ANTIBIOTIC RESISTANCE PATTERN OF ESCHERICHIA COLI DERIVED FROM RETAIL RAW MEAT IN NORTH SUMATERA, INDONESIA

Rita Rosmala Dewi\textsuperscript{1)}, Karina Mia Berutu\textsuperscript{1)}, Juli Mutiara Sihombing\textsuperscript{1)}
\textsuperscript{1)} Faculty of Agriculture and Animal Husbandry, Tjut Nyak Dhien University, Medan, Sumatera Utara, Gg. Rasmi No.28, Sei Sikambing C. II, Kec. Medan Helvetia, Kota Medan, Sumatera Utara 20123

*Corresponding Email: ritardewi@yahoo.com

Submitted 21 May 2023; Accepted 10 July 2023

ABSTRACT

Bacteria from animals raised for food that have developed antimicrobial resistance (AMR) may serve as a vehicle for its transmission from animal to human. Nevertheless, the antibiotic resistance profile of \textit{Escherichia coli} from raw meat is scarcely reported, especially in North Sumatra. The aim of this investigation was to investigate the retail raw meat for the presence of \textit{E. coli} and its antimicrobial resistance pattern. We purchased 80 packages of fresh meat products from four traditional markets located in Deli Serdang and Medan. \textit{Escherichia coli} was isolated by an established microbiology test and a phenotypic antimicrobial susceptibility test was conducted by the method of disk diffusion. The data analysis of antibiotic resistance and multi-drug resistance (MDR) levels was performed by using WHONET 5.6. The antibiotic resistance dissimilarity between the two regencies was analyzed by using chi-square analysis. This study observed about 19 \textit{E. coli} isolates (23.7\%) were obtained from raw meat. Resistance toward the antibiotics listed as critically important for veterinary and human therapy is increasing concern for public health. The isolates were highly resistant to ampicillin and tetracycline. Meanwhile gentamycin is susceptible. The MDR level of \textit{E. coli} in both regencies of North Sumatra was about 21.05\%. This finding contribute essential information on AMR in food animals and can be used to improve local and regional plans for the administration of antibiotics to livestock.

Key words: Antimicrobial resistance (AMR); Escherichia coli; multidrug resistance (MDR)
INTRODUCTION

Antimicrobial resistance (AMR) is a health burden globally. AMR among human, animal, and zoonotic pathogens has emerged and disseminated, posing a serious threat to human health globally (Vidovic & Vidovic, 2020). Illness involving AMR increases the risk of major medical condition and lengthy hospital stays, which in turn raises the cost of healthcare, the price of second-line medications, and the likelihood that treatments may fail (Dadgostar, 2019). According to the recent data published by Murray et al., (2022), there were about 12.7 million fatalities in 2019 that were directly related to bacterial AMR out of an expected 495 million deaths linked to bacterial AMR worldwide. Antibiotic-resistant bacteria may spread to people through a variety of complicated and unpredictable routes. Food-producing animals become the drivers for the antimicrobial resistance of pathogen including E. coli through the food chain or direct contamination to human (Vidovic & Vidovic, 2020).

Escherichia coli, a commensal bacterium of the intestinal flora of warm blood animals, is commonly used as indicator organisms for antimicrobial resistance (Moreno et al., 2000). This is due to their widespread distribution in the gut and ease with which they can acquire genes encoding antibiotic resistance as a result of their genomic plasticity (Azabo et al., 2022). E. coli engages in the enterobacterial gene pool as a resistance gene donor and recipient, enabling it to both acquire and provide resistance genes to other bacteria. (Poirel et al., 2018). Generally, antimicrobial resistance of E. coli is considered one of the important challenges in both humans and animals at a global scale and may contribute as a real public health concern.

