

Prevention strategies for escherichia coli



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a) As the snack food is made from meat, there are four types of bacteria that will possibly contaminate it which are *Escherichia. coli* , *Salmonella* , *Staphylococcus aureus*, and *Listeria monocytogenes* (FSIS, 2015).

Escherichia. coli is a bacterial that is usually present in the intestines of humans and animals. Although, most of them are harmless as they play an important role in the intestinal tract of a healthy individual. However, there are a few of them that are pathogenic as they can result in diarrhea and can be transmitted through the contact of human or animal faeces. Altogether, there are six pathotypes that are linked with diarrhea which are as follows Shiga toxin-producing *Escherichia. coli* (STEC), Enterotoxigenic *Escherichia. coli* (ETEC), Enteropathogenic *Escherichia. coli* (EPEC), Enteroaggregative *Escherichia. coli* (EAEC), Enteroinvasive *Escherichia. coli* (EIEC), Diffusely adherent *Escherichia. coli* (DAEC) (CDC, 2015).

However, the *Escherichia. coli* O157 strain, which is classified under Shiga toxin-producing *Escherichia. coli* (STEC), is considered the most harmful as it causes bloody diarrhea, kidney failure and can result in death (Anon., 2015).

It infects its host by producing large amounts of Shiga toxins that damages the intestinal lining severely to cause Hemorrhagic Colitis or otherwise known as bloody diarrhea. It can also cause Hemolytic uremic syndrome which results in kidney injury (Koo, 2014).

Salmonella is a common bacterial that usually cause food poisoning which targets the stomach and intestines. It is normally present in meat, eggs, unprocessed milk and poultry (Bech, 2014).

The symptoms are diarrhea, nausea, fever, stomach cramps, and vomiting which usually last for 4 to 7 days. The incubation period is between 12 and 72 hours upon infection (England, 2014).

However, one must consume *Salmonella* contaminated food in order to cause infection (FSIS, 2015).

Staphylococcus aureus is a common bacteria found on the skin, nasal passages, throats and hair of healthy individuals. Staphylococcal food contamination can occur when a person who is infected with the bacteria handles the steak without proper sanitary handling procedures. Other possible sources of meat contamination of Staphylococcus aureus can also take place such as the surfaces and equipment that the meat is prepared on (Anon., 2015).

Staphylococcal food poisoning happens when an individual ingests the enterotoxins that are produced in the contaminated meat, often due to the improper heating up of the meat to kill off most of the bacteria (USFDA, 2014).

Listeria monocytogenes is a bacterium that is usually found in soil, water, uncooked and processed meat, cooked or processed food, smoked salmon, vegetables and dairy products (CDC, 2013).

Ingestion of food contaminated with this bacterium can cause Listeriosis which is a serious infection (CDC, 2013).

Although *Listeria monocytogenes* can be killed by proper cooking, the bacteria can still contaminate the cooked meat due to physical hazards such as poor food handling practices and sanitation (FSIS, 2015).

Another potential food safety hazard that I have identified is the use of herbs and spices to marinate the steak. Herbs come from plants and spices are from seeds, bark or roots of plants (Ward, 2010).

Because they are from plants, which contains spore-producing bacteria, this indicates that the bacteria spores are capable of further contaminating raw meat which is in contact with soil and vegetative origin. This would introduce additional microbiological hazards such as *Bacillus spp.* and spore forming organisms which are able to survive the drying process and continue to germinate to produce toxins.

During the process of handling with this dried snack food, there should be a food safety management system such as The Hazard Analysis and Critical Control Point (HACCP) system. This system is used worldwide by all food businesses to identify and control microbiology activity as well as physical and chemical hazards that might be present during production. It consists of seven principles that govern and maintain food hygiene procedures (ASQ Food, 2014).

Therefore, I would advise her to take note of the possible food safety hazards that have been mentioned and the procedures of manufacturing this dried snack food has to be in compliance to the Hazard Analysis and Critical Control Point (HACCP) system.

b) There are several information that I would like to know as to assist the businesswoman in preparing the dried snack food safely for consumers. The following are the information required:

1. Where was the meat from?

Normally, the cattle are raised till maturity in a farm where they are given formulated food. During cattle raising, the cattle are injected with antibiotics to prevent diseases. In order to slaughter the cattle legally, a “ withdrawal” period is needed from the time the antibiotics is given. This is to give sufficient amount of time for the antibiotic residues to be released from the cattle.

The United States Department of Agriculture Food Safety and Inspection Service (FSIS) would conduct sample testing for antibiotic residues upon slaughtering. Results have shown that the percentages of residue violations are very low and there are no traceable antibiotic residues present in the tissues of the cattle (FSA, 2015).

There are several factors that have to be taken into consideration such as the conditions of the farms that the cattle are living and the food that they consume. For example, improper drainage of faeces, design of feeders and drinkers can contribute to the accumulation of bacterial contamination in the farm which leads to the dirty cattle. The cattle are then infected with diseases such as *pneumonia* , *coccidiosis* and *salmonellosis*. Thus, it is important to have a healthy livestock of cattle to avoid all these problems.

