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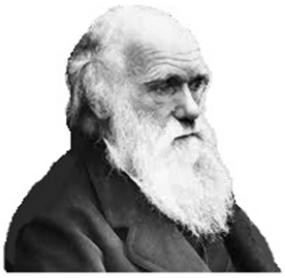

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Diversity of Boletaceae in western Burkina Faso

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ABSTRACT

Mycological outings to the Toussiambandogou, Dan, Mondon gallery forests and the Kou Classified Forest in western Burkina Faso over the last five years have resulted in the collection of one hundred and twenty (120) basidiomes of the Boletaceae family. They were dried and carefully preserved in the mycotheque of the Phytopathology and Tropical Mycology team of the Life and Earth Sciences Training and Research Unit (UFR/SVT) of the Joseph KI-ZERBO University. The various descriptions carried out on the fresh samples and on the exsiccata. They allowed to divide the collection into twelve genera (12), namely *Afroboletus* (4.17%), *Boletus* (18.33%), *Boletellus* (8.33%), *Crocinoboletus* (5%), Hourangia (0.83%), *Rubinoboletus* (19.17%), *Pulveroboletus* (16.67%), *Sotorius* (2.50%), *Suilus* (0.83%), *Strobilomyces* (2.50%), *Tylopilus* (6.67%) and *Xerocomus* (15%) and forty-nine (49) species of which thirteen species are formally described. These results show that the Toussiambandougou gallery forest has a good diversity of boletes, with a rate of 46.67%, followed by Dan (11.67%). The Kou Classified Forest, despite its wealth of ectomycotrophic woody species and the extensive protection afforded to it by the Ministry of the Environment, was one of the poorest biotopes in Boletaceae (3.33%). This observation could be explained by the closure of the vegetation cover that does not allow good aeration and also by the senescence of the plant species that make up this forest. The present study, which is purely taxonomic, reveals the richness of Boletaceae in three gallery forests in the province of Kenedougou and the Kou Classified Forest in the province of Houet in western Burkina Faso.

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Keywords: Diversity, Bolets, Identification, Forests, Burkina Faso

1. INTRODUCTION

Classified in the division of Basidiomycetes and more specifically in the class Agaricomycetes, the order Boletales includes not only tube fungi, but also blade fungi whose hymenium is easily separable. It is itself divided into families, of which one of the most numerically important is the Boletaceae family. According to Lebel *et al.* (2012), the Boletaceae contains seven (7) subfamilies, around thirty genera and around a thousand described species. Boletaceae, commonly known as 'boletes' (Orihara *et al.*, 2012), are mushrooms with soft, putrescible flesh that changes colour strongly when touched. They generally grow on the land, near trees in which they develop ectomycorrhizae with some tropical species of the Dipterocarpaceae, Euphorbiaceae, Cesalpiniaceae, Myrtaceae and Fagaceae families (Ba *et al.*, 2013). Much of the knowledge about boletes is often the result of the work of European mycologists (Binder *et al.*, 2006). A little later, African mycologists go in association with these pioneers, doing more thorough mycological inventory work in some parts of Central Africa (Eyi *et al.*, 2011) and in Benin in West Africa (De Kesel *et al.*, 2002). Mycology in Burkina Faso was to take off successively with the thesis work of Guissou (2005), Sanon (2015), Dabire (2020) and Nankone (2021). However, none of these works really focused on the macromycetes of the Boletaceae family. Hence the reason for the present study, which aims to highlight the presence and diversity of boletes in certain forests the west of the country through a good photograph of the specimens collected.

2. MATERIAL AND METHODS

2. 1. Study sites

The present study was carried out in the Kou Classified Forest, (KCF) in the province of Houet and in the Toussianbandougou, Dan, and Mondon gallery forests located in the province of Kenedougou, capital Orodara. They all belong to the Southern Sudanian zone, with rainfall ranging from 900-1200 mm per year (DREP-OUEST, 1995).

