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Prevalance of Salmonella in Eggs At Benedir Region In Somalia

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Abstract:

Background*: Salmonella qualifies to be one of the major pathogens that cause food poisoning to human. Feco-oral transmission is the main ways it gets established in the gut and causes disorders related to salmonellosis. It is of public health concern and it is among the most guarded pathogen in the world in order to mitigate it is devastating impacts in public health. One of the ways salmonella is acquired is by consuming contaminated raw or undercooked eggs, foods and water. Salmonella happens to be transmitted through poultry products as salmonella transmission is through trans ovarian in poultry. It also affects the productivity of poultry farms by causing pulorum diseases in poultry. Since poultry production in Somalia is new and struggling, the country depends on exporting both poultry meat and egg. This imported products does not go through quality checks therefore this paper is set to establish the overall prevalence of salmonellosis in eggs and compare prevalence of salmonellosis in locally produced eggs and exported eggs.*

Materials and Methods*: To determine the prevalence of salmonellosis in eggs in Banadir region, a cross sectional study was conducted between February 2019 to 2021 in Benedir region. Origin of imported eggs were purposively selected and tray sampling was simple random sampling, backyard poultry farms were also selected using simple random sampling. A total 400 egg samples were transported and processed in veterinary diagnostic laboratory at Gahayr compus and Duunyo diagnostic laboratory. The content of eggs and their surface were inoculated and microbiological examined to established the prevalence of salmonella contamination of Eggs.*

The bacteriological assessments were conducted through culturing using pre-enrichment (peptone water, enriched broth (TTB and RVC), XLD agar and BGA were used as selective media. And finally biochemical tests were used for confirmation.

Results*: The total sampled were 400 and 172 out of the 400-sample had growth of salmonella, making the prevalence of salmonellosis in eggs to be 43%. Eggs collected from the backyard poultry farms recorded the highest prevalence (64.9%), While the local commercial farms showed prevalence of 36.1% and imported eggs accounted 27.%.*

Comparing the number of eggs that had typical salmonella growth from the three sample categories shows that 67% of Eggs collected from backyard poultry farms had typical salmonella growth, while 12% of the eggs collected from local commercial poultry farms had typical salmonella growth the least was the imported eggs that 27.8% of eggs collected from imported eggs had typical salmonella growth.

The Prevalence of surface inoculum and content inoculum shows that the surface inoculum had the highest growth of salmonellosis accounting 61.1% and content inoculum had 39.9%.

Eggs collected from the back yard had 48(55%) egg surface growth and 39(44.8%) egg content growth, while local modern commercial poultry farms had 32(66.7%) egg surface growth and 16(33.3%) egg content growth. The imported eggs showed egg surface growth of 25(67.6%) and 12(34.4%)

Growth in the surface inoculum is suggestive that: Poor knowledge of egg handling, in adequate facilities and lack of quality control of eggs are the main constrains. It was concluded from the study that Salmonella is widespread in backyard poultry eggs and egg suppliers do not have knowledge of egg handling in addition they are not aware of the risks of contaminated eggs have to public consumers. It is recommended from the study that a joint and coordinated quality control measure for eggs is necessary to avoid the risk of salmonella organism.

Key Word*: Eggs; Salmonella; Chicken; Biochemical tests; Poultry.*

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I. Introduction

Salmonella distribution is worldwide and it is found in every corner of the world. It inflicts disease to poultry as well as affects human and animals. (djefal at el., 2018). Horizontal and vertical transmission of salmonellosis was described in poultry (Sangeeta et,al., 2010). Poultry and poultry products are major vehicle and source of foodborne disease. Eggs are implicated to be the major source of lifestyle related food poisoning. Such foods include egg butter, raw based egg mayonnaise. (Tan et,al., 2012) Eggs and egg products when improperly handled can be a source of food borne diseases, such as Salmonellosis. Salmonella is one of the major bacterial agent that cause food borne infection in humans leading food borne disease worldwide (Herikstad et al., 2002). Salmonellosis poses health threats to elderly people, children and immunocompromised individuals.

Salmonellosis in chicken was associated with productivity impacts. It causes reduced egg production in poultry farms both morbidity and mortality in young chick. (Sangeeta et,al., 2010) Chickens are reared for their eggs in the world wid. And eggs are the most nutritious food with varied vitamin and mineral contents this includes choline and selenium and vitamin B12, phosphorus and riboflavin. In addition to that they are having highest quality of protein available in the food. The protein found in the eggs is highly digestible with biological value of 94%. The yolk contains vitamins such as A, D, E, K and Folic acids, (ENC, 2004) and (Romo L., (2004)).

