ISSN: 2230-9926

Available online at http://www.journalijdr.com

IJDR

International Journal of Development Research

Vol. 10, Issue, 05, pp. 35509-35513, May, 2020

https://doi.org/10.37118/ijdr.18705.05.2020

RESEARCH ARTICLE OPEN ACCESS

CONTRIBUTION TO THE STUDY OF NUTRITIONAL VALUE OF *Termitomyces Letestui*, *TERMITOMYCESSINGIDENSIS* AND *TERMITOMYCES STRIATUS*, THREE COMESTIBLE MUSHROOMS IN THE REPUBLIC OF CONGO

J.P.L. Ossoko*[1,2], M.G. Dzondo[1,2], G.F.R. Adicolle Goum[1], V.N. Pandzou Yembe[2] and M.D. Mvoula Tsieri[1]

[1]Laboratory of Food Transformation and Quality. ENSAF: National Higher School of Agricultural and Forestry (Marien NGOUABI University) Brazzaville CONGO

[2]Centre de Recherche et d'Initiation des Projets de Technologie (Ministère de la Recherche Scientifique et de l'Innovation Technologique, CONGO- Brazzaville) : CRIPT

ARTICLE INFO

Article History:

Received 27th February, 2020
Received in revised form
03rd March, 2020
Accepted 19th April, 2020
Published online 25th May, 2020

KeyWords:

Termitomyces letestui,
Termitomycessingidensis,
Termitomyces striatus,
Nutritional value, Physico-chemical.

***Corresponding author:* J.P.L. Ossoko,**

ABSTRACT

Termitomyces letestui, Termitomyces singidensis and Termitomyces striatus, fungi that grow in the savannahs and forests of the Republic of Congo in the wild. These fungi are rich in protein (values ranging from 28 to 36.5%), lipids (1.47 to 4.43%) carbohydrates (31.56 to 45.34%). Ash content ranges from 13.73 to 38.97%. We got among the ions identified: Phosphorus: 119.7 to 222.7 mg/100g; Iron: 10 to 31.8 mg/100g; Calcium: 1.9 to 3.9 mg/100g; Sodium: 0.8 to 1.2 mg/100g; Potassium 302 to 333.8 mg/100g and Magnesium: 12.9 to 15.2 mg/100g. The value ranges from 247.09 to 267.23Kcal/100g.

Citation: *J.P.L. Ossoko, M.G. Dzondo, G.F.R. Adicolle Goum, V.N. Pandzou Yembe and M.D. Mvoula Tsieri.* "Contribution to the study of nutritional value of termitomyces letestui, termitomycessingidensis and termitomyces striatus, three comestible mushrooms in the Republic of Congo*", International Journal of Development Research*, 10, (05), 35509-35513.

INTRODUCTION

The consumption of mushrooms by humans is a very old activity. According to FAO (FAO, 1985), several species of edible fungi have been identified around the world. Nearly 300 species of edible wild mushrooms have been identified throughout sub-Saharan Africa (Rammeloo, 1993). The number of edible species reported varies from country to country due to vegetation variability and uneven inventories in each country.Mushrooms are essential for the livelihood of forest-dependent populations for their food and economic appeal. Wild mushrooms, part of the Non-Line Forest Products (PFNLS), are an interesting and underexploited source of proteins in the Republic of Congo; it is therefore an important resource for food security.

The genus of fungi studied here has been identified in most countries in West and Central Africa (Jérôme Degreef, 2016 ; Adejumo, 2015 ; Fadeyi, 2017 ; Yorou, 2017 ; Sydney, 2018 ; Nérée Onguene Awana, 2018 ; Malaisse, 2008 ; N'golo Abdoulaye Koné, 2018 and Jérôme Degreef, 2020). Mushrooms are organisms found in all terrestrial and marine ecosystems. They are a world hitherto unknown and ignored despite their remarkable importance in terms of food, nutrition, pharmaceuticals and the environment, not to mention that they form a group of Non-Line Forest Products whose exploitation generates promising added value for the reduction of poverty in rural areas (Yorou, 2017). *Termitomyces* represent the group of fungi most appreciated by mycophages because of their unrivalled organoleptic taste. Mushrooms are widely consumed by rural African populations as food resources (Yorou, 2017). In terms of the food value of fungi, some research has been established that there are significant variations between edible wild mushroom species, as well as their stage of development. It is obvious that the substrate also plays a decisive role in mineral salt concentrations. The food value of some African wildlife has been studied (Thoen, 1973). Because these fungi (*Termitomyces letestui*, *Termitomycessingidensis* and *Termitomyces striatus*) grow in the wild, these can be not only culturally useful, but also economically useful in the country's economy. These fungi can be a great asset if we can determine their physical-chemical and biochemical characteristics.So we thought it would be interesting to approach this study on the use of these fungi in order to know their real nutritional potential.

