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Poisoned: The Dirty Truth About Your Food

Abstract: The documentary "Poisoned: The Dirty Truth About Your Food" investigates the frequency and occurrence of foodborne diseases brought on by E. coli O157, Salmonella and Campylobacter jejuni, challenging the claim that the United States has the "safest food supply in the world." By examining the impacts of these bacteria and the procedures in place to remove them from food either before or after slaughter and processing, this systematic review investigates the statements in the documentary as well determines what policies are in place to ensure meat safety in the US. Gathering secondary literature on the bacterium, reading through initial, peer-reviewed studies on therapies, and US laws and public policies were used. The findings suggest that although certain interventions exhibit potential decreases in bacterial presence, deficiencies exist in legislation and their implementation, specifically with respect to Salmonella and Campylobacter. Public policy changes are necessary to address these issues and enhance food safety in the United States.

Introduction:

"We have the safest food supply in the world" is a claim commonly made by United States officials. This claim is directly addressed in the documentary *Poisoned: The Dirty Truth About Your Food*. Produced by Ross M. Dinerstein and Kristin Lazure, Poisoned was released on June 9th, 2023, by director Stephanie Soechtig and follows the food safety lawyer Bill Marler. The documentary also hosts interviews with Frank Yiannas, FDA Deputy Commissioner for Food Policy and Response, and Sandra Eskin, USDA Deputy Under Secretary for Food Safety. The documentary dives into both the policies and procedures in place to eradicate the harmful

bacteria from food produced and sold in the United States. The documentary specifically looks at the three most common bacteria that cause foodborne illness in the United States: E. Coli O157, Salmonella, and Campylobacter jejuni.[1]

The documentary *Poisoned* examined the different outbreaks of either E. Coli or Salmonella that previously happened in the United States, as well as examining the current state of Salmonella in the US chicken farms and factories. *Poisoned* also provides us with the testimonies of people who were either directly or indirectly affected by the US outbreaks and takes a look at their quality of life years down the line. Even though these bacteria can be cleared from our system within weeks, the possible long term effects may last a lifetime.[1–4] The main claim of the documentary *Poisoned* is that not enough is being done to ensure we have a safe food supply in the United Sates.[1]

This systematic review examines the claims made in *Poisoned* by first examining the effects of the three bacteria and then examining the ways they are removed before food hits the shelves. This review will also look at previous and proposed changes to public policy regarding the bacteria mentioned above in food supply. After looking at different studies and policies, conclusions are drawn about the way the United States currently handles bacteria, and compares it to the ways it could handle bacteria to make the food supply safer.

Objective:

The CDC estimates that 48 million people per year get sick from foodborne illnesses.[5] This is a startling number. All people who live in the United State who shop at grocery stores are at risk for contracting these illnesses. In order to increase safety, the researcher examined bacteria that people have or can contract from meat purchased in the United States. The researcher also compared previous public outrage that has led to changes in public policy with an

intended outcome of increased public understanding of food safety. Through this review we will answer the question: for United States food consumers, what scientific measures and public policies could improve or prevent foodborne illness contracted from meat purchased from the grocery store?

Methods

The documentary *Poisoned: The Dirty Truth About Your Food* was released on June 9th 2023 and contains interviews with government officials as well as CEOs and other workers on farms around the United States. Their claim that more can be done to increase food safety is under examination in this review.

First, second hand sources and literature reviews were gathered on the topic of three bacteria mentioned in the film: E. Coli 0157, Salmonella, and Campylobacter jejuni. A total of five sources were screened with 3 being included in this review. The information was gathered to form a basis of knowledge on the three bacteria. Second, a total of ten original, peer reviewed sources were screened with seven being included in this review. The original sources were both observational as well as intervention studies looking at the removal of one or multiple of the bacteria previously mentioned from animals, both alive and post-slaughter. These sources revealed ways different farms and factories around the world can decrease the presence of harmful bacteria in their animals or animal parts. Finally, the USDA policies and official stances on the three bacteria were examined, revealing what legislation factories and farms must comply with. The lapses in legislation or in specific direction were also highlighted for this review.

