

Edible mushrooms from Guyana

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Eleven species of mushrooms are currently known to be utilized as a food source by the indigenous Patamona Amerindians of the rain forested Pakaraima Mountains of Guyana. The majority of these fungi are undescribed species; many belong to groups that are infrequently collected for the table by North Americans (e.g. Clavulinaceae, Sarcoscyphaceae, Amanitaceae) whereas groups which contain highly prized culinary mushrooms by north temperate standards (e.g. Cantharellaceae) are traditionally shunned by the Patamona. Here we discuss some of the more commonly collected mushroom species of the Patamona and their methods of preparation as well as some mushrooms that we have discovered to be choice edibles of the region.

Keywords: Guyana, ethnomycology, mycophagy, *Dicymbe*, Neotropics, Patamona

Introduction

Mycological collecting activities spanning the last ten years in western Guyana have been especially rewarding for the authors and colleagues. The remote rain forests of this poorly-explored South American country have yielded a plethora of fleshy fungi, including many new and unusual species and even genera (Henkel, 1999; Henkel, Aime & Miller, 2000; Miller *et al.*, 2001; Henkel, 2001; Simmons, Henkel & Bas, 2001; Miller, Aime & Henkel, 2002; Aime, Henkel & Ryvardeen, 2003; Matheny, Aime & Henkel, 2003; Henkel, Roberts & Aime, 2004). Of particular significance is the presence, in the Pakaraima Mountains, of extensive stands of ectomycorrhizal (EM) trees of the leguminous genus *Dicymbe*. Ectomycorrhizal trees, and their attendant symbiotic macromycetes, had been thought to be largely absent from New World rain forests. The rich EM mycota we have discovered in association with Guyanese *Dicymbe* stands continues to provide fertile ground for systematic and ecological studies (Henkel, Terborgh & Vilgalys, 2002; Henkel, 2003).

In conjunction with the aforementioned studies, we have compiled information on edible mushrooms of the region. In collaboration with indigenous Amerindians of the Patamona tribe, we have

documented at least 17 species of edible fleshy fungi. Among these 17 species, including a number that are ectomycorrhizal, are many that are regularly eaten by the Patamona, while a few were found to be edible and good by visiting mycologists, but shunned by the Patamona. This intriguing fact, along with the dearth of knowledge concerning mycophagy among native Amazonians (Prance, 1973, 1984; Fidalgo & Prance, 1976), has stimulated us to explore this topic. We here provide what we have learned regarding the identity, methods of cooking, and cultural attributes of edible mushrooms from Guyana's Pakaraima Mountains.

Methods

Site description: All fungi were collected along the Upper Ireng River and Upper Potaro River drainages in the central Pakaraima Mountains of Western Guyana (Fig 1). This remote region is characterized by rugged sandstone ridges ranging to 2200 m in elevation and is entirely cloaked with primary tropical forest. Annual rainfall is very high (c. 3500-4000mm) with a pronounced peak during May and June. Temperature is very equitable during the May-June rainy season, rarely exceeding 27°C during the day, or dropping below 20°C at night. The ample May-June precipitation, the rich and varied organic substrata for saprotrophic fungi, and presence of ectomycorrhizal *Dicymbe* trees make these dense forests especially productive of fungal

