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# Prevalence of Microbial Contamination and Antibiotic Residue in Chicken Meat, Beef, and Offal in South Sulawesi

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## Abstract

Chicken meat, beef, and offal are important animal products. They easily spoiled due to bacterial contamination and might contain antibacterial residues derived from treatments during rearing and processing. This present work aimed to investigate location- and time-dependent value of TPC (Total Plate Count), and analyze antibiotic residue present in chicken meat, beef, and offal sampled in the Province of South Sulawesi. This current study was conducted by analyzing data released from UPT. Animal Product Quality Analysis in Department of Animal Husbandry and Animal Health, Province of South Sulawesi. Our experimental design was arranged according to completely randomized design with factorial (4×3), and carried out 5 replications. The results showed that two locations (Takalar District and Palopo District) had the lowest TPC value, while Palopo City possessed the highest TPC value. Regarding to antibiotic residue, the positive sample was only found in 2015, a chicken meat sample collected in Luwu Utara District.

**Keywords** : Total Plate Count (TPC), Antibiotic Residues.

## INTRODUCTION

Food safety undeniably needs to attempt, ensuring that foods are free from possible physical and biological contaminants as well as unwanted materials causing disadvantages on human health, while also considering compliance of religious requirements, belief, and culture, which make the food safe to consume as guaranteed by Indonesian governmental regulation about food, i.e. UU No. 18/2012. Food constitutes one of the key human need; besides nutritional composition, food safety and quality become one of foremost concerns.

Unsafety on food and product quality noticeably brings deleterious impacts to human health (even causing death) and may also cause economic loss. Cost and disadvantages due to the emerging problems of food safety must be together paid by many counterparts, including

household (consumers), industries, and government. Specifically, some of animal slaughterhouses, poultry slaughterhouses, markets in South Sulawesi did not meet all requirements; thus, food safety aspects of these animal products should be considered (Lonergan *et al*., 2005).

## MATERIALS AND METHODS

In this experiment, we used secondary data about microbial contamination level and antibiotic residue reported by UPT. Animal Product Quality Analysis in Department of Animal Husbandry and Animal Health, Province of South Sulawesi. Before analyzed, the last three-year data were sorted, representing 4 locations of district and city, north and south part of South Sulawesi.

The research was conducted according to the following steps:

1. Sampling
   a) Sample types

      Animal products were sampled for monitoring and surveillance by a team (PPC, *Petugas Pengambil Contoh*) of Laboratory of UPTD PMPP. Primary sample was collected, including animal products sold in retail or traditional markets, and animal slaughterhouse, in each epidemiological unit (district and city).

   b) Sampling method

      Simple Random Sampling was used, while the bias method was determined as follows:

      $$\mathbf{n = 4\,pq/L^2}$$

      where:

      n = number of sample
      p = prevalence
      q = 1 – p

      L = Error

      $450 = 4\times0{,}44(1\text{-}0{,}44)/ L^2$

      $L^2 = 0{,}99/450$

      L = 0,05 (confidence level 99,95%)

2. Sample Testing
   a. Total Plate Count (TPC)

      TPC was used as a procedure for the enumeration of microorganisms that grow in an agar medium under particular conditions (time and temperature) by using fresh samples (chicken meat, beef, offal) (Gobel *et al*, 2008).

   b. Determination of antibiotic residue

      For surveillance purposes, antibiotic residue was tested using a screening test prescribed by standard methods of SNI 7424 2008.

3. Collection and Tabulation of Data

   Experimental data of microbial contamination and antibiotic reside represented four locations (district and city) in South Sulawesi, while also regarding market chain of chicken meat, beef, and offal. For TPC, data were transformed into log 10 to adjust normality, required in analysis of variance.

TPC data were evaluated using analysis of variance, in accordance with experimental design, to observe the difference in terms of locations and times (period of 2013 to 2015). The

results of the TPC analysis were then expressed using mapping, while the result of antibiotic residue analysis was presented by descriptive.

