Gross and Histo-morphometrical study on Large Intestine of Native and Sonali Chicken of Bangladesh

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Gross and Histo-morphometrical study on Large Intestine of Native and Sonali Chicken of Bangladesh

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ABSTRACT

This study compares the large intestines of Native and Sonali chickens grown in Bangladesh, looking at anatomical and histological differences. Six hens were inspected: three Sonali at three months and three Native at four months. The Sonali and Native chickens differed in their cecum and colorectal measurements the dimensions of the cecum and colorectal varied between the Sonali and Native chickens, with Native chickens having bigger colorectal diameters (2.5 cm) than Sonali chickens (1.8 cm), and Sonali chickens having longer cecum lengths (15.2 cm) compared to Natives (13.6 cm). These findings advance knowledge of the intestinal anatomy of chickens and its differences from broilers. In comparison to Native chickens (229 mm mucosal length and 211 mm tunica muscularis), Sonali chickens have shorter mucosal lengths (159 mm) but longer tunica muscularis (290 mm). This implies that native hens may benefit from a nutrient advantage. Furthermore, Native chickens appear to have a stronger immune system than Sonali hens, which could increase their resistance to gastrointestinal illnesses. Additionally, unique histological traits in the intestinal mucosa suggest dietary and environmental changes, underscoring the possibility of increased nutrient absorption capability in Sonali hens.

CHAPTER 1

INTRODUCTION

Sonali is a hybrid between Rhode Island Red (RIR) cock and Fayoumi hen chicken (*Gallus domesticus*). In terms of both appearance and flavor, it resembles the common, nondescript chickens known as Native (meaning indigenous) in the area. It was implemented in Bangladesh's northern regions between 1996 and 2000, providing millions of rural women with new economic opportunities (FAO, 2015; Mitchell, 2015). According to a recent survey, consumption of Sonali chicken increased by up to 45% in July 2019 compared to its 20% consumption in July 2018 (Hasan, 2019). A great number of authors have evaluated the health of the chicken industry in Bangladesh and emphasized the ways that it has widened access to high-quality protein, boosted food security, and generated employment.

The Bangladesh Poultry Industries Central Committee (BPICC) estimates that the total investment in Bangladesh's poultry industry is around Tk. 3500 million and that it has provided employment opportunities for over 6 million people. By 2021, this number is expected to rise to 10 million, with many of these workers being unemployed women and young people (Mahmud, 2020; Seleque & Ansery, 2020). Free-range chickens play a significant role in providing high-quality meat and eggs to rural communities. The body needs animal protein, which may be found in foods like eggs and chicken meat. These foods also contribute to better public health.

The large intestine of chickens is made up of the cecum, a short, straight rectum connected to the ileum, and the cloaca. Each cecum consists of three parts: the proximal or base, the middle or body, and the distal or apex (Hirosh et al., 1998). There are two ceca, one on each side, that are elongated blind sacs. The short proximal part has a small lumen and a wall that is relatively thick; the lengthy middle part has a wall that is wider and shorter; and the short distal part extends to the designated end. Compared to other bowel sections, the caecum wall is thinner and contains lymphatic tissue primarily in the basal region that forms the cecal tonsil (Kajiwara et al., 2003). The cecum may perform a variety of functions, including nutrient absorption, the breakdown of small food particles, the

production of immunoglobulin and antibodies, the action of both beneficial and harmful microorganisms, the utilization and absorption of water, and the conversion of uric acids into amino acids.

