

Biochar as an Important Resource in Aquaculture

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Abstract

Biochar and activated charcoal, derived from biological substances through pyrolysis, supports animal health by removing toxins, enhancing organ function and clearing harmful heavy metals from the gut. It acts as a cleansing agent in water purification and helps in carbon sequestration as it is the purest form of carbon. Integrating activated biochar into animal feed or bedding helps neutralize contaminants, improve digestion and boost overall well-being. Biochar from waste such as paddy straw, often burned after rice harvests, can be converted into biochar or activated biochar, creating valuable products for agriculture, water purification and animal husbandry. This transformation addresses environmental issues and fosters a circular economy by turning waste into valuable resources.

Keywords: Activated biochar, Biochar, Growth, Water quality

Introduction

Aquaculture is an expanding sector globally, which signifies the sustainable culture of aquatic species and plays a vital role in meeting global food demands. Fish feed production, a sustainable approach in aquaculture, plays a greater role in fulfilling the needs of fisheries and aquaculture. The feed should contain the main vital component *i.e.*, protein for better survivability and growth rate. But with the increase amount of protein in fish feed will lead to increase in the amount of toxic nitrogenous substance and ammonia in the aquatic environment through decomposition of unutilised feed and the excreta of the fishes which will lead to reduce growth and survival rate, increase stress and increase disease susceptibility. To overcome the effect of this hazardous effect many researchers have proven the beneficial effect of charcoal in aquaculture and mitigate the harmful and toxic effect of ammonia in aquaculture. Biochar and activated biochar have advantageous effect like the removal of heavy metals and ammonia gas from aquatic environment which make the water quality suitable. Many experiments by researchers found that it also has many advantageous effects in fish physiological health and improves growth. Waste such as paddy straw etc which are left burnt in the field can be used for utilisation in producing biochar and activated biochar *i.e.*, into useful resources.

Charcoal and Activated Charcoal

Charcoal or activated charcoal is carbon matters which are

crystalline in nature. This are the carbonaceous component of wood, bamboo, paddy straw and many plants remain that are produced after heated at a temperature of about 300 to 900 °C (Wong *et al.*, 2024). Difference between charcoal and activated charcoal is that charcoal are the solid black component that are produced after being heated at specific temperature in absence of air whereas, activated charcoal are the charcoal that the activated with the help of physical or chemical components such as O₂, H₃PO₄, ZnCl₂, KOH, *etc.* *i.e.*, to increase the surface area and increase the pores to make it more efficient with minimum amount. Due to increasing awareness the activated charcoal is in a high demand.

Maintaining Water Quality

Charcoal plays a vital role in maintaining water quality *i.e.*, by absorbing harmful toxins heavy metals organic compounds and even some bacteria due to its high porosity from the aquatic environment acts in remediation. It improves the taste, odour and transparency of water. It acts with water through some chemical-physical interaction to remove the hazardous matter. Many researchers have come into conclusion that the charcoal and activated charcoal have a greater efficiency and cost effective in improving water quality in the fish culture system.

Fish Growth

Many researchers have found that on implementation of

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charcoal or activated charcoal have improve the growth of fish along with improvement of physiological health like increasing in intestinal villi length (Firdus et al., 2021) that will help in increase the efficiency of absorbing nutrients for metabolic activity and growth. It is also found removing of heavy metals (Abdel-Tawwab et al., 2017), that retard the growth and cause various health issues. Improve water quality will also help in increase metabolic activity of fish. Charcoal plays a vital role in improvement of fish growth with its advantageous factors. Activated charcoal as a feed supplement adds benefits to growth, nutritional and mineral absorption and blood parameters in grass carp (Amjad et al., 2024).

Process of Preparation

Many processes are there one of the process is as follows: The biological substances such as wood, rice husk, paddy straw was pyrolyzed at 500-700 °C for 2 hours to form biochar in muffle furnace. The biochar is then treated with activating agent such as KOH at different ratio weight by volume and kept in oven at 110 °C for 24 hours (Bari et al., 2022). It is then put at muffle furnace at 500 °C for activation for 1 hour. Then repeated washing with distilled water and dried in oven at 110 °C for 24 hours. The activated charcoal is then dried, ground, sieved and stored in an airtight container for use. The process is illustrated in the figure 1 below.

