

International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
 ISSN Online: 2617-4707
 NAAS Rating (2026): 5.29
 IJABR 2026; 10(2): 874-877
www.biochemjournal.com
 Received: 08-12-2025
 Accepted: 13-01-2026

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Influence of preslaughter transport distance on live weight Shrinkage in broiler birds

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DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i2k.7748>

Abstract

Preslaughter handling practices, particularly transport and holding conditions, play a crucial role in determining live weight shrinkage in broiler birds, thereby influencing economic losses along the broiler meat supply chain. The present study was conducted to evaluate the effect of preslaughter transport distance on shrinkage loss in live broiler chickens and to assess hourly live weight loss during holding at retail broiler meat shops. Market age broiler birds were transported over three distance categories, namely less than 50 km, 50-100 km, and more than 100 km, under routine commercial conditions. Live body weights were recorded before loading and immediately after unloading to determine shrinkage loss due to transport. Additionally, hourly live bird weight loss was recorded during holding at retail shops from 4:00 am to 10:00 am. Results indicated that preslaughter transport distance significantly influenced shrinkage loss ($p \leq 0.05$). Birds transported over less than 50 km exhibited significantly lower shrinkage loss ($1.13 \pm 0.12\%$) compared to those transported over 50-100 km ($1.89 \pm 0.12\%$) and more than 100 km ($1.88 \pm 0.08\%$). However, shrinkage loss did not differ significantly between the two longer transport distances. During holding at retail broiler meat shops, live bird weight loss showed a gradual numerical decline over time; however, differences among holding hours were not statistically significant ($p > 0.05$). The findings demonstrate that preslaughter transport distance is a critical factor contributing to live weight shrinkage in broiler birds, while short-term holding under retail conditions exerts a limited influence on hourly live bird weight loss. These results highlight the importance of optimizing preslaughter transport practices to minimize shrinkage losses in the broiler meat supply chain.

Keywords: Preslaughter transport, transport distance, shrinkage loss, live weight loss, broiler chickens, retail holding

Introduction

According to the annual report of the Department of Animal Husbandry and Dairying (2022-23), poultry meat accounted for 51.14 percent of the total meat production in the country, which stood at 9.77 million tonnes. Broiler meat production, estimated at around 5 million tonnes annually, is presently experiencing a steady growth rate of 4.95 percent per annum (BAHS, 2024). The broiler meat industry plays a vital role in meeting the growing demand for affordable animal protein, and minimizing quantitative losses along the production and marketing chain is essential for sustaining profitability and supply stability. Prakash and Prabakaran (2020a) [6] estimated a mean live shrinkage loss of 4.47 percent during broiler transportation and extrapolated this loss to national poultry meat production levels, indicating an annual economic loss of approximately ₹2,905 crores to the Indian poultry meat industry. Among the various factors contributing to pre-harvest losses, preslaughter handling practices such as feed withdrawal, catching, transportation, and holding at retail outlets have been recognized as major determinants of live weight shrinkage in broiler birds. Zhang *et al.* (2009) [11] reported that prolonged transportation led to glycogen depletion, alterations in muscle fibre characteristics and increased glycolytic activity, whereas the provision of adequate recovery periods after transport helped restore metabolic balance and reduce corticosterone levels, thereby improving meat quality attribute. Shrinkage loss, defined as the reduction in live body weight between farm and slaughter, directly translates into economic losses for producers, traders, and retailers.

Preslaughter transport is an unavoidable component of the broiler meat supply chain and exposes birds to multiple stressors, including handling, crate confinement, vibration, thermal stress, and prolonged feed and water deprivation. Wabeck (1972) ^[10] reported weight loss in broilers subjected to feed and water deprivation and observed that body shrinkage increased from 1.29 percent after four hours to 4.93 percent after 24 hours without access to feed and water. These stressors stimulate physiological responses that enhance water loss through respiration, defecation, and evaporation, leading to measurable reductions in live body weight. Previous studies have demonstrated that the magnitude of shrinkage loss is closely associated with transport duration and distance, with longer journeys generally resulting in higher live weight losses. However, the extent of shrinkage may plateau beyond certain transport distances due to physiological adaptation or depletion of readily mobilizable body reserves.