CHAPTER 2

MATERIALS AND METHOD

With a focus on age, weight, and morphological characteristics, the purpose of this research study was to examine the histological and gross differences in the large intestines of Sonali and Native chickens. Six hens were chosen for this task: three of the Sonali breed at three months old and three of the Native breeds at four months old. The poultry came from Pahartoli Bazar. The digestive systems were removed and dissected after compassionate killing for gross and histological studies. The age of the birds was noted for the gross study to take into consideration any potential age-related changes. Another metric that was recorded was the birds' weight. In addition to being measured and evaluated visually, the cecum and colorectum were also measured. These measurements gave us important information for comprehending the anatomical and morphological variations in the large intestines of the two breeds of chicken. Small pieces of the cecum and colorectum were removed from each bird for the histology component of the investigation. Then, for a full 24 hours, these tissue samples were carefully maintained in Blouin's solution. Blouin's fluid fixation procedure is crucial for preserving the tissues' structural integrity in histology. The fixed samples were put through a succession of alcohol-based dehydration processes, commencing at 70% and increasing the alcohol content to 80%, 90%, 95%, and finally 100%. The samples were cleaned with xylene, which helped clear away any remaining alcohol and rendered the tissues visible. To make the sectioning process easier, the tissue samples were dried and cleaned before being embedded in paraffin blocks. These were neatly sliced into thin portions of about 5 micrometers in thickness.

These sections were then put onto glass slides so they could be examined histologically. The cecum and colorectum samples were stained using hematoxylin and eosin (H&E), a common staining method in histology, to improve the contrast and visibility of numerous cellular features. The histological investigation phase started with the dyed tissue slices on glass slides. The cecum and colorectum in both Sonali and Native chicken samples were thoroughly studied, and many characteristics were compared using microscopic examination through LASEZ version 3.4.0. This extensive histological examination sought to pinpoint any

distinguishing traits, structural changes, or cellular variations between the two breeds of chicken in order to shed light on the potential causes of the considerable intestinal variations that were identified.

CHAPTER 3

RESULT & DISCUSSION

Gross difference in large intestine between Sonali and Native chicken

In this study, we focused on the age, weight, and morphological characteristics of the cecum and colorectum of two unique chicken breeds, Native and Sonali. The average length and diameter of the cecum and colorectum for both groups of chickens are shown in Table 1.

The cecum length ranged from 13.5 to 13.9 cm, with an average of 13.6 cm, and the diameter ranged from 2.0 to 2.8 cm, with an average of 2.4 cm, for the native chickens (Samples 1, 2, and 3). The colorectal length ranged from 6.0 to 6.8 cm, with an average of 6.4 cm, and its average diameter was 2.5 cm. Notably, these Native chickens were 120 days old and weighed 850 g, 758 g, and 900 g, respectively. The measurements of the cecum and colorectum were different in the Sonali hens (Samples 4, 5, and 6). The cecum length ranged from 13.0 to 17.0 cm, with an average of 15.2cm. The average cecum diameter was 2.1 cm. The diameter of the colorectum ranged from 1.5 to 1.9 cm, with an average of 1.8 cm, while its length ranged from 6.0 to 7.5 cm, with a median of 6.6 cm. Notably, these Sonali hens were 90 days old and weighed about 1000 g on average.

In our research, we found that the Deshi and Sonali hens' ceca measured 13.6 cm and 15.2 cm, respectively. In contrast, the cecum length of broiler chickens is 18.125 cm (Nasrin et al., 2012). According to our research, Deshi and Sonali chickens have lower cecum lengths than broilers do.

Furthermore, it is disclosed that the colorecta of the Deshi and Sonali hens measured 6.4 and 6.6 cm in length, respectively. The study conducted by Nasrin et al. reported a broiler's colorectum length of 8.8 cm. Thus, the colorectum lengths of both Deshi and Sonali chickens are significantly shorter than those of broilers.

Sample	Cecum		Colorectum	
	Length(cm)	Diameter(cm)	Length(cm)	Diameter(cm)
1	13.5	2.5	6	2.8
2	13.5	2	6.5	1.9
3	13.9	2.8	6.8	2.9
Average	**13.6**	**2.4**	**6.4**	**2.5**
4	13	2	6.5	2
5	15.5	2.5	6	1.5
6	17	1.8	7.5	1.9
Average	**15.2**	**2.1**	**6.6**	**1.8**

