

Nutraceutical Benefits of Cookies Produced from Wheat and Mushroom Flour: A Review

¹*Adetola, Rachel O., ¹Akinwande, Bolanle A., ¹Babarinde, Grace O. & ²Oboh, Ganiyu

¹Department of Food Science, Faculty of Food and Consumer Sciences, Ladoké Akintola University of Technology, Ogbomoso, Nigeria.

²Functional Foods and Nutraceuticals Unit, Department of Biochemistry
Federal University of Technology, Akure, Nigeria.

*Corresponding Author Email: pectoyin@gmail.com

Phone number: +2348034013334

ABSTRACT

Nutraceuticals play a special role in metabolic improvement and other physiological function of the body which indeed is beneficial in overcoming and preventing diseases. The combination of wheat and mushroom flour in cookie production presents an innovative approach to enhancing the nutritional value of this popular snack. Both wheat and mushrooms are rich sources of essential nutrients and bioactive compounds, making them promising ingredients for the development of functional foods. This qualitative summary aims to explore the nutraceutical potentials of cookies produced from wheat and mushroom flour. Combining wheat and mushroom flour while making cookies offers a novel way to raise the nutritious content of this well-liked snack. Due to their abundance in vital nutrients and bioactive substances, wheat and mushrooms are both excellent choices as components for functional food creation. In order to investigate the possible nutraceutical benefits of cookies made with wheat and mushroom flour, this qualitative summary was created. In conclusion, cookies made with a blend of wheat and mushroom flour have exciting potential as nutraceuticals. They provide a tasty and easy approach to add important nutrients and bioactive ingredients to your diet. To fully understand the best recipes, sensory qualities, and health benefits of these novel functional foods, more investigation is necessary. Nonetheless, the integration of wheat and mushroom flour represents a noteworthy advancement in the development of nutritious and health-promoting snacks.

Keywords: Nutraceutical, Benefits, Cookies, Wheat, Mushroom, Flour

Aims Research Journal Reference Format:

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1. INTRODUCTION

Nutraceuticals have received a considerable attention due to their safety, nutritional value and therapeutic effects (Puri *et al.*, 2022). It has been used as an alternative to modern medicines with prompt and quality health, increase the nutritional value of the diet, and prolong life (Dutta *et al.*, 2018). It is an intriguing topic that has emerged from the convergence of food science, nutrition, and health (Sikalidis, 2019). Its concentration is on creating food items that have potential health or

medical benefits beyond those of simple nutrition (Benvenga, 2019). Cookies made with a flour blend of wheat and mushrooms have become a particularly interesting choice among the wide variety of meals high in nutraceuticals (Rathore *et al.*, 2019). The issue is thoroughly explored in this introduction, which starts with a look at the growing interest in nutraceuticals and their possible health advantages (Daliu *et al.*, 2019). Also, the importance of using wheat and mushrooms in cookie dough has been examined (Chen *et al.*, 2021 and Biao *et al.*, 2020).

Interest in nutraceuticals has increased dramatically as a result of the rising incidence of chronic illnesses and rising consumer knowledge of the connection between diet and health (Vishvakarma *et al.*, 2023; Chopra *et al.*, 2022).

Nutraceuticals are foods that include bioactive substances that provide specific health benefits, as opposed to ordinary foods, which mainly provide needed nutrients for basic subsistence. It performs a special role in various diseases (Lokhande, 2018 and Vlaicu *et al.*, 2023). Numerous medicinal qualities, including anti-inflammatory, antioxidant, immune-boosting, and cardiovascular-protective benefits, have been demonstrated for these substances, which comprise vitamins, minerals, antioxidants, polyphenols, and phytochemicals (Shi *et al.*, 2022 and Elegbeleye *et al.*, 2022). The market for goods high in nutraceuticals, like cookies, is growing as customers become more health-conscious and look for functional meals to address particular health issues (Jayaweera, 2023 and Baker *et al.*, 2022).

Considering the distinct nutritional and functional qualities of both wheat and mushrooms, their use in cookie dough offers great potential (Das *et al.*, 2021; Koreti *et al.*, 2022 and Chen *et al.*, 2021). There are several bioactive substances in mushrooms, which add to their potential health advantages (Yadav and Negi, 2021). Mushrooms are typically seen as nutritional powerhouses (El Sebaaly *et al.*, 2021; Kapahi, 2018 and Kour *et al.*, 2021). Beta-glucans, for instance, have been demonstrated to improve immunological response and regulate inflammation; polysaccharides, on the other hand, demonstrate antioxidant properties and may offer some protection against illnesses linked to oxidative stress (Akbari *et al.*, 2022; Chen *et al.*, 2021 and Bai *et al.*, 2022). Mushrooms have an even better nutritional profile because they are also high in vitamins, minerals, and dietary fiber (Nagulwar *et al.*, 2020 and Alzand *et al.*, 2019). An adaptable and nourishing foundation for baked goods like cookies is provided by wheat, a staple crop and food in many civilizations (Siddiqui *et al.*, 2022 and Cauvain and Clark 2019).

