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Study of *Escherichia coli* and *Salmonella* sp. bacterial contamination from meatball seller on Bandar Buat market in Padang City

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ABSTRACT

An Meatball is a very popular food in Indonesia. Almost all levels of society like this food. Even though they have undergone food processing, meatballs are not completely safe from microbial contamination. The high protein content in meatballs can act as a substrate for the growth of microorganisms. The research has been carried out at the Padang Industrial Research and Standardization Center on 15 October-14 November 2019. Meatball samples are household and industrial production which is determined on purposive sampling in Padang City. The results showed that the sample of homemade meatballs contains the results of *Escherichia Coli* contamination at 4 APM/gram. The results of testing for *Salmonella* bacterial contamination were not found. Meanwhile, the meatball samples produced by the manufacturer showed that there was *Escherichia Coli* bacteria contamination of> 2,400 APM/gram and the results of testing *Salmonella Sp.* bacteria contamination on meatball samples were not found *Salmonella Sp.* bacteria. Based on the two test parameters, it can be concluded that the factory-produced packaged meat meatball samples and home-produced packaged meatballs are not suitable for consumption because one of the test parameters, namely the analysis of *Escherichia Coli* contamination on meatballs, does not meet SNI 3818: 2014 concerning meatballs.

Keywords: *pindang fish, logistic cost structure, supply chain, risk management*

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INTRODUCTION

Meat is a food ingredient that becomes the source of animal protein. The high level of meat consumption is due to the nutritional value contained in meat is more than other food ingredients. Besides, meat has essential amino acids that are more complete when compared to proteins of plant origin. Meat can be processed in a variety of attractive products with various shapes and flavors to extend the shelf life and increase economic value without reducing the nutritional value of the processed meat. Processed meat that has long been known and is very popular is meatballs (Firahmi et.al., 2015).

Meatballs are a very popular food in Indonesia. Almost all levels of society like this food, so it's no wonder that meatball sellers are spreading in every region. According to the Indonesian National Standard, the meat content in meatballs is at least

50%, but the reality is in the field to reduce production costs, many meatball sellers make meatballs that contain less than 50% meat (Fauziah, 2014)

Even though they have undergone food processing, meatballs are not completely safe from microbial contamination. The high protein content in meatballs can act as an intermediary or substrate for the growth of pathogenic microorganisms and other disease-causing organisms (Cahyadi, 2008), besides the high water content in meatballs due to processing can also cause microbial growth to be faster. Poor handling of processed food products and contamination can result in several dangerous diseases and even poisoning.

Foodborne illness by bacteria can be in the form of intoxication or infection. Intoxication through food is caused by the presence of bacterial toxins that are formed in food when the bacteria multiply, while foodborne infections are caused by the entry of bacteria into the body through contaminated food and the body reacts to these bacteria. Both of these will cause gastrointestinal disease. The most common bacteria that cause foodborne infections are *Salmonella* and *E. Coli* (Arlita et.al., 2014).

The results of previous research conducted by Harsojo and Andini in 2003, in their research to determine *Salmonella* bacteria in meatball samples using the plate count method, it turned out that bacterial contamination was quite high (11.4 x 107 colonies/g) so that when it was related to the Indonesian National Standard (1995) these meatballs do not meet the requirements because they have exceeded the permissible threshold. Besides, from the results of the identification of *Escherichia coli* which was carried out at the Bali Provincial Health Laboratory in June 2014, the results were: 3 negative samples and 1 positive sample Results of MPN values: sample 1 was 0/25 grams, sample 2 was 0/25 grams, sample 3 is 0/25 gram, and sample 4 is 240/25 gram

Escherichia coli comes from human and animal feces, is transmitted into food due to unhygienic behavior of handlers, washing of unclean equipment, the health of food processors and handlers, and use of washing water containing Coliform, *E. Coli*, and Faecal Coliform (Susanna and Hartono, 2003). *Salmonella* sp. are harmful bacteria that can contaminate meat and processed products (meatballs and sausages). These bacteria are excreted from the digestive tract of animals or humans along with feces. Therefore, products originating from farms are susceptible to contamination by *Salmonella* sp. Pain caused by *Salmonella* bacteria is called salmonellosis. The main mode of transmission is by ingesting bacteria in food derived from infected animal foods (Dona, 2016).

Pathogenic bacterial contamination in food and beverages can cause various kinds of diseases including typhoid, diarrhea, food poisoning, and so on. These diseases will more easily infect people who experience decreased immune system due to internal (intrinsic) and external (extrinsic) factors (Siagian, 2002).

Therefore, to ensure the health and safety of consumers, periodic bacteriological laboratory examinations must be carried out. Therefore, it is necessary to monitor meatball products from bacterial contamination per SNI. The purpose of this study was to determine the comparison of *Escherichia coli* and *Salmonella* sp. Contamination in factory-produced and home-produced meatballs.