The Kou Classified Forest is named after the river that crosses it from north to south and is located 20 km west of the town of Bobo-Dioulasso, between latitudes North 11°10'54" to 11°11'44" and longitudes West 04°26'08" to 04°26'49" (Figure 1). Its plant formation is very dense (covering more than 80%), with large trees that can reach heights of 30 m and trunk diameters of over 1.5 m (*Ceiba pentandra* (L.) Gaertn.), *Milicia excelsa* (Welw.) C.C. Berg or *Detarium senegalense* J.F.Gmel, *Lecaniodiscus cupanioides* Planch. Ex Bth. and *Malacantha alnifolia* (Baker) Pierre, *Berlinia grandiflora* (Vahl) Hutch. & Dalziel and *Elaeis guineensis* Jacq. (Guinko, 2005).

The Toussianbandougou, Dan, and Mondon gallery forests (Figure 2) are located successively about 10, 15 and 18 kilometres from the town of Orodara, on the Orodara-Beregadougou road axis at 10°52'28" N and 04°50'10" W. These forests appear not to have been the subject of any in-depth botanical study as there is apparently no scientific data on them

(Sanon, 2015). Their vegetation is mainly composed of *Berlinia grandiflora*, *Uapaca* sp., *Afzelia africana* and *Malacantha alnifolia*.

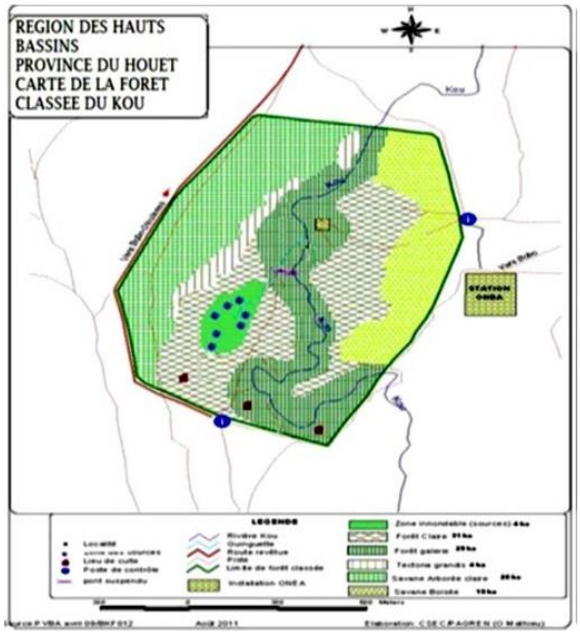

Figure 1. Map of the Kou Classified forest Dan (PVDA, avril 09/DKF 012)

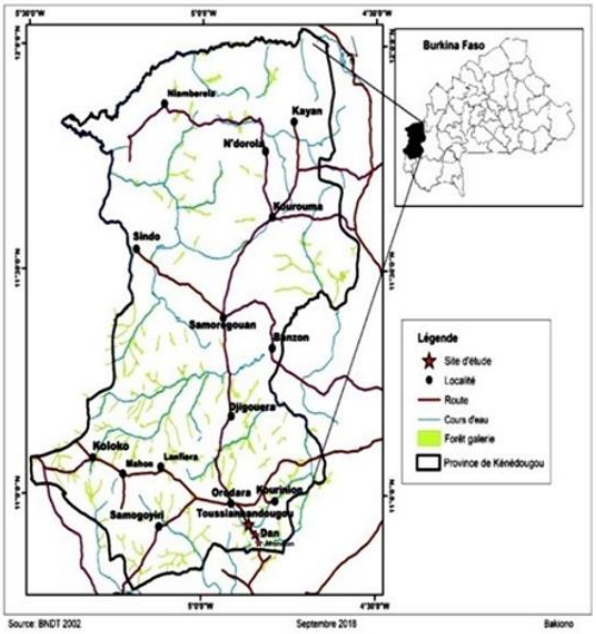

Figure 2. Location of the Toussianbandougou, and Mondon forests on the Kénédougou provincial map

