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Research Article

Effect of age on the quality of slaughterhouse by-products of indigenous cattle at Fulbaria, Mymensingh

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Abstract

Indigenous cattle are integral to rural livelihoods, food security, and the agricultural economy of Bangladesh, yet systematic data on the influence of age on slaughterhouse by-products remain scarce. The present study was conducted at Fulbaria, Mymensingh district, Bangladesh, to investigate the effects of age on slaughterhouse by-products of indigenous cattle. Live weight, warm carcass weight, and dressing percentage were recorded across five age groups: T0 = 0 permanent incisors (< 2 years), T1 = one pair permanent incisor (2 years), T2 = two pairs permanent incisors (2 years 6 months), T3 = three pairs permanent incisors (3 years) and T4 = four pairs permanent incisors (3.5–4 years). The results showed that the oldest age group, T4 (3.5–4 years), had significantly higher live weight, carcass weight, dressing percentage, and weights of most edible and inedible by-products compared to the younger groups. Specifically, T4 exhibited the highest values for head, heart, brain, skin, intestine, and blood. Lung weights were significantly greater in all groups except the youngest (T0), while liver and eye weights showed no significant differences across ages. Kidney weight was highest in T1 but lower in older groups, and tongue weight peaked in T1 with variable values in others. Teeth weight was significantly higher in T2, and hoof weight was greatest in T3. Market survey data revealed high economic returns from liver, heart, and kidney, emphasizing their contribution to carcass value. These findings suggest that optimizing slaughter age and promoting by-product utilization could enhance economic efficiency, reduce waste, and improve protein availability in Bangladesh. Overall, these findings indicate that male indigenous cattle aged 3.5 to 4 years (T4) offer the most favorable yield of meat by-products, although some specific by-products reach maximum weight at intermediate ages.

Introduction

Indigenous cattle play a vital role in sustaining rural livelihoods and ensuring national food security in Bangladesh. In addition to contributing to household nutrition, they provide draft power, support biodiversity conservation, and preserve local genetic resources (FAO, 2021). The livestock sector is one of the four main agricultural sub-sectors in Bangladesh and remains economically significant, contributing substantially to agricultural GDP and rural incomes (DLS, 2022). Annual meat production is approximately 0.687 million metric tons, of which beef accounts for 0.191 million metric tons (FAOSTAT, 2019).

Cattle and their by-products are important sources of high-quality protein, essential micronutrients, and raw materials for various industries (Islam et al., 2021; Liza et al., 2024). Everything from the abattoir or normal butcher's shop that is not sold directly as food can be considered as slaughterhouse by-products (Ali et al., 2013; Hossain et al., 2025). The by-products from slaughterhouses are usually classified into two sections such as edible by-products and inedible by-products. Several examples of edible byproducts are heart, liver, lungs, kidney, pancreas, thymus, spleen and edible fat, and inedible by-products consist of inedible raw bone, feet, hooves, horns, bile, blood and inedible fat (Aberle et al., 2001; Kawsar et al., 2006). Edible by products including liver, heart, kidneys, and edible fat may constitute up to 40% of carcass weight (Irshad and Sharma, 2015) and are rich in proteins, essential amino acids, minerals, vitamins, and bioactive compounds (Mullen et al., 2017; Alvarez et al., 2018; Torun et al., 2023; Tushar et al., 2023). However, their utilization is often limited due to cultural preferences, dietary habits, and lack of awareness (Fayemi et al., 2018). In developed countries, organ meat consumption is minimal, but promoting their nutritional benefits and gastronomic potential could improve acceptance and reduce waste (Sabbagh et al., 2023; Llauger et al., 2021).

Meat and byproducts are nutritionally valuable, but their production contributes to environmental challenges such as greenhouse gas emissions and biodiversity loss (Lafarga and Hayes, 2014; Llauger et al., 2021). Optimal utilization of slaughter byproducts can improve economic efficiency, reduce environmental impacts, and help address protein deficiencies in developing countries (Ayroe et al., 2016). In order for the livestock industry to remain economically competitive with vegetable protein sources, the economics of the global meat industry necessitate the utilization of animal by-products (Irshad and Sharma, 2015). Biological factors, particularly age and sex, are key determinants of carcass traits and byproduct quality. Age influences carcass maturity, carcass yield, edible body parts and meat offal's and proximate composition in beef cattle (Ali et al., 2013).