MATERIAL AND METHOD

This research was conducted on 14 October - 15 November 2019 at the Microbiology Laboratory of the Industrial Standardization Research Institute (BARISTAND) in Padang.

Sampling

The samples analyzed were factory-produced packaged meat meatballs obtained from mini markets in the Bandar Buat area, and home-produced meatballs obtained from one of the stall sellers at Bandar Buat Market. The analysis that will be carried out on this sample is the identification of *Escherichia coli* and *Salmonella* sp.

Analysis of *Escherichia coli* Bacterial Contamination

Escherichia coli bacteria are bacteria that live in the digestive tract of humans and animals, *Escherichia coli* is a facultative anaerobic bacteria that can grow in both aerobic and anaerobic conditions, bacteria classified as facultative anaerobes are common pathogenic bacteria. *Escherichia coli* has a short stem (coccobacilli) with a size of 0.4-0.7 μm x 1.4 μm, is motile (can move), does not have a nucleus, external organelles, or

cytoskeleton but has external organelles, namely villi which are thin filaments, and longer.

Foods that are often contaminated are chicken, pork, beef, seafood, eggs, and processed egg products, vegetables, fruit, and fruit juices. *E. Coli* is a bacteria that is sensitive to heat, can grow at temperatures between 10 - 40oC with an optimum temperature of 37oC. The optimum growth is at pH 7.0-7.5 and Aw minimum of 0.96.

Testing and calculation of *Escherichia coli* are carried out using the APM (Most Possible Number) method, which is to count the number of microbes using a liquid medium in a test tube, which generally uses 3 or 5 series of tubes and is followed by a biochemical test, namely IMVIC testing and then referred to in APM table.

Analysis of *Salmonella* sp.

Salmonella is a Gram-negative, non-spore-forming, facultative anaerobic rod, belonging to the Enterobacteriaceae family. These bacteria measuring 0.7-1.5 x 2-5 µm are motile with peritricus flagella, except for *Salmonella* Pullorum and *Salmonella* Gallinarum which are not motile because they do not have flagella. These bacteria grow optimally at 35-37°C, can catabolize various carbohydrates into acids and gases, use citrate as the sole carbon source, produce H2S, and can decarboxylate lysine to cadaverine and ornithine to turn into putrescin. *Salmonella* can grow at a maximum salt content of 8%.

Salmonella sp. bacteria can be contaminated in food and beverages that have been contaminated by human feces, the most common transmission occurs due to ingesting food containing *Salmonella* sp. Bacteria. *Salmonella* sp bacteria usually contaminate foods such as eggs, fish, and chicken meat. These bacteria can grow at a pH of 7.2 and an optimum temperature of 35-430C but will stop growing at a temperature of 46.60C. cleanliness so it is not contaminated.

Salmonella testing and calculations were carried out by conducting selective hatcheries using XLD media followed by biochemical tests and serological tests.

RESULT AND DISCUSSION

Results

The results of research on the analysis of factory and home-made meatballs are presented in Tables 1 and 2 below.

Meatball Packaging Factory Production

In the test results of *Escherichia coli* bacteria contamination by APM method (using 3 tubes) on packaged meat meatball samples produced by the factory, it was found that there was 4 APM/gram of *Escherichia coli* contamination. From these results it can be concluded that the meatball sample with code 0107 has been contaminated with *Escherichia coli* bacteria according to SNI 3818: 2014 that the limit of *Escherichia coli* bacteria contamination in meatballs is <3 APM/g.

Factors associated with the risk of *Escherichia coli* infection in factory-produced packaged meatballs are contamination of raw materials by animal waste, food made not through the cooking process, contaminated food after cooking, sold as a ready-to-eat menu, and contact with sick people or animals. Cattle are the main reservoir for *Escherichia coli* including raw meat (Melliawati, 2009).

While the test results of *Salmonella* sp bacteria contamination with XLD selective hatchery method on packaged meat meatball samples produced by the factory showed that *Salmonella* sp bacteria were not found. So it can be stated that the packaged meat meatball samples produced by the factory were negative from *Salmonella* sp. Following SNI 3818:2014, the limit of contamination of *Salmonella* sp bacteria on meatballs is negative/25 g or cannot exist in food.

Home Production Packaged Meatballs

In the test results of *Escherichia coli* bacteria contamination by APM method (using 3 tubes) on home-produced packaged meat meatball samples, it was found that there was *Escherichia coli* contamination of> 2,400 APM/gram. From these results it can be concluded that the sample of homemade meatballs has been contaminated with *Escherichia coli* bacteria according to SNI 3818: 2014 that the limit of *Escherichia coli* contamination in meatballs is <3 APM/g.

Factors associated with the risk of *Escherichia coli* infection in home-produced packaged meatballs are contamination of raw materials by animal waste, food made not through the cooking process, contaminated food after cooking, sold as a ready-to-eat menu, and contact with sick people or animals. Cattle are the main reservoir for *Escherichia coli* including raw meat (Melliawati, 2009).

