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Assessment of Losses in Sheep and Goat During Pre-Slaughter Transportation

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ABSTRACT

A study was conducted to estimate the different types of losses in sheep and goat during transport from shandy to slaughter house both in summer and winter seasons. Pre-slaughter losses were documented and different practices adapted in two different types of short (about 20 kms) and long (about 150 kms) distance transportation in the present study. A weight loss of 0.95 and 0.98 per cent was recorded in winter and summer seasons during short distance. A weight loss of 3.02 and 3.18 per cent was recorded in winter and summer seasons respectively during long distance transport of 150km which were lesser than earlier findings. There is no significant difference in total injuries, per cent actual weight loss in live animals, dead animals on arrival, weight loss due to excreta, total weight loss during winter and summer seasons in both types of transport. Some other observations also made like time of transit, average feed withdrawal time and average age of animals. Further, study revealed no significant difference in temperature and relative humidity observed in shandies and in transport vehicle between winter and summer seasons which might be due to transportation of animals in early morning hours in both the seasons. The lower losses in weight and mortality rate observed in this study may be correlated to the fact that the temperature and relative humidity of the transport environment were within the comfort zone of the animals.

Keywords: Sheep, Goat, Transportation, Pre-slaughter losses

Transport of sheep is most stressful and injurious stage in chain of operations from farm to slaughter house and leads to poor animal welfare and post-harvest losses (FAO 2001). As a result of centralization of abattoirs or slaughter houses in nearby major cities, livestock are subjected to travelling greater distances from rural markets or shandies and being exposed to more physical endurance and adverse climatic conditions. Transport of livestock especially small ruminants from local markets, shandies to cities where modern abattoirs are located is a common practice in countries like India.

Live weight loss during transportation and holding was of particular economic importance in small ruminants since the digestive tract comprises a greater proportion of live weight than in cattle and swine (Romans *et al*., 1994). Exposure to stress factors or stressors such as high or low temperature, humidity, precipitation, loud noises which are environmental and other factors like more stocking density, poor ventilation, feed and water withdrawal time, handling practices etc., will play important role primarily in animal welfare ,ultimately ends in poor meat quality. Transporting food animals by using vehicles not specifically designed for that purpose leads to injuries, stress and suffering in food animals (Javis and Cockram, 1994; Ayo and Oladele, 1996).

This study considered the practical small ruminant transporting conditions prevailing in and around Chennai which is a coastal city in India. According to India Metreological Department, Chennai (2017), the average maximum environmental temperature ranges from 38^{o}C to 42^{o}C and minimum temperatures of 28^{o}C -30^{o}C during summer months (March-June) in Chennai and adjacent

districts. Maximum temperatures of 30-32.4ºC and minimum temperatures of 19.5-22ºC in winter months (November- January) has been reported. Relative humidity (%) recorded at morning hours (8.30 am) in the range of 69-76 in summer months and 80-88 in winter months.

Information on the extent of the losses during post-harvest operations is important to the scientists and policymakers to work out research programmes and strategies to curtail these losses which help finally in ensuring food security. Post-harvest losses could occur anywhere in the post-harvest chain of interconnected phases or associated activities, from the time of harvest on the farm all the way through the food manufacturing, processing, marketing (e.g., retail) and consumption chain to the final decision by the consumer to eat or discard the food (Buzby *et al*., 2011).The annual value of post-harvest losses in India during the year 2013-14 had increased three fold when compared to 2005-06, which was about Rs 92,651 crore. The loss in livestock produce was about Rs 18,987 crore, out of which the loss in sheep and goat meat was about Rs 1235 crores. The post-harvest loss in meat sector was estimated to be 2.71%, in which 1.9% is during farm operations and 0.72% during storage and preservation (Jha *et al.,* 2015).

Post-harvest losses caused during transport is worthy of attention especially in small ruminants which is costliest meat In India, which may incur significant increase in losses to farmer or trader. Stress caused by transportation in animals causes shrinkage in bodyweight (Kannan *et al.,* 2002) and handling and transportation stress are of the most important ante-mortem factors affecting quality of carcass (Kannan *et al*., 2003). Stocking density during transportation is also an important factor to be considered in the aspect of both post-harvest losses and animal welfare. Faulty animal handling and management practices during transportation of sheep and goat leads to losses like live weight shrinkage and also losses in carcass weight due to bruising, condemnation, trimmings, reduced or deteriorated meat quality. There has been little investigation on extent of losses in sheep and goat during transport. Hence, a study was planned to assess the potential financial losses incurred due to quality and quantity losses during transport from shandies to slaughter houses in Chennai city.

