PEER REVIEWED

Mushroom Supplements:
Health Trends and Regulatory Environment

The mushroom supplement market in the UK has seen remarkable growth in recent years moving from niche to mainstream. Fuelled by increased consumer interest in the use of natural health and wellness products, functional foods and plant-based trends, the UK mushroom market generated a revenue of USD 1,271.5 million in 2023 and is expected to double by 2030 reaching USD 2,513.0 with projections suggesting continued expansion.[1]

Mushroom supplements are botanical dietary products derived from various species of medicinal and functional mushrooms and available in whole, extract, powder, or capsule form. Common species used include reishi (*Ganoderma lucidum*), lion's mane (*Hericium erinaceus*), chaga (*Inonotus obliquus*), and cordyceps (*Cordyceps sinensis*). These supplements may be sold as single-ingredient products or combined with other botanicals, vitamins, or minerals. Mushroom supplements are prized for their purported health benefits, which range from boosting immunity and enhancing cognitive function to supporting energy levels and reducing stress.

Use of medicinal mushrooms is not new. In Traditional Chinese Medicine (TCM) and other ancient healing systems, mushrooms have been used for centuries for their immune-boosting, anti-inflammatory, and adaptogenic properties. But what distinguishes the current mushroom supplement trend is the intersection of ancient wisdom and scientific study with the isolation of bioactive compounds responsible for many of the reported health benefits, such as beta-glucans, terpenoids, and polysaccharides, and exploring the effects of these compounds in clinical studies.[2]

The following review looks at key mushrooms in the current supplement market with a summary of their suggested health benefits as well as an overview of the current regulation of mushrooms in the UK, including regulatory classification, labelling, safety and enforcement mechanisms.

Health Benefits of Popular Mushrooms

Pre-clinical research and some small human studies indicate various mushrooms have beneficial health properties. However, large, rigorous clinical trials are needed to substantiate many of the claims made by supplement manufacturers. The strongest evidence for the seven most popular mushrooms in the UK market is as follows.

Shiitake *(Lentinula edodes)*

Research suggest that Shiitake mushrooms can provide a number of health benefits which in some countries are so highly valued that shiitake mushrooms are known as the 'elixir of life.'[3] Shiitake mushrooms have been found to potentially help support heart health. A laboratory study discovered that consuming Shiitake mushrooms helped lower cholesterol levels and led to less plaque on the artery walls.[4] Shiitake could be a useful mushroom in supporting the immune system. A four-week study done on 52 men and women found that daily Shiitake consumption of either 5g or 10g caused their immune markers to improve and inflammation levels to drop.[5]

Maitake *(Grifola frondosa)*

Maitake have been used traditionally in Chinese and Japanese medicines for hundreds of years and is now finding uses in Western countries. Rich in vitamin D, Maitake mushrooms are being taken to support bone health and immune health. Maitake also contain antioxidants, beta-glucans, vitamin B and C, copper, potassium, fibre and amino acids. During recent decades, Maitake ingredients, particularly beta-glucans, have been shown to have various bioactivities, including lowering blood sugar.[6] A 2015 laboratory study[7] showed that maitake mushroom can have a positive effect in type 2 diabetes. During the study, maitake mushroom consumption had a positive effect on glucose levels. This points to the need to evaluate maitake mushroom's potential to help treat type 2 diabetes in humans.

Reishi *(Ganoderma lucidum)*

Reishi (known as the Queen of Mushrooms) mushrooms are known for supporting immune health, modulating stress and improving sleep quality. Secondary outcomes from a 2016 Cochrane review were that Reishi mushrooms could improve immune function.[8] Other established activities include antioxidant, anti-bacterial, anti-fungal, anti-viral, and anti-inflammatory activity.[9] Research is ongoing into the mechanisms of action in the immune system[10] as well as into their antimicrobial and antioxidant effects.[11] Compounds such as triterpenes and polysaccharides in reishi are believed to be responsible for these effects.

Lion's Mane *(Hericium erinaceus)*

Lion's Mane mushrooms may improve cognitive function, according to laboratory research which showed that this type of mushroom could improve recognition memory.[12] Very preliminary evidence suggests a possibility that Lion's Mane mushrooms may reduce cognitive decline too through promotion of nerve growth factor (NGF) production[13] which is essential for brain health and could support memory, focus and neuroprotection. Lion's Mane may also boost immune health and be useful for anxiety and depression.