### Experimental Design

Factorial arrangement (4×3) on a completely randomized design (CRD) was performed, with five replications for each treatment. Locations as factor 1 included three districts (Maros, Takalar, Luwu) and one city (Palopo), while factor 2 was period of time, i.e. 2013 - 2015. Mathematical model was arranged as follows:

$Y_{ij} = \mu + \alpha_i + \beta_j + \varepsilon_{ij}$

where:

$Y_{ij}$ = Mean of the observed data
$\mu$ = Mean of the population
$\alpha_i$ = Factor sampling location
$\beta_j$ = Factor year of sampling j; j = 3 (2013, 2014, 2015)
$\varepsilon_{ij}$ = Error

Parameters observed included prevalence of microbial contamination and antibiotic residue present in chicken meat, beef, and offal (Nasution, 2004).

### Statistical Analysis

Data were evaluated using analysis of variance based on CRD-factorial. Descriptive analysis was also given according to location and year.

## RESULTS AND DISCUSSION

### TPC Value in 2013

Table 1 exhibits TPC value in 4 studied locations in 2013. The results showed that the value differed, depending on locations, types of animal products, and the interaction thereof.

Duncan test showed that TPC value in 2013 differed significantly among locations (P<0,05). Specifically, Takalar showed the lowest TPC value, while the highest one was attributed to Luwu Utara (Table 1). The main reason of this result may closely relate to condition of processing facilities including hygiene and sanitation in entire production chains.

Table 1. TPC value of animal products sampled in South Sulawesi in 2013

| Location | Animal products | | | Average |
|---|---|---|---|---|
| | Chicken Meat | Beef | Offal | |
| Palopo | 3,50±0,73 | 5,48±0,63 | 6,05±0,49 | 5,01±1,27$^{b}$ |
| Maros | 5,45±0,93 | 5,12±0,57 | 5,35±0,83 | 5,31±0,75$^{bc}$ |
| Luwu Utara | 5,05±1,18 | 6,56±0,36 | 5,52±0,54 | 5,71±0,97$^{c}$ |
| Takalar | 4,16±0,60 | 4,18±1,02 | 3,71±0,60 | 4,02±0,74$^{a}$ |
| Average | 4,54±1,13$^{a}$ | 5,33±1,07$^{b}$ | 5,16±1,06$^{b}$ | 5,01±1,12 |

Note: Different superscripts following means in similar row or column showed significant difference (P<0,05). SNI 7388 : 2009 Maximum Threshold for Microbial Contamination in Food, TPC : 1 x $10^6$ (CFU/gr).

Additionally, in the same year, TPC in chicken meat demonstrated the lowest value, compared to beef and offal. This is due to a shorter chain of poultry slaughtering process compared to ruminants, which make it possible to have a lower microbial contamination. Contaminants from cow's offals may also contaminate the beef and offal itself. TPC distribution based on types of meats was depicted in Figure 1.

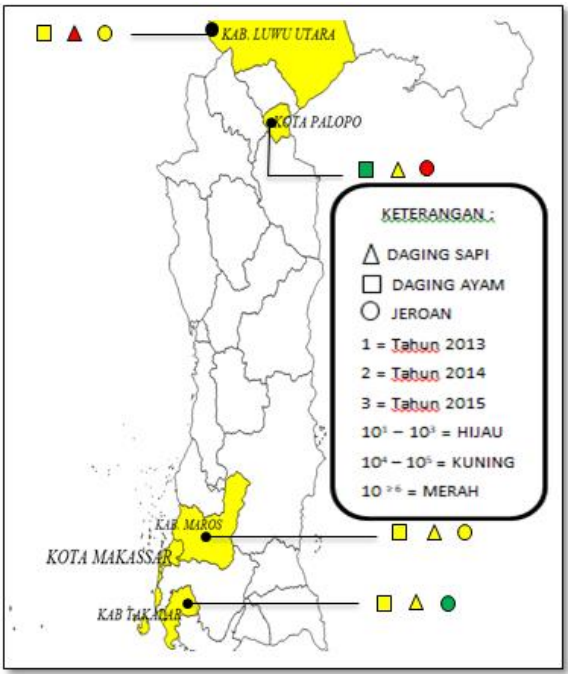


Figure 1. Distribution of TPC value based on types of meats sampled in South Sulawesi in 2013.

