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## Factors affecting live shrink loss in commercial broilers

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**Abstract**

The study was aimed at assessing the extent of live shrink loss (%) experienced by the broilers during transportation from the points of production to marketing centres. A total of 2.42 million broilers weighing 4717 MT brought by 1248 truck loads into Chennai city, Tamil Nadu, India for marketing were involved. The study period covered three different seasons namely rainy, winter and summer, the distance of transportation was classified as less than 100 km, 101-200 km, 201-300 km and above 300 km and the duration of transportation was classified as less than three hours, 3-6, 6-9 and above nine hours. The season of transport did not influence live shrink loss (%), while a linear increase in such a loss was witnessed with increase in both the distance or duration of transport. Consequent economic loss due to live shrink loss suffered by the Indian poultry meat industry was estimated to be around INR. 2,905 crores annually. Administration of B complex vitamins and ascorbic acid at the suggested levels were found to be useful in significantly ( $P \leq 0.01$ ) reducing live shrink loss during transportation of broilers.

**Keywords:** Broiler, live shrink loss, transportation, season, amelioration

**Introduction**

Poultry raising in India dates back to pre-historic times and commercial poultry production in the country is more than 40 years old. The seasonal variations in broiler prices affected the farmers, hatchery, broiler feed manufacturers, etc. and they were forced to find out means of overcoming the same. Thus started the practice of vertical integration or contract farming system of broiler production. One of the major outcome of integrated or contract system of broiler production is that it had enabled movement of broiler production units from urban or sub-urban areas to villages as the integrator arranges for wholesale movement of broilers across places covering even more than 500 km overnight.

In transit, the birds are exposed to a wide variety of potential stressors including motion, acceleration, vibration, impact of withdrawal of feed and water, noise, restriction of behaviour, social disruption and other micro-environmental factors (Kettlewell and Mitchell, 1994) [1]. Prakash *et al.* (2014) [2] found that live shrink loss was found to be 4.47 % and type of strain and season of transport did not influence live shrink loss. High ambient temperature coupled with high humidity not only reduces growth performance but also threatens the well-being of broilers during their journey towards abattoirs (Aldridge *et al.*, 2019) [3]. Temperature and humidity variations during transportation can cause high mortalities (Arikan *et al.*, 2017) [4], oxidative damage to muscles (Estevez, 2015) [5] and can also reduce physical appearance and functional characteristics of meat (Wilhelm and Maganhini, 2010; Xing *et al.*, 2015) [6, 7]. The extent of deterioration during transportation depends on the microclimate of the vehicle compared to the direct effect of the ambient environment (Simoes *et al.*, 2009) [8]. Considering the number of broilers/volume of broiler meat produced in the country, economic loss due to live shrink loss due to transportation and holding could be reasonably high. In spite of the fact that Indian broiler industry is worth more than INR. 6,5000 crores annually, no planned study has been carried out so far on the extent of loss so suffered, factors that might have a bearing on the same and the ways and means to minimise such a loss. Hence, the present study was undertaken to analyse the effect of season, distance and duration of transport and ameliorative measures to overcome the live shrink loss in commercial broilers.

**Materials and methods****Design of the study**

Wholesale broiler traders in Chennai city, Tamil Nadu, India were identified and approached.

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Their volume of operation, source of supply and mode of delivery were assessed. The live broilers grown under contract system in broiler farms located in rural areas are transported over night to the urban areas far away for marketing as they are the major consumption centres. A total of 2.42 million broilers transported in 1248 trucks by the whole sales traders over three different seasons were subjected to the study to assess the effect of season and duration of transport on live shrink loss (%).

### Broiler transportation practices

Persons hired for catching the broilers had some experience in catching of broilers. Catching and loading was usually carried out after the dawn to ensure less disturbance and facilitate transportation during night to minimise the stress and consequent loss in weight / due to death.