In Bangladesh, slaughterhouse practices are often unhygienic due to inadequate enforcement of the Animal Slaughter and Meat Quality Control Act (2011). Municipal slaughterhouses frequently lack veterinary inspection, and animals of various ages and health conditions, including immature and aged stock are slaughtered. This variability makes it important to understand how biological factors influence by-product quality. It is crucial to be aware of the age of the animals available for purchase, as age has been observed to influence the yield of carcasses, consumable body parts, and meat offal in beef cattle (Hossain et al., 2021; Islam et al., 2021).

Despite the significant nutritional and economic value of by-products, research on the influence of age on their quality in indigenous cattle is scarce. Existing food composition databases, such as FAO's GLEAM (FAO, 2021) and USDA Nutrient Database (USDA, 2011), provide limited or outdated information and rarely address biological variation. Therefore, the present study aims to evaluate the effect of age on the yield and quality of slaughterhouse by-products as well as to know the price and uses of edible by-products of indigenous cattle from indigenous cattle in Bangladesh, with the goal of improving utilization strategies, economic returns, and environmental sustainability.

Materials and Methods

The study was conducted in various markets and slaughterhouses including Baruka Bazar, Fulbaria Bazar, Asim Bazar, Taltola Bazar in Fulbaria, Mymensingh, Bangladesh. A total of 25 butchers, engaged in selling beef and by-products directly to consumers, were randomly selected from different markets. This selection was made to obtain representative data and fulfill the objectives of the study. Data collection was carried out over a period of four months, from March to August 2020. Information and samples were obtained through direct interviews with butchers and by making frequent personal visits to the slaughterhouses. The survey method was chosen as the primary approach due to its suitability for collecting both quantitative and qualitative information under time and resource constraints.

All types of data were collected from approximately 5 male animals in each age group. Age classification was determined by dentition following the method of and divided into five treatment groups (Table 1).

Table 1: Carcasses are divided into five groups according to estimated age of animal based on dentition

Treatment groups	Age
T_0	0 permanent incisors (less than 2 years old)
T_1	One pair of permanent incisors (2 years old)
T_2	Two pairs of permanent incisors (2 years 6 months old)
T_3	Three pairs of permanent incisors (3 years old)
T_4	Four pairs of permanent incisors (3.5 to 4 years old)

Live weight was measured using Schaeffer's formula: $W = \frac{(L \times G2)}{300}\ pound$

Where, W = weight, L = body length (inch) and G = heart girth (inch)
Warm and the chilled carcass weight and individual by-products were recorded using a digital weighing machine. Dressing percentage was calculated as:

$$Dressing\ percentage\ (DP\%) = \frac{Chilled\ carcass\ weight}{Live\ wt.\ of\ the\ animal} \times 100$$

The yield of each by-product was calculated as:

$$By - product\ yield\ (\%) = \frac{Weight\ of\ individual\ by - product}{Live\ wt.\ of\ the\ animal} \times 100$$

Market prices of major edible by-products (liver, heart, kidney, lungs, and brain) were also recorded.

Statistical Analysis

Data were analyzed using the MSTAT-C statistical software following a Completely Randomized Design (CRD) in one-way ANOVA. Mean differences were considered significant at $P < 0.05$ and $P < 0.01$. Results are presented as means ± standard deviation (SD).

