Mushroom Protein Hydrolysate

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ABSTRACT

Several years of research on protein hydrolysates have been conducted. But still relatively few, and bibliometric research specifically on this topic has not been done. This bibliometric research aims to analyze the topic of mushroom protein hydrolysate. Data obtained from Science direct with the keywords "hydrolysate" or "protein hydrolysate" or "mushroom" resulted in 15.485 publications from 2014-2024. Data was obtained from Sciencedirect and visualized with a network map using VOSviewer. The visualization results of the bibliometric study showed that the publication trend related to the keywords with a peak publication in 2024. Further research is needed to provide knowledge regarding the wider benefits of mushroom protein hydrolysate.

Keywords: hydrolysates, protein hydrolysates, fungi, bibliometrics, VOSviewer

INTRODUCTION

Protein hydrolysis is the breakdown of proteins into smaller peptide fragments with low molecular weight and free amino acids using chemicals or enzymes. Protein hydrolysate is a product of protein hydrolysis which is a substance containing a complex mixture of modified peptides, oligopeptides, polypeptides, and free amino acids. Protein hydrolysates and peptides can be derived from milk, fish, eggs, pork skin, beef, spinach, soybeans, wheat, and mushrooms can exert effects through the neurotransmitter system, Protein hydrolysates and peptides can regulate neurotransmitters and neurotransmitter receptors to exert anxiolytic and antidepressant effects, increase neurotrophic factors and BDNF/TrkB-ERK/CREB signaling pathways to support neurons, regulate neuronal expression and cell proliferation to reduce depression and anxiety, and downregulate CORT, CRH, and ACTH levels to regulate the HPA axis and reduce anxiety and depression (Li et al, 2024).

Global mushroom production reached 12.74 million tons in 2018 and is projected to reach 20.84 million tons by 2026 (Atallah et al, 2021) The increasing demand for these products has created an urgent need for innovation in the use of food mushroom products. Mushroom protein content per 100 grams contains 0.8 to 3.5 grams per 100 grams of fresh material or 19.0 to 39.0 grams per 100 grams of dry material (Bernaś et al, 2006; Jaworska et al, 2012). Mushroom proteins like plant proteins are usually bound to other biomolecules in the cellular structure, such as carbohydrates, lipids, nucleic acids, and polyphenols (Sá et al, 2022). As a result, such proteins have low bioavailability and functionality. Consequently, in order to extract the proteins and achieve their full bioavailability and functionality, several processing stages are required, such as hydrolysis. Mushroom protein extraction results in the production of protein extracts with protein hydrolysates. Mushrooms contain bioactive substances such as polyphenols, peptides, and polysaccharides

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that can enhance flavor and help create functional food products with potential health benefits (Navarro et al, 2024). Mushrooms used to enhance flavor can be extracted using enzymes. Enzymatic hydrolysis can produce peptide products that have a specific composition and amino sequence. Protein hydrolysis using enzymes can produce short peptides that have an umami flavor, thus enhancing the umami taste.

Mushroom protein hydrolysis has received greater attention in recent years as a natural flavor enhancer in food product development.

There is a strong umami flavor profile and bioactive peptides in hydrolysates. Mushroom protein hydrolysis has become very popular as a flavor enhancer. According to Ang and Ismail-Fitry's research, different mushroom protein hydrolysates were produced based on hydrolysis using stem bromelain enzyme.This mushroom protein hydrolysate can be used as a chicken soup flavoring.

The mushrooms used in this study were shiitake, oyster, bunashimeji, and enoki mushrooms that were hydrolyzed with stem bromelain at an enzyme/substrate ratio of 0.5% (m/m) for 20 hours. The results were obtained with a pH level of 6.5, and an ambient temperature of 40°C. . The enhancement effectiveness of different types of mushroom protein hydrolysates against mononatrium glutamate (MSG) was evaluated by 58 untrained panelists. Soups containing MSG received the highest scores of all the soups tested, while soups using oyster mushroom hydrolysate and bunashimeji scored better for aroma, flavor, and mouthfeel. In general, the soup containing no hydrolysate or MSG at all was preferred over the negative control.

According to observations made regarding the results, bunashimeji and oyster mushroom protein hydrolysate can be used to add flavor to food (Ang & Ismail-Fitry, 2019).

According to research conducted by Banjongsinsiri et al, (2016) hydrolysis of oyster mushrooms, abalone mushrooms, and shitake mushrooms with 15% papain enzyme and 24 hours incubation time produced the highest free amino acids, namely aspartic acid content of 20.95 mg/100 ml (oyster mushrooms), 3.76 mg/100 ml (abalone mushrooms), 0.77 mg/100 ml (shitake mushrooms). Furthermore, glutamic acid was 20.95 mg/100 ml (oyster mushroom), 3.76 mg/100 ml (abalone mushroom), and 0.77 mg/100 ml (shitake mushroom), respectively.