Table1: Length and diameter of large intestine of Native and Sonali chicken

Histological difference in large intestines between Sonali and Native chickens

Cecum

Significant conclusions emerged from our study's comparison of the gastrointestinal characteristics of Sonali and native chickens. Sonali chickens had average mucosal lengths of 159µ, which was much less than native chickens' average mucosal lengths of 229µ. In our study, no distinct muscularis mucosa was found in the mucosa of the cecum. In the citation of Batt (1925), there is well-developed muscularis mucosa, but in the citation of Looper and Looper (1929), it was said that there is an absence of muscularis mucosa in many birds, which resembles our study result. Sonali chickens had tunica muscularis that averaged 290µ in length as opposed to 211µ in native chicken. The difference in the lengths of the tunica muscularis and mucosa may reflect different methods of digestion. Native chickens might be better at absorbing nutrients because of their longer mucosal lining, while Sonali hens might be better at mechanical digestion because of their longer tunica muscularis. Furthermore, there was a higher concentration of goblet and plasma cells in the mucosal layer of native hens, suggesting a stronger immune and defensive response. This characteristic might strengthen their defenses against gastrointestinal illnesses.

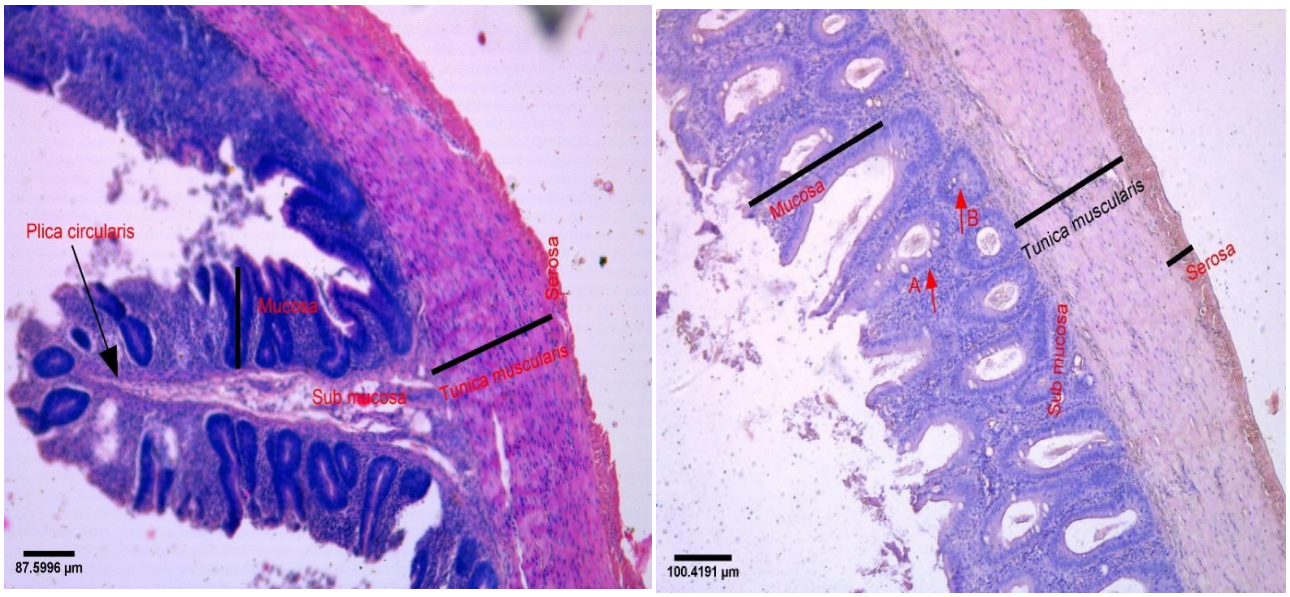


Fig 1 & 2: Histology of Cecum at Sonali (Fig 1) & Native (Fig 2) Chicken. Here, A & B stands for goblet cell & plasma cell

Colorectum

The colonic mucosa of Native and Sonali chickens has distinct histological characteristics. Sonali chickens have villi that are longer (525.49µ) and broader (121µ) than Native chickens, who have villi that are shorter (444.45µ) and narrower (68.85 mm). Sonali chickens have mucosal folds that are thicker (733.5µ) than Native chickens (666.125µ). These variants probably represent various dietary and environmental adaptations. The longer and wider villi of Sonali hens point to improved nutrient absorption capacity, which may be appropriate for dietary needs or resource availability (Guyton et al., 2008). The submucosa is poorly developed and largely invisible (Greschik et al., 1913), which is like this study. Native chickens may have evolved with diverse adaptations in the meantime. All things considered, these histological variations in the intestinal mucosa show how these chicken breeds have evolved special gut structures to enhance nutrition absorption and adapt to various ecological situations.

