

**Research Article****An Analysis of the Causes of Poultry Condemnations at A Nairobi Slaughter House, Kenya (2011-2014)**Mwimali MI<sup>1\*</sup>, Kitaa JMA<sup>2</sup> and Osoro LN<sup>1</sup><sup>1</sup>Ministry of Agriculture, Livestock and Fisheries<sup>2</sup>Faculty of Veterinary Medicine, University of Nairobi, Kenya

\*Corresponding author: maryannemwimali@yahoo.com

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A four year retrospective study was conducted in a Nairobi based slaughterhouse to evaluate the magnitude and prevalence of poultry losses caused by disease and pathological lesions. Linear regression analysis for the study of time trend and Kruskal-Wallis H test for investigation of differences were used as statistical methods. A total of 21,549,233 broilers were delivered to the plant for slaughter in the four year period starting 1<sup>st</sup> of January 2011 to 31<sup>st</sup> of December 2014. As a result of official veterinary inspection 405,778 (1.88%) birds were condemned due to ascites, emaciation, dead on arrival, imperfect bleeding, overscalding, mutilations and skin lesions. The calculation of the condemnation risk was based on quarters of the years. The number of broilers slaughtered increased across the four years and so was the risk of condemnations. Ascites and pre-slaughter mortality were the most frequent causes of condemnations accounting for 92.74% of all condemnations. The increase in the risk of condemnation due to emaciation across the study period from 0.07% to 0.23% was significant ( $P=0.02$ ). There were no trends in time for the ascites, DOAs (dead on arrival) and the other causes of rejection. Majority of the condemnations occurred during the coldest season which comes in the third quarter of the years. Most of the condemnations were due to disease and transport-related causes. These calls for improved disease control and prevention measures at farm level as well as animal welfare during handling prior to slaughter. The results could serve as baseline data in the poultry industry for future comparison.

**Key words:** Condemnations, Poultry, Slaughter, Ascites**INTRODUCTION**

The main objective of the broiler industry is to produce meat that is fit for human consumption. Ante-mortem and post-mortem inspections are carried out at the slaughterhouse to protect public health and ensure wholesomeness of meat. As much as it is an important source of proteins, meat can also serve as a vehicle for disease transmission thereby creating an epidemiological and zoonotic threat (Mellau *et al.* 2010). Meat inspection records kept at the slaughterhouse have the potential to serve as a pointer to the disease conditions prevalent in an area served by the abattoir as well as information on new or re-emerging diseases which are important in animal health, public health and food safety (Alton *et al.* 2010; Herenda & Jakel 1994). The prevalence of some diseases, especially those with no obvious clinical signs, can only be detected at slaughter hence abattoir records can be useful as sources of information in epidemiological and

preventive medicine of such diseases. These records, although with their own limitations, are an inexpensive and convenient source of information to stakeholders in the poultry industry (Khodaei *et al.* 2014) hence farmers can use such information to detect shortcomings in flock health and management while processors can use it to improve efficiency of their operations. Governments will on the other hand require such information to aid in developing disease control strategies. Ante-mortem inspection data may be used to monitor other health events such as welfare.

The meat inspection function in Kenya is under the State Department of Livestock. It is carried out by Inspecting Officers who are Veterinary Officers, Health Inspectors or any other person duly authorized by the Director of Veterinary Services in writing (Meat Control Act, 2010). The inspections are done independently of the livestock and abattoir owners and the findings reported to the Director of Veterinary Services. According to the

Meat Control Act, (2010), the official inspection of broilers consists of two investigations; an ante-mortem inspection to evaluate flock health and a post-mortem inspection to detect and withdraw from the food chain birds with grossly identifiable lesions that can compromise their safety and wholesomeness. Carcasses are condemned on the basis of macroscopic visual criteria which occur as a result of either disease, injury to the broiler before slaughter, maladjusted equipment or manual errors committed at processing (Jalilnia & Movassagh 2011).