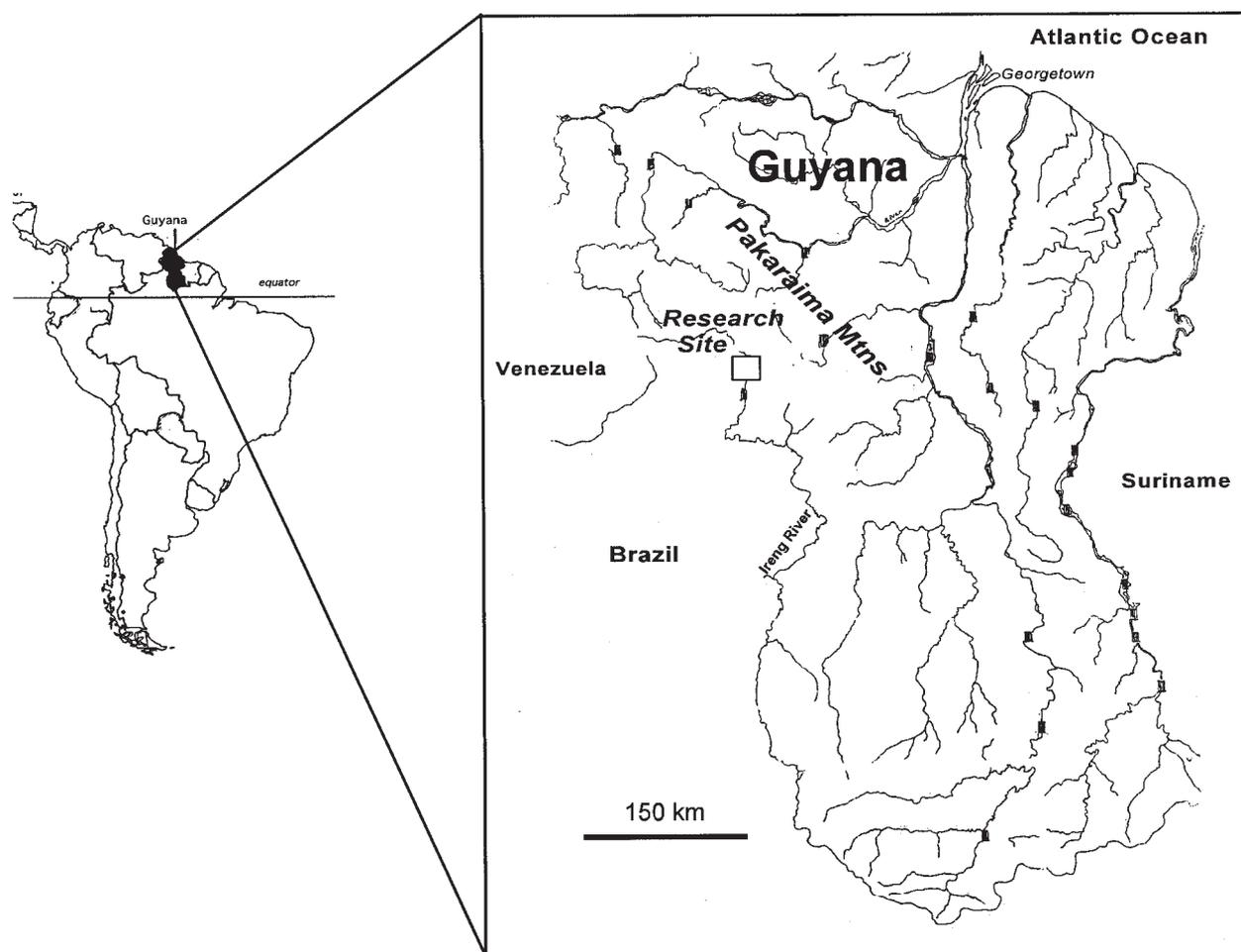


Fig 1 Map showing Guyana and study area in the Pakaraima Mountains.

fruit bodies (Henkel *et al.*, 2002; Henkel & Aime, unpubl. data).

Identification of edible fungi: In conjunction with various research activities from 1992-2002, mushrooms were frequently wild-collected by Patamona field assistants, brought into base camp, cooked and eaten. In 2000 we began to systematically collect, identify, and voucher the various fungi eaten by the Patamona. For each species habitat information, nutritional substratum, and fruiting seasonality were recorded. Patamona informants provided vernacular names (and occasionally their meanings), desirability of respective species, collecting strategies of men and women, preferred method of cooking, and additional elements of folklore. Batches of the various mushrooms were collected and prepared in the indigenous manner, sampled by us, and taste and texture recorded subjectively.

A number of macromycete species occurring in the area were suspected by us of being edible, based on taxonomic affinity, but, though fruiting abundantly,

were not eaten by the Patamona. These included members of the Cantharellaceae, Boletaceae, and Polyporaceae. We employed the time-honoured tradition of 'eat a little bit, and see the effects' to several of these species, and found some to be highly desirable edibles. Habitat information and various gustatory qualities were also noted for these species, and voucher specimens collected. Additionally, both indigenous and Western cooking methods (e.g. sauté) were applied to these mushrooms and qualities of each noted. This distinction between what is eaten and not eaten by the Amerindians among the universe of available edible fungi led us to query the Patamona further regarding the cultural basis for this discrepancy.

Fungi were identified as far as possible using standard references (Singer *et al.*, 1983; Singer, 1986; Dennis, 1970). A number of the edible species are undescribed and are currently under taxonomic study. These have been assigned provisional names in some cases. Voucher collections are deposited at the Humboldt State University, the University of Guyana, and Virginia Polytechnic Institute.