2. 2. Mycological excursions

Our investigations took place during the rainy season from July-September 2017 to 2021. Specimens were collected randomly according to the opportunistic method Mueller *et al*. (2007) in the different forest formations: Kou Classified Forest and Toussianbandougou, Dan, and Mondon gallery forests. During these outings, only macrofungi of the Boletaceae family were collected, and fleeting characteristics noted. The coordinates of the collection sites were recorded using a Garmin 60CS GPS, and the ectomycotrophic woody species under which the mushrooms were harvested were identified and noted. The mushrooms were dug up with a knife, photographed on site (Olympus 24x, Wide optical Zoom ED 4.5- 108.0 mm 1:3.0-6.9), carefully wrapped in aluminium foil to avoid contamination and then placed in an appropriate collection basket. After the fieldwork, the basidiomes were meticulously written using the method of De Kesel *et al.* (2002). Technical photographs were then taken and the samples were dried in a Dorrex electric desiccator for 12 to 24 hours at a temperature of 70 °C. The exsiccata were stored in hermetically sealed mini-grip plastic bags with their labels and sent to the Phytopathology and Tropical Mycology laboratory at Joseph KI-ZERBO University for other analysis.

2. 3. Carpophores identification

For the laboratory work of descriptions, a series of books were consulted for the identification of the different taxa. These include:

- Notes on bolete taxonomy Persoonia (Singer, 1973; 1978; 1981),
- Taxonomy and Nomenclatural notes on some Macromycetes (Kotlaba & Pouzar, 1972),
- The Bolets (Gilbert, 1931),
- The Boletaceae of North America (Murrill, 1900),
- Biodiversity of edible fungi in Benin (Yorou *et al.,* 2002 a & b),
- Benin Edible Mushroom Guide (De Kesel *et al.,* 2002).
- Edible fungi in western Burundi (Buyck, 1994),
- Mushrooms from the dense forests of Central Africa (Eyi *et al.,* 2011).

3. RESULTS

Mycological outings in the Toussiambandougou, Dan and Mondon gallery forests, and in the Kou Classified Forest resulted in the collection of one hundred twenty (120) basidiomes of macrofungi of the family Boletaceae (table 1). They allowed to divide the collection into twelve genera (12), namely: *Afroboletus* (4,17%), *Boletus* (18,33%), *Boletellus* (8,33%), *Crocinoboletus* (5%), *Hourangia* (0,83%), *Rubinoboletus* (19,17%), *Pulveroboletus* (16,67%), *Sotorius* (2,50%), *Suilus* (0,83%), *Strobilomyces* (2,50%), *Tylopilus* (6,67%) and *Xerocomus* (15%) and forty-nine (49) species (Figure 3). Four genera were quite abundant at collection sites: *Rubinoboletus*, *Boletus*, *Pulveroboletus* and *Xerocomus*. The study of the fungal diversity shows that, the Toussiambandougou gallery forest has a good richness in Boletaceae (46.67%) followed by the Dan gallery forest (11.67%) and finally the Mondon gallery forest (3.33%) and Kou (3, 33%). Carpophores can be grouped into three (3) groups: group 1: 65% of basidiomas are specific to one of the collection sites; group 2: 25.83% of carpophores are common to 2 sites and group 3: 9.17% common to 3 sites (Figure 4).