Ante-mortem and post-mortem condemnations represent production losses for the broiler industry, with both economic and public health consequences on the people involved. A number of studies have been done to determine the causes and prevalence of poultry rejections at slaughter (Ansong-Danquah 1987; Herenda & Jakel 1994; Ansari-Lari & Rezagholi 2007; Haslam *et al.* 2008; Lupo *et al.* 2008; Aliabad *et al.*, 2011; Jalilnia & Movassagh 2011; Alloui *et al.* 2012; Gholami *et al.* 2013; Khodaei *et al.* 2014). However, such information has not been fully exploited worldwide and is very scant for Africa and more so Kenya. In a number of studies done to determine causes of condemnation, cachexia has been implicated as the most common cause for condemnation (Gholami *et al.* 2013; Lupo *et al.* 2008; Jalilnia and Movassagh 2011). In Africa and particularly Kenya, information on causes of carcass condemnation is scant. Therefore farmers and other stakeholders in the poultry sector remain unaware of losses attributable to conditions leading to rejections at slaughter and therefore cannot implement corrective measures to reduce such losses both at the farm and plant levels. This information is warranted as some of the conditions are zoonotic therefore pose a public health concern in addition to causing economic losses as well as welfare concerns. The purpose of the present study was to investigate the character and prevalence of poultry losses due to disease and pathological conditions in a Nairobi slaughterhouse, Kenya, and also to analyse the dynamics of trends in prevalence of poultry condemnations during a four-year period. The results are useful to the poultry industry in serving as baseline data for future comparison.

## MATERIALS AND METHODS

### Study area

The study was conducted in a poultry slaughterhouse located on the suburbs of the Capital City of Nairobi, Kenya. The city is located at about 140 km south of the Equator and 480 km from the Indian Ocean, at around latitude 1°S and longitude 36°E. The city covers an area of approximately 690 square km and together with the surrounding counties of Kajiado, Machakos and Kiambu form the greater Nairobi Metropolitan. The altitude of Nairobi ranges from an average of 1500 metres in the East to approximately 1900 metres in the West. The mean annual rainfall ranges between 1000 in the west and 800mm in the east of the city. Relative humidity is high in the early hours of the day (80%) and decreases to about 40% later in the day while sunshine hours range between 4-9 hours. The city experiences bimodal rainfall patterns with long rains from mid or end of March to end of May

while short rains occur from October to December. There is a hot dry spell between January to early March and cold dry season in July to September (Gok. 2002). The mean annual temperature is 19°C.

Information on condemnation was stratified according to seasons of the year namely dry hot season (January to March), the wet rainy season (April to June), the Cold, dry season (July to September) and short rains (October to December) (GOK. 2002). Each season being approximately 3 months, the strata were referred to as first, second, third and fourth quarters respectively.

The slaughterhouse where the study was carried out has a capacity of processing about 20,000 broilers per day. The function of meat inspection is carried out by five meat hygiene inspectors who work under the supervision of a Veterinary doctor who reports to the Director of veterinary services. Routine meat inspection involved an ante-mortem examination of all broilers presented for slaughter just before slaughter and at this point only clinically healthy broilers proceed for slaughter while the dead and obviously diseased are destroyed. Inspection of the carcass involved a thorough examination of all the surfaces of the carcass as well as the viscera. Basic principles of Hazard Analysis and Critical Control Point (HACCP) are observed during processing as well as good manufacturing practices to ensure food safety. The plant has its own hatchery to supply day old chicks to its contracted farmers who raise the birds to market age. Operations at the level of the farm are overseen by the company's extension officers to ensure that set standards are maintained in all stages of production. It is possible that the broilers used in this study are not representative of the flocks as this is an export slaughterhouse. The broilers are slaughtered at average age of 42 days to yield carcasses of 1.5 – 2.2kg. The clientele includes leading hotels, fast food restaurants as well as neighbouring countries.

### Data

The data used in the present study were obtained from the condemnation records of one officially inspected abattoir located on the outskirts of Nairobi city. Permission to access the data was granted by the Director of Veterinary Services. Condemnation records were retrieved from daily condemnation books which covered the period from 1<sup>st</sup> of January 2011 to 31<sup>st</sup> of December 2014 (48 months). The birds presented for slaughter were from Nairobi and its surrounding areas which include Machakos, Kajiado, Kiambu and Naivasha. The records served as the sources of data from which information concerning poultry condemnations were extracted and analyzed. The data consisted of the date of delivery and slaughter, the number of birds condemned for specific causes of condemnation, the total number condemned and the total number of birds delivered to the abattoir for slaughter. For the purposes of this study, the total broilers were considered to be the sum of broilers rejected at ante-mortem and the total broilers slaughtered (i.e. approved at ante-mortem inspection). In addition, the dead on arrival category included broilers that died either in transit or at the lairage and the live birds that were condemned at ante-mortem inspection.

