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Research Article

Epidemiology of Non-Typhoidal Salmonellosis in Cattle and its Public Health Importance in Gambella Abattoir, South Western Ethiopia

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Abstract

Epidemiological study was conducted on nontyphoidal salmonellosis (NTS) in cattle and its public health importance to estimate prevalence of nontyphoidal *Salmonella* (NTS) among cattle in Gambella town southern Ethiopia. A total of 384 faecal samples was collected and examined for the presence of NTS using standard techniques and procedures outlined by the International standardization for organization (ISO 6579). From the total animal examined 32 (8.3%) (95% CI, 2.207 - 18.88) cattle were positive for NTS. There was significant association (P < 0.05) in the overall prevalence among age, Breed and body conditions. The prevalence of nontyphoidal salmonellosis (NTS) was 5.4% in male and 2.8% in Female, < 5 years age, 5 - 8 years and > 8 years of age 7 (1.8%) 19 (4.9%) and 6 (1.5%) was observed, poor, good and medium body conditioned animals 17 (4.4%), 12 (3.1%) and 3 (0.7%) are identified respectively. The overall abattoir sanitary environment was below the requirements of good hygiene practices (GHP) in slaughterhouse such a ways the population is endanger of meat born zoonosis and sanitation problems. Also, the overall prevalence reported by the current study was not despicable, because nontyphoidal *Salmonella* (NTS) are zoonotic disease. So, prevention and control of nontyphoidal salmonellosis in live animals and faecal meat contamination in abattoir risk reduction strategies should be implemented with awareness creation to abattoir worker about meat hygiene and food safety.

Keywords: *Abattoir; Cattle; Gambella; Non Typhoidal Salmonella; Public Health*

Introduction

Salmonellosis is an infection caused by *Salmonella* bacteria that mainly affects cattle, sheep, goats, chickens and humans. The species associated with salmonellosis in humans can be divided into those causing typhoid fever, which are transmitted from human to human, and nontyphoidal species, for which transmission through contaminated food is thought to cause 85% of human cases [25].

Nontyphoidal *Salmonella* (NTS) are zoonotic agents and a wide variety of animals have been identified as reservoirs. Infection in animal is of importance because of the direct economic consequences of salmonellosis attributable to mortality and morbidity. Food animals harbor a wide range of *Salmonella* serotypes and so act as source of contamination, which is of paramount epidemiological importance in non-typhoid human salmonellosis [52].

The global burden of nontyphoidal *Salmonella* gastroenteritis has been estimated to be 93.8 million cases of gastroenteritis each year, with 155 000 deaths. The threat of epidemic infections has increased due to the globalization of the food supply and the increased movements of people, animals and goods within and between countries [35]. Apart from the morbidity and mortality costs in humans and animals, restrictions to trade and discard of contaminated food are important socioeconomic problems of the bacteria [45].

Infections with salmonellosis occur when a susceptible animal ingests the bacteria. Cattle ingest feed or water that has been contaminated with faeces from animals shedding the organism. So, infected cattle shed the bacteria and act as source of infection [42]. Small ruminants, such as sheep and goats, are also potential carriers of *Salmonella* [6].

In Africa, NTS has consistently been reported as a leading cause of bacteremia among immunocompromised people, infants and newborns [34]. However, it is usually difficult to evaluate the situation of salmonellosis in developing countries; it is due to the very limited scope of studies and lack of coordinated epidemiological surveillance system [30]. In addition to this, under reporting of cases and the presence of other disease considered to be of higher priority may have over shadowed the problem of salmonellosis in some developing countries including Ethiopia [32]. The increased global population coupled with mass production of animal and human food could worsen the problem [14].

Ethiopia has the largest animal population in Africa and the living standard of the population is generally favorable for the transmission of pathogens from animals to humans and the vice versa. Despite salmonellosis being one of the important zoonotic diseases, surveillance and monitoring systems are not in place and the temporal and spatial distributions of the serotypes are not described [17].

In general, the primary sources of salmonellosis are considered to be food producing animals such as cattle, sheep and goat [48]. The pathogens are mainly disseminated by trade in animals and uncooked animal food products [18]. Hence the disease is common in intestinal illness which is caused by numerous *Salmonella* serovars with clinical manifestations that vary from severe enteric fever to mild food poisoning [18] both in humans [24] and animals [37].

