FUNGI Foods

Where do they fit in a plant-based diet?

An Expert Roundtable Discussion

NRAUS

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Background

The value of plant-based diets has become increasingly recognised over the past decade. They are now recommended in dietary guidelines internationally, including in Canada, Brazil, and the landmark EAT-Lancet report.[1-3] With the increasing focus on dietary patterns according to whether they are derived from 'plants' or 'animals', fungi foods – a separate kingdom to both plants and animals – appear to have been relatively ignored.

As dietary guidance shifts away from nutrients to dietary patterns, particularly those that are plant-based, where does that leave fungi foods, and mushrooms specifically?

This white paper, developed by Nutrition Research Australia (NRAUS) and funded by Hort Innovation, summarises an expert roundtable discussion, held virtually in November 2020. The NRAUS hosted roundtable brought together experts in different fields to present on various aspects of the role of fungi foods in a healthy diet.

Findings

The group heard that fungi foods are unique and biologically distinct from both plant-and animal-derived foods.[4] Classified as either lower order fungi (moulds and yeasts) or higher order fungi (mushrooms), they have been consumed and valued for thousands of years, including within Australian Indigenous culture, for their medicinal actions and culinary properties, with research supporting a unique nutritional and bioactive composition.[5, 6] The most commonly consumed edible mushroom worldwide is the *Agaricus bisporus* (*A. bisporus*) species[6]. Over the past 10-15 years, there has been a growing scientific evidence base of the health benefits of consuming *A. bisporus*, with a very recent systematic literature review[7] of mostly randomised controlled trials showing seven different potential benefits to human health.

A significant discussion point of the roundtable was how mushrooms, *A. bisporus* specifically, could have a greater focus in dietary guidance given their unique nutritional and bioactive composition, the growing substantiation of potential health effects, and valuable culinary properties, particularly in supporting plant based dietary patterns.

Recommendations

Three key areas were discussed as important in achieving this endeavour including further high-quality long term prospective observational and intervention studies, establishing clear serving size recommendations within a heathy dietary pattern, and more specific communication and recognition given to these unique and valuable foods in food group categories within dietary guidelines.

Background

The value of 'plant-based' diets has become increasingly recognised over the past decade. They are now recommended by guidelines internationally, including the National Dietary Guidelines in Canada and Brazil, and the landmark EAT-Lancet report,[1-3] for health and environmental reasons. With increasing recommendations on foods and dietary patterns based on whether they are derived from 'animals' or 'plants', the third food kingdom – 'fungi' – appear to have been relatively ignored.

Fungi are neither an animal nor a plant, and belong to their own biologically separate kingdom.[5] The most commonly eaten edible fungi, mushrooms, contain a unique package of micronutrients, as well as other bioactive and flavour compounds. There is a growing evidence base supporting positive human health effects from their consumption.[7] They offer unique nutritional, health, and culinary properties, yet this may fail to be exposed with their classification as a vegetable.

With the shift away from nutrients to dietary patterns, particularly those that are 'plant-based', where does that leave fungi foods, and mushrooms specifically? How can the unique properties of mushrooms be better captured in this context?

An expert roundtable was held virtually on the 25th of November 2020. The event, hosted by Nutrition Research Australia (NRAUS), brought together five experts across different fields, including nutrition research, food science, indigenous culture, and culinary nutrition, to explore these questions and to discuss the specific role of fungi foods in a healthy diet. The expert roundtable included five presentations and was followed by a panel discussion.

This white paper summarises the main themes and key messages from the roundtable presentations and discussion, offering evidenced-based insights for the consideration of health professionals and policy makers.

About the experts

Dr Emma Beckett

(PhD, MScMgt, GDipClinEpi, GCertHumNutr, BBiomedSci)

Emma moderated the event and panel discussion. Emma is a food and nutrition scientist and lecturer at the University of Newcastle, specialising in gene nutrient-environment interactions.

Glenn Cardwell

(BSc, GradDipDiet, GradDipAppSc)

Presentation: The Facts on Fungi: What are they and what makes them unique?

Glenn is an Advanced Accredited Practising Dietitian with nearly 40-years' experience in clinical and public health nutrition. At the time of the roundtable, he was a director at Dietitians Australia and his research was focused on mushrooms and vitamin D.