MATERIALS AND METHODS

In this study, data pertaining to various practices that are being practiced at the shandies/farm, transport and at slaughter house were documented during two seasons viz., summer and winter by travelling along with the vehicle while shifting the animals from the shandy to the slaughter house. The environmental temperature (ºC) and relative humidity (%) at the shandies was recorded using digital thermo-hygro meter (HTC, India) before, during and after loading of animals, during transit in truck and the average was calculated. Before loading animals, the weight of empty vehicle was taken at the weighing bridge. The data regarding the age of the animals was recorded by dentition pattern. The time from which the animals were without feed before loading was recorded by enquiring the owners and was expressed in hours. The number of animals loaded in each vehicle was recorded. The time taken by the load men to load the animals into the truck was recorded as the loading time. The weight of vehicle after loading animals was taken at weighing bridge near the shandies. The average body weight of animal from each shandy/farm was calculated from the difference of weight of the vehicle with animals and weight of empty vehicle. The temperature and relative humidity of the travel environment as well as in the truck during transit were recorded and the average was calculated. The distance of travel (Km) was calculated based on the distance from the farm and/or shandies where the animals were loaded till it reached the slaughter house.

In the present study transport about 20kms and 150 kms were taken for data collection. The time of travel (hours) was calculated based on the time taken from departure at the farm and/or shandies till they reached the slaughter house. Actual distance, time taken to reach the slaughter house from shandy was recorded and speed of vehicle during transport was calculated. The cost involved for transportation of animals were calculated based on the cost involved for loading of animals, food and refreshment charges, toll fee charges, fuel charges, parking charges, driver and load man charges, miscellaneous cost viz., vehicle repair etc.,. The cost of transport of individual animal was calculated based on the total cost of transport and the number of animal transported in vehicle. The time taken to unload the animals from the truck in the slaughter house and the number of animals in each truck was recorded. The weight

of the excreta in the truck was recorded by removing the contents into sacks and weighing it. Vehicle weight reported as the difference between the weight of vehicle with animals and without animals. The weight loss during transport was calculated based on the difference in weight of animals during loading at shandies and the weight of animals at the slaughter house.

Weight loss =

$$\frac{\text{Weight of animals at loading (Kg)} - \text{Weight of animals at slaughter house (Kg)}}{\text{Weight of animals at loading}} \times 100$$

The actual weight loss (tissue shrinkage) is the difference in the weight loss in live animals due to transport and excreta and expressed in percentage.

Actual Weight loss =

$$\frac{\text{Total weight loss (Kg)} - \text{Excreta weight (Kg)}}{\text{Total weight loss}} \times 100$$

The number of animals dead on arrival (DOA) or mortality was recorded and the percentage of mortality was calculated. The number of animals injured during transport was recorded.

RESULTS AND DISCUSSION

Different types of traditional practices followed by livestock owners observed in the study like the animals were painted on their dorsal region by owners/ middleman with various colors to differentiate and identify their animals from other animals. Some of the owners are using blades to cut the hair on the rump area sometimes different designs to mark their animals.

The mean ± S.E values of number and weight of live animals loaded in trucks, unloaded at slaughter house and average weight loss per animal during transport of about 20 kms from shandies to slaughter house in winter and summer seasons are presented in table 1. Cockram *et al.* (1996) recommended that for journeys lasting more than 3 h, sheep of 35 kg live weight should at least be given a space allowance of greater than 0.22 m^2 per sheep and possibly 0.27 m^2 per sheep. A weight loss of 0.95 and 0.98 per cent was recorded in winter and summer seasons during short distance. The mean ± S.E values of number and weight of live animals loaded in trucks, unloaded at slaughter house and average weight loss per animal during transport of about 150 kms from shandies to slaughter house in winter and summer seasons are presented in table 5. In both types of transport no significant difference was observed in per cent weight loss during winter and summer seasons in transport of animals from shandies to slaughter house. A weight loss of 3.02 and 3.18 per cent was recorded in winter and summer seasons during 150 km distance transportation respectively. Gracey *et al.* (1999)

