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Ganoderma lobenense (basidiomycetes), a new species from oil palm (*Elaeis guineensis*) in Cameroon

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Abstract: A species of *Ganoderma*, which could not be identified with any known species, was found in the Lobe oil palm plantations of PAMOL limited Cameroon during a survey of basal stem rot disease of oil palm in the South West Region of Cameroon. It has a septatipelis pileipellis (presence of septa at the top, middle and bottom parts of the pileipellis) which distinguishes it morphologically from other species of *Ganoderma*. Based on this distinct morphological character we describe it as a species new to science and named it *Ganoderma lobenense* R.K. Tonjock and A.M. Mih, with the specific epithet derived from the name of the type locality (Lobe), where the specimen was collected. The type specimen (HKAS 58059) is lodged at the HKAS (Herbarium of Cryptogams, Kunming Institute of Botany, Chinese Academy of Sciences) in China.

Keywords: Cameroon, *Ganodermataceae*, New Species, Septatipelis

1. Introduction

The morphological species concept also forms the basis for new fungal descriptions, as is required by the International Code for Botanical Nomenclature. The fact that so many taxa have already been described in terms of their morphological characteristics allows for comparisons to be drawn between existing taxa as well as between new and existing and/or described taxa [1]. Basidiocarps, which are the sexual structures in *Ganoderma* and other polypores, grow from a living, or more commonly, from a dead trunk or branch of a tree in the form of bracket. One of the two types of basidiocarp is produced, depending on the species: a laccate fruiting body with a shiny upper surface, or a non – laccate fruiting body with a dull upper surface. Basidiome features such as the size, context colour, and shape of the basidiocarp, have often been used in the taxonomy of *Ganoderma* species [2, 3].

The genus *Ganoderma* (Basidiomycota, Ganodermataceae) was first described by Karsten in 1881[4], with *Polyporus lucidus* (W. Curtis) Fr. (Syn. *G. lucidum* (W. Curtis) P. Karst.) as the type and only species. The double walled basidiospores with interwall pillars are a key diagnostic feature for the genus. Since then, several species have been described, occurring naturally as pathogens of important crop and forest species or as saprophytes. At least seven species have been associated with the highly devastating basal stem rot (BSR) disease of oil palm, *Elaeis guineensis* Jacq. in the major oil palm producing countries of the world [5]. In Cameroon, the BSR disease is highly prevalent in the oil palm belt [6] and has shown to be a major constraint to the production of this crop [7]. In a recent survey [6], of the seven distinguishable species of *Ganoderma* isolated from oil palm, four of them including *G. tornatum, G. steyaertanum, G. chalceum* and *G. zonatum* were known pathogens of oil palm elsewhere, one species *G. ryvardense* was a new report, one showed affinity to *G. tropicum*, but however well distinguishable from the latter, and the seventh which we describe here as new, looked unique to science considering the above mentioned distinctive features.

The natural infection of basal stem rot disease caused by species of *Ganoderma* in oil palm occurs as a result of contact between healthy roots and diseased tissues left buried in the soil [8]. Subsequent spread occurs by root to root contact once a few palms are infected [9]. Penetration is believed to be through wounded tissues or dead roots [10]. The role of basidiospores in spread is not clear. Huge numbers of basidiospores are released from basidiomata in oil palm fields but most plants remain uninfected [11]. Studies on direct artificial inoculation with basidiospores indicate that they lack the inoculum potential to initiate

disease in living palms [5]. The role of basidiospore therefore appears to be through a saprophytic phase where after colonizing oil palm stumps, debris, leaf axils or frond bases, dikaryotisation occurs and the products initiate infection by colonizing roots of living palms or their aerial parts [12]. Once the fungus penetrates, there is indiscriminate invasion of the xylem, phloem, pith, cortex and parenchyma [13]. Invasion causes the cortical tissues to disintegrate and become brown. In older roots, the fungus may be present as a whitish skin line layer on the inner surface of the exodermis [10]. In a cross section of an affected trunk, the lesions appear as light brown areas of rotting tissues, marked by darker irregular zonations with an outer edge of an irregular yellow zone. A yellow zone is found between the lesion edge and the healthy tissues; this zone usually smells of rancid. The disease tends to produce a layer of infected tissue across the base of the stem with infection of stem tissue radiating from the centre outwards, although some palms may show a more marked lateral development of stem rotting [13].