The basis of knowledge gained was compared and contrasted to the claims about the symptoms and ailments of the bacteria to ensure the documentary was presenting up to date, true information about the three bacteria discussed. The original studies were analyzed as a way to

determine the validity of the director and Bill Marler's claim that it is possible to do more for the public's safety. The laws and policies were also reviewed in order to determine the validity of the claim made by the documentary.

Results:

E. Coli O157

This bacteria is commonly found in dairy cows in the United States and can be contracted from contaminated meat, dairy products, and fruits and vegetables. Fruits and vegetables get the E. Coli bacteria on the outside when waste from the cows contaminates the water used to irrigate crops on a farm. During rainstorms, the cow's waste has the risk of being unknowingly transported by the movement of the rainwater. To kill the bacteria, beef must be cooked to a 160 degrees Fahrenheit and dairy products must be pasteurized. Fruits and vegetables must be properly washed to remove the bacteria. Another important thing to note is that the bacteria can also be transferred from person to person.

E. Coli 0157 is a Shiga toxin producing bacteria that, if left unchecked, can result in Hemolytic-Uremic Syndrome (HUS).[2] HUS causes damage to the blood vessels of the kidneys, affecting their function. When E. Coli enters our system, the bacteria binds to the intestinal mucosa and begin releasing the Shiga toxin. The toxin, in turn, disrupts protein synthesis in the epithelial cells lining intestinal mucosa, leading to cell death, and sloughing of the mucosa.[2] This causes abdominal cramps and diarrhea that turns bloody and in some cases vomiting that may also turn bloody.[2] The bacteria can also cause acute renal failure, but that is more common in children.[2]

Two studies performed on mice were examined. The first looked at how well galacto-oligosaccharide (GOS) is able to enhance the gut barrier to protect against E. coli O157.[6] For this

study, mice were separated into three groups with the first receiving GOS, the second receiving saline, and the third being a control.[6] The treatments lasted for three weeks after the mice were infected with E. coli.[6] The study showed GOS reduced E. coli in the ileum and colon by 35% and 38% respectively.[6] While bovine studies still must be conducted, the study shows how farmers are able to use GOS as a preventative as well as a treatment for E. coli in order to reduce rates before meat processing.

The second study involving mice looked at the preventative effect of bacillus subtilis, or hay bacillus, on mastitis is mice caused by E. coli.[7] Mastitis is the inflammation of breast tissue. This study divided pregnant mice into 6 groups: a control group, an E. coli group, four bacillus subtilis groups receiving different amounts, and a group receiving both E. coli and bacillus subtilis.[7] Their results showed decreases in tissue damage as well as inflammation in the group given both microorganisms.[7] Bacillus subtilis shows promise in reducing a side effect of E. coli, meaning farmers may be able to introduce this microorganism in order to increase dairy cows health on the farm, leading to less infections overall.

The documentary *Poisoned* makes mention of the Washington state E. coli outbreak that lead to changes in USDA policies.[1] The above interventions are ways that farmers can decrease presence of E. coli on farms to increase compliance the USDA policies.

Salmonella

The bacteria salmonellae often lives within both wild birds as well as domesticated or farmed birds like turkey and chicken. Because wild birds can be carriers, when they fly overhead and drop feces, the feces can spread the bacteria. The salmonella outbreak caused by the Peanut corporation of America saw the peanuts become contaminated when bird feces came into contact with peanuts after it fell through holes in the ceiling.[1]

Salmonellosis, the disease contracted from salmonella exhibits flu like symptoms.[3] This includes nausea, vomiting, abdominal pain, and diarrhea that turns bloody.[3] The bacteria may also cause a fever and may result in dehydration.[3] Certain populations are affected differently and see different levels of severity. Salmonella is killed at 165 degrees Fahrenheit, so chicken and eggs must be cooked to that internal temperature to avoid possible infection.[3] The pathology, symptoms, and treatments of salmonellosis described by Muck et al. are inline with the information presented in *Poisoned*.