**TPC Value in 2014**

TPC value for all studied meats sampled in four locations in South Sulawesi in 2014 was presented in Table 2. Statistical analysis showed that locations significantly affected TPC value ($P<0,05$), while types of meat did not show significant difference.

Table 2. TPC value of animal products sampled in South Sulawesi in 2014

| Location | Types of animal product | | | Average |
|---|---|---|---|---|
| | Chicken Meat | Beef | Offal | |
| Palopo | 4,79±0,89 | 4,85±0,46 | 5,08±0,35 | 4,91±0,58[b] |
| Maros | 3,53±0,38 | 4,23±0,93 | 4,76±1,00 | 4,17±0,92[a] |
| Luwu Utara | 5,12±1,08 | 5,12±0,51 | 4,60±0,91 | 4,95±0,84[b] |
| Takalar | 4,44±0,38 | 3,95±0,52 | 3,99±0,63 | 4,13±0,53[a] |
| Average | 4,47±0,92 | 4,54±0,75 | 4,61±0,81 | 4,54±0,82 |

Note: Different superscripts following means in similar row or column showed significant difference ($P<0,05$). SNI 7388 : 2009 Maximum Threshold for Microbial Contamination in Food, TPC : 1 x $10^6$ (CFU/ gr).

Duncan test showed that TPC value was significantly different based on locations (P<0,05). The highest contamination was found in Palopo and Luwu Utara, even though not significantly differed. Meanwhile, the lowest contamination was observed in Takalar and Maros.

Overall, our data suggested that chicken meat in Maros seemed to be less contaminated, while the highest contamination of chicken meat was found in Luwu Utara. For beef and offal, the lowest TPC value was attributed to Takalar. On the other hand, beef from Luwu Utara and offal from Palopo showed the highest TPC value. TPC distribution based on types of animal product was depicted in Figure 2.

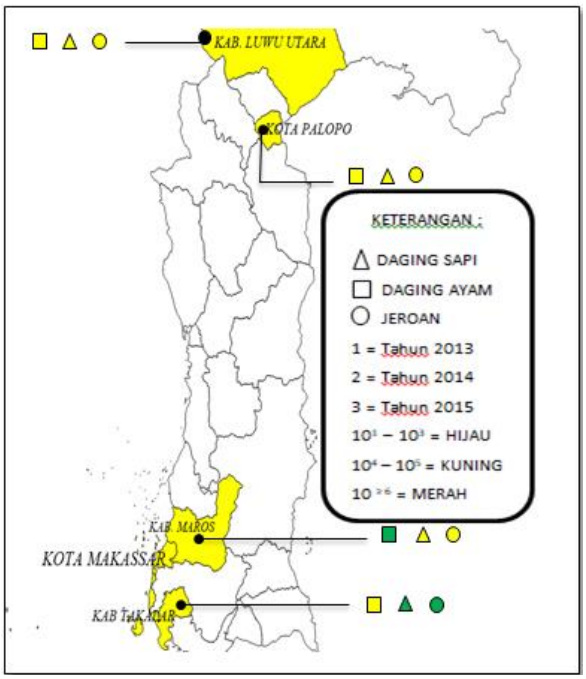


Figure 2. Distribution of TPC value based on types of meats sampled in South Sulawesi in 2014.

**TPC Value in 2015**

The results showed that both factors, sampling location and types of animal products, significantly differed, as presented in Table 3. Animal slaughterhouse is highly risky and susceptible to be contaminated by pathogenic microorganisms (Rahayu, 2006). Fardiaz (1992) found that beef was easily spoiled and could serve as a proper growth medium for microorganisms, due to high content of water and nutrients such as protein. TPC distribution based on types of animal products was depicted in Figure 3.

