Journal Healthcare Treatment Development
ISSN: 2799-1148
Vol : 03 , No. 04 , June-July 2023
http://journal.hmjournals.com/index.php/JHTD
DOI: https://doi.org/10.55529/jhtd.34.11.21

Epidemiology and Public Health Importance of Bovine Salmonellosis

Teshale Adere Senbeta*

**Jimma University College of Agriculture and Veterinary Medicine School of Veterinary Medicine, Ethiopia*

Corresponding Email: **teshadere@gmail.com*

Received: 12 February 2023 **Accepted:** 06 May 2023 **Published:** 13 June 2023

Abstract:** One of the most common foodborne illnesses in the world, bovine salmonellosis is an infectious zoonotic disease that affects both humans and animals. This essay reviewed the most recent epidemiology and public health information on bovine salmonellosis. It is brought on by S. typhimurium and Dublin species, which are the aetiological agents of diarrhoeal and systemic infections in humans. These species are most frequently found as secondary contaminants in food derived from animals and the environment, usually as a result of subclinical infection in food animals leading to contamination of meat, eggs, and milk or secondary contamination of fruits and vegetables that have been fertilized or irrigated by faecal wastes. Salmonellae are frequently found in large quantities in the environment, farm waste, human sewage, and any material that has been contaminated by feces. The normal inhibition of Salmonella is primarily disrupted in the rumen and small intestine when I starvation or reduced feed intake occur, (ii) the feeding strategy results in an increased pH in the abomasum, and (iii) antibiotic treatment kills the normal competing microflora of the intestine. These bacteria have developed mechanisms to survive and cope with the host inhibiting factors. Through the columnar enterocytes and specialized microfold enterocytes, the bacteria cling to and infiltrate intestinal cells in the mucosa mostly linked with the Peyer's patches in the terminal jejunum and ileum (M cells). Treatment for Salmonella infections that are not typhoidal in humans differs from that for typhoidal infections. Antibiotics should not be routinely used in the treatment of nontyphoidal Salmonella infection. Antibiotics should only be used when absolutely necessary because most non-typhoidal Salmonella infections are of the self-limiting variety, and their usage has little to no effect on the length of diarrhea or fever. Subacute antibiotic medication can potentially lengthen gastrointestinal carrier states and promote infection relapse. Therefore, spreading knowledge about the virus's significance for public health, using management techniques based on science, and practicing good hygiene are essential to reducing the risks of contracting the infection.

Journal Healthcare Treatment Development
ISSN: 2799-1148
Vol : 03 , No. 04 , June-July 2023
http://journal.hmjournals.com/index.php/JHTD
DOI: https://doi.org/10.55529/jhtd.34.11.21

Keywords: Bovine, Foodborne, Human, Salmonella, Zoonosis.

1. INTRODUCTION

Over the past 20 years, there has been a noticeable rise in the risk of food-borne illness, with roughly a quarter of the population being at higher risk [1]. Salmonellosis is one of the most prevalent food-borne infections in worldwide. Gram-negative rod-shaped bacteria with the ability to adapt to their surroundings are called salmonella. It is particularly dangerous as a foodborne pathogen because of its capacity to grow or endure in a wide range of circumstances[2]. Salmonella infections are mostly spread through food, but a small percentage (6% in different countries) can also be contracted from handling food animals, turtles, other reptiles or amphibians, chicks, and occasionally through contact with pet meals and treats[3,4]. The epidemiological patterns of infection prevalence and illness occurrences vary widely from one geographic region to another based on factors such as climate, population density, land use, farming methods, technologies for gathering and processing food, and consumer behaviors. One to three percent of domestic animals are thought to be infected. In the USA, samples of meat taken from a slaughterhouse in 1980 led to the isolation of 16274 Salmonella strains across 183 serotypes [5, 6]. Typhoid fever affects 16 million people annually, gastroenteritis affects 1.3 billion people, and Salmonella causes 3 million fatalities. According to a previous CDC report, the prevalence of S. enteritidis and S. heidelberg increased by 25% each, while the prevalence of S. enterica serovar Javiana increased by 82%. In contrast, the prevalence of S. typhimurium declined significantly (42% decline) from 1996–1998 to 2005 [7,4]. The behavior of S. Dublin and S. typhimurium in mature cattle varies significantly. Animals that recover from an infection with S. dublin may develop into persistent excreters, releasing up to 106 organisms per gram of feces daily. Salmonellosis in humans is mostly foodborne and spreads through the ingestion of tainted animal-based foods such meat, milk, poultry, and eggs. Cheese and ice cream were among the dairy products linked to the outbreak [6].

