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The potential of meat boiling water waste on plants: A systematic literature review

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Abstract

Boiling water waste from meat is often considered as useless waste, whereas it can be utilized as a potential source to support plant growth. The aim of this research is to identify the potential of meat boiling water waste as a nutrient source for plants, as well as to evaluate its impact on plant growth and soil quality. This study was conducted using a systematic literature review method, which involved the collection and analysis of various previous studies relevant to the researched topic. Through this literature review, it was found that meat boiling water contains essential nutrients such as nitrogen, phosphorus, potassium, and micronutrients that can enhance soil fertility and support plant growth. The research results indicate that the use of meat boiling water can contribute to plant growth, although there are potential negative impacts such as microbial contamination, nutrient excess or fat deposition if not managed properly. This research is expected to serve as an alternative organic fertilizer that can support sustainable agriculture, provided that it is managed correctly and considers risk factors. These findings provide new insights into waste management in the agricultural sector, with the hope of reducing dependence on chemical fertilizers and providing environmentally friendly solutions. In conclusion, meat boiling water waste has the potential to be a useful nutrient source for plants; however, careful management is required to minimize its negative impacts. Further research is needed to optimize the use of this waste in sustainable agriculture.

Keywords: Boiling water waste, plants, nutrients, systematic literature review, sustainable agriculture

Introduction

Wastewater is a general term used to describe water that has been used in household activities or industrial processes. It indicates that wastewater contains various types of pollutants, such as organic materials, chemicals, and often pathogens[1]. The reuse of wastewater in the agricultural sector includes the utilization of treated wastewater for irrigation purposes. This type of reuse is considered an effective method in water resource management, arising from the need for a regular supply to address water

shortages due to seasonal changes or instability in other water sources for year-round irrigation[2].Although the use of wastewater has been a long-standing practice, its management has not always been optimal or met the quality standards required for its intended use. Therefore, understanding the use of wastewater has evolved alongside human history[3].

The meat industry is one branch of the food industry that causes large-scale environmental damage. The wastewater generated from this industry contains various organic materials and environmentally harmful pollutants, as well as high levels of hazardous substances that can cause contamination. To address the waste issues from the meat industry, various treatment methods have been employed, such as ultrafiltration-reverse osmosis, chemical precipitation-reverse osmosis, and combinations of chemical precipitation with ultrafiltration-reverse osmosis[4]. Meat boiling water waste, produced from the cooking process of meat, is often regarded as useless waste and discarded. However, meat boiling water contains a number of compounds that have the potential to be reused, such as dissolved proteins, amino acids, fats, and minerals like calcium and phosphorus. This aligns with an article by Soesanto, which states that meat boiling water waste contains high nutrients, making it a potential source to support plant growth[5].This nutrient content is not only beneficial for plant health but can also enhance soil fertility. By utilizing meat boiling water waste as organic fertilizer, we can optimize the nutritional potential contained within it, thus providing dual benefits in sustainable agricultural practices.

In developing countries, including Indonesia, the amount of liquid waste from meat processing is significant, but its management is often not optimal. If not managed properly, this waste can pollute the environment. According to data from the FAO in 2019, it is estimated that around 1.3 billion tons of food is wasted each year, with a large portion of that being liquid waste that is not utilized[6]. Therefore, it is important to explore the potential of meat boiling water waste as a resource that can be utilized for other purposes, such as supporting sustainable agricultural sectors. On the other hand, the agricultural sector in Indonesia continues to face issues related to sustainability and natural resource management. The excessive use of chemical fertilizers leads to a decline in soil quality and contaminates water resources[7]. Therefore, it is important to seek alternative solutions that are more sustainable in supporting environmentally friendly agriculture. One potential solution is the utilization of organic waste, such as meat boiling water, which can be used as liquid organic fertilizer to improve soil fertility and increase agricultural yields.

The use of meat boiling water waste in agriculture as organic fertilizer has several advantages compared to chemical fertilizers. Meat boiling water waste contains nutrients that are easily absorbed by plants and can improve soil structure in the long term. For example, the use of meat boiling water waste rich in nitrogen can aid in the protein synthesis process in plants, supporting vegetative growth. However, there are challenges in managing meat boiling water waste[8]. One of the main challenges is microbial contamination that can occur if the meat boiling water is not processed properly. Microbial contamination can affect food safety and the quality of the meat boiling water, which in turn can impact the plants fertilized with it. Therefore, proper processing is essential to eliminate contaminants and ensure that meat boiling water is safe for use in agriculture.

One approach that can provide deeper insights into the potential utilization of meat boiling water is through the use of a Systematic Literature Review (SLR). The SLR method provides a systematic and

structured way to collect, evaluate, and analyze previous literature to gain a better understanding of the research topic. SLR also helps identify research trends, knowledge gaps, and provides direction for further research. In this context, SLR allows us to explore various findings regarding the potential of meat boiling water waste in the agricultural sector and its sustainability[9].