Contamination of antibiotic resistance bacteria in the food producing animal reported may due to the antibiotic application in the livestock. Resistance to particular antibiotics in commensal E. coli isolates from swine, poultry, and cattle is reported closely correlated with the level of use of these medications (Chantziaras et al., 2014). Antibiotics application in livestock is reported in the East Asia countries (Nhung et al., 2016) and worldwide (Van Boeckel et al., 2015). Indonesia is predicted among the five nations with the highest expected percentage elevates in consumption of antimicrobial by 2030 (Van Boeckel et al., 2015).

Furthermore, Indonesia, determined from 50 countries with the largest amounts of antibiotics applied in livestock in 2010, include Myanmar (205%), Indonesia (202%), Nigeria (163%), Peru (160%), and Vietnam (157%) (Van Boeckel et al., 2015). The large production of cattle to meet Indonesia's strong demand for beef meat (Agus & Widi, 2018) results in a high usage of antibiotics among the country's livestock. Farm animals including cattle has been shown to be a possible source of microorganisms resistant to antibiotics (Bitrus et al., 2019). Hence, the emergence of antibiotic resistance among pathogen from food-producing animals is a growing problem for veterinary medicine and public health.

In Indonesia, several investigations have been conducted the AMR in the food-producing animal product including raw meat in Surabaya (Effendi et al., 2020), poultry meat in Surabaya (Sudarmadi et al., 2020).
2020) and Bogor (Januari et al., 2019). Notwithstanding, there is dearth of information on antimicrobial residue from food-producing animal products (Arief & Taufik, 2019) and none of them discuss about AMR pattern of bacteria E. coli observed from raw meat in Medan, North Sumatera. The Statistic Central Berau of North Sumatera recorded the increased of production in beef cattle from 12,986,163 kg in 2020 to 13,286,017 kg in 2021 (BPS, 2022).

The high production of beef cattle may rise the high antibiotic usage in animal production. Then, the antibiotic consumption in livestock may disseminate the resistance bacteria the animal product from farm to fork. Hence, it calls the urgent necessity for antimicrobial resistance monitoring in livestock and the retail. Furthermore, such information is needed by policymakers to regulate the antimicrobials prudent use in animal production.

**MATERIALS AND METHODS**

**Study Area and Sampling**

This study was carried out in two regencies, Medan and Deli Serdang, of North Sumatera, Indonesia. Sampling was carried out between January and March 2023. In all, 80 samples of beef meats were selected from four traditional markets and examined for the presence of E. coli and antibiotic sensitivity test (AST). The laboratory analysis was conducted in the Microbiology laboratory, Tjut Nyak Dhien University.

**Isolation and Identification**

E. coli was isolated in accordance with (Jang et al., 2008) and (Adzitey et al., 2021). In total, 10 g of raw meat was pre-enriched in 90 mL of Peptone Buffered Water (Merck, Germany) and incubated at 37 C for 24 hours. The aliquots were streaked on Levine’s eosin-methylene blue agar (Merck, Germany) and incubated at 37 C for 24 hours. Biochemical tests were performed to identify E. coli using indole, Methyl Red,Voges–Proskauer, and citrate utilization test (IMViC), and Triple Sugar Iron Agar (TSIA) (Merck, Germany).

**Antibiotic Sensitivity Test**

The antibiotics susceptibility of E. coli was examined for 5 antibiotics. These antibiotics were performed using disk diffusion (concentration in µg): ciprofloxacin (5 µg), gentamycin (10 µg), chloramphenicol (30 µg), ampicillin (10 µg), and tetracycline (30 µg). The selection of antibiotics were according to WHO and OIE recommendation for the antimicrobials usage in human and farmed animals (OIE, 2015; WHO, 2019); The choice complied with Indonesia's Antimicrobial Resistance Integrated Surveillance (Suady, 2019). The method of disk diffusion for E coli was conducted in compliance with the Clinical and Laboratory Standards Institute (CLSI) guidelines (CLSI, 2018).

