SJIF Impact Factor: 5.464

WORLD JOURNAL OF ADVANCE HEALTHCARE RESEARCH

ISSN: 2457-0400
Volume: 4.
Issue: 3.
Page N. 31-35
Year: 2020

Original Article www.wjahr.com

NUTRITIONAL POTENTIAL OF THE EDIBLE WILD MUSHROOM *TERMITOMYCES LETESTUI* FROM BOUAFLE (COTE D'IVOIRE).

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Received date: 10 March 2020 **Revised date:** 30 March 2020 **Accepted date:** 20 April 2020

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ABSTRACT

In order to contribute to food security, wild edible mushrooms *Termitomyces letestui* from the department of Bouaflé were collected and analyzed. To do this, the usual analysis techniques that are: extraction of fat with Soxhlet, the determination method with HPLC…were used. The salient results obtained reveal that these mushrooms contain 88.50 ± 1.30% moisture; 22.8 ± 0.77% protein; 2.48 ± 0.02% lipid; 54.27 ± 0.12% carbohydrates. With these different nutrient levels, these mushrooms have an energy value of 328.38 ± 2.5 kcal / 100g of dry matter. The mineral elements of the mushrooms have also been determined. Among these, potassium is the most preponderant macroelement (3227.74 ± 10.5mg / 100g). Regarding trace elements, the most important element is iron with a content of 1068.82 ± 0.08 mg / 100g. In view of the proportions of these various important nutrients for consumers, it seems imperative to popularize these wild mushrooms with this study.

KEYWORDS: Mushrooms, *Termitomyces letestui*, Nutrients, Energetic value, Macroelements and trace elements.

1. INTRODUCTION

The fungi also called Fungi are defined as multicellular, heterotrophic and thallophyte eukaryotes. To date, they constitute an autonomous kingdom: the fungal kingdom. They are less sensitive than bacteria to environmental conditions and are resistant to acidic soil conditions. Also called fungi, they develop either in wet weather or by excessive watering **(Delahaye, 2011).** There are four classes of fungi depending on the appearance of the hyphae and the mode of reproduction: phycomycetes, ascomycetes, basidiomycetes and deuteromycetes **(Elisabeth et Guy, 2007).** Mushrooms are vitally important non-timber forest products, both nutritionally and economically **(Ndoye *et al.*, 2007).**

Mushrooms are widely exploited by rural African populations mainly as a food resource **(Eyi-Ndong *et al.*, 2011; Yorou *et al.*, 2014)** and / or as a source of income **(Boa, 2006; Koné *et al.*, 2013)**, thus contributing to the substantial reduction of rural poverty.

Each year, nearly 11 million children under the age of 5 die from the direct or indirect consequences of starvation and malnutrition. Millions more suffer from illnesses caused by nutritional deficiencies of vitamins, minerals and trace elements essential for health and physical development **(Black, 2003).**

According to **Heleno *et al.* (2010)**, mushrooms have an important nutritional value thanks to their richness in proteins, carbohydrates and fibers but they are low in fat.

In Côte d'Ivoire, many varieties of mushrooms are consumed by people. Among these varieties of fungi is *Termitomyces letestui*, which is mainly found in the department of Bouaflé.

Given the interest accorded to edible wild mushrooms by the populations of Côte d'Ivoire and faced with the difficulties encountered in obtaining animal nutrients, this work has therefore set itself the main objective of promoting and popularizing the edible wild mushroom *Termitomyces letestui*. To do this, we are interested in the determination of its physicochemical and biochemical constituents in order to make a contribution to the resolution of the food security problem facing developing countries.

2. MATERIALS AND METHODS

2.1. Study material

The biological material used in this study consists of wild edible fungi *Termitomyces letestui* **(Figure 1).** These mushrooms were collected from their natural habitat in the mesophilic forests of the Marahoué region of central Côte d'Ivoire (Bouaflé). The systematic identification and authentication of mushrooms were carried out at the National Floristic Center of Felix Houphouët Boigny University (Abidjan, Côte d'Ivoire).

Figure 1: Photograph of the wild fungus *Termitomyces letestui.*

2.2. Methods

2.2.1. Preparation of mushroom flour

The harvested mushrooms were first sorted. Then they were rinsed with distilled water twice. Finally a mass of 500g was weighed. After spreading on aluminum foil at room temperature for 20 min, then dried in the MEMMERT brand ventilated oven at 45 ° C for 2 days. After drying, the mushrooms were ground using a Mill IKA type grinder (Germany / Deutschland). The ground materials obtained were sieved using a 250 µm mesh sieve. After sieving, the flours were packed in labeled glass bottles, previously dried in an oven at 45 ° C and hermetically closed. These flasks of flour were stored in a desiccator at 25 ° C for further analysis.