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Table 1. Factors affecting protein hydrolysates

No.	Factors affecting the yield and quality of mushroom protein	Results	Reference
1.	Mushroom	Producing high-protein mushrooms can be helped by substrates that contain high protein, such as some of these substrates that produce protein content of 37.4 g/100 g and 32.4 g/100 g in different studies (spent beer seeds and wheat bran), 31.36 g/100g almond + walnut shells, 29.03 g/100g rice straw, 29.35 g/100 g wheat straw.	Lavell *et, al* (2018).
2.	Hydrolysis Method	1.Chemical hydrolysis a. Hydrolysis with acid Hydrolysis of fish protein with hydrochloric acid, papain enzyme and alkalase, and various temperatures and times obtained different types of hydrolysis affect the results of hydrolysis while temperature and time do not affect the degree of hydrolysis. The results of each optimal condition, namely the concentration of 4 M hydrochloric acid and a temperature of 100 0C, obtained a degree of hydrolysis of 50.70%, in the hydrolysis of 6% w/b papain enzyme and a temperature of 60 0C obtained a degree of hydrolysis of 87.15%, and hydrolysis with 6% w/b alkalase at a temperature of 60 0C and a time of 5 hours resulted in a degree of hydrolysis of 81.98%. b. Hydrolysis with alkali The hydrolysis time of 60-300 minutes showed little effect on alkaline hydrolysis, then there was a significant effect of temperature on alkaline hydrolysis, the temperature used was 110-150 0C resulting in a 100% hydrolysis rate at 150 0C but the use of too high temperatures can damage proteins, carbohydrates and nucleic acids. Furthermore, the effect of alkali solution concentration from 0-5% was found to have a significant effect on the hydrolysis rate, where 5% concentration produced the highest hydrolysis rate, 2. Hydrolysis with enzymes Enzymes that can be used come from microbes such as alcalase (endoprotease), flavorzyme, protamex, proteinase K, metalloproteases, serine-proteases, plants such as papain bromelain. And animals such as α - chymotrypsin, neutrase, trypsin (amino acid residues lysine and arginine)	Wisuthipha *et al*, (2016) Wang *et al*, (2016) Aguilar et al,(2019 Ding *et al*, *(*2021).
3.	Extraction Conditions	the value of the degree of hydrolysis increased as the temperature increased from 30 to 400C while the degree of hydrolysis was lower at a higher temperature of 600C. However, the degree of hydrolysis increased significantly when the incubation time was extended from 60 to 240 minutes. Ibrahim also wanted to know the effect of different enzyme concentrations on the protein extract from the same experiment. The enzyme concentrations used were 1.0%, 1.5% and 2.0%. Increasing the enzyme concentration from 1.0% to 1.5% significantly increased the hydrolysis, but when the enzyme concentration exceeded 1.5%, the hydrolysis remained constant.	Ibrahim, (2013).

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4.	Enzyme type and concentration	The food industry favors the use of enzymes for protein hydrolysis due to the proteolytic activity, enzymatic specificity, anti-inflammatory effects, digestion aid, mild enzymatic action, pH adjustment, and temperature tolerance of enzymes. These unique features of enzymes result in the production of hydrolysates with desired functionalproperties	Goswami et al, (2022).
5.	Processing	Depending on the degree of grinding, the cell walls and membranes of biological samples may break, thus facilitating the extraction of intracellular proteins. Milling is important especially when the goal is to maximize protein yields	Alsaud & Farid, (2020)

A number of studies related to mushroom protein hydrolysates have been conducted, but there are still few studies on this topic. And there is no bibliometric analysis study on this topic. Therefore, a bibliometric analysis related to mushroom protein hydrolysates was conducted.

MATERIALS AND METHODS

Data source

The data conducted in this research on mushroom protein hydrolysate was obtained from Science direct. The source of information on mushroom protein hydrolysates was obtained from the Science direct database because it provides more accurate and extensive data. The keywords used in the search in the Sciencedirect database were “hydrolysate” OR “protein hydrolysate” and “mushroom”. The scientific literature searched contained one of the keywords, terms or phrases in the title, abstract, article or keywords. A total of 15,485 publications were retrieved. The scientific literature was published in English and the scientific literature used was from the last 10 years (2014-2024) and limited to English publications.

Data Extraction and Analysis

Data extraction and analysis is done by collecting existing scientific literature from Sciencedirect, including titles, abstracts, articles, or relevant keywords. Once the data is extracted, it is analyzed to understand and evaluate the data that has been collected. The literature obtained is stored in the form of Research Information System (RIS). The data obtained was then exported to Vosviewers version 1.6.20 for further bibliometric analysis (van Eck and Waltman, 2023). The parameters used for the results of this study include publication trends, analysis of contributing publishers, keyword co-occurrence networks, and overlays.

Term Map

VOSviewer is a software tool for creating maps based on network data and for visualizing and exploring these maps. The functionality of VOSviewer can be summarized as follows: create maps based on network data, visualize and explore the maps. On the map there are bubbles representing words that appear in the literature. The color indicates the number of citations to publications containing that word.