Table 1: Mean ± SE values of weight loss in animals during short distance transportation from shandies to slaughter house

Season	No of live animals		Weight (kg)		Weight loss (kg)			Average weight loss per animal (g)
	Loaded in truck	Unloaded at slaughter house	Live animals loaded in truck	Live animals unloaded at slaughter house	Total loss	Excreta in truck	Actual loss (Tissue shrinkage)	
Winter (N = 6)	95.50±3.08	95.50±3.08	1450.35±56.78	1447.33±56.71	13.63±0.48	2.62±0.11	11.00±0.44	143.38±6.88
Summer (N = 6)	94.16±4.98	94.16±4.98	1471.33±81.39	1460.33±81.54	14.25±0.42	2.91±0.15	11.33±0.42	153.88±10.72
t value	0.228^{NS}	0.228^{NS}	-0.131^{NS}	-0.131^{NS}	-0.419^{NS}	-1.557^{NS}	0.00^{NS}	-0.532^{NS}

N-Number of trips; NS-Non Significant

stated that limit of transport shrinkage in food animals of 1.5- 2.0 per cent of their body weight during the first 24 hours of transport. Fisher *et al*. (2010) studied the effects of 12, 30 or 48 hours of road transport on the physiological and behavioural responses of sheep and reported that in 4–5-year-old goats, 12, 30 and 48 h journeys decreased live weight by 4.9%, 9.8% and 12.1%, respectively. Transportation stress has been associated with loss in live weight of goats as reported by earlier researchers (Kannan et al. 2002, Ambore *et al.* 2009). The weight losses observed in this study were lesser than the findings of Zhong *et al*. (2011) who reported weight loss of 7.18%, 9.04% and 9.57% after an 8-hour journey in 6, 12 and 24 month old sheep respectively. This could be attributed to the fact that in tropical areas like southern parts of India the variation in temperature during summer and winter is minimal. In addition, the current practices recorded in the present study revealed that there is a practice of smearing the animals tongue and lips with salt by the middlemen in order to make the animal drink more water in shandies, which might be the major reason for decreased loss of weight during transportation in both seasons. However higher weight loss was recorded during summer compared to winter.

The mean ± S.E values of per cent weight loss and total injuries (%) in animals during 20 km and 150 km transport from shandies to slaughter house in winter seasons and summer seasons were presented in table 2 and table 6 respectively. A total injuries (%) of 0.52 and 0.70 per cent was recorded in winter and summer seasons during short distance. There is no significant difference in total injuries, per cent actual weight loss in live animals, dead animals on arrival, weight loss due to excreta, total weight loss during winter and summer seasons in transport of animals from shandies to slaughter house in both type transports. Total injuries (%) of 0.90 and 1.03 per cent were recorded in winter and summer seasons during long distance transportation in this study. The results clearly signify that the current practices followed in the marketing are optimal for the welfare of the animals thereby resulting in lower total injuries during transport. No significant difference was observed in dead animals on arrival in transportation between summer and winter season where a dead on arrival of 0.045 and 0.043 per cent were recorded respectively. The results were in concurrent with Geyer (1982) who reported only 14 deaths among 234,434 sheep transported by road (0.006 per cent) and 0.031 per cent among lambs which had been brought

Table 2: Mean ± SE values of per cent weight loss and injuries (%) in animals during short distance transportation from shandies to slaughter house

Season	Total injuries (%)	Weight loss (%)		Total weight loss per animal (%)
		Actual loss (Tissue shrinkage)	Due to Excreta	
Winter	0.52 ± 0.22	0.75 ± 0.38	0.20 ± 0.07	0.95 ± 0.03
(N = 6)	(0.072 ± 0.04)	(0.086 ± 0.002)	(0.04 ± 0.008)	(0.09 ± 0.001)
Summer	0.70 ± 0.33	0.80 ± 0.06	0.17 ± 0.02	0.98 ± 0.07
(N = 6)	(0.083 ± 0.05)	(0.089 ± 0.003)	(0.04 ± 0.002)	(0.09 ± 0.003)
t value	-0.415^{NS}	-0.417 ^{NS}	1.320 ^{NS}	0.08 ^{NS}

N-Number of trips; NS-Non Significant; Values in parentheses are Arcsin √P mean.

