Analysis of Meat Microbial Contamination on the Beef Supply Chain in Makassar City

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Abstract. The source of bacterial contamination begins when the animal is slaughtered until the meat is consumed. Slaughterhouses (RPH), slaughterhouses (TPH) and traditional markets are the greatest possibility for meat to be contaminated with bacteria. The research began by taking samples of fresh beef purchased from the Makassar City Slaughterhouse (RPH), Slaughterhouse (TPH) and sales stalls in the market. The meat samples that were obtained were then tested for TPC, Escherchia coli, Salmonella sp, pH, meat color and water holding capacity at the UPT Laboratory for Quality Testing of Livestock Products at the South Sulawesi Province Animal Husbandry and Animal Health Service. It was concluded that there was e-coli microbial contamination in beef originating from RPH and TPH, salmonella showed negative results and the total plate count (TPC) was still within normal limits for microbial contamination and there was an influence of handling meat originating from RPH in the meat supply chain on meat quality of food products of animal origin.

1 Introduction

Food of animal origin is food that is easily damaged (perishable food) and has the potential to be dangerous for living creatures and the environment (hazardous foods) because it is easily contaminated physically, chemically and biologically so that it can endanger the safety of human life, animals, plants and the environment, as well as disturbing peace inner society [1]. In the food supply chain (products) move continuously from producers to consumers through production, processing, distribution, retail and consumer processes; Thus, food flows from farmers to consumers (from farm to table).

The high level of microorganism contamination in meat can reduce the quality of the meat and cause health problems for consumers. The provision of beef that is Safe, Healthy, Intact and Healthy (Aman, Sehat, Utuh dan Halal) is highly expected to meet the requirements for the Maximum Microbial Contamination Limit (BMCM) so that meat is obtained whose microbial content does not exceed the maximum limit, including according to (SNI 3932, 2008) Maximum Total Plate Count 1 x 10^6 cfu/g, Escherichia coli maximum 1 x 10 cfu/g and Salmonella must show negative results, while the pH value is 5.5 – 5.7 (normal pH) with a bright color [2]. Carcass quality is also greatly influenced by environmental conditions, slaughtering facilities and infrastructure at slaughterhouses (RPH) [3]. The source of bacterial

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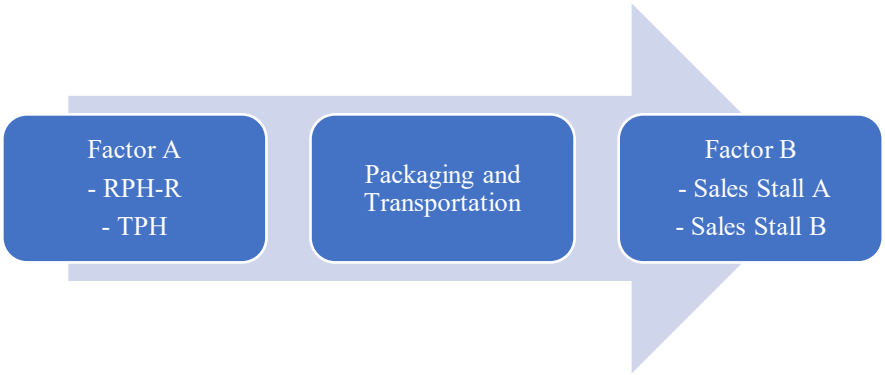
contamination begins when the animal is slaughtered until the meat is consumed. Slaughterhouses (RPH & TPH) and traditional markets are the greatest possibility for meat to be contaminated with bacteria.

Beef sold in traditional markets is very easily contaminated by bacteria. This is because the market is a place that is vulnerable and at quite high risk of contamination by pathogenic microbes. Sanitation and cleanliness of the sales environment has not received attention from either the traders themselves or related officers to minimize the level of microbial contamination. Places selling beef in traditional markets are still mixed with sellers of other basic necessities, apart from that the meat sold is only placed on tables and hung at room temperature. Selling meat in traditional markets is generally carried out in the open (without a cover). Meat is served in a location that is not guaranteed to be clean and has a high air temperature (room temperature) in these conditions, pathogenic microbes can thrive.

There is a condition where animal slaughtering is not centered on the Government Slaughterhouse so that the safety of meat contamination standards in Makassar City is not guaranteed because it is not supervised by authorized officers, in this case the relevant agencies. Differences in management, facilities, personnel and methods at government abattoirs and slaughterhouses will clearly have an impact on livestock slaughter results. There are many slaughterhouses that still do not meet the requirements and still lack supervision over livestock health and meat safety, so it is very important to carry out research regarding comparisons of meat quality results based on microbial contamination in the meat supply chain at government abattoirs and slaughterhouses (TPH) in Makasssar City with the aim of consumer safety.