Dr Flavia Fayet-Moore

(PhD, MNutrDiet, APD, RNutr, FASLM)

Presentation: How healthy are fungi? Examining their bioactive & health benefits

Founder and CEO of NRAUS, Flavia is a registered nutritionist, Accredited Practicing Dietitian, sports nutritionist, and Honorary Associate of the University of Sydney.

Jim Fuller

(AssocDegChem, BAgrSci)

Presentation: Beyond nutrients: The role of fungi foods in culinary nutrition

Currently Chief Science officer at Fable Food Co, Jim is a fine dining chef, and globally renowned mycologist educator and consultant.

Arpad Kalotas

(BScHons)

Presentation: Native mushrooms: The consumption of fungi in Indigenous culture

An environmental consultant, Arpad has expertise in botany, ethnobotany and Indigenous heritage research, predominantly throughout central Australia.

Professor Linda Tapsell

(PhD FDAA FNSA AM)

Presentation: Translating science into dietary advice: Where & how would fungi foods fit?

Professor Linda Tapsell AM is currently an Honorary Professorial Fellow at the Universty of Wollongong where she directed major food research centres and conducted dietary trials on the effects of food consumption on health. She is a Fellow of the Dietitans Australia and the Nutriton Society of Australia.

Fungi foods: What are they?

Classification

Fungi were biologically considered as plants until research in the 1960s recognised that they are a separate life form, with a closer relationship to animals than to plants[8]. They are now recognised as unique and distinct from both plants and animals, belonging to a separate 'third' food kingdom.[4, 5]

Fungi foods have a unique structural, chemical, and nutrition composition that sets them apart from plant and animal foods. They obtain nutrients from their environment either as parasites (from a plant, fungal, or animal host), saprophytes (from dead or decaying organic matter), or symbiotes (forming beneficial relationships with hosts).

"Fungi food are neither a plant nor an animal but belong to an entire kingdom of their own."

Glenn Cardwell

Figure 1

The Lower Fungi	The Higher Fungi
Yeast • Unicellular • Spores created internally **Moulds** • Multicellular • Filamentous • spores are produced on microscopic structures	**Commonly called Mushrooms** • Multicellular • Filamentous • Large woody or fleshy spore bearing structures - mushrooms
Usually found in soils, cereals or on the surfaces of everything.	Usually found everywhere there is sufficient moisture, often associated with plants. Grassy fields, forest soils, fallen trees.

Fungi are classified as either lower or higher order fungi.[9] The lower classes of fungi, like yeasts and moulds, produce spores in simple ways or on primitive microscopic structures, while the higher classes of fungi produce spores on larger, often woody or fleshy structures **(Figure 1)**.

If anything, the mushroom is more like an animal than a plant. Plants make their own food by generating glucose from photosynthesis, whereas animals have to source their food."

Jim Fuller

Historic and Contemporary Use

Fungi have been consumed and valued in traditional medicines by diverse human populations for thousands of years.[5, 6] The discovery of the first antibiotic of the modern health era, penicillin, came from the fungus *Penicillium notatum*.[10] There is evidence that the First Nation People of Australia valued and consumed a number of higher order fungi. Unfortunately, little is known of their nutritional value, and traditional and contemporary usage, but a wide variety of Australian native fungi have been identified and documented **(Figure 2)**.

Mushrooms are a significant part of the dietary pattern of China, Korea and Japan[11]. Today, the Asian Pacific region is a leader in the global mushroom market, with China representing over 80% of the global mushroom market.[11] In Australia, four out of five people report that they eat mushrooms, with around one third claiming to be regular consumers.[12]

As mushrooms are the most common source of fungi in the diet, they were the focus for the roundtable discussion.

White Button Mushroom: The most commonly eaten mushroom

The common white button mushroom, belonging to *A. bisporus* species, is a recent (1926) mutant form from an original wild ancestor. It is the most commonly consumed edible mushroom species worldwide.[6]

Agaricus bisporus (A. bisporus)

There are more than 2000 varieties of edible mushrooms worldwide, with the white button mushroom from the *A. bisporus* species the most commonly consumed.[6] In Australia, *A. bisporus* represents around 95% of fresh edible mushroom consumption. *A. bisporus* includes button mushrooms, cup and portobello mushrooms, with all being the same mushroom at different stages of maturity.