The transport cages were usually of 20 to 22.5 cm in height, 90 cm in length and 54 cm in breadth offering a floor space of 4860 cm<sup>2</sup> or 5.4 sq.ft. totally. Birds weighing a total of 30 kg were put into each cage normally and 25 kg during summer. The transport cages were so designed to ensure efficient usage of loading space of the truck in use. The body of the broiler transport trucks had their sides left open with only holding rails fitted to hold the cages in place. The transport cages were thoroughly secured. The truck used for transport normally could hold a total of 4800-5000 kg live broilers which was restricted to 4200 kg during summer.

### Season

The study period covered three different seasons namely rainy from September to November, winter from December to February and summer from March to May. Live broiler chicken brought into Chennai city from various places of the state and also from adjoining states of Karnataka and Andhra Pradesh were subjected to the study. Data on live shrink loss (%) during transportation of broilers for marketing were classified accordingly and analysed to draw inferences.

### Distance of Transport

The broiler production centres were located in different parts of the state and also in adjoining states of Andhra Pradesh and Karnataka and hence the distance of transportation varied from about 50 km to even 500 km. Accordingly, the distance of transportation of live broilers to the marketing centres was classified as less than 100 km, 101-200 km, 201-300 km and above 300 km and the data were so grouped for further analysis.

### Duration of Transport

As the distance of transportation varied, the duration of transportation also varied. It was classified as less than three hours, 3-6, 6-9 and above nine hours of transportation and the

influence of duration of transport of broilers before marketing on live shrink loss was analysed.

### Amelioration Measures

Live shrink loss results due to various stressors to which the broilers are exposed to during transportation. Hence, attempts were made to ameliorate the stress and reduce the live shrink loss by any one of the following methods:

- Administration of B complex vitamins in drinking water @ 20 g / 5000 birds three hours before catching (a commercial product containing B<sub>2</sub> - 1.2 mg, B<sub>6</sub> - 0.62 mg, B<sub>12</sub> - 6.25 mcg, nicotinamide - 25 mg and D - panthenol - 0.62 mg per g was employed).
- Ascorbic acid in drinking water @ 10 mg / kg body weight three hours before catching.
- Sodium salicylate @ 25 mg / kg body weight in drinking water three hours before catching.

Live shrink loss (%) in the above groups were compared with that in control group of broilers lifted from the same location.

### Analysis of Variance

Data collected on live shrink loss (%) were transformed into Arcsin values and analysed for the influence of main effects of season of transport, distance and duration of transport by analysing the variance. The interaction effects were negligible and hence were not considered.

### Correlation coefficients

Correlation coefficients were also worked out between live shrink loss (%) and other influencing factors (season, duration and distance) to identify the extent and direction of relationship, if any.

### Results and discussion

#### Effect of season

Season wise mean values for transit live shrink loss (%) are given in Table 1. Season was not found to influence live shrink loss (%) during transportation significantly ( $P \geq 0.05$ ) even though the loss during summer season was marginally lower than during rainy and winter seasons in that order. This is in contrary to the findings of Petracci *et al.* (2001)<sup>[9]</sup>, who found that during summer months or at high holding temperature, the live shrink loss was higher. However, the explanation offered by Northcutt (1999)<sup>[10]</sup> seemed more appropriate to the findings in the study that hot weather causes birds to be less active, make them consume less feed due to low energy demand and feed is also retained for a longer period of time in the gut of broilers. Moreover, as a matter of routine, the wholesalers reduce the density of stocking from 4800 kg to 4200 kg per standard truck load during summer which could have ensured better ventilation and reduced the ill effects of hot weather.

**Table 1:** Live shrink loss (%) among broilers as influenced by season of transport and marketing (Mean  $\pm$  S.E.)

Season	Live shrink loss <sup>NS</sup> (%)
Rainy	4.67 $\pm$ 0.217
Winter	4.49 $\pm$ 0.102
Summer	4.25 $\pm$ 0.083

<sup>NS</sup> -Not Significant ( $P \geq 0.05$ )

#### Effect of distance of transport

The data were grouped into four depending on the distance to which the broilers were transported to bring them to Chennai city for marketing and are presented in Table 2. Distance of

transport showed highly significant ( $P \leq 0.01$ ) influence on live shrink loss (%) with transport less than 200 km resulting in lesser losses compared to transport over 200 km. A linear trend in live shrink loss (%) with distance of transport was

evident. Transport for less than 100 km inflicted the least loss even though the number of such short transportations were very minimal compared to the other groups. Vecerek *et al.* (2006) [11] similarly reported increasing instances of broiler mortality with increasing distance of transportation to the processing plant from 50 km to over 300 km. As explained by Moran and Bilgili (1995) [12], initial loss experienced in live body weight due to transportation over a short distance might have resulted only in gut evacuation while transportation over long distances might have been accentuated by increased catabolism of body reserves.