It offers vital nutrients, like fiber, protein, carbs, and vitamins (like B vitamins) and minerals (like iron and magnesium) (Hoque *et al.*, 2023 and Godswill *et al.*, 2020;). Moreover, additional nutrients are frequently added to wheat-based goods to improve their nutritional value (Iqbal *et al.*, 2022 and Flambeau *et al.*, 2024). Cookie producers can create products that appeal to consumers' taste preferences and may have several health benefits by combining wheat flour with substances derived from mushrooms, such as extract or powder (Uriarte-Frías *et al.*, 2021; Soares *et al.*, 2023 and Sławińska *et al.*, 2022).

2. UNDERSTANDING NUTRACEUTICALS WITH THEIR ROLE IN HEALTH PROMOTION AND DISEASE PREVENTION

Nutraceuticals are a class of food items that incorporate more than just basic nutrition; they are a combination of nutrition and medications (pharmaceutical) (Vishvakarma *et al.*, 2023) as shown in Figure 1. These goods are rich in bioactive substances that have therapeutic effects and support the promotion and prevention of disease, including vitamins, minerals, antioxidants, polyphenols, and phytochemicals (Banwo *et al.*, 2021). Nutraceuticals, in contrast, provide tailored functional qualities that address certain health concerns (Manocha *et al.*, 2022). Conventional foods generally serve to fulfill nutritional requirements (Bene *et al.*, 2019). Also, it improves cellular health, promote a range of physiological processes, and reduce risk factors for chronic diseases thanks to their wide range of bioactive substances (Kussmann *et al.*, 2023).

Since they offer specific health benefits above and beyond those of normal nutrition, nutraceuticals are essential for promoting health and preventing disease. Growing consumer interest in functional foods and proactive health management is reflected in the rising popularity of nutraceutical products (Visen *et al.*, 2022). Manufacturers can satisfy consumer demand for easy-to-achieve ways to support their health goals by turning cookies into nutraceutical items by adding particular ingredients recognized for their health-promoting qualities (Silva Zamora, 2022).

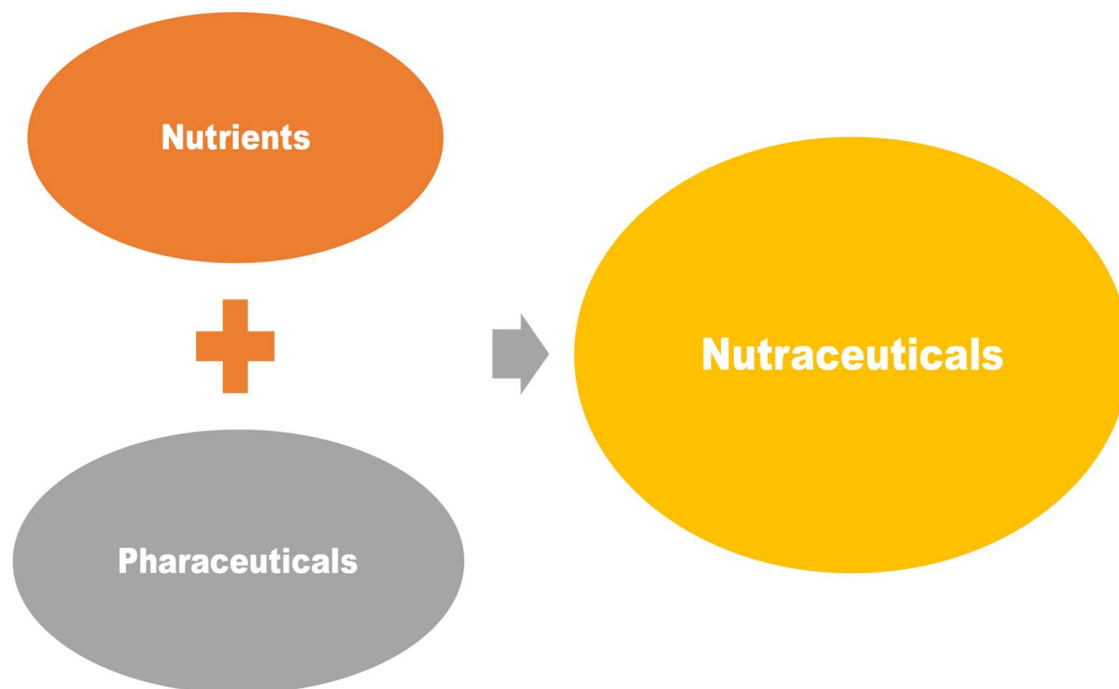


Figure 1: Linking Gaps Between Food and Drugs

2.1 Role of Nutraceuticals

Nutraceuticals play a varied and wide-ranging role in enhancing health and avoiding diseases through many physiological systems (Singh *et al.*, 2018 and Sharma *et al.*, 2022). These functional meals and dietary supplements go beyond simple nourishment to address particular health issues and offer therapeutic advantages (Hassan *et al.*, 2020). Fruits and vegetables, for instance, include antioxidants that scavenge free radicals and lower oxidative stress, guarding against inflammation and cellular damage. (Akbari *et al.*, 2022). Nutraceuticals helps in lowering blood cholesterol levels, reducing inflammation, and boosting vascular function, omega-3 fatty acids which are found in large quantities in fatty fish and some plant sources support cardiovascular health (Ghani *et al.*, 2019). Probiotics, which are helpful microorganisms included in fermented foods and dietary supplements, have similar effects on gut health, immunity, and possible relief from gastrointestinal illnesses (Gruevska, 2023).

