



UNIVERSITY OF LIFE SCIENCES "KING MIHAI I" FROM
TIMISOARA
"YOUNG PEOPLE AND MULTIDISCIPLINARY RESEARCH
IN APPLIED LIFE SCIENCES"

16-17 November 2023



"Young people and multidisciplinary
research in applied life sciences"

USE OF BY PRODUCTS FROM FOOD INDUSTRY AS FERTILIZERS

UNGUREANU ALEXANDRA, VICAR NICOLETA, CRISTA LAURA, LATO ALINA,
ISIDORA RADULOV

Abstract:

Food production and consumption generate a lot of waste and by-products that harm the environment. The FAO distinguishes between food losses, which occur between the producer and the market, and food waste, which is the discarding of safe and nutritious food. About a third of the food produced is wasted, which means wasting the resources used to produce it as well. Food waste is not only an economic problem, but also an environmental and moral problem. When food ends up in landfills, it releases methane (CH₄), a potent greenhouse gas that is 25 times stronger than carbon dioxide (CO₂) in warming the planet. One way to reduce food waste is to compost the inedible parts and use them to enrich the soil. Another way is to transform the by-products of food processing and manufacturing, which represent 14% of the total food waste, into soil amendments. This can improve soil services and crop productivity, while reducing the environmental impact of food production. This work shows how different types of food industry by-products (bentonite, keratin) can be used as soil improvers.

Key words: waste, soil amendments, soil fertility, bentonite, keratine

• Introduction

Soil quality is a key factor of sustainable agriculture, which is influenced by different physical and chemical properties, taking into account the influence of climate and external factors. Agriculture and the pressure to meet growing food demand causes many of the problems that threaten soil health, such as: degradation and decline caused by intensive practices; compaction under heavy machinery and inappropriate agronomic land cultivation practices; damage to biodiversity caused by monocultures and other land use and management practices; chemical pollution (eg pesticides, heavy metals, pharmaceuticals, plastics, etc.); neglect and abandonment of lands. Various current land and crop management practices have resulted in the degradation of soil quality, thus having a negative impact on the sustainability of agricultural inputs.

• Material and method

According to a recent study, more than 30 Mt of food waste is produced in the EU per year, with fruits and vegetables, including potatoes (11 Mt), oil crops (10 Mt), meat and fish (6 Mt), cereals (2.5 Mt) and dairy products (1.1 Mt) being the largest quantitative groups (Caldeira et al., 2019). Currently, in the EU, food waste reduction and reuse activities are fragmented, often applied with a small and limited profit margin, discouraging the participation of private companies and implementation by end users. This article aims to show that some categories of waste from the food industry, such as various inorganic (silicates, mineral nutrients) and organic (polymers, biochar, compost) products can be used as soil improvers and plant strengtheners. Various waste categories that have not been extensively addressed before, such as bentonite and keratin, as well as in recent approaches, already intensively studied, can be recycled as soil improvement products (biochar, composts), thus investigating innovative reuse strategies and reusing this waste and turning it into innovative products used beyond the current linear economy model.

• Results and discussions

- As a result of the use of **bentonite** in the beverage industry, significant amounts of waste result, with an impact on the environment. When used as a clarifying agent, bentonite acquires a protein load that makes it a potentially useful fertilizer and are also potentially useful for soil amendment.
- The use of bentonite as a soil amendment is of particular interest from an economic point of view due to its low cost and the high amounts of bentonite waste resulting from the food industry. Various studies on the use of bentonite as an agricultural soil amendment have demonstrated a significant improvement in water holding capacity [3] and reduction in soil bulk density [7] in semi-arid agricultural areas. Improving soil quality through the use of bentonite has been shown to improve the establishment of field crops such as maize (*Zea mays* L.), millet (*Panicum miliaceum* L.) and pumpkin (*Cucurbita pepo* L.) [3,7,8].
- Incorporation of bentonite into soil can improve the overall agronomic quality of sandy soils (10,11) by increasing soil water holding capacity (12,13), stability of soil aggregates and total cation exchange capacity (14). These proven beneficial effects promote the widespread use of bentonite as a soil conditioner in many arid parts of the world (15) in order to improve crop growth and yield. However, there are not many studies on how soil microbial communities are influenced by bentonite application. A study made by Zhang et al. (2020) shows that bentonite improved sandy soil structure, water content and nutrient concentration and also induced compositional shifts in microbial functional guilds. Same study shows that bentonite enriched fungal phytopathogens but may also promote soil fungistasis.