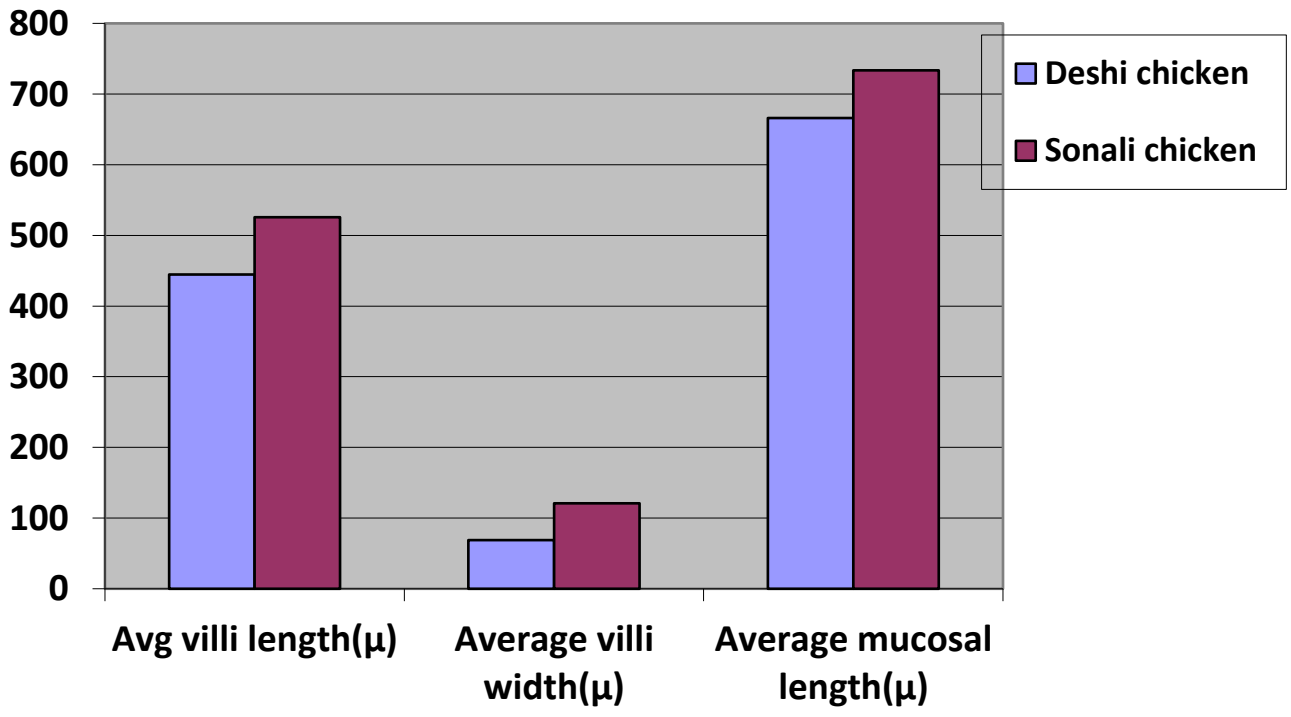
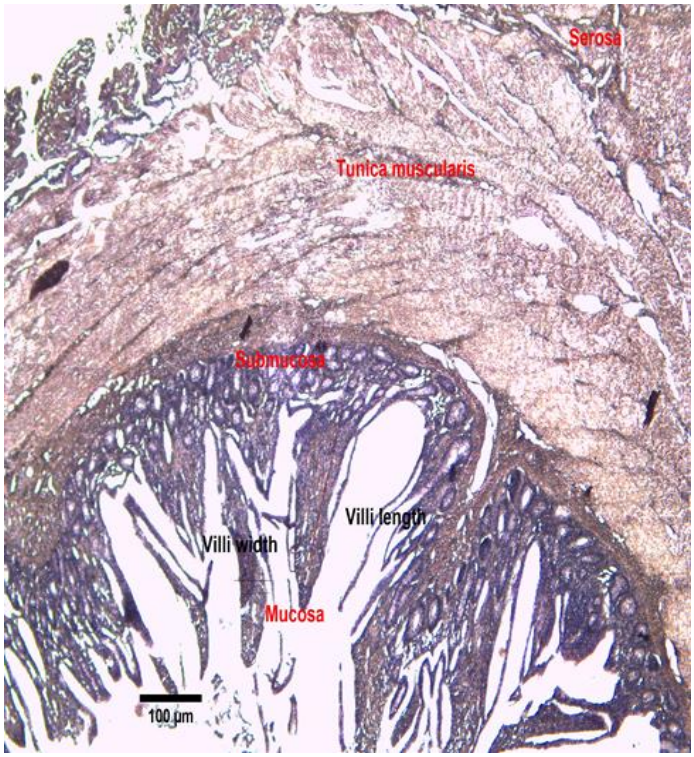