Results and discussion

Traditional methods of cooking: The cooking method preferred by the Patamona for nearly all edible mushrooms involves steaming the mushrooms in wild forest leaves beside a campfire (Fig 2). Fresh leaves are



Fig 2 Estine Andrew preparing to steam wild mushrooms in a leaf packet, Upper Potaro River.

collected on the spot from broad-leaved monocots such as palms, Marantaceae, or Cyrtanthaceae. Interestingly, not all broad-leaved plants are used, an example being the Melastomataceae, members of which are abundant in the forest under story, but impart undesirable flavors to the finished product. Fresh mushrooms are cleaned of debris and rinsed in river water, sprinkled with salt if available, and placed in a pile in the middle of 2-3 layered leaves. The leaves are then folded around the mushrooms to make a triangular bundle, which is tied at the top with strips of forest vine. The bundle is then placed within 10-20 cm of a slow burning wood fire. After 5-10 minutes the bundle is turned over and left to cook for another 5-10 minutes. At this point the outer leaf layer is burnt black, and steam and bubbling water may be emitted

from the bundle. The bundle is then untied and the leaves unfolded to reveal a steaming pile of mushrooms, which may be sprinkled with additional salt, and eaten immediately using the fingers. While nearly all wild mushrooms are prepared in this manner by the Patamona, at least one species of *Macrocybe* ('wailan-mulé', transl. 'young tapir'), is not. To avoid gastrointestinal upset, the massive fruit bodies of this species must be boiled in several changes of water before eating. The active toxic compounds in this species of *Macrocybe* are unknown.

A second method of cooking involves the simple addition of edible mushrooms to the family 'pepperpot'. The traditional Amerindian pepperpot, called 'tuma' by the Patamona, is a cooking pot kept perpetually warm on the household hearth, into which the daily catch of wild meat, fish, etc., are added to a salty broth containing liberal doses of very hot peppers (*Capsicum* spp.). In our case, recently collected mushrooms were added directly to the pepperpot, boiled, and consumed with cassava bread (*Manihot esculenta*). All mushrooms consumed by the Patamona may be prepared in this manner except for *Lentinula* cf. *boryana* ('kapiokwok')



Fig 3 Fruiting habit, *Lentinula* cf. *boryana*, "kapiokwok".

which, although a highly esteemed edible, will impart an undesirable mucilaginous consistency to the 'tuma'.

Mushroom harvesting: Among the Patamona, women are clearly the 'champions' when it comes to mushroom picking. While men are only 'opportunistic' mushroomers, picking up a few of the more desirable species when encountered on hunting trips, etc., women engage in active premeditated mushrooming. On these forays, women will revisit favourite patches over successive rainy seasons to collect *Clavulina esculenta* ('kunmudlutse'), *Clavulina* sp. ('tepurumeng'), *Lentinula* sp. ('kapiokwok') and other gregarious fruiters, in quantity. Children of both sexes will also engage in this activity, boys until the ages of 14-15. Estine Andrew, wife of one of the authors (CA), is known to spot troops of 'kapiokwok' buttons on logs in the forest and will return in 2-3 days, basket in hand, to harvest the delectable bounty (Fig 3). Species that are found only in drier wood present in the slash and burn gardens (e.g. *Lentinus crinitus*) are collected when in season by women and children in their daily agricultural pursuits. No effort is made to preserve fungi; those collected are eaten fresh.

Solitary fruiting edible mushrooms, due to their sporadic and unpredictable localities, are collected opportunistically by both women and men. An example is *Amanita perphaea* ('pulutukwe'), an edible held in such high esteem that, when encountered by men deep in the forest, will immediately be harvested, carefully cut up, folded into a package of fresh leaves, and carried home to the wife as a special treat.

Who eats what: Among the Patamona inhabiting the upper Ireng River, many of the 11 edible species reported here are eaten by everyone. One exception includes *Boletellus ananas* ('aawahgo'), which we consistently recorded as being eaten only by Patamona living along Yuarka Creek, a small tributary off the Upper Ireng. Additionally, one of us (CA) has noted that a recent Ackawaio Amerindian immigrant from the Upper Mazaruni River (c. 50 km to the North) regularly consumed *Tylopilus ballouii*, an abundant bolete in the upper Ireng River that is shunned by the Patamona. Apparently some of the Patamona have now begun to eat this mushroom, based on the recommendation of the Ackawaio.

