans les aliments de démarrage et croissance des poulets de chair standard. Mémoire présenté en vue de l'obtention du diplôme de master en Sciences Agronomiques (non publié). Dept. Scie. Agro., Univ. Marien Ngouabi, ENSAF, Congo, Brazzaville. 39 p.
11. Mbajiorgu, C.A., J.W. Ng'ambi, and D. Norris (2011). Effect of varying dietary energy to protein ratio level on growth and productivity of indigenous Venda chickens. Asian Journal Poultry Science 6 (4): 344-352
12. Mezajoug Kenfack, R.B. (2010). Propriétés nutritionnelles et fonctionnelles des protéines des tourteaux de concentras et d'isolats de *Ricinodendron heudelotii* (bail.) Pierre E pax et de *Tetracarpidium conophorum* (Müll. Arg.). Thèse de doctorat. Dept. Biotec. Alim., Univ. N'Gaoundéré Cameroun.188p.
13. Moula, N., N. Antoine-Moussiaux, F. Farnir, J. Detilleux, P. Leroy (2009). Réhabilitation socioéconomique d 'une poule locale en voie d 'extinction : la Poule Kabyle (Thayazit lekvayel). Ann. Méd. Vét. 153 : 178-186.
14. Mugumaarhahama, Y., R.B.B. Ayagirwe, V.B. Mutwedu, J.M. Sadiki, P. Baenyi, A.C. Mushagalusa and E.B. Bisimwa (2016). Caractérisation des systèmes de production de poule locale dans deux zones agro-écologiques du Sud-Kivu (République Démocratique du Congo). Livest. Res. Rural Dev. 28(1) :1-15.
15. Ntsoumou, V.M., P.P. Adzona, J.B. Bati, T. Kengue, B.B. Mabanza-Mbanza, A.J. Saboukoulou, A.F. Ndinga, J.R. Guembo and H. Banga-Mboko (2021). Evaluation de la substitution du tourteau de Glycine max (soja) par le tourteau de *Tetracarpidium conophorum* (Müll. Arg.) Hutch. & Dalz sur les performances des poules pondeuses. Int. J. of Bio. Chem. Sci. 15(6) :2526-2542. https://dx.doi.org/10.4314/ijbcs.v15i6.22
16. Ntsoumou, V.M., P.P. Adzona, T.M. Ndoulou and H. Banga-Mboko (2023). Rendement et composition chimique du tourteau *de Tetracarpidium conophorum* (Müll. Arg.) Hutch. & Dalz Produit par

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Pression Mécanique et Hydrodistillation. Eur. Sci. J. 19(36). 175-192. https://doi.org/10.19044/esj.2023.v19n36p175

17. Onu, P.N., M.C. Ayo-Enwern and E.O. Ahaotu (2010). Evaluation of carcass Characteristics and Cost Effectiveness of Broiler Chicks Fed Synthetic Lysine and Methionine supplemented soya bean-Based Diets. Int. J. Sci. Nat. 1(1): 22-26.
18. Ouedraogo, B., B. Bale, S.J. Zoundi, and L. Sawadogo (2015). Caractéristiques de l'aviculture villageoise et influence des techniques d'amélioration sur ses performances zootechniques dans la province du Sourou. Région Nord-Ouest Burkinabè. Int. J. of Bio. Chem. Sci. 9 (3) :1528-1543.
19. Samba, G. (2014). Le Congo-Brazzaville : climat et environnement. Le Harmattan. En ligne archive. Consulté le 10/09/2023. 168p.
20. Saya Ngouonomba, H.J., I. Opoye, P. Mopoundza and P. Akouango (2019). Aperçu de quelques paramètres qualitatifs dans la caractérisation morpho-biométrique des poules locales (*Gallus gallus*) ou *Batéké* dans les périphéries Nord et Sud de Brazzaville en République du Congo. J. Anim. Sci. 2 (42) : 7175-7197 : *https:doi.org/10.35759/janmPISci.v42-2.1.*
21. Soki kimpala, E.D (2024). Effet d'une alimentation fractionnée à base du tourteau de *Tetracarpidium conophorum* sur les performances de croissance des poulets de chair Cobb 500. Mémoire en vue de l'obtention du master en productions et santé animale (non publié). Dept. Scie. Agro., Univ. Marien Ngouabi, ENSAF, Congo, Brazzaville. 60p.