**Data analysis**

The data were retrieved manually from the daily condemnations books and recorded in data capture sheets before being transferred to Microsoft Excel 2007. Descriptive statistics were used to determine the proportions of condemnation which was defined as the number of broilers condemned over the total number of broilers delivered for slaughter. The condemnation proportions were summarized in form of tables and charts. The differences in the proportions of condemnations were tested by Kruskal-Wallis H test, they were considered significant at 95% confidence level ( $P \leq 0.05$ ). Data were analyzed on a 3-month (quarterly) and annual basis for the specific causes of rejection. The average risks of condemnations in the four quarters of the each year for the study period were estimated and Kruskal-Wallis H test was used to test for the differences in the risk of condemnation in the different seasons of the year. Linear regression was used to check for time trend in the risk of condemnations over the years.

**RESULTS**

In the four year period from January 2011 to December 2014 a total of 21,549,233 broilers were presented for slaughter. The mean annual number of broilers was 5,387,308 with a minimum of 5,118,241 broilers in 2011 and a maximum of 5,751,115 broilers in 2014 (Figure 1).

Within the four year period a total of 405,778 (1.88%) broilers were declared as not fit for human consumption due to various reasons: inadequate bleeding, over scalding, emaciation, ascites, dead on arrival (DOA), skin lesions, mutilations and other non-specific reasons. The number and percentage of broilers condemned for various reasons are given in Table 1. Specific disease conditions observed were ascites and emaciation while slaughter related conditions included inadequate bleeding, mutilations and over scalding.

The risk of condemnations increased from 1.50% in 2011 to 2.16% in 2014 with an average condemnation rate of approximately 1.88% for the 4-year period under study. The total number of broilers delivered to the abattoir for slaughter generally increased from 2011 to 2014 so did the proportions of condemnation which increased from 1.50% to 2.20%

Ascites (57.40%) and cadavers (35.34%) were the main causes of condemnations accounting for 92.74% of all condemnations during the study period. Emaciation, inadequate bleeding, over scalding, skin lesions and mutilations were the other causes of condemnation during the study period. Table 1 summarizes the causes of broiler condemnations for the four years under study.

Table 2 is a summary of the number of birds delivered for slaughter during the four years under study, the number and the percentage condemned. It also shows percentage condemnations in respective quarters of the four years as well as condemnations by cause in the different quarters.

From the results, there has been a general increase in the proportions of birds condemned from 1.5% to 2.16% across the four years. The highest proportion of condemnations occurred in the third quarter (Figure 2).

This is consistent for all the four years. The first quarters have the least proportion of condemnation for the years.

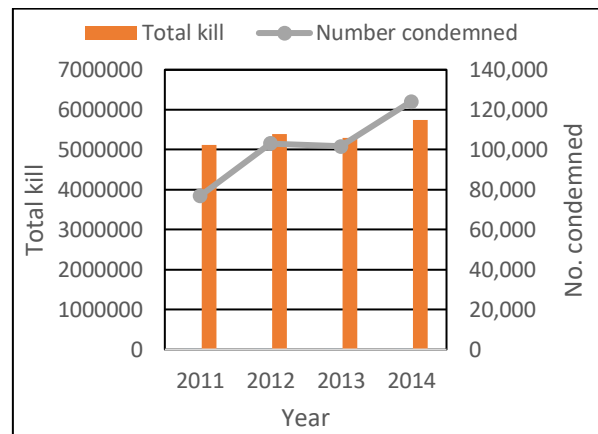
Apart from the first quarter of 2011, Ascites accounted for more than 50% of all condemnations in each quarter. A comparison by year showed that the third quarters have the highest percentage of condemnations as far as ascites is concerned.

Apart from 2013, the other years have their first quarters having the highest proportions of condemnations due to DOA while the third quarter has the least proportion of condemnations due to DOA except 2013.