There are two factors that can contribute to the contamination of meat production chain such as direct and indirect contact of contamination. Direct

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contact can occur when bacteria that are present on the skin of the cattle such as excrement and mud which can contaminate the meat during the slaughtering process. Whereas, indirect contact could occur when the hands, tools and equipment that are used to slaughter the cattle contains bacteria which will then infect the meat (FSA, 2002).

2. How was the uncooked meat handled?

For proper handling of raw beef, place them in a sealed disposable plastic bag. You can either freeze it at -17.8°C so as to keep it longer (about 6 to 12 months) or refrigerate at 4.4°C but have to consume it within 3 to 5 days (Safety, 2015). The reason why the meat is to be kept at cold temperatures is because this is to inhibit bacterial growth.

3. Time, temperature and conditions of marinating and cooking the meat?

First, the raw steak is marinated with herbs and spices which will introduce additional microbial hazard such as spore forming bacteria to the meat. Thus, for safe marinating procedures, do not marinate at room temperature as most bacteria are able to grow quickly. Instead, marinate the meat in a cold environment so as to avoid entering the danger zone, which is between 4°C and 60°C . For beef steak, the approximate time taken to marinate would be 2 to 4 hours (Stradley, 2014).

For safe cooking of steak, cook them at a minimum internal temperature of 62.8°C for about 4 - 5 minutes per side and allow the meat to rest for at least 3 minutes before eating. This is done to kill off most of the bacteria that might be present on the meat. However, do not cook the steak partially as this does not destroy most of the bacteria and might multiply (USDA, 2015).

4. Time and temperature of the drying process?

I would suggest drying the marinated steak strips using an oven at 75°C as there is a constant circulation of dry air and heat source. The temperature is important in drying this snack food because gentle heating will not be sufficient as this does not ensure that any bacteria that might still be present on the meat prior to cooking are killed (USDA, 2015).

For example, bacteria such as *Bacillus flavother must* have a maximum temperature cardinal value of 72°C and if the meat is cooked to the temperature of 60°C, the bacteria will still be able to survive (Todar, 2008 - 2012).

Thus, they will continue to multiply in numbers and colonize the meat.

5. Storage of final dried meat product? How long is the meat product stored?

Always ensure to store dried meat in a vacuum packaging as this will minimize oxygen levels which inhibit the growth of aerobic bacteria. It also helps to reduce the oxidation of the meat which will result in meat spoilage. These will extend the shelf life of the snack food (Anon., 2012).

A sealed dried meat product can be stored to a period of 12 months. However, if the dried meat product is made from home, then it can only be kept for about 1 to 2 months (USDA, 2013).

6. Is water activity taken into consideration?

Water is a requirement for bacteria growth, thus, it must be removed so as to inhibit the growth of microorganisms. It can be reduced by the drying

process and the addition of salt to preserve the meat. How the salt works is that it would absorb all the water on the meat by the process called osmosis (Martin R. Adams and Maurice O. Moss, 2008).

7. Are there hygiene practices done in the preparation of the dried snack food?

To prevent cross-contamination, good hygiene practices and procedures are required in regards to handling the snack food. Food handlers should always wash their hands thoroughly with surfactants such as soap before and after handling with meat products. Always clean and disinfect all utensils, equipment and work surfaces before the preparation of the meat product. And do not mix raw and cooked food. Instead, incorporate the use of separate working and storage areas of raw, cooked and dried meat products (FSA, 2015).

c) I would suggest the use of aerobic plate count and immunomagnetic separation to test the presence of *Salmonella spp.* and *Escherichia coli O157*

In aerobic plate count, dilutions of the food sample are carried out and are then plated onto agar plates which contain suitable growth nutrients to favor the growth of microorganisms. The plates are then incubated at temperatures that bacteria can grow. After the incubation period, the total numbers of bacterial colonies are counted; therefore, the total number of viable cells can be estimated (Hayes, 1995).

The levels of Aerobic Colony Count (ACC) are used as a guidance to determine if the food product is safe for consumption (Agency, 2009). For

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example, if the Aerobic Colony Count (ACC) levels of bacteria have exceeded the expected level, the product cannot be consumed.

For *Salmonella spp.*, the infectious dose is normally 10⁵ organisms, which is quite a big number. Whereas, as for *Escherichia. coli O157*, the infectious dose is less than 50 organisms (Inc., 2004).

For *Escherichia. coli O157 and Salmonella*, Immunomagnetic separation is used as the “ gold standard” to detect and isolate the bacteria as it is specific and sensitive. Then targeted organism is then isolated which will undergo serotyping for characterization (Inc, 2004).

According to the guidelines for the microbiological safety of ready-to-eat foods, they are to be cooked and processed properly, especially with the addition of herbs and spices. It also includes bacteria that can possibly be from the source of poor hygiene. Lastly, tests on ready-to-eat foods are required so that food products which are not in compliance with the microbiological food safety criteria can be identified to protect public health (Agency, 2009).

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