Fig 3: Histological difference of Colorectum between Sonali and Native chicken. Here Native chicken shown as Deshi chicken.



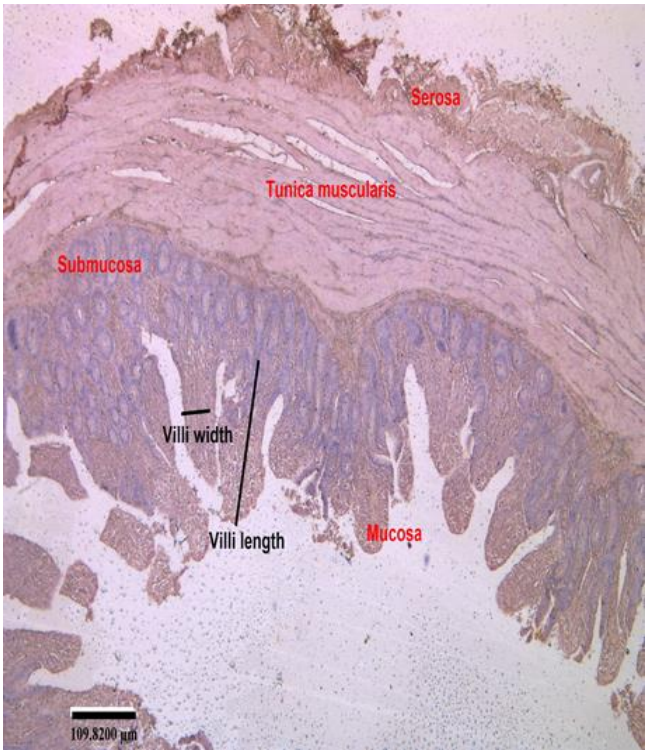


Fig 3 & 4: Histological difference of colorectum between Native (Fig 3) and Sonali (Fig 4) chicken

CHAPTER 4

CONCLUSION

In conclusion, when compared to Native and Sonali hens' digestive systems, they show intriguing differences. The lengths of the cecum and colorectum are noticeably reduced in these local breeds, which may indicate a specialization for effective nutrition absorption. Deshi hens may be better at absorbing nutrients due to their expanded mucosal lining, making them suitable for regions with low nutrition availability. On the other side, sonali hens have longer tunica muscularis, which suggests improved mechanical digestion. Additionally, the increased number of goblet and plasma cells found in the mucosal layer of native hens suggests a more active immune response, which may increase resistance to gastrointestinal illnesses. The Sonali hens' longer and wider villi highlight their improved potential for nutritional absorption, which may be useful in environments with erratic food resources. The flexibility and potential benefits of native chicken breeds in various agricultural and ecological situations are highlighted by these findings. Clarifying how these special digestive characteristics can be used for sustainable poultry production and increased food security will require more research.

CHAPTER 5

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