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Investigation of Quinolone Residues and Total Aerobic Mesophilic Bacteria in Some Poultry Meat and Chicken Eggs

Zeliha Sevde TEK[1], Burak DEMİRHAN[2], Buket ER DEMİRHAN[2*]

[1] Karabük Provincial Health Directorate, Karabük University Training and Research Hospital, Karabük, TURKEY
[2] Gazi University, Faculty of Pharmacy, Department of Pharmaceutical Basic Sciences, Ankara, TURKEY
** Corresponding author: B. Er Demirhan e-mail: erbuket@gazi.edu.tr*

RESEARCH ARTICLE

Abstract

The presence of quinolones in poultry meat and eggs and the determination of the total aerobic mesophilic bacteria (TAMB) are essential regarding food safety and public health. In this study, quinolone residues and TAMB counts of chicken meat, turkey meat, and chicken eggs sold in supermarkets in Ankara, Turkey were investigated. For this purpose, a total of 84 food samples (40 chicken meats, 14 turkey meats, and 30 chicken eggs) were obtained from different markets in Ankara, and the quinolone residues in the samples were analyzed by enzyme-linked immunosorbent assay (ELISA) technique. The TAMB counts in the samples were investigated with classical culture methods. As a result, the mean level (±S.E) of positive quinolone residue was found to be 56.69±12.41 µg/kg in turkey meat samples. The presence of quinolone was not found in chicken meat samples. The mean levels of TAMB counts of the chicken and turkey meat samples were found 4.87±0.07 and 4.44±0.09 log CFU/g, respectively. Quinolone residues were not detected in chicken egg samples, and TAMB count was also below the detection limit (<10^2 CFU/g) in the contents of chicken egg samples. Monitoring quinolone residues in poultry meat is important in terms of public health and product quality.

Keywords: antibiotic; food; quinolone; ELISA; microbiological analysis

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INTRODUCTION

From farm to fork along the food chain, microbial, chemical, and physical hazards could threaten food safety (Fung et al., 2018). Antibiotic residues in foods of animal-origin are a source of concern regarding food safety (Singh et al., 2014). Antibiotics have been applied for many years in animals produced for food purposes, such as animal husbandry, beekeeping, and aquaculture, to treat infectious diseases (Peris-Vicente et al., 2022). They can also be used as prophylactic, metaphylactic, or growth promoters (Peris-Vicente et al., 2022; Quesada et al., 2013). As a result of the administration of antibiotics to animals, antibiotic residues may be found in foods of animal-origin (Darwish et al., 2013). It has been reported that the presence of antibiotics is found in various foods such as beef, poultry, honey, and chicken eggs (Er et al., 2013; Mahmoudi and Norian, 2015; Hasanen et al., 2016; Lu et al., 2019; Er Demirhan et al., 2022). Antibiotic residues in foods of animal-origin can cause various health problems in humans. These problems include toxic effects, transfer of antibiotic-resistant bacteria to humans, immunopathological effects, carcinogenicity, mutagenicity, nephropathy, hepatotoxicity, reproductive disorders, bone marrow toxicity, and allergy (Darwish et al., 2013). Quinolones are classified among the most important synthetic antibiotics used in human and veterinary medicine (Ahmed,

2017). Quinolones are bactericidal antibiotics that kill bacterial cells (Yan and Bryant, 2023). Fluoroquinolones are frequently used in poultry production and human medicine (Gouvêa et al., 2015). The presence of pharmaceutically active compounds in the environment is considered one of the common problems in terms of ecological risk (Andreu et al., 2007). When quinolones are not eliminated in the animal body, they may cause residues in animal-origin food products, such as eggs, milk, and meat. In this case, due to the widespread use of quinolones, especially their misuse and excessive use, the possibility of excessive residues in animal-origin foods are inevitable. When these residues are above maximum limits, they could cause serious food safety problems (Zhang and Cheng, 2017). It is stated that quinolone antibiotics, when taken into the human body through food, may damage more than one system, and at the same time, drug-resistant pathogens may emerge (Liu et al., 2023).

Poultry meat and eggs are among the most widely consumed animal-based foods (Mottet and Tempio, 2017). Chicken meat and eggs are easily available foods that are sources of high-quality protein, vitamins, and micronutrients (Melesse, 2014). Compared to other poultry, turkeys have the highest edible body weight. Turkey meat contains B-group vitamins, phosphorus, and minerals necessary for the human body (Amirkhanov et al., 2017). Turkey meat is advantageous due to its high protein, low fat, more B-group vitamins, and low cholesterol content (Igenbayev et al., 2019). Turkey meat is popular worldwide and is used in many regional cuisines (Gálvez et al., 2018).

