

ANNOTATION
Dissertations for the degree of Doctor of Philosophy (PhD)
in the specialty "6D070100-Biotechnology"
RESEARCH OF BIOTECHNOLOGICAL PROCESSES AND
DEVELOPMENT OF GERODIETIC SEMI-FINISHED PRODUCTS FROM
TILAPIA FISH
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Relevance of the study:

The progressive aging of the population is one of the key trends of the 21st century, which has a profound impact on social, social and health systems worldwide. According to forecasts by the World Health Organization, by 2025 the number of people over 60 years old will reach 1.2 billion people (16% of the total population), and by 2050 the age will reach 2 billion (21%). In Kazakhstan, similar demographic changes are already becoming apparent: according to data for 2019, the share of people over 60 years old was 11.6%, and over 65 years old - 7.5% of the total population. The increase in life expectancy from 68.3 to 73.12 years in recent years indicates progress in healthcare, but the quality of nutrition of the population remains an important problem that modern society requires. Research shows that the diet of the elderly population of Kazakhstan often does not correspond to the principles of healthy eating, characterized by the predominance of saturated fats, simple reasons and lack of polyunsaturated fatty acids, proteins and vital vitamins. Such an imbalance can contribute to the development of chronic diseases and a decrease in the quality of life. This ninth special role includes the introduction of products enriched with functional components aimed at maintaining human health. One of the promising discoveries is the development of gerontological products based on aquacultures, in particular, Nile tilapia (*Oreochromis niloticus*), which has high nutritional value, easily digestible protein, external links of polyunsaturated fatty acids and the content of organic metals and toxins.

Novelty of the study:

For the first time, a multidisciplinary analysis of biotechnological processes for creating semi-finished products based on tilapia using adapted probiotic cultures was carried out; the study makes a significant contribution to the development of aquaculture, improving the quality and safety of food products, taking into account the requirements of gerodietics and the principles that determine development. Feed additives that contribute to increasing the biological value of meat and fish were studied, and their organoleptic properties were confirmed. For the first time, a histological and morphological analysis of Nile tilapia under various growing conditions was performed, as well as an assessment of the probiotic strain E.coli 64G as a means of accelerating meat stabilization and improving its textural characteristics.

Purpose of the study:

Research of biotechnological processes for the production of semi-finished products from tilapia fish using probiotic strains, as well as the development of technical solutions for the production of a range of fish products with controlled properties and improved consumer quality indicators.

Research objectives:

1. To study the microbiological parameters of water in various reservoirs (pools, ponds) for aquaculture of Nile tilapia;
2. To study the analysis of nutritional and biological value of Nile tilapia fish meat for gerodietetic nutrition
3. To determine the probiotic activity of the drug Enteracol in herbal dietetic products;
4. To study the histological and technological properties of semi-finished products (sausages and meatballs) from Nile tilapia

Object of study: Tilapia (Tilapia) belongs to the order *Perciformes* , a genus of fish from the Cichlid family . (*Cichlidae*), species Nile tilapia (*Oreochromis niloticus*)

Subject of the study: Probiotic effect in the development of a gerodietetic semi-finished product from tilapia fish.

Theoretical significance of the study:

The study makes a significant contribution to the development of theoretical knowledge in the biotechnology and ecology of Nile tilapia, as well as the mechanisms of interaction of probiotic strains with aquatic organisms. Particular attention is paid to the study of biotechnological processes in the use of probiotics to improve the health and growth of tilapia. This study can contribute to the development of new biotechnological methods and strategies in aquaculture applicable on a global scale. In addition, the study contributes to gerodietics by exploring the potential of tilapia as a dietary product for the elderly population, which can help in the development of new food products to improve health and quality of life.

Practical value of the study:

At a practical level, the results of the study provide a basis for improving aquaculture practices in Kazakhstan, including commercialization of developments in the field of organic fish products. The use of innovative biotechnological approaches in tilapia production using probiotics and environmentally friendly feeds helps to improve the quality and safety of products. This, in turn, can significantly increase the economic benefits of fish production, ensuring sustainable growth of

the industry and expanding the export potential of organic products from Kazakhstan to international markets.

Connection with the plan of the main scientific works: The dissertation work was completed within the framework of the commercialization project of the Scientific Foundation 2016-2019 No. 236-16-GK "Production of organic products from fish (tilapia, African clariform , etc.) grown on the basis of local environmentally friendly feed in accordance with international standards."

AsylTasEngineering LLP , in the laboratory of the Research Center for Quality and Safety Assessment of Food Products of the Almaty Technological University and in the laboratory of the Kazakh-Japanese Center at the Kazakh National Agrarian Research University.

The main provisions submitted for defense:

1) The results of microbiological analysis of water conducted at 11 water bodies of the TENGRY FISH LLC farm showed that the level of QMAFAnM is within 1.7×10^3 – 4.0×10^4 CFU/g (cm³), which corresponds to the permissible standards ($MPC \leq 5 \times 10^4$ CFU/g (cm³)). The minimum values were recorded in well No. 2 (1.7×10^3 CFU/g (cm³)), the maximum - in the water at the entrance (4.0×10^4 CFU/g (cm³)). When conducting BGKP (coliform exclusions) and pathogenic studies, including *Salmonella* spp ., their presence was not detected in all research samples, the water of all the studied objects meets sanitary and hygienic requirements, which confirms its conductivity for breeding Nile tilapia. Monitoring the microbiological indicators of water, raw materials and semi-finished products should be a controlled part of technological processes in the production of fish products