Table 3: Mean ± SE values of age, feed withdrawal time and time consumed during short distance transportation of animals from shandies to slaughter house

	Average age of animals (months)	Feed withdrawal time (hours)	Duration of loading of animals (mins)	Duration of transport from shandies to slaughter house (mins)	Duration of unloading of animals (mins)	Total duration of transport from shandies to slaughter house (mins)
Winter (N = 6)	7.41 ± 0.20	12.50 ± 0.34	60.83 ± 2.38	52.50 ± 2.14	26.66 ± 1.66	140.00 ± 3.42
Summer (N = 6)	7.50 ± 0.22	13.00 ± 0.51	64.16 ± 3.00	53.33 ± 1.66	25.83 ± 1.53	143.33 ± 3.07
t value	-0.277^{NS}	-0.808^{NS}	-0.869 ^{NS}	-0.307 ^{NS}	0.368 ^{NS}	0.7255^{NS}

N-Number of trips NS-Non Significant

through the auction markets (Knowles *et al.,* 1994). The total injuries recorded in this study are lesser than the results obtained by McNally and Warriss (1996) who found that the prevalence of bruising was significantly higher in animals bought from live auction markets (7.8%) than in those bought through dealers (6.3%) or direct from farms (4.8%). There were no deaths during short distance transportation it is in accordance with the Grandin, 1993 who observed that animal which travelled only a short distance, directly from their farm of origin to the abattoir, have lower mortality rate, less bruising and lower stress response than animals which arrive from live auction markets some distance away. In long distance transport no significant difference was observed in dead animals on arrival in transportation between summer and winter season where a dead on arrival of 0.045 and 0.043 per cent were recorded respectively. The results were in concurrent with Geyer (1982) who reported only 14 deaths among 234,434 sheep transported by road (0.006 per cent) and 0.031 per cent among lambs which had been brought through the auction markets (Knowles *et al.,* 1994). The results clearly signify that the current practices followed in the marketing are optimal for the welfare of the animals thereby resulting in lower total injuries during transport.

The mean ± S.E values of age, feed withdrawal time and time consumed during short distance transportation of animals from shandies to slaughter house in winter and summer seasons were presented in table 3 and table 6 for short and long distance transport respectively. No significant difference in age, feed withdrawal time and time consumed for transportation of animals to reach the slaughter house during winter and summer seasons in both types transport. The feed withdrawal period in the present study ranged from 12 to 15 hours during both short and long distance transportation. The observations were in accordance with the Shupe (1978) who studied the transporting of sheep from pastures and markets, suggested that in sheep, feed and water should be withheld for 15 to 18 hours prior to trucking on journeys of less than eight hours. No significant difference was observed in loss due to excreta (%) as well as tissue shrinkage during transportation of animals. Actual weight loss of 2.90 and 3.05 per cent was recorded in winter and summer seasons during transportation and were below the limit of transport shrinkage in food animals of 1.5- 2.0 per cent of their body weight during the first 24 hours of transport (Gracey *et al.* 1999). Kannan *et al*. (2003) found that the stress response of goat to transportation begin decreasing within 3 h after transportation and also reported that live weight shrinkage, attributable to feed withdrawal and dehydration, could be as high as 10 per cent in the summer. The lower levels of tissue shrinkage in the present study may be correlated to the optimal feed withdrawal period and minimal stress to animals during transportation. The average age of animals transported from shandies to slaughter house ranged from 7-8 months and between 9-10 months during both short and long distance transportation respectively. The analysis of variance revealed no significant difference in age, feed withdrawal time and time consumed for transportation of animal to reach the slaughter house during winter and summer season.

