SUMMARY

MONITORING ANTIMICROBIAL RESISTANCE OF SOME ZOONOTIC AND COMMENSAL BACTERIA

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The doctoral thesis entitled *"Monitoring Antimicrobial Resistance of Some Zoonotic and Commensal Bacteria"* primarily focused on the transfer of antimicrobial resistance between animals and humans, highlighting the importance of monitoring and testing animal-derived products to ensure their quality and public health safety. The resistance of zoonotic bacteria to antimicrobial substances represent a problem that affects both human and animal health, with negative economic consequences at a global level. Thus, monitoring antimicrobial resistance is a necessity in the field of public and veterinary health, and the choice of topic reflects an awareness of the importance of developing new strategies to combat and prevent antimicrobial resistance.

The main purpose of this doctoral thesis was to monitor the acquired resistance to antimicrobial substances of zoonotic and commensal bacteria such as E. coli, Salmonella, and Campylobacter from samples collected from poultry meat. **The objectives** pursued during the study included identifying and monitoring the dynamics of E. coli, Campylobacter, and Salmonella bacteria, as well as monitoring quality indicators of poultry meat and poultry meat products through microbiological and physicochemical determinations.

The doctoral thesis is structured into two main parts, in accordance with current regulations: a part containing the bibliographic study and a second part comprising the author's personal research.

The first part consists of a synthetic presentation of current data on resistance to antimicrobial medication. It includes three chapters presented over 31 pages, which represent about one-third of the total length of the thesis.

Chapter I is titled *"The Evolution of Antimicrobial Resistance"* and consists of eight subchapters that present the most important details regarding the evolution of antibiotic resistance. This chapter contains information on the discovery of antibiotics and their evolution over time, the expansion of the range of antibiotics, the beneficial effects of using antimicrobial substances, as well as the evolution of antibiotic resistance in the context of extensive administration, and the factors contributing to its emergence and

development. Additionally, it briefly presents the impact of antimicrobial resistance on public health, possible strategies to counteract antibiotic resistance, future perspectives, and research directions, highlighting the challenges and opportunities in managing antibiotic resistance.

Chapter II, titled "*Dynamics of Antimicrobial Resistance of Potentially Pathogenic Bacteria in the Food Sector*", consists of five subchapters describing the implications and role of the food sector in the dissemination of antibiotic resistance, measures that can be implemented for better management of antimicrobial resistance in food practices, practices for investigating the dynamics of antimicrobial resistance in the food sector, and, lastly, some sustainable practices recommended for implementation in the food industry.

Chapter III, entitled "*Analysis of Antibiotic Resistance Profiles*", includes data regarding compliance with hygiene and food quality standards, the microbiological diversity of food products, the identification of potential pathogens, antibiotic resistance profiles, and the implications of bacterial isolates in food safety.

The second part includes the author's original research, presented over 64 pages, representing more than two-thirds of the thesis. This part outlines the objectives and scope of the research, four chapters describing the studies conducted, and a final chapter containing conclusions and final recommendations. Each study is composed of four subchapters: *Introduction* (highlighting the study's purpose and current knowledge), *Materials and Methods* (listing the methods used and materials employed), *Results and Discussions* (presenting the results of the analyses and their interpretation), and *Partial Conclusions* (summarizing the conclusions drawn from the study).

Chapter IV, titled *"Identification and Monitoring of the Dynamics of E. coli Bacteria in Poultry Meat"*, presents the importance of detecting this microorganism in food safety. E. coli is considered a significant indicator of food safety, making its detection in finished products crucial for preventing certain diseases, particularly digestive ones. For this study, poultry meat samples were collected from a slaughterhouse over two years, and E. coli detection, enumeration, and antimicrobial susceptibility tests were performed.

The results indicated that during the two years of study, there were no values exceeding the maximum permissible limit for this bacterium. Continuous monitoring indicated a plateau dynamic, with no high bacterial loads that could represent food alerts. The study correlated the development and multiplication of the bacteria in samples with external factors (such as heat), with higher values obtained in summer months than the rest of the year. By determining antimicrobial resistance and susceptibility, a very low incidence of antimicrobial-resistant bacteria was demonstrated.