In Somalia, the production of poultry meat and table eggs is limited. Some rural Households close to urban centers keep five to ten (5-10) layers in free range systems and bring their eggs to markets. There are also emerging modern local commercial poultry farms in Somalia but failed to fill the demand gap for eggs and chicken meat in Somalia. The huge gap for egg demand is supplemented by imported eggs from other countries.

Somali people consume raw eggs because they believe it has more nutritional value then boiled or fried eggs. This will make worse of the situation, because there is high possibility of food poisoning due to consumption of raw eggs. Therefore, this research determined the prevalence of salmonella contamination in eggs in Mogadishu.

II. Material And Methods

This prospective comparative study was carried out on patients of Department of general Medicine at Dr. Ram Manohar Lohia Combined Hospital, Vibhuti Khand, Gomti Nagar, Lucknow, Uttar Pradesh from November 2014 to November 2015. A total 300 adult subjects (both male and females) of aged ≥ 18, years were for in this study.

Study Design: The study was cross-sectional **Study Location**: Mogadishu is the capital city of Somalia; it is located in the southeastern part of Somalia. It is consisting of 18 districts and has a population of 2425000. Mogadishu neighbors the agricultural heart of Somalia and it is surrounded by the lower and middle Shabelle districts. The city is rich in both livestock production and crop production. In particular, it hosts the young emerging commercial poultry farms and dairy farms in Somalia. It is also the major entry points of food imports to Somalia. It is the center of trade and commerce and main egg consumer in the country and has an international airport near in Indian ocean and is also has international seaport. Being the capital city of Somalia. The temperature ranges between 25.4 C and 28.5C.

Study Duration: The study was cross-sectional that started February 2018 and concluded in February 2021. There was ample time to meticulously collect samples and process without overstretching the researchers to avoid errors in inoculation, collection and processing.

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Sample size: 400 egg samples.

Sample size calculation: To find proper sample size for the study in order to avoid confounding factors and sample errors secondary formula for unknown population was used to determine the sample size which is

$$\frac{\mathbf{z^2 x\, p(1+p)}}{\mathrm{e}^{\mathbf{2}}}$$

where Z2= 1.96, P= 0.5 and e = margin of error of 5 % .

$$\frac{\mathbf{1.96^2 x\, 0.5(1+0.5)}}{\mathbf{0.05^2}} = \mathbf{384}$$

The total samples collected during the study was 420 samples and 20 samples broke during transportation and 400 samples were successfully processed.

Sample collection and transportation

Samples were collected from backyards poultry farms, modern commercial local poultry farms and Imported egg traders in the market. sample were identified with labels and but into separate sterile paper bags to avoid contamination. The samples were transported to SNU FVH laboratory for further processing.

Sampling procedure and labelling

There were two major sample categorization of eggs during the study and each major category there were sub strata of samples. Eggs imported from turkey, Yemen, emirates were sampled and labelled as imported eggs. Locally produced eggs from backyard poultry farms and modern commercial poultry farms were collected and labeled as local eggs. Eggs were collected in sterile bags and labeled according to their origin and shop sold.

Laboratory procedure.

In this study the egg shell was swabbed and inoculated in order to estimate the level of egg surface contamination as a result of the environment, while the contents of the egg were also inoculating so that the research highlights the likelihood of vertical salmonella transmission.

Egg surface swabbing and inoculation

In order to successfully recover salmonella that was stressed by the environment, non-selective pri-enrichments was done by preparing Peptone water for inoculation. A cotton swab smeared throughout the surface of the eggs was dipped into the 9 ml of peptone water in universal bottle.

Egg content inoculation

The egg surface was sterilized with 70% absolute alcohol and dried. With sterile knife the egg was broken, and it is content poured into a sterile beaker. The content was mixed thoroughly, and 1ml of the content was transferred into 9 ML of peptone water contained in universal bottle. As per WHO protocol for feaces and food salmonella isolation two selective enrichment was prepared and labelled selective enrichment I and II. In selective enrichment I, Mueller-Kaufmann Tetrathionate broth (TTB) was prepared. One (1) ml of inoculated egg surface peptone water and 1 ml of egg content inoculum was each transferred into two separate universal bottle containing 9 ml TTB and incubated for 24 hours under 37 c degrees.

In selective enrichment II, Rappaport vassiliadis soy peptone broth (RVS) was prepared. One (1) ml of inoculated egg surface peptone water and 1 ml of egg content inoculum was each transferred into two separate universal bottle containing 9 ml RVS and incubated for 24 hours under 41.5 degrees.