Result and Discussion

Live Weight, Warm Carcass Weight, and Dressing Percentage

Live weight, warm carcass weight and dressing percentage of slaughtered indigenous cattle on the basis of age group are given in Table 2. The parameters differed significantly (p<0.01) among age groups of indigenous cattle. The mean live weight increased steadily from 161.98 ± 23.59 kg in the youngest group (T0; < 2 years) to 314.22 ± 37.36 kg in the oldest group (T4; 3.5–4 years). Warm carcass weight followed the same progressive trend as live weight, showing significant differences (p<0.01) among age groups. It rose from 73.43 ± 12.69 kg (T0) to 166.64 ± 33.45 kg (T4). Dressing percentage also improved with age, rising in animals from 45.19% (T0) to 52.58% (T4). These results align with the findings of Robertson et al. (2001) and Yagoub and Babiker (2008), who also reported that carcass weight increases with age. Similarly, Billah et al. (2021) showed the experimental effect of age on quantity of slaughterhouse by products of indigenous sheep and found that live weight, warm carcass weight and dressing percentage increased with the advancement of age. Moreover, Hossain et al. (2023) demonstrated that, significant enhancement of warm carcass weight and dressing percentage of Black Bengal goats with increase of age. Rao et al. (2009) observed a gradual increase in the slaughter weight of non-descript buffaloes as their age increased, regardless of their sex. According to Agnihotri (1992), buffaloes require approximately two years to attain a live weight of 200 kg. The increase in carcass weight with age is attributable to enhanced muscle deposition and fat accumulation, and the meat quality was also studied by several researchers (Hossain et al., 2022a, 2022b and 2023; Irshad et al., 2012).

Litwińczuk et al. (2006) discovered that the carcass conformation class and dressing percentage improved in association with an increase in the slaughter weight of heifers and bulls. The improvement with age is likely the result of a reduction in the relative gastrointestinal content, an increase in fat cover, and a greater muscle-to-bone ratio. Kondaiah et al. (1983) noted higher dressing yields in older animals as a result of improved carcass composition. The carcass output of 15 male and 30 female buffaloes of various breeds from two separate locations of India were examined. Both male and female buffaloes had slaughter weights of 410.57±104.92 kg and 470.18±72.74 kg, with carcass yields of 41.58% and 43.06% respectively (Borghese, 2005), implies positive correlation between slaughter weight and dressing percentage. According to Sanudo et al. (1997), higher carcass weight indicates more muscle and fat accumulation, which means greater dimensions carcass and all of its components. Overall, the progressive increases in live weight, warm carcass weight, and dressing percentage with advancing age, in indigenous cattle, underscore the influence of growth, muscle deposition, and body composition on carcass yield and market value.

Edible and Inedible By-Products

Weights of edible by-products (liver, heart, kidney, and lungs) differed significantly ($p<0.01$) among age groups (Table 2). In animals, head weight increased from 6.93 ± 1.12 kg (T0) to 15.58 ± 0.94 kg (T4), reflecting skeletal and muscular growth. Heart weight rose from 0.74 ± 0.15 kg (T0) to 1.68 ± 0.26 kg (T4), consistent with the cardiovascular demands of a larger body. Brain weight increased with age, while liver weight did not differ significantly ($p>0.05$), suggesting early stabilization of liver growth. Kidney weight varied significantly without a consistent trend, possibly due to individual variation. Lung weight peaked in intermediate-aged cattle (T2), likely reflecting developmental changes in respiratory capacity. Similar findings were in

According to Billah et al. (2021) weight of heart, kidney, lung, liver and skin were significantly ($P<0.01$) increasing with the increase of age.

Inedible by-products (skin, intestine, hoof, blood, etc.) also showed significant ($p<0.01$) increases with age (Table 2). In treatment groups, skin weight rose from 18.83 ± 1.93 kg (T0) to 31.42 ± 1.43 kg (T4), while intestine weight increased from 39.80 ± 6.03 kg (T0) to 61.33 ± 2.71 kg (T4). Blood yield doubled from 13.07 ± 1.80 kg (T0) to 24.95 ± 2.62 kg (T4), reflecting greater total blood volume in larger animals. This is in agreement with the results obtained by Kondaiah et al. (1983) in young and spent buffaloes. Salem et al. (1983) observed that weight of the head; hide and feet increased with age. Head and skin yields were notably higher in older cattle, as also reported by Hossain et al. (2002).