The normal inhibition of Salmonella is primarily disrupted in the rumen and small intestine when (i) starvation or reduced feed intake occur, (ii) the feeding strategy results in a rise in pH in the abomasum, and (iii) antibiotic treatment kills the normal competing microflora of the intestine. These bacteria have evolved defenses to withstand and cope with host inhibitors. Through the columnar enterocytes and specialized microfold enterocytes, the bacteria attach to and infiltrate intestinal cells in the mucosa mostly linked with the Peyer's patches in the terminal jejunum and ileum[8].

Salmonellosis that causes acute or subacute enteritis often affects adult cattle, and it has been known to cause abortions in pregnant animals when the disease is still in its early stages. Animals that are severely impacted exhibit fever, depression, decreased appetite, and decreased milk production. These symptoms are followed by foul-smelling diarrhea, mucoid faces that typically contain a blood clot and a shred of necrotic intestinal mucosa, and other signs. [9 ,10,11].

The incubation period and the quantity of germs consumed determine the infection and clinical symptoms in humans. Affected individuals have abrupt nausea, vomiting, and diarrhea that smells like watery bird droppings that typically last only a few hours. The feces

Journal Healthcare Treatment Development
ISSN: 2799-1148
Vol : 03 , No. 04 , June-July 2023
http://journal.hmjournals.com/index.php/JHTD
DOI: https://doi.org/10.55529/jhtd.34.11.21

may also contain blood or mucus if the colon is compromised. It is not unusual to get a fever as high as 39°C[12].

Although a provisional diagnosis may be made, there is no pathognomonic sign or clinical finding during postmortem examination that are specific to salmonellosis. The identification of the bacteria should be done either on a sick animal or during a necropsy by separating the organisms from the animal's feces and counting the viable organisms. It is necessary to collect feces samples, which should obviously be done before giving antibiotics. Although less accurate than feces culture and requiring caution to prevent contamination, it may also be possible to isolate an organism from oral secretions and via blood culture [13,14,7 15].

Comprehensive preventive methods that work for all Salmonellae may be required in animals to address the diversity of Salmonella serovars present on farms and the possibility that different serovars may exhibit different virulence factors [16]. Treatment for Salmonella infections that are not typhoidal in humans differs from that for typhoidal infections. Antibiotics should not be routinely used in the treatment of nontyphoidal Salmonella infection. Antibiotics should only be used when absolutely necessary because most non-typhoidal Salmonella infections are of the self-limiting variety, and their usage has little to no effect on the length of diarrhea or fever. Additionally, Subacute antibiotic therapy increases infection relapse and prolongs gastrointestinal carrier states. The primary goal of treatment should be to address any dehydration that may result from protracted diarrhea by replacing lost fluid and electrolytes [2].

As soon as salmonellosis in a herd has been identified, the control measure should be taken; if possible, isolate apparently infected animals into one group to treat severely ill animals, and affected animals should implement measures to reduce public health concerns, such as not consuming raw milk. Immediately after the outbreak or situation has passed, the area should be physically cleaned and the building should be disinfected [14].

In Ethiopia the study conducted by [17] reported a prevalence of 6% in cattle and 7.6% in human. Moreover, according to [18]) stated, from lactating cows and in contact humans in dairy farms of Addis Ababa determined the overall prevalence of 13.6% of the humans and 10.7% of cows shaded salmonella. Therefore, the objectives of this paper are: to describe the current epidemiological aspects of bovine salmonellosis as well as public health importance of the disease.

