Prevalence of Antibiotic Residues in Table Eggs in Damietta Governorate

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Prevalence of Antibiotic Residues in Table Eggs in Damietta Governorate

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Abstract

OBJECTIVE: To detect antibiotic residues in table eggs in Damietta Province, Egypt.
DESIGN: Descriptive study.
SAMPLES: Ninety-eight egg samples (51 market and 47 balady eggs) were randomly collected from different private farms and markets in Damietta Province, Egypt.
PROCEDURES: Premi SP-NT qualitatively analyzed the samples, positive screened egg samples were analyzed using high-performance liquid chromatography for the detection of amoxicillin, ampicillin, tetracycline, and oxytetracycline.
RESULTS: Results of Premi SP-NT showed that antibiotic residues were detected in 49 (96%) out of 51 market egg samples, of which 40 (85%) out of 47 balady egg samples. High-performance liquid chromatography results confirmed that residues of tetracycline and oxytetracycline were detected in 100% of the examined eggs. Amoxicillin was detected in 100% of the examined egg samples. Ampicillin and amoxicillin were detected in 100% of eggs. However, 66% of the market eggs contained both ampicillin and amoxicillin.
CONCLUSION: The presence of ampicillin, amoxicillin, tetracycline, and oxytetracycline residues in 100% of the examined eggs suggests the misuse of antibiotics in poultry farms. Therefore, Premi SP-NT is recommended as a rough screening test for poultry farms in Egypt, and the antibiotic withdrawal period should be noted.

Keywords: Antibiotic residues, High-performance liquid chromatography, Premi test, Table egg

1. Introduction

In poultry farms, antibiotics are added to feed or drinking water not only for disease treatment but also to promote growth and better utilization of the feed [1].

The most commonly used antibiotics are tetracycline, gentamicin, neomycin, tylosine, erythromycin, virginiamycin, ceftiofur, and bacitracin, which are usually helpful in reducing and preventing respiratory diseases and necrotic enteritis infections; fluoroquinolones and/or quinolone compounds are used to treat gastroenteritis, skin, or soft tissue infections; sulfonamide compounds are administered as preventive and chemotherapeutic agents against coccidiosis, fowl typhoid, coryza, and pul-lorum disease, whereas piperman, oxytetracycline, amoxicillin, ciprofloxacin, and sulfa drugs are used to treat coccidiosis [2].

The continuous use of antibiotics can be a serious problem for consumers because of the possible presence of its residues in different food materials from animal sources (eggs, milk, meat, and dairy products). Low levels of antibiotics consumed by humans over long periods can lead to allergies, carcinogenic effects, and potentially harmful effects on human intestinal microflora [3].

Accordingly, effective control of the residues of these substances in eggs is crucial for the protection of public health [1]. The nontherapeutic use of antibiotics as growth promoters in poultry feed in some countries has increased the resistance of disease pathogens to antibiotics, which transfers acquired resistance to their generations and other
unrelated bacteria through plasmids. Resistant strains can also be transmitted to humans through food, which can have severe consequences on public health [4].

Insufficient legislation, unawareness, and noncompliance with antimicrobial withdrawal periods have contributed to the high rates of antimicrobial residues reported in poultry products, especially eggs that are widely used by humans [5].

The analytical procedures for the determination of veterinary drug residues in food can be classified as screening or quantitative and confirmatory methods. Microbiological inhibitory plate test methods can be used to screen antimicrobial residues. Furthermore, these methods are not sensitive enough or specific; therefore, the aim of this study was to establish a postscreening step to determine the identity of the previously detected inhibitory substance [6].

Microbiological methods play an essential role in the analysis of residues, as they are inexpensive and simple to perform; they can detect a broad spectrum of antimicrobial substances. Their simplicity makes them suitable for screening. However, because of their low sensitivity and specificity, most standard microbiological tests only indicate the presence of an inhibiting agent, and physicochemical methods are needed to identify and quantify the residue.

Therefore, the availability of simple and reliable screening systems for the detection of antibiotics is essential to ensure the safety of the products. Recently, a broad-spectrum screening test for the detection of antibiotic residues was developed. The disappearance of antibiotic residues from eggs depends mostly on the plasma drug levels. The disappearance of antibiotic residues from eggs usually takes 2–3 days from the egg white, whereas disappearance from the yolk usually takes 10 days [7]. Withdrawal of the medication is necessary so that the levels of drug residues above the maximum residue limit (MRL) can be avoided in foods of animal origin, such as meat, milk, and eggs. In turn, this protects humans from unnecessary exposure to antimicrobials [8].