Infected animals are the source of the organisms [12,16]. The faecal wastes from infected animals and humans are important sources of bacterial contamination of the environment and the food chain [36]. Members of *Salmonella enterica* subspecies *enterica* are widely distributed in the environment and in the intestinal tracts of animals [8]. People can become infected following a failure of personal hygiene after contact with infected animals and or other infected people [2,8]. Also, it has substantial financial and social impacts; it is estimated to cost nations billions of dollars annually [37].

NTS represents an important human and animal pathogen worldwide [23]. A number of studies conducted on poultry, pig, poultry meat, minced beef and humans in Ethiopia showed that *Salmonella* are prevalent in various slaughtered animals and their meat products and human beings [3,7,33,44,46]. There is paucity of well documented information on the prevalence and occurrence of salmonellosis in the most common live animals such as cattle in Ethiopia and south west part of the country. On other hand abattoir fecal bacterial cross contamination of the environment in the food chain to the humans, especially in Gambella was not studded.

Objective of the Study

The objectives of this study is designed to estimate the prevalence of NTS in cattle and public health importance in Gambella town abattoir south west, Ethiopia

Materials and Methods

Description of the study area

The study was conducted at Gambella Abattoir of Gambella regional state, southwest Ethiopia from November 2019 to April 2019.

The Gambella People's Regional State is located south west Ethiopia between the geographical coordinates of 6° 28'38" to 8° 34' North Latitude and 33° to 35° 11'11" East Longitude, 766 km far from Addis Ababa which covers an area of about 34,063 km^2. The Region is bounded to the North, North East and East by Oromya National Regional State, to the South and Southeast by the Southern Nations and Nationalities and People's Regional State and to the Southwest, West and Northwest by the Republic of south Sudan [10].

Most of Gambella region is flat and its climate is hot and humid. The mean annual temperature of the Region varies from 17.3°C to 28.3°C and absolute maximum temperature occurs in mid-March and is about 45°C and the absolute minimum temperature occurs in December and is 10.3°C. The annual rainfall of the Region in the lower altitudes varies from 900 - 1,500 mm; at higher altitudes it ranges from 1,900 - 2,100 mm. The annual evapotranspiration in the Gambella reaches about 1,612 mm and the maximum value occurs in March and is about 212 mm [9].

Based on the 2013/2014 Census conducted by the Central Statistical Agency of Ethiopia (CSA), the Gambella Region has total population estimation of 406,000 and livestock population of Gambella 253,389 cattle, 39,564 sheep and 83,897 goats [11].

Gambella town abattoir

Gambella town abattoir was previously administered under Gambella town retailers union but know Gambella People's National and Regional State Gambella town Administration Council office of Gambella Town Municipality took the ownership responsibility. The abattoir is the only source of inspected beef for all inhabitants of the town.

The average number of animals slaughtered per day during the study period was about 25 - 30 except up to 50 cattle during holidays, all 100% of the slaughtered animals being cattle, cattle's were slaughtered in this abattoir and apparently healthy cattle ready for slaughter and those antibiotic treated for at last 2 weeks prior to the study were the excluded, finally cattle were selected randomly.

The abattoir has one slaughter house for Christian and Muslim and 34 meat retailers which directly receive carcass from the abattoir, each of retailers were pay 400 birr for the workers and municipal office with 130birrs for car rents and the service they offered in abattoir slaughtered cattle. Animals for slaughter are derived from different areas of the Gambella town, Gambella Woreda (Lare, Jekawo, Nignang and Itang) including Felata peoples whose trans-boundary moved their animals for search of food and water in the region and Bure and Mettu highland areas.

At the Gambella abattoir there were four Veterinary professionals with one supervisor and 25-28 workers assigned by the government to undertake regular slaughtering activities. Veterinarians perform anti-mortem and post-mortem inspection, and the reaming activities are carried out by workers. There was no clear division of the slaughtering process into stunning, bleeding, skinning, evisceration, cutting and delivery in the Gambella abattoir. Bleeding and evisceration was conducted on a horizontal position on the floor and outside the slaughter house on the grand and workers were not hoisted the carcass but after flying and eviscerated on the floor. There were no means of sterilizing equipment.

Study population

The study population constitutes zebu cattle of various body condition scores, age groups and sexes therefore Local Nure, Horro and Felata breed cattle were used as study population for the prevalence study.

Study design

A cross sectional study were conducted in Gambella town abattoir of the Gambella region to determine the prevalence of Salmonellosis in cattle slaughtered in Gambella Abattoir with its public health importance, south west Ethiopia.

Inclusion

Gambella municipal abattoir cattle faeces were isolated and identified only for Non typhoidal *Salmonella*.