2 Materials and metodhs



The tools used in this research include: Durham tubes, Petri dishes, test tubes, serology tubes measuring 10 x 75 mm, pipettes (sizes 1 ml, 2 ml, 5 ml, 10 ml), volumetrics, media bottles, colony counters (colony counter) scissors, tweezers, inoculation needle (ose), stomacher, Bunsen burner, pH meter, color meter, scales, magnetic stirrer, vortex shaker, incubator, water bath, autoclave, sterile cabinet (clean bench), paper gauze, press, refrigerator (refrigerator) and freezer. The research began by taking samples of fresh beef purchased from the Makassar City Slaughterhouse, Slaughterhouse (TPH) and then the meat is transported to the market and samples of the meat are taken again at the meat sales stall for laboratory tested for TPC, *Escherchia coli*, *Salmonella sp*, pH, meat color and water holding capacity at the UPT Laboratory for Quality Testing of Livestock Products at the South Sulawesi Province Animal Husbandry and Animal Health Service.

3 Results and discussion

The results of the Slaughterhouse Total Plate Count test show that samples still meet the standard bacterial count requirements. The results of the test were seen in the second sampling which exceeded the standard requirements for the microbiological quality of beef, a maximum of 1 x 10^6 the number of microorganism contamination. The Salmonella sp test results for all samples showed negative results. Degree of Acidity (pH) Based on the results of observations of the physical quality of meat at the Makassar City RPH, it is known that the pH range for beef from the Makassar City RPH is between 6.7 – 7.4 and after arriving at the traditional market is between 6.5 – 7.2 while The pH value of meat from TPH is between 6.1 – 6.6 and after arriving at the traditional market is between 5.5 – 6.4. The results of research on meat color from slaughterhouses heading to this market show low brightness values. Meanwhile, meat originating from slaughterhouses shows intermediate values. The water holding capacity of the Makassar City RPH and TPH to traditional markets varies but is still within normal values. Meanwhile, meat originating from slaughterhouses shows intermediate values. The water holding capacity of the Makassar City RPH and TPH to traditional markets varies but is still within normal values. Based on a 2x3 randomized block design test on the parameters pH, color and water holding capacity, it shows that there is an influence of handling meat originating from slaughterhouses in the meat supply chain compared to meat originating from TPH on the quality of meat products of animal origin.

Table 1. Results of microbiological contamination tests for beef at ruminant slaughterhouses.

No	Location		TPC	E. Coli	Salmonella
1	RPH	1	2,1 x 10^4	< 10	Negatif
2		2	1,9 x 10^5	3,8 x 10^3	Negatif
3		3	2,3 x 10^4	< 10	Negatif
4	Market 1	1	2,2 x 10^4	< 10	Negatif
5		2	3,6 x 10^5	3,8 x 10^3	Negatif
6		3	2,4 x 10^4	< 10	Negatif
7	Market 2	1	2,5 x 10^4	< 10	Negatif
8		2	3,7 x 10^5	4 x 10^3	Negatif
9		3	2,6 x 10^4	< 10	Negatif

Table 2. Results of microbiological contamination tests for beef at slaughterhouses (TPH).

No	Location		TPC	E. Coli	Salmonella
1	TPH	1	2,0 x 10^4	2,6 x 10^3	Negatif
2		2	2,1 x 104	< 10	Negatif
3		3	1,4 x 10^4	< 10	Negatif
4	Market 1	1	1,9 x 10^4	3,7 x 10^3	Negatif
5		2	3,2 x 104	< 10	Negatif
6		3	3,3 x 10^4	< 10	Negatif
7	Market 2	1	3,5 x 10^4	3,5 x 10^3	Negatif
8		2	3,7 x 10^5	< 10	Negatif
9		3	2,6 x 10^4	< 10	Negatif

Based on the results of observations of the beef supply chain from RPH/TPH to traditional markets, increased contamination was only found in the E-coli test. From the results of testing samples of beef animal products, in general the level of hygiene of meat slaughtered in

slaughterhouses/TPH sold in the market is still low when compared with the requirements set out in the Indonesian National Standards.

The Total Plate Count test results when compared with the SNI values show that the samples examined still meet the requirements for standard bacterial counts. Meat handling indicates that the meat sample is still handled well so that it is still suitable for consumption even though the conditions or procedures carried out are still far from the expected standards.

The detection results of Salmonella sp in beef samples from RPH, TPH and Makassar City Traditional Market showed negative results even though environmental conditions appeared to be far from the expected sanitation hygiene standards.

Table 3. Degree of acidity (ph) of beef in slaughterhouses.

