Chemistry review

Chemical wonders of fungi

Fungi are an important, but often overlooked, kingdom of organisms. **Suhayla Bint-Ahmed** takes a look at just three ways in which the chemistry of a few species of fungi is having an impact

Original culture plate on which Alexander Fleming first observed bacteria being inhibited by *Penicillium* mould

Miraculous mould

Fungi have been used to make huge advancements in medicine, beginning in 1928 when scientist Alexander Fleming accidently made a discovery that led to the synthesis of penicillin. Fleming discovered an invading mould species belonging to the *Penicillium* genus growing on his agar plate of bacteria. He noticed that bacteria had not grown in the areas invaded by the mould.

Decades later, scientists determined how the drug derived from the mould stops the bacteria growing. The β-lactam ring in penicillin (highlighted in Figure 1) bonds covalently to the enzyme DD-transpeptidase, which is responsible for forming crosslinks within the bacterial cell wall. With the enzyme activity blocked, the bacteria cannot produce a functioning cell wall and so cannot grow and replicate (CHEMISTRY REVIEW Vol. 27, No. 1, p. 8).

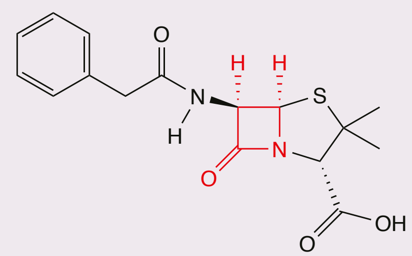

Figure 1 Penicillin G with the beta-lactam ring (a cyclic amide) highlighted in red

Marvellous mushrooms

Disposable nappies contribute 5–15% of Mexico's solid waste. These present a problem, being slow to break down in landfills. Nappies contain synthetic polymers, such as polypropylene, but it is the natural polymer cellulose that leads to their slow degradation. This is due to cellulose's crystalline structure and its ability to form hydrogen bonds (CHEMISTRY REVIEW Vol. 27, No. 4, pp. 28–32).

A proposed solution to this waste problem is to use the fungus *Pleurotus ostreatus*, also known as the oyster mushroom.

This fungus produces cellulase, an enzyme that hydrolyses the β-1,4-glycosidic bonds in the cellulose polymer (Figure 2), reducing the solid waste mass by up to 90% as it grows. This fungus is now used commercially in agriculture for purposes such as biodegradation of wheat straw. The mushrooms can be harvested to eat and the by-products can be used in producing animal feeds.

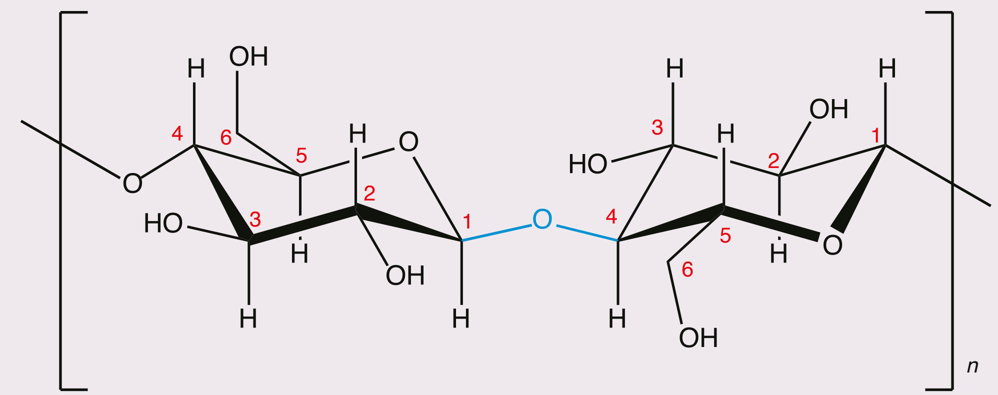

Figure 2 Cellulose is a long-chain polymer composed of cellobiose units, each of which is made from two glucose molecules joined by a β-1,4-glycosidic linkage (shown in blue)

Oyster mushrooms

Bioluminescent fungi

All aglow

You may find yourself enthralled by the beauty of bioluminescent fungi, which have recently regained the attention of scientists due to their biochemical properties. Their bioluminescence is caused by an oxidation reaction, yielding the compound 3-hydroxyhispidin (Figure 3).

Bioluminescent fungi are being considered as a medium for exploring the effects of toxicants on soil organisms, as their emission of bright-green light is reduced when they are exposed to these toxic substances. Their bioluminescence diminishes, allowing for a broader screening of hazardous compounds and their potential effects on terrestrial species.

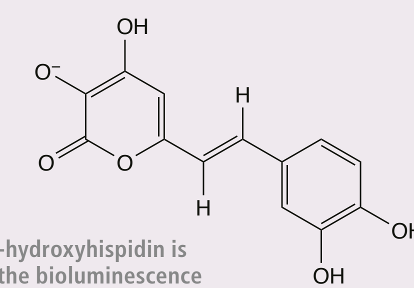

Figure 3 3-hydroxyhispidin is involved in the bioluminescence of some species of fungi

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