**Data Analysis**

Antimicrobial sensitivity test data of E. coli isolates from raw meat were analyzed separately in WHONET 5.6 (WHO, 2006a, 2006b). The MAR index was determined and interpreted by using the formula : \( a/b \), where ‘\( a \)’ represent the antibiotics number to which an isolates was resistant and ‘\( b \)’ represent the antibiotic tested (Krumperman, 1983).

The phenotypic pattern of AMR and frequency of MDR were analyzed by WHONET 5.6 software. The chi-square test was performed to compare the discrepancies in the AMR pattern across the regencies of Medan and Deli Serdang. The MDR frequency to bacteria both Medan and Deli Serdang regency was sorted and compared. SPSS was the software employed for the statistical analyses, with a significance level of \( \alpha = 0.05 \).

**RESULTS AND DISSCUSION**

**The E. coli Prevalence**

Overall, E. coli prevalence in raw meat from traditional market from Sumatera

89
Utara was about 23.7%. Meanwhile, the prevalence of *E coli* from markets in two regencies including Medan and Deli Serdang was about 20% (95% CI = 12.2, 30.8) and 22.5% (95% CI = 14.6-34.5) respectively (Table 1). This study also compared the *E. coli* contamination between two regencies at the retail stage. It revealed that there were no significant differences in *E. coli* proportion obtained from raw meat between traditional market in Medan and Deli Serdang ($\chi^2 = 0.075$, $p = 0.785$).

### Table 1. *Escherichia coli* derived from raw meat in the traditional Market in Medan and Deli Serdang Regency, North Sumatera

<table>
<thead>
<tr>
<th>Regency</th>
<th>Total</th>
<th>Prevalence (95%CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medan</td>
<td>40</td>
<td>8(20; 12.2-30.8)</td>
</tr>
<tr>
<td>Deli Serdang</td>
<td>40</td>
<td>11(27.5; 18.6-40.5)</td>
</tr>
</tbody>
</table>

The contamination of *E coli* in animal products especially meat were also reported from Indonesia (Bahri et al., 2019; Bontong et al., 2012; Elsie, 2016) as well as worldwide (Adzitey et al., 2021). Even though this study showed the lower prevalence compare to other investigations from Egypt about 54% (Gwida et al., 2014) and Ghana about 80% (Adzitey et al., 2021). Meanwhile, this investigation found to be higher compare to developed countries such as Europe (1.0%) as well as Italy (11.6%) (EFSA, 2018; Nobili et al., 2022) where there is a high premium placed on handling animals hygienically and processing them into meat and meat products.

Many aspects, including accuracy, the isolation and detection method used, the quantity of samples acquired, the type of samples analyzed, the period of sampling, the level of cleanliness maintained, and the location of sampling, may be highlighted by the stark disparities in *E coli* prevalence between nations. (Adzitey et al., 2020; EFSA, 2018; Gwida et al., 2014; Nobili et al., 2022).

Most meats contain approximately high water activity (aw) about 0.99 which is preferable for the microbes growth (Enock et al., 2017). The presence of *E. coli* in the meat samples suggests that lapses take place throughout the transport, sale of the meat, and slaughter of the animals (Koutsoumanis et al., 2022). This is because a disease-free animal's muscle is unavoidably sterile. After the process of animal slaughtered, the exposed meat are vulnerable to contamination by microbes (Adzitey et al., 2020). *E. coli* has been observed to flourish naturally in farm animals' digestive tracts. (Bélanger et al., 2011).

Therefore, when the digestive tract ruptures during evisceration, the contaminated meats possibly become the reason of *E coli* contamination in meat samples. In addition, knives, tables and utensils that worn in the market were cross contaminated and found to be positive *E. coli* (Adzitey et al., 2020). It has been established that *E. coli* serves as an indicator bacterium for indicating unsanitary conditions in the food processing chain (Martin et al., 2016).

