Article

Warm weather transport of broiler chickens in Manitoba. I. Farm management factors associated with death loss in transit to slaughter

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Abstract — This observational study was conducted to identify flock of origin level factors associated with mortality during transport to slaughter of 1 090 733 Manitoba broiler chickens in spring and early summer. The death loss in transit was 0.346% (3778 birds). Death loss on the farm of origin during the growing phase of production and bird body weight at slaughter were associated with increased mortality in-transit. Death loss during production significantly exceeded, while crowding of growing birds was significantly less than, European proposed animal welfare standards.

Résumé — Transport des poulets à griller par temps chaud au Manitoba. 1 — Facteurs de gestion des élevages associés à la mortalité dans le transport vers l'abattoir. Cette étude a été réalisée pour identifier les différents facteurs de mortalité associés aux troupeaux d'origine au cours du transport vers l'abattoir de 1 090 733 poulets à griller du Manitoba au printemps et au début de l'été. La mortalité au cours du transport a été de 0,346 % (3778 oiseaux). La mortalité à la ferme d'origine au cours de la période de croissance et le poids des oiseaux à l'abattoir étaient associés à l'augmentation de la mortalité pendant le transport. La mortalité au cours de la période de croissance dépassait significativement les normes européennes de bien être des animaux alors que le surpeuplement des animaux en croissance était significativement moindre.

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Introduction

The welfare of chickens in broiler production is becoming a consumer concern in relation to both method of production (1) and transportation to slaughter (2,3). In the European Union (EU), these concerns have resulted in a proposal for regulatory standards that aims to introduce animal welfare improvements in the intensive farming of chickens by means of technical and management requirements for the slaughter establishments, enhanced monitoring on the farms, and an increased flow of information among the producer, competent authorities, and the slaughterhouse (4). Some of the welfare specific standards proposed in this document are a stocking density of no more than 30 kg/m^2 in the production area and a maximum, age adjusted, cumulative mortality during production (3.28% for 38-day-old broilers) (4).

In western Canada, little research has been done on risk factors related to warm weather broiler mortality in-transit. Little current information is available to estimate the proportional impact of the health of the flock preloading versus the conditions of a specific truck load in determining or increasing the risk of in-transit loss. Work in other countries with similar production systems suggests that in the broiler industry, 0.1% to 0.2% transport mortality is common and generally less than 0.5% of the birds loaded (2,5–9).

The purpose of this project was to identify risk factors in flock of origin for broiler chicken death during transit to slaughter under late spring and summer weather conditions in Manitoba.

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Materials and methods

This observational study was conducted over 2 consecutive broiler production cycles. Geographically, the broiler grower industry in Manitoba is clustered around 2 slaughter facilities, with the provincial veterinary diagnostic laboratory within a