Table 1. Classification of basidiomas collected by genus, species and collection site

Genera	Species	Collection sites	N° collection
Afroboletus	*Afroboletus* sp.1	FGT	Bb 132 ; 121
	Afroboletus sp.2	FGD, FCM	Bb 78 ; 83 ; 88
Boletus	*Boletus* cf. *fraternus*	FGD	Bb 66 ; 115 ; 016 ; 020
	Boletus sp.1	FGT	Bb 13
	Boletus sp.2		Bb 29
	Boletus sp.3		Bb 32
	Boletus sp.4		Bb 44 ; 48
	Boletus sp.5		Bb 49
	Boletus sp.6		Bb 136
	Boletus sp.7		Bb 52

	Boletus sp.8		Bb 90 ; 122 ; 133
	Boletus sp.9	FGT, FGD	Bb 58, 41, 60, 68
	Boletus sp.10	FGD	Bb 113
	Boletus sp. 11	FGT	Bb 45 ; 99
	Boletus sp. 12		Bb 50
Boletellus	*Boletellus* cf. *ananiceps*	FGT, FCD	Bb 40, 64, 98
	Boletellus cf. *dissiliens.*	FGT	Bb 11 ; 51
	Boletelus cf. *lindeii*		Bb 39, 89, 120
	Boletellus sp.		Bb 25
Crocinoboletus	*Crocinoboletus* sp.1		Bb 27, 124
	Crocinoboletus sp.2		Bb 75, 138
	Crocinoboletus sp.3	FGD	Bb 22, 77
Hourangia	*Hourangia* cf. *cheoi*	FGT	Bb 024
Rubinoboletus	*Rubinoboletus* cf. *griseus*		Bb 19 ; 26 ; 86 ; 139 ; 80 ; 81 ; 84 ; 97
	Rubinoboletus cf. *luteopupureus*		Bb 003 ; 12 ; 35 ; 45 ; 54 ; 70 ; 116
	Rubinoboletus sp.1	FGT, FGD	Bb 87 ; 117
	Rubinoboletus sp.2	FGT,FCK	Bb 65 ; 61 ;100
	Rubinoboletus sp.3	FGT, FGD, FCK	Bb 112 ; 145 ; 140
Pulveroboletus	*Pulveroboletus* cf. *lignicota*	FGT; FGD,FGM	Bb 31 ; 102 ; 103 ; 106 ; 114 ; 123 ; 128
	Pulveroboletus cf. *africanus*	FGT	Bb 30
	Pulvéroboletus cf. *ravenelii*		Bb 47
	Pulveroboletus cf. *sokponianus*	FGT, FGD	Bb 73 ; 94 ; 79
	Pulveroboletus sp.1	FGT	Bb 007
	Pulveroboletus sp.2	FGT, FGD	Bb 118 ; 109
	Pulveroboletus sp.3	FGM	Bb 53 ; 76 ; 126 ; 110
Sotorius	*Sotorius* cf. *australiensis*	FGD	Bb 63
	Sotorius cf. *exismius*		Bb 21 ; 62
Suilus	*Suilus* sp.	FCK	Bb 101

Strobilomycès	*Strobilomycès* cf. *strobilaceus*		Bb 93 ; 141 ; 143
Tylopilus	*Tylopilus* cf. *alboata*	FGT	Bb 23 ; 43 ; 71 ; 95 ; 131
	Tylopilus sp.1		Bb 72
	Tylopilus sp.2		Bb 74
	Tylopilus sp.3		Bb 137
Xerocomus	*Xerocomus* cf. *subspinulosus*		Bb 67 ; 108
	Xercomus sp.1	FGT, FGD	Bb 16 ; 20 ; 107 ; 129 ; 134
	Xeromus sp.2	FGT, FGD, FCM	Bb 56
	Xeromus sp.3	FGD, FCM,	Bb 52 ; 85 ; 105
	Xeromus sp.4	FGD,	Bb 121 ; 57 ; 146
	Xerocomus sp.5	FGT, FGD	Bb 34 ; 38
	Xerocomus sp.6	FGD	Bb 127

