

THE OCCURRENCE OF GASTRIC LESIONS IN SLAUGHTERED PIGS AT THE KUMASI ABATTOIR, GHANA

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ABSTRACT

Information on the occurrence of gastric lesions in pigs in Ghana is lacking in literature. This study was designed as a preliminary investigation to determine the occurrence and pattern of gastric lesion in pigs in Ghana. Ante-mortem animal assessment and post-slaughter stomach evaluation were conducted on 75 pigs out of a total of 694 slaughtered between October, 2014 and March, 2015 at the Kumasi abattoir. The gross lesions observed on the gastric mucosa were graded using standard technique. Stomach contents were assessed and tissue sections were used for histopathology evaluation. The data obtained were cross tabulated and analyzed using *Chi-square* and One-way ANOVA. Significance was determined at $p < 0.05$. The prevalence of gastric lesions in the sampled population was 25.3% while the non-glandular stomach (*pars oesophagea*) and glandular had a prevalence of 17.3% and 21.3% respectively. The predominant lesions observed were epithelial changes in the *pars oesophagea* and ulcers in glandular region of the stomach. Epithelial changes were restricted to the non-glandular region and it affected 8 (42.1%) of the stomachs with lesions. Erosions and ulceration were observed in the *pars oesophagea* and glandular stomach while mucosa damage was restricted to the glandular stomach. Lesions were observed in the two breeds studied and the stomach contents of the pigs were mostly finely grounded compounded feed, millet/maize chaff or cassava based feed. Histopathological evaluation of gastric mucosa tissues revealed erosion, multifocal ulcerations with occasional presence of silver staining micro-organisms. There was no significant association between breed, age, sex and occurrence of gastric lesions in pigs. Stomach content volume and feed type were identified as risk factors. Evidence of stomach infection with spirochetes was also observed. Our findings reveal the occurrence of gastric lesions in pigs in Ghana and its associated risk factors. It is therefore recommended that stake-holders should adopt on-farm and abattoir periodic monitoring of the condition as well as improved animal welfare and hygiene practices both on farm and in transit.

Keywords: Erosions, gastric lesions, occurrence, slaughtered pigs, ulcerations.

INTRODUCTION

Swine production is an integral part of rural economy in most parts of the world; approximately 1.3 billion pigs are produced each year worldwide (Seid and Abebaw, 2008). Pigs are raised primarily as sources of food (meat) and are a source of animal protein, which contains essential amino acids needed for human growth.

In Ghana, pig farming is an emerging livestock farming opportunity mostly active in the Greater Accra and Ashanti regions with population and production estimates of 536,000 pigs and 18,026 metric tons of pork respectively. Mostly, the Large white, Landrace and Ashanti Black are the breeds found in Ghana. In Accra, more than 300 pigs are slaughtered daily to supply the growing demand for pork products in Ghana (GNAPF, 2014). Pigs are susceptible to a number of disease conditions of which gastric lesions are of great importance.

The stomach of the pig is characterized by its great fragility, particularly in the *pars oesophagea* zone close to the cardiac region which increases its susceptibility to lesions (Omotosho *et al.*, 2015). Investigations have shown that gastric lesions including erosions and ulcerations are common conditions in pigs especially in growing pigs than breeding animals in Nigeria (Majekodunmi *et al.*, 2013). Gastric lesions in pigs include ulcerations, lacerations, erosions and epithelial changes. Age, sex, heredity, infection and parasitism, toxicity, trauma, nutrition and management have been reported to be some of the risk factors to the disease (Friendship, 1999; Monteiro, 2011 and Omotosho *et al.*, 2015).

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With the increasing number of reports by researchers on the disease from various regions of the world (Cattoli *et al.*, 1999; Monteiro, 2011), there is a need for an investigation to ascertain the occurrence of the gastric lesions in pigs in Ghana. This study therefore attempts to document the occurrence of the condition in slaughtered pigs at the Kumasi Abattoir with a focus on its prevalence and predisposing factors.

