



Effect of Exposure to Slaughter Ambient on Behavioral and Carcass Parameters in Goats

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Received: 10 Feb., 2025

Revised: 10 March, 2025

Accepted: 15 March, 2025

ABSTRACT

The present study was undertaken to assess the effect of exposure to slaughter ambient on various behavioural and carcass parameters in goats. A total of 18 bucks (Boer cross, 8-12 months of age, 24-28 kg live weight) were divided into 3 groups (n=6) viz., C- goats slaughtered alone, E - goats exposed to slaughter ambient by witnessing the slaughter of goat from S group, S- goats slaughtered in front of E groups. The goats were Halal slaughtered, and various behavioural parameters (vocalization, escape behaviour, turning backwards, and urination), blood loss, time to death, and carcass shrinkage were assessed. The exposure to slaughter ambient in goats affected the behavioural responses, with medium-grade responses for vocalization and avoidance behaviour in 50% of goats. The exposure to slaughter ambient in goats did not significantly affect the time to death, bleed-out percentage, and carcass shrinkage percentage. Thus, the present study highlighted the issue of animal welfare and emotional stress induced by exposure to slaughter ambient in goats as indicated by behavioural responses.

HIGHLIGHTS

- Exposure to slaughter ambient affected behavioural parameters in goats.
- Exposure to slaughter ambient not significantly affected the carcass parameters.

Keywords: Behavioral response, Goats, Slaughter ambient, Welfare

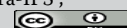
Slaughterhouses have several stressors that potentially cause stress responses and impair animal welfare status. The novelty of the environment, mixing of unfamiliar animals, changes in the social hierarchy, movements of humans and vehicles, noise, microclimatic conditions, odor, and semiochemicals from blood and other animal products are some important determinants of the stress in animals during their stay at the slaughterhouse (Grandin,

2014, 2020). In addition, the rough handling of animals by inappropriate and excessive use of electrical prods, and physical mishandling of animals during various

How to cite this article: Kumar, P., Abubakar, A.A., Ahmed, M.A., Hayat, M.N., Rahman, Md M., Abdul, M., Adamu, G., Ajat, M., Kaka, U., Goh, Y-M. and Sazili, A.Q. (2025). Effect of Exposure to Slaughter Ambient on Behavioral and Carcass Parameters in Goats. *J. Anim. Res.*, 15(02): 67-73.

Source of Support: Universiti Putra Malaysia Geran Putra-IPS ;

Conflict of Interest: None





preslaughter operations further aggravate stress. They could cause muscle injuries, skin bruises, blemishes, and bone fractures. These factors lead to gross violations of animal welfare principles (Kumar *et al.*, 2022a; b).

There are several reports of rough handling of animals during slaughtering throughout the world (Alam *et al.*, 2020; Gallo *et al.*, 2018; Kumar *et al.*, 2024 a,b). During the slaughter process, especially in ritual slaughter and slaughter of animals in groups, the animals are exposed to slaughter ambient. The various semiochemicals released from the blood, urine, vocalization of animals, movements of sharp equipment, unfamiliar animals, objects, and persons, as well as noise, cause stress in animals, which affects their welfare and meat quality (Rahman and Aidaros, 2012). With the increasing concerns among people for the treatment meted out to animals during the whole production chain and consumer preference for meat produced by following the proper animal welfare practices, the issue of mitigating preslaughter stress is paramount for the meat industry (Kumar *et al.*, 2022c; Mathur *et al.*, 2021; Xing *et al.*, 2019).

Goat proves an ideal small ruminant due to their disease resistance, ability to thrive, and production under scarce resources and harsh climatic conditions and distribution worldwide. Due to their less neophobic and exploratory nature, goats are more prone to stress. Thus, the present study was undertaken to assess the effect of exposure to slaughter ambient on various behavioural responses and carcass parameters in goats. The outcome of the present study would be beneficial for improving animal welfare during slaughter by minimizing preslaughter stress.