Chen et al studies the effects of probiotics on the growth, intestinal flora, and immune function of chicks infected with salmonella.[8] Chen placed chicks into four groups, a control group, and three groups infected with salmonella.[8] One of the three groups received no treatment of probiotics, one received probiotics after infection, and the last group received probiotic treatment before infection.[8] The researchers were testing how large the chicks grew as well as how the probiotic fortified the chick's immune system against salmonella. When compared to the other groups infected with salmonella, the group treated with probiotics prior to infection had the lowest mortality and grew the largest.[8] Chen's results show that being proactive instead of reactive can save farms from unnecessary deaths due to salmonella. Probiotics were shown to bolster the chick's immune system against salmonella, This shows the effectiveness of probiotics if they are given to chicks at a young age before they come into possible contact with salmonella from other chicks or animals on the farm.

A study conducted by Redweik et al examined the effect of combing a probiotic and the live salmonella vaccine against salmonella in leghorn chickens.[9] Their study also sorted chickens into four groups, however all four were infected with salmonella or avian e. coli. One group received no treatment, the next received only the probiotic, the third received only the salmonella

vaccine, and the fourth received both the probiotic and vaccine.[9] The researchers results showed the double treatment group's fecal samples were the only samples that remained negative for salmonella.[9] While Redwiek's intervention did now show that combining probiotics with the vaccine would increase serum antibody response, they showed synergistic effects in enhancing bactericidal activity in the blood.[9] While probiotics and the vaccine don't change immune responses, they are able to assist the gut microbiome in flourishing and diversifying with "healthy" bacteria.

Gonzales et al examined the impact of processing interventions across factories that attempted to remove salmonella from the meat before it went to the market.[10] The study examined multiple different factories across the US and looked at what processes they used and which were most effective.[10] Their research shows that irradiation, the use of radiation, was the most effective way to remove salmonella from chicken meat.[10] Unfortunately, their results also showed that irradiation is also the most expensive procedure used and is therefore often substituted with a less costly method, such as chlorine or peroxyacetic acid.[10] Both chlorine and peroxyacetic acid are less effective in the removal of salmonella, but chicken producers opt for these methods to cut corners on costs. As long as the levels of salmonella found are within FDA limits, the factory continues to operate.[10] This fact highlights the claim of the documentary, that more can be done to make our food safer. The safety of our chicken supply suffers in order to increase profits.

All three studies show ways to decrease salmonella, before or after slaughter, however the methods described are not required to be used on every farm. By putting the above interventions or factory procedures into use, we can rapidly decrease salmonella in our chicken supply.

Campylobacter Jejuni

The bacteria Campylobacter, specifically the C. Jejuni species that can cause campylobacteriosis, is one of the leading causes of foodborne illness.[1,4] Campylobacter can be often found in the stomach of farm animals.[1,4]

The C. Jejuni species causes abdominal pain, fever, inflation of the small intestine, and diarrhea that turns bloody.[4] It has also been known to cause some immunoreactive complications.[4] Similar to salmonella, campylobacter can be killed at 165 degrees Fahrenheit.[4]

The effectiveness of B lymphocytes role in clearing campylobacter from the intestinal track of chickens was studies by Lacharme-Lora et al.[11] In order to test this, broiler chickens were infected with campylobacter at 21 days of age and then subsequently culled at 14, 28, or 63 days after infection.[11] It is important to note that the average lifespan of a commercial broiler chicken is 6 weeks or 42 days.[11] Their short lifespan is due them being slaughtered for meat. Whie B lymphocytes were shown to clear campylobacter jejuni from intestinal tracks, not all the bacteria is cleared form the gi track within 42 days.[11] Their results show that farmers need to involve another intervention in order to clear the harmful bacteria from the chickens before processing. With no intervention, the campylobacter will spread quickly through the farms with no chicken's immune system able to stop it.