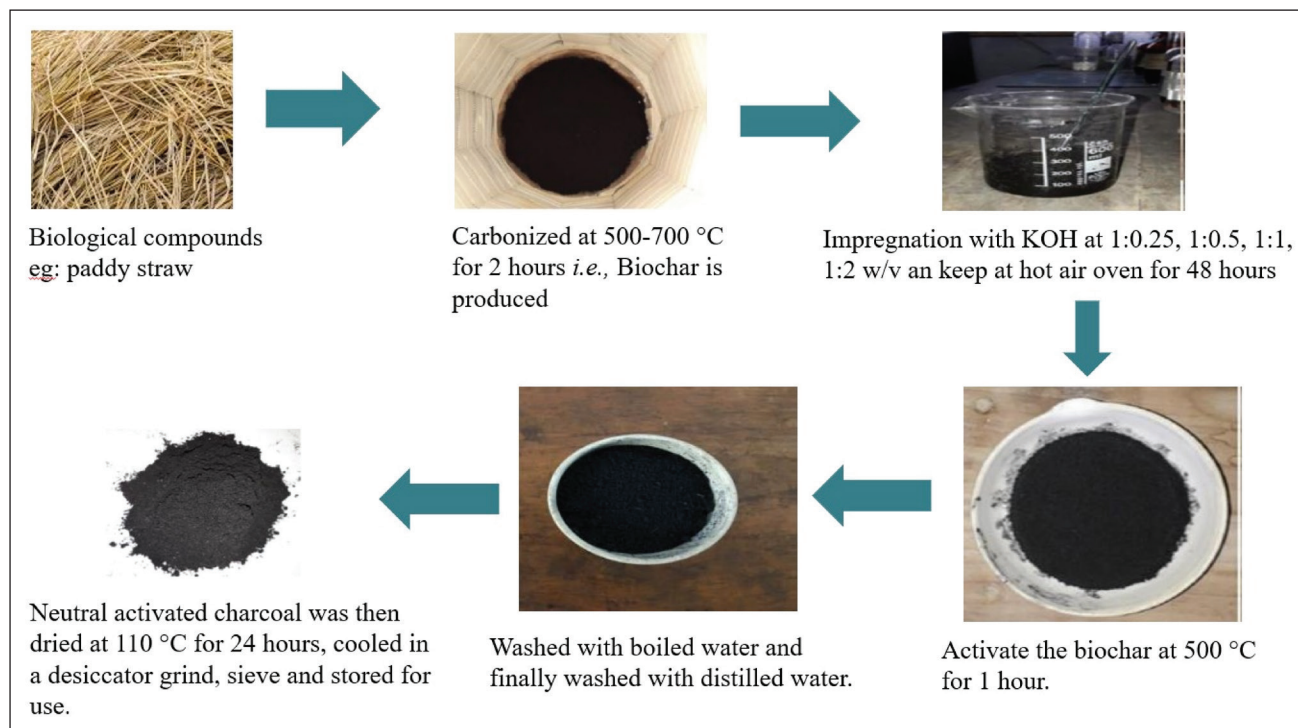


Figure 1: Preparation procedure of biochar and activated biochar (Bari et al., 2022)

Potential of Biochar

Due to its high absorption and adsorption help in enhancement of hygiene by attracting toxic substances such as pathogen, heavy metals (Cd, Cu, Pb and Zn in fish bodies) preventing the effect of toxins (alcohols, analgesics, antimicrobial agents, plant and animal toxins and endogenous toxins, as well as gases such as methane and stomach gas) and harmful compound by absorption and adsorption mechanism because of their high porous structure. Some research shows that it helps in bioremediation and can control the odours of some compounds such as cow dung. Some publications show improvement in gastrointestinal disorders in animals. It helps in growth performance in fish and the treatment of water quality by reducing ammonia and lower phosphate levels could serve as an effective treatment of water in aquarium tanks.

Challenges and Future Directions in Biochar Production

Limited research is preventing the application of overall benefit of the activated biochar in aquaculture. A number of barriers to increasing biochar production are expensive,

variable feedstock quality and the need for efficient technologies. Future advancements might increase production efficiency, minimize expenses and maximize feedstock utilization. Policies and incentives may help encourage broader adoption as well.

Conclusion

It is not harmful to animal consumption and has many benefits in growth nutrient uptake. It has also been found increment in the intestinal villi of fish. It removes pollutants and improves the health of the animal as well as the environment. In view of these advantages, new research and technologies for production should be adopted for a greener and more economical way of utilizing strategies. Biochar and paddy straw utilization are essential for advancing sustainability and reducing environmental impact. Biochar aids in carbon sequestration, soil health and emission reduction.

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