The effects of cooking temperature on the stability of different antibiotics indicated a variation in the balance, depending on the antibiotic tested. Most antimicrobials eventually show a decrease in potency when exposed to cooking conditions.

2. Materials and methods

A total of 98 commercial egg samples (51 market egg samples and 47 balady egg samples) were collected from distributors and retail markets in various parts of Damietta City, Damietta Province, Egypt. The egg samples were then immediately taken to the laboratory of the Animal Health Research Institute, Damietta branch, for analysis.

2.1. Processing of the samples

Egg samples were transported to the Animal Health Research Laboratory, Damietta branch, and processed within 24 h of collection. The surface of each egg was disinfected using a piece of sterile cotton soaked in 70 % (v/v) ethyl alcohol in a safety cabinet (under septic conditions). A small crack was made at the tipi of the egg using sterile thumb forceps, after which albumen and yolk were carefully mixed using a sterile cotton swab. The mixture was subsequently moved into a sterile universal container and preserved at −20 °C until further analysis.

2.2. Evaluation of antibiotic residues

Two methods were used simultaneously to determine the presence of antibiotic residues in the examined table eggs: the Premi test microbiological inhibition assay and high-performance liquid chromatography (HPLC) as a confirmatory analysis.

Premi test was purchased from DSM (Santa Clara, CA, United States) and combines the principle of agar diffusion test with the change in color caused by growth metabolism of the test microorganism Bacillus stearothermophilus, a thermophilic bacterium highly sensitive to many antibiotics and sulfonamides. Homogenized liquid egg samples (100 µl) were pipetted onto the agar surface using a pipette supplied with a kit. The tubes were covered with aluminum foil and placed in a water bath heated to 80 °C for 10 min. After this heat pretreatment, the ampules were incubated for 3 h and 15 min at 64 ± 1 °C, and the change in color was evaluated.

HPLC analysis was used for the identification, determination, and confirmatory analysis of antibiotic residue levels in 25 positive samples using the Premi test assay. Moreover, HPLC can detect antimicrobials at levels below the MRL [8,9]: simply amoxicillin (98 % standard), amoxicillin (99 % standard), tetracycline HCl, and oxytetracycline HCl standards were obtained from Sigma Chemical Co. (Sigma-Aldrich, Inc., St. Louis, MO, United States.) All reagents, organic solvents, methanol, EDTA, and ethyl acetate were of HPLC grade, and ultrapure water (El-Naser Pharmaceutical Chemicals Co., Oubour, Qalyubia, Egypt) was purchased from El-Naser Pharmaceutical Chemicals Co. The experiment is discussed in detail [10,11].
2.3. Standard and stock solutions

Stock solutions of different concentrations of amoxicillin and ampicillin were prepared by dissolving each analyte in ultrapure water. Working standard solutions with varying concentrations of amoxicillin and ampicillin were prepared by diluting the stock solutions with deionized water. The stock solutions were stable for 6 months at −20 °C. Fresh working solutions were prepared by appropriate dilution of the stock solution before use. Similarly, stock solutions of tetracycline and oxytetracycline (1 mg/ml) were prepared in methanol and stored at −20 °C for up to 1 month, and working standard solutions were made in 0.01 N HCl and prepared immediately before use. All standard solutions were stored in amber bottles protected from light.

2.4. Sample extraction

2.4.1. Quantitation of ampicillin and amoxicillin residues

A 5-g sample of homogenized eggs was weighed into a 50-ml polypropylene centrifuge tube. Five milliliters of acetonitrile were added to the sample, and the mixture was vortexed for 1 min. Subsequently, 15 ml acetonitrile was added, and the mixture was vortexed for 2 min. After centrifugation at 8000 rpm for 10 min, the supernatant was transferred to another 50-ml polypropylene centrifuge tube. Twenty milliliters of dichloromethane were added to the mixture, which was vortexed for 2 min. After centrifugation at 6500 rpm for 10 min, 1 ml of the supernatant was transferred to a 10-ml glass test tube.