2. Literature Review

2.1 Etiology and Nomenclature

Salmonella is a rod-shaped, gram-negative bacteria that has the ability to adapt to its surroundings. It is particularly dangerous as a foodborne pathogen because of its capacity to grow or endure in a wide range of circumstances. Animals' gastrointestinal tracts are salmonella's favorite home, and there, it frequently develops a connection with its host that causes little to no clinical disease. However, from there, the bacteria can easily contaminate soils, waterways, and surfaces and shed in feces, potentially infecting other animals. Importantly, fecal shedding also causes contamination of the hide and effluent during the slaughter process. Depending on the environment, Salmonella can multiply either through aerobic or anaerobic processes.Diverse strains can thrive under a variety of environments, including temperatures between 2°C (36°F) and 54°C (129°F) and pH values between 4.0 and

Journal Healthcare Treatment Development
ISSN: 2799-1148
Vol : 03 , No. 04 , June-July 2023
http://journal.hmjournals.com/index.php/JHTD
DOI: https://doi.org/10.55529/jhtd.34.11.21

9.5, even though a temperature of 37°C (98.6°F) and a pH of 6.5 to 7.5 are ideal[19,2]. Salmonella can also endure extreme temperatures, including remaining in frozen meat for up to a year[20].

The genus has two species: Firstly, there is S. enterica, which is further classified into six subspecies: enterica, salamae, arizonae, diarizonae, houtenae, and indica; and secondly, there is S. enterica subsp. indica.Secondly, there is S. bongori (formerly known as S. enterica subsp. bongori)[21].

The other subspecies and S. bongori are primarily isolated from cold-blooded animals and account for less than 1% of clinical isolates, whereas Salmonella enteric subspecies is largely isolated from warm-blooded animals and accounts for more than 99% of clinical isolates. Salmonella enterica subspecies I serotype Typhimurium, for instance, has replaced the Kauffmann species Salmonella Typhimurium as an example[22].

Table 1: Serotype of Salmonella enterica

Serotype of Salmonella enterica	**Host**	**Illness in Humans**
Typhimurium	Humans, Cattle,	Gastrointestinal
Newport	cattle, swine, horses, sheep,	Gastrointestinal
Dublin Typhi Para typhi	Cattle, swine, sheep, Humans only Humans only	Gastrointestinal Typhoid fever Typhoid fever

2.2 Epidemiology

Salmonella infections are mostly spread through food, although a small percentage (6%) can also be contracted from handling food animals, other reptiles or amphibians, chicks, or occasionally through contact with pet meals and treats [3,4]. The epidemiological patterns of infection prevalence and illness occurrences vary widely from one geographic region to another based on factors such as climate, population density, land use, farming methods, technologies for gathering and processing food, and consumer behaviors. Furthermore, Salmonella contamination or infection are invariably difficult due to the vast differences in biology between serovars. The most prevalent species is S. entritidis, followed by S. typhimurium, both of which are widespread throughout the world[23].

2.2.2 Infection source and mode of transmission

Global food safety challenges are brought on by the range of foods that contribute to the burden of Salmonella-related disease. The entire food industry has made significant efforts to reduce Salmonella spp. infection. The chance of direct transmission to humans increases with the number of interactions. When it comes to host-adapted serovars of Salmonella, farm animals are most likely to contract the illness from other members of their own species[24,25,26].

2.2.3 Mode of transmission in cattle

Significant variations exist between S. Dublin and S. typhimurium behavior in adult cattle. Animals with S. dublin infections that recover may develop into persistent excreters, releasing up to 106 organisms per gram of feces daily. Other herds may be infected and only expel the germs during stress, especially during parturition. Salmonella transmission via aerosol has long been believed and experimental aerosol infection of calves has just been confirmed. Salmonella transmission via aerosol has long been believed and experimental aerosol infection of calves has just been confirmed. Furthermore, flooding can cause pasture contamination, and there are numerous reports of clinical cases in adult cattle that resulted from grazing freshly flooded grass[14,7].

2.2.4 Mode of transmission in human

Salmonellosis in humans is mostly foodborne and is spread by ingesting tainted foods of animal origin as meat, milk, poultry, and eggs. Cheese and ice cream were among the dairy products linked to the outbreak. However, a recent outbreak has also been linked to foods like lettuce, tomatoes, cilantro, alfalfa sprouts, and almonds[14,7 ,27].