- Application of residual bentonite from a winery to an acidic soil resulted in increased soil N, K and P content, as well as pH and cation exchange capacity. Environmental disadvantages of residual bentonite include high soluble copper content, although its conversion in soil to less soluble forms reduces its potential phytotoxicity (4).

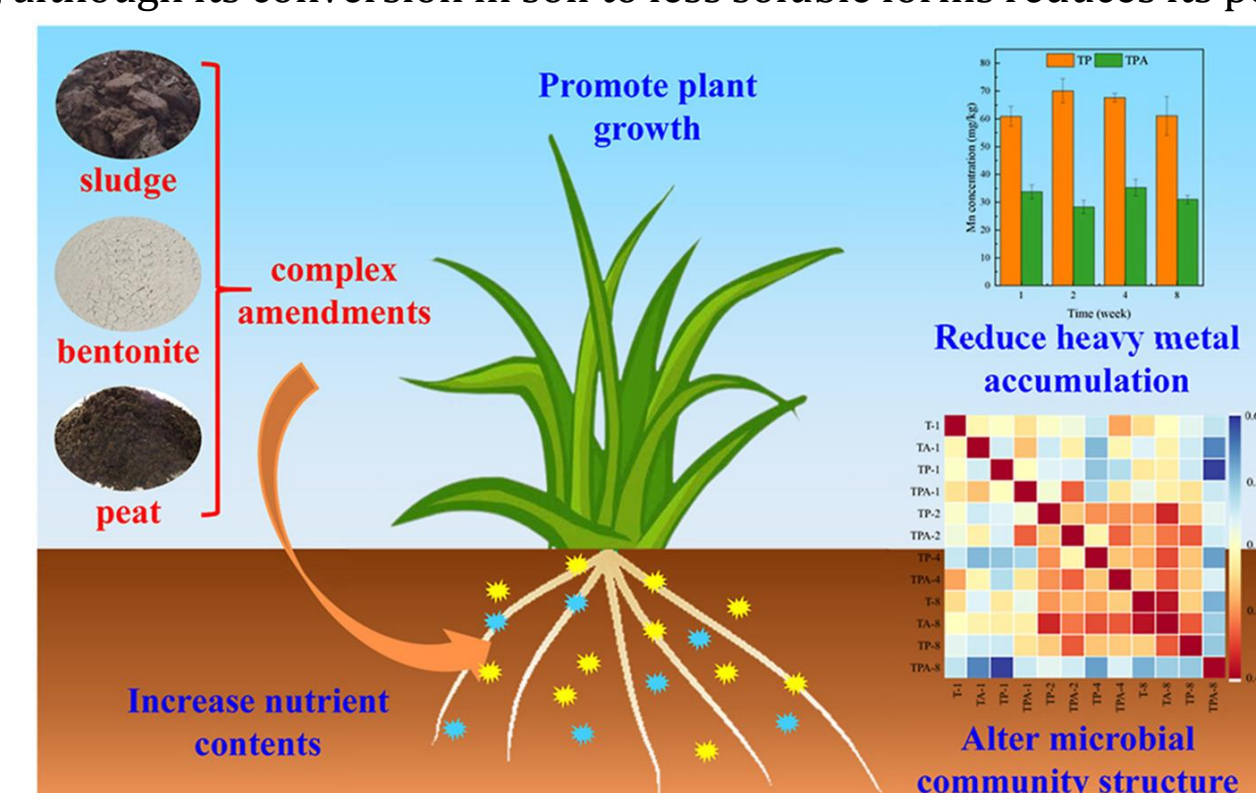


Fig. 1 The use of bentonite (https://ars.els-cdn.com/content/image/1-s2.0-S0045653523003193-ga1_lrg.jpg)