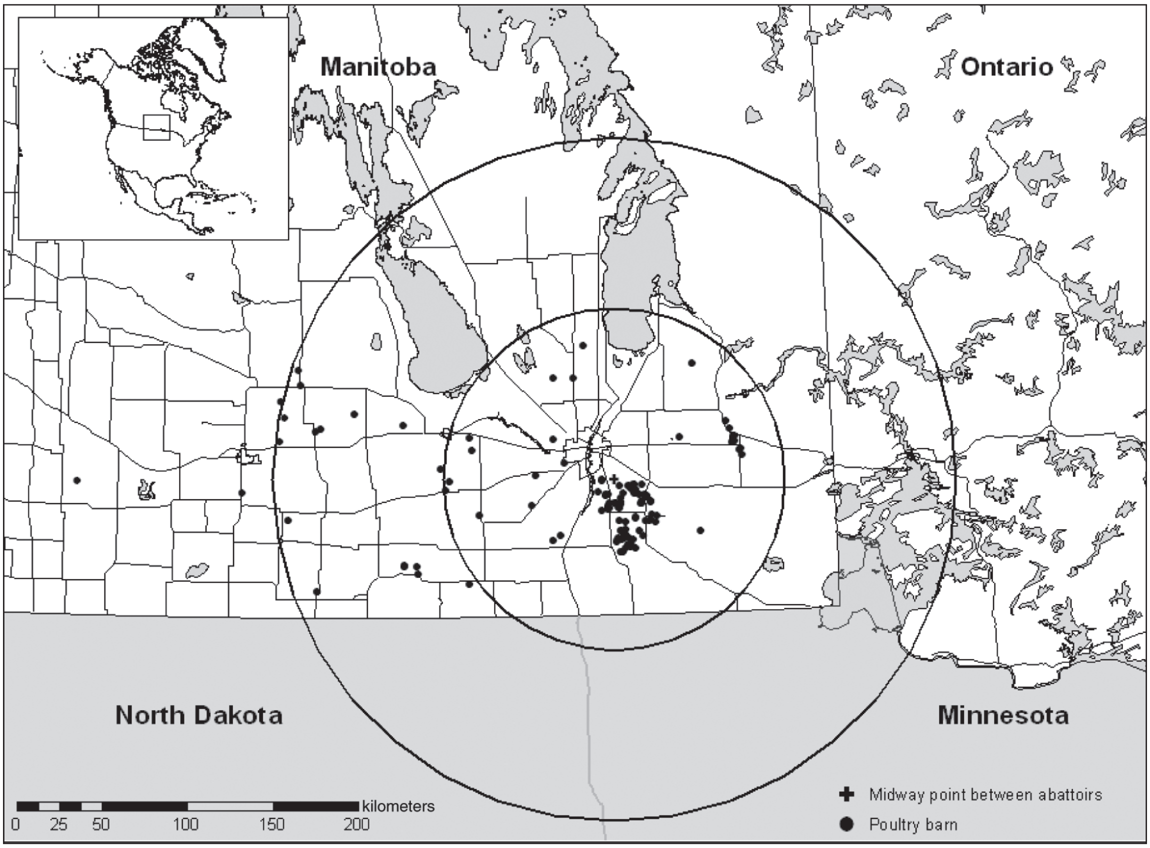

Figure 1. Map of southern Manitoba indicating the location of 125 broiler chicken growers (●) in relation to major highway transport routes. Mapped barn locations were approximated by using the sectional central point from the quarter section (65 ha plot) where the barn is located. The mid point between the 2 major abattoirs (✚) is central to concentric circles representing 100-km and 200-km distances from this point. Ninety-five percent of producers are located within 132 linear km from the point midway between the 2 abattoirs (map was created and calculations done in ArcGIS 9.0; Environmental Systems Research Institute, Redlands, California, USA).

5-minute drive from 1 of these. Of 125 producers in 2002, 122 farms (97.6%) were within 200 km of a point midway between the major abattoirs, and 85% lay within 100 km of this point (Figure 1).

Abattoirs participated in the study 1/d/wk, alternating Tuesday and Thursday. The 1st slaughter day was randomly assigned to an abattoir by the flip of a coin. Each abattoir participated in the program for 10 consecutive weeks between May 22 and August 1, 2002. Broiler chickens dead at unloading were counted and causes of carcass condemnation were recorded for each flock.

Producers were recruited to the program by direct telephone contact based on their slaughter schedule. Each farm was visited on the preslaughter day when information specific to the flock production records was collected and all available fresh in-barn mortalities were collected for postmortem evaluation. The information was obtained by interview with the flock manager and from the flock sheet, which is a brief history of production, required under food safety regulations (10).

The total number of day-old birds (FlockSize) was used to calculate on-farm weekly mortality rates. The number of live birds loaded for transport to slaughter was the flock size at slaughter (Del2Plant). The total death loss accumulated through the production period (ShrinkOnFarm) was calculated as the numerical difference between Del2Plant and the FlockSize expressed as a percentage of FlockSize. To compensate for older birds having an increased cumulative mortality, age adjusted mortality ratio (AgeAdjMort) was calculated by dividing ShrinkOnFarm by the European standard maximal cumulative death loss target (1% plus 0.06% [age in days]) (4). Final barn stocking density (BarnDensity) was calculated as the total weight of chickens arriving at the slaughter plant divided by the floor area of the barn ($kg \cdot m^{-2}$). Bird live weight at slaughter was calculated from the cumulative weight of loaded birds (from truck scale tickets) divided by the Del2Plant. The flock condemnation rate (CondemRate) was calculated as the number of carcasses condemned at postmortem veterinary inspection (by the abattoir veterinarian-in-charge) divided by the Del2Plant, minus the cumulative dead at unloading (FlockDAU) from all trucks. Cumulative dead at unloading was the sum of all birds DAU from all trucks transporting broilers from any flock divided by Del2Plant expressed as a percentage.

Chick quality was assessed by early death loss, total mortality in the first 7 d of brooding (Week-1Mort) (11,12), and