2.3 Pathogenesis

The three main determinants of the outcome of a Salmonella infection are the infective dosage, the host-influencing risk factor, and the level of immunity [6]. Ingestion of the bacterium through tainted feed and water is the most typical way for cattle to become infected. It may spread to the host's other bodily parts through the lymph fluid or blood, and it typically also results in the discharge of bacteria from the feces. The normal inhibition of Salmonella is primarily disrupted in the rumen and small intestine when (i) starvation or reduced feed intake occur, (ii) the feeding strategy results in a rise in pH in the abomasum, and (iii) antibiotic treatment kills the normal competing microflora of the intestine. These bacteria have evolved defenses to withstand and cope with host inhibitors. Through the columnar enterocytes and specialized microfold enterocytes, the bacteria attach to and infiltrate intestinal cells in the mucosa mostly linked with the Peyer's patches in the terminal jejunum and ileum[8].

The high levels of volatile fatty acids and the typical pH below 7 in the rumen generally hinder the growth of salmonellae [28,23,29].Following passage through the intestinal epithelium, the bacteria enter macrophages in the underlying lymphoid tissue and are then discharged to the neighborhood lymph nodes, which serve as crucial barriers to further spread. The bacteria survive and reproduce inside the macrophages, and if this barrier is broken, they are able to enter the organs that contain reticuloendothelial tissue [8, 22].

2.4. Clinical Signs

Adult cattle typically have acute or subacute enteric salmonellosis, and pregnant animals may miscarry while the disease is still in its early stages. Animals with severe disease display fever, sadness, inappetence, and a decrease un milk production. Following these symptoms is fowl-smelling diarrhea with mucoid faces that typically contain a blood clot and a shred of necrotic intestinal mucosa. Dehydration and mucus membrane congestion in the colon may be visible symptoms. About a week is spent with the acute illness. At any stage of pregnancy, S. dublin in particular but also other serovars, can cause abortion in cows. Dysentery may start two or four weeks before an abortion, or it may start before. In contrast, cows with no

Journal Healthcare Treatment Development
ISSN: 2799-1148
Vol : 03 , No. 04 , June-July 2023
http://journal.hmjournals.com/index.php/JHTD
DOI: https://doi.org/10.55529/jhtd.34.11.21

signs of pregnancy may nonetheless go through with one. Dysentery can either start before an abortion or follow it within two to four weeks. In contrast, abortion can occur in apparently healthy cows, with placentitis and/or septicemia being the main factors in the fetus's death. About 70% of abortions result in placenta retention, but subsequent fertility is typically unaffected [9,10,1,11]. In calves, clinical illness is most prevalent between the ages of 2 and 6 weeks. Clinical symptoms can differ, but often the enteric form of the illness—which is marked by pyrexia, lethargy, and anorexia—predominates. This is followed by diarrhea, which may contain mucus and fibrin. Due to the presence of necrotic intestinal mucosa, the feces may become bloody and "stringy." Salmonellosis is quite varied, and in certain animals especially very young animals rapid proliferation happens in the intestines and throughout the body and is linked to inadequate immunoglobulin G from colostrum absorption or calves having insufficient or no colostrum[11,32].

2.5. Diagnosis

2.5.1 Techniques for culturing salmonella

The conventional Salmonella culture procedure includes biochemical screening, serological confirmation, pre-enrichment, isolation of pure culture, and selective enrichment. It takes around 5-7 days to complete. According to the recommended procedure by international health organizations like the USDA and FDA, a nonselective broth such as lactose broth, tryptic soy broth, nutrient broth, skim milk, or buffered peptone water is used for 6–24 hours prior to enrichment. Three-sugar iron agar and lysine iron agar are used for biochemical testing, which takes an additional 4 to 24 hours [33].

2.5.2 Antibodies detection method

A sensitive and economical way for mass screening animal herds for signs of a Salmonella infection in the past or present is the detection of antibodies to Salmonella by EIA. The method's drawback is that the immunological response of each animal is not evoked until 1-2 weeks after the infection occurs. There are several commercial testing kits available for testing pigs, cattle, and poultry. This technique has the obvious benefit of being automatable and not requiring incubation to increase the number of bacterial cells [34].
An established method for analyzing antigens is the enzyme immunoassay. Salmonella antigens are attached to antibodies tagged with an enzyme, and the amount of antigen present is assessed by enzymatic conversion of a substrate. Typically, this results in a color change that may be observed visually or measured using a spectrophotometer. The pre-enrichment and selective enrichment techniques used in typical cultural procedures are what the EIAs rely on to produce enough Salmonella cells for detectionWith EIA technology, which permits identification at an earlier stage of culture and/or resuscitation, findings can be obtained even more quickly[35].