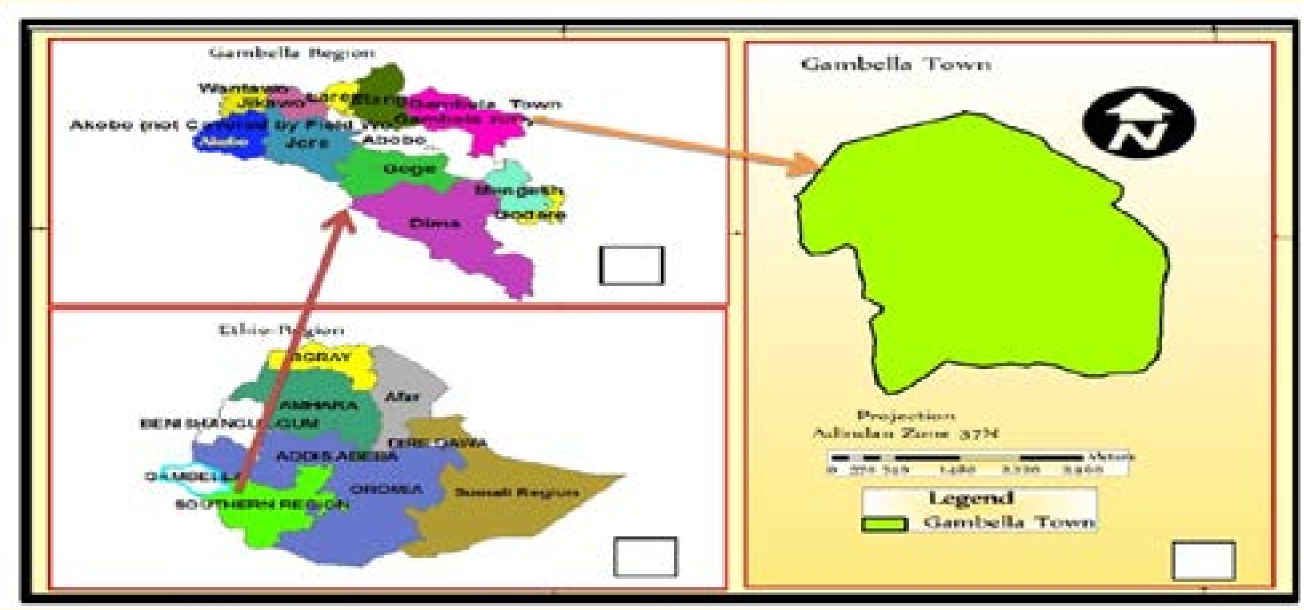

Figure 1: *Map of the study area [5].*

Exclusion

Due to lack of municipal abattoir in the area Abol and Bonga area isolation and identification of *Salmonella* were not included in this study.

Sampling method and sample size

Then study animals were selected using systematic simple random sampling method. The sample size required for the study was calculated by the formula given by [49]:

$$n = \frac{1.96^2 P_{exp} (1- P_{exp})}{d^2}$$

Where:

n = Required sample size

P_{exp} = Expected prevalence

d = Desired absolute precision.

Since there was no previous prevalence study in the area, 95% confidence interval, 50% expected prevalence and 5% precision were used. By using the above formula the required sample size becomes 384 cattle and by using Arsham's formula 100 interviewees were incorporated but due to less number of abattoir worker all of them were taken to assess the public health importance of NTS in the study area.

Method of cattle feacal sample collection

Fresh faecal sample were directly collected from the rectum of live cattle with sterile gloves. These samples were collected aseptically in sterile bottles which were free from disinfectant residues. During sampling each breed of animals, sex, Body condition, source of animal and address of the owners were recorded. Finally, the bottles were labeled and put into an ice box with ice packs and transported to Jimma Laboratory for microbiological analysis.

Figure 2: *Fecal sample collection.*

Isolation and identification of *Salmonella* from the cattle feaces

Isolation and identification of *Salmonella* were done based on International Organization for Standardization (ISO) recommendations for detection of *Salmonella* species in animal faeces and environmental samples [26]. The bacteriological media were prepared according to manufacturer's recommendations.

Pre-enrichment and selective enrichment

25 gram of fresh faecal samples was collected from individual animal were crashed in sampling bottles using individual sterile wooden spatula then it were added in the disposable plastic container to pre-enrich in 225ml of buffered peptone water (Oxoid, CM 0509, Basingstoke, and Hampshire, England) to obtain 1 part sample and 9 part buffer. The sample were mixed well by shaking then incubated at 37°C for 16 hours. Selanite cysteine broth will be used for selective enrichment for the sample and 1 ml of the pre enriched broth were transferred into a tube containing 10 ml Selanite cysteine broth (SC: Difco™, Becton, Dickinson, USA) and incubated at 37°C for 18 hours.