2.4.2. Quantitation of tetracycline and oxytetracycline residues

Egg samples were extracted by liquid–liquid extraction according to the method described by Senyuva et al. [12]. Two grams of homogenized egg sample were taken and transferred into the centrifuge tube, 100 μl (100 μg/ml) of tetracycline was added as internal standard, 0.1 g citric acid, 1 ml nitric acid (30 %), 4 ml methanol, and 1 ml deionized water were added, respectively. The suspension was vortexed, placed in an ultrasonic water bath for 15 min, and then centrifuged at 5300 rpm for 10 min. The supernatant was filtered through a 0.22 μm syringe filter, and 20 μl of solution was injected into the HPLC for analysis.

2.5. Chromatographic conditions

The HPLC system was a constant liquid chromatography pump, Agilent 1200 series Co. (Germany). Variable wavelength detector, Germany and software chemstation. The mobile phase for ampicillin and amoxicillin quantitation was 0.1 % trifluoroacetic acid and acetonitrile (50 : 50). It was pumped at a flow rate of 1.0 ml/min, and ampicillin and amoxicillin were detected at a wavelength of 254 nm. The injected volume was 50 μl. The HPLC column was C18 (250 × 4.6 mm i.d., 5 mm) Hypersil Eclipse XDP. The mobile phase consisted of ultrapure water 2 : 1H2SO4, and acetonitrile 85 : 15 (v/v) was pumped at a 1.5 ml/min flow rate. The fluorescence detector was set at a wavelength of 360 nm. The injected volume was 20 μl, and chromatography was performed at 24 °C. The HPLC column was a Hypersil Eclipse XDP C18 (5 μM, 205 × 4.6 mm). A fresh mobile phase was prepared daily before the experiment.

3. Results

Egg samples were qualitatively tested using the Premi test, and the results showed that 40 (85 %) out of 47 balady egg samples were positive for antibiotic residues. In addition, 49 (96 %) of 51 market egg samples yielded positive results, as shown in Table 1.

Twenty-five samples (10 balady eggs and 15 market eggs) were tested using HPLC to detect antibiotic residues (ampicillin, amoxicillin, tetracycline, and oxytetracycline). The results showed that all 10 (100 %) balady egg samples contained ampicillin, amoxicillin, oxytetracycline, and tetracycline residues, 10 (66.66 %) market egg samples out of 15 samples contained amoxicillin and ampicillin, and all 15 (100 %) market egg samples contained oxytetracycline and tetracycline residues, as shown in Tables 2 and 3.

<table>
<thead>
<tr>
<th>Examined egg samples</th>
<th>Number of samples</th>
<th>Positive samples in Premi test Number</th>
<th>%</th>
<th>Negative samples in Premi test Number</th>
<th>%</th>
<th>Positive samples in HPLC Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balady eggs</td>
<td>47</td>
<td>40</td>
<td>85</td>
<td>7</td>
<td>14.9</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>Market eggs</td>
<td>51</td>
<td>49</td>
<td>96</td>
<td>2</td>
<td>3.9</td>
<td>15</td>
<td>60</td>
</tr>
<tr>
<td>Total</td>
<td>98</td>
<td>89</td>
<td>90.8</td>
<td>9</td>
<td>9.18</td>
<td>25</td>
<td>25.5</td>
</tr>
</tbody>
</table>
As shown in Table 4, the results of tetracycline and oxytetracycline concentrations (ppb) in positive egg samples were compared to the MRL recommended by the European Union legislation, which was set to 200 ppb. The ampicillin and amoxicillin concentrations (ppb) in positive egg samples were also compared to the MRL, as recommended by the European Union legislation, which was set to 10 ppb, as shown in Table 5, Fig. 1.

### Table 2. Incidence of antibiotic residues (ampicillin and amoxicillin) in examined egg samples using high-performance liquid chromatography method.

<table>
<thead>
<tr>
<th>Examined samples</th>
<th>Number of eggs</th>
<th>Ampicillin</th>
<th>Number of positive</th>
<th>%</th>
<th>Amoxicillin</th>
<th>Number of positive</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balady eggs</td>
<td>10</td>
<td>10</td>
<td>100</td>
<td>100</td>
<td>10</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Market eggs</td>
<td>15</td>
<td>10</td>
<td>66.66</td>
<td>10</td>
<td>10</td>
<td>66.66</td>
<td>10</td>
</tr>
</tbody>
</table>

### Table 3. Incidence of antibiotic residues (tetracycline and oxytetracycline) in examined egg samples using high-performance liquid chromatography method.