2.5.3 Serological test and nucleic acid-based assays

Serological techniques including ELISA, serum agglutination, and complement fixation can be used to diagnose salmonellosis retrospectively or to identify carriers[34,15]. Tests based on RNA or DNA Salmonella has been found in a variety of food samples utilizing the nucleic acid sequence-based amplification method (NASBA), reverse transcriptase PCR, and real-

Journal Healthcare Treatment Development
ISSN: 2799-1148
Vol : 03 , No. 04 , June-July 2023
http://journal.hmjournals.com/index.php/JHTD
DOI: https://doi.org/10.55529/jhtd.34.11.21

time quantitative polymerase chain reaction (Q-PCR). Salmonella cells that are still alive have been detected using the NASBA method, which has been shown to be more sensitive than RT PCR and to require less amplification cycles than traditional PCR methods [36,35].

2.7 Treatments

Comprehensive preventive methods that work for all Salmonellae may be required in animals to address the diversity of Salmonella serovars present on farms and the possibility that different serovars may exhibit different virulence factors [16]. Septicemic salmonellosis must be treated quickly, however, it is questionable whether or not to treat intestinal salmonellosis with antibiotics.Oral antibiotics may affect the gut microflora, prevent competitive antagonistic behavior, and lengthen the organism's time in the shadows. Additionally, there is worry that a Salmonella strain chosen by an oral antibiotic may later infect people. Antibiotics like ampicillin and cephalosporin cause bacterial lyses and endotoxin leakage. NSAIDs may be utilized to lessen endotoxemia's effects [38,39]. For calves who are mildly or moderately dehydrated, oral fluid and electrolytes may be somewhat useful and far less expensive than IV fluid Specific electrolytes (NaCl, KCl) can be given to drinking water for cattle that are willing to consume them in order to assist in correcting their electrolyte levels [39, 15, 4]. All Salmonella gastroenteritis patients require proper hydration and electrolyte management, but young children and elderly patients require it more than anybody else [13,40].

2.8 Prevention and Controls

As soon as salmonellosis in a herd has been identified, the control measure should be taken; if possible, isolate apparently infected animals into one group to treat severely ill animals, and affected animals should implement measures to reduce public health concerns, such as not consuming raw milk. Immediately after the outbreak or situation has passed, the area should be physically cleaned and the building should be disinfected. Large herd sizes, more intensive and crowded husbandry, and the move toward free-stall barns with loose housing are all factors that may support the contamination of the entire facility with feces and increase the prevalence of epidemic salmonellosis [14].
In an experimental study, a virulent S. choleraesuis vaccination successfully protected young calves from S. dublin-caused salmonellosis in calves. The optimal strategy is to immunize the cow when she is pregnant because this provides calves with 6 weeks of passive protection [26]. After vaccination, anti-lipoplisaccharide immunoglobins are evident in calves who received a modified aromatic dependent S. dublin bacterium vaccine when they were between three and four weeks old. It has been proven that a safe live oral vaccine against S. typhimurium and S. dublin regulates defense against experimental infection with virulent wide type strains of the organisms[14].
Live and attenuated vaccines are commercially generated from a rough strain of bacteria. A lesser amount of protection may be induced by inactivated bacterins, according to some research. The veterinary research institute developed a live, attenuated vaccine containing a virulent rough mutant of Salmonella dublin as well as an active vaccination against bovine salmonellosis made from isolates of Salmonella typhomurium, Salmonella dublin, and Salmonella bovis morbificans.[27,39].

Journal Healthcare Treatment Development
ISSN: 2799-1148
Vol : 03 , No. 04 , June-July 2023
http://journal.hmjournals.com/index.php/JHTD
DOI: https://doi.org/10.55529/jhtd.34.11.21

2.9 Public health aspect of bovine salmonellosis

Salmonellosis is a serious worldwide public health issue that affects a sizable population, causes significant morbidity, and consequently also has a sizable economic impact. Even though most infections result in mild to moderate self-limiting illness, fatal infections do happen occasionally [2]. Foodborne infections continue to be the most significant public health issue in the majority of countries [22,41] despite advancements in hygiene, food processing, food handler education, and consumer knowledge.