In addition to transport-related losses, holding of live birds at retail broiler meat shops prior to slaughter further contributes to shrinkage due to continued fasting and environmental exposure. Under typical retail conditions, birds are often held without access to feed and water for several hours, particularly during early morning marketing periods. Although such short-term holding is common in commercial practice, information on hourly live weight loss patterns during retail holding is limited, especially under field conditions in developing poultry markets.

In the Indian context, where live bird marketing predominates and transport distances from farms to retail outlets are highly variable, systematic data on preslaughter shrinkage losses remain scarce. Petracci *et al.* (2001) ^[5] observed that broilers exposed to a higher ambient temperature of 34 °C exhibited the greatest live weight loss (5.7 percent) compared to birds maintained at 29.5 °C (3.9 percent) and 25 °C (3.2 percent). They further reported that birds subjected to 34 °C showed markedly lower carcass yields after processing when expressed on the basis of original body weight. Understanding the relative contribution of transport distance and holding duration to live weight shrinkage is critical for identifying intervention points to reduce avoidable losses in the broiler meat supply chain.

Therefore, the present study was undertaken to evaluate the effect of preslaughter transport distance on shrinkage loss in live broiler birds and to assess hourly live bird weight loss during holding at retail broiler meat shops. The findings of this study are expected to provide practical insights for optimizing preslaughter management practices aimed at minimizing quantitative losses in broiler production and marketing systems.

Materials and Methods

Experimental birds and study design

The present study was conducted to evaluate shrinkage loss in live broiler birds during preslaughter transport over varying distances and subsequent holding at retail broiler meat shops. Commercial broiler chickens of uniform market age (5-6 weeks) and comparable live body weight were procured from integrated poultry farms following standard management and feeding practices. Birds were selected randomly to minimize bias and ensure uniformity across treatments.

The experiment was designed to assess the effect of preslaughter transport distance on live weight shrinkage. Transport distances were categorized into three groups: less than 50 km, 50-100 km, and more than 100 km. Each transport category comprised an equal number of birds, and all handling procedures were carried out under prevailing commercial conditions to reflect real-field scenarios.

Preslaughter transport conditions

Birds were transported in standard commercial plastic poultry crates commonly used in the region. Stocking density within crates was maintained uniformly across all transport distance groups in accordance with prevailing commercial practices. Transport was carried out using covered vehicles to protect birds from direct environmental exposure. No feed or water was provided to the birds during transport, simulating routine preslaughter feed withdrawal practices.

Transport duration varied according to distance categories, while other factors such as crate type, loading density, and handling practices were kept constant to the extent possible. Ambient temperature and relative humidity during transport were recorded to account for environmental influences on shrinkage loss.

Measurement of shrinkage loss during transport

Individual live body weights of broiler birds were recorded immediately before loading at the farm using a calibrated digital weighing balance. Upon arrival at the destination retail broiler meat shops, birds were reweighed immediately after unloading. Shrinkage loss during transport was calculated as the difference between pre-transport and post-transport live body weights and expressed as a percentage of initial live weight using the following formula:

$$\text{Shrinkage loss (\%)} = \frac{\text{Pre-transport weight} - \text{Post-transport weight}}{\text{Pre-transport weight}} \times 100$$

Holding of birds at retail broiler meat shops

After transport, birds were held under typical retail broiler meat shop conditions prior to slaughter. Birds were kept in holding crates without access to feed and water, reflecting standard retail practices. Holding conditions, including ambient temperature and ventilation, were monitored throughout the holding period.

Hourly live weight loss during holding

To assess live weight loss during holding, individual bird weights were recorded at hourly intervals from 4:00 am to 10:00 am. Weighing was performed using the same calibrated digital balance to ensure consistency. Care was taken to minimize handling stress during repeated measurements. Hourly weight loss was calculated by subtracting the live weight recorded at the beginning of each hour from the subsequent hourly weight and was expressed in both absolute terms (g) and as a percentage of live weight.