MATERIALS AND METHODS

Plant material : The plant material in our study consists of three species of wild mushrooms consumed in the Republic of Congo and harvested from most of the country's savannahs, from north to south and from east to west; they are *Termitomyces letestui*, *Termitomycessingidensis* and *Termitomyces striatus*.

Figure 1. ***Termitomyces letestui***

Figure 2. ***Termitomyces singidensis***

Figure 3. ***Termitomyces striatus***

Figure 4. Dried mushrooms out of the oven

Methods : We described the methods used to determine the humidity, lipid, protein, ash and some major minerals, carbohydrate content and energy value of each species of fungus.

Determining humidity (H) : Humidity was determined using the AOAC method (*AOAC,* 2005) 2g of the mushrooms are placed in a capsule previously weighed and put in the oven (Memmert, Germany) at 70oC until the mass becomes constant.

Determining the content of raw ash (C) and major minerals: 2g of ground mushroom cakes were used to determine ash levels using the gravity method (AOAC, 2005). The samples are incineration in a mitten oven at 550°C for 6 hours. The ash rate obtained after incineration is calculated.Mineral content is measured by atomic absorption spectrophotometry (Perkin-Elmer 1100) on ash obtained after mineralization. Before dosing, the ashes are diluted in a solution containing 10% lanthane chloride as an interaction corrector (concentration: 116 g of LaCl3 in 1 litre of concentrated HCl diluted to a quarter).

Determining Fat Levels (MG) : The lipids contained in 5 g of dried and ground mushrooms were extracted using the Soxhlet method (NF ISO 82 62-3, 2006) by 200 mL of hexane for 6 hours. Excess solvent is evaporated to rotavapor (IKA HB 10 basic).

Protein Level Determination (P) : About 0.1 g of ground mushrooms is used to determine the level of raw proteins from the total nitrogen dosage using the Kjeldhal method (AOAC, 2015). Protein levels were obtained by multiplying the total nitrogen content by a convention factor of 6.25.

Determining total carbohydrates (G): Carbohydrate content (G) was estimated by the difference method. Using this method (AOAC, 2015), it was calculated by subtracting from 100, the sum of moisture (H), fat (MG), proteins (P) and ash (C) contained in the sample.

Determination of Energy Value (VE) : The total energy value was calculated using the Manzi method (1999) cited by Diallo Koffi et al. (Diallo Koffi Séraphin, 2015).
It is determined using the following formula:

VE (kcal/100g) = (CHO x 4) + (CL x 9) + (CP x 4) with CHO = % of carbohydrates,
CL = % of fat and CP = % of protein.

RESULTS AND DISCUSSION

Humidity : The three fungi studied have substantially the same water content. The average water content obtained is 25%. Some authors (Okoro, 2015), working on 5 species of Nigerian fungus (*Lentinus squarrosulus*, *Volvariella volvacea*, *Coprinus micaceus*, *Lepiotaprocera*, and *Auricularia auricula* L) found water content of 13.01 to 92.02%. These results incorporate those obtained in this study. Some authors have found water content in the range of 7 to 8% on 3 wild fungi (*Macrolepiota dolichaula*, *M. procera*, and *M. rhacodes*) (Babita Kumari And Narender Singh Atri, 2014). Others have found valuesranging from 7.12 to 12.36 working on five species of fungi (*Pleurotus ostreatus* (7.12%); *Termitomyces robusta* (11.40%); *Volvariella volcacea* (12.36%); *Termitomyces microcarpus* (9.69%) and *Pleurotus pulmonarius* (10.99%)) (Adejumo, 2015). The results obtained in our study show that these fungi do not keep better than those studied by these authors. Obviously, the water content varies with species and experimental conditions.