MATERIALS AND METHODS

Study area and sample size

The study was conducted at the biggest abattoir in Kumasi which serves most parts of Ashanti Region, a region known for active pig farming. A random sampling of pigs for stomach lesions was carried out at the pig section of the abattoir. Further examination of the affected stomachs was carried out at the Animal Science Department, Kwame Nkrumah University of Science and Technology. The sampling lasted for 5 months and a total of 75 stomachs from slaughtered pigs (73 Large White and 2 Ashanti Black) were randomly sampled from 694 pigs slaughtered within the period.

Sample size determination

The required sample size was determined with the International Fund for Agricultural Development (IFAD) sample size calculation tool:

$$n = \frac{t^2 \times p(1-p)}{m^2}$$

Where,

n = required sample size t = confidence level at 95% (standard value of 1.96)

p = estimated prevalence in the project area was estimated at 5% (0.05).

since there was no previous report on the condition in Ghana.

m = margin of error at 5% (standard value of 0.05).

$n = (1.96)^2(0.05)(0.95)/0.05^2$

n = 73.

The adequate sample size is 73 and in this study 75 stomachs were sampled.

Breed, sex and age determination

Records of the age of the pigs were obtained from the owners on presentation to the abattoir. Physical parameters which included the ear conformation, skin and bristle coloration and breeding history were used to differentiate between breeds. Examination of the external genitalia aided in sex differentiation into male, female and castrates. The castrates were exempted from the study.

Carcass examination

The stomachs were carefully harvested and cut open along the greater curvature. The volume, type and particle size of the stomach contents were recorded. The contents were removed and the mucosa surface was gently washed under flowing water to clean and preserve the stomach mucosa. The mucosa surface was carefully observed for gross lesion across the four regions. Tissue sections from lesions and normal portions of the stomachs were collected and fixed in 10% buffered formalin for histopathology.

Gastric lesion morphometry, histopathology and lesion scoring

The extent of gastric lesion was determined by gross examination of the stomachs. The lesions observed in the *pars oesophagea* and glandular stomach (*cardia*, *fundus* and *antrum*) were recorded. Twenty four (24) tissue sections were stained with H&E and Warthin-Starry silver stains.

Gastric lesions were noted by critical observation and scrutiny of individual stomachs. The most predominant gross lesion in each of the two regions of the stomach was used for the scoring. The occurrence of lesions was scored using previously described scoring technique (Omosho *et al.*, 2015). The scores are: 0 indicating no lesion; 1 indicating slight keratosis; 2 indicating severe keratosis and thickened epithelium; 3 indicating erosions; 4 indicating mucosa damage (lacerations, scars and puncture wounds); and 5 indicating ulceration. The summation of scores for each stomach was used to group the stomachs into Grade 1 (score 1–5), Grade 2 (score 6–10), Grade 3 (score 11–15), and Grade 4 (score 16–20).

Data obtained were presented as frequency counts and percentages. Variables and lesion grades were cross-tabulated and subjected to chi-square for test of association. Lesion scores in each stomach region was subjected to analysis of variance (ANOVA) and presented as mean \pm standard deviation. Significance was determined at $p < 0.05$.

RESULTS AND DISCUSSION

The prevalence of gastric lesions in this study was 25.3% as 19 out of the 75 stomachs had visible gross lesions. This included a prevalence of 17.3% (13) in the non-glandular stomach and 21.3% (16) in the glandular stomach (Table 1). Epithelial changes were restricted to the non-glandular region. Erosions and ulceration were observed in the *pars oesophagea* and glandular stomach while mucosa damage was restricted to the glandular stomach (Table 2). There was no significant association between age, sex and breed and the occurrence/grade of gastric lesions in the pigs (Table 3-5). There was a significant association between the volume of stomach content and gastric lesions in pigs (Table 6). There is also a significant correlation ($r = -0.42$) between stomach content volume and gastric lesions (Table 7). The Mean \pm SD of scores is higher in the stomachs with lower content volume (Table 8). The Mean \pm SD of lesions in stomachs with various stomach contents is presented in Table 9.

Table 1. Occurrence and distribution of gastric lesions in the non-glandular and glandular regions of the pig stomach from Kumasi Abattoir.