Statistical analysis

Data obtained on shrinkage loss during transport and hourly live weight loss during holding were subjected to statistical analysis using appropriate statistical software based on the standard procedures outlined by Snedocor and Cochran,

(1994) [9]. Transport distance was considered as the main factor affecting shrinkage loss. Mean values and standard errors were calculated for each treatment group. Differences among transport distance categories and holding periods were evaluated using analysis of variance (ANOVA), and statistical significance was considered at $p \leq 0.05$.

Results

Effect of pre-slaughter transport distance (km) on shrinkage (Mean $\pm$ SE) of broiler chicken meat

Preslaughter transport distance significantly influenced shrinkage loss in live broiler birds (Table 1). Birds transported over distances of less than 50 km recorded a significantly lower shrinkage loss ($1.13 \pm 0.12\%$) compared to those transported over 50-100 km ($1.89 \pm 0.12\%$) and more than 100 km ($1.88 \pm 0.08\%$) ($p \leq 0.05$). Shrinkage loss did not differ significantly between birds transported over 50-100 km and more than 100 km. Analysis of variance further confirmed a highly significant effect of transport distance on shrinkage loss ($p \leq 0.05$).

Table 1: Effect of pre-slaughter transport distance (km) on shrinkage (Mean $\pm$ SE) of broiler chicken meat

Physico-chemical properties	Transport			P-Value
	< 50 km	50-100 km	> 100 km	
Shrinkage loss (percent)	1.13 ± 0.12^a	1.89 ± 0.12^b	1.88 ± 0.08^b	0.001**

Means bearing different superscripts are significantly different ($p \leq 0.05$).

Effect of preslaughter transport on shrinkage during different hours of holding at retail broiler chicken meat shops

Live bird weight loss recorded during holding at retail broiler meat shops from 4:00 am to 10:00 am is presented in Table 2. Live weight loss showed a gradual numerical decline from 2.58 ± 0.09 g at 4:00 am to 2.40 ± 0.08 g at 10:00 am. However, analysis of variance indicated that differences in live bird weight loss across holding hours were not statistically significant ($p > 0.05$). Shrinkage loss expressed as percentage varied across holding hours, with the highest value observed at 8:00 am (2.01%).

Table 2: Effect of preslaughter transport on shrinkage (Mean $\pm$ SE) during different hours of holding at retail broiler chicken meat shops

Physico-chemical properties	Holding hours							P-Value
	4:00 am	5:00 am	6:00 am	7:00 am	8:00 am	9:00 am	10:00 am	
Live bird weight loss (gms)	2.58 ± 0.09	2.55 ± 0.09	2.52 ± 0.09	2.49 ± 0.09	2.44 ± 0.08	2.42 ± 0.08	2.40 ± 0.08	0.136 ^{NS}
Shrinkage loss (percent)	0.0	1.16	1.18	1.19	2.01	0.82	0.83	

Discussions

The results obtained in the present study are discussed in relation to the effect of preslaughter transport distance and subsequent holding duration at retail broiler meat shops on shrinkage loss in live broiler birds. Previous studies on poultry transport stress suggested that birds required adequate rest and rehydration to recover before slaughter (Rajkumar *et al.*, 2016) [7]. The findings are presented with appropriate statistical analysis and interpreted in the context of preslaughter handling practices and their contribution to live weight losses under commercial conditions. Emphasis has been placed on distinguishing statistically significant effects from numerical trends to provide a realistic assessment of factors influencing shrinkage loss in the broiler meat supply chain.