To protect consumers' health, it is necessary to regularly monitor the content of quinolones in food products of animal-origin. Thus, to ensure food safety, the maximum residue limits (MRL) of various quinolones in animal-origin foods have been determined by regulatory agencies and governments worldwide (Zhang and Cheng, 2017). According to the Turkish Food Codex (TFC), the maximum residue levels of the sum of enrofloxacin and ciprofloxacin in chicken muscle should not exceed 100 µg/kg; danofloxacin should not exceed 200 µg/kg in chicken muscle; difloxacin should not exceed 300 µg/kg in chicken muscle; flumequin should not exceed 400 µg/kg in chicken muscle; and oxolinic acid should not exceed 100 µg/kg in food animal muscle. Maximum residue levels are specified for sarafloxacin in chicken skin, fat and liver. The other provision section of the same regulation states that these antibiotics cannot be used in animals from which eggs are produced for human consumption (TFC, 2017).

Poultry and egg products are often a concern for foodborne infections caused by microorganisms (Yenilmez and Bulancak, 2020). As with most meats, raw poultry is frequently highly contaminated with microorganisms (Guergueb et al., 2021). The presence of foodborne pathogens such as Salmonella, *Escherichia coli*, *Listeria monocytogenes*, *Clostridium perfringens*, and *Staphylococcus aureus* in meat and poultry products is a major risk to public health (Lika et al., 2021; Musa et al., 2021; Ramtahal et al., 2022; Sioutas et al., 2023). Epidemiological reports indicate that contaminated poultry meat is still the primary cause of human food poisoning. Pathogenic and spoilage microorganisms in poultry meat and products remain a significant concern for suppliers, consumers, and public health officials worldwide (Khalafalla et al., 2015). At the same time, microbial contamination of eggs has negative implications for the poultry industry. Diseases caused by contaminated eggs constitute a severe public health problem (Al Momani et al., 2018).

The aim of this study is to determine the quinolone antibiotic residue amounts and the total aerobic mesophilic bacteria (TAMB) counts in chicken meat, turkey meat, and chicken eggs obtained from different markets in Ankara, Turkey.

MATERIALS AND METHODS

Sample collection

In the current study, a total of 40 chicken meats from 4 different firms (A, B, C, and D), 14 turkey meats from one firm (E), and 30 chicken eggs from 3 different firms (E, F, and G), were collected from markets in Ankara, Turkey. The samples were transported in the cold chain (4°C), preserved at cold storage (4°C) soon after collection, and analyzed as quickly as possible. Samples with different serial numbers were collected and analyzed. Eggs with intact outer shells were used in the analyses.

The Determination of Quinolone Residues

Quinolones were determined by an ELISA method using the Ridascreen Quinolones/ELISA kit (R-Biopharm AG, Darmstadt, Germany). The method is a competitive enzyme immunoassay for the quantitative analysis of quinolones. This assay was performed according to the manufacturer's guidelines. The ELISA kit showed specifity to ciprofloxacin (100%), norfloxacin (>100%), enrofloxacin (>100%), marbofloxacin (>100%), danofloxacin (>100%), difloxacin (>100%), flumequine (>100%), ofloxacin (>100%), sarafloxacin (43%), and oxolinic acid (24%). The detection limits were reported as 10 µg/kg for chicken and turkey meat and 9 µg/kg for eggs in the test kit.

Sample preparations were done according to the instructions of the Ridascreen kit. Each chicken and turkey meat sample were homogenized. One g of the homogenized meat sample was transferred to centrifuge tubes, and 4 mL methanol/distilled water (70/30 v/v) was added to the samples and mixed well for 10 min. Subsequently, these

were centrifuged (Sigma 2-16 KL, Germany) at 4000 g for 10 min at room temperature (20 - 25 °C) and supernatant was diluted at 1:2 (1+1) with wash buffer. Chicken eggs were homogenized, and 1 g of the homogenized sample was weighed. Nine mL methanol /distilled water (35/65 v/v) was added to the samples, mixed well for 10 min, and centrifuged at 4000 g for 10 min at room temperature (20 - 25 ° C). Then, 50 µL of the standard solutions, all samples, and controls were added to the well.