	Non-Glandular Stomach (NGS)	Glandular stomach (GS)			Total (GS)n (%)
	<i>Pars Oesophagea</i> n (%)	<i>Cardia</i> n (%)	<i>Fundus</i> n (%)	<i>Antrum</i> n (%)	
Lesion (+)	13 (17.3)	5 (6.7)	12 (16)	7 (9.3)	16 (21.3)
No lesion (-)	62 (82.7)	70 (93.3)	63 (84)	68 (90.7)	

* Lesions occurred in the non-glandular and glandular stomach region in some samples.

Table 2. Type and distribution of gastric lesions across the stomach regions in pigs from Kumasi Abattoir.

Lesion (Score)	Non-glandular stomach (NGS)	Glandular Stomach (GS)		
	<i>Pars Oesophagea</i>	<i>Cardia</i>	<i>Fundus</i>	<i>Antrum</i>
Slight Hyperkeratosis (1)	3	0	0	0
Severe Hyperkeratosis (2)	5	0	0	0
Erosion (3)	2	0	3	0
Mucosa Damage (4)	0	2	1	3
Ulcer (5)	3	3	8	4

Table 3. Association between age and occurrence/grade of gastric lesions in pigs from Kumasi Abattoir

Age (Years)	Grade of Lesions					Total	Pearson Chi-square value	P-value
	Non	1	2	3	4			
>1	28	4	3	1	2	38	14.75	0.256
1-2	16	2	2	2	0	22		
2-3	12	1	0	0	0	13		
3-4	0	1	1	0	0	2		

Table 4. Association between sex and occurrence/grade of gastric lesions in pigs from Kumasi Abattoir

Sex	Grade of Lesions					Total	Pearson Chi-square value	P-value
	Non	1	2	3	4			
Male	26	3	2	1	0	32	2.22	0.695
Female	30	5	4	2	2	43		

Table 5. Association between breed and occurrence/grade of gastric lesions in pigs from Kumasi Abattoir

Breed	Grade of Lesions					Total	Pearson Chi-square value	P-value
	Non	1	2	3	4			
Large white	55	7	6	3	2	73	2.23	0.680
Ashanti Black	1	1	0	0	0	2		
Total	56	8	6	3	2	75		

Table 6. Association between stomach content volume and occurrence/grade of gastric lesion in pigs from Kumasi Abattoir

Volume	Grade of Lesions					Total	Pearson Chi-square value	P-value
	Non	1	2	3	4			
Empty	2	1	1	2	2	8	35.656	0.000
Sparse	12	4	1	0	0	17		
Moderate	26	3	3	1	0	32		
Full	16	0	2	0	0	18		
Total	56	8	6	3	2	75		

Table 7. Correlation of stomach content volume with gastric lesion grade in pig stomachs

	Gastric lesion grade
Stomach content volume	-.419**

**Correlation is significant at the 0.01 level (2-tailed)

Table 8. Analysis of variance of the lesion scores (Mean ± SD) in different regions of the stomach with respect to volume of stomach content in pigs from Kumasi Abattoir

Volume	<i>Pars oesophagea</i>	<i>Cardia</i>	<i>Fundus</i>	<i>Antrum</i>
Empty	2.75 ± 2.12	2.63 ± 2.26	2.88 ± 2.47	1.63 ± 2.26
Sparse	0.18 ± 0.73	0.29 ± 1.21	0.67 ± 1.50	1.24 ± 0.97
Moderate	0.19 ± 0.47	0.00 ± 0.00	0.31 ± 1.23	0.47 ± 1.48
Full	0.11 ± 0.47	0.278 ± 1.18	0.50 ± 1.47	0.00 ± 0.00
Total	1.44 ± 1.15	1.31 ± 1.16	1.71 ± 1.67	1.43 ± 1.35

Table 9. Analysis of variance of the lesion scores (Mean ± SD) in different regions of the stomach based on various feed types in the stomach of pigs from Kumasi Abattoir