MATERIALS AND METHODS

Ethical approval

The Institutional Animals Care and Use Committee of Universiti Putra Malaysia approved the present study with approval No.: UPM/IACUC/AUP-R003/2022, dated 27 May 2022.

Animals

A total of 18 bucks (Boer cross, 8-12 months of age, 24-28 kg live weight) were purchased from Global Field

Trading, Jalan 9/6, Seksyen 9, 43650 Bandar Baru, Bangi, Malaysia and housed at small ruminant housing facility at the Institute of Tropical Agriculture and Food Security in Universiti Putra Malaysia (latitude 2°59'06.5" N and longitude 101°43'40.7" E) for 2 weeks for acclimatization. During their stay, bucks were dewormed and fed twice daily (morning-chopped fresh Napier grass and evening pellets) and *ad libitum* potable water. Various physiological parameters (feeding pattern, breathing, rectal temperature, heart rate, and gait) were closely observed and recorded on the animal monitoring sheet (Kumar *et al.*, 2024b). Before the start of the experiment, the healthy bucks were road transported in a covered lorry (capacity 1.5 tons) to the research slaughterhouse of the Department of Animal Science, Faculty of Agriculture, UPM (258059.000" N; 10144006.400" E) in the evening hours (3.30-4.30 pm) covering 2.0 km within 30 - 40 mins (in loading, transit, and unloading). The bucks were rested overnight in the lairage with the provision of *ad libitum* water.

Experimental design

To replicate the practice of slaughter during religious sacrifice in developing countries, the goats were exposed to the slaughter environment through their auditory, olfactory, and visual senses. The distance between the goat visualizing the slaughter process and the slaughtered goat was kept at the same (approx. 2 m) throughout the study (Kumar *et al.*, 2023a). The goats were divided into three groups viz., C group: Control group where a goat was slaughtered alone, without the presence of any other goats; E group: Goats exposed to the slaughter environment by witnessing the slaughter of one goat from the S group; S group: Goats slaughtered in front of one E-group goat. The goats were Halal slaughtered by transverse severance of the carotid arteries and jugular veins by the trained slaughterman following the standard protocols outlined in the MS 1500:2009 (Department of Standards Malaysia, 2009).

Recording of behavioral responses

The behavior responses of goats during exposure to slaughter ambient were recorded digitally through video recording using close-circuit television cameras (Reolink Ltd, Wan Chai, Hong Kong Island) by two technical staff members with vast experience in goat handling and

animal welfare (Kumar *et al.*, 2024b). The behavioural observation included escape behaviour (avoiding stressors or situations), frequency and intensity/ pitch of vocalization, and involuntary urination, as per Table 1.

Measurement of time to death

The determination of state of death in the present study was determined by carefully observing the signs of the absence of life. The death during slaughter was confirmed by the absence of pupillary and corneal reflexes, flaccid tongue, absence of breathing, and fully dilated pupils as per Malaysian Protocol for the Halal Meat and Poultry Production, Department of Islamic Development, Malaysia (MS 1500:2009).

Estimation of blood loss

The live weights of goats were noted before slaughter. The following formula calculated the amount of blood loss:

$$\text{Blood loss (\%)} = (\text{weight of carcass after bleeding} / \text{live weight}) \times 100$$

Determination of carcass shrinkage

The shrinkage (%) was calculated by measuring the hot carcass weight immediately after slaughter. The carcasses were hung in the cold storage and reweighed after 24 h. The reduction in the carcass weight due to the evaporation of moisture from the carcass was noted, and shrinkage (%) was calculated as:

$$\text{Shrinkage (\%)} = [(\text{hot carcass weight} - \text{cold carcass weight}) / \text{hot carcass weight}] \times 100$$

Statistical analysis

The data generated in the study were tested for normal distribution using a Shapiro–Wilk test using SPSS Statistics Version 20 software (IBM Corporation, New York, USA). The mean values of various parameters during exposure to slaughter ambient were compared with Duncan's multiple-range test (DMRT) through a One-way Analysis of Variance (ANOVA, n=6). The p-value of less than 0.05 was considered statistically significant.