Protein content : Protein values obtained in this study indicate that fungi are a good source of protein; this also confirms some work (Cotonou), that says that the protein content of mushrooms is between that of meat and that of vegetables.The following table shows the protein level in the three fungi we studied. The protein levels of the mushrooms studied are shown in the following table:

Samples	Protein levels (%)
Termitomyces letestui	36.5±3.91
Termitomyces singidensis	28±2
Termytomyces striatus	30.38±2.72

The values obtained show that *Termitomycessingidensis* is less rich in protein than *Termitomyces striatus* which in turn is less rich in protein than *Termitomyces letestui*. It also appears from the results obtained that mushrooms are very rich in protein. Some authors found an average of 12.07 to 27% protein on 5 species of Nigerian fungi [15]. Others found values ranging from 16.45-19.95% protein on other wild fungi [16]. From this observation, we deduce that the fungi studied are richer in protein than those studied by these previous authors.

Fat content : Soxhlet extraction of the oil of the three species of fungi gives levels as shown in the table below.

Samples	Fat levels (%)
Termitomyces letestui	4.43±0.65
Termitomyces singidensis	1.47±0.21
Termytomyces striatus	4.41±0.97

The values obtained show that *Termitomycessingidensis* is less lipid-rich than *Termytomyces striatus* which in turn is less fat-rich than *Termytomyces letestui*.Some authors found average values ranging from 0.9 to 2.58% fat on 5 species of wild mushrooms (Okoro, 2012), Others, on the other hand, found total fat values ranging from 2.9 to 3.4% on other wild mushrooms (Babita Kumari And Narender Singh Atri, 2014).
The intake of lipids to the body by fungi is probably low in percentage terms but it would be interesting to know its composition in fatty acids.A study conducted in Côte d'Ivoire by other authors yielded lipid results ranging from 3.19 to 4.91% (**Kan Benjamin Kouamé, 2018**). These results corroborate those obtained in this study on *Termitomyces letestui* (4.43%) and *Termitomyces striatus* (4.41%), on the other hand *Termitomycessingidensis* is very low in fat than the mushrooms studied in Côte d'Ivoire.

Ash and mineral rate : The following table gives us the ash rate of each of the species studied.

Samples	Ash rate (%)
Termitomyces letestui	13.73±1.58
Termitomyces singidensis	38.97±2.89
Termytomyces striatus	18.74±1.94

Some authors have found values ranging from 4.12 to 11.12% ash on 5 species of Nigerian fungi (Okoro, 2012). Others found values ranging from 1.92 to 7.3% ash on other fungi (Babita Kumari, 2014) values ranging from 12.36 to 27.87% on three species of fungi in Côte d'Ivoire (Babita Kumari, 2014) and values ranging from 8 to 12% on some edible mushrooms (Saiful Islam, 2013). Some of our values seem higher and surely deserve further study; Mushrooms are a good source of minerals.

The mineral content (Mg, Ca, K, Na, P, and Fe) are presented in the table below.

Samples	Mineral elements (mg/100g)					
	Mg	Ca	K	Na	P	Fe
Termitomyces letestui	12,9	1,9	323,9	01,2	222,7	10
Termitomyces singidensis	14,7	2,5	302,0	0,8	119,7	31,8
Termytomyces striatus	15,2	3,9	333,4	01,2	213,8	11,5

From this study, it appears that potassium is the most represented element, followed by phosphorus. Magnesium and iron are fairly well represented too. Some authors have found that representatives are calcium and magnesium when working on five species of fungi in Côte d'Ivoire: Calcium (*Pleurotus osteatus* (87.5 mg/100g); *Termitomyces robusta* (54.10

mg/100g); *Volvariella volvacea* (37.15 mg/100g); *Termitomyces microcarpus* (38.45 mg/100g) and *Pleurotus pulmonarius* (38.45 mg/100g)) and Magnesium (*Pleurotus osteatus* (51.27 mg/100g); *Termitomyces robusta* (32.42 mg/100g); *Volvariella volvacea* (25.22 mg/100g); *Termitomyces microcarpus* (40.75 mg/100g) and *Pleurotus pulmonarius* (20.75 mg/100g)) (Adejumo, 2015). Other authors also found mostly the same elements with an average of 1321 mg/100g of potassium and 549 mg/100g of calcium in 5 species of Nigerian fungi [[15] and 156-254 mg/100g of magnesium and 241-276 mg/100g of iron on other wild mushrooms (Babita Kumari, 2014). All these results indicate the presence of minerals in fungi. These identified minerals are essential to the proper functioning of the body.