2.2.2. Analysis of biochemical and mineral compounds of *Termitomyces letestui* samples

Proximate compositions (ash, fat, proteins and dry matter) of the *Termitomyces letestui* samples were evaluated using the **AOAC (1990)** method.

Total sugars were determined according to the method described by **Dubois *et al.* (1956)** using phenol and concentrated sulfuric acid while the reducing sugars were determined according to the method of **Bernfeld (1955)** using 3,5 dinitrosalicylic acid (DNS).

Carbohydrates were determined using the calculation method recommended by **FAO (2002).**

The energy value of mushrooms was calculated using the formula described by **Crisan and Sands (1978).**

The minerals were measured by atomic absorption spectrophotometry according to the digestion method of the **AOAC (1990)** using strong acids**.**

2.2.3. Statistical analysis

The statistical analysis of all the results covers the calculation of the mean, affected by the standard deviation. The statistical differences between the samples and the measured parameters were verified by ANOVA using IBM SPSS STATISTICS version 20.0 software. The comparison of the means was made using the Duncan's Test with a significance level fixed at 5%.

3. RESULTS AND DISCUSSION

3.1. Biochemical compounds

The biochemical analysis of wild edible mushrooms *Termitomyces letestui* gave a humidity rate of 88.50 ± 1.30% and a dry matter rate of 11.50 ± 0.23%. This dry matter is made up of 22.8 ± 0.77% protein, 2.48 ± 0.02% lipid, 59.02 ± 0.12% total carbohydrates, 15.70 ± 0.10 % ash, 23.6 ± 0.60% total sugars and 0.84 ± 0.01% reducing sugars. The energy value is 328.38 ± 2.5 kcal / 100g of dry matter **(Table I).**

Analysis of the biochemical composition of *Termitomyces letestui* mushrooms has shown that these fungi contain a water content of 88.50 ± 1.30%. This result is in agreement with the results of several studies on edible mushrooms, in particular those of **Gaur *et al.*, 2016; Muthu et Shanmugasundaram, 2016** who indicate humidity levels between 82.6 ± 0.05% and 92.36 ± 0.06%. Termitomyces letestui mushrooms can be

described as highly perishable food. Indeed, it is well established that a high water content of food products promotes their sensitivity to microbial growth and to enzymatic activities which accelerate their deterioration **(Aremu *et al.*, 2009).**

Termitomyces letestui mushrooms are rich in protein, i.e. 22.8 g / 100g of protein dry matter. This content is in the range of protein contents 16.07 ± 0.04% and 31.86% of several fungi (*Lentinus edodes, Ganoderma lucidum, Pleurotus eryngii, Volvariella volvacea, Pleurotus ostreatus, Boletus edulis*) reported by some authors **(Rana, 2016; Salamat *et al.*, 2017).**

Termitomyces letestui mushrooms are characterized by a low lipid content (2.48%). The result obtained in this work is in agreement with the results of **Chong *et al.*, 2007**; **Obinna-Echem et Chukunda, 2018** for the mushrooms *Pleurotus ostreatus, Lentinus edodes, Volvariella* sp., *Pleurotus* sp.1, *Pleurotus* sp.2, *Trametes, Galiela rufa, Hygrocybe* sp., *Lentinellus omphallodes, Lentinus cilliatus, Schizophyllum commune, Auricularia auricular-judea* which indicated lipid contents between 1.10 ± 0.08% and 8.5 ± 0.06%.

The total carbohydrate content of *Termitomyces letestui* mushrooms is 59.02 ± 0.12%. This result agrees with those obtained by other authors such as **Kayodé *et al.*, 2016; Upadhyaya *et al.*, 2017; Chukunda et Nnadi, 2018** for *Marasmius oreades, Pleurotus citrinopileatus, Pleurotus tuber-regium, Laetiporus sulphureus, Polypore 1, Trametes elegans, Stereum complicatum, Lenzites betulina, Stereum complicatum, Trametes versicolor, Trichaptum subchartaceum, Ganoderma Lucidium* (31.24 ± 2.70% to 59.842%).

As for the energy value of the *Termitomyces letestui* mushroom, it is 328.38 Kcal / 100g. It is much higher than that found by **Zoho *et al.* (2016)** for the same species studied (purchased at markets in the Abidjan district, Côte d'Ivoire) (186.09 kcal / 100g).

In addition, some authors place the energy value of mushrooms between 291.04 ± 6.97 Kcal / 100 g and 387.05 ± 0.28 Kcal / 100 g **(Mridu et Atri, 2017; Roy *et al.*, 2017).** The fact that that of *Termitomyces letestui* (328.38 Kcal / 100g) is higher is a definite advantage for this mushroom.