Table 1: Scale for the measurement of behavioural responses

Responses	Observations	Scale	Grading
Vocalization	Numbers of bleats and their pitch during handling	0	Absence of vocalization, goat remain calm
		1	Low grade (1-4 bleats)
		2	Medium grade (5-8 bleats)
		3	Intense grade (continuous bleating)
Escape behavior	Try to escape the handler while moving from lairage to slaughter point	0	No attempt to escape the handler
		1	Low grade (Escape behavior at the initial stage of handling only)
		2	Medium grade (Trying to escape the handler in intervals throughout the handling)
		3	Intense grade (Continuous resisting and trying to escape the handler)
Turning backward	Goat turns around or moves backwards as a reaction to the handling	0	Absence of response
		1	Low grade (Slightly move away to handler)
		2	Medium grade (Turning backward or moving backward movement in goats)
		3	Intense grade (Fast and rapid turning around and moving backward movement)
Urination	Involuntary urination	Positive (+ ve)	Presence of urination
		Negative (- ve)	Absence of urination

RESULTS AND DISCUSSION

Behavioural parameters

The exposure to slaughter ambient in goats affected the behavioural parameters. The vocalization and avoidance behaviour were present in 50% of goats upon exposure to slaughter ambient (Table 2). The vocalization intensity was a medium score (scored 2). The avoidance behaviour was of medium grade (scored 2). The vocalization could be due to the stress caused by visualizing the slaughtering of conspecific, the separation of the goat from the group, and the novelty of the environment. Urination behaviour was absent in all goats observed. As for stress responses and stress reactivity in animals, multivariant and overall responses depend upon the complex interactions of the stress intensity and duration with genetic and managemental factors. The goats with previous exposure to negative enrichment had more exciting reactions (Miranda-de la Lama *et al.*, 2013).

The various stressors in the slaughterhouse activate the SPA and HPA systems, releasing catecholamines and cortisol. Under the influences of hormones, animals increase the energy production needed for fight-or-flight response (Tilbrook and Ralph, 2018). This is manifested in the form of various behavioural responses. Changes in the emotional state of goats cause a change in the behavioural, physiological, cognitive, and subjective components (Lerner and Keltner, 2001). This emotional stress due to the exposure to slaughter ambient resulted in changing the behavioural responses in the goats. Vocalization in the goats during pre-slaughter handling is an important indicator of the welfare status of goats

with higher intensity correlated with the signs of fear and distress (Siebert *et al.*, 2011). Similarly, Kumar *et al.* (2024b) observed various behavioural responses, such as vocalization, turning backwards, escape behaviour and urination, during the preslaughter handling of goats by untrained and contact-trained handlers. As in the present study, emotional stress is of very short duration (4-6 min) in the context of slaughter, with varying degrees of intensities or threat levels.

Time to death

The time to death is crucial in animal welfare during the slaughtering of animals. In the present study, the time to death did not show significant ($p>0.05$) differences (Table 3). The time to death was observed to be the longest for goats that were exposed to slaughter ambient. The Control goats were recorded to take the shortest time to death. A shorter duration from the neck cut to death is desirable for reducing the pain, stress, and fear during slaughter. In addition, the quality of the time is also crucial during slaughter (Fuseini *et al.*, 2016). In the present study, the act of slaughter was performed by a trained and certified slaughterman on all goats to minimize individual variations. The knife was properly sharpened before slaughter cut to reduce pain and stress (Kumar *et al.*, 2023b). Thus, stressed goats have taken a longer duration to the onset of death as compared to calm animals. Grandin also reported similar observations (Grandin, 2006).

In addition, in the case of slaughter without stunning, the time to reach the stage of unconsciousness and quality of death is more important than the time to reach unconsciousness and death. The time to death is not of

Table 2: Effect of exposure to slaughter ambient on behavioral parameters in goats

Parameters	Control		S		E	
	Frequency*	Scale**	Frequency*	Scale**	Frequency*	Scale**
Vocalization	—	—	—	—	50%	2
Turning backward	—	—	—	—	100%	1
Escape behavior	—	—	—	—	100%	2
Urination	—	—	—	—	—	0

*Frequency- number of animals showed the behavioral responses under handling stressors, **Scale for vocalization, turning backward, and escape behaviour: 0 -absence of response, 1- mild response, 2- medium response, 3-intense response, Scale for urination: - as absent + as present. Control- goat slaughtered alone, S- goats slaughtered in front of E, E- goats slaughtered after exposure to slaughter ambient.