2.2 Increasing Popularity of Nutraceutical Products

One of the primary drivers is the growing awareness of the link between diet and health, as consumers increasingly recognize the role of nutrition in preventing chronic diseases and promoting overall well-being (Neuhouser, 2019; Didinger and Thompson, 2022). As individuals seek proactive approaches to health maintenance and disease prevention, there is a heightened interest in functional foods and dietary supplements that offer targeted health benefits (Dominguez *et al.*, 2020; Pandey *et al.*, 2024). Additionally, novel nutraceutical products with improved bioavailability, stability, and efficacy have been made possible by developments in food science and technology (Goncalves *et al.*, 2018; Asghar *et al.*, 2018). Manufacturers are creating goods that deliver bioactive chemicals in optimal forms and quantities, guaranteeing maximum health advantages for consumers, by utilizing scientific research and technological breakthroughs (Neekhara *et al.*, 2022 and Neffe-Skocinska *et al.*, 2018). Moreover, the proliferation of distribution channels, such as specialized shops and internet platforms, has improved accessibility to nutraceutical products, increasing their availability to a wider range of customers (Chopra *et al.*, 2022).

Manufacturers have emphasized the functional qualities and health-promoting advantages of nutraceutical goods in their advertising and labeling, which has contributed significantly to their growing popularity (Anil *et al.*, 2022). Nutraceuticals have become more well-known and more trustworthy to consumers because to consumer education programs like health campaigns, nutritional seminars, and product conventions (Ozcan and Gurses, 2018). Since health-conscious consumers are looking for quick and easy ways to support their health goals, nutraceutical products have become increasingly popular and accepted (Chopra *et al.*, 2022 and Jayaweera, 2023).

3. MUSHROOM: ITS NUTRITIONAL COMPOSITION AND BENEFITS

Mushrooms have been used for highly valued food and pharmaceutical purposes because of their role as a tonic and their benefits to health (Goswami *et al.*, 2020). Mushrooms are nutritionally important, as they are rich in protein, fibres, and minerals, while poor in fats (Gupta *et al.*, 2019). They are often regarded as a nutritional powerhouse due to their impressive array of vitamins, minerals, and antioxidants. Mushrooms are particularly rich in various B vitamins, including riboflavin (B2), niacin (B3), pantothenic acid (B5), and biotin (B7) (Sarkar *et al.*, 2024). These vitamins are essential for energy metabolism, nervous system function, and skin health. Vitamin D content in mushrooms is noteworthy, especially when they are exposed to sunlight or UV light during growth (Singh, 2023).

Vitamin D plays a crucial role in bone health, immune function, and mood regulation (Casseb *et al.*, 2019). Also, mushrooms provide significant amounts of minerals like potassium, phosphorus, copper, selenium, and zinc (Altaf *et al.*, 2020). Potassium is essential mineral for heart health and muscle function, which is abundant in mushrooms and helps to regulate blood pressure and fluid balance within the body (Amin *et al.*, 2022; Oyetayo, 2023). Copper is involved in the production of red blood cells and collagen, while selenium and zinc act as antioxidants, supporting immune function and cell integrity (Islam *et al.*, 2023; Jomova *et al.*, 2022).

The antioxidant properties of mushrooms are attributed to various compounds such as phenolic compounds, flavonoids, and polysaccharides (Shaffique *et al.*, 2021). These antioxidants help combat oxidative stress by neutralizing free radicals, thereby reducing inflammation and lowering the risk of chronic diseases (Engwa *et al.*, 2022).

Mushrooms contain beta-glucans, polysaccharides known for their immunomodulatory effects in the support of the immune system (Konusova *et al.*, 2021). Beta-glucans stimulate the activity of immune cells such as macrophages, dendritic cells, and natural killer cells, enhancing the body's defense against infections and diseases (Wu *et al.*, 2021). Additionally, mushrooms are rich in ergothioneine, an antioxidant with unique protective properties that support immune function and combat cellular damage caused by oxidative stress (Shaffique *et al.*, 2021).

Research suggests that mushrooms possess anti-cancer properties due to compounds like ergothioneine, conjugated linoleic acid (CLA), and polysaccharides (Matsugo *et al.*, 2022). These compounds inhibit tumour growth, promote apoptosis (programmed cell death) in cancer cells, and exert anti-inflammatory effects, reducing the risk of various cancers, including breast, prostate, and colon cancer (Costea *et al.*, 2020). Furthermore, mushrooms contain selenium, a trace mineral with antioxidant properties that may help prevent DNA damage and inhibit cancer progression (Tsivileva & Perfileva, 2017).