Percentage of By-Products Relative to Live Weight

When expressed as a percentage of live weight (Table 3), liver contributed the highest proportion among edible by-products (1.04%–4.28%), and skin contributed the highest among inedible by-products (9.99%–12.11%). The proportion of intestines (19.51%–24.57%) was notably high in younger cattle, likely due to the relatively larger digestive tract at early growth stages. Rahaman (2001) carried out an experiment to determine the various by-products of cattle on live weight. Based on estimated live weight, the biggest percentage of inedible by-products is hides, and the highest percentage of edible by-products is liver aligns with (Hossain et al., 2002).

The weight of edible and inedible byproducts significantly affects the live weight of cattle from various age groups (Terry et al., 1990). The result also shows that there is a positive correlation between live weight and weight of edible and inedible by-products of animals which increased with the advancement of age and this is consistent with the findings of Hasan et al. (2004).

Market Value and Utilization

Liver, heart, and kidney commanded the highest market prices (BDT 500–650/kg), driven by demand for human consumption and research (Table 4). In some cases, liver was priced higher than prime meat cuts. Lungs fetched lower prices (BDT 350–450/kg) and were used for both human consumption and pet feed. Brain (BDT 550–600/kg) was usually sold with the head. The economic significance of by-products highlights their contribution to carcass value beyond meat yield, supporting efficient utilization in slaughterhouse operations. The presence of such high-value by-products can enhance carcass value, supporting Aberle et al. (2001) statement that full utilization of by-products increases profitability.

Table 2: Live weight, warm carcass weight and dressing percentage and weight of different by-products (edible and inedible) in different age group of indigenous cattle (n=25)

Parameters	T0 (%)	T1 (%)	T2 (%)	T3 (%)	T4 (%)	P-value	Level of significance	Mean± SD
Live weight (kg)	161.98±23.59^{d}	206.56±11.65^{c}	222.72±6.83b^{c}	248.78±19.30^{b}	314.22±37.36^{a}	0.01	**	230.85±25.17
Carcass weight (kg)	73.43±12.69	93.92±7.42c^{d}	106.30±3.20b^{c}	121.24±11.24^{b}	166.64±33.45^{a}	0.01	**	112.3±15.68
Dressing (%)	45.19±2.15^{b}	45.40±1.31^{b}	47.76±1.23^{b}	48.32±2.91^{b}	52.58±4.09^{a}	0.01	**	47.85±1.33
Head(kg)	6.93±1.12^{d}	9.61±1.26^{c}	10.60±0.88^{bc}	12.18±2.69^{b}	15.58±0.94^{a}	0.01	**	10.98±1.43
Liver(kg)	2.77±0.40	3.09±0.11	3.14±0.20	3.01±0.37	3.30±0.24	0.085	NS	3.06±0.09
Heart(kg)	0.74±0.15^{b}	0.89±0.04^{b}	0.88±0.08^{b}	0.95±0.22^{b}	1.68±0.26^{a}	0.01	**	1.03±0.17
Kidney(kg)	0.70±0.13^{ab}	0.82±0.04^{a}	0.56±0.09^{b}	0.70±0.17^{ab}	0.54±0.18^{b}	0.01	**	0.66±0.05
Lungs(kg)	1.29±0.26^{b}	1.8d4±0.19^{a}	2.13±0.15^{a}	1.91±0.42^{a}	1.87±0.34^{a}	0.01	**	1.81±0.14
Brain(kg)	0.48±0.05^{cd}	0.60±0.07^{bc}	0.45±0.09^{d}	0.62±0.12^{b}	0.82±0.12^{a}	0.01	**	0.59±0.07
Skin(kg)	18.83±1.93^{c}	25.04±1.39^{b}	24.87±2.59^{b}	28.40±5.58^{ab}	31.42±1.43^{a}	0.01	**	25.71±2.10
Intestine(kg)	39.80±6.03^{d}	49.01±0.67^{c}	50.58±1.67^{bc}	54.94±4.13^{b}	61.33±2.71^{a}	0.01	**	51.13±3.55
Tongue(kg)	1.25±0.23b^{c}	1.71±0.07^{a}	1.11±0.12^{c}	1.26±0.15^{bc}	1.37±0.12^{b}	0.01	**	1.34±0.10
Eye(kg)	0.17±0.02	0.18±0.01	0.18±0.01	0.20±0.06	0.22±0.03	0.119	NS	0.19±0.01
Teeth(kg)	1.09±0.49^{d}	2.10±0.32^{b}	2.63±0.12^{a}	1.65±0.27^{c}	2.06±0.20^{b}	0.01	**	1.91±0.26
Hoof(kg)	1.19±0.15^{d}	2.01±0.36^{b}	1.60±0.08^{c}	2.41±0.40^{a}	2.29±0.27a^{b}	0.01	**	1.90±0.23
Blood(kg)	13.07±1.80^{d}	15.64±0.95^{c}	17.81±0.56b^{c}	19.90±1.55^{b}	24.95±2.62^{a}	0.01	**	18.27±2.02