Therefore, the occurrence of contamination raw meats in the markets from both regencies possibly derived from cross-contamination from food chain and meats handling at the retail stage. We found that there were no differences of *E coli* prevalence between the traditional market from Medan and Deli Serdang.

Hence, this study highlighted that the hygienic condition of the meat stalls in the traditional market between Medan and Deli Serdang is comparable. Since *E. coli* is considered an important bacteria from food-producing animals due to their ability to transmit the diseases through food chain of animal products (Heredia & García, 2018) as well as their resistant phenotype (Bitrus et al., 2018), then potential public health hazard from meat products sold in the traditional markets in the studied area is on the rise.
**Antibiotic Susceptibility of E. coli Bacteria**

Overall, 19 isolates comprising *E. coli* from Medan (n=8) and Deli Serdang (n=11) were tested to antibiotic susceptibility testing (AST). Figures 1. depicted the *E. coli* isolates antibiograms. Different levels of resistance against the five antibiotics tested were demonstrated in the antimicrobial resistance profile of *E. coli* isolates from traditional markets in North Sumatera Province shown in Figure 1.

**Figure 1.** Antibiotic susceptibility pattern of *E. coli* isolates recovered from raw meat obtained from traditional market of North Sumatera against antimicrobials tested. R: Resistant; I: Intermediate; S: Susceptible

**Figure 2.** Antibiotic susceptibility pattern of *E. coli* isolates recovered from raw meat obtained from traditional market of Medan Regency against antimicrobials tested. R: Resistant; I: Intermediate; S: Susceptible
The highest level of resistance was recovered for ampicillin (68.4%; 95% CI = 43.5-86.4) and tetracycline (42.1%; 21.1-66.0). Varying levels of resistance to the five antibiotics tested have been observed in the antimicrobial resistance profile of E. coli obtained from raw meat in the traditional market of the Medan Regency (Figure 2). The highest level of resistance is toward ampicillin (90.9%; 95% CI=57.1-99.5) and tetracycline (36.4 %;12.4-68.4). The profile of antibiotic resistance among E. coli isolates from raw meat in traditional market of Deli Serdang Regency in Figure 3 illustrated varying levels of resistance against the five antibiotics tested. The highest level of resistance recorded for ampicillin (36.4%; 95% CI=10.2-74.1) and tetracycline (36.4%; 95% CI=10.2-74.1).

Many nations have designated the AMR surveillance involving food-producing animals a top priority, including Indonesia, due to the emergence of AMR in livestock and their products in the retail stage. The very high resistance prevalence to ampicillin and tetracycline supports the previous report of Indonesia surveillance of livestock by Suady, (2019). However slightly lower level of ciprofloxacin was reported in this study. The very high resistance against ampicillin (100%) and tetracycline (89%) were also recorded from raw meat from traditional market in Surabaya (Effendi et al., 2020), which is in accordance with this findings. The high resistance observed for tetracycline was in accordance with that reported in E. coli isolated from raw meat from Nepal (Saud et al., 2019) and Ghana (Adzitey et al., 2021). In contrast, the lower prevalence of chloramphenicol and sensitive to gentamycin was recorded in this study compare to aforementioned studies. Improper handling of contaminated raw meat possibly caused the cross-contamination of resistant bacteria in the food chain (Aworh et al., 2021; Hammerum & Heuer, 2009) or during the slaughter process (Alexander et al., 2010).

Moreover, the high level of tetracycline and ampicillin resistance recorded possibly indicate the high consumed of these antibiotics in the human and veterinary medicine, for instance Roth et al., (2019) reported that resistant E coli can be contaminate food animals from antibiotic usage in farm level. Tetracycline and ampicillin have been used extensively in the diseases therapy of human and animal infections (OIE, 2007). Additionally,
tetracycline is frequently used as growth promotors in animal feed at subtherapeutic concentrations (Chopra & Roberts, 2001). Yusuf et al., (2018) also found that tetracycline is the most antibiotics used in Indonesia’s cattle based on their investigation through several provinces of Indonesia.