Turkey Tail *(Trametes versicolor)*

Turkey tail mushrooms are being researched for immune boosting and prebiotic properties. They contain ingredients such as polysaccaropeptide (PSP) and polysaccharide-K (PSK) that boost various types of white cells that reduce inflammation, fight infection and boost immunity.[14] Turkey tail contains prebiotics which help nourish healthy gut bacteria.[15] Research has found that treatment with turkey tail may have a similarly positive effect on the gut microbiome as treatment with prebiotic supplements.16 A laboratory study found that turkey tail extract modified gut bacteria composition by increasing populations of beneficial bacteria like Bifidobacterium and Lactobacillus while reducing potentially harmful bacteria, such as Clostridium and Staphylococcus.[17]

Cordyceps *(Cordyceps sinensis)*

Cordyceps may help boost exercise performance and reduce fatigue by increasing the production of adenosine triphosphate (ATP), a molecule required for the production of energy.[18] A 6-week placebo-controlled study in healthy older adults using a stationary bike found that in participants taking 3 grams per day of a synthetic strain of Cordyceps VO_2 max (a measure of fitness) increased by 7% while participants given the placebo pill showed no change.[19] In a 12-week study also in healthy

older adults, Cordyceps given at a dose of 1g daily improved measures of exercise performance.[20] Emerging evidence suggests benefits of Cordyceps on heart health but this evidence needs to be confirmed in clinical studies in humans. Cordyceps may keep blood sugar levels within a healthy range by mimicking the action of insulin. In several laboratory studies Cordyceps has been shown to decrease blood sugar levels.[21,22]

Chaga *(Inonotus obliquus)*

Chaga is best known for its antioxidant content and its ability to fight inflammation which is important for overall internal health, helping in the maintenance of the health or body systems, cells and organs. It contains compounds such as polysaccharides, betulinic acid and melanin. Research has found that Chaga impacts immune response through the production of cytokines which are specific proteins that regulate the immune system in immune cells. Chaga also regulates antibody production.[23] Research also suggests that Chaga can prevent harmful cytokines being produced, these can otherwise trigger inflammation.[24] Chaga may also offer support for blood sugar. In a laboratory study,[25] treatment with Chaga showed a mild blood sugar-lowering effect. In another study Chaga supplements led to a 31% decrease in blood sugar levels over three weeks.[26]

Mushroom Supplement Formats

Mushroom supplements are available in a variety of formats: capsules, powders, tinctures, teas, coffees, sparkling drinks, protein bars and chocolate. Combination products containing mushrooms with vitamins, adaptogens and other botanicals for targeted benefits such as energy, immunity, relaxation are increasing in availability.

This wide variety caters to a varied demographic with differences in preferences and lifestyles, including:

- Young people attracted by social media and the desire for wellness
- Older adults looking for cognitive and immune support as part of healthy ageing
- Athletes, sports people and gym attenders interested in enhanced energy, endurance and recovery.

Many consumers of all demographics have preferences for healthy living through natural plant-based preparations.

Availability

Mushroom supplements are widely available across the UK in major pharmacy chains and independent pharmacies; high street health and supplement shops; supermarkets with supplement and wellness sections; on-line retailers (e.g. Amazon); and direct to consumer brand websites.

UK Regulatory Framework

Following Brexit, the UK has established its own regulatory pathway for supplements, distinct from the EU, though much of the framework remains harmonised.

Mushroom supplements are considered to be botanicals with preparations made from whole or parts of the mushroom plant and processed by for example pressing, squeezing, extraction, distillation, concentration, drying or fermentation.[27] As botanicals, mushrooms can fall into any of the regulatory categories depending on their composition, intended use and health claims. These are food supplements, novel foods and herbal medicinal products including those registered under the Traditional Herbal Registration (THR) scheme.