Fifty microliters of conjugate and 50 µL of antibody were added to each well, respectively, and mixed gently and incubated for 1 h in a refrigerator (2-8°C). At the end of the incubation, the liquid was poured from the wells and washed twice with the washing buffer. One hundred microliters of the substrate/chromogen were added to each well and incubated at room temperature for 15 min in the dark. One hundred microliters of the stop solution were added to each well. After adding the stop solution, the absorbance was measured at 450 nm within 30 min in an ELISA plate reader (SpectraMax, Germany). The principle of the test is based on the antigen-antibody reaction. Microplate wells were coated with capture antibodies directed against anti-quinolone antibodies. Ciprofloxacin enzyme conjugate and anti-quinolone antibodies are added to the standards and sample solution. Free quinolones and ciprofloxacin conjugate compete for quinolone antibody binding sites (competitive enzyme immunoassay). Anti-quinolone antibodies are also bound by immobilized capture antibodies. Unbound conjugates are then removed by the washing step. Substrate/Chromogen is added to the wells, incubated, and a blue-colored final product is formed. The color changes from blue to yellow due to the addition of the stop solution. Absorption is inversely proportional to the quinolone concentration in the sample. Quinolone concentrations were calculated through the guidelines of the Ridascreen kit (Anonymous, 2022). Ridasoft Win PC Software was used to evaluate the data obtained. Calibration curves were plotted as the half-logarithmic concentration versus the mean absorbance at each concentration divided by the mean absorbance of the zero standard (B/Bo). The fact that B/Bo values are decreasing is a good result in terms of the reliability of the test. After evaluating the B/Bo values, the results of the samples were calculated.

TAMB Analysis of Samples

TAMB counts of the samples were determined by the classical culture method (Halkman, 2005). Ten grams of chicken, turkey meat, and egg samples were weighed aseptically. Then, 90 mL of maximum recovery diluent (MRD, Merck 1.12535, Darmstadt, Germany) was added to the sample, and the sample was homogenized using a Stomacher laboratory mixer (Bagmixer 400, France). Serial dilutions were created by taking 1 mL of this homogeneous sample and diluting it with 9 mL of MRD. Inoculations were made using the spread plate method from three serial dilutions on Plate Count Agar (PCA, Merck 1.05463, Darmstadt, Germany). Then, PCA plates were incubated at 37 °C for 48 h. The temperature and time parameters (37 °C for 48 h) we use in microbiological analysis were chosen to determine the potential microbiological risk in foods. Colonies growing on the plates at the end of the incubation period were counted and expressed as log colony-forming units per gram sample (log CFU/g) (Tek, 2023).

Statistical Analyses

IBM SPSS 28.0 was used for statistical analysis. One-way ANOVA and Independent sample t-tests were conducted for statistical analyses (Daniel, 1991).

RESULTS AND DISCUSSIONS

Overall, quinolone antibiotic residues were found in 7.14% of the analyzed samples. Quinolone was not found in chicken meat and chicken egg samples. The mean level (±S.E) of quinolone antibiotic residue was 56.69±12.41 µg/kg in positive turkey meat samples (Table 1). In positive turkey meat samples, quinolone antibiotic residue was detected in concentrations ranging between 10.09 and 82.47 µg/kg.

Table 1. The values of quinolone antibiotic residue in Turkey meat (µg/kg)

Firm	N (positive)	Mean value±S.E	Minimum	Maximum
E	14 (6)	56.69±12.41	10.09	82.47

The mean level of TAMB counts of the chicken and turkey meat samples were found 4.87±0.07 and 4.44±0.09 log CFU/g, respectively (Table 2). The mean TAMB value of turkey meat was lower than that of chicken meat, and the difference was found to be statistically significant ($p<0.05$). On the other hand, the TAMB count was also below the detection limit ($<10^2$ CFU/g) in chicken egg samples. Our data revealed that mean levels of quinolone in chicken and turkey meat samples were lower than the residue value mentioned in the TFC (TFC, 2017).

Table 2. TAMB counts of chicken meat and turkey meat samples (log CFU/g)

Foods	Mean value±S.E	Minimum	Maximum
Chicken meat	4.87^{a}±0.07	3.95	7.21
Turkey meat	4.44^{b}±0.09	4.00	5.08

Note: a-b: means within a group in a column not sharing a common superscript letter are significantly different ($p<0.05$)

In Table 3, when the data of the TAMB numbers of the firms (A, B, C, and D) of the chicken meat samples were examined, it was determined that the D firm had the lowest value and the difference between the mean TAMB numbers of the D firm, and the other firms was statistically significant ($p<0.05$).

