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Influence of stocking density on serum uric acid and malonaldehyde levels during medium and long distance transport in commercial broiler chicken

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Abstract

A study was carried out to evaluate the effect of stocking density and transport distance on blood parameters when the broilers are transported for a medium and long distance of 250 and 350 km. The broiler birds were transported to 250 and 350 km with a stocking density of 480 and 350 sq.cm. The broilers were slaughtered without rest and with rest for four hours, blood samples were collected for the analysis of serum uric acid and malonaldehyde. The broilers transported for 350 km under stocking density of 480 sq. cm with feed not withdrawn and slaughtered without rest had significant higher level of MDA than the broiler slaughtered with rest. The broilers transported for 350 km under stocking density of 350 sq. cm with feed not withdrawn and slaughtered with rest had a significantly increased level of MDA than the broiler slaughtered without rest. The broilers transported for 350 km under stocking density of 480 sq. cm with feed not withdrawn and slaughtered without rest had significant higher level of MDA than the broiler slaughtered with rest. The broilers transported for 350 km under stocking density of 350 sq. cm with feed not withdrawn and slaughtered with rest had a significantly increased level of MDA than the broiler slaughtered without rest.

Keywords: Uric acid, malonaldehyde (max 4 key words in English)

1. Introduction

Poultry industry in India has made a remarkable growth rate of 8.51 and 7.52 per cent respectively (BAHS, 2019) ^[2] in egg and broiler chicken meat production ever since its inception, as against 2.90 per cent for agricultural crops (Economic Survey, 2019–2020) ^[5]. Estimates from the All India Poultry Breeders Association states that poultry contributes for 17.31 billion USD of total India's gross value and provides direct and indirect employment to 50 million people. Within the poultry sector, broiler segment constitutes about 65.30 and layer segment constitutes 34.70 per cent, respectively with a monthly turnover of 400 million chicks and 8,400 million eggs, respectively (ICRA, 2020) ^[8].

Broiler chicken rearing is mostly being carried out by intensive system in different geographical areas and are to be transported by road over a long distance to urban areas or centralized processing plants. Transportation is an essential component of the poultry industry, but leads to enormous stress on birds because they are provided with a little space for behavioural thermoregulation. The proportion of broiler chicken dead on arrival (DOA) has been reported to vary from 0.15 to 0.67 per cent (Mitchell, 2006) ^[9]. Transportation of broiler resulted in average mortality of 0.30 to 0.40 per cent and mortality rate increases with the length of journey (Petracci *et al.*, 2006) ^[11]. Transportation stress not only affects the chicken welfare but also decrease the quality of meat.

2. Materials and Methods

The selected broilers were divided into two groups: group I feed withdrawn for 4 hours before the transport and group II without feed withdrawal, the birds were loaded manually in to the crates (Dimension: 88cm x 52cm). The crates were weighed after loading with the nine broilers per crate with the stocking density 480 sq cm (Indian standard 5238: 2001 Transport

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of poultry and Code of Practice) in four crates (Two crates for each group I and II) and 13 broilers per crate with the stocking density of 350 sq cm (routine practice) in four crates (Two crates for each group I and II). The transport trial was conducted during the late evening time starting from seven o'clock. The time taken for travelling 250 and 350 km was 5 and 7 hour. After the transport crates along with the birds were unloaded and weighed for measuring the weight loss. The birds were slaughtered immediately after transport without rest and blood samples were collected in each group and the remaining birds were slaughtered by giving 4 hours rest before slaughter for the analysis of uric acid and malonaldehyde.

3. Results and Discussion

3.1 Uric acid

The results (Mean $\pm$ SE) of serum uric acid (mg/dl) in broiler chicken slaughtered without rest and with rest after transport are presented in the Table 1. The serum uric acid of the broilers transported for 250 km with stocking density of 480 sq. cm after feed withdrawn and slaughtered without rest and with rest for 4 hours were 2.70 ± 0.64 and 2.07 ± 0.44 , respectively and for the broilers transported under stocking density of 350 sq. cm were 3.08 ± 0.75 and 2.62 ± 0.91 , respectively. The broilers transported for 250 km with stocking density of 480 sq. cm without feed withdrawn and slaughtered without rest and with rest for 4 hours were 3.06 ± 0.68 and 1.41 ± 0.42 , respectively and for the broilers transported under stocking density of 350 sq. cm were 3.05 ± 0.50 and 2.62 ± 0.47 , respectively. There was significant difference ($p < 0.05$) in the serum uric acid for the broilers slaughtered after transported 250 km, without rest and with rest for 4 hours when compared with the control group. The broilers transported for 250 km with feed not withdrawn under stocking density of 480 sq. cm and slaughtered without rest had significantly ($p < 0.05$) increased level of uric acid when compared with the control. The broilers transported with stocking density of 350 sq. cm and slaughtered without rest with feed withdrawn and not withdrawn had significantly ($p < 0.05$) higher level of uric acid when compared with control.