The mean ± S.E values of time, temperature and relative humidity relationship during in weight loss during short distance transport from shandies to slaughter house in winter and summer seasons were presented in table 4. The mean ± S.E values of time, temperature and relative

Table 4: Mean ± SE values of time, temperature and relative humidity during short distance transport from shandies to slaughter house

	Distance from shandies to slaughter house (Km)	Period of transport (Minutes)	Temperature in shandies while loading (°C)	Temperature inside vehicle (°C)	Relative humidity in shandies while loading (%)	Relative humidity inside vehicle (%)	Total weight loss (%)
Winter (N = 6)	14.33 ± 0.21	52.50 ± 2.14	23.80 ± 0.43	25.95 ± 0.30	82.75 ± 1.13	75.75 ± 0.76	0.95 ± 0.03 (0.97 ± 0.001)
Summer (N = 6)	14.50 ± 0.34	53.33 ± 1.66	27.93 ± 0.35	30.10 ± 0.32	67.91 ± 0.76	64.37 ± 0.87	0.98 ± 0.07 (0.09 ± 0.003)
T value	-0.415 NS	-0.307 NS	-7.418 NS	-9.330 NS	10.813 NS	9.840 NS	0.08 NS

N-Number of trips, NS-Non Significant Values in parentheses are Arcsin √P mean

Table 5: Mean ± SE values of weight loss in animals during transportation from shandies to slaughter house

Season	No of live animals			Weight of Animals loaded (kg)			Weight loss (kg)			Avg. weight loss per animal (g)
	Loaded in truck	Unloaded in slaughter house	Dead on arrival	Live animals loaded in truck	Live animals unloaded in slaughter house	Dead on arrival	Total loss	Due to Excreta in truck	Actual loss (Tissue shrinkage)	
Winter (N = 6)	385.83 ± 10.20	385.66 ± 10.20	0.16 ± 0.10	8286.66 ± 243.49	8033.41 ± 239.95	3.54 ± 3.50	262.00 ± 12.38	8.75 ± 0.25	253.25 ± 12.58	680.19 ± 32.40
Summer (N = 6)	369.50 ± 12.58	369.33 ± 12.65	0.16 ± 0.10	7743.33 ± 295.23	7497.08 ± 293.73	3.32 ± 3.20	254.91 ± 10.39	8.66 ± 0.27	246.25 ± 10.29	694.00 ± 37.90
T value	1.008 ^{NS}	1.005 ^{NS}	0.000^{NS}	1.420 ^{NS}	1.374 ^{NS}	0.45 ^{NS}	0.887^{NS}	0.222^{NS}	0.879 ^{NS}	0.112 ^{NS}

N-Number of trips NS-Non Significant.

Table 6: Mean ± SE values of per cent weight loss and injuries (%) in animals during long distance transportation from shandies to slaughter house

Season	Total injuries (%)	Deadon arrival	Per cent weight loss		Total weight loss per animal (%)
			Actual loss	Due to Excreta	
Winter (N = 6)	0.90 ± 0.56	0.043 ± 0.007	2.90 ± 0.12	0.11 ± 0.01	3.02 ± 0.11
	(0.09 ± 0.07)	(0.021 ± 0.001)	(0.17 ± 0.003)	(0.03 ± 0.001)	(0.17 ± 0.003)
Summer (N = 6)	1.03 ± 0.60	0.045 ± 0.007	3.05 ± 0.12	0.13 ± 0.012	3.18 ± 0.13
	(0.10 ± 0.07)	(0.021 ± 0.001)	(0.17 ± 0.003)	(0.03 ± 0.001)	(0.17 ± 0.003)
t value	-0.405^{NS}	-0.0169^{NS}	-0.219 ^{NS}	-0.500 ^{NS}	-0.255 ^{NS}

N-Number of trip NS-Non Significant Values in parentheses are Arcsin √P mean.