Feed	<i>Pars oesophagea</i>	<i>Cardia</i>	<i>Fundus</i>	<i>Antrum</i>
Compounded feed	0.52 ± 1.27	0.13 ± 1.31	1.17 ± 2.06	0.17 ± 0.83
Millet/Maize Chaff	0.16 ± 0.89	0.16 ± 0.90	0.26 ± 1.03	0.16 ± 0.89
Cassava	0.15 ± 0.38	0.38 ± 1.39	1.38 ± 1.39	0.69 ± 1.70
Total	1.28 ± 0.98	1.28 ± 1.14	1.60 ± 1.56	1.27 ± 1.08

Foreign bodies were observed in the stomach content of some of the pigs which included polythene bags, bristles, metals and stones. Histology revealed the accumulation of silver staining spiral organism suspected to be *Helicobacter species* in the mucosa lining of 29.2% (7) of the 24 samples processed.

This study documents for the first time the occurrence and pathological features of gastric lesions in pigs in Ghana. Gastric lesions were observed across all the four gland-type regions of the stomach with varied pattern of

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occurrence with the most frequently encountered gastric lesion in this investigation being gastric ulcerations characterized by area of acid-peptic digestion. This lesion was more frequently encountered in the fundus which is in contrast to previous reports (Amory *et al.*, 2006; Appino *et al.*, 2006) of more ulceration in the *pars oesophagea* in pigs. This unusual occurrence may be connected with the occurrence of certain risk factors (Omotosho *et al.*, 2015) that are peculiar to this tropical environment and some adopted husbandry practices by farmers which increases stress during production. Other lesions encountered included epithelial changes in the non-glandular (*pars oesophagea*) region of the stomach, erosions and mucosa damage due mostly to traumatic injuries.

Evaluation of the age of pigs presented for slaughter at the abattoir reveal that many of the pigs were below one year of age and some were affected with gastric lesions. Although age was not associated with the occurrence of gastric lesions in this study, the presence of this pathology at this critical growing phase of pigs may be a source of reduced growth and production output as it has been established that gastric lesions, in addition to being a cause of anaemia and sudden mortality in pigs also causes reduces growth rate (Dirkzwager *et al.*, 1998; Eisemann *et al.*, 2002). There was no association between sex and gastric lesions occurrence in the studied pigs but both sexes were affected. Many previous studies also found no significant association between these variables (Elbers *et al.*, 1995; Guise *et al.*, 1997; Robertson *et al.*, 2002).