There are many benefits to be gained from utilizing meat boiling water waste; however, it is important to conduct further research on the long-term impacts of its use on soil quality and agricultural yields. Although an increase in crop yields has been observed after the application of meat boiling water, the long-term effects on soil sustainability are not yet fully understood in some studies. Therefore, further research is needed to understand its long-term effects and develop technologies that can minimize risks to the soil. This research aims to provide a deeper understanding of the potential utilization of meat boiling water waste on plants, as well as to identify the challenges and solutions associated with its use in the agricultural sector. By employing a SLR approach, this study reviews various previous studies discussing the utilization of meat boiling water waste in agriculture and its sustainability. This literature review is expected to uncover solutions and recommendations that.

Material and methods

Study description

This research employs a SLR approach to analyze and evaluate various existing studies regarding the utilization of meat boiling water waste in the agricultural sector, particularly in the context of organic fertilizers. The design of this research aims to identify the potential and challenges present, as well as the solutions proposed by previous researchers[10].

Population and sample

This study consists of all relevant literature related to the topic of meat boiling water waste, organic fertilizers, and their applications in sustainable agriculture. This research does not randomly select samples but rather conducts selection based on specific inclusion and exclusion criteria. Only studies published in peer-reviewed journals that discuss the main topic—namely, the utilization of meat boiling water waste as organic fertilizer—are considered for analysis.

Sample collection technique

This research was conducted by identifying articles published in various scientific databases, such as Google Scholar, JSTOR, PubMed, and Science Direct. The inclusion criteria used include articles discussing the utilization of meat boiling water waste in agriculture, organic fertilizers, and their sustainability. Additionally, only articles published in the last five years were selected to ensure the currency of the information. The researcher also excluded articles that were not relevant to the topic or did not meet scientific quality standards. The article selection process involved reviewing abstracts, conclusions, and research methodologies.

Data analysis technique

This study uses a descriptive qualitative method to compile findings from the collected literature. Each selected article is analyzed to identify various potentials, challenges, and solutions that have been proposed regarding the use of meat boiling water in agriculture. The collected data is then grouped and synthesized to provide an overview of the current developments and trends in this field. The analysis

process involves assessing the methodological quality of each study and the findings, as well as noting knowledge gaps that need further investigation.

Result

The results of the SLR on the utilization of meat boiling water waste as organic fertilizer indicate that this waste contains a significant amount of nutrients beneficial for plant growth. Based on the existing literature, meat boiling water contains various nutrients and flavour components, such as proteins, amino acids, vitamins, and minerals. Meat broth contains 2.48% protein; 0.19% amino nitrogen; 16.59% fat; 10.04% sugar; and 94.46% moisture content. Additionally, meat boiling water waste also contains macronutrients such as nitrogen (N), phosphorus (P), potassium (K), and micronutrients such as calcium (Ca), magnesium (Mg), as well as amino acids and dissolved proteins that play a role in the plant growth process[11]. The following table presents the nutrient content in meat boiling water waste based on literature from several studies:

Based on the literature, the application of wastewater from meat boiling has a positive impact on soil quality as a liquid organic fertilizer. The use of organic fertilizers provides many benefits for improving land quality. Organic fertilizers generally have advantages such as: (1) containing a complete range of nutrients, both macronutrients and micronutrients; (2) producing organic acids, including humic acid, sulfuric acid, hormones, and enzymes that are not found in synthetic fertilizers, which are very beneficial for plants and the environment; (3) containing macro- and microorganisms that play a significant role in improving the physical and especially the biological properties of the soil; (4) improving and maintaining soil structure; (5) acting as a buffer for soil pH and balancing the nutrients provided; (6) helping to maintain soil moisture; (7) being usable in large and even excessive amounts; (8) having no adverse effects on the environment[12].

On the other hand, because treated/untreated wastewater contains toxic substances such as potentially toxic elements (PTEs), meat boiling water waste can cause soil contamination, microbial issues, and fat deposition. This can lead to nutrient damage in plants, ultimately causing losses for farmers[13]. Therefore, proper processing of meat boiling water waste is necessary before it is applied to plants.

Table 1. Nutrient content in meat boiling water waste

Nutrient	Benefits for Plants
N	Meat broth contains N derived from proteins, which is essential for the vegetative growth of plants.
P	This element is important for root development and flowering in plants.
K	K plays a role in water regulation and enhances plant resistance to stress.
Ca	Ca is important for cell wall formation and root growth.
Micronutrients	Meat broth may also contain micronutrients such as Mg, Fe, and Mnwhich are required in small amounts for plant growth.