> There is very little known of the nutritional values of wild edible fungi utilised by Indigenous peoples, and opportunities exist for Indigenous communities and other researchers to undertake more detailed studies, including Indigenous biocultural knowledge of fungi in general.'
>
> **Arpad Kalotas**

Figure 2: Native Australian Fungi

Australia is known to have a number of native wild fungi which were valued and consumed by Indigenous Australians. These include:

- **True truffles** *Elderia arenivaga, Mattirolomces mulpu, Mycoclelandia arenacea and M. bulundari* predominantly found in arid Australia,
- **Myrtle Beech Orange** *(Cyttaria gunnii)*, a host-specific fungus on Myrtle beech *(Nothofagus cunninghamii)* in Tasmania and southern Victoria,
- **Native Bread** *(Laccocephalum mylittae)*, that grows in southwest Western Australia and the Eastern states in rainforests and Eucalypt forests,
- **White Punk** *(Laetiporus portentosus)*, a parasitic 'shelf' or 'bracket' fungus on eucalypts found throughout Southern Australia,
- **Horse Dung Puffballs** *(Pisolithus spp.)*, found throughout Australia,
- **Beefsteak Fungus** *(Fistulina hepatica)*, a 'shelf fungus' on living and dead eucalypt wood, found predominantly across southern Australia, and
- **Mulga Bolete** *(unidentified species)* of arid regions.

Native bread (pictured) was a much sought-after fungus of the First Nation Peoples throughout its range. It was regarded for it's good taste and may have played a significant role in traditional subsistence activities at certain times of the year.

Photo courtesy of Eileen Laidlaw (CC BY-SA)

What makes mushrooms unique?

Nutritional and bioactive composition

Mushrooms provide micronutrients and bioactive compounds found across different food groups, including vegetables, grains, nuts, and meats, as well as three unique bioactive compounds not commonly found in animals or plants **(Figure 3)**.

Mushrooms (*A. bisporus*) contain:[13]

- Flavonoids, common to vegetables.
- Beta-glucan and B vitamins, common to some grains.[14]
- Vitamin D, selenium and biotin common to animal foods.
- Copper common to some nuts.
- Chitin, a unique prebiotic fibre that is only found in mushrooms, crustaceans and insects.[15]
- Ergothioneine,[16] the sulphur containing amino acid antioxidant, which is otherwise only produced by bacteria.[17]
- Ergosterol, a sterol compound found in high concentrations in the fungi cell wall and converts to vitamin D when exposed to ultraviolet (UV) light.[18]

When mushrooms are exposed to ultraviolet (UV) light (either during the drying process or after purchase), ergosterol is converted to highly bioavailable ergocalciferol (vitamin D2). A serve (3 'Cup mushrooms') of UV exposed mushrooms provides 24ug (nearly 1000IU) vitamin D, which is over 100% of the daily adequate intake across all age groups and the equivalent found in most vitamin D supplements.[21]

The vitamin D in mushrooms has been shown to be largely stable during cooking, particularly at low temperatures, and for up to 8 days refrigeration.[18, 21] A meta-analysis of randomised controlled trials showed that UV exposed mushrooms were effective in increasing active vitamin D levels in adults with low levels of vitamin D,[22] and randomised controlled trials have shown that it can be just as effective as supplements at increasing vitamin D levels in the blood.[23, 24]