- The production of biofertilizers using animal or plant waste, rich in carbon, nitrogen and other elements, represents an economical way of obtaining new types of fertilizing resources, reducing, at the same time, the amount of waste produced in the food industry. Waste from the food industry containing keratin, such as feathers, but also their degradation bacteria, is a source for the production of biofertilizers.
- Feather hydrolyzate, which can be used as biofertilizer, is obtained by biological treatment of feathers with keratinolytic microbes. The hydrolyzate will contain amino acids, soluble proteins and peptides, ensuring the development of microbes in the rhizosphere, which promote the absorption and use of nutrients from the soil. Following the application of the hydrolyzate, the water retention capacity, the C/N ratio and the mineral content of the soil are improved (21)
- Keratin extracted from waste bovine hair, treated with Acrylic acid and N,N-methylenebis acrylamide in order to form keratin-based superabsorbent (KSA). KSA could improve water-retention of soil and could be used in combination with fertilizer like urea in order to improve the utilization rate of fertilizers by slowing down release of nutrients

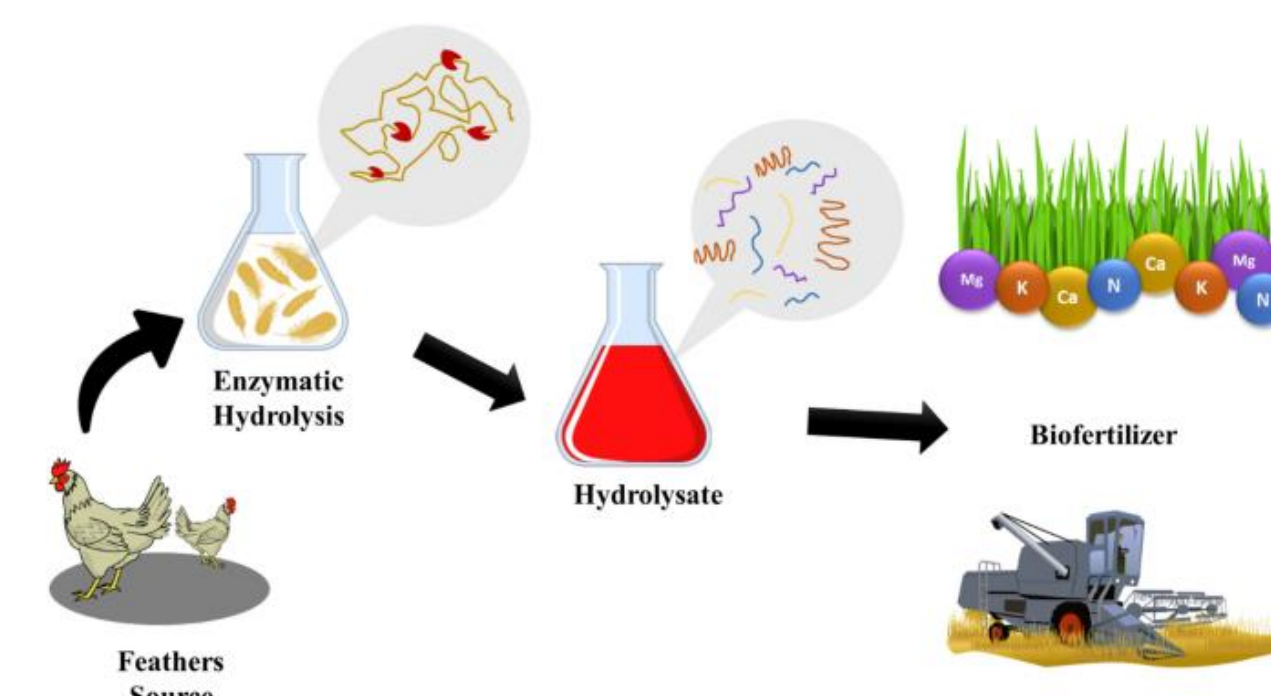


Fig. 2 Chicken Feather Waste Hydrolysate as a Potential Biofertilizer

(<https://link.springer.com/article/10.1007/s12649-023-02123-6>)

• Conclusions

The use of bentonite in agriculture is quite important, because it is a tool for amending the soil, has a low cost and improves the soil's ability to retain water. The production of biofertilizers made from animal or vegetable waste plays an essential role in the agricultural field, because it represents a more economical way to obtain new types of fertilizing resources by reducing animal or vegetable waste.

Acknowledgement:

This research paper is supported by the project Consolidation of the research - innovation ecosystem within USVT code CNFIS-FDI_2023-F-0343