A number of mushroom species (e.g. *Cantharellus guyanensis*, *Craterellus* sp. 1, *Laetiporus sulphureus*) were decreed as edible and choice by us, but habitually avoided by the Patamona (Table 1; see Fig 4). Once the edibility and desirability of these species had been confirmed over successive field seasons, repeated queries to Patamona assistants and villagers invariably drew a negative response as to whether they ever consumed these species. With time, our Patamona assistants began to eat these mushrooms with us, and, realizing their desirability as food, have begun to harvest these species in the vicinity of their villages.

Mushroom profiles: species eaten by the Patamona

Species of edible fungi, vernacular name if used, their nutritional substratum, voucher specimen number, whether eaten by the Patamona, and desirability are

Table 1 Edible mushroom species recorded in the Pakaraima Mountains of Guyana, with nutritional substratum, desirability by the Patamona Amerindians, vernacular name, and voucher specimen number.

Species	Substratum	Eaten by Patamona ¹	Vernacular	voucher #
<i>Amanita perphaea</i> Simmons, T.W. Henkel & Bas	EM	+++	pulutukwe	TH 8195
<i>Boletellus ananas</i> (Curt.) Murr.	EM	+	aawahgo	TH 8614
<i>Cantharellus guyanensis</i> Mont.	EM	-	-	TH 8242
<i>Clavulina</i> sp. 1	EM	+++	kunmudlutse	TH 8460
<i>Clavulina</i> sp. 2	EM	++	tepurumeng	TH 8217
<i>Clavulina</i> sp. 3	EM	-	-	TH 8286
<i>Clavulina craterelloides</i> Thacker & T.W. Henkel	EM	-	-	TH 8520
<i>Craterellus</i> sp. 1	EM	-	-	TH 8235
<i>Cookeina</i> sp.	Wood	+	agubana	TH 8519
<i>Favolus brasiliensis</i> Fr.	Wood	+	katsala	MCA 2364
<i>Laetiporus sulphureus</i> (Bull.:Fr.) Murr.	Wood	-	-	-
<i>Lentinula</i> cf. <i>boryana</i> (Berk. & Mont.) Pegler	Wood	+++	kapiokwok	MCA 1010
<i>Lentinus crinitus</i> (L. ex Fr.) Fr.	Wood	+	kewetuik	MCA 2325
<i>Macrocybe</i> sp.	Terrestrial	+	wailan mule	-
<i>Pleurotus</i> sp.	Wood	++	eegepunupe	MCA 1212
<i>Tylopilus ballouii</i> (Peck) Singer	EM	+	-	TH 8409
<i>Xerocomus</i> sp. 1	EM	-	-	TH 8395

¹"+" indicates species is eaten by the Patamona; number of "+" signs indicates subjective estimate of desirability of species among Patamona



Fig 4 Edible mushrooms of the Pakaraima Mountains. a. *Clavulina* sp. 1, "kunmudlutse" b. *Clavulina* sp. 2., "tepurumeng" c. *Amanita perphaea*, "pulutukwe" d. *Lentinula* cf. *boryana*, "kapiokwok" e. Ascomata of *Cookeina* sp., "agubana" f. *Boletellus ananas* g. *Cantharellus guyanensis* h. *Craterellus* sp. 1

recorded in Table 1. Eleven species were recorded as eaten by the Patamona, while the edibility of six additional species were assessed by us. The most commonly encountered or highly prized edibles are discussed below.

1) *Clavulina* sp. 1: 'kunmudlutse'

This coral fungus is one of the most highly prized edibles among the Patamona. *Clavulina* sp. 1 is a beautiful mushroom easily recognized in the field by its coppery-orange, dichotomously branching fruit body, reaching 10 cm in height, which has a rich, apricot-colored hymenium over its upper 2/3 when mature (Fig 4). The species fruits exclusively under *Dicymbe corymbosa*, in infrequent but gregarious patches during the early to mid May-June rainy season. During this period Patamona women will make repeated forays to *Dicymbe* forest to collect it in quantity. The mushroom is wonderfully fragrant when fresh, can be eaten raw in the field, has a rich, tangy-nutty flavor, and is chewy (but not tough) in texture. It retains these qualities when cooked in leaves and pepperpot, and has been sautéed in butter to great effect by visiting mycologists.

Clavulina sp. 1 contributes to an unusually rich suite (15+ species) of *Clavulina* spp. apparently endemic to *Dicymbe* forests; most of which are new to science (Thacker & Henkel, 2004; & unpubl. data).