In young palms, the external symptoms of basal stem rot normally comprise a one sided yellowing, or mottling of the lower fronds, followed by necrosis [10]. The newly unfolded leaves are shorter than normal and chlorotic, and additionally the tips maybe necrotic. As the disease progresses within the plant, the diseased palm may take on an overall pale appearance, with retarded growth and the spear leaves remain unopened [10]. Similar symptoms are observed in mature palms with multiple unopened spear leaves and a generally pale leaf canopy. Affected leaves die, necrosis sets in, beginning with the oldest leaves and extending progressively upwards through the crown. Dead desiccated fronds droop at the point of attachment to the trunk or fracture at some point along the rachis and hang down to form a skirt of dead leaves.

2. Materials and Methods

2.1. Location of the Study

This study was conducted in oil palm plantations in Lobe of PAMOL Plantation Ltd in Ekondo Titi Sub-Division (04°34 to 04°40 N and 09°04 to 09°10 E), the South West of Cameroon. The location's benefits from the equatorial climate, which is characterized with an annual rainfall of 3,559 mm, relative humidity of 90 % and an annual temperature of 27° C. The year is divided into two seasons: dry season that runs from December to February, but interrupted with light rain, and a rainy season, which runs from March to November each year. These periods of two rainy seasons are the result of the Intertropical Convergence Zone (ITCZ), which influences the climate of this equatorial area. The soil is sandy clay and chemically poor (low organic content), but generally appreciable for oil palm cultivation [14].

2.2. Sampling and Macro-Morphological Identification

Ganoderma basidiocarps were collected from oil palm plant in the Lobe Estate of PAMOL Ltd in Southwestern region of Cameroon during a collection trip undertaken in 2008. Each specimen was scored for macro-morphological characters including texture of the cuticle (laccate/non-laccate), attachment of basidiocarp (stipitate/sessile/dimidiate), basidiocarp shape (applanate/imbricate/concave), number of concentric zones on pileus, margin shape (lobed/rounded/acute) basidiocarp colour, pore colour, pores per mm-1, pore diameter, dissepiments and axes, tube size and colour, context size and colour. The descriptions were compared with those for *Ganoderma* described by various authors [15, 1 6 - 17, 18, 19, 20].

2.3. Micro-Morphological Characterization

For internal morphology, free-hand thin sections of dried basidiocarps passing through the hymenium were prepared. The sections were mounted in 5% KOH and observed under a compound microscope having a combination of 10x, 40x eyepiece and 100x objectives. Twenty measurements were taken of pore diameter, thickness of dissepiments and the distance between axes of pores. Twenty randomly selected basidiospores, from each specimen were measured, inclusive and exclusive of ornamentation. The results were coded as n/m/p where n is number of basidiospores measured, m is number of basidioma involved and p number of collections. The dimension of spores is given with the notation form (a) b–c (d) which takes into account the lowest (a) and highest (d) extreme values and the range b–c that contains a minimum of 90% of the values. The length/diameter ratio, Q, was calculated and the mean (Q_m) and standard deviations estimated.

2.4. Taxonomy

Ganoderma lobenense, Kinge and Mih sp. Nov MycoBank MB 561930

2.4.1. Diagnosis

Basidiomata annuua, dimidiata, circularis, concava, circa 12.5 cm longa, circa 8 cm lata, superficies pilealis rubella, obscure undulata, tribus circulis concentricorum munita, margine rubello, undulato. Hymenophorus ligneus, brunneus. Contextus rubello-brunneus, 10 mm profundus. Tuba 11 mm profunda.Superficies pororum flavida. Pori angulares, 3-4/mm, 140-260 µm diam., dissepimentis 60-145 µm crassis, axibus 195-370 µm distantibus. Basidiosporae ellipsoidales vel stilloformes, apice subtruncato, ovoido vel plano; ornamentum apici ovoidi nullum; cum ornamento 10-14 × (5-)6-8 µm, ornamento excluso 9-12(-13) × (4-)5-7 µm. Endosporae valde ornatae, distincte echinulae.Cellulae pilleipellis clavatae vel subclavatae, ramosae, parti apicali constrictae, in basali, mediana vel apicali partibus septatae, 2.3-3.8 µm diam, vel septataepellis.

Type: Kinge (UB-0078) 13 November 2008, Lobe Estate, South West Region, Cameroon. Collection deposited in Kunming Institute of Botany, herbarium with voucher specimen number 58059.

Etymology: The epithet refers to the name of the place where the species was found.