**Table 2:** Live shrink loss (%) among broilers as influenced by distance of transport and marketing (Mean  $\pm$  S.E.)

Distance (km)	Live shrink loss** (%)
< 100	0.90 <sup>a</sup> $\pm$ 0.417
100 – 200	3.83 <sup>b</sup> $\pm$ 0.145
200 – 300	4.61 <sup>c</sup> $\pm$ 0.143
> 300	4.64 <sup>c</sup> $\pm$ 0.099

\*\* Means carrying different superscripts differ significantly ( $P \leq 0.01$ )

### Effect of duration of transport

The length of time of transportation of broilers from production centres to marketing centres was also found to have significantly ( $P \leq 0.01$ ) influenced live shrink loss (%) with a linear increase in the same accompanying an increase in duration of transport as presented in Table 3. Consequently, the mean loss for < 3 h duration was the least and that for > 9 h duration the highest compared to other groups. Kettle well and Mitchell (1994) [1] also reported variation in the time of the journey which averaged < 3 h but extended over 12 h. Moreover, Warriss *et al.* (1999) [13] observed a similar linear increase in live weight loss and worked out the same to be 0.23% per hour of transport. Northcutt *et al.* (2003) [14] explained that live shrink loss (%) increased significantly with time off feed. The findings in the present study are also in agreement with those of Bianchi *et al.* (2005) [15] who stated that the birds transported for less than 3.5 h exhibited a significantly lower live weight loss compared to medium (3.5-5 h) and long (>5 h) transport times.

**Table 3:** Live shrink loss (%) among broilers as influenced by duration of transport (Mean  $\pm$  S.E.)

Duration (h)	Live shrink loss** (%)
< 3	3.83 <sup>a</sup> $\pm$ 0.248
3 – 6	4.44 <sup>b</sup> $\pm$ 0.069
6 – 9	4.59 <sup>b</sup> $\pm$ 0.208
> 9	5.86 <sup>c</sup> $\pm$ 0.495

\*\* Means carrying different superscripts differ significantly ( $P \leq 0.01$ )

### Correlation co-efficients

Relationships between the various groupings within each factor considered and the transit live shrink loss (%) were also analysed by working out respective correlation co-efficients to know the direction and extent of relationship and the results obtained are presented in Table 4. Relationships between transit live shrink loss (%) and distance ( $P \leq 0.01$ ; + 0.216), duration ( $P \leq 0.05$ ; + 0.071) were all found to be positive emphasising that the above loss increased with increasing distance / duration of transport and also for increasing live body weight of broilers. Correlation coefficients arrived at also reemphasised the earlier findings that the distance and

duration were the significant factors that influenced transit live shrink loss (%) experienced by broilers transported for marketing and the season of transport did not influence live shrink loss (%).

**Table 4:** Correlation Co-efficient between live shrink loss (%) and different factors

Co-variable	'r' value
Season	- 0.031 <sup>NS</sup>
Distance	+ 0.216 <sup>**</sup>
Duration	+ 0.071 <sup>*</sup>

NS -Not Significant ( $P \geq 0.05$ ) \* -Significant ( $P \leq 0.05$ ) \*\* -Highly Significant ( $P \leq 0.01$ )

### Amelioration measures

#### B complex Vitamins

Pre-transit supplementation of B complex vitamins had significantly ( $P \leq 0.01$ ) reduced the loss with the values being  $5.14 \pm 0.16$  and  $2.77 \pm 0.09$  for groups without or with B complex supplementation and are presented in Table 5. Moran and Bilgili (1995) [12] indicated that apart from initial loss due to evacuation of the digestive system, subsequent weight loss could be due to catabolism of energy reserves. As B complex group of vitamins are known to play a major role in the energy metabolism and are hence considered as anti-stress factors, efficient utilisation of energy reserves and consequent stress alleviation would have helped in reducing live shrink loss (%) during transport of broilers. Narahari (1997) [16] also advocated higher levels of multi vitamins for stressed birds.