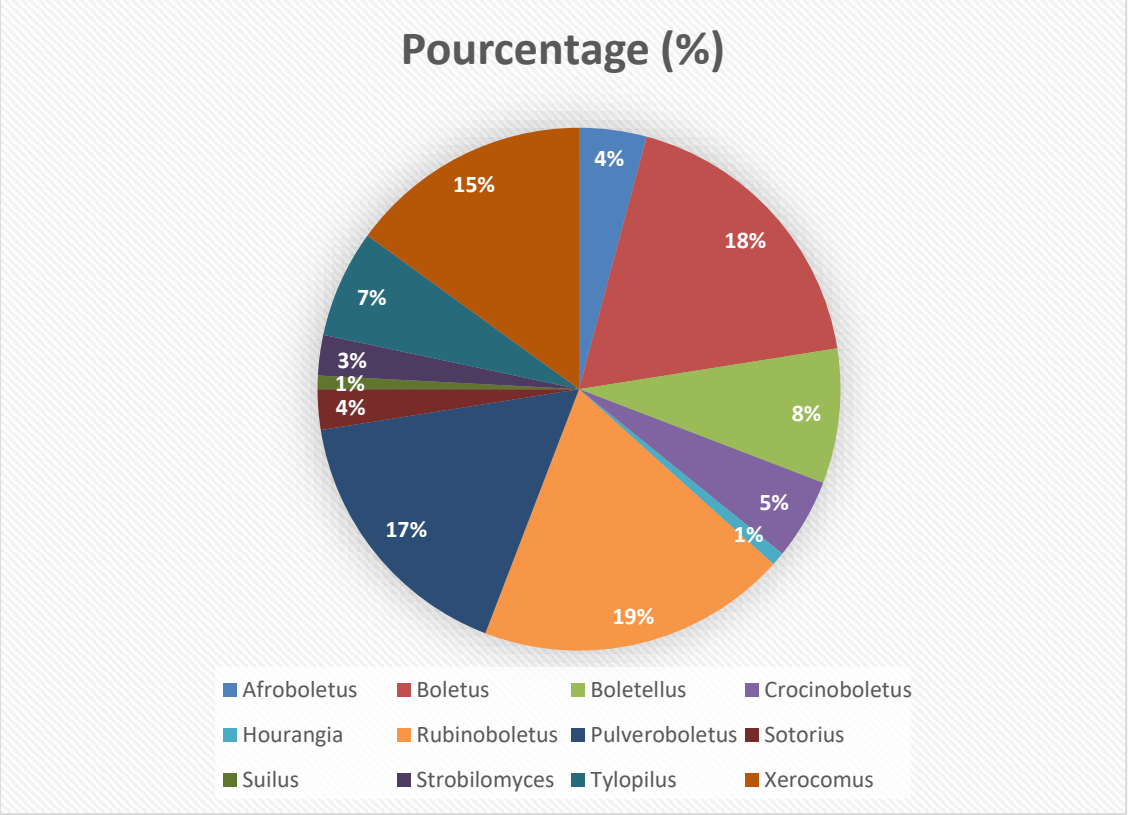

Figure 3. Distribution of Basidioma in genera

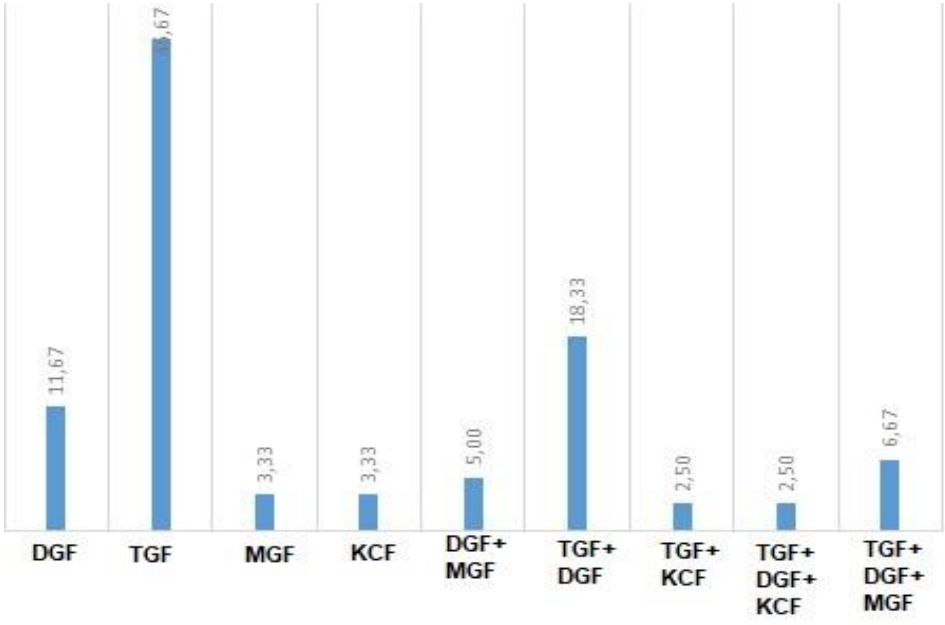

Figure 4. Distribution of carpophores collected by site

Legend: FGD: Dan Gallery Forest (DGF); TGF: Toussiambandougou Gallery Forest; MGF: Mondon Gallery Forest; KCF: Kou Classified Forest.

The various fresh carpophores of the boletes collected were photographed in their fresh state, accompanied by their labels, and then grouped according to the collection sites (Plates 1-6)

Plate 1. Specimens specific to the Toussiambandougou gallery forest

Plate 1. Specimens specific to the Toussiambandougou gallery forest (continuation and end)
A: *Afroboletus* sp.1 ; **B :** *Rubinoboletus* cf. *luteopupureus* ; **C :** *Boletelus* cf. *lindeii* ; **D :** *Boletellus* cf. *dissiliens* ; **E :** *Boletus* sp.1 ; **F :** *Boletus* sp.6 ; **G :** *Rubinoboletus* cf. *griseus* ; **H :** *Pulveroboletus* cf. *ravenelii* ; **I :** *Tylopilus* sp.2 ; **J :** *Tylopilus* sp.3 ; **K :** *Xerocomus* cf. *subspinulosus* ; *L : Crocinoboletus* sp.2 ; **M :** *Hourangia* cf. *cheoi* ; **N :** *Crocinoboletus* sp.1 ; **O :** *Boletus* sp.2 ; **P :** *Boletellus* sp. ; **Q :** *Boletus* sp.3 ; **R :** *Boletus* sp.4 ; **S :** *Boletus* sp.5 ; **T :** *Boletus* sp.12 ; **U :** *Boletus* sp.7 ; **V :** *Boletus* sp.8 ; **W :** *Boletus* sp.11

