



Here we go gathering!

A German-Beninese team is studying
the world of fungi in West Africa

By Stefanie Hense

Meike Piepenbring, mycology professor at Goethe University Frankfurt, is studying the fungi of Benin together with a mycology group led by Professor Nourou S. Yorou at the Université de Parakou. Their aim is not only to discover new species in the largely unexplored realm of fungi. The scientific team also wants to develop new cultivation methods for edible mushrooms.

Fungi are found everywhere, on the forest floor, on human skin, in the deep sea and possibly even in space; as spores, as filamentous webs, as mushrooms. They break down all kinds of organic material, grow as parasites in or on living organisms, or enter into partnerships for life with plants or – in the case of lichens – with algae and/or cyanobacteria. In 2017, researchers from London and Berlin reported in the journal *Microbiology Spectrum* that the fungal world presumably has the second greatest biodiversity on our planet after the animal kingdom. According to their estimates, there could be between 2.2 and 3.8 million fungal species, of which to date only around 140,000 are known and have been described by scientists.

That most fungal species are yet to be discovered is particularly true for tropical Africa. Mycologist Meike Piepenbring is aware of this: “Two years ago, my research group at Goethe University Frankfurt compiled and published a list of all the fungal species known for West Africa. It contains the names of over 4,800 species. We assume that this list doesn’t include even 15 percent of the species that actually exist in this area.” Together with her collaboration partner Nourou Yorou from the Université de Parakou in Benin, Piepenbring is searching for unknown fungal species. The chances of the German-Beninese working group finding them there for the first time – and of describing unknown species or even genera as new to science – are quite good.

Edible and medicinal mushrooms

In a first step, the research team is documenting fungi already known to the local people. The people of Benin greatly value mushrooms, as they make an important contribution to the population’s diet. “Mushrooms contain a lot of

1 The edible mushroom *Lactifluus gymnocarpus* grows in the tree savannahs of tropical Africa. Its common name, Kpayenkping-gbèka, indicates the place where it is found: “Mushroom that grows under the uapaca tree”.



Photo: Meike Piepenbring

2 Off to spot fungi: Nourou S. Yorou from the Université de Parakou.

3 A new species of fungus from Benin, a previously unknown bolete, the species or genus of which even the most modern molecular genetic methods have so far been unable to determine.

4 Meike Piepenbring underway in the forest with doctoral candidates Affoussatou Tabé, Université de Parakou, and Miguel Bermúdez, Goethe University Frankfurt.

IN A NUTSHELL

- Mushrooms can play an important role in a person's diet as a substitute for meat. In addition, some species are used to treat diseases.
- According to estimates, so far only about five percent of all fungal species have been described by scientists.
- Researchers from Goethe University Frankfurt and the Université de Parakou are busy classifying locally known and new fungal species in Benin and developing techniques to cultivate edible mushrooms.



The author

Dr Stefanie Hense, 51, is a freelance science journalist. Having studied physics and earned her doctoral degree, she was first a trainee at the FAZ newspaper and then worked there in the political newsroom. Today she writes for UniReport and GoetheSpektrum, media of Goethe University Frankfurt.

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protein, as well as D vitamins, minerals and trace elements,” says Yorou. “That makes them a potential substitute for meat and a valuable supplement to millet, manioc and yam, above all when supplies are depleted towards the end of the dry season and new crops cannot yet be harvested at the beginning of the wet season.” Knowledge about how to use fungi, for example as food and as medicinal mushrooms, has a long tradition in the various ethnic groups of Benin and is passed on by word of mouth from parents to their children, especially in rural areas. “By documenting this knowledge, we want to preserve it at the same time. This is all the more important as more and more young people are moving to the cities, with the result that this knowledge is being lost,” comments Piepenbring.

That is why the members of Yorou's working group are travelling to villages in Benin and asking which mushrooms the people collect and what names they give them. They compare the



Photo: Felix Hampe & Cathrin Manz



Photo: Daouda Dongnima

results of this research, referred to as “ethnomycology”, with standard mycological classification: To which genus, to which species, does a particular mushroom traditionally belong? Do different names exist for it in various parts of the country? Do ethnic groups agree on the properties of a certain species, or is the one or other type considered edible and tasty in the first village, inedible in the second, and even poisonous in the third?

Analysis of genotype and constituents

The “FunTrAF” project (Diversity and Uses of Fungi in Tropical Africa), which started in 2020, is funded by Germany's Federal Ministry of Education and Research, and in the summer of 2021 a container set off across the North Sea and the Atlantic Ocean with equipment for the laboratories in Parakou. Inside: a sterile workbench, refrigerators, freezers, PCR devices for analysing genetic material as well as computers, glass devices and consumables to the value of €45,000. The Université de Parakou had provided Yorou with rooms beforehand, and through the arrival of the lab equipment it became clear to Yorou that he also needed to improve the labs' power supply, as Piepenbring reports. “Nourou told me how the fuse regularly



Photo: Meike Piepenbring

also testing whether the fungi grow on shredded crops and harvest waste instead of on artificial culture media containing sugar: millet husks, potatoes, other starchy tubers or the inner part of corn cobs.