Food Supplements

The majority of mushroom supplements in the UK are classified as food supplements. Food supplements are defined as concentrated sources of nutrients (e.g. vitamins and minerals) or other, often botanical substances, with nutritional or physiological effects. Ingredients may be present alone or in combination, marketed in dose forms, namely forms such as capsules, tablets, pastilles, pills and other similar forms such as sachets of powders, ampoules of liquids, drop dispensing bottles and other forms of liquids and powders. They are designed to be taken in measured small unit quantities.[28] Only permitted vitamins and minerals can be added to food supplements as listed in the relevant annexes to the regulations.

Mushroom supplements marketed as food supplements are mainly regulated under:

- General Food Law Regulation (EC) No 178/2002 (as retained in UK law).[29] Supplements must not contain substances that are unsafe or not authorised for use in food. The Food Standards Agency (FSA) is responsible for food safety and novel foods regulation in England, Wales and Northern Ireland and Food Standards Scotland is the responsible body in Scotland. Manufacturers must notify the competent authority of any new product placed on the market.
- Food labelling law. Key labelling requirements include the name of the food supplement; name and quantity of mushroom species used; recommended daily dose; list of ingredients, allergens and additives; warnings not to exceed the stated daily dose; statements that supplements should not replace a varied diet and healthy lifestyle; name and address of the manufacturer, packer or seller; best before or use by date.[30]
- The Food Supplements (England) Regulations[31] and equivalent regulations in Wales, Scotland and Northern Ireland.
- Department of Health and Social Care (DHSC), which oversees food supplement legislation and policy
- Nutrition and Health Claims These must be registered in the UK under the Great Britain (GB) Nutrition and Health Claims (NHC) Register.[32] At the time of writing, there are no authorised claims for mushrooms themselves so only claims authorised in the NHC register in relation to the substances within the mushrooms themselves should be made. Some Article 13.1 health claims are on hold, including reishi mushrooms for immune support and blood cholesterol but these are not authorised.[33] Having evidence to support that the conditions of use for any claims are met, is essential.
- Trading Standards which enforce labelling and consumer protection regulations at the local authority level.

The Advertising Standards Authority (ASA)

The ASA is the self-regulatory organisation of the advertising industry in the UK. The ASA is a non-statutory organisation and so cannot interpret or enforce legislation. However, its code of advertising practice broadly reflects legislation in many instances. The ASA has made several rulings on different mushroom products, including products claiming they treat anxiety.[34]

Novel Foods

Some mushroom derived ingredients not traditionally consumed in the UK or the European Union (EU) before 15 May 1997 may be considered novel foods and require authorisation as novel foods. For example, Turkey Tail (Trametes versicolor) and certain species of Cordyceps such as Cordyceps militaris, are novel foods in the EU and not authorised for sale. Similarly, a UK Advertising Standards Authority (ASA) ruling said that the

FSA were likely to consider these mushroom species as unauthorised novel foods that do not have the relevant authorisation for marketing – meaning they and products containing them, should not be sold in the UK.[35] Manufacturers should check they have the necessary pre-market authorisation to market any mushroom which may be a novel food.

Novel foods are regulated in the UK under the Novel Foods (England) Regulations 2018.[36] Requirements for novel food authorisation include submission of a detailed safety dossier, including toxicological data; evidence of production methods and quality controls; details of the history of use and anticipated intake; approval and addition to the UK's list of authorised novel foods before marketing and sale.

Medicinal Products

If a mushroom supplement is presented for the treatment or prevention of disease, it may be classified as a medicine. Such medicinal claims can be made only by medicinal products which must be licensed by the Medicines and Healthcare products Regulatory Agency (MHRA).

Traditional Herbal Medicines

A Traditional Herbal Medicine is considered to be a medicinal herbal product consisting of active ingredients of herbal origin. An application for Traditional Herbal Registration (THR) may be made to the MHRA.[37] Such products are only authorised if there is evidence that the herbal medicinal product has been traditionally used to treat the stated condition for a minimum of 30 years. A THR means the medicine complies with quality standards relating to safety and manufacturing, and it provides information about how and when to use it. The product carries a THR marking on its packaging. THR is not considered a useful route for mushroom regulation.

Safety and Quality Assurance

Food (supplement) business operators are responsible for ensuring that mushroom supplements are safe for consumption. This involves:

- Following good manufacturing practices (GMP)
- Conducting hazard analysis and critical control point (HACCP) assessments
- Performing microbiological testing for contaminants (e.g., heavy metals, pesticides, mycotoxins, pathogenic bacteria)
- Ensuring traceability and accurate documentation at every stage of production.