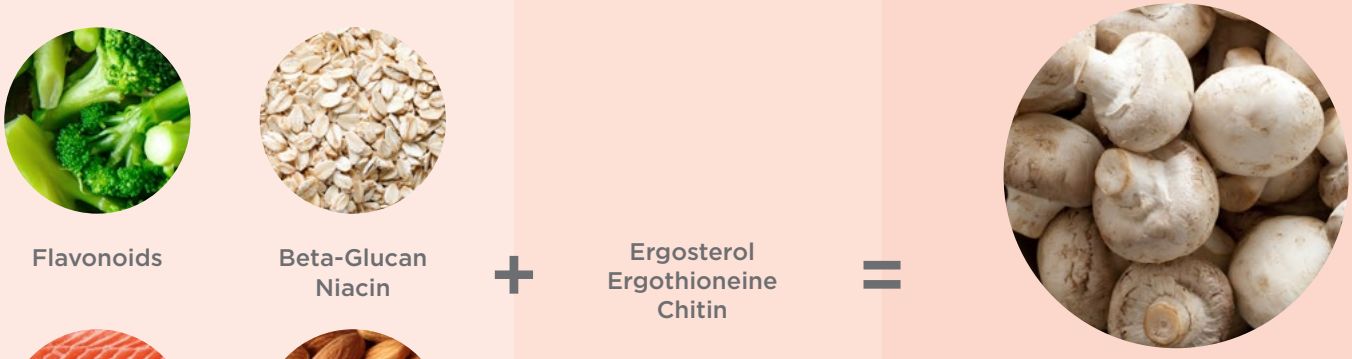
Mushrooms (*A. bisporus*) contain three unique bioactive compounds not commonly found in animals or plants.

Chitin – Prebiotic fibre properties found only in crustaceans, insects and fungi.[15]

Ergosterol – a steroid found in high concentrations in fungi cell walls.[17] On exposure to UV light ergosterol is converted to vitamin D2 (ergocalciferol).

Ergothioneine – made only by bacteria and fungi, experimental studies show it to be an immune modifier with antioxidant and cytoprotective actions.[19, 20]

Figure 3 **Mushrooms: A unique nutritional profile**



Mushrooms (*A. bisporus*) share key nutritional components with vegetables, grains, nuts and animal foods. Additionally, they contain 3 bioactives, ergosterol, ergothioneine and chitin, that are not commonly found in plants or animals.

28%
more antioxidants in the cap (vs the stem)[25]

40%
more beta-glucans in the stem (vs the cap)[26]

Which part is best?

Research shows that the concentration of bioactives in mushrooms depends on:[7]

- the type of mushroom,
- the cooking method used,
- the mushroom's structural component (stem, gills versus cap), and
- the duration of UV exposure.

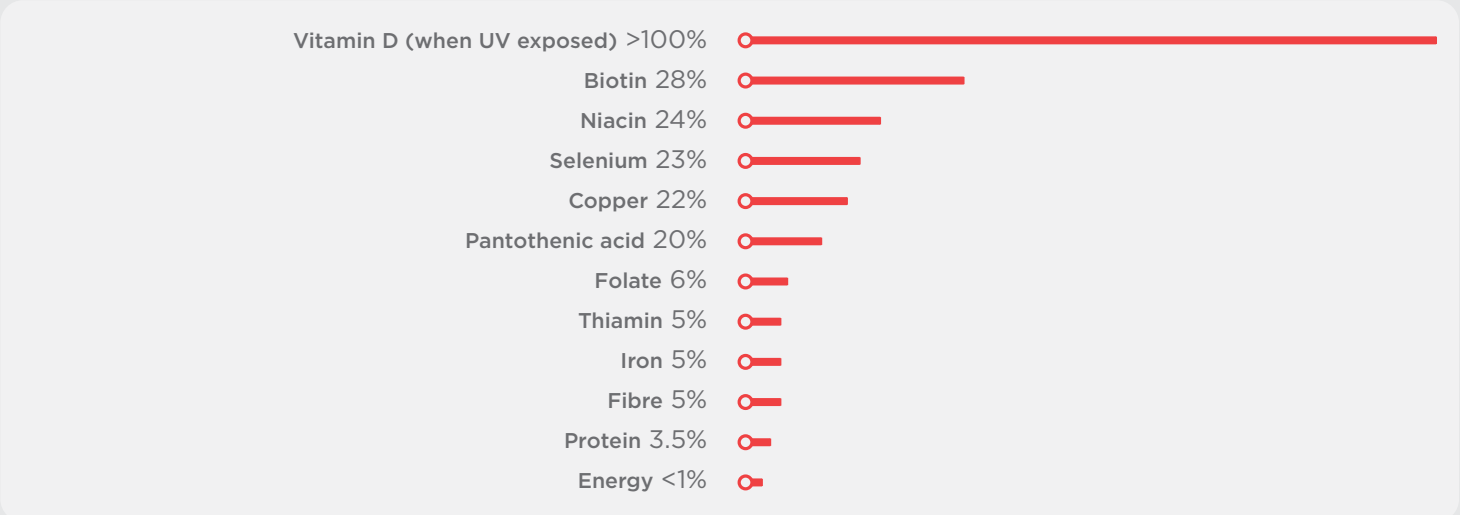
Cooking appears to increase the level of some bioactive compounds such as beta-glucans, whilst decreasing others such as flavonoids and vitamin D.[27-29]