Table 1. Comparison of overall flock performance and flock performance by plant

	Summary statistics		Plant 1 n = 40		Plant 2 n = 54		
Variable	Mean	$s_{\bar{x}}$	Mean	$s_{\bar{x}}$	Mean	$s_{\bar{x}}$	P^a
AgeAtKill (d)	38.7	1.80	37.8	1.68	39.4	1.57	0.0001
BirdWeight (kg)	1.919	0.146	1.8256	0.1415	1.9833	0.1096	0.0001[b]
ExtraChick	27.3	10.4	21.0	3.97	32.15	11.0	0.0001[b]
CondemRate (%)	1.70	2.63	0.828	0.508	2.34	3.31	0.0016[b]
FlockDAU (%)	0.376	0.606	0.223	0.134	0.489	0.775	0.0167[b]
ShrinkOnFarm (%)	6.94	3.80	5.96	2.11	7.67	4.55	0.0175[b]
BarnDensity ($kg \cdot m^{-2}$)	24.5	3.45	23.5	2.95	25.1	3.66	0.0296
Del2Plant	11 604	4457	12 790	5132	10 724	3692	0.034[b]
AgeAdjMort	2.047	1.088	1.827	0.650	2.210	1.304	0.065[b]

[a] Two-Sample T-test
[b] Unequal variances, $s_{\bar{x}}$ = standard error of the mean
AgeAtKill — number of days of age of broilers when slaughtered where chicks were 1 d old when placed
BirdWeight — average live weight of broiler at slaughter
ExtraChick — number of extra chicks placed at the discretion of the hatchery per 1000 chicks contracted to the farm
CondemRate — number of broilers condemned divided by the number of broilers delivered alive to the plant
FlockDAU — number of birds dead at unloading divided by the number of birds loaded
ShrinkOnFarm — difference between the number of chicks placed on day 1 and the number Del2Plant
BarnDensity — mass of live chicken loaded on truck from the barn divided by the barn area
Del2Plant — number of broilers loaded at the farm
AgeAdjMort — ratio of percentage of broilers dying prior to market age over the EU proposed target for that age (see text)

Table 2. Flock factors associated with FlockDAU (n = 94)

	Stepwise linear regression[a] Adjusted R^2 0.1237				
Variable	Coefficient	$s_{\bar{x}}$	T	P	VIF[2]
ShrinkOnFarm	1.074	0.4783	2.25	0.0271	1.0
BirdWeight (g)	4.882	1.604	3.04	0.0031	1.0

Unforced variables in Analysis: AgeAdjMort, DIB, DIB%
[a] Abattoir as the weighted variable
$s_{\bar{x}}$ = standard error of the mean, T = T statistic, tests the hypothesis that a regression coefficient is 0, VIF = Variance Inflation Factor
ShrinkOnFarm — a flock level variable and is the difference between the number of chicks placed on day 1 and the number delivered to the slaughterhouse
BirdWeight — average live weight of broiler at slaughter
AgeAdjMort — ratio of percentage of broilers dying prior to market age over the EU proposed target for that age in days (see text)
DIB — number of birds dead in the barn on the day prior to slaughter
DIB% — DIB divided by the number of live birds loaded on slaughter day as a percent

number of extra chicks placed per thousand (ExtraChick), as reported by the farmer. Weekly mortality was calculated from farm records as the number of dead and culled chicks in any 7 d of residence divided by the number of chicks on farm on day 1 of that week. Antibiotic usage during production was recorded but not included in the statistical analysis, as only 4 of 94 flocks used antibiotics during production.

Hatcheries (n = 4) were associated with 1 of the 2 abattoirs through ownership and management. Approximate date of slaughter was known at the time of chick placement. Producers were able to sell to either abattoir but tended to associate long-term with either one or other hatchery-abattoir production system. Both abattoirs had similar covered truck holding facilities equipped with high volume fans to move air between the loaded trucks. Chickens were held in the transport crates on the truck until immediately prior to shackling for slaughter. Data were pooled and "Plant," a dichotomous variable representing the uncontrollable differences in production complexes, was included as a weighted variable in the statistical analysis.

All data were entered weekly (Friday) in a computer database program (Access; Microsoft Corporation, Redmond, Washington, USA) and reviewed for omissions and errors. Database information was exported into software (Excel; Microsoft Corporation) for manipulation and analyzed by using a statistical analysis program (Statistix 8 for Windows; Analytical Software, Tallahassee, Florida, USA).

Production variables associated with FlockDAU at P = 0.20 (Pearson correlation) were analyzed by stepwise linear regression to eliminate highly correlated variables and arrive at a final model.

Results

During the 20 surveillance days, 1 090 733 broiler chickens originating from 94 flocks arrived for slaughter in 198 loads. Slaughter volume was roughly equivalent for both abattoirs, 511 618 from 40 flocks (98 loads) versus 579 115 from 54 flocks (100 loads). The aggregate DAU rate was 0.346% (3778 birds). No flock was lost from the study due to the owner declining participation.