Kingsbury et al. examined processing in factories in New Zealand to see how they removed campylobacter from the meat of already slaughtered chickens.[12] The researchers examined 3 different factories in New Zealand.[12] The study found primary processing procedure to be very similar except one plant had a higher reduction due to higher scald temperatures used.[12] The major difference found was that two of the three factories did the secondary processing steps on cite, while the third factory exported the chicken to a different facility.[12]

Changing facilities meant a lag in time between processing steps allowing microorganisms to that were not eliminated in the first round to spread and multiply before entering the second step of processing.[12] We can also assume that in the transportation process the chicken can be exposed to more microorganisms outside the factory as well as suffer damages during transport, reducing profit. The results of Kingsbury et al.'s study shows us how slight differences in processing can positively or negatively effect the campylobacter amount in chicken. Neither the USDA not the FDA have strict regulations in place for the processing of chicken and leave plans up to the factories. If the US agencies would standardize procedures, they would be able to cut back on campylobacter in the chicken.

	Live Interventions	**Processing Interventions**	**Public Policy**
E. Coli O157	GOS prebiotic proved effective Bacillus Subtilis proved affective	N/A	Declared an adulterant If found in products they must be recalled
Salmonella	Probiotics proved effective. Vaccine combined with probiotics proved to be beneficial	Irradiation proved most effective but least used due to cost	Proposed rule to make an adulterant "Maximum" amounts allowed on farms and in factories before FDA shuts them down
Campylobacter Jejuni	Immune system / no intervention proved ineffective	Slight differences in processing and transportation affect concentrations	No proposed rule "Maximum" amounts allowed on farms and in factories before FDA shuts them down

Public Policy

The documentary covered the Washington state outbreak that was caused by Jack in the Box ignoring cooking temperature policies which lead to an E. Coli outbreak. This outbreak led to the death of 4 children as well as changes in USDA policy surrounding E. Coli.[1,13] After this

outbreak, E. Coli was declared an adulterant in food, and as such if it is detected in testing, those products are immediately recalled.[1,13,14] This was declared under Code of Federal Regulation title 9 chapter 3 subchapter E part 417.[13]

Also under title 9, there is required testing in place for both salmonella and campylobacter, but if high amount are found the USDA requires the facilities to take "proper measures".[13] They do not have any set policies in place once a high level of the bacteria is detected and expect the facility to present their own plan to reduce rates. This has previously led to facilities forging test results.[1]

As the documentary highlights, there is not much regulation regarding salmonella and campylobacter. In the documentary, Bill Marler said if the US government were to begin cracking down on salmonella and campylobacter in their products, the industry would "cluck loudly" and there would be a lot of push back from the corperations.[1] In interviews with the FDA and USDA representatives, both stated multiple times that it is "congress's problem" to push the legislation on them and it is not their administrations responsibility to form these new policies.[1] This means the US places responsibility in the hands of the cooks to truly get rid of salmonella and campylobacter.

Currently there is a proposed rule by the USDA that specific amounts or stereotypes of salmonella be labeled an adulterant in food, however they are receiving push back from the industry due to the additional costs that will have to go into manufacturing.[15]

Discussion:

E. coli O157, Salmonella, and Campylobacter jejuni have and will continue to cause millions of outbreaks per year.[5] While the interventions surrounding E. coli have yet to be proven in a bovine sample, both salmonella and campylobacter interventions have proven that

more can be done in farms and factories to reduce infection rates. Public policy has cracked down on E. coli but have yet to remove salmonella and campylobacter from the market. While it is ultimately in the hands of the USDA and FDA, lobbying by large corporations have been influential in the process of creating policies surrounding microorganisms. While there are steps in place to remove microorganisms, studies examined above show that more steps can be taken in order to keep the US food supply safe.