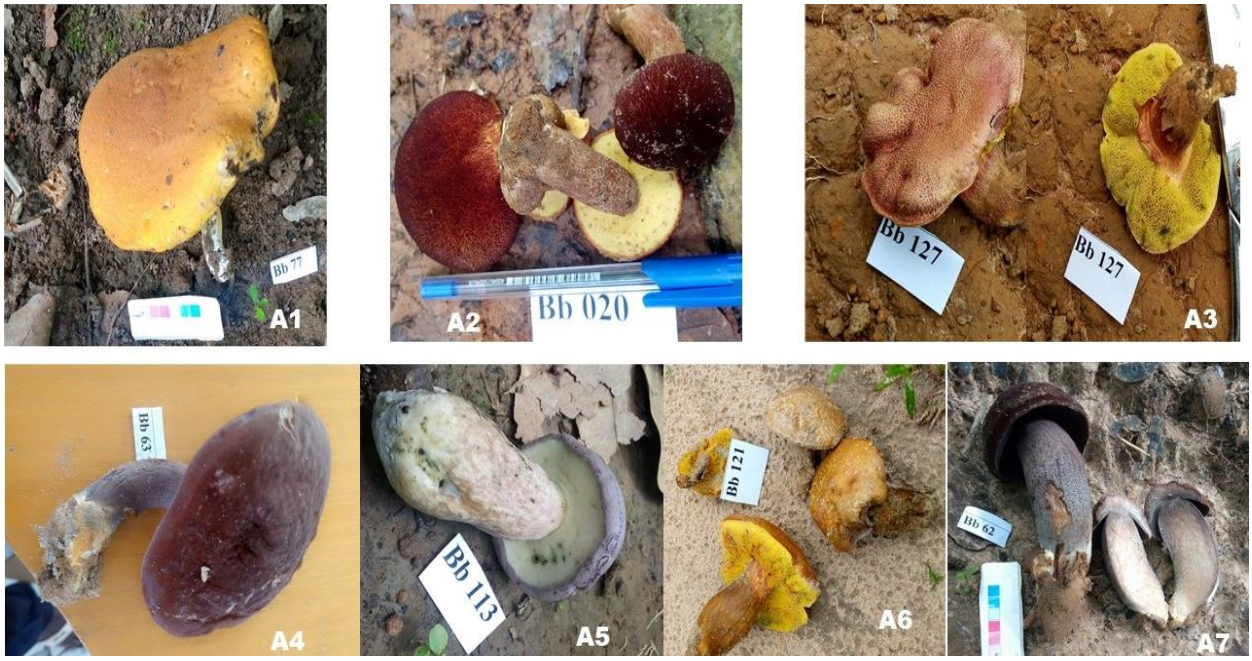

Plate 2. Specimens specific to the Dan gallery forest.
A1 : *Crocinoboletus* sp.3 ; **A2** : *Boletus* cf. *fraternus* ; **A3** : *Xerocomus* sp.6 ; **A4** : *Sotorius* cf. *australiensis* ; **A5** : *Boletus* sp.10 ; **A6** : *Xerocomus* sp.4 ; **A7** : *Sotorius* cf. *exismius*

Plate 3. Specimens specific to the Mondon gallery forest (*Pulveroboletus* sp.3)

Plate 4. Specimens specific to the Kou classified forest.
C1 : *Strobilomyces* cf. *strobilaceus*; **C2** : *Suilus* sp.