<table>
<thead>
<tr>
<th>Egg samples</th>
<th>Number of positive samples (N=25)</th>
<th>Oxytetracycline</th>
<th>Tetracycline</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum</td>
<td>Maximum</td>
<td>Mean ± SE</td>
</tr>
<tr>
<td>Balady</td>
<td>10</td>
<td>180.95</td>
<td>212.6</td>
</tr>
<tr>
<td>Market</td>
<td>15</td>
<td>46.03</td>
<td>279.73</td>
</tr>
</tbody>
</table>

### Table 4. Tetracyclines concentrations (ppb) in positive egg samples using HPLC analysis.

<table>
<thead>
<tr>
<th>TYPE</th>
<th>Sample number</th>
<th>Oxytetracycline(ppb)*</th>
<th>Tetracycline(ppb)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balady</td>
<td>1</td>
<td>180.95</td>
<td>121.3</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>212.6*</td>
<td>109.16</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>190.59</td>
<td>134.06</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>201.3*</td>
<td>102.6</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>208.04*</td>
<td>115.03</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>186.1</td>
<td>103.07</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>207.9*</td>
<td>127.1</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>193.2</td>
<td>112</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>197.5</td>
<td>110.7</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>210.7*</td>
<td>131.2</td>
</tr>
<tr>
<td>Market</td>
<td>11</td>
<td>153.9</td>
<td>147.1</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>46.03</td>
<td>18.73</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>90.8</td>
<td>253.17*</td>
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<tr>
<td></td>
<td>14</td>
<td>234.8*</td>
<td>69.3</td>
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<td>145.1</td>
<td>128.12</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>207.02*</td>
<td>206.1*</td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>54.2</td>
<td>201.18*</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>128.6</td>
<td>94.16</td>
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<tr>
<td></td>
<td>19</td>
<td>216.2*</td>
<td>79.7</td>
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<tr>
<td></td>
<td>20</td>
<td>68.7</td>
<td>131.07</td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>202.9*</td>
<td>198.1</td>
</tr>
<tr>
<td></td>
<td>22</td>
<td>279.73*</td>
<td>265.9*</td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>117.2</td>
<td>148.12</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>184.12</td>
<td>89.1</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>109.15</td>
<td>236.8*</td>
</tr>
</tbody>
</table>

PPB = Part Per Billion
* = Above MRL (MRL=200 ppb)

4. Discussion

Our results coincided with those reported by Nonga et al. [5], who analyzed 70 egg samples with the Delvo test kit and showed positive results for antibiotic residues.

Similar results were reported by Islam et al. [13], who obtained an overall prevalence of antibiotic residues detected by the microbiological assay of 60 % in eggs.

Similar results were reported by Antown [14] and Fath and Bab [15].

Similarly, Sirdar reported that the incidence of antimicrobial residues was 61.1, 60.2, and 68.7 % in the examined egg samples. The widespread spread of antibiotic residues in eggs results from the addition of antimicrobials to food and water consumed by laying hens, coupled with noncompliance with waiting periods [16].

Ezenduka and colleagues screened eggs from 25 commercial farms and 10 selling openings to determine the prevalence of antimicrobial drugs. All 25 farms tested positive for antimicrobial residues in their eggs. The high incidence of antimicrobial residues in eggs due to the use of antimicrobials in feed or in water consumed by laying hens is coupled with noncompliance with withdrawal periods [17].

In contrast, lower results were reported in different studies: Adesiyun et al. [18] showed 6.5 % of farm samples and 15.2 % of market egg samples in Trinidad, and the prevalence rate of 34.2 % reported in retail points in Nigeria by Ezenduka et al. [17]. Nonga et al. [5], also showed that nearly 21.4 % of farm egg samples in Tanzania were positive for antibiotic residues.

Using microbiological assay tests, Amal and Nermeen [19] revealed that the incidence of
antibacterial residues was 6.6, 20, and 13.3% in balady, brown farm eggs, and white farm eggs, respectively. While Omeiza et al. [20] identified antimicrobial drug residues in commercial eggs in Nigeria using the Premi test and showed an occurrence of 7.6% residue out of the 1440 commercial eggs analyzed.

In addition, Shahbazi and colleagues recorded lower findings than our results to assess the prevalence of drug residues in eggs presented in Kermanshah, Iran; 120 eggs were collected randomly. The results showed that 3.3% of the tested eggs had antibiotic residues. The Premi test is a multiple microbial inhibitor test to detect antimicrobial agents. It is an economical, easy-to-use screening test that provides results within a relatively short period (2.30–3.00 h) [21].