T0= 0 permanent incisors (less than 2 years old) T1 = One pair permanent incisor (2 years old), T2= Two pair permanent incisors (2 years 6 months old), T3 = Three pair permanent incisors (3 Years old), T4 = Four pair permanent incisors (3.5 years to 4 years old) ** = Significant at 1% level of probability, NS = Not significant. Means with different superscripts within the raw are significantly different ($p<0.01$)

Table 3: Percentage of different by-products (edible and inedible) relative to live weight in different age group of indigenous cattle (n=25)

Parameters	T0 (%)	T1 (%)	T2 (%)	T3 (%)	T4 (%)
Dressing percentage	45.19	45.40	47.75	48.32	52.65
Head	4.28	4.64	4.75	4.88	4.98
Liver	4.28	1.49	1.38	1.20	1.04
Heart	0.45	0.42	0.35	0.38	0.53
Kidney	0.43	0.39	0.25	0.27	0.17
Lungs	0.79	1.34	0.95	0.76	0.59
Brain	0.29	0.29	0.19	0.24	0.26
Skin	11.62	12.11	11.15	11.23	9.99
Intestine	24.57	23.71	22.60	22.04	19.51
Tongue	0.77	0.82	0.49	0.50	0.43
Eye	0.10	0.08	0.08	0.24	0.07
Teeth	0.80	1.01	1.01	0.65	0.65
Hoof	0.73	0.97	0.71	0.96	0.72
Blood	8.06	7.56	7.99	7.98	7.94

T0= 0 permanent incisors (less than 2 years old) T1 = One pair permanent incisor (2 years old), T2= Two pair permanent incisors (2 years 6 months old), T3 = Three pair permanent incisors (3 Years old), T4 = Four pair permanent incisors (3.5 years to 4 years old)

Table 4: Price of most edible by-products

By-products	Price BDT/Kg	Uses
Liver	600-650	Liver is consumed by humans. Additionally, it is used to feed pets like dogs and for research purposes. Sometimes the price of liver is higher.
Heart	600-650	It is consumed by humans. It is employed for research purposes as well. It is typically sold with meat.
Kidney	500-600	It is used for human consumption. Furthermore, it is used for research purposes. Generally, it is sold with meat.
Lungs	350-450	It is consumed by humans. It is also utilized as animal feed for pets. It is typically sold for less than by-products from slaughterhouses.
Brain	550-600	The brain is consumed by humans. It is used for research purposes as well. It is occasionally sold with a head.

Conclusion

The study clearly demonstrates that age significantly influences live weight, carcass weight, dressing percentage, and most slaughterhouse by-products in indigenous cattle. Cattle aged 3.5 to 4 years (T4) exhibited the highest overall meat yield and by-product weights, indicating this as the optimal age for slaughter to maximize production efficiency. While most by-products increased with age, a few peaked at intermediate ages, suggesting targeted utilization strategies could enhance economic returns. These findings provide valuable insights for farmers and processors to optimize slaughter timing and improve resource use in Bangladesh's indigenous cattle industry.

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