Table 3. TAMB counts of chicken meat samples (log CFU/g)

Firms	N	Mean value±S.E	Minimum	Maximum
A	10	4.87^{a}±0.09	4.00	5.61
B	10	5.32^{a}±0.15	4.60	7.01
C	10	5.29^{a}±0.17	4.00	7.21
D	10	4.27^{b}±0.03	3.95	4.74

Note: a-b: means within a group in a column not sharing a common superscript letter are significantly different ($p<0.05$)

Some studies on quinolone residues in poultry animals have been performed in Turkey and many other countries. Er et al. (2013) analyzed 231 chicken and beef meat samples in Turkey and found a quinolone antibiotic residue rate in chicken meat samples to be 45.7%. At the same time, it was also stated that the mean levels of quinolone antibiotic residue in chicken meat were 30.81± 3.04 µg/kg. Arslanbaş et al. (2018) analyzed 300 samples of chicken meat in Turkey for the enrofloxacin, doxycycline, and tylosin by HPLC and found enrofloxacin residue ratios in 2% of samples above the established maximum limits. Silfrany et al. (2013) analyzed chicken meat using an equinox test, and they detected quinolone residues in 9 (6.6%) of 135 chicken breast meat samples in the Dominican Republic. Hasanen et al. (2016) analyzed 120 poultry products (chicken breast meat, chicken thigh, chicken liver, chicken kidney, turkey breast, turkey leg, turkey liver, and turkey kidney) about ciprofloxacin residue concentrations in Egypt by HPLC. It was stated that ciprofloxacin residues were found to be 131.7±25.2 µg/kg in chicken breast meat, 92.11±30.1 µg/kg in chicken thigh meat, 119.2±12.5 µg/kg in turkey breast meat, and 83.2±19.6 µg/kg in turkey thigh meat.

Sarker et al. (2018) investigated ciprofloxacin and enrofloxacin residues in 160 chicken breast meat, leg meat, and liver in Bangladesh. Researchers found ciprofloxacin residues in 39% of chicken breast meat and enrofloxacin residues in 21% of chicken breast meat, ciprofloxacin residues in 42% of chicken thighs, and enrofloxacin residues in 24% of chicken thighs. In a study conducted in China by Yang et al. (2020), it was reported that 36 chicken offal, 60 chicken meat, and 50 poultry egg samples were investigated for the presence of 11 quinolones, 10 tetracycline, and 18 sulfonamide group antibiotic residues. Researchers detected quinolone group antibiotic residues in 16.7% of chicken meat, 41.6% of offal, and 22% of eggs, which contained quinolone antibiotic residue within the range of 0.4 µg/kg and 624.2 µg/kg. Mahmoudi and Norian (2015) stated that there were antibiotic residues in 60.66% of 150 egg samples and that they detected enrofloxacin at a mean level of 14.77±0.77 ng/L in 85.7% of the samples containing residue. Compared to previous studies, quinolone antibiotic residues could not be detected in chicken meat and egg samples in our study.

Pena et al. (2010) investigated the residues of four fluoroquinolone antibiotics (enrofloxacin, ciprofloxacin, norfloxacin, and sarafloxacin) in 61 chicken and 37 turkey meat samples in Portugal, using the liquid chromatography method. They found that 44.2% of chicken meat samples and 37.8% of turkey meat samples contained residues. They also reported the mean level of total fluoroquinolone residue as 75.5±36.1 µg/kg in chicken meat and 73.0±35.0 µg/kg in turkey meat. Compared to the study conducted by Pena et al. (2010), the mean quinolone residue level in turkey meat was lower in our study. Teimuri et al. (2018) investigated quinolone residues in 60 chicken and turkey meats and reported that the average quinolone residue in turkey meat was 21.36±15.31 µg/kg. According to our results, although the average quinolone residue they found was low, they stated that 20% of samples exceeded the maximum limit. It was seen that the number of samples in some of the studies on quinolone antibiotic residues was less than in our study. It has also been stated that methods such as ELISA, HPLC, equinox and TLC are used.

It is stated that quinolones may directly affect health but pose a potential risk to public health by causing the emergence of resistant bacteria. In addition, these antibiotic residues may cause allergic hypersensitivity reactions or toxic effects (Er et al., 2013).