Table I: Biochemical composition of *Termitomyces letestui* mushrooms.

Parameters	Content (%)
Moisture	88.50±1.30
Dry Matter	11.50±0.23
Ash	15.70±0.10
Proteins	22.8±0.77
Lipids	2.48±0.02
Carbohydrates	59.02±0.12
Total sugar	23.6±0.60
Reducing sugar	0.84±0.01
Energetic Value (Kcal/100g)	328.38±2.5

The values in the table are the means of three tests, assigned standard deviations.

3.2. Mineral compounds

Table II indicates the contents of macro-elements expressed mg / 100 g of dry matter of the fungus *Termitomyces letestui*. The sodium, calcium, magnesium and potassium levels are respectively 45.23 ± 0.35 mg / 100g, 166.92 ± 5.95 mg / 100g, 80.81 ± 3.1 mg / 100g and 3227.74 ± 10.5 mg / 100g DM.

The contents of trace elements contained in the fungus *Termitomyces letestui* are presented in **Table III**. The contents of the trace elements in particular iron, copper, zinc, manganese are respectively 1068.82 ± 7.08 mg / 100g, 2.33 ± 0.01 mg / 100g, 3.22 ± 0.2 mg / 100g and 4.71 ± 0.07 mg / 100g DM.

The mineral profile indicates that the fungus *Termitomyces letestui* contains significant amounts of macroelements (sodium, calcium, magnesium, potassium) and trace elements (iron, copper, zinc, manganese). Concerning macro-elements, potassium is the most preponderant element with a content of 3227.74 ± 1.5 mg / 100g. This result is corroborated by those of Mshandete and Cuff (2007) who found potassium contents between 1324 and 3232 mg / 100 g for three species of edible wild mushrooms *(Coprinus cinereus, Pleurotus flabellatus, Volvariella volvaceae*). **Malik and Srivastava (1982)** have shown that potassium plays an essential role in the synthesis of proteins and amino acids. The consumption of this mushroom could make it possible to overcome the deficit of potassium and other mineral elements in subjects in a situation of deficiency.

The magnesium content of *Termitomyces letestui* mushrooms is 80.81 ± 3.1 mg / 100g. It is superior to that of fungi (*Agaricus bisporus, Calocybe indica, Lentinula edodes, Lentinula sajor-caju, Macrocybe gigantea*) reported by **Gaur *et al.* 2016** (between 6.4 and 45.60 mg / 100g).

The potassium content of *Termitomyces letestui* is higher than that of sodium, which means that it could prevent high blood pressure **(Adrogue et Madias, 2007; Adepoju et Oyewole, 2008).**

At the level of trace elements, iron is the most abundant with a content of 1068.82 ± 7.08 mg / 100 g. This iron content is close to that reported by **Zoho *et al.* (2016)** for the same species (purchased at markets in the district of Abidjan, Côte d'Ivoire) (1076.28 ± 0.17 mg / 100g). With regard to copper, manganese and zinc, these minerals are present in low contents in the fungi analyzed in this work.

These levels are lower than those of mushrooms reported by other authors **(Akyüz et Kirbağ, 2010; Masamba et Kazombo-Mwale, 2010).**

Table II: Macro-elements content of the fungus Termitomyces letestui.

Macro-elements	Content (mg/100g)
Potassium	3227,74±10,5
Sodium	45,23±0,35
Calcium	166,92±5,95
Magnésium	80,81±3,1

The values in the table are the means of three tests, assigned standard deviations

Table III: Trace elements contents of the fungus *Termitomyces letestui.*

Trace elements	Content (mg/100g)
Iron	1068,82±7,08
Copper	2,33±0,01
Zinc	3,22±0,2
Manganese	4,71±0,07

The values in the table are the means of three tests, assigned standard deviations

4. CONCLUSION AND RECOMMENDATION

The physicochemical characteristics of wild edible fungi *Termitomyces letestui* were determined in this study. The results obtained revealed that these mushrooms are good sources of proteins, carbohydrates and minerals (iron, potassium, calcium) and low in lipids. These mushrooms contain a high content of water, thus constituting an obstacle to their conservation over a long period.

Due to their high protein and mineral content, these mushrooms could be used as a substitute for meat and other sources of nutrients essential to the body but which have become inaccessible. This will effectively fight against the protein and mineral deficiency that prevails in developing countries including Côte d'Ivoire. This will allow even the most deprived populations to access the nutrients essential for the proper functioning of their organism.

ACKNOWLEDGEMENTS

This work received no specific financial support. However, the authors are grateful to Agri-Food Biotechnology Laboratory and to National Floristic Centre at the University Félix Houphouët Boigny (Abidjan, Côte d'Ivoire) where the systematic identification and authentication of the mushrooms have been carried out.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest

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