Table 3. TPC value of animal products sampled in South Sulawesi in 2015

| Location | Types of animal product | | | Average |
|---|---|---|---|---|
| | Chicken meat | Beef | Offal | |
| Palopo | 5,17±0,53 | 4,77±1,72 | 5,62±1,28 | 5,18±1,23[b] |
| Maros | 3,46±0,86 | 5,74±1,60 | 4,74±1,45 | 4,65±1,57[ab] |
| Luwu Utara | 3,42±1,05 | 4,17±1,01 | 4,74±1,45 | 4,11±1,23[a] |
| Takalar | 3,57±0,25 | 4,21±0,74 | 3,63±1,30 | 3,80±0,86[a] |
| Rata-Rata | 3,91±1,01[a] | 4,72±1,38[b] | 4,68±1,45[b] | 4,43±1,33 |

Note: Different superscripts following means in similar row or column showed significant difference (P<0,05). SNI 7388 : 2009 Maximum Threshold for Microbial Contamination in Food, TPC : 1 x $10^6$ (CFU/ gr).

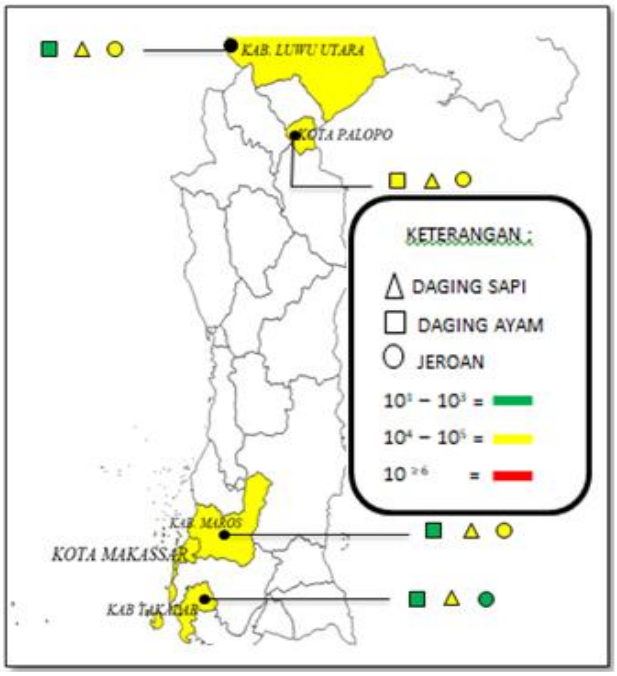


Figure 3. Distribution of TPC value based on types of animal products sampled in South Sulawesi in 2015.

## TPC Value for Beef

Table 4 presents TPC value of beef samples from study sites in South Sulawesi. Based on statistical analysis, both factors demonstrated significant difference in TPC value for each sampling location. Among these sampling locations, Takalar was significantly found to have the lowest average value of TPC, while, based on year of sampling, the TPC value in 2013 was significantly higher than that in 2014 and 2015.

Table 4. TPC value of beef sampled in South Sulawesi between 2013 - 2015

| Location | Year | | | Average |
|---|---|---|---|---|
| | 2013 | 2014 | 2015 | |
| Palopo | 5,48±0,63 | 4,85±0,46 | 4,77±1,72 | 5,03±1,06$^b$ |
| Maros | 5,12±0,57 | 4,23±0,93 | 5,74±1,60 | 5,03±1,22$^b$ |
| Luwu Utara | 6,56±0,36 | 5,12±0,51 | 4,17±1,01 | 5,28±1,19$^b$ |
| Takalar | 4,18±1,02 | 3,95±0,52 | 4,21±0,74 | 4,11±0,74$^a$ |
| Average | 5,33±1,07$^b$ | 4,54±0,75$^a$ | 4,72±1,38$^a$ | 4,86±1,13 |

Note: Different superscripts following means in similar row or column showed significant difference (P<0,05). SNI 7388 : 2009 Maximum Threshold for Microbial Contamination in Food, TPC : 1 x $10^6$ (CFU/gr).