The low sodium and high potassium content of mushrooms contribute to heart health by helping to regulate blood pressure and maintain electrolyte balance (Singh, 2023). Potassium also supports muscle function and may reduce the risk of stroke and heart disease (McLean & Wang, 2021). Beta-glucans found in mushrooms have been shown to lower cholesterol levels by binding to bile acids and promoting their excretion, thereby reducing the risk of atherosclerosis and cardiovascular events (Singla *et al.*, 2024). Mushrooms are low in calories and fat but high in fiber, making them a valuable addition to weight loss or weight management diets (Mustafa *et al.*, 2022).

The fiber content promotes satiety, reducing hunger and calorie intake, while also supporting digestive health. Mushrooms addition into meals can help an individual feel satisfied for longer period, leading to reduced overall calorie consumption and potentially aiding in weight loss efforts (Salleh *et al.*, 2019). A sufficient intake of mushrooms can enhance adequate antioxidant defence, fight against diseases and positively contribute to a good healthy life (Bamigboye *et al.*, 2021). Analytical reports on proximate composition revealed significant variation from species to species (Ritota & Manzi, 2019).

4. WHEAT: ITS NUTRITIONAL COMPOSITION AND BENEFITS

Wheat is a staple food that has been a dietary cornerstone for centuries, offering an array of essential nutrients vital for overall health and well-being (Verma *et al.*, 2023). The comprehensive nutritional benefits of wheat are particular focus on its high fiber content, abundance of vitamins and minerals, and the health advantages of consuming wheat products (Arzani & Ashraf, 2017). Wheat is a nutrient-dense grain packed with essential vitamins, minerals, and dietary fiber. Wheat is notably rich in dietary fiber, with both soluble and insoluble forms present in significant amounts (Khalid *et al.*, 2023). As a basic ingredient in many baked items, wheat flour contributes minerals like iron and magnesium as well as carbs, proteins, fiber, and vitamins, especially B vitamins (Ajayi *et al.*, 2020; Gulati *et al.*, 2020). It also contains phenolic acids and flavonoids, which are bioactive compounds rich in antioxidants that may improve health by reducing the risk of chronic disorders (Rahman *et al.*, 2021).

These fibers contribute to digestive health, regulate bowel movements, and aid in weight management by promoting satiety (McRae, 2020; Gill *et al.*, 2021). Soluble fiber found in wheat helps lower cholesterol levels, while insoluble fiber adds bulk to stool and facilitates regular bowel movements, preventing constipation (Nweze *et al.*, 2021). Wheat is an excellent source of various B vitamins, including thiamine (B1), riboflavin (B2), niacin (B3), pantothenic acid (B5), pyridoxine (B6), and folate (B9) (Hrubsa *et al.*, 2022 and Hoque *et al.*, 2023).

These vitamins play vital roles in energy metabolism, nervous system function, and red blood cell production (Tardy *et al.*, 2020). Wheat also contains vitamin E, an antioxidant that protects cells from oxidative damage, and vitamin K, essential for blood clotting and bone health (Rafeeq *et al.*, 2020; Radhika *et al.*, 2022). Wheat is rich in minerals such as magnesium, phosphorus, zinc, iron, and selenium (Salantur & Karaoğlu, 2021). These minerals are involved in numerous physiological processes, including bone health, immune function, and energy production (Stefanache *et al.*, 2023). Iron, in particular, is crucial for the formation of hemoglobin and oxygen transport in the blood, making wheat an important dietary source for preventing iron deficiency anemia (Shubham *et al.*, 2020).

Wheat contains high fiber content (soluble and insoluble fiber) which helps to maintain regular bowel movements, strengthens the digestive system, and wards against constipation (Gill *et al.*, 2021). In addition, fiber serves as a prebiotic, feeding good bacteria in the stomach and maintaining a balanced microbiome (Singh *et al.*, 2018). Wheat contains essential vitamins such as B vitamins (thiamin, riboflavin, niacin, and folate) which are crucial for energy metabolism and nerve function (Dreher and Dreher, 2023). Due to the high fiber content, it has been linked to a decreased risk of gastrointestinal diseases, such as diverticulosis and colon cancer (Gill *et al.*, 2021).

Frequent use of wheat products has been associated with a lower risk of developing long-term conditions such type 2 diabetes, heart disease, and several types of cancer (Hu *et al.*, 2020). Wheat's fiber, antioxidants, and phytochemicals offer defense against oxidative stress, inflammation, and insulin resistance, reducing the likelihood of acquiring these illnesses (Guan *et al.*, 2021). Wheat foods, with their high fiber content and low glycemic index, help regulate blood sugar levels and promote feelings of fullness, aiding in weight management and appetite control. Studies have shown that individuals who consume whole grains, including wheat, as part of a balanced diet are more likely to maintain a healthy weight and reduce the risk of obesity.