The term "salmonellosis incidence" refers to the discovery of Salmonella in animals, a collection of animal products, or an environment that may be specifically associated with identified animals or with animal feed. On the human side, the control of disease legislation requires a certified medical practitioner in a separate nation to notify the local government if a patient has or is suspected of having a foodborne disease [30,15]. Numerous studies provide conclusive proof of harmful effects on human health brought on by the presence of resistant bacteria[4].

2.10 Prevalence of Salmonellosis in Ethiopia

Public health issues related to foodborne illnesses exist in both industrialized and poor nations. Unsafe food consumption causes illness and even death in millions of individuals [42]. Salmonella infections most frequently occur in nations with subpar food preparation and handling standards, as well as those without sanitary sewage disposal [43]. Salmonellosis is frequently prevalent in Ethiopia and may be the most common zoonotic disease worldwide. The prevalence was reported to be 7.6% in humans and 6% in cattle in the Alemayehu et al. (2013) study. In addition, Addis, et al. (2011) noted that in dairy farms in Addis Abeba, salmonella was found in 10.7% of cows and 13.6% of persons who came into contact with breastfeeding cows. The author claims that dairy farm workers as well as the general public may be at risk of contracting Salmonella from breastfeeding cows.. The author claims that dairy farm workers as well as the general public may be at risk of contracting Salmonella from breastfeeding cows. In Selale, Asela, Akaki, and Debre Zeit, samples of cow's milk and combined bulk tanks were analyzed; the findings revealed that neither pooled nor bulk tank samples had any Salmonella contamination[40].

3. CONCLUSION AND RECOMMENDATIONS

A common foodborne illness around the world is salmonellosis. Salmonellosis epidemics in humans have been linked to both meat and milk consumption. Consuming raw animal products might contain zoonotic agents. By maintaining a high quality of hygiene throughout the entire process of producing food, the incidences can be reduced. Clinical symptoms displayed by infected animals can range widely, and animal species, age groups, animal use, and geographic location all clearly influence the likelihood of human infection. Also isolated from sick persons are the same strains.

Considering the aforementioned information, the following recommendations are made:

- ✓ Pasteurizing raw milk or milk products before ingestion is advised.
- ✓ You shouldn't consume raw meat unless it has been cooked.

Journal Healthcare Treatment Development
ISSN: 2799-1148
Vol : 03 , No. 04 , June-July 2023
http://journal.hmjournals.com/index.php/JHTD
DOI: https://doi.org/10.55529/jhtd.34.11.21

✓ A high level of multidisciplinary collaboration is essential. The slaughterhouse and lairage must be clean before the animals are slaughtered.
✓ The application of basic and applied research to the agent that causes foodborne salmonellosis will be a crucial step for novel strategies to prevent and control the illness.