2) *Clavulina* sp. 2: 'tepurumeng', referring to a grayish, stinging wasp of the same color.

Clavulina sp. 2 is another undescribed species of the *Clavulina* suite associated with *Dicymbe*. 'Tepurumeng' is similar in size and shape to *Clavulina* sp. 1 but is entirely dark gray in color, with thickened, light gray hymenium over the upper 2/3 (Fig 4). *Clavulina* sp. 2 fruits more frequently than *Clavulina* sp. 1 but is less gregarious, and is therefore collected in less quantity. In taste and texture 'tepurumeng' is very similar to 'kunmudlutse', and is therefore held in high regard by the Patamona. 'Tepurumeng' has been a consistent fruiter throughout the May-June rains on all of our expeditions, providing a welcome addition to camp cuisine.

3) *Amanita perphaea* Simmons, T.W. Henkel, and Bas: 'pulutukwe'

The genus *Amanita* is well represented in the Pakaraimas, but only one species is eaten. *Amanita perphaea*, the 'pulutukwe' so revered by the Patamona, is characterized by a large (up to 15 cm diameter), dull grayish pileus, an equal, slightly rooting stipe, with a fragile, evanescent annular skirt (Fig 4). *Amanita perphaea* fruits solitarily or at most in pairs, often with a button and mature fruiting body occurring together. While only occasionally encountered in the *Dicymbe*

forests, 'pulutukwe' fruits throughout the May-June rainy season. This is fortunate, as 'pulutukwe' is truly a delicacy, with a subtle, sweet taste similar to that of the north temperate Caesar's mushroom, *Amanita caesarea*. The Patamona invariably cook 'pulutukwe' with the leaf method as the taste is too desirable to 'lose' in a pot full of other foods.

4) *Lentinula* cf. *boryana*: 'kapiokwok'

Lentinula cf. *boryana*, or 'kapiokwok', is the most sought after saprotrophic mushroom by the Patamona. The lignicolous 'kapiokwok' fruits in troops on large fallen logs throughout the rainy season and during wet interludes of the dry season (Figs 3, 4). The slight mushrooms have white pilei up to three cm in diameter, often suffused with rouge splotches with age, white lamellae, and a tan, solid-fibrous stipe reminiscent of that of the shiitake (*L. edodes*). Large quantities of 'kapiokwok' are collected when available, and individual logs are visited on successive years, yielding consistent harvests. 'Kapiokwok' are cooked by all different methods by the Patamona but are, in the authors' opinions, best steamed in the leaf, where the dense, meaty-gelatinous texture, and rich, shiitake-like taste are best expressed.

5) *Cookeina* sp.: 'agubana'

'Agubana' is a discomycete that occasionally fruits in large numbers on dead branches in the understory and is a favorite of the Patamona women. Its usual manner of preparation is leaf steaming; it has a mild taste and pleasantly crunchy texture. The bright yellow-orange, bowl-shaped, hair-covered fruiting bodies are quite distinctive and not confusable with anything else (Fig 4). As such, it is one of the few fungi readily collected by Patamona children, and even those as young as two years of age recognize and harvest 'agubana' in the field. 'Agubana' is very similar to *Cookeina tricholoma*, an edible species utilized in Western Africa (van Dijk, Onguene & Kuyper, 2003), but lacks the long pedicellate stipe of that taxon.

6) *Boletellus ananas* (Curt.) Murr.: 'aa-wah-go'

Boletellus ananas, or 'aa-wah-go', is the 'black sheep' of edible mushrooms among the Patamona. While shunned as food by most of the 400 villagers along the Ireng, the mushroom is considered a delicacy by a small, local band of the tribe, who live up the Yuarka ('Monkey') Creek tributary approximately 15 km from the main village of Kanawapai. Most of our field assistants from the Ireng area consistently declined to eat 'aa-wah-go'. Nonetheless, we have eaten the mushroom with co-workers from Yuarka Creek. *Boletellus ananas* is a striking bolete, superficially resembling *Strobilomyces* with its shaggy-squamulose pileus, but combines this feature with a brick-red

pileipellis, yellow, blue-staining tube mouths, and brick-red stipe (Fig 6). The taste of this mushroom is insipid, though the texture is acceptable; one of us (TH) felt a slight gastro-intestinal disturbance after eating a leaf-steamed specimen. Interestingly, *B. ananas* occurs in southeast Asia, Central America, southeastern US, Guyana, and even Madagascar (Corner, 1972; Singer *et al.*, 1983; S.L. Miller, pers. comm.)