Sample	1	2	3
RPH	6,7 – 6,9	7,1 – 7,3	7,0 – 7,4
Market 1	6,7 – 6,9	6,5 – 7,2	6,7 – 7,1
Market 2	6,7 – 6,9	6,5 – 7,2	6,7 – 7,1

Table 4. Degree of acidity (pH) of beef in slaughterhouses (TPH).

Sample	1	2	3
TPH	6,5 – 6,6	6,3 – 6,4	6,1 – 6,3
Market 1	6,4 – 6,5	6,0 – 6,2	5,9 – 6,0
Market 2	6,4 – 6,5	5,9 – 6,2	5,5 – 5,8

Degree of Acidity (pH) Based on the results of observations of the physical quality of meat in the Makassar City RPH, it is known that the pH range of beef in the Makassar City RPH is between 6.7 – 7.4 and the Makassar City Traditional Market is between 6.5 – 7.2 while the value The pH of meat in TPH is between 6.1 – 6.6 and in traditional markets is between 5.5 – 6.4.

Table 5. Degree of beef color in ruminant slaughterhouses.

Color	Repeated	RPH	Market 1	Market 2
L*	1	24,92	28,77	27,24
	2	20,22	18,70	27,19
	3	27,19	24,14	20,45
	Average	**24.11**	**23.87**	**24.96**
a*	1	18,52	20,85	17,64
	2	15,74	22,93	23,45
	3	13,46	23,88	18,39
	Average	**15.90**	**22.55**	**19.82**
b*	1	2,91	4,08	2,86
	2	3,68	4,45	8,28
	3	2,02	3,45	1,70
	Average	**2.87**	**3.99**	**4.28**

Table 6. Degree of color of beef at the slaughterhouse (TPH).

Color	Repeated	TPH	Market 1	Market 2
L*	1	47,53	42,50	42,96
	2	46,97	39,65	38,44
	3	41,09	44,02	48,70
	Average	**45.20**	**42.06**	**43.37**
a*	1	11,38	17,29	17,44
	2	13,41	18,61	17,34
	3	20,04	15,01	14,35
	Average	**14.94**	**16.97**	**16.38**

b*	1	1,40	5,96	6,69
	2	1,92	4,41	2,36
	3	4,80	7,78	8,88
	Average	**2.71**	**6.05**	**5.98**

The results of research on meat color L*, a* and b* from slaughterhouses heading to this market show low values. This also shows that the meat supply chain process from slaughterhouses to traditional markets has an influence on the color of the meat. Meanwhile, meat originating from slaughterhouses shows an L* value that is not too low, but the a* and b* values appear low.

Table 7. Water-holding capacity of beef in slaughterhouses.

Sample	**Repated**		
	1	**2**	**3**
RPH	29,18	35,98	29,22
Market 1	45,97	26,48	22,23
Market 2	46,40	32,10	36,51

Table 8. Water-holding capacity of beef in slaughterhouses (TPH).

Sample	**Repeated**		
	1	**2**	**3**
TPH	54,27	52,81	50,9
Market 1	43,78	45,47	47,22
Market 2	41,61	46,53	42,36

The normal range for the water holding capacity of beef is between 44.31 – 77.67%. The water holding capacity of Makassar City slaughterhouses to traditional markets varies but is still within normal values, according to [4], that the normal range of water holding capacity is between 20% to 60%.

Based on the results of the analysis of microorganisms in the slaughterhouse, TPH and Traditional Market in Makassar City, several results showed that exceeded the standard requirements for microbiological quality of beef, a maximum of 1 x 106 the number of microorganism contamination. The emergence of Escherchia coli is caused by various factors, for example the slaughtering process at slaughterhouses (RPH) and slaughterhouses that do not implement proper sanitation and hygiene or differences in conditions during the distribution of beef from the slaughterhouse to the market.

The emergence of Escherchia coli is caused by various factors, for example the slaughtering process at slaughterhouses (RPH) and slaughterhouses that do not implement proper sanitation and hygiene or differences in conditions during the distribution of beef from the slaughterhouse to the market. The pH value of meat will be determined by the amount of lactate produced from glycogen during the anaerobic glycolysis process and this will be limited if glycogen is depleted due to fatigue, hunger or fear of the animal before slaughter [5]. The brightness of the meat color indicates the level of freshness of the meat [6]. The brightness value (L*) of meat is determined by the pH and fat content in the meat. If the pH and fat content are higher, the lower the brightness of the meat. This high water holding capacity is caused by the high pH of the meat. This is in accordance with the opinion of Irianto [7], that water holding capacity will increase if the pH value of meat increases. This is because when the pH of the meat is low, the structure of the meat is open, thereby reducing the water holding capacity, and the high pH value of the meat causes the meat structure to be closed so that the water holding capacity is high.