Plating out and identification

Salmonella Shigella Agar (SS) plates was used for plating out and identification. A loop full of inoculums from SC broth cultures were plated onto SSA (SSA; Oxoid, CM 0469, Basingstoke, England) and *Salmonella Shigella* Agar (SSA; LAB^M, LAB 052, Lancashire, UK) plates prepared according to the manufacturer direction. The plates were incubated at 37°C for 18 hours. After incubation, the plates were examined for the presence of typical and suspect colonies. Slight or if no typical colonies of *Salmonella* were re-incubated at 37°C for another 18 - 24hr. Typical colonies of *Salmonella* grown on SSA-agar has a slightly transparent zone of reddish color and a black center, a pink-red zone were also seen in the media surrounding the colonies. On SS Agar *Salmonella* shows a black center with lightly pale zone. For confirmation, about five presumptive or suspected colonies were selected from the selective plating media. If the suspected colonies on each plate were selected and colonies were streaked onto the surface of nutrient agar plates (Oxoid CM 0003, Basingstoke, England) and incubated at 37°C for 24hrs.

Biochemical identification

For Biochemical confirmation five typical or suspected pure *Salmonella* colonies were selected from every selective plating media. The selected colonies were streaked onto the surface of pre-dried nutrient agar plates and incubated at 37°C ± 1°C for 24 hrs ± 3 hrs. Then, the pure cultures on nutrient agar were used for biochemical and serological confirmation [26].

The biochemical tests include glucose, lactose and sucrose fermentation and gas and H_2S production in KIA agar (KIA; LAB^M, LAB 059, Lancashire, UK), urease test (Urea Agar Base 500g; HIMEDIA^R, M 112A) and IMVIC test (Indole, methyl red -Voges Proskauer (MR-VP Medium 500g; HIMEDIA^R, M 070) and Simmons Citrate 500g; HIMEDIA^R, M 099. KIA slants were inoculated by stabbing the butt and streaking the slant. The isolates producing Red (alkaline) slant, yellow (acid) butt, gas and with or without hydrogen sulphide production (H_2S) considered as positive on KIA. Urease negative, Methyl red positive, Voges Proskauer negative Indole negative and Citrate positive results were identified as *Salmonella* (showed in Appendix 7.2) [20,22,26].

Questionnaires survey

Structured questionnaire were designed and used to assess about the knowledge and attitude abattoir workers on the disease of salmonellosis, meat hygiene and food safety. Those personnel who are responsible in the production of beef carcass were interviewed. The personal observations include hygienic practice in the abattoir and personal hygiene of abattoir worker has also conducted.

Data management and analysis

Microsoft Excel was used for data entry and management. Descriptive statistics such as percentage, proportion, frequency distribution were applied to compute some of the data. The data were analyzed by comparing proportions, using Pearson's chi-square or Fisher's exact test based on the number of observations per contingency table cells, in order to see the association between sex, Age, Breed, Body condition and source of cattle. Statistically significant associations between variable were considered when the P value were less than 0.05. All statistical analysis was performed using SPSS version 20 software package.

Result and Discussion

Overall *Salmonella* isolation and prevalence

From the total of 384 fecal samples examined 32 were found positive for nontyphoidal *Salmonella* isolate, resulting with 8.3% (95% CI, 2.207 - 18.88) of prevalence. Summary of the prevalence of *Salmonella* from fecal samples in the Gambella town abattoirs was presented in table 1. However, *Salmonella* samples collected and isolate detected in the abattoir were statistical significant ($p > 0.05$) (Table 4) this finding reveled that there was a considerable rate of cattle contamination in the Gambella town abattoir, which potentially poses a risk of causing food-associated illness. These findings in agreement with the previous studies undertaken and reported as 13.3% *Salmonella* positive [11] and direct relationship between *Salmonella* infection rates in cattle, where an increase in the infection rates of the latter has coincided with high incidence.