Table 1. Analysis results of packaged meatballs produced by the factory

No	Parameter	Unit	Quality standards	No	Parameter
1.	Escherichia coli	APM/gram	< 3	4	SNI-19-2897-1992
2.	Salmonella sp	/25 gram	negative/25 gram	negatif	SNI-19-2897-1992

Table 2. Analysis results of home-produced packaged meatballs

No	Parameter	Unit	Quality standards SNI 3818:2014	Test result	Test Method
1.	Escherichia coli	APM/gram	< 3	>2400	SNI-19-2897-1992
2.	Salmonella sp	/25 gram	negative/25 gram	negatif	SNI-19-2897-1992

In home-produced packaged meatballs, it is usually stored in a refrigerator or a place mixed with other different food ingredients such as raw meat, fish, vegetables, and others. So that the meatball can be easily contaminated and contaminated with *Escherichia coli* bacteria.

Escherichia coli grows well at temperatures between 8°-46° C and the optimum temperature is 37°C. Bacteria that are kept below the minimum temperature or slightly above temperature, will not die immediately but are in a state of sleep or dormancy (Melliawati, 2009). This explains that meatballs that have been contaminated with *Escherichia coli* bacteria, even though stored at a temperature below the minimum temperature or slightly above the temperature will not kill the bacteria.

While the test results of *Salmonella* sp bacteria contamination with XLD selective hatchery method on home-produced packaged meat meatball samples (0304) showed that *Salmonella* sp bacteria were not found. So it can be stated that the packaged meat meatball samples produced by the factory were negative from *Salmonella* sp. Following SNI 3818: 2014, the limit of contamination of *Salmonella* sp bacteria on meatballs is negative/25 g or not in food.

Comparison of Escherichia coli and Salmonella sp

Based on the results of the tests that have been carried out, the results show that the factory-produced meatball samples have less *Escherichia coli* contamination than the home-produced packaged meat meatball samples, this can be a consideration for the feasibility of consuming factory-produced meatballs.

The small amount of *Escherichia coli* contamination in factory-produced meatballs is due to the implementation of SOPs at the production site so that sterilization and sanitation are better maintained, while home-produced meatballs do not have SOPs or certain standards in the production process so that sterilization and sanitation are not maintained. According to Erna Sofiana (2012), the presence of *Escherichia coli* and *Salmonella* sp in snack food samples can be influenced by several things such as raw materials, water, serving, containers, and environmental cleanliness (Sofiana, 2012).

According to Motarjemi (2003), utensils and cooking utensils used in food preparation can also be a source of contamination. If the equipment is used again without being cleaned properly. The contamination of germs on cooking utensils and food is caused by inadequate washing facilities, the washing method does not comply with the provisions, there is no special place for storing cooking utensils, and is not carried out by disinfection. Wipes that are left wet can also spread widely on food and food surfaces when the rag is used.

Meanwhile, the results of *Salmonella* sp bacteria contamination showed that the factory-produced packaged meat meatball samples (0107) and home-produced packaged meatballs (0304) did not contain *Salmonella* sp bacteria. The absence of

Salmonella bacteria in meatballs indicates that factory-produced and home-produced packaged meatballs in Padang City are free from *Salmonella* because they do not contain bacteria that can interfere with health caused by *Salmonella* bacteria.

According to Handayani's research, 2018 The absence of *Salmonella* in meatballs shows that boiling affects the presence of *Salmonella* bacteria in food because it is known that meatballs undergo a heating process during handling, to kill *Salmonella* in food, generally for a minimum of 12 minutes at a temperature of 600C. Therefore, the longer the meatballs are boiled or heated, the number of *Salmonella* bacteria will be less or even none at all. This can occur because in the process of making meatballs, through the boiling process with boiling water (heating at 100oC) (Handayani and Wahyudi, 2018).

Based on the two test parameters, it can be concluded that the factory-produced packaged meat meatball samples and home-produced packaged meatballs are not suitable for consumption because one of the test parameters, namely the analysis of *Escherichia coli* contamination on meatballs, does not meet SNI 3818: 2014 concerning meatballs.

The results of the analysis of *Escherichia coli* contamination on the 0304 meatball sample showed a number> 2,400 APM/gram. This result was greater than the analysis result for the 0107 meatball sample, which was 4 APM/gram. While the analysis of *Salmonella* sp bacteria contamination in meatball samples with code 0107 and 0304 was neither found nor negative. Based on the two test parameters, it can be concluded that the factory-produced packaged meat meatball samples (0107) and home-produced packaged meatballs (0304) are not suitable for consumption because one of the test parameters, namely the analysis of *Escherichia coli* bacterial contamination on meatballs, does not meet SNI 3818: 2014 concerning meatballs.

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