Table 7: Mean ± SE values of age, feed withdrawal time and time consumed during long distance transportation of animals from shandies to slaughter house

Season	Average age of animals (months)	Feed withdrawal time (hours)	Duration of loading of animals (mins)	Duration of unloading of animals (mins)	Duration of transport from shandies to slaughter house (mins)	Total duration of transport from shandies to slaughter house (mins)
Winter (N = 6)	10.00 ± 0.57	13.50 ± 0.50	137.66 ± 6.00	45.83 ± 1.53	275.00 ± 9.21	452.50 ± 15.96
Summer (N = 6)	10.66 ± 0.42	14.00 ± 0.36	131.66 ± 9.80	40.83 ± 1.53	258.33 ± 9.80	430.83 ± 9.44
t value	-0.93^{NS}	-0.80^{NS}	0.23 ^{NS}	-2.301 ^{NS}	1.238 ^{NS}	1.168^{NS}

N-Number of trips NS-Non Significant

Table 8: Mean ± SE values of time, temperature and relative humidity during long distance transport from shandies to slaughter house

Season	Distance from shandies to slaughter house (Km)	Period of transport (Minutes)	Temperature in shandies while loading (°C)	Temperature inside vehicle (°C)	Relative humidity in shandies while loading (%)	Relative humidity inside vehicle (%)	Total weight loss (%)
Winter (N = 6)	161.83 ± 0.87	275.00 ± 9.21	23.75 ± 0.26	25.93 ± 0.31	82.91 ± 1.26	75.88 ± 0.85	3.02 ± 0.11 (0.17 ± 0.003)
Summer (N = 6)	168.00 ± 0.68	258.35 ± 9.80	28.06 ± 0.22	29.98 ± 0.22	69.66 ± 0.57	66.32 ± 0.71	3.18 ± 0.13 (0.17 ± 0.003)
T value	-5.565 NS	1.238 NS	-12.211 NS	-10.386 NS	9.567 NS	8.583 NS	-0.255 NS

N-Number of trips NS-Non Significant Values in parentheses are Arcsin √P mean.

humidity relationship during long distance transport from shandies to slaughter house in winter and summer seasons are presented in table 8. The mean ± S.E values of temperature in shandies while loading (°C) in winter and summer seasons were 23.80 ± 0.43 and 27.93 ± 0.35 respectively. The mean ± S.E values of total weight loss (per cent) during short distance transportation from shandies to slaughter house in winter and summer seasons were 0.95 ± 0.03, 0.98 ± 0.07 and their respective arcsin √P values were 0.97 ± 0.001 and 0.98 ± 0.003 respectively. No significant difference in time, temperature and relative humidity was observed in shandies and transport vehicle between winter and summer seasons in short distance transport of animals from shandies to slaughter house in both types of transport. This might be due to transportation of animals in early morning hours in both the season. The time consumed for transportation of animals in short distance transport from shandies to slaughter house revealed no significant difference during winter and summer season with an average time of 140 - 143 minutes (approximately 2 hours). No significant difference in age, feed withdrawal time and time consumed for transportation of animals to reach the slaughter house during winter and summer seasons. The time consumed for long transportation of animals from shandies to slaughter house with an average time of 430 – 452 minutes (approximately 7 hours) during transportation in both seasons. Transportation time is one of the major factors that determine mortality rate, weight loss as well as injuries to animals. The major factors determining the well-being of farm animals in road transport were vehicle design, stocking density, ventilation, standard of driving and quality of the road (Fazio and Ferlazzo, 2003).

There was no significant difference in temperature and relative humidity was observed in the shandies and transport vehicle between winter and summer season may be due to transportation of animals in early morning hours in both the season. In the present study the lower loss in weight and mortality may be correlated to the fact that the temperature and relative humidity of the transport environment were within the comfort zone of the animals. In addition, it was observed that animals were generally transported during early morning hours during winter and summer so as to maintain the optimal temperature and relative humidity to prevent losses.

Fisher *et al*. (2002) studied the effects of stocking density on environmental conditions for lambs on road transport vehicles found that a stationary period resulted in a rapid increase in temperature humidity index on board the vehicle. However, the rate of temperature humidity index increase varied with the stocking density of the sheep.

CONCLUSION

Minimization of losses in these operations would directly benefit the farmers and rural entrepreneurs. In the present study the lower loss in weight and mortality may be correlated to the fact that the temperature and relative humidity of the transport environment were within the comfort zone of the animals. In addition, it was observed that animals were generally transported during early morning hours during winter and summer so as to maintain the optimal temperature and relative humidity to prevent losses. Infrastructural improvement is required at market level and location of markets, marketing practices,

handling methods and polices needs to be looked into changed scenario of demand and supply pattern.

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