Spread on selective Plating

Xylose lysine dextrose (XLD) and Brilliant Green Agar (BGA) was prepared as per the manufacturer's instruction. Ten (10) microliters full loop from Both the content inoculum and egg surface inoculum was streaked into two separate plates containing XLD and two separate plates containing BGA incubated for 24 hours under 36 degrees.

Growth reading

Colony morphology on both XLD and BGA was read. Colonies that showed transparent red halo and a black center or pink red zone on XLD was suspected of Salmonella growth. While colonies on BGA that appeared red or imparted red/pink color to the surrounding agar were recorded as salmonella suspects.

Selection and subculture of suspect salmonella colonies

Two suspect Colonies each from XLD and BGA were transferred into nutrient agar for purification and incubated for 24 hours under 37 degrees.

Biochemical test for identification

The purified colonies were father cultured on conventional biochemical test for salmonellosis. TSI: Triple Sugar Iron Agar LIA: Lysine Iron Agar MIO: Motility-Indol-Ornithine Agar Urea: Urea Agar Citrate (Simmons): Simmons Citrate Agar. incubated for 24 hours under 37 c degrees.

Data analysis procedure

Pre-designed forms were used for recoding data collected in the field. And the results were entered in excel spread sheets and then transferred to SPSS-21 for analysis.

Inclusion and exclusion criteria

Based on this study eggs that had cracks were left from the study.

Ethical issues

The study was authorized by the faculty dean and research committee Under this study the traders that their eggs were sampled remained confidential and were not shared with anyone to avoid consumer disruption. The traders were informed that participation of the research was voluntary, and their consent was taken.

III. Result

Overall prevalence of Salmonella in Eggs.

One hundred seventy-two eggs tested positive for salmonellosis making the prevalence of salmonellosis in eggs to be 43%. The total sampled were 400 and 172 out of the 400-samples had a typical salmonella growth. Eggs collected from the backyard poultry farms recorded the highest prevalence 64.9% while the local modern commercial farms showed prevalence of 36.1% and imported eggs accounted 27.8% prevalence.

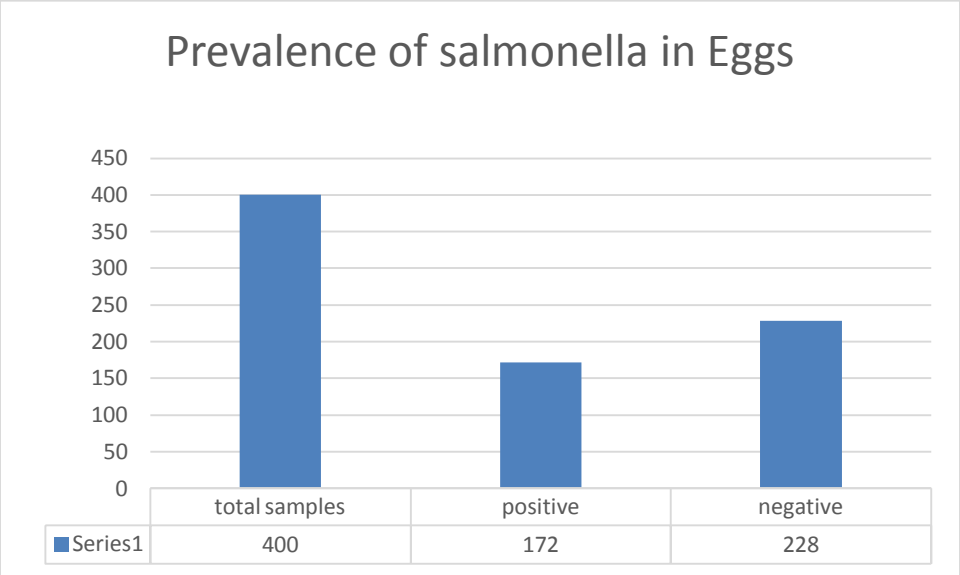


Figure1 Prevalence of salmonella in Eggs

The above histogram shows the overall prevalence of salmonellosis in eggs in Banadir region. According to the finding in the laboratory 43% of the samples had typical salmonella growth in XLD and BGA and confirmed through biochemical chemical test.

Table 1. Prevalence of Salmonella in eggs collected from Backyard poultry farms.

Location	Total sample	Positive	%
Household Backyard poultry farms	134	87	64.9

The table above shows the eggs collected from households that rear backyard poultry for egg production it shows the highest positive of the three variables compared, it is prevalence is 86(64.7%)

Table 2 Prevalence of Salmonella in local modern commercial poultry farms.