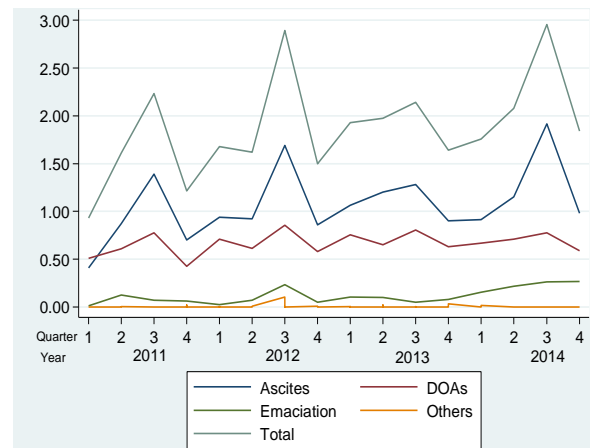
The highest annual proportion of condemnation due to emaciation occurred in 2014 while the least annual condemnation due to emaciation was in 2011. The results depict a general increase in the proportion of condemnations due to emaciation across the four years with a proportion of 0.07% in 2011 and 0.22% in 2014. Relative increase as a proportion of condemnations rose from 4.4% to 10.7% in the period of study.

**Trends in frequency of various causes of condemnations**

Condemnation causes that contributed to the highest proportions of condemnations in the four seasons are ascites, DOAs and emaciation in that order of decreasing magnitude. Other reasons of condemnations had very small little contribution to the total condemnations.



**Fig. 1:** Number of broilers delivered for slaughter and the number condemned during the period between 2011 and 2014.



**Fig. 2:** Trends in frequency of various causes of condemnation of poultry in a Nairobi slaughterhouse, Kenya, between 2011 and 2014.

**Table 1:** Causes of carcass condemnations at a poultry slaughterhouse in Nairobi, Kenya for the period 2011-2014.

Cause of condemnation	Poultry condemned		Relative %
	No.	% condemned of condemnations	
Ascites	232,906	1.081	57.4
D.O.A	143,397	0.665	35.3
Emaciation	26,004	0.121	6.4
Unspecified	2,622	0.012	0.6
Skin lesions	337	0.002	0.1
Over scald	146	0.001	0.0
Total condemned	405,778	1.883	100
Total slaughtered	21,549,233		

**Table 2:** Seasonal slaughter and condemnations in a Nairobi slaughterhouse during the period 2011-2014.

Quarter	Number slaughtered	Number condemned (%)
1	4,950,535	78,477 (1.59)
2	5,113,864	93,599 (1.83)
3	5,528,804	141,293 (2.56)
4	5,956,030	92,409 (1.55)
	$\chi^2(3)=7.963, P=0.0468$	$\chi^2(3)=8.228, P=0.0415$

**Condemnations by season**

A Kruskal-Wallis H test was used to test whether there were differences in the annual total number of broilers delivered for slaughter to the plant and whether the proportions of condemnations differed with season across the years. The number of birds delivered annually for slaughter could not be treated as proportions of the total number of birds alive in the area each year because these data was not available. The test showed that there was a significant difference in the number of broiler birds delivered for slaughter in each of the four seasons, ( $\chi^2=7.963, P= 0.0468$ ) and also a significant difference in the number of broilers condemned in each season ( $\chi^2 = 8.228, P=0.0415$ ). While the number of broilers delivered for slaughter increased with the quarters of the year, the number of condemned birds was highest in the cold season which occurs in the months of July through September.

**Effect of time trend on risk of condemnation by cause**

According to the results of the regression analysis in Table 3, a significant increase was observed in the condemnation risk due to emaciation over the study period from 0.01% in first quarter of 2011 to 0.27% in the fourth quarter of 2014 ( $P=0.02$ ). This means the risk of condemnation due to emaciation varied significantly over the study period. The value of  $R^2$  (the coefficient of determination at 0.40%) explains that there may be other factors other than time that are causing the variations in condemnations due to emaciation and need to be

investigated. The risk of condemnation due to the other causes of condemnation did not vary significantly over the different seasons.