"Tan your mushrooms and save your skin. Exposing 1 portobello mushroom to 15 minutes of sunlight can provide the same amount of vitamin D as a low dose vitamin D supplement (1000IU)."

Dr Flavia Fayet-Moore

Mushroom's (*A. bisporus*) Nutritional Profile[13, 30]

% recommended daily or adequate intake^ per 100g



**based on nutritional composition common, fresh, raw* A. bisporus *and estimated intake of average adult 8700kJ/day and Nutrient Reference Values for male 31-50 years[13, 30]*

The culinary X-factor

Beyond their nutritional and bioactive profile, mushrooms contain unique flavour compounds including glutamates, ribonucleotides, and a number of synergistic volatiles, which are often referred to as odour active compounds. Together, these compounds are responsible for the characteristic 'umami' savoury taste and the pleasant odours associated with cooked mushrooms,[31] that can help to enhance the flavour of meals and with less salt.

As the flavour compounds occur intracellularly, in order for the flavour to be fully appreciated, they need the cell wall to be degraded.[32] Drying, freezing, and boiling are the best methods to degrade the cell wall and strengthen the mushroom's umami taste, enhancing its flavour.

'Mushrooms and associated fungi (yeast) extracts offer a nutritious, lower salt but still flavoursome way to provide the savoury 'umami' taste that can help drive palatability of other foods.'

Jim Fuller

Jim Fuller, Chef turned mycologist, recommends breaking down the resistant cell walls of mushrooms during cooking to allow the flavour compounds to be released. Whilst these compounds are present externally with lower fungi, mushrooms flavour compounds are located intracellularly. Access to these compounds is often key to the flavour.

In order to release the flavour notes, the cell wall must first be broken, and this does not necessarily happen with simple cooking methods such as frying, but drying, freezing or boiling will all help to break down the cell wall more easily.

Jim's top tip is to simply boil your mushrooms by:

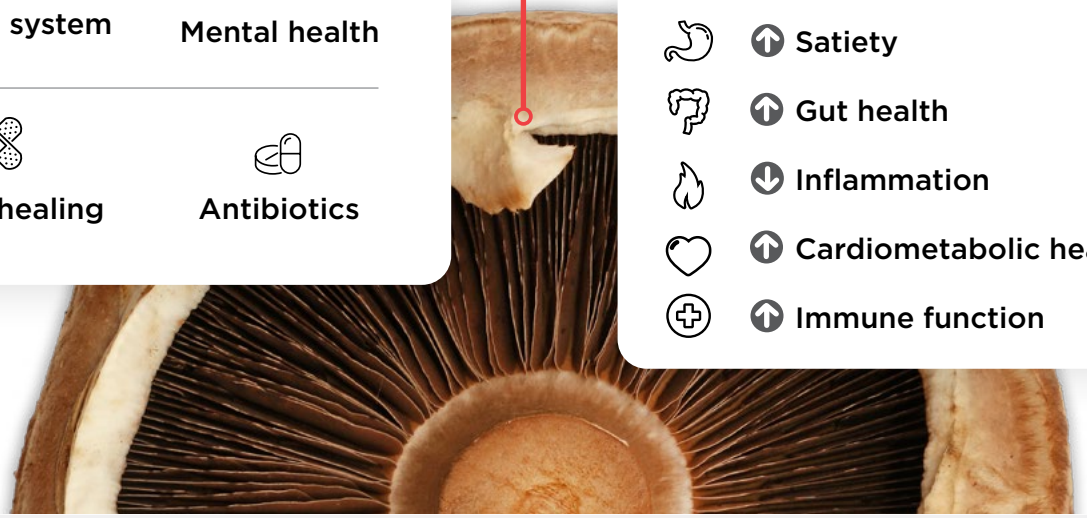
1. Pouring a little water in a hot pan and bring to the boil,
2. Throwing in your mushrooms, and then
3. Reducing the water before you then sauté.