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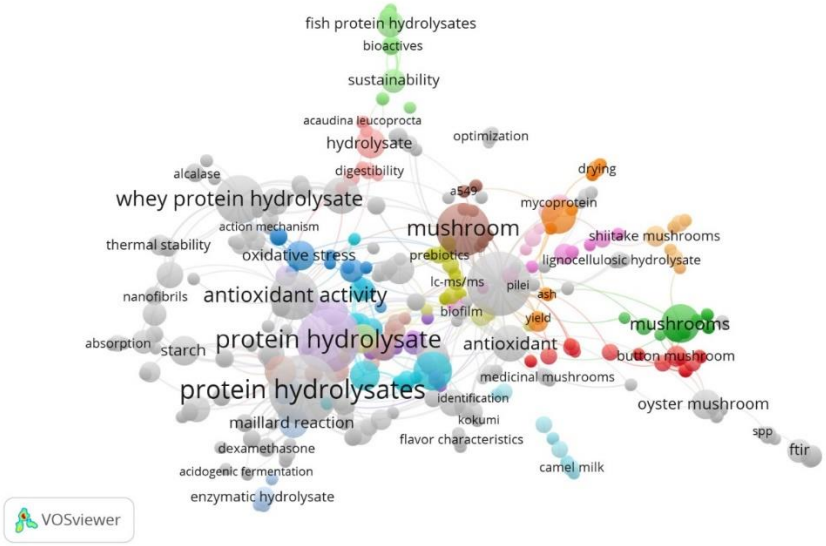
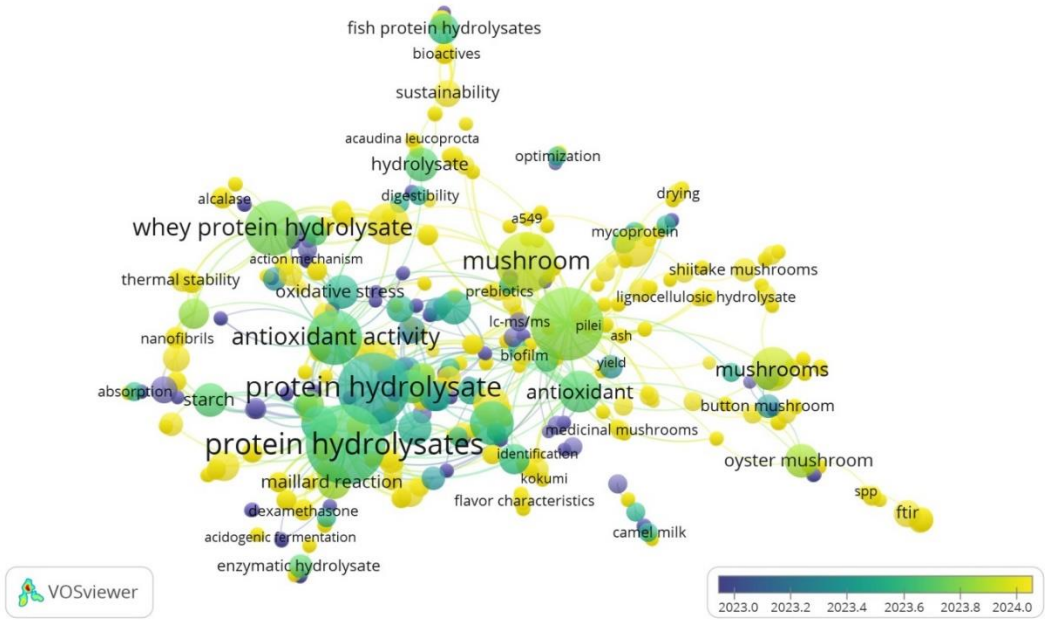
RESULTS AND DISCUSSION

Keyword co-occurrence network and overlay



Pig. 1 Keyword co-occurrence network from Sciencedirect database

Based on the search terms that have been used, it can be seen in the visual representation in figure 1 that mushroom protein hydrolysate is associated with having antioxidant activity, dexamethause, enzyme hydrolysate, bioactive peptide, product. Furthermore, the antioxidant activity correlated with the fungus. The protein hydrolysate had the largest bubble size. This shows that there have been many studies that discuss protein hydrolysates. However, there has not been much discussion about mushroom protein hydrolysate. This can be seen from the small size of the mushroom. The mushroom bubble map is connected to the protein hydrolysate bubble map which explains that not much research has been done on this.



Pig 2. Keyword co-occurrence overlay from Sciencedirect database

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Based on the keywords used, it can be seen in Figure 2. It can be seen that there is a trend of protein hydrolysate publications from 2014-2024, many of which were carried out in 2023 in blue. Larger bubbles in protein hydrolysates indicate a trend of many publications. In the bubble there is a correlation of protein hydrolysate with antioxidant activity with mold. This happens because maltodextrin is a group of polysaccharides consisting of glucose molecules. The novelty of this research has begun to be widely expolited in 2024 marked with yellow color on the bubble map.

CONCLUSIONS

The study of mushroom protein hydrolysates requires a variety of scientific literature such as scientific publications, citations, author partnerships, research networks, research maps, and other trends. From the literature obtained from Sciencedirect between 2014 and 20124. Based on VOSviewers visualization, there are still few research trends on mushroom protein hydrolysates. Because this research trend is still new in 2023.

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