CHICKEN BONE WASTE: A STUDY OF THE METHOD FOR OBTAINING HYDROXYAPATITE

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Abstract: This thesis analyzes, through the processing of chicken bone waste as a secondary mineral raw material, the existing methods of obtaining hydroxyapatite Ca10(PO4)6(OH)2 based on scientific literature. The separation of organic components contained in animal bones — in particular collagen and lipids — together with the preservation of the mineral calcium phosphate fraction, was investigated as the main stage of the hydroxyapatite production technology. The research was carried out through the following stages: preliminary treatment of the bone, crushing, defatting, chemical purification, and thermal processing.

Keywords: bone waste, hydroxyapatite, calcination, calcium phosphate, thermal processing.

Introduction. Animal bone waste generated in the meat and food industry contains, alongside organic substances, large amounts of calcium-phosphate mineral components. Instead of simply disposing of this waste, converting it into products with high added value is considered one of the promising directions for the rational use of resources. Chicken bone waste is a secondary biological raw material rich in calcium and phosphorus, and is a promising source for obtaining hydroxyapatite Ca10(PO4)6(OH)2\mathrm{Ca_{10}(PO_4)_6(OH)_2} as a promising source. Scientific research has found that broiler chicken bones contain, on average, 18,9 ± 0,386 % Ca and 13,906 ± 0,320 % P present. As a result of cleaning chicken bones from organic residues and calcining them in the temperature range of 700–900 °C, a crystalline hydroxyapatite phase can be obtained. In particular, calcination at 800 °C for 3 hours was applied for effective removal of organic matter, while at higher temperatures the crystallinity of the material increases. However, at 1000 °C and above, a partial phase transformation of hydroxyapatite and β\beta-tricalcium phosphate may form. Therefore, processing chicken bone waste is a promising direction not only for obtaining high-value calcium-phosphate biomaterials, but also for converting biological

waste into a resource. Below are presented the results of the international application of chicken bones.

Table 1

Areas of application of chicken bone waste

No.	Application direction	Product obtained from chicken bone	Application area	Scientific and practical significance
1	Biomedicine	Hydroxyapatite	Bone implants, filling of bone defects, tissue engineering	A Ca–P biomaterial close to natural bone mineral
2	Veterinary medicine	Powder and granules	Veterinary bone transplantation and bone grafts	Converting poultry waste into a high-value biomaterial
3	Wastewater treatment	Adsorbent	$Cd2^{+}$, adsorption of heavy metal ions.	Ion exchange and adsorption via the mineral surface
4	Catalysis	CaO	Organic synthesis and oxidation reactions	Possesses acid–base active sites
5	Biodiesel production	CaO	Transesterification reaction	Waste-based heterogeneous catalyst
6	Agriculture	Bone char and phosphate material	Slow-release phosphorus fertilizer and soil remediation	A long-term source of phosphorus
7	Electrochemistry	Carbon–calcium phosphate bone char	Electrode and energy storage materials	A combination of mineral and carbon phases
8	Environmental remediation	Modified bone char	Immobilization of toxic elements	Adsorption and ion

			in soil	exchange
9	Polymer composites	Finely dispersed HAp/bone char	Mineral filler for polymers	A promising direction for improving hardness and functional properties

The most actively studied applications of hydroxyapatite obtained from chicken bone waste are biomedicine and water treatment. For example, based on HAp obtained from chicken femur bone and beak, Cd2+ ion removal from an aqueous medium was studied; the specific surface area of the sample obtained from chicken femur bone was 16,72 m^2/g, with maximum adsorption determined at pH 6, 25 °C, 80 minutes, and an adsorbent concentration of 2 g/L.

Conclusion Within the framework of this study, it was found that the sequence mechanical cleaning → washing/defatting → drying → crushing → calcination at 700–900∘C → crushing and fractionation is a promising technology for obtaining hydroxyapatite from chicken bone waste.

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