Older aged mushrooms are often considered the tastiest because they undergo autodigestion as the cell wall is naturally breaking apart. This makes the internal contents more easily accessed.

Mushrooms and health:
A traditional food for the modern health era

Long traditional use with growing evidence base of human health effects[7]

- Immune system
- Mental health
- Wound healing
- Antibiotics



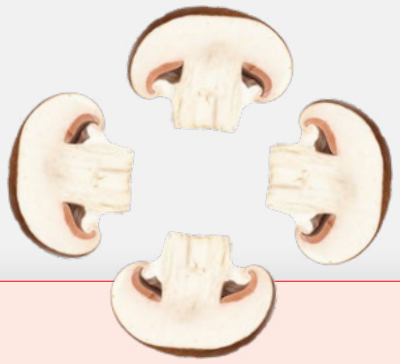
Recent scientific health effects of *A. Bisporus* mushrooms[7]

- Cancer risk & its metabolites
- Vitamin D status
- Satiety
- Gut health
- Inflammation
- Cardiometabolic health
- Immune function

Mushrooms have a long traditional medicinal usage, and are highly valued for their immunomodulatory actions.[6] A number of experimental and *in vivo* animal model studies have shown that mushrooms, of different species, can have a favourable influence on immune function, glycaemic control, lipid profile, blood pressure, bone density, gut health, cancer and cognitive function.[30, 33-42]

Over the past decade, the scientific evidence base, including human studies supporting potential health benefits from consuming the most common edible mushroom, *A. bisporus*, has grown substantially. A recent scoping review showed seven different health benefits from 15 different human studies, of which eleven were randomised controlled trials (RCTs).[7]

The actions of unique bioactive compounds in mushrooms may explain these health effects. Beta-glucans, ergothioneine, and ergosterol have been shown in experimental studies to have immunomodulating and anti-tumour effects.[43-45] Ergothioneine has demonstrated antioxidant and cytoprotective actions,[19, 20] whilst beta-glucans, particularly those from mushrooms, have immune stimulating properties.[46, 47]



Mushrooms and immunity support

Mushrooms are rich in bioactive compounds, including vitamin D, ergosterol, ergothioneine, beta-glucan and selenium, all favourably linked to immune function in experimental studies.[41, 42] The few human studies to date suggest that consumption of the common edible mushroom species (*A. bisporus*) is linked with an increase in immune markers and associated with a decreased risk and progression of cancer.[48-50] Further high-quality human studies are needed to fully elucidate mushrooms role in immunity and corresponding health benefits.

A recent systematic review of evidence suggests that consuming common edible mushrooms (*A. bisporus*) may improve vitamin D status (strongest evidence), have a positive impact on immune function and inflammatory markers, and a beneficial effect on metabolic syndrome and markers of gastrointestinal health, as well as cancer risk reduction (ovarian) and management (prostate).[7] Further research would consolidate these initial observations.

Emerging Health Benefits of common edible Mushrooms (*A. bisporus*)

Vitamin D Status

The strongest evidence of mushrooms on health appears to be on vitamin D status.[51] This is highly relevant to populations like Australia, with almost 1 in 4 deficient (serum 25(OH)D <50 nmol/L) and a further 2 in 5 insufficient (serum 25(OH)D 50 to <75 nmol/L).[52, 53]

Research supports that consumption of UVB exposed mushrooms was as effective at increasing and maintaining serum vitamin D levels as vitamin D supplementation in individuals with and without vitamin D deficiency at baseline.[51] The retention of vitamin D in mushrooms is reported up to 8 days in fridge.[18]

Gut Health

Interest in gut health has increased exponentially over recent years. Understanding what drives a healthy gut is still in its infancy, and current knowledge suggests that a healthy gut is dependent on an abundant and diverse gut microbiota.[54] Lower gut microbiota diversity is associated with a range of disorders and disease states, including cardiovascular disease, type 2 diabetes and inflammatory bowel disease.[54]