The present study revealed an overall prevalence rate of 8.3%, However, the current study revealed higher prevalence of *Salmonella* than the range cited by Gay JM., *et al*. [16] indicated that the prevalence of *Salmonella* in cattle, in Australia who detects 6.8% of *Salmonella*

Variable	Percent (%)	Prevalence	df	χ^2	P-value
Sex			1	0.736	0.391
Age			2	5.234	0.073
Body Condition			2	49.972	0.000
Breed			2	13.286	0.001
Source of Cattle			3	7.339	0.062
Overall prevalence	100	8.3			

Table 1: *Overall prevalence of Salmonella in Gambella town abattoir.*

Variables	Mean	SD	Value	Pearson Chi-Square	Df
Sex	1.28	0.449	103.791	0.391	1
Age	2.26	0.727	108.477	0.073	2
Body Condition	1.64	0.706	129.405	0.000	2
Breed	2.04	0.820	110.005	0.001	2
Source of Cattle	1.96	1.129	103.844	0.062	3

Table 2: *Chi-square statistical significance level of test for Salmonella.*

from faeces of cattle, 1.8% *Salmonella* from Addis Ababa findings by Behailu H., *et al*. [9], Molla W., *et al*. [32] reported 1.9% of *Salmonella* from slaughter cattle faeces of Addis Ababa and Debre-Zeit abattoir, while 4.8% [41], 7.6%, Gizachew M and Mulugeta K [19] reported in Baher Dar Ethiopia and Kagambèga A., *et al*. [28], Alebachew K and Mekonin A [3] and Anbessa D and Ketema B [7] reported 3.1% and 3.3% *Salmonella* from cattle faeces in Debre-Zeit and Jimma and also higher than 0.0% from Egypt [13]**,** in Iraq 2% [52], in Namibia 0.50% [38] 4.5% in [47], 6% in Central India [29] abattoirs respectively.

Unlikely, this finding was lower than 11.6% prevalence reported by Fegan., *et al.* 2004 from slaughter cattle faeces in USA and much lower than 34.2% from adult cattle in California [49].

In this study, Out of 384 examined cattle 277 (72.1%) and 107 (27.9%) were male and Female respectively. The prevalence of non typhoidal *Salmonella* were higher in the case of male cattle slaughtered in Gambella abattoir 21 (5.4%) followed by 11 (2.8%) respectively and this difference in prevalence was statistically significant (χ^2 = 0.736, P = 0.391 df = 1) indicated in table 4. *Salmonella* among different age groups was also calculated and it was found that 64 (16.7%), 155 (40.4%) and 165 (43.0%) of *Salmonella* prevalence identified in cattle were < 5, 5 - 8 and > 8 years of age respectively. The prevalence of *Salmonella* were higher in the case of > 8 years of age 19 (4.9%) followed by < 5 years age and 5 - 8 years 6 (1.5%) and 7 (1.8%) respectively and this difference in prevalence was statistically not significant (χ^2 = 5.234, P = 0.073, df = 2) (Table 3 and 4).

The difference in the overall prevalence of *Salmonella* among age groups was no any significant (P < 0.05) (Table 4) but > 8 years of age shows higher prevalence 19 (4.9%) these may be due to variation in the response to infection with *Salmonella* and it was also some precipitating factors such as long distance transport, concurrent disease, acute deprivation of food, was usually necessary to cause the disease in old and young animals than adult [37]. In agreement to these study [39] indicated a negative relationship between age and disease but in contrast with the present study the prevalence of *Salmonella* infection was increased with the increase in age with the [3] reported an increase in the prevalence of *Salmonella* with increase in age.

Variable	Positive	Frequency (N=384)	Percent (%)	Prevalence	df	χ^2	P-value
Sex	32			3.8	1	0.736	0.391
Male	21	277	72.1	5.4			
Female	11	107	27.9	2.8			
Age	32			2		5.234	0.073
< 5 years old	6	64	16.7	1.5			
5 - 8 years old	7	155	40.4	1.8			
> 8 years old	19	165	43.0	4.9			
Body Condition	32			3.8	2	49.972	0.000
Good	12	191	49.7	3.1			
Medium	3	142	37.0	0.7			
poor	17	51	13.3	4.4			
Breed	32			3.8	2	13.286	0.001
Felata	19	122	31.8	4.9			
Abigar	9	136	35.4	2.3			
Horo	4	126	32.8	1.0			
Source of Cattle	32			3.8	2	7.339	0.042
Gambella Town	23	188	49.0	5.9			
Bure	4	87	22.7	1.0			
Mettu	2	46	12.0	0.5			
Gambella Woreda	3	63	16.4	0.7			