5. TRANSFORMATION OF COOKIES INTO NUTRACEUTICAL PRODUCTS

The exploration of nutraceutical potentials in cookies produced from wheat and mushroom composite flour represents an exciting frontier in the field of functional foods (Mohd Zaini *et al.*, 2023). By harnessing the nutritional power of mushrooms and wheat, cookie manufacturers have the opportunity to develop products that not only satisfy consumer cravings but also contribute to overall health and well-being. As research continues to uncover the therapeutic potential of nutraceutical-rich foods, the future of functional cookies holds tremendous promise for promoting a healthier and more nutritious diet for consumers (Tripathi *et al.*, 2021).

Cookies, traditionally viewed as indulgent treats, can be transformed into nutraceutical products by incorporating specific ingredients known for their health-promoting properties (Kumar *et al.*, 2022). By carefully selecting and incorporating these ingredients into cookie formulations, manufacturers can create products that offer both indulgence and functional benefits.

Some key ingredients that can be used to transform cookies into nutraceutical products include:

- i. **Whole Grains:** Incorporating whole grain flours, such as wheat flour, oats, or barley flour, adds dietary fiber, vitamins, minerals, and phytonutrients to cookies (Chiedu *et al.*, 2023). Whole grains have been associated with numerous health benefits, including improved digestive health, reduced risk of heart disease, and enhanced weight management (Calinoiu *et al.*, 2018).
- ii. **Nuts and Seeds:** Adding nuts and seeds, such as almonds, walnuts, flaxseeds, or chia seeds, enriches cookies with protein, healthy fats, fiber, vitamins, and minerals (Stamatie *et al.*, 2023; Oso *et al.*, 2021). These ingredients provide satiety, support cardiovascular health, and may help regulate blood sugar levels (Munekata *et al.*, 2021).
- iii. **Dried Fruits:** Dried fruits include raisins, peaches, cranberries, plums or apricots, enhances the flavour, texture, and nutritional profile of cookies (Jeszka-Skowron & Czarczyńska-Goślińska, 2020). Dried fruits contribute natural sweetness, fiber, vitamins, and antioxidants, making them a nutritious addition to nutraceutical cookies (Saleh & Aghajanzadeh, 2020)
- iv. **Functional Ingredients:** Incorporating functional ingredients like probiotics, omega-3 fatty acids, plant sterols, or antioxidants into cookies boosts their nutraceutical value (Das *et al.*, 2023; Sharma & Yadav, 2022). These ingredients offer specific health benefits, such as improving gut health, reducing inflammation, and supporting immune function (Peng *et al.*, 2020; Dahiya & Nigam, 2022).

These products included fruits, vegetables, medicinal plants, herbs, minerals, vitamins, nuts, crops and probiotics that play an essential role in modulating the various physiological and pathophysiological processes of the body as shown in Figure 2 (Gupta *et al.*, 2013).

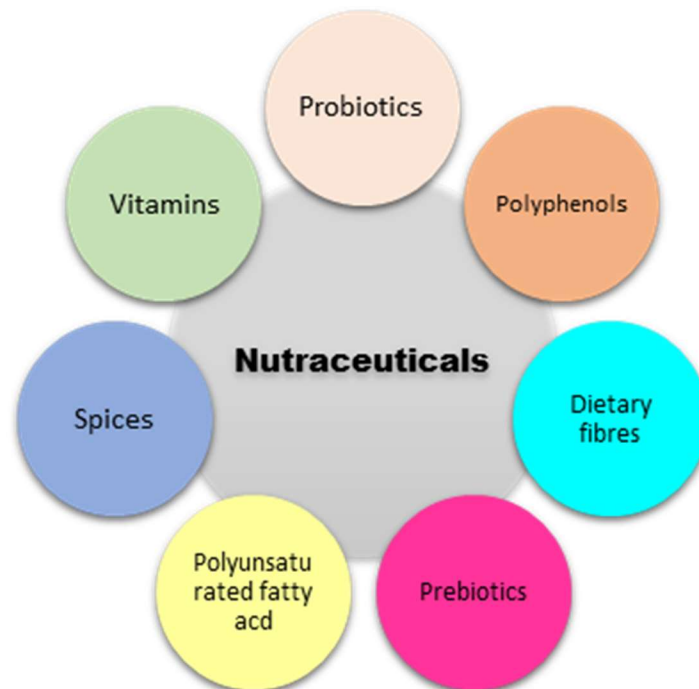


Figure 2: Common Types of Nutraceuticals
(Source: Gupta *et al.*, 2013)

By including these particular chemicals in their cookie formulas, producers may produce nutraceutical items that appeal to customers who are health-conscious and looking for fun and easy methods to boost their wellbeing (Manoharlal *et al.*, 2023). A beneficial complement to a well-balanced diet, these cookies offer a tasty and fulfilling snack alternative that also has practical benefits (Sammugam & Pasupuleti, 2019).