In addition, Hind and Ibrahim used a microbiological inhibition assay to detect antibiotic residues in table eggs in Khartoum, Sudan. They showed that the examined egg samples were positive for antibiotic residues in Omdurman, Khartoum, and Khartoum North, with 34 (18.9%), 28 (15.6%), and 28 (15.6%), respectively [22]. Also, Alomirah et al. [23] conducted a study in Kuwait and found that all egg samples from a shopping place were negative for residues.

The unrestrained increase in scale/backyard farming and management systems seems to affect the incidence of antimicrobial drug residues. On the other hand, Elnasri analyzed 157 eggs collected from 83 open system farms and 74 sale points (markets) in Khartoum State. Antibiotic residues were detected in 55.4% of the farm samples, with a lower percentage of sale point samples (43.2%) being positive using the Premi test [24].

Serge and colleagues conducted a study to detect antibiotic residues in eggs consumed in Burkina Faso and collected 400 eggs from four areas of Burkina Faso. Microbiological methods have been used to detect the presence of antibiotic residues. The study revealed that 41.75% of the eggs consumed in Burkina Faso contained antibiotic residues [25].

The sensitivity and specificity of microbiological methods for residue testing are generally low. However, being a simple method makes it appropriate for screening purposes, as shown by Tajik et al. [26].

These tests are more suitable for regulatory purposes and provide a more accurate assessment of contamination levels of poultry products with veterinary drug residues, as reported by Kabir et al. [27].

An HPLC procedure is described for the identification and quantification of tetracycline antibiotic residues (oxytetracycline, tetracycline, chlortetracycline, and oxytetracycline) in eggs. The use of HPLC for detecting antibiotic residues at levels below the MRL was confirmed by FAO/WHO [9] and Jevinova et al. [8].

The results shown in Table 2 and Fig. 2 show that all the analyzed balady egg samples, 10 (100%) were positive for ampicillin, amoxicillin, tetracycline, and oxytetracycline residues. On the other hand, out of 15 market egg-positive samples using the Premi test, 10 (66.66%) were positive for ampicillin and amoxicillin. However, all examined samples, 15 (100%) were confirmed to be positive for tetracycline and oxytetracycline residues.

According to the results of this study, the highest contamination rate of antibiotic residues was related to tetracycline and oxytetracycline groups in market

<table>
<thead>
<tr>
<th>Egg samples</th>
<th>Ampicillin</th>
<th>Amoxicillin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of positive samples (N = 20)</td>
<td>Minimum</td>
<td>Maximum</td>
</tr>
<tr>
<td>Balady</td>
<td>10</td>
<td>3.2</td>
</tr>
<tr>
<td>Market</td>
<td>10</td>
<td>3.5</td>
</tr>
</tbody>
</table>

The maximum residue limit recommended by the European Union (EU) legislation for ampicillin and amoxicillin residues in table eggs was set to 10 ppb.
egg samples, whereas ampicillin, amoxicillin, tetracycline, and oxytetracycline were present in all balady egg samples. The results of the current study reveal a common abuse of antibiotics by egg-laying poultry farms and show noncompliance with the recommendations regarding the use of antimicrobials at the national level to protect humans (Fig. 3).

Amoxicillin and ampicillin are β-lactam antibiotics of broad-spectrum nature and are commonly prescribed by veterinarians because of their broad-spectrum nature; they are used extensively in veterinary medicine as chemotherapeutic, growth-promoting and/or prophylactic agents by killing or inhibiting the growth of Gram-positive and Gram-negative microorganisms, including several pathogenic enteric microorganisms, as explained by Lara et al. [28]. However, this uncontrolled wide use can lead to residues being found in food with subsequent allergies in people with a history of allergy to penicillin and may result in the development of penicillin-resistant microorganisms.

The findings of our study, as shown in Table 6 and Fig. 4 showed that ampicillin residues (ppb) µg/g were detected in 10 (100 %) of the examined 15 market egg samples and failed in five with a mean value of 4.66 ± 0.29. The analyzed 10 (100 %) balady
egg samples were positive for ampicillin residues, with a mean value of 3.75 ± 0.1. Amoxicillin contents were detected in both market and balady egg samples at concentrations ranging from 2.5 to 4.7 with a mean value of 3.27 ± 0.20 ppb and a range of 2.8 to 4.7 and mean of 3.77 ± 0.23 ppb in examined market and balady egg samples, respectively. All analyzed egg samples showed ampicillin and amoxicillin residue concentrations lower than the MRL specified by Commission Regulation (EC) 508/1999.