2) The results of a comprehensive study of the chemical composition and nutritional value of Nile tilapia with the introduction of an unconventional feed additive and new feed recipes into the diet confirmed their safety and positive effect on the nutritional value of fish. Analysis of the fatty acid profile showed a decrease in the level of saturated fatty acids (SFA) from 27.26% to 26.32% and an increase in polyunsaturated fatty acids (PUFA) from 34.67% to 35.72%, indicating an improvement in the lipid composition. The PUFA/SFA ratio was taken from 1.27 to 1.35 , which corresponds to the balance of fatty acids for the prevention of cardiovascular diseases. The content of oleic acid (C18: 1 n9) changed to the greatest extent in the 2nd group (21.78%). docosahexaenoic acid (C22:6 n-3, DHA) in group 1 (16.08%) and eicosatetraenoic acid (C20:5 n-3, EPA) in group 4 (4.22%). These fatty acids have cardioprotective , anti-inflammatory and neuroprotective properties. properties, making Nile tilapia a staple in the human diet. The amino acid composition study showed an increase in the total content of essential amino acids (EAA) from 5.68% to 6.32% and nonessential amino acids (NEAA) from 7.23% to 7.76%. In the 4th group, the lysine level reached 1.92%, which is 111% higher than the control group (0.91%), and the content of methionine, tryptophan and phenylalanine also increased. The increased concentration of glutamic acid (3.05%) was noted in the 3rd group, which confirms the real biological value of tilapia meat. Comparative analysis with the data of other studies showed that the ratio of n-6/n-3

PUFA was 0.53, corresponding to the norm (≥ 0.45), and the ratio of DHA (C22:6 n-3) to EPA (C20:5 n-3) reached 3.94%, which is higher than that of most freshwater fish. The obtained results confirm the prospects of using these feed technologies in aquaculture to create fish products with high biological value.

3) The results of the study confirm that the drug Enterokol, developed on the basis of the E. coli 64G strain, meets the probiotic requirements and can be used in the composition of durable products. The E. coli 64G strain has proven its safety and lack of toxicity, which allows its use in the food industry. The strain demonstrated high antagonistic activity when applied to pathogenic and opportunistic studies, which makes it competitive among probiotics. E. coli 64G is resistant to bile (up to 20%) and hydrochloric acid (up to 1.5%), which ensures its ability to pass through the gastrointestinal tract and maintain resistance. Experiments on laboratory animals showed 100% safety of the strain: no negative changes were detected over 20 observations. In the control group, mortality was 100%, while among the animals receiving probiotics, mortality decreased to 10%. After taking E. coli 64G, the amount of useful substances decreased by 7 times, and pathogenic microflora decreased by 3-4 times. The E. coli 64G strain is stable under production conditions and can be preferred for use in functional nutrition, including among people, 75% of whom have nutritional disorders.

4) Histological analysis of semi-finished products showed that the use of the probiotic E. coli 64 provides a stable structure of muscle tissue in sausages, contributing to a uniform texture and resistance of connective tissue to dynamic loads. The average content of muscle tissue was 40.2%, connective tissue - 29.4%, fat - 14.7%, vegetable components - 15.7%. Histological examination showed that part of the mince was homogenized, muscle fibers retained integrity, and connective tissue demonstrated resistance to mechanical processing. Comparative analysis of semi-finished products from Nile tilapia and clarias catfish revealed a number of significant advantages of tilapia. In particular, the moisture content in tilapia is 26.91%, which is significantly lower than in clarias catfish (37.3%), which provides semi-finished products with texture stability and resistance to spoilage. The pH values for both species were high (6.7) and the protein content reached 15.5% for tilapia and 15.8% for catfish, confirming their essential nutritional value.

Testing the work.

1. The report on the topic "Development of gerodietetic semi-finished products using a probiotic strain for the rehabilitation of intestinal microflora" was successfully heard at the International Conference "XVIII Global teaching Dubai", which took place at Amity University, UAE, Dubai (8-14 May 2023)
2. The report on the topic "Innovative technologies in the breeding and commercialization of tilapia fish: scientific research and industry prospects" was successfully heard at the International Conference in the UK, London (January 22-29, 2024)

3. Participated in " VI " An international book publication of the Commonwealth of Independent States, organized by the Association of Legal Entities in the form of the association "National Movement "Bobek". 1st degree diploma in the competition "Best Teacher of 2022 ", Kazakhstan, Almaty
4. Participated in the "III International Book Publication", "Best Young Scientists-2022" and was awarded the 1st degree Diploma in the competition among scientific and educational institutions of the Commonwealth of Independent States, organized by the Association of Legal Entities in the form of the Association "National Movement "Bobek", Kazakhstan, Almaty
5. The report "Study of gerodietetic fish semi-finished product for rehabilitation of intestinal microflora" was successfully heard at the I International Forum " Asfen.Forum , new generation-2023" on June 5-6, 2023 in Kazakhstan , Almaty

Publications . 21 works have been published on the topic of the dissertation, including 2 articles in journals recommended by the Committee for Quality Assurance in Education , 4 works in journals included in the Web of Science (1) and Scopus (Q1, Q 2, Q 2) databases , 7 articles in other publications, 5 reports and 3 conference abstracts , 6 patents for inventions and 1 utility model.

Structure and volume of the dissertation . The dissertation consists of an introduction, literature review, materials and methods, results and their discussion, conclusion, list of references. The work is presented on 155 pages, contains 11 tables, 25 figures and appendices.