5.1 Combining Mushrooms and Wheat in Cookie Production

Combining mushrooms and wheat in cookie production offers a creative and innovative way to enhance the nutritional value, flavour, and texture of baked goods (Owheruo *et al.*, 2023 and Sławińska *et al.*, 2024). By incorporating composite flours made from mushroom and wheat, bakers can create delicious and nutritious cookies that appeal to health-conscious consumers seeking innovative culinary experiences. In recent years, there has been a growing interest in developing innovative food products that offer enhanced nutritional benefits without compromising taste or texture (Guiné *et al.*, 2020). One such approach involves the creation of composite flours by blending traditional wheat flour with alternative ingredients (Wang and Jian, 2022). The concept of using a composite flour made from mushrooms and wheat in cookie recipes is a prime example of this innovation (Vlaic *et al.*, 2019). Mushroom powder, derived from various mushroom species like shiitake, oyster, or porcini, is rich in essential nutrients like vitamins, and minerals and bioactive compounds (Lu, 2018 and Das *et al.*, 2021).

When combined with wheat flour, which serves as the base ingredient, the resulting composite flour offers a significant nutritional boost on its nutritional profile (Barakat, 2021 and Ajani *et al.*, 2020). Mushrooms are particularly renowned for their high levels of antioxidants, including polysaccharides, phenolic compounds, and flavonoids, which contribute to overall health and well-being (Ustun *et al.*, 2018 and Adetunji *et al.*, 2022). Beyond its nutritional benefits, mushrooms impart a unique flavour profile to baked goods (Das *et al.*, 2021 and Balan *et al.*, 2021). The earthy, umami-rich taste of mushrooms complements the sweet and savoury elements found in cookie recipes, adding depth and complexity to the final product (Sakai, 2019). The incorporation of mushroom powder into wheat flour allows bakers to experiment with flavour combinations, creating cookies that are both delicious and distinctive (Bakara *et al.*, 2023; Dhanapal and Rajoo, 2023).

The combination of mushrooms and wheat in composite flour offers synergistic antioxidant effects (Uriarte-Frías *et al.*, 2021 and Ahmad *et al.*, 2022). While wheat contains antioxidants such as phenolic acids and carotenoids, mushrooms boast a diverse range of antioxidant compounds, including beta-glucans and ergothioneine (Bell *et al.*, 2022 and Kour *et al.*, 2022). Together, these ingredients work synergistically to combat oxidative stress, reduce inflammation, and support overall health (Ruhee and Suzuki, 2020). Mushroom polysaccharides, particularly beta-glucans, have been shown to enhance nutrient absorption in the digestive tract (Cerletti *et al.*, 2021 and Kozarski *et al.*, 2023). When combined with the dietary fiber present in wheat flour, which promotes gut health and regulates digestion, the composite flour facilitates optimal nutrient utilization (Yao *et al.*, 2022).

This synergistic effect may lead to improved overall nutrient absorption and greater bioavailability of essential vitamins and minerals. The addition of mushroom-wheat composite flour into cookie recipes introduces a harmonious balance of flavours (Nair & Augustine, 2018 and Melse-Boonstra, 2020). The earthy, savoury notes of mushrooms complement the nutty sweetness of wheat, creating cookies with a rich and complex flavour profile (Starwood, 2021). Bakers can experiment with different mushroom varieties and flour ratios to achieve the desired taste and texture in their cookies, catering to a wide range of culinary references (Salehi, 2019).

5.2 Nutraceutical Potential of Mushroom and Wheat Cookies

Nutraceutical properties of cookies produced from mushroom and wheat flour provides a potent combination of antioxidants, including phenolic compounds, flavonoids, ergothioneine and polysaccharides (Ho *et al.*, 2020; Kumar *et al.*, 2021). These antioxidants help neutralize free radicals, reducing oxidative stress and inflammation in the body (Adwas *et al.*, 2019). Mushrooms are known for their immune-modulating properties, thanks to compounds like beta-glucans and polysaccharides. When incorporated into cookies, these compounds support immune function, helping the body defend against infections and diseases (Chugh *et al.*, 2022). The inclusion of wheat in the composite flour ensures a good dose of dietary fiber in cookies. Fiber aids digestion, promotes satiety, and regulates blood sugar levels, contributing to overall digestive health and weight management. Also, mushrooms and wheat are both rich sources of essential nutrient like vitamins and minerals (Ogidi *et al.*, 2023). Cookies made from composite flour provide nutrients like B vitamins, iron, zinc, and selenium, supporting various bodily functions such as energy metabolism, cognitive health, and immune function (Oso & Ashafa, 2021).

Compounds like polysaccharides and conjugated linoleic acid (CLA) in mushrooms exhibit anti-cancer effects by inhibiting tumour growth and promoting apoptosis in cancer cells (Venturella *et al.*, 2021). Wheat contributes essential vitamins (B vitamins) and minerals (iron, magnesium, zinc) crucial for energy metabolism, nerve function, and overall health (Godswill *et al.*, 2020 and Igbal *et al.*, 2022).

Also, addition of nutraceutical ingredients like mushrooms and whole wheat into cookies offers a convenient way to obtain their health benefits without altering dietary habits significantly (Uriarte-Frías *et al.*, 2021). Nutraceutical cookies offer a convenient way to incorporate the health benefits of mushrooms and wheat into one's diet. It helps to introduce nutritious ingredients into the diet, especially for children who may be hesitant to consume mushrooms or whole grains. (Chen *et al.*, 2021). They can be easily packed for on-the-go consumption, making them a convenient snack option for busy individuals seeking nutritious alternatives (Forbes *et al.*, 2016).

