Exploring the impact of Halal and Jhatka slaughter on welfare, meat quality and proteomic changes in slow growing broiler chicken

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I. INTRODUCTION

Slaughtering is a critical step in the meat production process that affects animal welfare and meat quality. Different slaughter techniques may exert varying level of stress and impacts post-mortem muscle metabolism affecting meat quality. Current study explores the impact of two ritual slaughter techniques like halal and jhatka that are normally performed without any stunning prior to bleeding. Various stress parameters influencing welfare and meat quality were assessed in slow growing broilers.

II. MATERIALS AND METHODS

A total of 75 slow-growing broiler chickens (50-day-old males, Plymouth Rock x Red Cornish breeds, multi-coloured) were divided into three experimental groups (Jhatka slaughtered [JS], Halal slaughtered [HS], and slaughter with electrical stunning [ES]) in a completely randomised design. The experiment was replicated on five different occasions with 5 birds in each group (n=25). In JS and HS groups, birds were traditionally slaughtered without any stunning. After slaughter, blood and meat samples were collected and analysed for stress-indicating markers, including blood biochemical, enzymatic, and hormonal changes, meat quality and proteomic analysis. Statistical analysis using a two-way ANOVA was performed with OriginPro software to evaluate the impact of the three slaughter methods during post-mortem storage at 1, 4, 8, 12, and 24 h, considering repeated measures for welfare and meat quality and proteomics analysis. Least-square means were determined for significant F tests ($P<0.05$) and differentiated using least significant differences.

III. RESULTS AND DISCUSSION

The lactate dehydrogenase (LDH) level was markedly elevated ($P<0.05$) in ES group, whereas higher ($P<0.05$) levels of cortisol and triiodothyronine (T3) and lower ($P<0.05$) concentration of creatine kinase were observed in JS and HS birds, respectively. The LDH and CK were reported extensively as indicators of stress and their increased concentration in plasma reflect changes in tissue function or sign of cell injury [1]. The blood glucose level, creatinine, total protein, alanine aminotransferase (ALT), aspartate aminotransferase (AST), and thyroxine (T4) were found to be non-significant ($P>0.05$) between the groups. Bleeding efficiency was lowest in ES relative to JS and HS groups. Halal slaughter presented the maximum bleeding compared to others, which might be due to the incidence of ventricular fibrillation and arrest of the heart function during application of electric shock (stunning) [3]. The stress induced in ES and JS may cause vasoconstriction limiting the blood flow compared to halal (non-stunned) birds [4].

Higher ($P<0.05$) pH was observed in JS meat, whereas higher *a** value and WHC was found in ES samples. Higher WHC might be due to the net charge effect [5]. Similar results were reported for electrically stunned and non-stunned chicken breast samples [6]. The shear force values were higher ($P<0.05$) in the HS samples; however, no difference was observed for TBARS, cooking loss %, and MFI % between the groups. The 2-dimensional gel electrophoresis (2-DE) (Fig. 1) coupled to MALDI-TOF MS of meat samples has identified a total of 94 protein spots, out of which 14, 10, and 42 spots exhibited significant differences ($P<0.05$) in normalized volume, intensity, and area, between HS, JS and ES samples, respectively. Proteins demonstrating positive correlation with stress, namely Glyceraldehyde-3-phosphate dehydrogenase (GAPDH), and L-lactate dehydrogenase (LDH)-A chain were overabundant in JS broilers (Fig. 1). These proteins operate synergistically to modulate anti-stress capabilities, respond to heat stress, regulate metabolic and inflammatory responses, manage stress responses, and control energy metabolism [7] as evident by bioinformatics and string analysis (Fig 2).

Table 1. Blood biochemical and physio-chemical properties of breast muscle of broiler chickens with different slaughter techniques

	JS	HS	ES	RSE	P-value
Blood biochemical parameters					
Glucose (mg/dl)	244[a]	239[a]	212[a]	0.670	0.096
Creatinine (mg/dl)	0.35[a]	0.40[a]	0.40[a]	0.732	0.125
Total protein (g/dl)	4.95[a]	5.25[a]	4.25[a]	0.808	0.115
Lactate dehydrogenase (LDH) (U/L)	766[ab]	596[b]	863[a]	0.880	<0.05
Creatine kinase (CK) (U/L)	4144[a]	1601[b]	6063[a]	0.847	<0.01
Aspartate Transferase (AST) (IU/L)	240[a]	219[a]	208[a]	0.764	0.302
Alanine aminotransferase (ALT) (IU/L)	18.6[a]	21.6[a]	13.7[a]	0.833	0.15
Cortisol (µg/dl)	0.21[a]	0.15[b]	0.14[b]	0.521	<0.01
Triiodothyronine (T3) (ng/dl)	2.10[a]	1.50[c]	1.88[b]	0.868	<.0.001
Thyroxine (T4) (µg/dl)	3.45[a]	3.56[a]	3.43[a]	0.923	0.315
Meat quality parameters					
Bleeding efficiency (%)	3.61[b]	4.52[a]	2.74[c]	0.812	<0.05
WHC (%)	32.1 [b]	30.8[c]	35.0[a]	0.660	<0.001
TBARS	0.04[a]	0.04[a]	0.04[a]	0.863	0.949
Cooked pH	6.28[a]	6.08[b]	5.94[b]	0.539	<0.01
Cooking loss (%)	29.2[a]	30.7[a]	30.3[a]	0.862	0.269
Shear force (N)	14.8[b]	19.3[a]	15.5[b]	0.859	<0.001
MFI (%)	28.4[a]	28.5[a]	28.6[a]	0.860	0.989

[a–c] Means without a common superscript were determined to be significantly different between slaughter methods. JS- jhatka slaughter; HS – halal slaughter; ES – electrical stunning; RSE – residual standard error

Figure 1. Representative 2DE gel and MS spectra (GP3 & LDH) of Jhatka slaughtered chicken

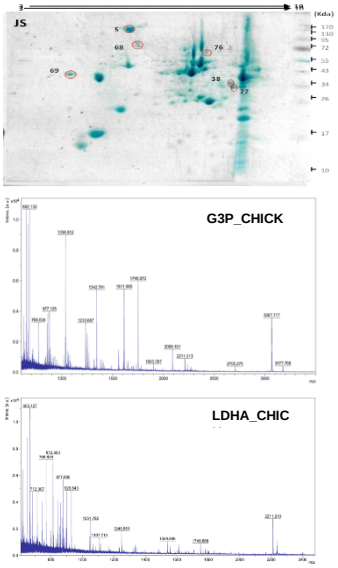

Figure 2. String analysis

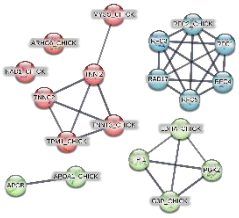

Table 2. Differential abundance in *Pectoralis major* muscles of jhatka slaughtered (JS) slow-growing broiler chickens identified through MALDI-TOF/MS analysis.

Spot ID[a]	Proteins	Accession no.	Spot ratio[b]
38	Glyceraldehyde-3-phosphate dehydrogenase	G3P_CHICK	4.21
77	L-lactate dehydrogenase A chain	LDHA_CHICK	3.13

IV. CONCLUSION

Current findings explore the impact of different slaughter techniques on meat quality as well as animal welfare. By comprehending the changes that occur during the slaughter process, producers can make well-informed decisions about ways to enhance meat production and animal welfare standards.

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