A randomised controlled trial showed that the replacement of meat meals for mushroom meals led to greater stool weight, less strain, decreased odour and changes in specific microbiota in the gut with greater abundance of Bacteroidetes and lower abundance of Firmicutes.[55]

Immunity & Cancer

With the re-emergence of infectious disease, the nutritional modulation of the immune system has become an important focus for clinicians and consumers,[56] and research with mushrooms is emerging. In one study, compared to usual diet, eating 100g of cooked white button mushrooms for 7 days was associated with increased serum IgA osmolarity, secretion rate, and concentration, all markers of immune function.[48]

A Chinese case control study showed consumption of >2g white button mushrooms per day reduced the odds of ovarian cancer by 32%.[49]
A phase 1 clinical trial showed that a mushroom extract at increased doses (4-14g extract/day), equivalent to 40-140g fresh white button mushroom was associated with decreased total prostate specific antigen (PSA) levels in 36% of patients.[50]

How can mushrooms fit into dietary guidance targeting healthy dietary patterns?

With increasing scientific evidence, the focus of dietary guidelines has shifted to start with dietary patterns, identifying foods that contribute to these patterns and then ensuring the food combinations meet nutrient requirements and avoid the risk of chronic disease. This trend is evidenced in the recently released Dietary Guidelines for Americans.[57] With the COVID-19 pandemic, there is further recognition of the need to consider the concurrent susceptibility to infection alongside that of chronic disease.

> 'In view of our understanding of poorer outcomes from COVID 19 in those with diet related chronic disease, future dietary guidelines will need to consider not only chronic disease prevention, but also how the associated inflammation may play out in our immune response.'
>
> **Dr Linda Tapsell**

Dietary patterns vary depending on life stage, accessible and preferred foods and cuisines, and considerations for the environment, particularly toward plant based foods. The unique characteristics of mushrooms, including their nutritional and bioactive components, warrants considered attention in the modern Australian context.

Given that cuisine has a significant influence on dietary patterns, mushrooms may help drive plant based dietary patterns while contributing to their nutritional value. As for the food supply generally, the environmental impact of modern mushroom production would still benefit from further research.

How can we achieve greater focus on mushrooms?

Considering the scope of information discussed thus far, directions for the future can be seen as the need for further research exposing the health benefits of mushroom consumption, establishing evidence-based serving guidance for intakes in a healthy dietary pattern, and communications that acknowledge the uniqueness and value of mushrooms, particularly in plant based cuisines.

Further research

Most research to date on the health effects of *A. bisporus* in humans has been observational and short term. Little is known about the health effects of the lower fungi foods (e.g., moulds, yeast). A greater body of research overall will strengthen the evidence base supporting mushrooms as a significantly healthy food.

In food research studies it would help if mushrooms were classified as separate food items, independent of vegetables for example in food frequency questionnaires. This would enable better identification of associations between intakes and health outcomes through analyses of nationally representative cohort studies from across the globe.

Additional nutritional and bioactive compositional research is a second research priority, with a focus on diverse lower and higher fungi foods, including those of cultural importance to our First Nation people and those produced sustainably.

Establish clear serve sizes

Establishing and communicating clear and practical serve sizes specific to fungi foods, with mushrooms as a focus, is also considered important in providing more concrete dietary guidance. Currently mushrooms are classified as a vegetable, with a serve defined by the Australian Guide to Healthy Eating as 75g *(1 cup uncooked)*, or about three '*Cup mushrooms'*, based on their culinary usage.[46]

For *A. bisporus* mushrooms, the strongest evidence for health benefits is in improving vitamin D status. Research shows that 100g of mushrooms exposed to UV light for 10-15 minutes is enough to meet >100% of daily requirements across all age groups, and as effective as a vitamin D supplement in treating vitamin D deficiency.[51]

Larger quantities may bring additional health benefits. For example, one study found around 226g mushrooms (equivalent to around nine '*Cup mushrooms*') produced a positive effect on the gut microbiota.[55]

'Based on current limited evidence we should be aiming to consume at least 3 *Cup Mushrooms* (1 cup uncooked) regularly'

Dr Flavia Fayet-Moore

Dietary guidelines recognition

As single foods, there is no mention of the unique nutritional value of fungi foods, nor their bioactive composition or health benefits in the current Australian Dietary Guidelines. The guides do however refer to food groups and mushrooms are included in the vegetable group.