The serum uric acid of the broilers transported for 350 km with stocking density of 480 sq. cm after feed withdrawn and slaughtered without rest and with rest for 4 hours were 2.86 ± 0.59 and 2.22 ± 0.56 , respectively and for the broilers transported under stocking density of 350 sq. cm were 2.24 ± 0.64 and 2.02 ± 0.26 , respectively. The broilers transported for 350 km with stocking density of 480 sq. cm without feed withdrawn and slaughtered without rest and with rest for 4 hours were 2.46 ± 0.51 and 1.05 ± 0.35 , respectively and for the broilers transported under stocking density of 350 sq. cm were 2.46 ± 0.21 and 1.78 ± 0.27 , respectively. There was a significant difference ($p < 0.05$) in the serum uric acid between the broilers slaughtered after transported for 350 km, without rest and with rest for 4 hours when compared with the control group. The broilers transported for 350 km under stocking density of 480 sq. cm with feed not withdrawn and slaughtered without rest had significant ($p < 0.05$) increase in the level of uric acid when compared with broilers slaughtered with rest. The broilers transported under stocking density of 350 sq. cm with feed not withdrawn and slaughtered without rest had significant ($p < 0.05$) increase in the level of uric acid when compared with control.

Table 1: Mean ($\pm$ S.E.) serum uric acid (mg/dl) in broiler chicken slaughtered without rest and with rest after transport

Treatment		Transport distance (km)	
Rest before slaughter	Feed	250	350
Control (without transport)		0.91 ^a ±0.26	0.91 ^a ±0.26
Stocking density 480 sq. cm			
Without rest	Withdrawn	2.70 ^{ab} ±0.64	2.86 ^b ±0.59
4 hour rest		2.07 ^{ab} ±0.44	2.22 ^{ab} ±0.56
Without rest	Not withdrawn	3.06 ^b ±0.68	2.46 ^b ±0.51
4 hour rest		1.41 ^{ab} ±0.42	1.05 ^a ±0.35
Stocking density 350 sq. cm			
Without rest	Withdrawn	3.08 ^b ±0.75	2.24 ^{ab} ±0.64
4 hour rest		2.62 ^{ab} ±0.91	2.02 ^{ab} ±0.26
Without rest	Not withdrawn	3.05 ^b ±0.50	2.46 ^b ±0.21
4 hour rest		2.62 ^{ab} ±0.47	1.78 ^{ab} ±0.27

^{abc}Means with different superscripts in a column differ significantly ($P < 0.05$) (n=6)

The results of the current study coincide with the findings of Delezie *et al.* (2007)^[4] who found that broilers transported 1.5 hr under high stocking density had significantly increased plasma uric acid level when compared with broilers transported under low stocking density. Hussnain *et al.* (2020)^[7] found that birds transported for 240 km had significantly higher uric acid levels when compared to birds transported for 80 and 160 km transport. He *et al.* (2022)^[6] found that serum uric acid level for the broilers transported for 3 h was $133 \mu\text{mol/L}$, which increased significantly when compared with control group (121 ng mL). Rajendrakumar *et al.* (2023)^[13] found that broilers transported upto 150 km with stocking density of 480 sq. cm and with feed withdrawn and slaughtered without rest had significant ($p < 0.05$) increase in the level of uric acid when compared with the broilers slaughtered with rest of 4 hr. The broilers transported upto 150 km after feed withdrawn under stocking density of 350 sq. cm and slaughtered after 4 hr rest had a significantly ($p < 0.05$) increased level of uric acid when compared control group.

On the contrary to the findings Sarkar *et al.* (2013)^[12] found that broilers transported by paddle van for a period of 2.5 hr, plasma uric acid levels showed no significant variation when compared with the control. Al-Abdullatif *et al.* (2021)^[1] observed that uric acid level of the broilers transported for 4 h had no significant effect.

3.2 Malonaldehyde (MDA)

The results (Mean $\pm$ SE) of serum malonaldehyde ($\mu\text{g/dl}$) in broiler chicken slaughtered without rest and with rest after transport are presented in the Table 2. The serum MDA of the broilers transported for 250 km with stocking density of 480 sq. cm after feed withdrawn and slaughtered without rest and with rest for 4 hours were 0.31 ± 0.02 and 0.42 ± 0.06 , respectively and for the broilers transported under stocking density of 350 sq. cm were 0.54 ± 0.03 and 0.47 ± 0.06 , respectively. The broilers transported for 250 km with stocking density of 480 sq. cm without feed withdrawn and slaughtered without rest and with rest for 4 hours were 0.48 ± 0.08 and 0.47 ± 0.04 , respectively and for the broilers transported under stocking density of 350 sq. cm were 0.51 ± 0.04 and 0.47 ± 0.04 , respectively. There was significant increase ($p < 0.05$) in the serum MDA for the broilers slaughtered after transported for 250 km, without rest and with rest for 4 hours when compared with the control group.