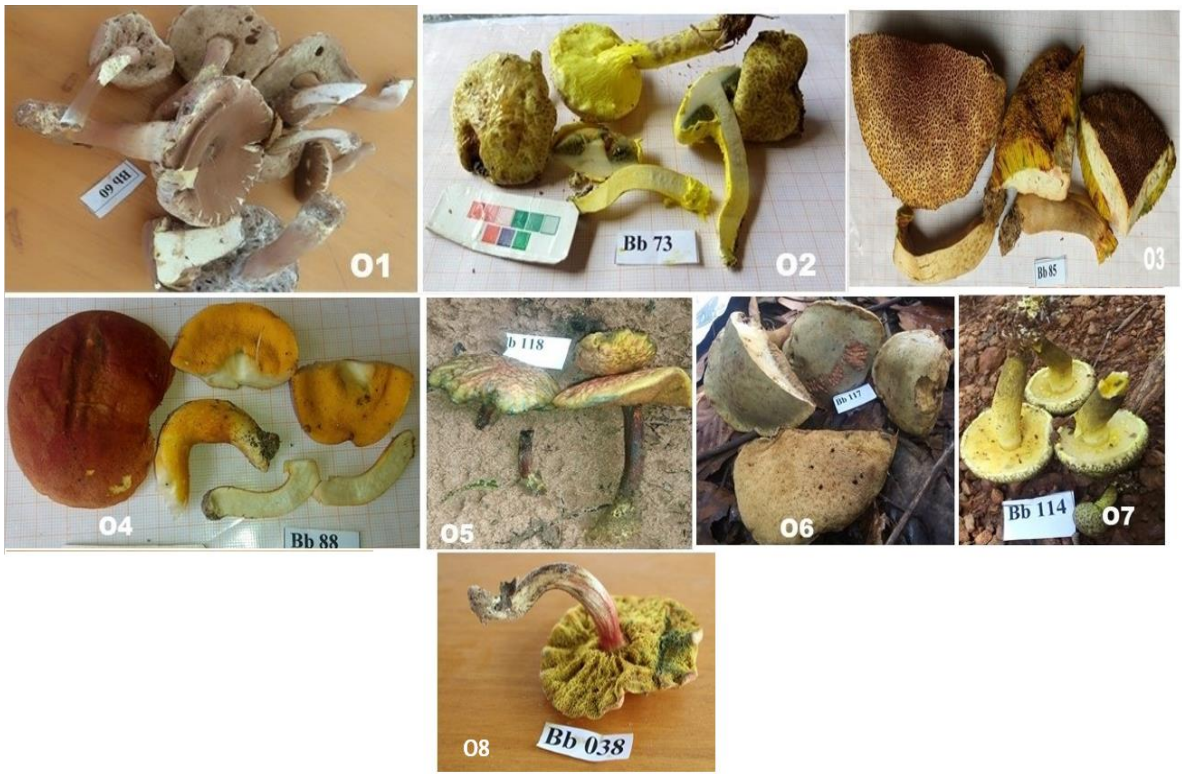

Plate 5. Diversity of Boletaceae common to the three gallery forests of the Kenedougou province (Orodara)
O1: *Boletus* sp.9; **O2**: *Pulveroboletus* cf. *sokponianus*; **O3**: *Xerocomus* sp. 3; **O4**: *Afroboletus* sp. 2; **O5**: *Pulveroboletus* sp. 2; **O6**: *Rubinoboletus* sp. 1; **O7**: *Pulveroboletus* cf. *lignicota*; **O8**: *Xerocomus* sp. 5

Plate 6. Diversity of Boletaceae common to all four study sites
H1: *Rubinoboletus* sp. 2; **H2:** *Rubinoboletus* sp. 3

4. DISCUSSION

From the identification of specimens collected at the various sites over these five years, we note a good diversity of Boletaceae, especially in the Toussiambandougou and Dan gallery forests. This richness could be explained by the presence of young ectomycotrophic woody plants, which are the preferred host plants for boletes. These biotopes are not very overcrowded and tend to be wooded savannahs, but they are subject to less human pressure because they are home to places reserved for religious worship. On the other hand, in the Mondon gallery forest, a low diversity of boletes was noted, which can be explained by the narrowness of the forest and the small number of ectomycotrophic woody species. In addition, the site is highly anthropised, being strewn with farmers' fields on all sides. The Kou classified forest, for its part, recorded a low diversity of Boletaceae despite the protection it enjoys from the Ministry of the Environment and its large plant cover rich in ectomycotrophic woody species. This contact could be justified by the fact that 80% of the Kou classified forest is covered, making it difficult for the sun's rays to reach the undergrowth. In addition, there is a lot of leaf litter and twigs that have not decomposed, resulting in poor soil aeration and hindering the action of soil micro-organisms. Finally, we note that this is an ageing forest, so it is less active and less rich in soil microorganisms. Within the diversity of boletes collected, two genera are dominant. These are the genera *Boletus* with thirteen (13) species and *Xerocomus* with seven (7) species. Our research work is in line with that carried out in China by Li *et al.*, 2011 and Wu *et al.*, (2015 and 2016) who showed that the genus *Boletus* contains more species. Indeed, identification work in recent years in China has brought to light several new species belonging to the genus *Boletus*.

5. CONCLUSION

The study revealed the presence of macromycetes of the Boletaceae family in theToussiambandougou, Dan, Mondon gallery and in the Kou classified forest in western Burkina Faso. Photographed, described and preserved in the mycotheque of the Joseph KI-ZERBO University in Ouagadougou, this invaluable herbarium is tangible proof that Burkina Faso, despite being a sahelian country, still has some forest reserves that contain a fair amount of fungal diversity. With the cumulative accelerated anthropization in the aging state of some forest reserves, it becomes imperative that mycological outings be organized throughout the country in order to make a national inventory of the diversity of macroscopic fungi in Burkina Faso.

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