**DISCUSSION**

Pathological lesions in at slaughter may be influenced by factors such as diet, management practices as well as breed (Ansari-Lari & Rezaghali 2007). The present study revealed that the broiler condemnation prevalence at slaughterhouse during the study period gradually rose from 1.50% in 2011 to 2.16% in 2014. Though, the mean condemnation risk of 1.88% found in this study is comparable with those of Ansong-Danquah (1987) and Haslam *et al.* (2008) who reported 1.72% and 1.23% respectively, it varied substantially with other studies. Lower risks have been reported in a number of studies; 0.33% (Gholami *et al.* 2013), 0.67% (Aliabad *et al.* 2011), 0.47% (Ansari-Lari & Rezaghali 2007), 1.0% (Jakob *et al.* 1998), 0.37% (Jalilnia & Movasagh 2011 ) while higher rates have been reported from south America at 8.3% and 3.6% for two different slaughterhouses (Santana *et al.* 2008) and 3% (Yogaratnam 1995). There was a general increase in the annual risk of condemnation across the study period and most of the condemnations occurred in the third quarter of each year i.e. months of July, August and September. This particular quarter of the year is usually cold and dry with temperatures as low as 15°C, hence low ambient temperatures could be impacting negatively on the quality of birds. Just as the overall condemnation risk was different when compared with other studies, so was the relative reasons for the condemnation. The main causes of condemnation were ascites and DOA which accounted for more than 92% of all rejects.

Ascites a metabolic disorder mediated by factors in the environment, nutrition and genetics (Decuypere *et al.* 2000) characterised by accumulation of fluids within the abdominal cavity accounted for 1.08% of condemnations during the four year period. The proportions of poultry rejects due to ascites were highest during the third quarter which could be explained by the ambient temperatures during this period, a possible factor for ascites (Balog 2003). The low temperatures may necessitate farmers to reduce ventilation in order to keep the poultry houses warm with the available heat which reduces ventilation leading to high levels of ammonia which predisposing lung diseases hence ascites. The rapid growth rate and better feed efficiency that is encouraged in broiler industry puts a metabolic strain by causing a mismatch

**Table 3:** Regression for the effect of time trend on risk of condemnation by cause

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Ascites	DOAs	Emaciation	Machine damage	Over scalding	Skin lesion	Unspecified	Total
Season	0.03 (0.02)	0.01 (0.01)	0.01* (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)	0.05 (0.03)
_cons	0.80* (0.18)	0.61* (0.06)	0.02 (0.03)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.01 (0.01)	1.45* (0.26)
adj. $R^2$	0.112	0.021	0.399	-0.069	-0.071	-0.003	-0.071	0.151
F	2.90	1.32	10.97	0.03	0.00	0.96	0.00	3.66
N	16	16	16	16	16	16	16	16

Standard errors in parentheses; \* $P<0.05$ .

between oxygen demand and oxygen delivery hence facilitating the development of ascites (Balog 2003). Ascites and emaciation were the major disease conditions responsible for condemnations of broilers accounting for 63.81% of all the condemnations. Slaughter related causes of rejection accounted for approximately 36% with cadavers taking the biggest share of 35.34%. These compared well with the findings of Njue (1997) who had earlier established that the major causes of broiler condemnation at a Poultry Processing plant in Kenya were for cadavers and ascites at 51.5% and 26.1% respectively. However, the study did not indicate the overall risk of condemnation.

DOAs refer to birds that die between the farm and the slaughter or the lairage just before slaughter and those culled during ante-mortem inspection. The prevalence in this study was 0.67% which translated to a relative prevalence of 35.34% of all poultry rejects. This compares well with other studies; 0.42% (Bayliss & Hinton 1990), 0.22% to 0.42% (Yogarathnam 1995), 0.24%, 0.67% and 0.52% for free range, vegetarian and standard birds respectively (Herenda & Jakel 1994). Pre-slaughter mortalities have welfare as well as economic implications as studies indicate that such birds would have been fit for human consumption in addition to the cost of treatment, feeds and even disposal (Vial *et al.* 2015). Factors associated with diminished broiler welfare hence mortalities have been studied and include feed and water withdrawal, long transit times, physical injury, flock health status, social disruptions, new environments, unfamiliar noises and motions, high ambient temperature and overcrowding (Bayliss & Hinton 1990; Warriss *et al.* 2005; Nijdam *et al.* 2004). The study revealed increased frequency of DOAs in all third quarters of the study period. This being the coldest quarter of the year (July, August and September) and the increased numbers of DOAs may reflect the effects of cold stress during the time of broiler harvest and transport. Additionally, increased transit times may play a part in causing mortalities as farms are scattered across four counties and the roads leading to the slaughterhouse have high traffic hence long transit times resulting in metabolic exhaustion of birds.