The broilers transported for 250 km after feed not withdrawn under stocking density of 480 sq. cm and slaughtered after without rest and with rest had significantly ($p<0.05$) higher level of MDA when compared with control. The broilers transported for 250 km after feed not withdrawn under stocking density of 480 sq. cm and slaughtered after without rest had significantly ($p<0.05$) higher level of MDA when compared with broilers slaughtered with rest of 4hr and control. The broilers transported for 250 km after feed withdrawn and not withdrawn under stocking density of 350 sq. cm and slaughtered after without rest and with rest had significantly ($p<0.05$) higher level of MDA when compared with control.

Table 2: Mean ($\pm$ S.E.) of serum malonaldehyde ($\mu\text{g/dl}$) in broiler chicken slaughtered without rest and with rest after transport

Treatment		Transport distance (km)	
Rest before slaughter	Feed	250	350
Control (without transport)		0.27 ^a ±0.04	0.27 ^a ±0.04
Stocking density 480 sq. cm			
Without rest	Withdrawn	0.31 ^{ab} ±0.02	0.53 ^{de} ±0.04
4 hour rest		0.42 ^{bc} ±0.06	0.51 ^{cde} ±0.09
Without rest	Not withdrawn	0.48 ^c ±0.08	0.58 ^e ±0.02
4 hour rest		0.47 ^c ±0.04	0.30 ^{ab} ±0.02
Stocking density 350 sq. cm			
Without rest	Withdrawn	0.54 ^c ±0.03	0.32 ^{ab} ±0.03
4 hour rest		0.47 ^c ±0.06	0.41 ^{bcd} ±0.04
Without rest	Not withdrawn	0.51 ^c ±0.04	0.38 ^{abc} ±0.02
4 hour rest		0.47 ^c ±0.04	0.55 ^{de} ±0.05

^{abcde}Means with different superscripts in a column differ significantly ($P<0.05$) (n=6)

The serum MDA of the broilers transported for 350 km with stocking density of 480 sq. cm after feed withdrawn and slaughtered without rest and with rest for 4 hours were 0.53 ± 0.04 and 0.51 ± 0.09 , respectively and for the broilers transported under stocking density of 350 sq. cm were 0.32 ± 0.03 and 0.41 ± 0.04 , respectively. The broilers transported for 350 km with stocking density of 480 sq. cm without feed withdrawn and slaughtered without rest and with rest for 4 hours were 0.58 ± 0.02 and 0.30 ± 0.02 , respectively and for the broilers transported under stocking density of 350 sq. cm were 0.38 ± 0.02 and 0.55 ± 0.05 , respectively. There was a significant increase ($p<0.05$) in the serum MDA for the broilers slaughtered after transported for 350km, without rest and with rest for 4 hours when compared with the control group. The broilers transported under stocking density of 480 sq. cm with feed not withdrawn and slaughtered without rest had significant ($p<0.05$) higher level of MDA than the broiler slaughtered with rest. The broilers transported under stocking density of 350 sq. cm with feed not withdrawn and slaughtered with rest had a significantly ($p<0.05$) increased level of MDA than the broiler slaughtered without rest. The study results agreed with the findings of Perai *et al.* (2014) [10] reported that plasma malonaldehyde concentration increased significantly in broilers after 3 hr transport when compared with before transport. He *et al.* (2022) [6] also found that serum malonaldehyde level for the broilers transported for 3 h were 10.64 nmol/mL, which increased significantly when compared with control group (7.95 nmol/mL), respectively. Rajendrakumar *et al.* (2023) [13] found that broilers transported upto 150 km with stocking density of 480 sq. cm and slaughtered without rest had a significantly reduced level of MDA when compared with the broilers slaughtered with rest of 4 hr. The broilers transported upto 150 km with stocking density of 350 sq.cm with feed

withdrawn, slaughtered with rest and with feed not withdrawn, slaughtered without rest had a significantly ($p<0.05$) decreased level of MDA. On the contrary to the findings Delezie *et al.* (2007) [4] and Castellinia *et al.* (2016) [3] observed that transport had no significant difference on MDA of broiler.

4. Conclusion

The 4 hour rest after transport upto 250 km reduced the level of uric acid in the broilers transported with stocking density of 480 and 350 sq. cm with feed withdrawn and not withdrawn. The level of MDA did not decrease significantly with rest of 4 hours after transport upto 250 km. The broilers transported under stocking density of 480 sq.cm with feed not withdrawn and slaughtered after 4 hour rest had significantly decreased MDA, whereas in 350 sq.cm after 4 hour rest had increased level of serum MDA.

Conflict of Interest

Not available

Financial Support

Not available

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