4. REFERENCES

1. CDC, (2004) Preliminary Food Net data on the incidence of infection with pathogens transmitted commonly through food. Selected sites, United States, MMWR, 53:338.
2. Temesgen Zekarias and Teferi Mandado (2020) Public Health Importance of Bovine Salmonellosis in Ethiopia: A Rev. Global Vet., 22 (1): 01-08, 2020.
3. Scallan, E.; Hoekstra, R. M.; Angulo, F. J.; Tauxe, R. V.; Widdowson, M. A.; ROY, S. L.; JONES, J. L.; GRIFFIN, P. M. 2011. Foodborne illness acquired in the United States-major pathogens. Emerging Infectious Diseases, 17, 7-15.
4. Magwedere K, Rauff D, De Klerk G, Keddy KH, Dziva F. Incidence of nontyphoidalSalmonella in foodproducing animals, animal feed, and associated environment in South Africa, 2012±2014. Clin Infect Dis. 2015; 61, S283±S289. doi: 10.1093/cid/civ663 PMID: 26449943.
5. Acha PN, Szyfres B (2001) Zoonosis and communicable disease common to man and animals 3rd ed. 233-245
6. Tekalign Woldehana Uro. (201 9). Salmonellosis: A Review. Int. J. Adv. Res. Biol. Sci. 6(10): 79-88.DOI: http://dx.doi.org/10.22192/ijarbs.2019.06.10.008
7. Scherer CA, Miller SI (2001) Molecular Pathogenesis of Salmonellae. In: Groisman, E.A. (Ed). Principles of Bacterial Pathogenesis. Academic Press, New York, pp. 265-333. Senthikumar B and Prabakaran G. (2005) Multi drug resistant Salmonella typhi in Asymptomatic Typhoid carriers among food handlers in Namakkal District, TamilNadu. Indian. J Med Microbiol. 23: 92-94.
8. FDA/CFSAN (2008) Food Safety A to Z Reference Guide Salmonnella. Fluit AC (2005) Towards more virulent and antibiotic-resistant Salmonella? FEMS Immunol Med Microbiol 43:1-11.
9. CDC, (2003) Multistate outbreak of Salmonella serotype Typhimurium infections associated with drinking unpasteurized milk. Illinois, Indiana, Ohio, and Tennessee, 2002 - 2003. MMWR, 52: 613.
10. Buncic, S. (2006). Integrated food safety and Veterinary Public Health.Sava Buncic.P.Cm, Pp. 7-8.
11. Krauss HM, Albert W, Appel M, Henery B, Lesenberg D, et al. (2003) Zoonosis infectious disease from animals to humans. 3rd edition. American Society, for Microbiology: 234-236.
12. Jones PJ, Weston PR, SwailT (2007) Salmonellosis In: Bovine medicine, diseases and husbandry of cattle. Edited by Andrew, A.H. 2nd Edition: Blackwell publishing 215-230.
13. Molla B, Alemayehu D, Salah W (2003) Sources and distribution of Salmonella serotypes isolated from food animals, slaughterhouse personnel and retail meat products in Ethiopia: 1997-2002.Ethip.J.HealthDev, 17(1):63-70.

Journal Healthcare Treatment Development
ISSN: 2799-1148
Vol : 03 , No. 04 , June-July 2023
http://journal.hmjournals.com/index.php/JHTD
DOI: https://doi.org/10.55529/jhtd.34.11.21

14. Kemal J (2014) A Review on the Public Health Importance of Bovine Salmonellosis. J Veterinar Sci Technol 5:175. doi:10.4172/2157-7579.1000175
15. Mohler VL, Izzo MM, House JK (2009) Salmonella in calves. Vet Clin North Am Food Anim Pract 25: 37-54, vi
16. Addis, Z., N. Kebede, Z. Sisay, H. Alemayehu, A. Yirsawand and T. Kassa, 2011. Prevalence and antimicrobial resistance of Salmonella isolated from lactating cows and in contact humans in dairy farms of Addis Ababa: a cross sectional study, University of Gondar, College of Medicine and Health Science, Department of Medical Laboratory Science. BMC Infectious Diseases, 11: 1-10.
17. Li, H. P.; Wang, H.; D'aoust, J. Y.; Maurer, J. 2013. Salmonella species. Food microbiology: fundamentals and frontiers, 225-261.
18. Muller, K.; Aabo, S.; Birk, T.; Mordhorst, H.; Bjarnadottir, B.; Agerso, Y. 2012. Survival and growth of epidemically successful and nonsuccessful Salmonella enterica clones after freezing and dehydration. Journal of Food Protection, 75, 456-464
19. WHO, 2003c. Global Salm-Surv: AglobalSalmonella surveillance and laboratory support project of the World Health Organization.4th ed. In: Hendriksen, R. S. (ed.). Isolation of Salmonella, LaboratorProtocols, Level 1 Training Course. Pp. 1 -19.
20. Andrews, H. L. and Baumler, A. J. 2005.Salmonella species. In Fratamico, P. M Bhunia, A. K. and Smith,J. L. (eds.). Foodborne pathogens: Microbiology and molecular biology, UnitedKingdom: Horizon Scientific Press Ltd, Pp. 327- 339.
21. Radostitis OM, Gay CC, Hinchliff KW, Constable PD (2007) Veterinary Medicine: A text book of the disease of cattle, horses, sheep, pigs, and goats. 10th ed. Elsevier Ltd. 325-326
22. OIE, 2000. Salmonellosis. In: Manual Standards for Diagnostic Test and Vaccines, 4th ed. France, Paris, pp: 1-18.
23. Chao MR, Hsien CH, Yeh CM, Chou SJ, Chu C, Su YC, Yu CY (2007) Assessing the prevalence of Salmonella enterica in poultry hatcheries by using hatched eggshell membranes. PoultSci 86: 1651 -1655.
24. Mamman PH, Kazeem HM, Raji MA, Nok AJ, Kwaga JKP.Isolation and characterization of Salmonella Gallinarum from outbreaks of fowl typhoid in Kaduna State, Nigeria.Int J Public Health Epidemiol.2014; 3, 082±088.
25. Moussa IM, Ashgan MH, Mahmoud MH, Al-Doss AA (2011) Rapid detection of Salmonella enterica in food of animal origins collected from Riyadh, King Saudi Arabia. African Journal of Microbiology Research.5(15): 2173-2178.
26. Bäumler AJ, Tsolis RM, Heffron F (2000) Virulence Mechanisms of Salmonella and their Genetic Basis. In: Wray, C., Wray, A. (Eds.), Salmonella in Domestic Animals. CABI Publishing, New York, pp. 57-72.
27. Alexander, K. A., Warnick, L. D. and Wiedmann, M. (2009) Antimicrobial resistant Salmonella in dairy cattle in the United States.Vet Res Com
28. Quinn J, Markey BK (2003) Concise Review of Veterinary Microbiology: Blackwell publishing
29. L. Plym, Forshell and M. Wierup (2006) Salmonella contamination:a significant challenge tothe global marketing of animal food products. Rev. sci. tech. Off. int. Epiz., 25 (2), 541-554