Furthermore, on the OIE antibiotic list, ampicillin and tetracycline are classified as veterinary critically important antibiotics (VCIA), which are crucial for treating diseases in animal production. (OIE, 2007). Therefore, high resistance toward these antibiotics leading to a significant risk to human and animal health. Consumers may be at risk for health problems because meat and other animal sources have been demonstrated to be a significant route for extraintestinal MDR bacteria, particularly for Salmonella and E. coli (Xu et al., 2022; Yamaji et al., 2018).

**Disparities between Resistance Profile of E. coli Isolates from Traditional market in Medan and Deli Serdang**

The pattern of antimicrobial resistance of E. coli isolated from raw meat collected from the traditional market of Medan and Deli Serdang are provided in Table 2. The majority of E. coli isolates were ampicillin (37.5 to 90.9%) and tetracycline (36.4 to 37.5%) resistant in both Medan and Deli Serdang Traditional markets (Table 2). In comparison to Deli Serdang, E. coli isolates from Medan demonstrated higher prevalence of ampicillin resistance. Meanwhile E coli isolates obtained from Deli Serdang demonstrated higher level resistance toward chloramphenicol, ciprofloxacin and tetracycline.

All tested antibiotics resistance patterns for E. coli from Medan and Deli Serdang regency are similar. Resistance was highest for tetracycline and ampicillin and susceptible is for gentamycin. Meanwhile, there were statistically significant variations between the level of AMR in E. coli obtained from Medan and Deli Serdang regency for ampicillin, while there were no statistically significant variations in proportion of MDR among E. coli isolated from Medan and Deli Serdang traditional market ($\chi^2 = 3.074 \ p = 0.080$). Significant discrepancies were observed only for ampicillin resistance. (Table 2). Microbes can exchange genes that give each other resistance when they are in close proximity to one another (Peterson & Kaur, 2018). In addition, E coli is reported acts as resistance genes donor and recipients then this allow them to acquire resistance genes from other bacteria and disseminate it to other bacteria (Cho et al., 2019). This ambience may lead about resemblance and divergence in their pattern of resistance.

Table 2. Antimicrobial Resistance Profile between E. coli isolates from Traditional market of Medan and Deli Serdang, North Sumatera.

<table>
<thead>
<tr>
<th>Antimicrobial Agent</th>
<th>Resistance % (95% CI)</th>
<th>Medan</th>
<th>Deli Serdang</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampicillin</td>
<td>90.9 (57.1-99.5)</td>
<td>37.5 (10.2-74.1)*</td>
<td></td>
</tr>
<tr>
<td>Chloramphenicol</td>
<td>9.1 (0.5-42.9)</td>
<td>25 (4.5-64.4)</td>
<td></td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>18.2 (3.2-52.3)</td>
<td>25 (4.5-64.4)</td>
<td></td>
</tr>
<tr>
<td>Gentamycin</td>
<td>0 (0.0-32.1)</td>
<td>0 (0.0-40.2)</td>
<td></td>
</tr>
<tr>
<td>Tetracycline</td>
<td>36.4 (12.4-68.4)</td>
<td>37.5 (10.2-74.1)</td>
<td></td>
</tr>
</tbody>
</table>

* Significant difference between E coli from Medan and Deli Serdang, $P < 0.05$.