Mushroom and wheat cookies boast a delicious flavour profile that appeals to a wide range of tastes (Uukule, 2020). The earthy notes of mushrooms complement the nutty sweetness of wheat, creating a uniquely satisfying treat. They can be enjoyed on their own or paired with beverages like tea or coffee (Crosson *et al.*, 2023). Cookies are a universally beloved snack, making them an ideal vehicle for delivering nutraceutical components to individuals of all ages (Shirhatti *et al.*, 2023). The familiar taste and texture of cookies enhance their appeal and encourage regular consumption (Tan *et al.*, 2017). Also, cookies make it easier for individuals of all ages to enjoy the health benefits of these ingredients.

Regular consumption of nutraceutical cookies can contribute to overall well-being by promoting digestive health, supporting immune function, and reducing the risk of chronic diseases (Maurya *et al.*, 2021). The cumulative effects of antioxidants, fiber, immune-boosting compounds and essential nutrients help maintain optimal health and vitality (Kim *et al.*, 2023). Nutraceutical cookies may play a role in disease prevention, particularly in conditions associated with oxidative stress and inflammation, such as cardiovascular disease, diabetes, and certain cancers (Devi *et al.*, 2018; Ramesh *et al.*, 2024). The antioxidant-rich ingredients in these cookies help protect cells from damage and mitigate the risk of chronic illnesses (Nirmala *et al.*, 2018).

The fiber content in wheat and the prebiotic properties of mushrooms promote a healthy gut microbiome, which is linked to various aspects of health, including immune function, digestion, and mental well-being (Jawhara, 2023). Incorporating nutraceutical cookies into a balanced diet underscores the importance of a holistic approach to wellness (Pandey *et al.*, 2024). Nourishing the body with wholesome ingredients, individuals can proactively support their health and well-being, ultimately leading to a higher quality of life (Zhou *et al.*, 2024).

Mushrooms are a popular ingredient in various culinary dishes, including cookies, due to their unique flavour and nutritional benefits (Rangel-Vargas *et al.*, 2021; Das *et al.*, 2021 and Kumar *et al.*, 2021). However, there are several safety concerns associated with mushroom consumption that need to be addressed to ensure consumer safety (Fung *et al.*, 2018). It is essential to cook mushrooms thoroughly before consumption to eliminate any potential harmful bacteria or toxins (Gupta and Gupta, 2020). Proper cooking techniques, such as baking, sauteing, or boiling can help to ensure that mushrooms are safe to eat (Coe and Spiro, 2022).

Avoid consuming raw mushrooms, especially wild varieties, as they may contain toxins that can cause gastrointestinal upset or other adverse reactions (Beug, 2021 and El-Ramady *et al.*, 2022). While mushrooms are generally considered safe for consumption, some individuals may be allergic to certain types of mushrooms (White *et al.*, 2019). Common symptoms of mushroom allergies include itching, swelling, hives, or in severe cases, anaphylaxis (Beug, 2021). Consumers should be aware of their allergies and carefully read ingredient labels when purchasing mushroom products (Blom *et al.*, 2018).

In cookie production, the quality of ingredients directly impacts the taste, texture, and nutritional value of the final product (Bawa *et al.*, 2020). Using high-quality wheat and mushrooms is essential to ensure optimal nutritional benefits for consumers (You *et al.*, 2022). Wheat flour is a primary ingredient in cookies and serves as a significant source of carbohydrates, fiber, and essential nutrients such as vitamins and minerals (Akusu *et al.*, 2019 and Igbal *et al.*, 2022). Choosing high-quality wheat flour ensures that cookies are nutritious and provide sustained energy (Cauvain & Clark, 2019). Mushrooms are low in calories and fat but rich in essential nutrients such as vitamins (e.g., vitamin D, B vitamins) and minerals (e.g., potassium, selenium) (Singh, 2023 and Lesa *et al.*, 2022).

Incorporating high-quality mushrooms into cookie recipes adds nutritional value without compromising taste or texture (Owheruo *et al.*, 2023). High-quality ingredients, including wheat flour and mushrooms, contribute to the overall flavour profile and texture of cookies (Rathore *et al.*, 2019). Fresh, flavourful mushrooms impart a savoury umami taste to cookies, while high-quality wheat flour ensures a soft, chewy texture that enhances the eating experience (Nachay & Malochleb, 2019).

Selecting reliable sources of mushroom and wheat products is crucial to ensure safety, quality, and nutritional value (Carrasco *et al.*, 2018 and Ho *et al.*, 2020). These indicate that the products meet high standards for safety and quality as source transparency, freshness and appearance, customer reviews and recommendations, proper cooking techniques toxin awareness and identification of allergic reactions (Okpala *et al.*, 2023).