Table 3: *Prevalence of non typhoidal Salmonella.*

Knowledge examined in questionnaire and Participants responses	Frequency (N)	Percent (%)
Sex		
Male	17	85.0%
Female	3	15.0%
Age	20	16.7%
Educational status		
High school (9-12)	11	55.0%
Certificate	4	20.0%
Diploma and above	5	25.0%
Heard about Typhoid		
Parasite	9	45.0%
Hereditary	11	55.0%
Couse for *Salmonella*		
Food	7	35.0%
Other	13	65.0%
Transmitted from Animal Food		
Yes	7	35.0%
No	13	65.0%

salmonellosis preventable disease		
Yes	4	20.0%
No	16	80.0%
signs and symptoms of Salmonellosis		
Abdominal Cramp	20	100.0%
Treatment used during encountered Salmonellosis		
Modern	12	60.0%
Traditional	8	40.0%
Work experience in abattoir		
1-2 year	7	35.0%
3-5 year	7	35.0%
5-8 year	6	30.0%
Personal care while working		
Yes	13	65.0%
No	7	35.0%
Eating, smoking and chewing chat		
Yes	9	45.0%
No	11	55.0%
Placement in the abattoir		
All	20	100.0%
Faulty evisceration		
Yes	12	60.0%
No	8	40.0%
Handling cattle without stress full condition		
Yes	20	100.0%
Bleed Animal during slaughtering		
Complete Bleeding	4	20.0%
Incomplete Bleeding	6	30.0%
Both	10	50.0%
Job related training		
Yes	20	100.0%
Job related medical test		
No	20	100.0%
Couse for carcass contamination on slaughter house process		
Faeces	6	30.0%
Dirty water	8	40.0%
Handling with dirty equipments	6	30.0%
Met contamination pose any health risk		
Yes	20	100.0%

Table 4: *Abattoir workers/slaughter house responses about Salmonella.*

Body condition of cattle slaughtered in the study, 191 (49.7%), 142 (37.0%), 51 (13.3%) were good, medium and Poor Body condition of cattle slaughtered at Gambella town abattoir respectively. The prevalence of NTS were higher in the case of poor body condition 17 (4.4%) followed by good and medium 12 (3.1%), 3 (0.7%) respectively and this difference in prevalence was statistically significant (χ^2

= 49.972, P = 0.000, df = 2) (Table 3 and 4). The present study revealed an overall prevalence breed with 136 (35.4%), 122 (31.8%) and 126 (32.8%) were Felata, Abigar and Horo breeds respectively. In addition, the prevalence of *Salmonella* were higher in the case of Felata breed 9 (4.9%) followed by Abigar and Horo breeds 19 (2.3)% and 4 (1.0%) respectively and this difference in prevalence was statistically significant (χ^2 = 13.286, P = 0.001, df = 2) (Table 4).

Source of cattle included in the study, 188 (49.0%), 87 (22.7%), 46 (12.0%), 63 (16.4%) were from Gambella Town, Bure, Mettu and Gambella woreda respectively. The prevalence of *Salmonella* were higher from the Gambella Town 23 (5.9%) followed by Bure, Gambella Woreda and Mettu 4 (1.0%), 3 (0.7%), 2 (0.5%) respectively and this difference in prevalence was statistically significant (χ^2 = 7.339, P = .042, df = 2) (Table 3). These study was in agreement with Mahmood., *et al.* (2014) reported highest prevalence of *Salmonella* in animal of low land areas, which turned out to be an ideal environment temperature for the occurrence of *Salmonella* and these may be animals are vital for the development of infestation because may be due to high movements of Felata cattle and availability of their cattle in the Gambella town market which may influence the prevalence of *Salmonella* in the area. On other hand these reports show lowest prevalence of *Salmonella* in Mettu 46 (11.9%). The probable reason for the fecal prevalence disparity from these studies may be due to seasonal variation in *Salmonella* shedding among animals difference in infection prevention practices by animal owners and other factors such as variation in hygiene status.

Public knowledge and attitude about the salmonellosis

Out of abattoir workers interviewed, all of them responded that, they were not heard about the disease called typhoid/*Salmonella.* But, 9 (45.0%) and 11 (55.0%) of abattoir worker responded that parasitic and hereditary of disease respectively and others 7 (35.0%) responded that salmonellosis could be transmitted from the food of animal origins but rest of them from the other source 13 (65.0%). Lack of knowledge and awareness of abattoir workers regarding NTS may responsible for carcass contamination during slaughtering and evisceration.