The results presented in Table 5 and Fig. 4 show that in all examined markets, 15 (100 %) and 10 (66.66 %) out of the balady egg samples were positive for oxytetracycline and tetracycline, respectively. Residual oxytetracycline and tetracycline contents ranged from 46.03 to 279.73 and 18.73 to 265.9, as expressed in ppb in market egg samples. In balady egg samples, it ranged from 180.95 to 212.60 and 102.60 to 134.06, respectively. The mean ± SE levels of oxytetracycline and tetracycline in market egg samples were 149.23 ± 18.12 and 151.11 ± 19.02, respectively. In contrast, the examined balady egg sample concentration was 198.88 ± 3.47 and 116.62 ± 3.56, respectively. The mean levels of oxytetracycline and tetracycline residues in eggs were lower than the MRLs set by the Codex Alimentarius Commission.

Nearly the present findings agree with those reported by Tijjani et al. [29], who revealed that the overall mean concentration of tetracycline in eggs from layer farms and retail outlets was below the maximum residue level of 200 µg/kg set by the Codex Alimentarius Commission.

Lower results were reported by De Ruyck and colleagues, who used HPLC to determine tetracycline antibiotics in eggs. The mean oxytetracycline concentrations in positive egg samples compared with Maximum Residue Limit.

### Table 6. Ampicillin and Amoxicillin concentrations (ppb) in positive egg samples compared with Maximum Residue Limit.

<table>
<thead>
<tr>
<th>Egg samples</th>
<th>Ampicillin</th>
<th></th>
<th></th>
<th>Amoxicillin</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of positive samples (N = 20)</td>
<td>Minimum</td>
<td>Maximum</td>
<td>Mean ± SE</td>
<td>Number of positive samples (N = 20)</td>
<td>Minimum</td>
</tr>
<tr>
<td>Balady</td>
<td>10</td>
<td>3.2</td>
<td>4.1</td>
<td>3.75 ± 0.1</td>
<td>10</td>
<td>2.8</td>
</tr>
<tr>
<td>Market</td>
<td>10</td>
<td>3.5</td>
<td>5.9</td>
<td>4.66 ± 0.29</td>
<td>10</td>
<td>2.5</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>3.2</td>
<td>5.9</td>
<td>4.2 ± 0.18</td>
<td>20</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Recommendation of Maximum Residue Limit (MRL) by European Union (EU) legislation for Ampicillin and Amoxicillin residues in table eggs is set to 10 ppb.

Fig. 4. Premi® Test kit and instruments.
residue value in the eggs was lower than the MRL level and reached 118 ng/g [10].

A higher concentration of tetracycline residue was reported by Fagbamila et al. [2], who reported a very high concentration of tetracycline contamination in table eggs in Jos, Plateau State, which agrees with the findings of Omeiza and Daniel [30], who reported a tetracycline residue concentration of 479 μg/kg in table eggs in Ibadan. Nonga et al. [5] also reported a high concentration of tetracycline contamination in table eggs in Tanzania. The top results of oxytetracycline residues detected in table eggs in studies conducted by Al-Ghamdi et al. [31] exceeded the 200 ppb eggs limit (MRL), as stated by The European Union [32].

In a previous study by Olatoye and Kayode, oxytetracycline residues in chicken eggs collected from five markets in Ibadan metropolis were analyzed using HPLC. The examined samples contained detectable oxytetracycline with an overall mean residue concentration of 479.0 μg/kg above the Codex Alimentarius Commission MRL. This study suggests that poultry eggs should be distributed to the market until the end of the drug withdrawal period. The withdrawal period of drugs was observed before table egg distribution to avoid antimicrobial resistance and to notify both owners and consumers about the hazards of antibiotic residues [33].

5. Conclusion

Our study showed widespread abuse of antimicrobials among poultry farms, which led to an increase in the levels of their residues in eggs. This increase resulted from the absence of direct veterinary supervision and a lack of knowledge about the appropriate dosage of the drugs or withdrawal periods.

Authors contribution

H.A. and H.M. conducted the experiment, analytical procedures, and research writing. M.E. conducted the experiment design and revised the manuscript. H.M. revised the manuscript.

Funding statement

No fund.

Data access statement

Data are available in this study.

Research ethics committee permission

The current research work was permitted to be executed according to the standards of the Research Ethics Committee, Faculty of Veterinary Medicine, Mansoura University.

Conflicts of interest

There are no conflicts of interest.

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