5.3 Importance of Using High-Quality Wheat and Mushrooms in Cookie Production

The flavor, texture, and nutritional content of cookies are strongly influenced by the quality of the ingredients used in their manufacture so as to provide customers with the best possible nutritional value, premium wheat and mushrooms must be used (Das *et al.*, 2021). Inform customers of the dietary distinctions between whole wheat, white whole wheat, and enhanced wheat flour products (Gomez *et al.*, 2020). Whereas refined wheat flour is lower in fiber, vitamins, and minerals, whole wheat flour is made from the whole grain, including the bran, germ, and endosperm (Igbal *et al.*, 2022). Besides being a major source of fiber, carbs, and important elements including vitamins and minerals, wheat flour is one of the main ingredients of cookies (Kishorgoliya *et al.*, 2018).

Making cookies using premium wheat flour guarantees that they are wholesome and provide you energy for a long time (Drummond & Brefere, 2021). As a low-calorie, high-nutrient food, mushrooms are abundant in potassium, selenium, and other minerals as well as vitamins (including vitamin D and B vitamins) (Awuchi *et al.*, 2020). Exquisite mushrooms offer nutrients to cookie recipes without sacrificing flavor or consistency (Dhanapal, & Rajoo, 2023). Stress the health benefits of many types of mushrooms, including oyster, cremini, and shiitake (Rizzo *et al.*, 2021).

Offering options to meet consumers' taste preferences and dietary requirements, each variety has a distinct flavor character and nutrient composition (Liem, & Russell, 2019). Give information about organic certifications, fair labor practices, and sustainable agricultural techniques as well as details regarding the procurement procedures for wheat and mushrooms (De Cianni *et al.*, 2023). Customers are showing a growing inclination to back businesses that use ecologically sustainable and moral production practices (Font *et al.*, 2019). There are nutritional advantages to certain nutrients, it's important to convey accurate information without overstating any possible negative impacts on health. Customers should be urged to eat a varied diet that is high in nutrients, which is a balanced diet.

5.4 Nutraceutical Cookies as a Dietary Supplement

Integrating such functional foods into dietary patterns can contribute to a healthier lifestyle and improved quality of life (Dominguez *et al.*, 2022). Additionally, these cookies are formulated to provide additional health benefits beyond basic nutrition (Bakara *et al.*, 2023). They often contain functional ingredients such as vitamins, minerals, antioxidants, and other bioactive compounds that may promote health and well-being (Kussmann *et al.*, 2023). Nutraceutical cookies made from mushroom and wheat composite flour offer a convenient, enjoyable, and effective way to obtain the health benefits of these ingredients (Slawinska *et al.*, 2024). They have the potential to positively impact overall well-being and disease prevention due to their potent nutraceutical properties and delicious flavor profile (Sikarwar *et al.*, 2024).

However, it's essential to recognize that nutraceutical cookies should be viewed as a supplement to, rather than a replacement for, a balanced diet. They can contribute to overall nutrient intake, they should not be relied upon as the sole source of essential nutrients (Sutton *et al.*, 2013). Nutraceutical cookies should be incorporated into a diet that includes a variety of nutrient-dense foods such as fruits, vegetables, whole grains, lean proteins, and healthy fats (Kataki *et al.*, 2019). These foods provide essential nutrients, fiber, and phytochemicals that support overall health and reduce the risk of chronic diseases (Arshad *et al.*, 2021). While nutraceutical cookies may offer specific health benefits, they may not provide all the nutrients found in whole foods. Therefore, it's essential to diversify nutrient sources by consuming a wide range of foods from different food groups to ensure adequate nutrient intake (Dwivedi *et al.*, 2017).

6. CONCLUSIONS

In conclusion, wheat and mushroom stands as a nutritional powerhouse, offering a wealth of health-promoting benefits through its fiber-rich composition, abundance of vitamins and minerals, and role in reducing the risk of chronic diseases. Incorporating whole wheat flour into cookie production not only enhances the nutritional value of cookies but also provides consumers with a healthier and more wholesome indulgence option. Safety and quality considerations are paramount when incorporating mushrooms and wheat into food products such as cookies. By following proper cooking techniques, using high-quality ingredients, and selecting reliable sources, consumers can enjoy delicious and nutritious cookies with confidence. Awareness of potential safety concerns, such as allergic reactions, and adherence to quality standards are essential for promoting consumer health and satisfaction. Ensuring the safety and quality of mushroom and wheat products requires attention to detail at every stage of production, from sourcing to consumption.

Also, by implementing proper safety protocols, using high-quality ingredients, and providing transparent information to consumers, manufacturers can promote confidence in their products and contribute to a positive eating experience. Continuous education and awareness about safety concerns, nutritional benefits, and sourcing practices are essential for fostering a culture of food safety and sustainability. Incorporating nutraceutical cookies into a balanced diet requires mindfulness, moderation, and attention to overall dietary patterns. While nutraceutical cookies can offer specific health benefits, they should be viewed as a supplement to, rather than a replacement for, a diverse and nutrient-rich diet. Portion control, moderation, and pairing nutraceutical cookies with other complementary foods such as fruits, vegetables, nuts, seeds can help maintain a balanced eating pattern and support overall health and well-being.

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