Species eaten by the mycologists

Several macromycete species not eaten by the Patamona were deemed edible and good by us over the course of the study. These included *Cantharellus guyanensis*, *Craterellus* sp. 1. (Fig 4), and *Laetiporus sulphureus*. *Cantharellus guyanensis*, a small chanterelle fruiting under *D. corymbosa*, is every bit as delectable as the temperate *C. cibarius*. *Craterellus* sp. 1, a very large-bodied, abundantly-fruiting mushroom, is highly palatable and reminiscent, both in texture and taste, of *C. cornucopioides* in North America. *Laetiporus sulphureus*, while very infrequently encountered on standing hardwoods in the rain forest, is identical in taste and texture to the 'chicken of the woods' of the eastern U.S. Each of these taxa appeared to be traditionally shunned by the Patamona, though several of our co-workers have begun to utilize them as food sources.

Other taxa eaten by us but deemed unpalatable included *Clavulina craterelloides*, *Clavulina* sp. 3, and *Xerocomus* sp. 1.

Endnote

The Patamona Amerindians of the Upper Ireng River have incorporated fleshy fungi into their pantheon of edible wild foods. The breadth of wild organisms in other taxonomic groups (e.g. vertebrates, invertebrates, plants, etc.) used by the subsistence Patamona is wide, and mushrooms appear to play a seasonally important dietary role. Ectomycorrhizal fungi associated with regionally-restricted *Dicymbe* spp. present a unique fungal resource to the Patamona previously unrecorded in Amazonian ethnomycology (Prance, 1973, 1984; Fidalgo & Prance, 1976). Interestingly, the Patamona report no seriously poisonous mushrooms among their local mycota. The fact that not all locally available edible mushrooms are utilized by the Patamona may reflect the evolving state of their knowledge regarding mushrooms, in which known edible species are condoned and others remain unknown, and therefore taboo.

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Fungi at Aberystwyth National Science Week

Every year as part of Science Week, the Institute of Biological Sciences (IBS) at the University of Wales Aberystwyth organises 2 days of hands-on science for 750 local children aged between 9 and 11. This has become an established part of the school curriculum. The stalls are mainly from the Institute of Biological Sciences but others also attend including IGER, Ceredigion Council, North Ceredigion Bat group and the Forestry Commission.

This year's event was called "So you want to be a scientist?" with the aim of encouraging children to think about what scientists do and considering the sciences for their further education and career. At this event we (The Mycology Research group) always have a stall to promote interest in fungi. Our overall theme is the ubiquity of fungi with posters covering everything fungal – from recycling of organic matter, yeast, fungal disease and antibiotic production. With this age group the most attractive aspect of the posters was the "Yuck factor" associated with some of the photographs of human fungal disease and "weird fungi" such as the fruiting body of dry rot growing out of the wall of an abandoned bathroom.

The children's focus on learning about science is maintained via a question sheet that they fill in as they visit the stalls. Our question concerned optimal temperature for yeast activity. For this exercise we simply mixed glucose, baker's yeast (*Saccharomyces cerevisiae*) and water, and placed this in tubes with balloons over the top. The tubes were incubated at different temperatures and the children could assess yeast activity according to the inflation of the balloon.

This year one of our more popular demonstrations was the story of how the fungus got its spots. This was taken from the BMS's "An explainer's guide to fungi". Once the growth of the fruiting body (balloon) breaking-up the veil (toilet paper) had been demonstrated the children could take the balloon away with them. Suddenly everyone wanted to see the demonstration so that they could have a balloon! They were particularly impressed when one balloon burst covering the demonstrator with toilet paper.

All of the children (and their teachers) were invited to "Feel the fungus". This consisted of a box with two hand holes and contained fresh and dried Jew's Ear Fungus (*Auricularia auricula*). They were asked to feel and describe the dried material first and then the fresh, wet fungus. The reactions varied between screams of horror and delight with braver souls professing cool nonchalance. They were then shown a piece of the fresh fungus and told about it.

Whereas many of the stalls were exhibiting tanks containing fish and other livestock, our tank contained a whole sliced loaf of very mouldy bread. This showed the involvement of fungi both in the production of bread and its final decay. We also demonstrated the importance of preservatives in bread manufacture by showing the differences in fungal growth on slices of commercial bread and home-made bread (without salt).

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