Data showed that Takalar had the lowest TPC value of 4,13 (CFU/gr), being significantly lower than other sampling locations, i.e. Palopo (5,03 CFU/gr), Maros (5,03 CFU/gr), and Luwu

Utara (5,28 CFU/gr). We found that this result could be associated with the better processing facilities in Takalar, also supported by higher processor's awareness on hygiene and sanitation. Geographically, Takalar exists nearby Makassar City, which enables to possess a shorter cold chain of the product, this reducing time prior to analysis of TPC. Distribution of TPC value for beef sampled in 2013 – 2015 in South Sulawesi was depicted in Figure 4.

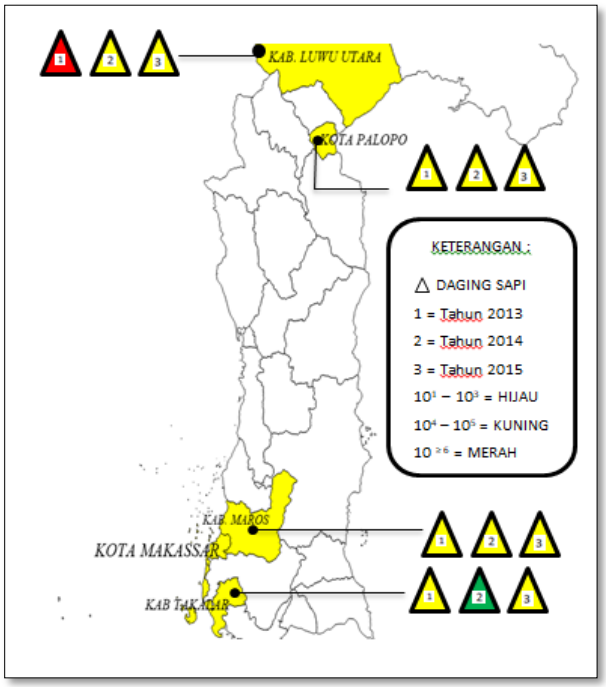


Figure 4. Distribution of TPC value for beef sampled in 2013 – 2015 in South Sulawesi

## TPC Value for Offal

Table 5 exhibits TPC value for offal collected in some locations in South Sulawesi. Statistical analysis showed that the value did not significantly differ, from 2013 to 2015, and at each sampling location (P>0,05).

Table 5. TPC value of offal sampled in South Sulawesi between 2013 - 2015

| Location | Year | | | Average |
|---|---|---|---|---|
| | 2013 | 2014 | 2015 | |
| Palopo | 6,05±0,49 | 5,08±0,35 | 5,17±0,53 | 5,43±0,62[b] |
| Maros | 5,35±0,83 | 4,76±1,00 | 4,74±1,45 | 4,95±1,08[b] |
| Luwu Utara | 5,52±0,54 | 4,60±0,91 | 4,74±1,45 | 4,95±1,05[b] |
| Takalar | 3,71±0,60 | 3,99±0,63 | 3,63±1,30 | 3,78±0,85[a] |
| Average | 5,16±1,06 | 4,61±0,81 | 4,57±1,28 | 4,78±1,09 |

Note: Different superscripts following means in similar row or column showed significant difference (P<0,05). SNI 7388 : 2009 Maximum Threshold for Microbial Contamination in Food, TPC : 1 x $10^6$ (CFU/ gr).

The results demonstrated that the highest contamination was found in 2013, while based on sampling location, Palopo was recorded to show the highest TPC value. The processing facilities seemed to improve, thus resulting in a lower value of TPC in following years. The awareness of processors on hygiene and sanitation was also less satisfying.