Lu et al. (2019) investigated 11 quinolone antibiotic residues in chicken meat and egg samples using the UPLC-MS/MS method in China. They determined the concentrations of enrofloxacin and ciprofloxacin in 6 of 60 chicken meat samples as 4.88-44.4 μg/kg and <7 μg/kg, respectively. However, they reported the concentrations of enrofloxacin and ciprofloxacin as 1.09-5.22 μg/kg and <7 μg/kg, respectively, in 8 of 110 egg samples.

Moscoso et al. (2015) investigated quinolone residues using the Equinox test (colorimetric assay) in 342 egg samples collected from 48 different farms in the Dominican Republic. They found that 51% of chicken egg samples contained quinolone residues at levels higher than the maximum residue limits of the European Union and the U.S.

Department of Agriculture. Quinolone residues were not detected in chicken meat and eggs in our study. This can be explained by preventing misuse and unnecessary use of antibiotics, adhering to proper withdrawal periods before slaughter, and carrying out strict controls.

Poultry meat is sensitive to microbiological changes and is a perishable food (Lázaro et al., 2015). Ensuring the microbial safety of poultry meat and products is an important issue. During and after slaughter, animal microbiota, slaughterhouse environment, and equipment can contaminate carcasses and processed meat products. Some of these bacteria can survive or grow during the processing and storage of poultry meat (Rouger et al., 2017). Therefore, the presence of the total number of mesophilic bacteria in chickens is an indicator of the hygienic level (Maharjan et al., 2019). In a study conducted in Ankara, Efe and Gümüşsoy (2005) analyzed the skin, thigh, and breast parts of 150 chicken samples microbiologically. As a result, they stated that they determined the mean levels of total aerobic mesophilic organisms in chicken thigh and breast meat as $3.3x10^5$ CFU/g and $6.3x10^5$ CFU/g, respectively. The TAMB numbers detected in chicken meat by Efe and Gümüşsoy (2005) are similar to our study. In another study conducted by Yüksel et al. (2013) in Erzurum, 30 chicken breast meat, chicken baguette, and chicken liver were investigated microbiologically. They determined the mean level of total aerobic mesophilic organisms in breast meat and chicken baguette as 7.01 log CFU/g and 9.70 log CFU/ baguette, respectively. Sağun et al. (1996) investigated the general colony number in 20 pieces of chicken thigh and chicken breast meat sold in Van using PCA medium. Researchers stated that the mean value of the general colony count was $1.4x10^6$ CFU/g in chicken thighs and $1.0x10^7$ CFU/g in chicken breast meat. In a study conducted by Yıldırım et al. (2015), they performed TAMB count on 25 chicken breast meat and 25 chicken thigh meats sold in Tokat using PCA medium. They found that the mean level of TAMB number was $6.28x10^7$ CFU/g in chicken breast meats and $4.19x10^7$ CFU/g in chicken thigh meats. The TAMB counts detected in chicken meat by Yüksel et al. (2013), Sağun et al. (1996) and Yıldırım et al. (2015) were higher than in our study.

TAMB count was investigated using PCA medium in a total of 175 poultry samples, including 50 chicken thighs, 50 chicken wing meats, 50 cubed turkey meats, and 25 quail meats, offered for packaged consumption in Istanbul by Sezen (2009). The researcher reported that mean TAMB counts were $6x10^7$ CFU/g in chicken thigh samples, $1.3x10^8$ CFU/g in chicken wing meat, and $6x10^7$ CFU/g in turkey cubed meat. The TAMB counts detected in chicken meat and turkey meat by Sezen (2009) were higher than in our study.

In our study, the mean TAMB values of chicken and turkey meat were determined as 4.87±0.07 and 4.44±0.09 log CFU/g, respectively. When compared to studies conducted in Turkey, it was observed that researchers mostly found higher or parallel values in chicken and turkey meat compared to our research. These differences are thought to be related to reasons such as the technical and hygienic status of poultry meat production sites, product sales, storage conditions, and different carcass parts of the samples.

Incili et al. (2019) investigated the TAMB count in 144 market eggs and 144 village eggs offered for consumption in Elazığ, using PCA medium. They stated that they determined the mean TAMB value in conventional and village eggs' content as 1.29±0.09 log CFU/mL and 1.14±0.08 log CFU/mL, respectively. Erkan et al. (2008) investigated the number of TAMB in PCA medium in 100 market eggs and 100 village eggs offered for consumption in Diyarbakır. They reported that the mean TAMB number was 6.72 log CFU/mL in village eggs and 5.68 log CFU/mL in market eggs.