Pre-slaughter handling and transport of broilers are demanding operations that might compromise welfare (Vieira *et al.* 2011) and a high prevalence at the slaughterhouse indicates the need to create awareness as concerns welfare of birds for those involved in handling and transport of birds. It has been noted that more attention needs to be paid to the catching process so as to reduce the DOAs (Bayliss & Hinton 1990). The numbers could also be exacerbated by traumatic injuries or pre-existing disease conditions hence it has been suggested that careful handling of broilers at harvest can reduce pre-slaughter mortality (Nijdam *et al.* 2006).

A shortcoming of the data used was unavailability of records of partial condemnations hence the study was not able to establish prevalence of such conditions. Another shortcoming was susceptibility to bias and unreliability of the condemnation records. Although the findings have been quoted to the exact digit, the validity of the data is difficult to verify and bias may occur at the level of inspection, recording and data collection. The ability of

the inspector to correctly visualize and identify the pathological findings before recording without bias varies with individuals. The researcher's ability to read and record the condemnation information in a reproducible manner without bias also varies with individuals. Bias may arise from missing information, conflicting data and illegibility. Another source of bias that may compromise results is the occurrence of two pathological lesions in the same broiler but end up being placed in one of the groups.

Reducing transport times, feed and water withdrawal times, lairage times, catching and transporting at low ambient temperatures might help in reducing pre-slaughter mortality. It has been argued that a correct feeding plan before slaughter should be in place so as to put in consideration the duration on farm, in transit and at the lairage so as to reduce stress on birds (Pettracci *et al.* 2010). Environmental control at the lairage in the event of prolonged lairage times should also be implemented in case of extreme environmental temperatures.

Emaciation is the excessive loss of body condition with conspicuous visibility of bone structure. It was the third most important cause of condemnations in this study. Regression analysis of the data obtained in the study revealed a significant increase in the condemnation due to emaciation from 0.01% to 0.27%. Chronic disease, nutrition, parasites are some of the causes of emaciation. In broiler flocks, emaciation is a pointer of long standing disease conditions in the live birds which are influenced by the farm management practices (Ansong-Danquah 1987). Average risk of condemnation due to emaciation for the study period was 0.12% which was comparable to other studies; 0.11% (Jalinia & Movassagh 2011), 0.15% (Gholami *et al.* 2013), 0.09% (Santana *et al.* 2008). The risk was lower to what has been reported from Algeria in at 2.1% (Alloui *et al.* 2012), France at 0.3% (Lupo *et al.* 2008) and the United Kingdom at 0.2% (Haslam *et al.* 2008).

## Conclusion

From the results obtained in this study, ascites is the main cause of condemnation losses at the Nairobi slaughterhouse followed by DOAs and emaciation to a small extent. The general condemnation losses may be more than what the study has indicated since this poultry company under study has one of the best farm practises in the country, hence results may not reflect the true picture. Within the limits of the data collected from study, a number of conclusions could be drawn: That ascites is a major cause of poultry condemnations and the losses could be more at the farm level. Therefore, measures to reduce its prevalence such as farmer education on good management practices including the right stocking density and brooder management. Further research work is needed on proper feed formulation to cater for rapidly growing broilers. The possibility of breeding broilers that are less susceptible to ascites can also be explored. For DOAs, the catching procedure, transport and lairage times should be adjusted to cater for the welfare of the birds thus reduce losses. Emaciation has shown an increasing trend and the condition in broiler birds that are fed ad libitum maybe a sign of long standing disease. Hence diseases control and prevention measures such as vaccination, culling sick birds, deworming and

prophylactic treatment e.g. use of coccidiostats in feeds or water should be put in place to prevent suffering and loss of birds.

Meat inspection data remains a useful tool for evaluation of the broiler condemnation at slaughter therefore can be used to propose prevention measures. The study has provided information regarding the causes of condemnations in Kenya that can be used as baseline data for future comparisons as well as formulate hypotheses to be investigated further such as the study of the risk factors at farm level for broiler condemnations at slaughter.

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