The average broiler chicken came from a flock of 11 604, s = 4457 birds, was 38.7, s = 1.8 d of age (1-day-old when placed), and weighed 1.92, s = 0.146 kg. The BarnDensity averaged 24.5, s = 3.45 $kg \cdot m^{-2}$ with 7 of the 94 flocks exceeding 30 $kg \cdot m^{-2}$ (max 32.4 $kg \cdot m^{-2}$). The AgeAdjMort ratio was 2.0468, s = 1.0878 (max 6.54), and was 1 or less in 3 of 94 flocks. Average weekly mortality was 1.17%, 0.77%, 0.823%, 0.938%, and 1.15% for weeks 1 to 5 of production, respectively. The mean FlockDAU rate was 0.376%, s = 0.608 (max 3.62%).

The 2 plants were under different veterinarians-in-charge and also targeted different markets, which resulted in an abattoir effect on several important factors under study, such as condemnation rate, bird age, and market bird weight (Table 1). When controlled for the effect of production system, the number of birds removed from the flock prior to shipping (ShrinkOnFarm) and the live body weight of broilers at the time of slaughter (BirdWeight) were associated with number of broilers dead at unloading (FlockDAU) and accounted for 12.4% of the variability in FlockDAU (Table 2). The percentage of birds dead in barn the day prior to loading was not statistically associated with FlockDAU (Pearson correlation P = 0.063), but was associated with ShrinkOnFarm (P = 0.001) and AgeAdjMort (P = 0.001).

The ExtraChick and Week-1 mortality were not correlated in flock data (Pearson correlation, P = 0.777), and ExtraChick showed considerable variation, mean 27.3, s = 10.4, (range 0–54.5). However, ExtraChick was correlated with CondemRate (Pearson correlation P = 0.0032) and DaysAtKill (P = 0.0341). CondemRate was also correlated with ShrinkOnFarm (P = 0.0193).

Complete weekly (5 wk) death loss was available for 91 of 94 flocks. In only 33 of 94 flock records did the summation of weekly mortality numbers approach (within 95% of) the ShrinkOnFarm value.

Discussion

Manitoba produced 26.7 million broiler chickens in 2002 (13); this study captured 4.1% of annual production and was limited to a single major weather pattern.

Previous studies of broiler death in transit have focused largely on the causes of individual bird death or risk factors associated with loading and transport. This study attempted to examine farm production variables that may contribute to transport related mortality. The proposed EU maximal on farm stocking density of less than 30 $kg \cdot m^{-2}$ appears to be exceeded rarely in normal production practice in Manitoba.

The flocks in this study, on average, had twice the death loss (Table 1, AgeAdjMort) during production than the suggested welfare target for the EU (4). The median ShrinkOnFarm of 6.94% is also higher than a 1992 national estimate in the UK of 5.4% (14).

Hatcheries in Manitoba officially provide 2% "extra chicks," for which they do not bill the farmer, in each shipment of day-old broilers. This practice has been reported previously in other countries and is to compensate for Week-1 mortality (15). The practice of placing extra chicks was examined in an attempt to understand this hatchery management behavior and because the number of chicks placed is essential to calculating cumulative mortality rates, a suggested animal welfare indicator. Week-1 mortality is thought to be a direct measure of chick health at hatch and survivability (1,11,12). The ExtraChick and the Week-1 mortality were not correlated in flock data, suggesting that the provision of surplus chicks was not a hatchery compensatory response to a poor quality hatch. Flocks with high ExtraChick scores tended to grow to an older age and have higher ShrinkOnFarm. If the production cycle included in this study represented a typical production cycle for the producer, the hatchery practice of placing "surplus" chicks on a farm would appear to be consistent with a desire of the hatchery to maintain dependable product flow at slaughter and partially compensate within the system for producers growing larger birds or for producers known to have high condemnation rates or loss on farm.

There was a significant discrepancy (more than 5%) on 2/3 of the farms between the sum of weekly death loss and the ShrinkOnFarm. This can be explained by either a failure of farmers to accurately record weekly mortalities or a failure to load live, light weight poultry for slaughter at the time of marketing the flock. The weekly death loss data was collected on the day prior to loading, and there was no method in the study design to identify numbers of live, but not loaded, poultry on loading day.

This study suggests either that cumulative on-farm mortality during grow-out is significantly different in Manitoba from that expected for production systems in the EU or that there are market forces that foster high levels of on-farm culling. In calculating financial settlement to the farmer in Manitoba, the abattoir deducts the financial equivalent of the average weight of broiler loaded for each broiler humanely slaughtered and subsequently condemned at inspection. This system provides a farmer with financial incentive not to load emaciated or small broilers, and farmers appear to be responding to this incentive. Weekly death rates were relatively similar in week-2 through week-5, consistent with ongoing culling of poor birds.

The final regression model in the study supports a hypothesis that death in transit is associated with larger birds, which has been reported previously (7), and with unidentified factors common to the risk of increased death loss during the grow-out period.

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ARTICLE

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