Studies are also conducted internationally on TAMB count in poultry meat and eggs. Guergueb et al. (2014) determined the average TAMB number in 60 chicken carcasses as 5.01 log CFU/g in Algeria. In a survey conducted in Croatia by Kozačinski et al. (2006), microbiological analysis was performed on a total of 66 samples, including 21 skinless chicken breast meat (fillets), 19 skin-on chicken breast meat, and 26 frozen chicken minced meat. The researchers found that the TAMB count in chicken meat samples ranged from 2.30 to 5.41 log CFU/g, with a mean of 4.72 ± 0.38 log CFU/g in fillets and a mean of 3.67 ± 0.88 log CFU/g in breast meat with skin. Javadi and Safarmashaei (2011) investigated 80 chicken meat samples microbiologically in Iran and determined the mean levels of total bacterial count in chicken meat as 5.06515 ± 0.13891 log CFU/g. In another study conducted in Palestine, Adwan et al. (2015) investigated the TAMB counts in 13 fresh chicken meat, 9 turkey meat, 13 beef, and 5 frozen food samples. They found that the TAMB number varied between 6.95 - 7.78 log CFU/g in fresh meat samples. Damena et al. (2022) conducted a study in Ethiopia, and TAMB count was analyzed in 60 egg samples. They found the mean TAMB count as 9.31 log CFU/mL in eggs and 1.52-9.36 log CFU/mL in egg content. Mahdavi et al. (2012) investigated 525 egg samples microbiologically in Iran. They determined the mean level of total number of bacteria in the eggs as $3.95x10^4$ CFU/g. Osei-Somuah et al. (2005) investigated the microbiological quality of 12 egg

samples in Ghana. Researchers stated that the egg content's total number of living organisms varies between 4.87 - 6.13 log CFU/g. In some microbiological studies on poultry meat and products conducted in different countries, fewer samples were analyzed compared to our study.

Differences are observed between the analysis results in microbiological studies in which the number of TAMB in eggs is determined. These differences are thought to be related to the analysis method, the hygienic condition of the places where the eggs are obtained, the disorder of the physical structure of the egg, and the storage conditions. In our study, TAMB analysis was performed on the content of the eggs, and it was found below the detection limit ($<10^2$ CFU/g). It is thought that this is because the eggs may have been obtained from healthy chickens reared under suitable conditions. Company-owned and packaged products were used. At the same time, one of the reasons why TAMB numbers are below the detection limit is that the outer shells of the samples analyzed are intact. Eggs with broken or cracked outer shells were not preferred for analysis because the risk of microbiological contamination would increase as their protective barriers were broken, and eggs in this condition were not recommended for consumption.

CONCLUSIONS

The presence of antibiotics and pathogen/spoilage microorganisms in food products poses health hazards to the consumer. Hence, analytical and microbiological control of risky foods as animal sources are important. Poultry meat and chicken eggs are widely consumed due to their high nutritional value and economical nature. Quinolone residues may be found in these foods for various reasons. Within the scope of the study, a total of 84 food samples were analyzed in terms of quinolone antibiotics and microbiological qualities. In our study, quinolone antibiotics were not found in chicken meat and eggs. It is thought that the chicken meat and egg samples examined in this study do not pose a health risk regarding quinolones. It was also observed that quinolone residue levels detected in turkey meat were low in the study. Regularly monitoring products such as poultry meat and eggs for antibiotics protects public health and product quality. Due to the potential adverse effects of these veterinary drugs on human health, quinolone residues in these foods must be monitored, and the residues must be controlled. In addition, total mesophilic bacteria were detected at a mean level of 4.27-5.32 log CFU/g in 54 chicken and turkey meat samples. However, TAMB was not found in the egg content. For this reason, even if these foods' quinolone antibiotic residue levels do not exceed the maximum limits specified in the Turkish Food Codex, analysis of these foods for antibiotic residues and regular microbiological analyses are critical for protecting human health. It is important for consumers, in terms of health and quality, to use labeled products and to read the label information carefully and consume products that have not expired. It is very important for poultry meat to be consumed cooked and the central temperature of the meat to be at least 72 °C in terms of the inhibition of microorganisms. Although the microorganism load in the inner parts of the eggs is less than 10^2 CFU/g, it is recommended to comply with the necessary hygiene rules for the outer parts of the eggs. Since the presence of microorganisms and antibiotic residues in foods may lead to risks such as antibiotic resistance, regular monitoring of antibiotic residues and microbial load will guide future studies.

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Conflicts of Interest

The authors declare that they do not have any conflict of interest.

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