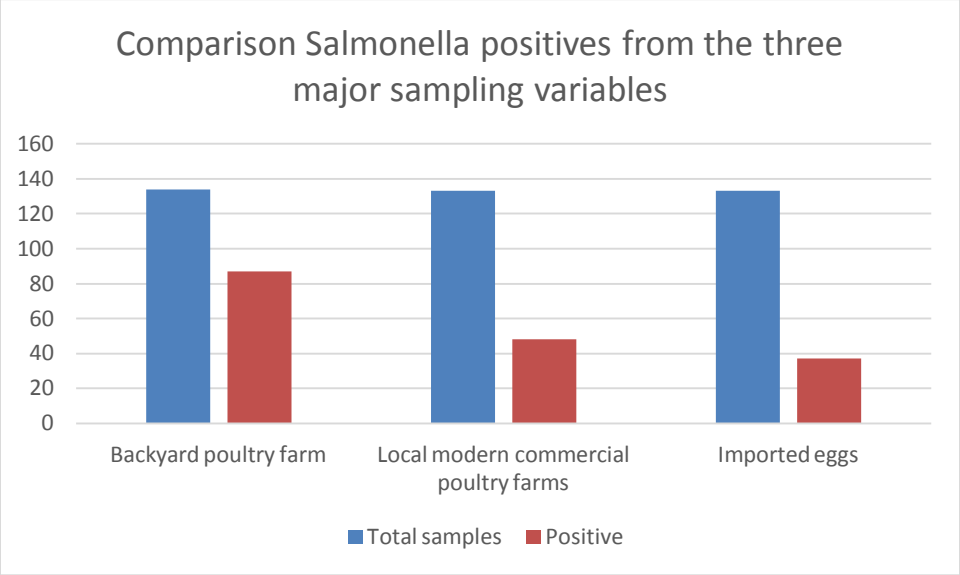
Location	Total	Positive	%
Local commercial poultry farms	133	48	36.1

The table above shows results from eggs collected from local commercial poultry farms out of 33 samples collected 48(36.1%) had salmonellosis.

Table 3 Prevalence of Salmonella in Imported eggs.

Location	Total	Positive	%
Imported	133	37	27.8

The table above shows resulted from imported eggs that were tested for salmonellosis. It shows that 37(27.8%) were positive for salmonella.



The chart above compares the number of salmonella samples from the three major variables: The highest (87) salmonella positive is seen in eggs collected from backyard poultry farms in Mogadishu, and it is followed by local modern commercial farms (48) positive samples and the least positive samples (37) recorded were eggs collected from import terminals.

Table 4. comparison of inoculation site versus location

Sample categories					
		Backyard poultry farm	**Local modern commercial poultry farms**	**Imported eggs**	**Percentage**
Inoculation site	Surface Swab Inoculation	48 (55.2%)	32 (66.7%)	25 (67.6%)	105 (61.1%)
	Egg Content Inoculation	39 (44.8%)	16 (33.3%)	12 (34.4%)	67 (38.9%)

The table shows results found from inoculation made from egg surface and egg contents in eggs collected from Backyard poultry farms, Modern local commercial farms and Imported eggs. Eggs collected from the backyard poultry farms has highest growth both in surface egg swab culture (48) and Content culture (39), and the second highest was local commercial farms that showed surface egg swab growth of 32 eggs and content inoculum of 16 and the least was imported eggs that had surface egg swab growth of 25 and content inoculum growth of 12. In percentage wise Eggs collected from the back yard had 55% egg surface growth and 44.8% egg content growth, while local modern commercial poultry farms had 66.7% egg surface growth and 33.3% egg content growth. The imported eggs showed egg surface growth of 67.6% and 34.4%. This is suggestive that imported eggs has the highest egg surface contamination due to the multiple hands it passes through to final or retailers shops.

IV. Discussion

The finding of this study reveals that the overall prevalence of salmonellosis in eggs is 43% this is high as compared to other studies in Somaliland which suggests prevalence of 20%. Other reports from India suggests that occurrence of salmonella in eggs were 27% (Piknova et, al,. 2002). The prevalence of salmonellosis in eggs is influenced by complex varaits which includes flock size, vaccination, stress, flock age and cleaning routines. (Whiley et, al., 2015).