Carbohydrate content: The carbohydrate content of the mushrooms studied are presented in the following table:

The results obtained show that *Termitomyces letestui* is richer in carbohydrates followed by *Termitomyces striatus* and finally *Termitomycessingidensis*. These values are higher than those obtained by some authors on five species of fungi [4]: *Pleurotus osteatus* (33.57%); *Termitomyces robusta* (19.36%); *Volvariella volvacea* (13.17%); Termitomyces microcarpus (8.27%) and *Pleurotus pulmonarius* (37.64%).However, these results are lower compared to those obtained on *Termitomyces letestui* (53.83%) studied by other authors and from 56.2 to 68.1% obtained from other wild mushrooms. Mushrooms are also a source of carbohydrates.

Energy Value (VE) : The energy values obtained are 247.09 Kcal/100g for *Termitomyces striatus*, 251.47 Kcal/100g for *Termitomycessingidensis* and 267.23 Kcal/100g for *Termitomyces letestui*. These values range from 243.14 to 323.15 Kcal/100g, values obtained by some authors on three species of mushrooms from Côte d'Ivoire.

Conclusion and Perspectives: The consumption of fungi in Congo for *Termitomyces letestui*, *Termitomycessingidensis* and *Termitomyces striatus* contributes to the improvement of the nutritional status of populations in both rural, periurban and urban areas. This study allowed us to achieve this goal by determining the physical-chemical composition of the fungi studied, results: water (25%); lipids (1.47 to 4.43%); proteins (28 to 36.5%); carbohydrates (31.56 to 45.34%); ash (13.73 to 38.97%) and the energy value ranging from 247.09 to 267.23Kcal/100g. These mushrooms with a protein content of 28 to 36.5%, are a good source of protein. They are mainly a good source of minerals including Potassium (302 to 333.7 mg/100 g) and phosphorus (119.7 to 222.7 mg/100g).Studies need to be done to continue this work. In perspective, we are looking at:

- complete this study with an inventory of edible mushrooms from Congo;
- do the physical-chemical analysis of the other species in order to select the most nutritional ones for their domestication;
- study their conservation for permanent supply.

REFERENCES

AOAC (2005). Official method of analysis of the Association of official Analytical Chemist, 5th ad. AOAC Press, Arlington, Virginia, USA.

Babita Kumari And Narender Singh Atri, 2014. Nutritional and nutraceutical potential of wild edible macrolepiotoid mushrooms of north india. In, International Journal of Pharmacy and Pharmaceutical Sciences Vol. 6 Issue 2, pp. 200-204.

De Kesel A., Codjia, J.T.C. et Yorou, S.N. 2002. Guide des champignons comestibles du Bénin. Cotonou, République du Bénin, Jardin Botanique National de Belgique et Centre International d'Ecodéveloppement Intégré. 275 pp

Diallo Koffi Séraphin, Koné Kisselmina Youssouf, Soro Doudjo, Assidjo Nogbou Emmanuel, Yao Kouassi Benjamin, Gnakri Dago, 2015. Caractérisation Biochimique et Fonctionnelle des Graines de Sept Cultivars de Voandzou [Vigna Subterranea (l.) Verdc. Fabaceae] Cultivés en Côte d'Ivoire. European Scientific Journal. vol.11, No.27. 2-17 p.