Basidiospores (Fig. 1); (n/m/p) 20/1/1; including ornamentation 10-14 x (5) 6-8 µm, Q=1.38-1.93(2), Qm=1.71+-0.17, and excluding ornamentation 9-12(13) x (4)5-7 µm, Q=1.43-2(2.25), Qm=1.80 ± 0.20, ellipsoid or

ovoid to drop shape with slightly or broadly truncated apex, pale yellow, wall thickness measuring about 0.5µm, strongly ornamented and distinctly echinulate at the base.

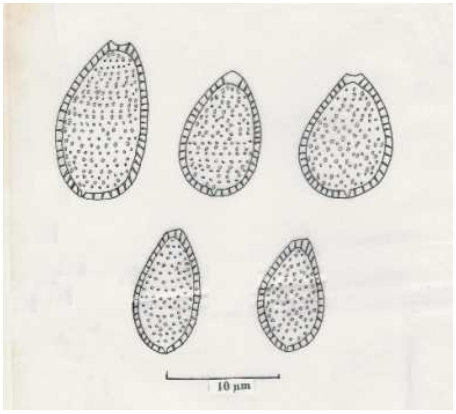

Figure 1. *Basidiospores of Ganoderma lobenense (from holotype)*

Pileipellis (Fig. 2); A palisade of clavate or subclavate hyphal elements, some of which are branched and constricted at the apex, terminal elements measuring up to 2.3 – 3.8 µm diameter, distinct presence of irregularly distributed septum at the top, mid and bottom positions of the cells, hence it is septatipellis.

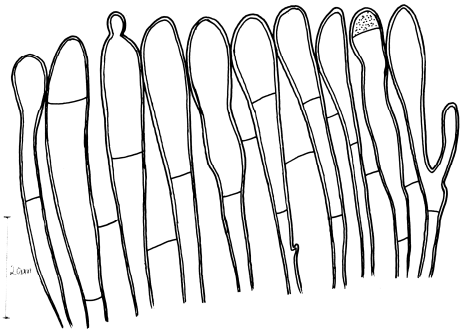

Figure 2. *Pileipellis of Ganoderma lobenense (from holotype)*

Figure 3. *Basidiocarp of G. lobenense.*

Basidiocarp (Fig. 3); Basidiocarp annual, sessile; pileus concave and circular. Upper surface of pileus up to 12 cm length and 8.5 cm width, reddish and concolorous to margins. Colour of pore surface is yellowish. The context and tube depths are 10 and 11 mm respectively. Pore angular 3-4 per mm; pore diameter 140-260 µm, dissepiments 60-145 µm and axes 195-370 µm.

Habitat and Distribution; Pathogenic on oil palm, so far only known from Lobe in South West Region of Cameroon.

2.5. Discussion

Although researchers have a general feeling that use of morphological features alone is not sufficient for identification of *Ganoderma* species [21, 22, 23], comparative morphology is still a key method of identification for *Ganoderma* species especially in the tropics where infrastructure is limiting. The most reliable morphological characters of *Ganoderma* are those of the crust and spores [23, 24], *Ganoderma lobenense* is characterized by its large basidiospores with its apex slightly truncated, ovoid or flat and the ovoid apex lacks ornamentation at the tip. The pileipellis is also a diagnostic feature in this species by having distinct septa which are irregularly distributed at different positions of the apical cells of the pileus at top, mid and bottom. The present species is similar to *G. septatum* in having also distinct septa in the pileipellis cells. However, it differs from *G. septatum* since in the latter, the septa occur exclusively around the middle part of the pileipellis cells, whereas in *G. lobenense* there are three septa occurring about equidistantly within the cell. Also the apical cells are clavate and subcylindrical in *G. septatum* whereas in *G lobenense*, they are clavate, subclavate, branched and constricted at the apex. More still *G. septatum* has a long stipe with relatively short basidiospores (9-9.85-11.5 x 6-7.05-7.5 µm) [25, 26], while in *G. lobenense* the stipe is dimidiate and the basidiospores are longer (10-14 x (5)6-8 µm). *G. lobenense* is also likely very rare. It was only encountered once in a single location. It was never collected during subsequent surveys, suggesting that it might be endangered. The identity of the pathogen is crucial in deciding the most efficient and economic disease management in oil palm plantation in Lobe estate in South West Region of Cameroon.

3. Conclusion

Identifying and documenting *Ganoderma lobenense* is important considering the usefulness of different species of *Ganoderma* in traditional medicine and as plant pathogen. Evidently, the identity of this pathogen is crucial in deciding the most efficient and economic disease management practices and methods.

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