16 (80.0%) of the respondents responded the possibility of Salmonellosis prevention after infection but Only 4 (20.0%) responded that not possible. Almost all respondents did not know the sign and symptoms salmonellosis in the abattoir workers, these may implicate that they may easily transmit the NTS to the carcass unknowingly. Treatment was one of the solutions after the individual was sick of *Salmonella* according to the respondents' response 12 (60.0%) and uses modern type of treatment whenever they encounter *Salmonella* type of infection but 8 (40.0%) did not know the choice of drug for *Salmonella* treatment and choose traditional methods of treatment.

7 (35.0%) of worker have one up to five year experience in the abattoir but 6 (30.0%) of them eight years of experience, 11 (55.0%) of them do not eat, smoking and chewing while working in the abattoir. All (100.0%) workers were placed in all activities in the abattoir like stunning, slaughtering, flying and evisceration processes. Also all (100.0%) of respondents responded that they do not get job related training nor job related medical test during their stay in the abattoir and they were handled cattle without stress full condition, 12 (60.0%) of respondents practice faulty evisceration with 10 (50.0%) both complete and incomplete bleeding, these may facilitate that cross contamination between workers, carcasses and feces of the cattle slaughtered in the abattoir during the study. Even though all abattoir workers know that feces, dirty water and handling with dirty equipment's can cause carcass contamination on slaughter house process and result for meat contamination that pose for any health risk for human consumption.

From these studies direct observations may highly reveal that carcass contamination in the abattoir due to absence of hot water, sterilizer, cooling facility in the abattoir and carcass retention room in the abattoir and lairage. During slaughtering equipment's (Knives, carcass holding plastics) were placed on unclean surfaces (floor), in their (workers) mouth and on the hide of slaughtered animals. No protective clothes and their cloths were unclean, blood tinged, animal feaces and frequently in contact with carcasses. There were no separate compartments for final carcasses and animals to be slaughtered and there was no soap or other cleaning materials before and after working. The possible factors that favor the transmission and prevalence of salmonellosis may include environmental and personal

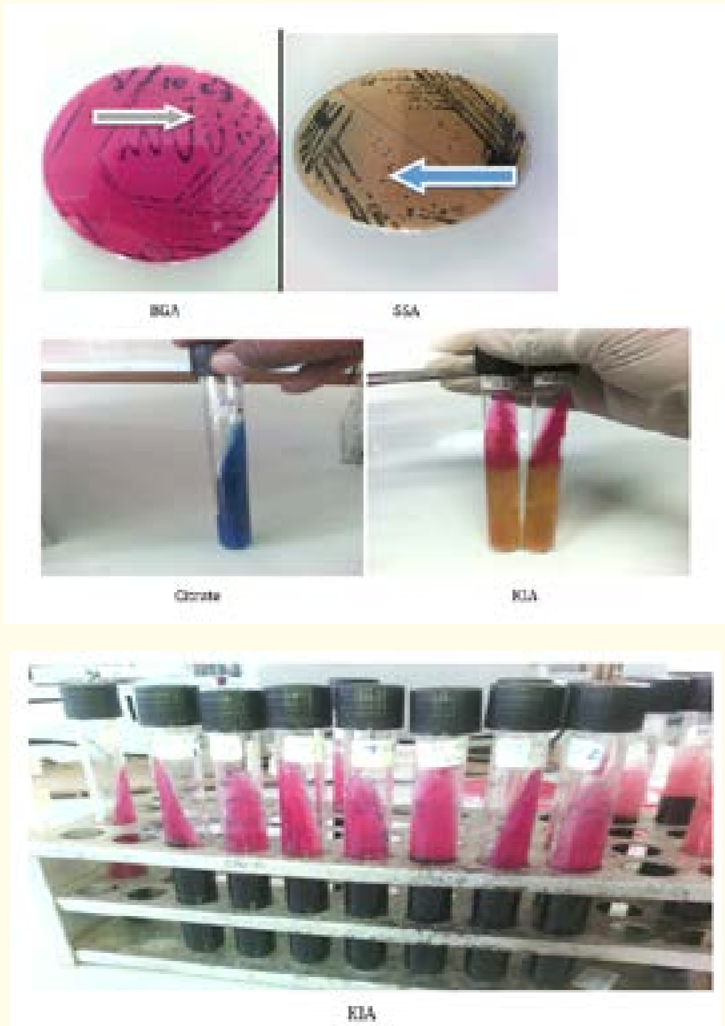

Figure 3: *Salmonella colony characteristics on different media and biochemical tests.*

sanitation, socio-economic and living standards, availability of water supply and awareness of safe food handling and preparation among individuals.