Importation and Online Sales

Mushroom supplements imported into the UK must comply with all relevant UK legislation, regardless of their country of origin Imported supplements must be notified to the FSA if they constitute a new product. Products bought online from overseas vendors may bypass UK regulations, but importers and distributors are still liable for non-compliance. Online marketplaces are increasingly scrutinised by authorities to protect consumers from unsafe or mislabelled products. Consumers should be wary of unverified health claims or supplements not labelled in accordance with UK law.

Enforcement and Penalties

Enforcement action may be taken by Trading Standards, the FSA, or the MHRA, depending on the nature of the issue:

- Product recalls and market withdrawals for unsafe or non-compliant products.
- Fines or prosecution for serious breaches, such as misrepresentation or sale of unauthorised novel foods or medicines.
- Closure of non-compliant businesses or online listings.

Consumer complaints can trigger investigations, and there are established channels for whistleblowing or reporting unsafe products.

Challenges for Industry

- **Education and misinformation:** With the proliferation of unsubstantiated claims, consumer education is vital for sales of mushroom supplements if they are to maintain credibility. The UK's digitally knowledgeable population often seeks online resources before making supplement choices making science-backed marketing essential.
- **Product quality:** Variability in potency, purity and sourcing can affect efficacy and consumer trust. Content analysis with appropriate third-party testing and clear, transparent labelling is essential to ensure efficacy and quality.
- **Adulteration:** Mushroom supplement adulteration is a significant issue where products are mislabelled or contain

undisclosed ingredients, potentially compromising quality and efficacy. Common forms of adulteration include using mycelium grown on grain instead of the desired fruiting body, incorrect species identification, and the addition of cheaper fillers.[38] This can lead to consumers not receiving the intended health benefits and can damage the reputation of the mushroom supplement industry.

- **Lack of standardisation:** Dosage can vary widely between brands, and the concentration is not aways indicated. Whole mushroom powder supplements may offer wide benefits while extracts often concentrate specific bioactives with specific health benefits.

- **Sustainability and supply chains:** Consumers are increasingly concerned about how and where their supplements are produced and sourced. Transparent supply chains, organic ingredients, regenerative agriculture to improve soil health through mushroom production and ethical labour force are important to many consumers.

- **Changes in compliance:** Brands must remain vigilant to changes in compliance and labelling requirements.

Mushrooms in Medical Treatment Development

Mushrooms are increasingly being explored for their potential in medicinal development, particularly due to the bioactive compounds they contain, such as psilocybin and other alkaloids. Psilocybin, found in certain mushrooms, is already approved in Australia for treatment-resistant depression and is under investigation for other mental health conditions in various countries.[39]

Over 130 medicinal effects of mushrooms have been reported, including anti-diabetic, antioxidant, antimicrobial, anticancer, prebiotic, immunomodulating, anti-inflammatory and cardiovascular benefits. Several mushrooms have been tested in phase I, II, or III clinical trials for various diseases, including cancers and neurodegenerative disorders, as well as to affect immunity.[40,41] Overall, few phase III trials have been performed, and in many cases, these trials included a relatively small number of patients. Therefore, despite the promising published clinical data, especially on immune modulation, more work is required to clarify the therapeutic value of mushrooms.

Conclusion

The mushroom supplement market in the UK is growing rapidly with growth expected to continue. Medicinal mushrooms have a long history of use in Eastern Medicine and modern scientific enquiry is revealing several health benefits, although more robust clinical trials are needed to verify emerging findings. The regulatory landscape is challenging. Most mushroom supplements are classified as food supplements and subject to food law, which means they must be labelled according to UK food labelling law, contain no unsafe ingredients, with no adulteration and assured purity with no contaminants. As food supplements mushrooms can only make health claims and these must be registered with the Great Britian NHC register. Brands must remain vigilant to changes in compliance and labelling requirements. Mushrooms are increasingly being explored for their potential in drug development in various conditions, particularly due to the bioactive compounds they contain, such as psilocybin and other alkaloids.

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