**Table 5:** Effect of different amelioration measures on mean ( $\pm$  S.E.) live shrink loss (%)

Sl. No.	Amelioration measure	Live shrink loss (%)		
		Treatment	Control	't' value
1.	B complex vitamins	2.77 <sup>a</sup> $\pm$ 0.09	5.14 <sup>b</sup> $\pm$ 0.16	6.64 <sup>**</sup>
2.	Ascorbic acid	2.18 <sup>a</sup> $\pm$ 0.11	3.87 <sup>b</sup> $\pm$ 0.21	4.09 <sup>**</sup>
3.	Sodium Salicylate	1.95 $\pm$ 0.19	3.21 $\pm$ 0.38	1.18 <sup>NS</sup>

<sup>NS</sup> -Not significant ( $P \geq 0.05$ )

\*\* Means within each row carrying different superscripts differ significantly ( $P \leq 0.01$ )

#### Ascorbic Acid (AA)

Ascorbic acid (Vitamin C) supplementation 3 h prior to loading was found to reduce transit live shrink loss (%) among broilers from  $3.87 \pm 0.21$  to  $2.18 \pm 0.11$  and the quantum of reduction was found to be statistically significant ( $P \leq 0.01$ ). Fletcher and Cason (1991) [17] indicated that AA supplementation could significantly reduce the physiological stress response in birds. During transportation, birds could not dissipate heat fast enough, their body temperature rises and the bird becomes heat stressed. Narahari (1997) [16] and Gursu *et al.* (2004) [18] agreed that AA or Vitamin C was highly effective in alleviating heat stress. Accordingly, the broilers when supplemented with AA before transportation would have been well prepared to meet / offset the possible thermal stress during transportation which would have helped in reducing the transit live shrink loss significantly.

#### Sodium Salicylate

Mean live shrink loss (%) values for control and sodium salicylate through drinking water 3 h before catching revealed that the treatment though marginally effective, did not significantly ( $P \geq 0.05$ ) cut down the loss. Broilers loose

weight due to catabolism of energy reserves during transportation (Moran and Bilgili, 1995)<sup>[12]</sup> and birds become hyperthermic. The claims of Narahari (1997)<sup>[16]</sup>, Baert and DeBacher (2003)<sup>[19]</sup> and Naseem *et al.* (2005)<sup>[20]</sup> that sodium salicylate was effective against heat stress was not enough to mitigate the transport stress and save the birds significantly from losing their weight during transportation even though they could have been subjected to heat stress along the way. It is, however, advisable for the wholesale traders and the industry people to try out the above measures on a wider scale and revalidate the findings for their own benefit.

### Economic Loss

A total of 4.06 million MT of poultry meat was produced in India during 2018-19 (BAHS, 2019)<sup>[21]</sup>. As poultry meat is sold at INR.160 per kg at retail shops on an average, the value of poultry meat produced in the country amounts to INR. 65,000 crores. If we consider that mean live shrink loss of 4.47% estimated in this study is translated to the entire poultry meat business, the industry would be losing about INR. 2905 crores annually through live shrink loss alone. Hence, the industry will be benefited if appropriate amelioration measures are identified and adopted to minimise the above loss substantially. The adverse effect of live shrink loss on economics of broiler production had been emphasised by many authors (Bianchi *et al.*, 2005 and Aral *et al.*, 2014)<sup>[15, 22]</sup>.

This study showed that transportation of broilers in different season did not influence the live shrink loss (%), where as duration and distance of transport were found to influence the same positively. Administration of B complex vitamins (or) and ascorbic acid (Vitamin C) in water 3 hours before transport of broilers would significantly reduce the live shrink loss (%) which in turn minimise economic loss to the broiler industry.

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