The overall abattoir sanitary environment was below the requirements of good hygiene practices (GHP) in slaughterhouses. The internal and external facilities and sanitary conditions of the slaughter house were very poor. Neither place for disposal of condemned carcasses nor facilities for wastewater treatment exist and it is not friendly with the environment. The abattoir workers had no clothing, boot, apron and other accessories. Three assistant meat inspectors were delivered services only during ante mortem and no one was carried out postmortem examination during the study period in such a ways the population is endanger of meat born zoonosis and sanitation problems.

This was in agreement with the [50] Salmonellosis represents an important public health problem among the common bacterial foodborne pathogens worldwide. The presence of *Salmonella* in food animals and the consequent cross-contamination of edible carcass present a significant food-safety hazard [21]. Food animals such as cattle may carry *Salmonella* at slaughter and can serve as sources of contamination and provide an opportunity for entry of the pathogen into the food products. This implies that the presence of *Salmonella* in slaughter cattle and slaughter house environment and the potential cross contamination of carcasses and edible organs can pose a significant food-safety hazard [7]. And foodborne gastroenteritis caused by non-typhoidal *Salmonella* represents a major public health problem worldwide. As *Salmonella* is transmitted through contaminated food or water, its presence in food animals and food animal products has relevant public health implications. Thus, monitoring food safety is a key point in preventing and controlling the spread of *Salmonella*, as well as in providing healthier food product [47].

Conclusion and Recommendation

The present study showed that, overall prevalence of NTS from cattle was 8.3% (95% CI, 2.207 - 1.888) and there was significant association ($P < 0.05$) in the overall prevalence among age, Breed and body conditions and these shows that, crucial factors related with the prevalence of non-typhoidal *Salmonella* (NTS). Symptomatic cattle presented for slaughter may be contribute to meat contamination because of *Salmonella* in the intestines that has a high chance of being transferred onto the carcass.

The prevalence of *Salmonella* was higher in the case of Felata breed followed by Nure indicate that, uncontrolled free movements of the Felata people to the region with local cattle may be crate the chance for prevalence of NTS in the study area. Lack of knowledge and awareness of abattoir workers regarding NTS may responsible for carcass contamination during slaughtering and evisceration. As abattoir workers did not know the sign and symptoms salmonellosis, these may implicate that they may easily transmit the NTS to the carcass unknowingly. Even though all abattoir workers know that feces, dirty water and handling with dirty equipment's can cause carcass contamination on slaughter house process and result for meat contamination that pose for any health risk for human consumption, incomplete bleeding may facilitate that cross contamination between workers, carcasses and feces of the cattle slaughtered in the abattoir during the study.

The overall abattoir sanitary environment was below the requirements of good hygiene practices (GHP) in slaughterhouses. The internal and external facilities and sanitary conditions of the slaughter house were very poor. Neither place for disposal of condemned carcasses nor facilities for wastewater treatment exist and it is not friendly with the environment. The abattoir workers had no clothing, boot, apron and other accessories. Three assistant meat inspectors were delivered services only during ante mortem and no one was carried out postmortem examination during the study period in such a ways the population is endanger of meat born zoonosis and sanitation problems. The possible factors that favor the transmission and prevalence of salmonellosis may include environmental and personal sanitation, socio-economic and living standards, availability of water supply, and awareness of safe food handling and preparation among individuals.

Current study was not despicable, because non typhoidal *Salmonella* are zoonotic disease and a wide variety of animals have been identified as reservoirs. From which food animals harbor a wide range of *Salmonella* so act as source of contamination, which is of paramount epidemiological importance. Carrier animals excrete *Salmonella* bacteria in large numbers, sometimes intermittently during their entire life time without showing clinical symptom, then the excreted bacteria infect other animals.

Generally, to control and prevent salmonellosis in live animals and animal products, the following recommendation should be implemented for risk reduction strategies throughout the food chain:

- Reduce different stressors on live animals because of *Salmonella* in the intestines that have a high chance of being transferred onto the carcass.

- Slaughtered cattle Fecal and water contamination should be prevented
- Since, foods of animal origin are an important source of human infection, in many countries including Ethiopia, possible source of salmonellosis for the community unless carriers are treated or other preventive measures are taken before slaughtering
- Abattoir sanitary environment should be keep to the requirements of good hygiene practices (GHP) in slaughterhouses.
- Awareness creation to abattoir worker about meat hygiene and food safety should be implemented
- Detailed further study on *Salmonella* serotypes for the source contamination should be considered and with their public Health importance.

Conflict of Interest

Authors have declared that no competing interests exist.

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