Gaznur Zikri M [8], states that the factors causing microorganism contamination in meat can be caused by poor sanitation and hygiene of equipment, contamination from gastrointestinal contents and also due to the use of water in slaughterhouses that is not guaranteed to be clean [9]. Contamination through equipment that is not clean and sterile can occur during the slaughter process, namely through blood circulation. When the knife used for cutting is not clean, it can contaminate the bloodstream during cutting. Rananda Rizki M [10], also stated that contamination does not only occur through equipment during cutting or cross-contamination of the slaughterer's hands with the meat being cut, but can also occur through the floor of the slaughtering area. Meat that is placed on the floor after slaughtering can also be contaminated with microorganisms in the floor environment [11], factors supporting the occurrence of microbial contamination in meat are packaging, shipping and storage factors as well as processing meat before consumption. When sending meat to the market using sacks or plastic bags and the possibility of contamination during the process of weighing the meat, packing and sending samples to the UPT veterinary laboratory, there is also the possibility of contamination. However [12], also believes that microbial contamination does not only occur during slaughter and distribution of meat at the slaughterhouse, but contamination can also occur when livestock are on the farm until they reach the dining table. Contamination of meat that exceeds normal standard limits will cause a decrease in the quality of the meat produced. Furthermore, the physical and chemical form of meat can change quickly, resulting in changes in color, consistency, odor (bad smell), and changes in taste.

4 Conclusion

There is e-coli microbial contamination in beef originating from RPH and TPH, salmonella shows negative results and the total plate count (TPC) is still within normal limits (SNI 3932:2008)) microbial contamination of food products of animal origin in the meat supply chain in the city Makassar and there is an influence of the handling of meat originating from slaughterhouses in the meat supply chain on the quality of meat from food products of animal origin.

References

1. S. Ma'arif, I. Suandy, E. Handayani, N. Triwijayanti, A. Riandi, A. B. Niasono, F. Nurrachmawati, L. N. Amalina. Pedoman Pengawasan Kesmavet. Direktorat Kesehatan Masyarakat Veteriner. Direktorat Jenderal Peternakan dan Kesehatan Hewan. Kementerian Pertanian RI (2022)

2. J. M. Jay, M.J. Loessner, D.A. Golden. Modern Food Microbiology. Seventh Edition. USA. Springer Science and Bussuness Media (2005)

3. E. Gustiani. Pengendalian Cemaran Mikroba Pada Bahan Asal Ternak (daging dan susu) Mulai Dari Peternakan Sampai dihidangkan. J. Litbang. Pertanian, **28**, 3 (2009)

4. S. Ilmu dan Teknologi Daging. Gadjah Mada University Press. Yogyakarta (2005)

5. K. A. Buckle, R. A. Edwards, G. H. Fleet, dan M. Wootton. Ilmu Pangan. Terjemahan: Hari Purnomo Adiono. UI Press. Jakarta (1987)

6. S. J. Walker. The Principles and Practice of Shelf-life Prediction for Microorganisms. Book of Shelf-life Evaluation of Foods. Aspen Publisher. Gaithersburg (2000)

7. K. Irianto. Mikrobiologi Menguak Dunia Mikroorganisme, jilid 1, Yrama. Widya, Bandung (2006)

8. Z. M. Gaznur, N. H. P. Rudy. Evaluasi Penerapan Standar Sanitasi dan Higiene di Rumah Potong Hewan Kategori II (Evaluation Of Sanitation And Hygiene Standard Implementation At Category Ii Abattoir). Jurnal Veteriner, **18** (2017)

9. H. A. Darsono. Studi Kandungan Logam Berat dengan Analisis Aktivasi Neutron dan Mikroba Patogen pada Jeroan Serta Daging Sapi. Jurnal Ilmiah Aplikasi Isotop dan Radiasi, **9** (2013).

10. R. M. Rananda, D. A. Julizar. Identifikasi Bakteri Escherichia coli O157:H7 dalam Daging Sapi yang Berasal dari Rumah Potong Hewan Lubuk Buaya. FK Unand (2016).

11. K. Bambang. Mutu Fisik dan Mikrobiologi Daging Sapi Asal Rumah Potong Hewan (RPH) Kota Pekanbaru Peternakan, **10**, 1 (2013)

12. S. Fardiaz. Mikrobiologi Pengelolaan Pangan. Departemen Pendidikan dan Kebudayaan Direktorat Jendral Pendidikan Tinggi, Pusat Antar Universitas Pangan dan Gizi. Institut Pertanian Bogor. Bogor (1992)