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ИСПОЛЬЗОВАНИЕ ВТОРИЧНОГО СЫРЬЯ ПТИЦЕПЕРЕРАБАТЫВАЮЩЕЙ ОТРАСЛИ ДЛЯ ПОЛУЧЕНИЯ ВЯЗКОГО ГИДРОЛИЗАТА КЕРАТИНА

THE USE OF SECONDARY RAW MATERIALS OF THE POULTRY-PROCESSING INDUSTRY FOR OBTAINING VISCOUS KERATIN HYDROLYSATE

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Аннотация

В представленной работе рассматриваются проблемы эффективного использования вторичного сырья птицеперерабатывающей отрасли для решения экологических проблем близлежащих к птицефабрикам территорий.

Материалы, методы, результаты и обсуждение

Изучается возможность использования ультразвуковых волн в процессе проведения гидролиза кератинсодержащих отходов птицеперерабатывающих предприятий.Представляется эффективным использование возможностей ультразвукового излучения (УЗИ) для выделения кератина из пухо-перьевых отходов, так как существующие технологии предлагают жесткие технологические условия требующие поддержание высоких температур, давления и высоких концентраций реагентов. Применение таких режимов приводит к полному разложению молекулы кератина, потере полезных свойств и деградации, кроме того, использование существующих методов зачастую является экономически невыгодным за счет высоких расходов энергии и ресурсов.

Заключение

В работе проводится анализ возможности применения ультразвуковых волн для интенсификации процесса гидролиза. Предполагается, что использование ультразвуковых волн позволит снизить расход энергоресурсов за счет интенсификации процесса и значительно ускорит процесс гидролиза. Рассматривается возможность увеличения массовой доли готового продукта на выходе.

Ключевые слова: вторичное сырье, сырье животного происхождения, кератин, отходы птицеперерабатывающей отрасли, пухо-перьевые отходы, щелочной гидролиз кератина, ультразвуковые волны, интенсификация процесс, вязкий гидролизат.

Abstract

The presented paper considers the problems of effective use of secondary raw materials of the poultry processing industry to solve environmental problems of territories adjacent to poultry farms.

Materials, methods, results and discussion

The possibility of using ultrasonic waves in the process of hydrolysis of keratin-containing waste from poultry processing enterprises is being studied.It seems effective to use the capabilities of ultrasound radiation (ultrasound) to isolate keratin from down-feather waste, since existing technologies offer strict technological conditions that require maintaining high temperatures, pressure and high concentrations of reagents. The use of such modes leads to the complete decomposition of the keratin molecule, loss of useful properties and degradation, in addition, the use of existing methods is often economically unprofitable due to high energy and resource costs.

Conclusion

The paper analyzes the possibility of using ultrasonic waves to intensify the hydrolysis process. It is assumed that the use of ultrasonic waves will reduce the consumption of energy resources due to the intensification of the process and significantly accelerate the hydrolysis process. The possibility of increasing the mass fraction of the finished product at the output is being considered.

Key words: secondary raw materials, raw materials of animal origin, keratin, waste from the poultry processing industry, down-feather waste, alkaline hydrolysis of keratin, ultrasonic waves, intensification of the process, viscous hydrolysate.

Introduction

The increase in the consumption of poultry meat leads to a significant increase in the number of poultry farms and poultry processing enterprises. The problem of effective use of secondary raw materials – keratin-containing down feather waste – is becoming urgent. The total amount of non-food waste during poultry processing is 15.3-18.5% of the live weight of the bird, including feathers, down – 4.0-7%.

Materials and methods

Feathers are waste that belongs to the 4th hazard group, and, in the event of an accident, the recovery period can take up to 5 years.

With a livestock of 10 million broilers, feather waste can exceed 950 tons per year, and meat and bone waste – 5 thousand tons per year.

Utilization of poultry processing wastes results in a significant problem for the poultry industry enterprises and is gaining more and more economic importance, creating a certain burden on the cost of finished products. Today, the average level of industrial processing of secondary raw materials in the poultry industry barely reaches 20%. The remaining 80% is disposed of by landfill or incineration, which results in air, soil and water pollution. However, non-food waste from the poultry industry after appropriate processing can be involved in economic circulation, since they are sources of valuable minerals [1,2].

The main component of down and feather waste is keratin. Keratin is a protein with high mechanical strength, which among materials of biological origin is second only to chitin in strength. The horny derivatives of the epidermis of the skin are mainly composed of keratins – such structures as hair, nails, rhino horns, feathers and ramfoteca of birds' beaks, etc. Moreover, the content of keratin in them reaches 55-87%. Keratin contains amino acids and about sulfur-containing amino acids. Most of the amino acids that are used for the manufacture of biostimulants are found in keratin, that is, down and feather waste [3].

Таблица 1 - Amino acid content in keratin.