F. Malaisse, A. De Kesel, G. N'gasse and G. Lognay. 2008. Diversité des champignons consommés par les pygmées Bofi de la Lobaye (République centrafricaine).*Geo-Eco-Trop*, 32: 1 – 8

FAO 1995. Produits Forestiers Non Ligneux 17. Champignons comestibles sauvages vue d'ensemble sur leur utilisation et leur importancepour les populations. *Trade restrictions affecting international trade in non-wood forest products*, by M. Iqbal. Non-wood Forest Products, No. 8. Rome. 156 p

Jérôme Degreef, Bill Kasongo, Elias Niyongabo, André De Kesel. 2020. Edible mushrooms, a vulnerable ecosystem service from African miombo woodlands. *Biotechnol. Agron. Soc. Environ.* 24(2), 70-80

Jérôme Degreef, Laurent Demuynck, Assumpta Mukandera, Gudula Nyirandayambaje, Benoît Nzigidahera, André De Kesel. 2016. Wild edible mushrooms, a valuable resource for food security and rural development in Burundi and Rwanda. *Biotechnol. Agron. Soc. Environ.* 20(4), 441-452

Kan Benjamin Kouamé, Anauma Casimir Koko, Massé Diomandé, Ibrahim Konaté, Nogbou Emmanuel Assidjo. 2018. Caractérisation physicochimique de trois espèces de champignons sauvages comestibles couramment rencontrées dans la région du Haut-Sassandra (Côte d'Ivoire). Journal of Applied Biosciences 121: 12110-12120

MD. Saiful Islam.2013. Cultivation Techniques of Edible Mushrooms:Agaricus bisporus, Pleurotus spp., Lentinula edodes and Volvariella volvocea. Registration Number: 851220383130. 34p.https://www.researchgate.net/publication/275179411

N. S. Yorou, J. E. I. Codjia, E. Sanon et K. I. Tchan. 2017. Les Champignons sauvages utiles: une mine d'or au sein des forêts béninoises.*Bulletin de la Recherche Agronomique du Bénin (BRAB) Numéro spécial Écologie Appliquée, Faune, Flore & Champignons (EAFFC) –* http://www.slire.net &http://www.inrab.org *: 1840-7099*

N'golo Abdoulaye Koné, Bakary Soro, Linda Patricia Louyounan Vanié-Léabo, Souleymane Konaté, Adama Bakayoko and Daouda Koné. 2018. Diversity, phenology and distribution of*Termitomyces* species in Côte d'Ivoire. Mycology, Vol. 9, No. 4, 307–315

Nérée Onguene Awana, Armelle Nadine Tchudjo Tchuente, Thomas W. Kuyper. 2018 Biodiversité des macrochampignons sauvages comestibles de la forêt humide du Sud-Cameroun.*Bois et Forêts des Tropiques – Volume 338 – 4e trimestre – p. 87-99*

O. G. Fadeyi, S. A. Badou, H. L. Aignon, J. E. I. Codjia, J. K. Moutouama, N. S. Yorou. 2017. Etudes

Ethnomycologiques et Identification des Champignons Sauvages Comestibles les plus consommés dans la région des monts-kouffe au Benin (Afrique de l'Ouest). *Agronomie Africaine 29 (1) : 93 - 109*

Okoro, I. O., Achuba, F. I. 2012. Proximate and mineral analysis of some wild edible mushrooms in African Journal of Biotechnology Vol. 11(30), pp. 7720-7724.

Rammeloo, J., Walleyn, R. 1993. The edible fungi of Africa south of the Sahara: a literature survey. In *Scripta Bot. Belg. 5: 1-62.*

Sydney T. Ndolo Ebika, Jean E.I. Codjia, Nourou S. Yorou et Attibayeba. 2018. Les champignons sauvages comestibles et connaissances endogènes des peuples autochtones Mbènzèlè et Ngombe de la République du Congo. *J. Appl. Biosci.126: 12675-12685*

T.O.Adejumo, M.E.Coker and V.O.Akinmoladun, 2015. Identification and Evaluation of Nutritional Status of some Edible and Medicinal Mushrooms in Akoko Area, Ondo State, Nigeria. *International Journal of Current Microbiology and Applied Sciences.*Volume 4, pp. 1011-1028

Thoen, D., Parent, G., Lukungu, T. 1973. L'usage des champignons dans le Haut- Shaba (République du Zaïre). Bull. Trim. Centr. Etudes Probl. Soc. Econ. 100-101: 69-85.

****