**Multidrug Resistance and MAR Index**

Table 3 depict the Multiple Antibiotics Resistance (MAR) index of E coli isolated from traditional market in North Sumatera. The identification if high-threat sources resistant faecal contamination of food could be showed by the MAR indexing of bacteria, including E. coli (Ranasinghe et al., 2022). Up till now, no study has investigated the MAR index of meat-origin E. coli in North Sumatera. The average MAR index across 19 isolates was
0.33, with a range of 0 to 0.8. The combined antimicrobial agent patterns with the highest MAR value of 0.8 are as follows: Amp Cip Chl Te. Value of MAR greater than 0.2 denotes a high contamination risk where application of antibiotics frequently used. This finding revealed 78.9% had indexes between 0.2-0.8 which is represent resistance to at least one or more antibiotics agents. Studies described by (Ranasinghe et al., 2022) and (Adzitey et al., 2021) showed the presence of high MAR in a relatively similar level with study. The high prevalence demonstrates a significant adverse impact in usage of common antibiotic. High prevalence of ampicillin and tetracycline from raw meat possibly shows the frequent usage of common antibiotics (Ranasinghe et al., 2022). Due to the widespread imprudent use and out-of-date antimicrobial agents, the worldwide burden of MAR has increased to unacceptable proportions (Okeke et al., 2005; Ranasinghe et al., 2022).

**Table 3.** Antibiotic resistance profile and multiple antibiotic resistance index of individual *Escherichia coli* isolated from meat samples from Traditional market in North Sumatera

<table>
<thead>
<tr>
<th>Serial Number</th>
<th><em>Escherichia coli</em> isolate Code</th>
<th>Regency</th>
<th>Antibiotic Resistance Profile</th>
<th>MAR Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>P7</td>
<td>Medan</td>
<td>Amp Cip Chl Te</td>
<td>0.8</td>
</tr>
<tr>
<td>2</td>
<td>P8</td>
<td>Medan</td>
<td>Amp Cip Chl Te</td>
<td>0.8</td>
</tr>
<tr>
<td>3</td>
<td>K6</td>
<td>Deli Serdang</td>
<td>Amp Chl Te</td>
<td>0.6</td>
</tr>
<tr>
<td>4</td>
<td>J16</td>
<td>Deli Serdang</td>
<td>Amp Cip Te</td>
<td>0.6</td>
</tr>
<tr>
<td>5</td>
<td>K98</td>
<td>Deli Serdang</td>
<td>Amp Cip</td>
<td>0.4</td>
</tr>
<tr>
<td>6</td>
<td>J25</td>
<td>Deli Serdang</td>
<td>Amp Cip</td>
<td>0.4</td>
</tr>
<tr>
<td>7</td>
<td>P5</td>
<td>Medan</td>
<td>Amp Te</td>
<td>0.4</td>
</tr>
<tr>
<td>8</td>
<td>K15</td>
<td>Deli Serdang</td>
<td>Amp Te</td>
<td>0.4</td>
</tr>
<tr>
<td>9</td>
<td>P14</td>
<td>Medan</td>
<td>Amp Te</td>
<td>0.4</td>
</tr>
<tr>
<td>10</td>
<td>J8</td>
<td>Deli Serdang</td>
<td>Amp Te</td>
<td>0.4</td>
</tr>
<tr>
<td>11</td>
<td>J22</td>
<td>Deli Serdang</td>
<td>Amp</td>
<td>0.2</td>
</tr>
<tr>
<td>12</td>
<td>K11</td>
<td>Deli Serdang</td>
<td>Amp</td>
<td>0.2</td>
</tr>
<tr>
<td>13</td>
<td>K18</td>
<td>Deli Serdang</td>
<td>Amp</td>
<td>0.2</td>
</tr>
<tr>
<td>14</td>
<td>K3</td>
<td>Deli Serdang</td>
<td>Amp</td>
<td>0.2</td>
</tr>
<tr>
<td>15</td>
<td>K7</td>
<td>Deli Serdang</td>
<td>Cip</td>
<td>0.2</td>
</tr>
<tr>
<td>16</td>
<td>P3</td>
<td>Medan</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>17</td>
<td>P4</td>
<td>Medan</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>18</td>
<td>P10</td>
<td>Medan</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>19</td>
<td>P13</td>
<td>Medan</td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