Amino acid	% content
Aspartic acid	0,52
Threonine	0,43
Serine	1,05
Glutamic acid	0,92
Proline	0,89
Glycine	0,63
α-alanine	0,39
cystine	0,48
Valine	0,55
Methionine	0,13
Isoleucine	0,36
Leucine	0,65
Tyrosine	0,23
Phenylalanine	0,38
Lysine	0,17
Histidine	0,05
Arginine	0,58
Tryptophan	Not determined

Results and discussion

Having studied the component composition of keratin, it can be concluded that its use can be effective as an organomineral fertilizer with a biostimulant effect. The main characteristic of keratin is considered to be high chemical and mechanical strength and resistance to external influences. Such indicators are an obstacle to natural degradation, affect the speed of composting, but can be a necessary quality when considering the possibility of using down and feather waste as a natural biopolymer.

For hydrolysis, we can use any kind of alkali, be it NaOH or Ca (OH) 2. But given the specifics of further use, our choice will stop at caustic potassium. The pH of the resulting hydrolyzate can be varied; for these purposes, we propose to use phosphoric acid. To intensify the process, exposure to ultrasonic waves is used. It is assumed that the use of ultrasonic treatment will accelerate the hydrolysis process, increase the mass fraction of the finished product and reduce energy and resource costs, which in turn will lead to a decrease in the cost and increase the profitability of disposal of keratin-containing waste.

Under the influence of ultrasonic action, turbulent flows are created in the extractant used, the flow rate of raw materials (keratin-containing waste) increases, as a result of an increase in speed, the fastest swelling and destruction of the keratin structure occurs.

Further work was aimed at creating a device with the help of which it was possible to carry out ultrasonic action on the raw material and to increase the contact area of the extractant with the raw material Fig. 1.

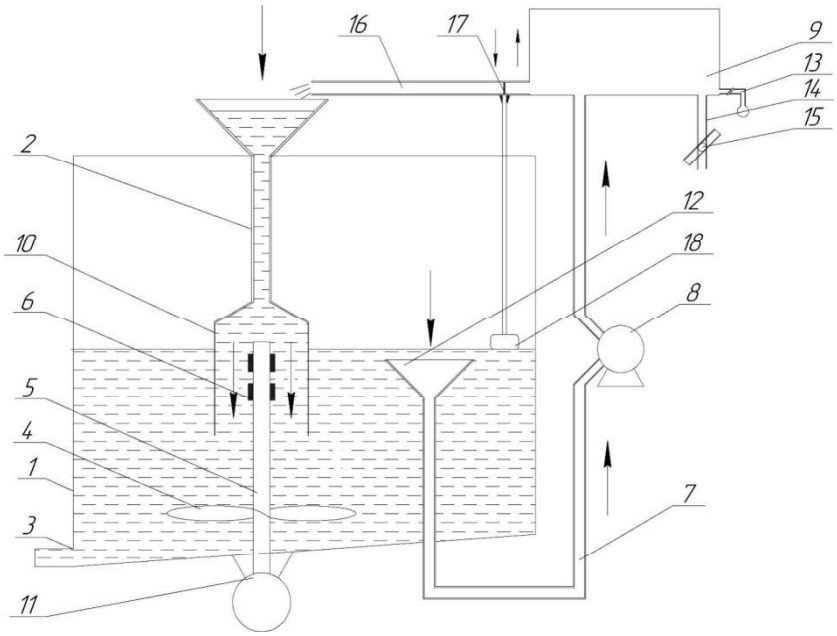

Figure 1. Device for hydrolysis of keratin-containing raw materials

The developed device for carrying out hydrolysis with ultrasonic action contains a housing 1 with a feed pipe for raw materials and an extractant 2 equipped with a funnel, a pipe for draining solid impurities 3, a paddle mixer 4 located inside the housing 1 on the drive shaft 5, an ultrasound source 6 and a recirculation pipeline extractant 7, equipped with a pump 8 and connected to the storage tank 9. The feed pipe for raw materials and extractant 2 is equipped with a cylinder 10, a coaxial shaft 5 of a paddle mixer 4, connected to a drive 11. The ultrasound source 6 located above paddle mixer 4 is made in the form of a magnetostrictive transducer, the design which is an annular laminated twisted core with alternating layers of magnetostrictive active material, covering the inner and outer surfaces of the transducer, and an excitation winding, toroidally enclosing the core. The principle of operation of a converter of this type is based on the effect of magnetostriction, which consists in changing the size of ferromagnetic bodies under the influence of an alternating magnetic field, and the degree of deformation of various ferromagnetic materials depends on the magnitude of its strength. At the same level with the ultrasound source 6, a loading recirculating funnel 12 is installed, connected by a pipeline 7 with a storage tank 9. The storage tank 9 has a sampler 13, a drain pipe 14 with a tap 15 and communicates with the funnel of the feed pipe and extractant 2 by pipeline 16, equipped with a valve 17 controlled by a float regulator 18.

Conclusion

Due to the use of ultrasonic processing of keratin-containing raw materials, an intensification of the hydrolysis process occurs, while the processing time of raw materials decreases, and accordingly, the energy resources of the enterprise are saved. In this case, the mass fraction of the finished product increases. Thus, we get a device that, with the consumption of less energy resources, is capable of producing a large mass of the finished product.

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