Soeparno (2009) found that contamination in surface of the meat/carcass occurred from animal slaughtering to consumption. The source of contamination in animal slaughterhouse was mainly from soil, processors, feces in the digestive tracts, water, processing equipments, and air. Distribution of TPC value for offal sampled in 2013 – 2015 in South Sulawesi was depicted in Figure 5.

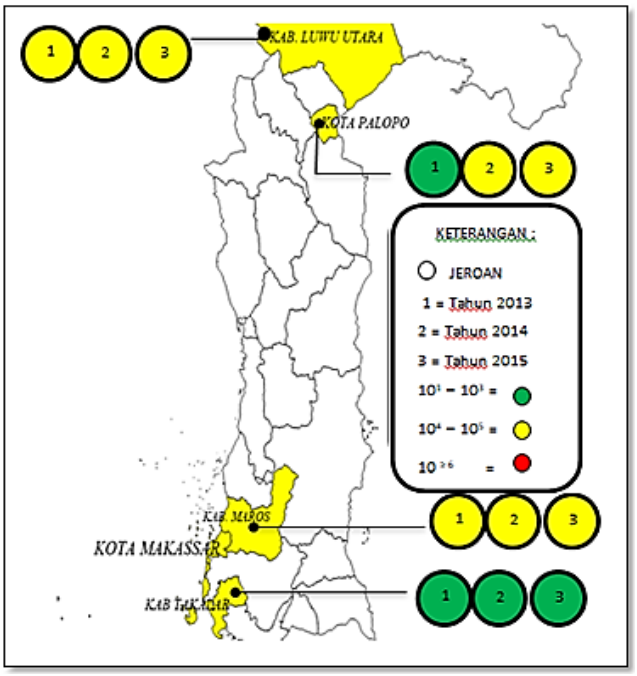


Figure 5. Distribution of TPC value for offal sampled in 2013 – 2015 in South Sulawesi

## TPC Value for Chicken Meat

The results showed that both factors, time and location of sampling, showed significant difference in TPC value for chicken meat (P>0,05). As presented in Table 6, the lowest TPC value in 2013 was found Palopo, while the highest one was attributed to Maros. In 2014, the lowest TPC value was found in Maros, while the highest one was recorded in Luwu Utara. In 2015, the lowest TPC value was found in Luwu Utara, while the highest one was attributed to Palopo.

Table 6. TPC value of chicken meat sampled in South Sulawesi between 2013 - 2015

| Location | Year | | | Average |
|---|---|---|---|---|
| | 2013 | 2014 | 2015 | |
| Palopo | 3,50±0,73 | 4,79±0,89 | 5,62±1,28 | 4,64±1,29 |
| Maros | 5,45±0,93 | 3,53±0,38 | 3,46±0,86 | 4,15±1,19 |
| Luwu Utara | 5,05±1,18 | 5,12±1,08 | 3,42±1,05 | 4,53±1,30 |
| Takalar | 4,16±0,60 | 4,44±0,38 | 3,57±0,25 | 4,06±0,55 |
| Average | 4,54±1,13 | 4,47±0,92 | 4,02±1,28 | 4,34±1,12 |

Note: Different superscripts following means in similar row or column showed significant difference (P<0,05). SNI 7388 : 2009 Maximum Threshold for Microbial Contamination in Food, TPC : 1 x $10^6$ (CFU/gr).

The difference in TPC value among sampling locations may resulted from a variety of hygiene, sanitation, and cold chain in animal slaughterhouse and market. Hygiene seemed to be a major factor contributing to TPC value. To improve hygiene levels could be attempted by a regular cleaning practice. Distribution of TPC value of chicken meat sampled in 2013 – 2015 in South Sulawesi was depicted in Figure 6.