Chapter V, entitled *"Identification and Monitoring of the Dynamics of Campylobacter Bacteria in Poultry Meat"*, covers the monitoring of this zoonotic pathogen responsible for causing several foodborne illnesses in humans. Due to the high prevalence of microorganisms from the Campylobacter genus in poultry meat, early detection is necessary to prevent potential outbreaks and implement strategies to

combat campylobacteriosis. In this study, poultry meat samples from a slaughterhouse were analyzed over six years for the detection and identification of Campylobacter spp.

The data obtained from the analyses showed a low incidence of Campylobacter bacteria in the analyzed poultry meat samples and, implicitly, no resistance to antimicrobials in microorganisms of the Campylobacter genus. The cautious use of antibiotics in poultry therapy, compliance with waiting times, and preventive measures against antibiotic resistance have resulted in reduced exposure of this pathogen in the analyzed products.

Chapter VI, titled *"Identification and Monitoring of the Dynamics of Salmonella Bacteria in Poultry Meat"*, presents the impact and importance of the bacterium on human and animal health. Early identification of Salmonella bacteria can reduce the economic pressure caused by diseases produced by these microorganisms. During this study, minced meat, mechanically separated meat, and prepared poultry meat samples were analyzed over three years, performing detection, enumeration, and serotyping of Salmonella bacteria.

The results showed the absence of the bacterium in the analyzed samples, thereby supporting the regulations implemented concerning food safety. The absence of Salmonella spp. detection also implies the absence of antibiotic-resistant isolates, supporting the correlation of prudent antibiotic use in food animals with the reduction of antimicrobial resistance in finished products.

Chapter VII, "*Monitoring Quality Indicators of Poultry Meat and Meat Products*", evaluates the quality indicators that are essential for food safety. In this study, microbiological and physicochemical determinations were conducted over two years on poultry meat collected from a slaughterhouse. Determining the total number of germs (TNG), evaluating easily hydrolyzable nitrogen, measuring pH, and determining the percentage of moisture, crude protein, and free fat allowed the assessment of the freshness of the analyzed samples.

The data obtained from microbiological examinations showed that the analyzed samples were within the validity period, with the total number of germs well below the maximum permissible limit. The low level of easily hydrolyzable nitrogen indicated no alteration of the poultry meat samples. Moreover, other quality indicators (pH, moisture, protein, fat) presented values within the parameters, supporting the freshness of the samples when corroborating microbiological and physicochemical results.

Chapter VIII contains the general conclusions obtained from the analysis of the studies conducted and recommendations necessary to continue the efforts made in recent years to reduce antibiotic resistance. These recommendations include indispensable measures such as strict compliance with all regulations imposed by European and national legislation regarding the use of antimicrobial medication (for both humans and animals), informing and raising awareness among all parties involved in the food sector about the importance of reducing antibiotic resistance, and continuing constant monitoring of antimicrobial resistance for zoonotic and commensal bacteria.

The bibliography includes 137 sources, most of which are recent (published in the last five years), and the thesis comprises 22 tables and 17 figures.

The resistance of bacteria to antimicrobial medication is continuously evolving, necessitating constant updating of practices and regulations in the field. While research and innovation in the medical field are extensive, bringing new insights constantly, new antibiotics cannot be discovered quickly enough to combat increasingly resistant bacteria due to gene transfer. Therefore, monitoring is key to preventing potential outbreaks caused by resistant bacteria.

Annually, the European Food Safety Authority (EFSA) and the European Centre for Disease Prevention and Control (ECDC) prepare the EU Summary Report (EUSR) on antimicrobial resistance in microorganisms, including data on the occurrence and temporal trends of resistance in zoonotic bacteria from humans, zoonotic bacterial isolates, and indicators from animals and derived food products. For the preparation of these reports, consistent data from monitoring is required, thus necessitating the surveillance of the behavior of bacterial strains isolated from food products against antibiotics and, based on the obtained results, the development of new initiatives in the fight against antimicrobial resistance.

This research innovates through a unique approach to antibiotic resistance, encompassing the link between the environment, animals, food, and humans. Its originality lies in the current relevance of the topic and the "One Health" perspective, connecting the effects of antibiotic use in animals with the emergence or reduction of antimicrobial-resistant bacterial isolates in animal-origin foods. According to the studies conducted, the measures taken at the European Union level and national legislative regulations concerning the reduction of antibiotic resistance have been very effective, and their compliance has reduced the incidence of antimicrobial-resistant microorganisms. The presented studies make significant contributions to improving food safety by providing feasible recommendations in the field and demonstrating their effectiveness.