Free licences for farmers

The intention is to protect the newly developed techniques against foreign corporations through patents, says Yorou. Local farmers, by contrast, will receive licences free of charge as soon as the development work has been completed. “By doing this, we want to foster economic independence, especially among women and young people,” explains Yorou. Our aim is to reduce unemployment, food insecurity and extreme poverty in Benin’s rural communities.”

5 In the mycology laboratory at the Université de Parakou, doctoral researcher Azize Boukary looks at his fungal cultures in the refrigerator, which has just been delivered by container from Frankfurt.

6 This yellowy-green fungus was first described scientifically in 2018 by Nourou Yorou and his team. They named it *Pulveroboletus sokponianus* after the Beninese ecologist Nestor Sokpon.

blew as soon as someone switched on the steam steriliser!”

The mycologists from Frankfurt and Parakou like being out and about together for field work, that is, gathering fungi in the forest or savannah or at the roadside, and learn from each other in the process: from the technical equipment and scientific background of the one as well as from the knowledge of the fungi, plants, climate and other local conditions of the other. And last but not least from the collection and export permits that the Beninese colleagues obtain from local authorities. The team collects specimens for the herbaria in Parakou and Frankfurt, and together the researchers begin examining and documenting the morphology of the fungi directly on site with the help of the “donated” binoculars and microscopes. In future, the scientists in Benin also want to sequence the genetic material of the fungi, while the natural products of mushrooms are analysed in Germany by means of high-pressure liquid chromatography, among other methods.

Mushrooms as meat substitute

The purpose of the mycological project is not just basic research: Yorou and his group are looking for ways to cultivate edible mushrooms and thus expand and improve their use. “In this subproject, we’re developing locally adapted techniques that can be used to cultivate edible mushrooms,” explains Yorou. There are many native species that are popular with the local people, he says, and yet no one has ever tried to cultivate them.

“So we’ve devised or optimised production techniques for four native species,” he continues. “We isolated cells from fungi in the forest as pure strains.” A series of analyses followed in order to find out under which conditions a particular fungus reproduces best: at what temperature, pH and humidity, as well as requirements concerning special minerals. The researchers are



Photo: Felix Hampe & Cathrin Manz



Russula congoana is often found in semi-open savannah forests. Although it is relatively small, it is often gathered as an edible mushroom due to its mild taste, especially since it forms fruiting bodies in large quantities at the beginning of the wet season.

Photo: Felix Hampe & Cathrin Manz

ABOUT MEIKE PIEPENBRING



Meike Piepenbring, born in 1967, studied biology in Cologne and Clermont-Ferrand (France). After her diploma, she discovered fungi, which is why she then completed her doctoral degree (1994) and her postdoctoral degree (habilitation) (1999) in mycology in Tübingen. She was appointed as a professor at Goethe University Frankfurt in 2001 and has since devoted herself to the search for undiscovered tropical fungi in Central America and Africa, the phylogeny of specific groups of fungi and the diversity of fungi and their significance in the Taunus or in the Science Garden of Goethe University Frankfurt on Riedberg Campus.

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ABOUT NOUROU S. YOROU



Nourou S. Yorou, born in 1974, studied agricultural science in Abomey-Calavi (Benin) and then went to LMU Munich to work on the anatomy, phylogeny and evolution of tropical fungi from the Thelephorales order for his doctoral degree. After that, he led a junior research group at LMU for three years on the mycology of tropical Africa. Since taking up a professorship at the Université de Parakou in Benin in 2014, his main interest has been the sustainable cultivation of fungi, the symbioses of fungi and plants (mycorrhiza) as well as the preservation of endangered fungal species and their partner plants.

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Piepenbring makes a remark to which she attaches particular importance: “What we’re doing as German researchers in Benin is not development aid, but development cooperation.” Many Germans, she says, believe that they are technically superior to people in African countries, but this is not the case. For example, Piepenbring has personally experienced that Africans have sophisticated knowledge of cultivation and preservation methods for their crops which do not require electricity or fossil energy sources. That’s why reporting on her experiences, continuing to take young people from her research group to Benin and showing them a different picture of Africa are important to her. “In addition, we’re pursuing an overarching objective with FunTrAf,” she adds. “We want to provide our partner in Benin with equipment and methodological knowledge in such a way that he can conduct good research independently in the long term and train his own young team. And then he will advance African mycology under his own steam.” ●