MAR: Multiple Antibiotic resistance index, Amp: Ampicillin, Cip: Ciprofloxacin, Chl: Chloramphenicol, Te: Tetracycline

**Figure 4.** Multi-drug resistance of *E. coli* from raw meat recovered from traditional market on Medan and Deli Serdang regency. Numbers inside the brackets “()” denote the number of isolates; those on bars indicate percent isolates showing resistance; non-MDR = Resistant against only 1 or 2 classes of antibiotics; MDR=Multidrug resistance.
A high level of MDR (25%) was observed for E. coli from Medan, with another 25% resistant to one or two antibiotics agents tested (Figure 4). Overall, 18.2% of E. coli isolated from raw meat in Deli Serdang traditional market was resistant to multiple classes of antibiotics; 81.8% was resistant to one or two antibiotic classes (Figure 4).

The relatively high MDR prevalence in food producing animal is steadily reported in multiple studies from Indonesia (Effendi et al., 2020), Nepal (Saud et al., 2019), and Ghana (Adzitey et al., 2021). Initially, MDR bacteria were associated with hospital-acquired infections (Bharadwaj et al., 2022). However, the extensive application of antibiotics nowadays in the human and veterinary medicine elevate the emergence of MDR among bacteria (Canechi et al., 2023). By accumulating genes that each code for resistance to a different agent on resistance plasmids or transposons, or by the actions of multidrug efflux pumps, each of which can release more than one drug type, bacteria can develop multidrug resistance (Nikaido, 2009). In addition, E. coli has an ability as the reservoir of resistance traits that can disseminates the multi-drug resistance genes among bacteria (Szmolka & Nagy, 2013).

The high level of MDR revealed in this study may increase the awareness of MDR development in the food-producing animal products. The food industry is becoming increasingly concerned about the potential hazards of MDR due to the seriousness of the diseases that MDR zoonotic pathogens may cause, which could result in a deprivation of consumer confidence and, as a result, a decline in demand for animal origin foods (Pérez-Rodríguez & Mercanoglu Taban, 2019).

Therefore, surveillance and monitoring of antibiotics resistance in E coli and other public health significance bacteria from food of animal origin is essential to provide the information is needed by policymakers to regulate the antimicrobials prudent use in animal production.

CONCLUSION

This is the first report of AMR phenotypic, MDR and MAR index isolated from meat in North Sumatera. The resistant and MDR E. coli was observed in the raw meat isolated from traditional market in North Sumatera. This study highlighted high resistance toward ampicillin and tetracycline in both regencies of North Sumatera. Since these antibiotics listed under veterinary critically important antibiotics that are of particular importance in treating diseases in animal production as well as human, this may jeopardize the public health through animal products contamination of resistant E coli. Relatively High MDR among E coli isolates found in this study also raise the hazard for public health. The MAR result in this study concerning the traditional market may serve as the high-risk resistant bacteria contamination in the food chain. Therefore, for the future, the comprehensive data about AMR “from farm to fork” of North Sumatera is needed for better understanding regarding the dissemination of AMR in the food producing animal products.

ACKNOWLEDGMENT

The authors would like to thank to Ika Julianti from Faculty of Pharmacy, Tjut Nyak Dhien University for the laboratory assistance and Yunida Berliana, the Dean of Faculty of Agriculture and Animal Husbandry, Tjut Nyak Dhien University for the administration support during research.

REFERENCES


Cho, S., Nguyen, H. A. T., McDonald, J. M., Woodley, T. A., Hiott, L. M., Barrett,


Koutsoumanis, K., Allende, A., Álvarez-Ordóñez, A., Bolton, D., Bover-Cid, S., Chemaly, M., Davies, R., De Cesare, A., Herman, L., Hilbert, F., Lindqvist, R., Nauta, M., Ru, G., Simmons, M., Skandamis, P., Suffredini, E., Argüello-Rodríguez,


OIE. (2007). *OIE List of Antimicrobials of Veterinary Importance*.