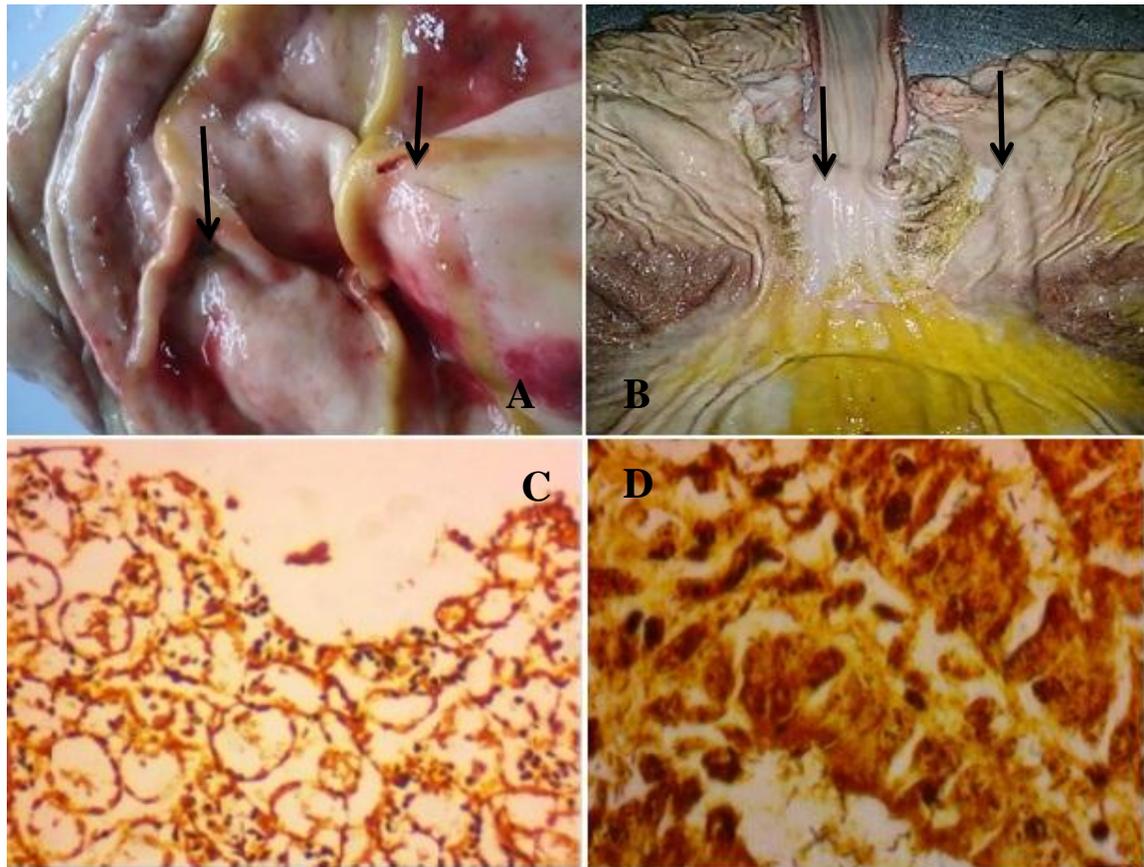


Figure 1. A- Ulcers in the glandular region of the pig stomach (*Fundus*). B- Epithelial changes (Keratinosis) in the Non-glandular region (*pars oesophagea*) of the pig stomach. C- Thinned surface mucosa, atrophy of mucous neck and parietal cells. Few micro-erosions on mucosa. D- Gastric pit and neck cell hyperplasia with few infiltrates in propia (lymphocytes, macrophages). Micro-erosions on mucosa. Squamous metaplasia and mucous & GALT hyperplasia in *cardia*.

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There is a significant association between stomach content volume and gastric lesions. Analysis of scores reveal that stomachs that was empty or with sparse stomach content had a higher lesion score. Variations were also observed in the type of feed ingested. Compounded feed products with fine particle sizes were observed in some of the stomachs with lesions. Earlier report by Lawrence *et al.* (1998) observed finely ground diets were associated with an increased prevalence of gastric lesions compared to those fed with coarsely ground diets. Bubenik *et al.* (1998) also reported that coarsely ground diets have a gastro-protective effect, which stimulates the production of melatonin in the stomach tissues which reduces incidence of gastric lesions in pigs. From this study, stomach content volume is observed to be associated with the incidence of gastric lesions in pigs while particle size and content type are previously established predisposing factors.

Foreign materials such as nails and bristles were occasionally encountered in the gastric contents. The process of feed mixing in the fundus in the presence of these materials may predispose to wearing off of mucous membrane of the stomach with subsequent exposure of the walls of the fundus to gastric juice. This further emphasizes the importance of hygiene in swine feed production.

Both breeds sampled during this investigation were affected with gastric lesions but breed influence could not be ascertained as more Large White than Ashanti Black were presented at the abattoir and sampled. However the role of genetics in the pathogenesis of this condition should be further investigated in indigenous and foreign breeds of pigs in Ghana. The findings at histology show the presence of silver staining spiral organism suspected to be *Helicobacter species*. Further studies on detection and characterization of the organism is needed to determine the circulation of *Helicobacter species* in the pig population.

CONCLUSION

This study shows for the first time the occurrence of gastric lesions as an important disease condition of pigs in Ghana with a prevalence of 25.3%. Stomach content volume and type are associated variables. The presence of nails, polythene sheets and bristles in diets suggestive of poor husbandry practices and stress may be important contributory factors to gastric lesions in pigs as previously reported (Omotosho *et al.*, 2015). To reduce the incidence of gastric lesions, proper management and the use of gastro-protective feeding with a focus of consideration of feed hygiene, right particle size, overall feed quality and quantity is advocated.

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