Backyard poultry farming was high compare to commercial and imported eggs that come from modern farming method that practices regular disposal of poultry manure. Similar is reported by loeta et,al., 2010 who reported higher positivity in free range poultry compared to caged poultry. Modern farming methods is recognized as a contributing factor in reducing salmonella contamination of eggs and poultry farms. (whiley et,al., 2015). The commercial and imported eggs may have used salmonella vaccine which can be associated with reduced egg contamination compared to backyard poultry production (Berghause et,al., 2011)

In this study it was found out that eggshell surface contamination was found out to be 61.1% of the 172 samples that were positive, and the internal egg contamination of salmonella was 38.9% of the 172 samples that

were positive. Egg contamination occurs during oviposition in the case were eggs are laid in dirty boxes, and feces dropped by infected hens can also predispose egg to get salmonella contamination. (Uzzau et, al., 2000) Contamination of eggs can occur systemically after hens ingest salmonella contaminated feeds. Internal egg contamination by salmonella can occur horizontal during or after Oviposition. Salmonella can penetrate through egg shells when guts of hens are invaded by salmonellosis, or when intact with salmonella laden feaces in infected poultry farms. (Messens et,al., 2005). As the result suggest the eggs surface contamination which fall under the horizontal contamination is the most prevalent as compared to internal egg contamination this is in agreement with (Barrow et.al., 1991); (Bichler et, al., 1996) who argue that horizontal contamination is the most important way of egg contamination.

Salmonella outer shell egg contamination is associated with contaminated nest box, hatchery trucks, hatchery environment, chicken drooping, moist organic materials like litters and feed remedial. Salmonella egg contamination is exacerbated by room temperature storage of soiled eggs (Schoeni et,al., 1995) and as a result it is ascribed that feces serves a nutritional reservoir for salmonella although salmonella can survive and grow on the egg shell in the absence of fecal contamination when exposed on low temperature and humidity. (Messens et. al., 2006). This survival and growth on lower temperature is associated with the slow metabolism caused by cold and dry conditions of the eggshell. However, there is no distinguishing factors that limits the colonization of other salmonella serotypes on the outer surface of eggs the most prevalent serotype reported is salmonella enteritidis (Braden et, al.,2006). Factors associated with eggshell penetration includes cracked eggshell, immediate cooling after oviposition, positive temperature differential (Fajardo et,al., 1995)(Board, 1985)

V. Conclusion

Salmonellosis contamination in eggs is complex issues as it goes through various stages that can predispose eggs to get contaminated. It has public health consequence in particular to the weakest groups of the communities these includes elderly people, young children and mothers. Proper handling and storage are the major control strategies of eggs destined to the table. And farm level contamination is paramount and need farmers to educated on ways of controlling salmonellosis contamination at the farm. The study found 43% prevalence of salmonellosis and the backyard poultry farms being the highest contaminated eggs. This could be associated with farm hygiene, verticale transmission, horizontal transmission, poor storage mechanisms, and transportation huddles experienced. The least contamination was seen in imported eggs show a prevalence of 9%.

VI. Recommendation

Irradiation and pasteurization are the two major methods used to reduces contamination of eggs by salmonellosis. Proper storage of eggs and ph are also important in reducing salmonella contamination in eggs. Eggs should be stored 0-6 c celciuss and fluctuation of temperature should be avoided. Cleaning and disinfection of farms before introducing the new flock is also paramount in controlling salmonella contamination of eggs. Recommended egg handling during cocking to avoid contamination Eggs should be washed thoroughly before breaking

Eggs should be subject at leas 71 c heat when preparing for consumption

Nests should be kept as clean as possible by removing faeces and broken eggs out of nests and cleaning nest pads. Nest material must be kept topped up and fresh.

Dirty eggs must either be dry cleaned or washed and these procedures must be carried out very carefully to prevent the risk of increased contamination.

Cool all eggs immediately after collection. Cool rooms should be set at 15 ºC and be capable of maintaining this temperature.

Eggs offered for sale must be free of faeces, dirt and stains and must only be sold in clean and dry packaging.

Consumers must be Avoid using cracked eggs as they are more likely to be contaminated and present a higher health risk

Eggs stained with dirt should be washed. Washed eggs should then be used as soon as possible.

Avoid contaminating the egg contents with the outside of the shell when cracking.

Prevent cross-contamination between raw eggs and other food.

Conflict of interests

The authors are here by declaring there is no conflict of interest

Authors contribution

The authors contributed towards the research and writing the manuscript as follows:

Abdirahman Bare Dubad: Conception of the research problem, literature review, research design, data collection, analysis and drafting the manuscript.

Mohamed Abdellrahman Mohamed: Literature review, research design, data analysis and revising the manuscript.
Osman Hassan Afrah: Research design, data collection, literature review interpretation of data and revising the manuscript.
Hassan Mohamed Hassan: Conception of the research problem, literature review, research design, data collection, analysis and drafting the manuscript.
Abdirizak Mohamed Hassan: Conception of the research problem, literature review, research design, data collection, analysis and drafting the manuscript.
Fardowso Abdirahman: Conception of the research problem, literature review, research design, data collection, analysis and drafting the manuscript.

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