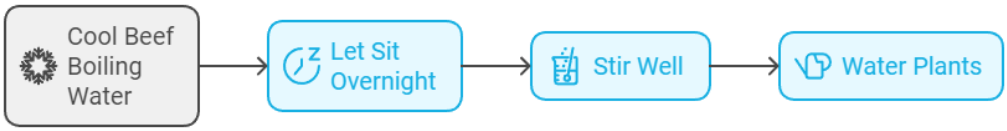

Figure 1. Application of meat boiling water waste for plant

Utilization of meat boiling water waste as organic fertilizer

The utilization of meat boiling water waste as organic fertilizer in the agricultural sector, as explained in various studies, shows that this waste contains essential nutrients needed by plants for growth and development. The N, P, and K in meat boiling water can enhance the vegetative growth of plants by increasing protein synthesis in plant cells, accelerating root formation, and improving soil quality[14]. In addition, the content of amino acids and dissolved proteins in meat boiling water can enhance the activity of soil microorganisms that function in the decomposition of organic matter and improve soil structure[15]. This process contributes to increased soil fertility and enhances the soil's capacity to retain water, which is crucial for areas with low rainfall. This indicates that the nitrogen and phosphorus content in meat boiling water serves as a primary nutrient source for plants.

However, as found in several studies, there are challenges in using meat boiling water as organic fertilizer. One of the main issues faced is the fat content in meat boiling water, which, while important as an energy source for plants, can cause soil pore blockage if not processed properly. This can hinder root growth and affect the plant's ability to absorb water and nutrients. Therefore, some studies suggest that meat boiling water undergo filtration or other processing to reduce fat content before being used as fertilizer.

Potential microbial contamination and proper processing

Based on a SLR, the utilization of meat boiling water in agriculture also needs to consider the potential for microbial contamination. Improperly processed meat boiling water can carry pathogenic microorganisms that may harm plants and soil quality[16]. To ensure the safety of using this waste, processing methods such as pasteurization and filtration are necessary to eliminate pathogens present in the meat boiling water. With proper processing, meat boiling water can become a safe and effective organic fertilizer for agricultural use. The following are the steps for applying meat boiling water waste to plants:

According to the **Figure 1**, the application of meat boiling water waste for plants includes several steps, as follows: cool the beef boiling water let it sit overnight, stir well, and water to the plants. Beef boiling water can be used to water plants, but it must be cooled first before application. This is because watering plants with hot beef boiling water can kill them. For better results, the beef boiling water should be left to sit for a maximum of one night. However, avoid letting it sit for more than one night as it may develop an odour. After letting it sit overnight, stir the beef boiling water until the clumps dissolve. After stirring, take the beef boiling water using a ladle or cup and water the plants. If you have chili plants that are flowering and fruiting, this beef boiling water is very good for application[17,18].

Long-term impact on soil sustainability

The use of meat boiling water shows positive short-term impacts on plant growth and soil fertility. However, some studies also indicate the need for further research to understand its long-term effects on soil sustainability. The increase in organic matter in the soil due to fertilization with meat boiling water can enhance soil fertility in the long term, but excessive use or improper application can negatively affect soil quality, such as the accumulation of inorganic nitrogen in the soil, which can impact the biodegradation of carbon compounds[2]. Additionally, excessive nutrient supply in the soil can have adverse effects. Nutrients such as phosphorus and nitrates can enter runoff or leach into groundwater, leading to eutrophication or habitat poisoning. Therefore, it is important to conduct further research on the long-term effects of using meat boiling water waste on soil quality and agricultural yields[19].

Challenges and solutions

Overall, although the utilization of meat boiling water has significant potential to support sustainable agriculture, there are several challenges that need to be addressed[20]. Further waste processing, such as filtration to remove contaminants, pasteurization to kill microbes, or the use of pathogen microbial technology, and the use of microorganisms to decompose the organic material present in meat boiling water are essential to reduce the potential risk of microbial contamination and optimize the nutrient content in meat boiling water. Therefore, a careful approach is needed in utilizing meat boiling water waste as organic fertilizer, along with further research to determine the best ways to manage this waste effectively.

Conclusions

The utilization of meat boiling water waste as organic fertilizer in the agricultural sector shows significant potential to enhance soil fertility and support plant growth. This waste contains various essential nutrients, such as nitrogen, phosphorus, and potassium, which can improve soil quality and increase agricultural yields. However, challenges in managing this waste, such as the potential for microbial contamination and high fat content, require special attention. Proper processing methods, such as filtration and pasteurization, are crucial to ensure the safety and effectiveness of using meat boiling water waste. Further research is needed to understand the long-term impacts of its use on soil quality and to develop technologies that can minimize risks. With careful approaches and good management, meat boiling water waste can become a valuable resource in supporting sustainable agriculture and reducing dependence on chemical fertilizers.

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Conflicts of Interest

The author declares that there are no conflicts of interest related to this research. All data and information presented in this article are the results of independent research and are not influenced by personal or financial interests.

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