Effect of Preslaughter Transport Distance on Shrinkage Loss in Broiler Birds

The observed increase in shrinkage loss with increasing transport distance may be attributed to prolonged feed and water withdrawal, physical exertion during handling, and exposure to transport-induced stressors such as crate confinement, vibration, and thermal stress. Baracho *et al.* (2006) [3] reported that broilers experienced weight losses ranging from 0.5 to 2 percent during transportation and from 0.1 to 5 percent while held at the processing plant. Birds subjected to short-distance transport experienced comparatively lower physiological stress and shorter fasting duration, resulting in reduced live weight loss. Aral *et al.* (2014) [1] reported that broilers lost an average of 5.43 percent of their live weight during transportation, indicating that longer transport duration resulted in greater shrinkage. They further observed that, depending on loading density and transport conditions, weight loss varied widely, ranging from 2.13 percent to as high as 12.27 percent. Jacobs *et al.* (2017) [4] developed a predictive model to estimate

transportation-related weight loss in broilers and reported an average body weight reduction of approximately 40.8 g per hour of transit. In contrast, birds transported over moderate and long distances underwent extended stress exposure, leading to increased water loss through respiration, defecation, and evaporation.

The lack of a significant difference in shrinkage loss between birds transported over 50-100 km and those transported over more than 100 km suggests a possible stabilization or plateau in live weight loss beyond a certain transport distance. This phenomenon may be due to early depletion of gut contents and readily mobilizable body water during the initial stages of transport, after which further losses occur at a slower rate. Findings highlight that even moderate preslaughter transport distances can cause substantial shrinkage loss, emphasizing the need for improved transport management strategies to minimize economic losses in the broiler meat supply chain.

Effect of Holding Duration at Retail Broiler Meat Shops on Live Weight Loss

The non-significant effect of holding duration on live bird weight loss suggests that short-term holding under retail conditions contributes minimally to additional shrinkage when compared to transport-induced losses. Zhang *et al.* (2019) [11] reported that broilers subjected to transportation exhibited a live weight loss of 3.16 percent after 3 hours of transit, compared to a loss of 1.79 percent in non-transported birds following a 9-hour fasting period. Although continued fasting and environmental exposure during holding may lead to incremental moisture loss, the rate of weight loss appears to decline over time, possibly due to reduced bird activity and metabolic adaptation. Ramakrishnan *et al.* (2021) [8] reported that seasonal variations played a significant role in influencing live weight shrinkage, mortality rate and average weight loss in

broilers. The numerically higher shrinkage observed during mid-holding hours may reflect the cumulative effects of prior transport stress combined with ongoing feed and water deprivation; however, the absence of statistical significance indicates that these variations should be interpreted cautiously.

Overall, the findings indicate that preslaughter transport distance plays a more dominant role in determining shrinkage loss than short-duration holding at retail broiler meat shops. Therefore, mitigation strategies aimed at reducing live weight losses should primarily focus on optimizing transport distance, duration, and handling practices rather than short-term retail holding management.

Conclusion

The present study demonstrated that preslaughter transport distance significantly influences shrinkage loss in live broiler birds. Birds transported over distances of less than 50 km exhibited significantly lower shrinkage loss compared to those transported over 50-100 km and more than 100 km, indicating that transport-related stress and prolonged feed and water withdrawal are major contributors to live weight loss. The absence of a significant difference between the two longer transport distances suggests that shrinkage loss tends to stabilize beyond moderate transport distances.

In contrast, short-term holding of broiler birds at retail meat shops from 4:00 am to 10:00 am resulted in only minor and statistically non-significant variations in live bird weight loss. This indicates that transport contributes more substantially to overall shrinkage loss than brief holding under typical retail conditions.

From a practical perspective, these findings highlight the importance of optimizing preslaughter transport practices to minimize avoidable live weight losses in the broiler meat supply chain. Reducing transport distance wherever feasible, improving handling during loading and unloading, and minimizing transport duration can substantially lower shrinkage losses and associated economic impacts. The results also suggest that management interventions targeting transport efficiency may yield greater benefits than modifications to short-term retail holding practices. Overall, the study provides valuable insights for producers, transporters, and retailers aiming to improve efficiency and sustainability in broiler meat marketing systems.

Acknowledgments

Thanks to the Tamilnadu Veterinary and Animal Sciences University, Chennai-51 for the financial support. It was declared that there was no conflict of interest.

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