Journal Healthcare Treatment Development
ISSN: 2799-1148
Vol : 03 , No. 04 , June-July 2023
http://journal.hmjournals.com/index.php/JHTD
DOI: https://doi.org/10.55529/jhtd.34.11.21

30. Hans PR, Dean OC, Morris P (2006) Salmonella infection in: Foodborne Infections and Intoxications 3rd Edition. Food Science and Technology International Series: 57-136.
31. Zamora BM, Hartung M (2002) Chemiluminescent immunoassay as a microtiter system for the detection of Salmonella antibodies in the meat juice of slaughter pigs. J Vet Med B Infect Dis Vet Public Health 49: 338-345.
32. Arun K Bhunia (2008) Mechanisms and Pathogenesis In: Foodborne Microbial Pathogens: pp. 201-215.
33. Much P, Pichler J, Kasper S, Lassnig H, Kornschober C, Buchner A, Konig C, Allerberger F (2009) A foodborne outbreak of SalmonellaEnteritidis phage type 6 in Austria, 2008. Wien KlinWochenschr 121: 132-136
34. Davison, S. 2005. Salmonellosis. Merck veterinary manual 10th edition. Edited by Cynthia, M. kahn. Merik and Co.J (inc. White House Station, N.J U.S.A).
35. Kagambèga A, Lienemann T, Aulu L, TraoreÂ AS, Barro N, Siitonen A et al. Prevalence and characterization of Salmonella entericafrom the feces of cattle, poultry, swine and hedgehogs in Burkina Faso and their comparison to human Salmonella isolates. BMC Microbiol.2013; 13, 253. PMCID: PMC3828578doi: 10.1186/1471 -2180-13-253 PMID: 24215206.
36. Sophia, D., 2011. Microbiological Quality of Milk Produced in Urban and Peri-Urban Farms in Central Ethiopia and its Public Health Impact, MSc Thesis, The Ohio State University.
37. Zewdu, E. and P. Cornelius, (2009) Antimicrobial resistance pattern of Salmonella serotypes isolated from food items and personnel in Addis Ababa Ethiopia. Trop. Anim. Health Pro., 41: 241-249.
38. WHO, (2002). safer food for better health. World Health Organization global strategy for food safety Geneva, Switzerland.
39. Senthikumar B and Prabakaran G. Multi drug resistant Salmonella typhi in Asymptomatic Typhoid carriers among food handlers in Namakkal District, TamilNadu. Indian. J Med Microbiol. 2005; 23: 92-94.