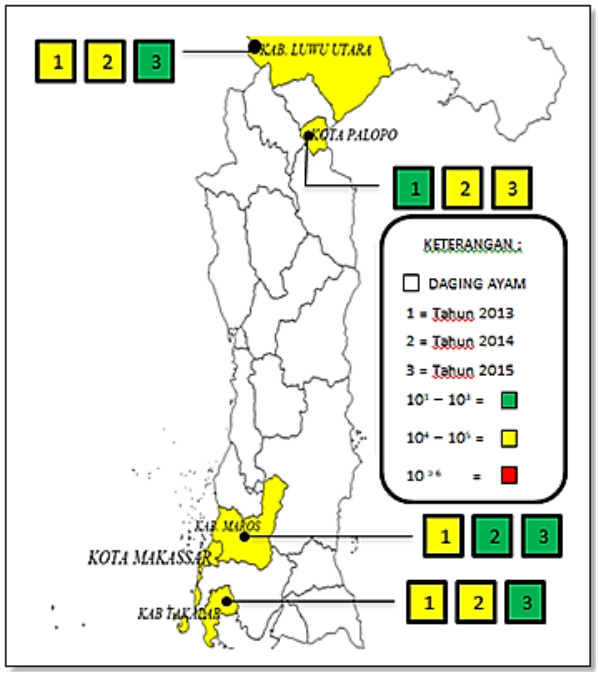


Figure 6. Distribution of TPC value for chicken meat sampled in 2013 – 2015 in South Sulawesi

## Antibiotic Residue

As presented in Table 7, antibiotic residue test was not conducted in 2013, but it is carried out in 2014 and 2015. In 2014, all samples collected in four sampling locations were confirmed "negative" to antibiotic residue. Meanwhile, antibiotic residue showed "positive" in chicken meat, found in Luwu Utara. Based on the data, we reported that the use of antibiotic for livestocks in South Sulawesi was properly controlled.

Table 7. Antibiotic residue of animal products sampled in South Sulawesi between 2013-2015.

| No. | Location | Samples | Residue | | |
|---|---|---|---|---|---|
| | | | 2013 | 2014 | 2015 |
| 1. | Kota Palopo | Beef | Not conducted | Negative | Negative |
| | | Offal | Not conducted | Negative | Negative |
| | | Chicken meat | Not conducted | Negative | Negative |
| 2. | Maros | Beef | Not conducted | Negative | Negative |
| | | Offal | Not conducted | Negative | Negative |
| | | Chicken meat | Not conducted | Negative | Negative |

| | | | | | |
|---|---|---|---|---|---|
| | | Beef | Not conducted | Negative | Negative |
| 3. | Luwu Utara | Offal | Not conducted | Negative | Negative |
| | | Chicken meat | Not conducted | Negative | ***Positive*** |
| | | Beef | Not conducted | Negative | Negative |
| 4. | Takalar | Offal | Not conducted | Negative | Negative |
| | | Chicken meat | Not conducted | Negative | Negative |

Source: Primary Data, 2013 – 2015

This is noteworthy that excessive usage of antibiotic in either live or slaughtered livestocks may promote deleterious effects on the livestock and the consumers. Sudigdoadi (2007) stated that improper application of antibiotic caused adverse impacts, which promote resistance of infectious bacteria to antibiotic, even in higher dose, and possibly cause detrimental effects on health.

## CONCLUSION

Based on the results and discussion, we concluded that Takalar was found to have the lowest TPC, while Palopo was observed to have the highest TPC. In addition, TPC value seemed to attenuate, occurring in each sample and location between 2013 – 2015, while TPC for chicken meat was found to show the lowest value in comparison with beef and offal. The antibiotic residue tested in all samples was almost entirely found as "negative"; one sample was found "positive", occurring in chicken meat collected in 2015 and found in Luwu Utara.

## SUGGESTIONS

Based on our findings, we suggest that there is a need to a regular surveillance focusing mainly on TPC value and antibiotic residue, enabling to control animal products before consumed. In addition, processing facilities for meat, offal, and chicken meat need a remarkable improvement. Improved comprehension on production and processing of beef, offal, and chicken meat are also necessary, which may significantly contribute to reduction of contamination risk and antibiotic residue.

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