This systematic review was limited by only using original sources to obtain data about interventions. This review also only examined the meat supply in the US and did not discuss or look at ways microorganisms affect or can be removed from other products. This review leads us to the conclusion that more research can be done on different ways to remove microorganisms. While interventions are present, not all are standardized or are seen as “cost effective” to the factory or farm owners. While there are policies and scientific measures that can be put in place to prevent bacteria from infecting our food, the pushback from large cooperations has taken precedent over public safety. This is why it’s so important to find a cost-effective measure to hold public safety as a priority.

References:

1. Poisoned: The Dirty Truth About Your Food (2023) - IMDb. Accessed February 25, 2024. https://www.imdb.com/title/tt27548083/
2. Ameer MA, Wasey A, Salen P. Escherichia coli (e Coli 0157 H7). *StatPearls*. Published online August 8, 2023. Accessed February 25, 2024. https://www.ncbi.nlm.nih.gov/books/NBK507845/
3. Munck N, Smith J, Bates J, Glass K, Hald T, Kirk MD. Salmonella, Food Safety and Food Handling Practices. *Foods 2021, Vol 10, Page 907*. 2021;10(5):907. doi:10.3390/FOODS10050907
4. Igwaran A, Okoh AI. Human campylobacteriosis: A public health concern of global importance. *Heliyon*. Published online 2017:e02814. doi:10.1016/j.heliyon.2019.e02814
5. Estimates of Foodborne Illness in the United States | Estimates of Foodborne Illness | CDC. Accessed March 2, 2024. https://www.cdc.gov/foodborneburden/index.html
6. Zou Y, Wang J, Wang Y, et al. Protection of Galacto-Oligosaccharide against E. coli O157 Colonization through Enhancing Gut Barrier Function and Modulating Gut Microbiota. *Foods 2020, Vol 9, Page 1710*. 2020;9(11):1710. doi:10.3390/FOODS9111710
7. Hu X, Tang R, Zhao C, et al. The Prevention Effect of Bacillus subtilis on Escherichia coli-Induced Mastitis in Mice by Suppressing the NF-κB and MAPK Signaling Pathways. doi:10.1007/s12602-021-09854-9
8. Chen C, Li J, Zhang H, et al. Effects of a probiotic on the growth performance, intestinal flora, and immune function of chicks infected with Salmonella pullorum. doi:10.1016/j.psj.2020.07.017
9. Redweik GAJ, Stromberg ZR, Van Goor A, Mellata M. Protection against avian pathogenic Escherichia coli and Salmonella Kentucky exhibited in chickens given both probiotics and live Salmonella vaccine. *Poult Sci*. 2020;99(2):752-762. doi:10.1016/J.PSJ.2019.10.038
10. González RJ, Sampedro F, Feirtag JM, Sánchez-Plata MX, Hedberg CW. Prioritization of Chicken Meat Processing Interventions on the Basis of Reducing the Salmonella Residual Relative Risk. *J Food Prot*. 2019;82(9):1575-1582. doi:10.4315/0362-028X.JFP-19-033
11. Lacharme-Lora L, Chaloner G, Gilroy R, et al. B lymphocytes play a limited role in clearance of Campylobacter jejuni from the chicken intestinal tract. Published online 2017. doi:10.1038/srep45090
12. Kingsbury JM, Horn B, Armstrong B, et al. The impact of primary and secondary processing steps on Campylobacter concentrations on chicken carcasses and portions. *Food Microbiol*. 2023;110:104168. doi:10.1016/J.FM.2022.104168
13. Federal Register :: E. coli O157:H7 Contamination of Beef Products. Accessed February 26, 2024. https://www.federalregister.gov/documents/2002/10/07/02-25504/e-coli-o157h7-contamination-of-beef-products
14. What does “adulterated” mean? Accessed February 25, 2024. https://ask.usda.gov/s/article/What-does-adulterated-mean
15. View Rule. Accessed February 26, 2024. https://www.reginfo.gov/public/do/eAgendaViewRule?pubId=202310&RIN=0583-AD96