Table 3: Effect of exposure to slaughter ambient on time to death, carcass shrink and blood loss in goats

Parameters	Control	S	E	P value
Time to death (min)	3.21±0.03	3.25±0.03	3.35±0.05	0.532
Carcass shrink (%)	3.84±0.52	3.97±0.28	5.03±0.43	0.128
Blood loss (%)	4.73±0.87	3.51±0.31	3.44±0.38	0.239

*Values are mean ±standard error with different superscripts small letters a, b, c--within a row-wise differ significantly ($p < 0.05$), Control-goat slaughtered alone, S- goats slaughtered in front of E, E- goats slaughtered after exposure to slaughter ambient, n=6, level of significance $p < 0.05$.

much importance if the animal is expiring calmly without showing signs of stress. However, time to death becomes relevant if animals struggle during the slaughtering process (Regenstein, 2017). Further, emphasis should be placed on good slaughtering practices, as improperly done slaughter may jeopardize animal welfare (Regenstein, 2017). Further, the time to lose consciousness and the onset of death varies between individual animals and species (Velarde and Dalmau, 2018) and is determined by several factors, such as the quality and sharpness of the knife (Kumar *et al.*, 2023b), the effectiveness of clean cut and position of cut (Gibson *et al.*, 2015), position of animal (Imlan *et al.*, 2021), and flow of blood (Sazili *et al.*, 2023).

Blood loss

The bleed-out percentage of all goats studied in the study was observed to have comparable ($p > 0.05$) values; however, the Control goats recorded higher bleed-out, and E goats were recorded with the lowest value (Table 3). This lowest bleed-out could be due to psychological stress caused due to the exposure to slaughter ambient. A proper bleed-out of the carcass is important as blood is not consumed under Halal slaughter, and a rapid bleed-out is preferred as it causes early loss of consciousness and onset of death by depriving oxygenated blood to the brain (Sazili *et al.*, 2023). The bleeding is affected by several factors such as size and patency of the sticking wound, dressing procedure/ cut to allow free flow of blood, muscle contraction, carcass orientation, and duration of bleeding (Gregory, 2005). The comparable non-significant blood loss values in the present study could be due to the similar slaughter procedure performed by the same trained and expert slaughterman. In general, when the animal is bled properly, about 75-85% of the total volume of blood

(approx 4% of body weight) is lost during slaughter when the heart is still beating (Farouk *et al.*, 2014).

Carcass shrinkage

Carcass shrink affects the carcass yield and economics of the production (Table 3). The shrink (%) in the present study was recorded as comparable ($p > 0.05$) among all three groups, but the E group exhibited the highest shrinkage percentage among all samples. The stress levels in the animals before slaughter have an impact on the shrinkage. The higher carcass shrink in stressed animals could be due to higher physiological activities leading to higher temperatures of carcasses and other changes related to higher anaerobic glycolysis. Grandin also reported higher live and carcass shrink in cattle upon improper and rough handling (Grandin, 1980).

CONCLUSION

Based on the present study, it can be concluded that exposure to slaughter ambient affected behavioural responses, carcass, and blood biochemical factors. The present study highlighted the issue of animal welfare and emotional stress in goats upon exposure to slaughter ambient. However, there is a need to conduct a study on exposure to slaughter ambient and its effect on various behavioural, carcass and blood biochemical parameters in goats with a higher sample size to get more insights into this aspect.

ACKNOWLEDGMENTS

The authors would like to acknowledge the Geran Putra-IPS (Vote No.: 9737800) funded by the Universiti Putra Malaysia (UPM) for Project No.: GP-IPS/2022/9737800 as the financial grant for the research work.



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