This classification may mask the unique characteristics of mushrooms as fungi foods, and miss opportunities for cultural and cuisine use. However, as consumers seem to perceive and use them as a vegetable, it is debatable whether arguing for a separation of mushrooms or fungi foods into their own food group has a place here.

On the other hand, there is a case for seeing mushrooms as unique, distinguishable from plant- and animal-derived foods in both the nutritional and culinary context. In this sense, naming them within a food group, similar to foods like legumes and nuts, may be appropriate.

How can we achieve greater focus for mushrooms?

Three key recommendations were provided by the expert panel for attaining more focus on mushrooms in dietary guidance to the public.

1. Conduct further research:
The effects of fungi foods on human health to be a research priority, with mushrooms categorised independently of vegetables.

2. Establish clear serve sizes:
Aim for at least 1 cup uncooked mushrooms regularly. Dietary modelling research is recommended to position this serve recommendations in the context of overall healthy dietary pattern.

3. Dietary Guidelines recognition:
Based on their uniqueness from plant-and animal-derived food, there is opportunity for greater recognition in nutrition guidelines, similar to legumes and nuts.

Key takeway messages

- Fungi foods comprise their own food kingdom, distinct from both animals and plants.
- Traditionally valued for thousands of years, including with our First Nation People, and with a strong medicinal reputation in Asian cultures.
- Mushrooms contain unique flavour compounds that contribute to their well-regarded savoury ‘umami’ taste profile, a known desirable culinary driver of taste.
- Mushrooms have a unique nutritional composition, comprising micronutrients and bioactive compounds found in both plants and animals, along with three bioactive compounds (Ergosterol, Ergothioneine and Chitin) not commonly found in both.
- Emerging research has shown mushrooms to have favourable effects on gut health, inflammation, immune function, cancer risk and satiety. It has been established that consuming UV enriched types improve vitamin D status.

Consensus of the expert roundtable

The roundtable concluded that fungi foods are unique, distinct from both plant and animal foods. The unique nutritional, bioactive, health and culinary properties of *A. bisporus* mushrooms, make them worthy of a greater focus, especially in the modern Australian health context. As we move increasingly towards plant-based diets, this distinct food deserves the consideration of a more prominent place in research and subsequent dietary guidance.

Three key areas were discussed as important in achieving greater focus in research and dietary guidance, including:

- further high-quality long term prospective epidemiological and intervention studies,
- establishing clear serving recommendations for dietary intake, and
- specific communications given to these unique and valuable foods in dietary guidelines.

‘As dietary guidance aims to combat chronic disease and the re-emergence of infectious disease, while moving towards plant-based diets for environmental sustainability, mushrooms offer a unique combination of nutrients and bioactives shown to improve health, as well as valuable culinary properties. This makes them a valuable food for the modern health era.’

Making the most of mushrooms: 5 practical tips

Tan them:

Placing 1 cup of mushrooms in the sun for 15 minutes can provide greater than 100% of the daily adequate intake of vitamin D (15µg/day).[18] Increasing the surface area exposed to UVB light helps to increase the rate that ergosterol is converted to Vitamin D, so face the 'gills' (the underside of the mushroom) to the sun, or slice mushrooms, for maximum Vitamin D.

Choose 'one serve' regularly:

The common edible mushroom species *A. bisporus* includes white button mushrooms, cup mushrooms and portobello. 1 serve = 1 cup (uncooked mushrooms) = 1 Portobello, 3 Cup or 5 Button mushrooms.

Eat them whole:

While the 'cap' of mushrooms is a richer source of antioxidants, its stem contains 40% more of the soluble fibre beta-glucan.[26]

Cook on low:

A versatile food, mushrooms can be enjoyed raw or cooked. To maintain antioxidant and nutrients, cook on a lower heat.[28]

Add lemon juice:

Adding lemon juice to mushrooms when cooking can help to retain their vitamin D content.[27]

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