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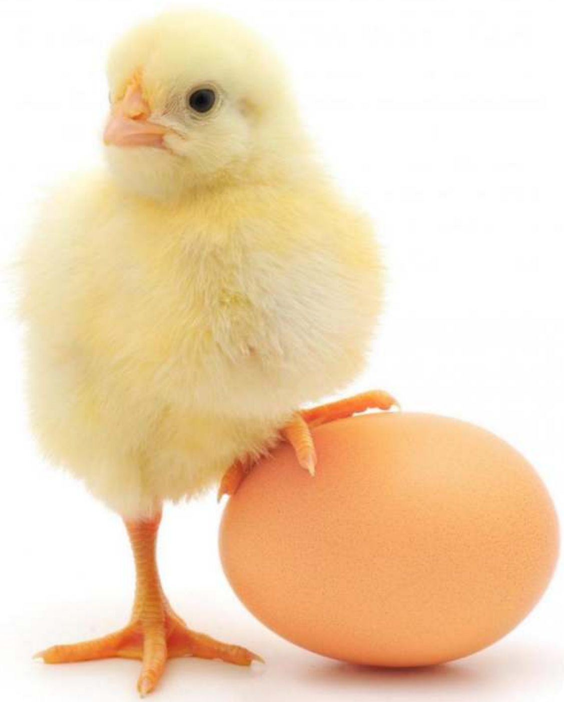

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Effect of an Organic Acid Product During Feed Withdrawal on Broiler Mortality, Shrinkage and Carcass Condemnation Following Transport to Processing

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Abstract: In poultry and other species, economic losses during transport are due to mortality, carcass shrinkage (carcass dehydration) and carcass condemnation. Feed Withdrawal (FW) prior to processing is necessary to reduce fecal ingesta contamination of carcasses during processing. Direct acidification of the water with specific concentrations of some Organic Acids (OA) has been shown to significantly reduce the amount of potential pathogens such as *Salmonella* on the carcasses by antemortem disinfection of the crops when used during the pre-slaughter feed withdrawal period. However, reduced water consumption due to effective OA concentrations have been shown to increase carcass shrink. In the present study, the effect of a commercially available mix of flavored organic acids significantly reduced carcass condemnation at the processing plant in 3/3 trials ($p<0.05$) % and mortality during transportation in 1/3 trials (0.40% treated *vs.* 0.65% control). A consistent improvement of average body weights at the farm and at the processing plant due to reduction of carcass shrinkage and condemnation at the processing plant were also observed in the treated marked age broiler chickens. Water intake was numerically higher in treated birds when compared with non-treated birds (72.9 mL *vs.* 62.5 mL). During FW, this OA product could be useful to reduce mortality, shrinkage and carcass condemnation during transportation to the processing plant of broiler chickens.

Key words: Organic acids, broilers, mortality, carcass shrinkage, carcass condemnation and transportation

Introduction

Feed Withdrawal (FW) prior to processing of poultry is an efficient and commonly employed method to attempt to reduce contamination of carcasses by contents of the gastrointestinal tract during processing (Veerkamp, 1986). Fecal material or ingesta and bacteria associated with these contaminants, may be introduced to the broiler carcass during processing. Damage to the intestines may occur during evisceration process, leading to carcass contamination (Sams, 2001). Russell (2003) reported that intestines cut during the evisceration process ranged from 2 to 34% of broilers evaluated in 1 processing plant. At a commercial processing plant, 25% of crops collected at the cropper machine were observed to have been damaged (Hargis *et al.*, 1995). An increased concern over *Salmonella* contamination of carcasses has resulted in intensified USDA concerns about detecting fecal or ingesta contamination (USDA, 1993). Such contamination, although having many indirect causes, is directly related to the amount and condition of ingesta in the gastrointestinal (GI) tract at the time of processing. The amount and condition of the ingesta, in turn, is primarily related to feed and water intake prior to processing and to their rate of passage through the GI (Duke *et al.*, 1997). With broilers, studies have indicated that 8 to 10 h are needed to minimize fecal contamination (Wabeck, 1972). However, shrinkage (carcass dehydration) begins immediately after FW (Benibo and Farr, 1985; Denton, 1985; Veerkamp, 1986), resulting in recommendations that slaughter take place within 4 to 6 h after FW to minimize shrinkage. Thus, processing schedules need to be established taking into account FW effects on both gut fullness and shrinkage. Gall bladder filling during FW must also be considered, because a filled bladder is more easily ruptured. Direct acidification of the water with organic acids could significantly reduce the amount of recoverable *Salmonella* on the carcasses, crops and cecal tonsils when used during the pre-slaughter feed withdrawal period (Byrd *et al.*, 2001; Jarquin *et al.*, 2007; Wolfenden *et al.*, 2007). In the present study, the effect of a commercially available buffered and flavored mix of organic acids were used during Feed Withdrawal (FW) to evaluate the mortality, shrinkage and carcass condemnation during transportation of market age broilers to the processing plant.

Materials and Methods

Organic acids: An organic acid-based product (Perform-Max Optimizer II™, Sigrah-Zellet Mexico, S.A. de C.V., Cuernavaca, Morelos Mexico) was used during FW at a dose of (1L/1,000L water) according to manufacturer's directions. This commercial Organic Acid (OA) product is a combination of 5 different organic acids (lactic, acetic, tannic, propionic and caprylic acids) along with proprietary flavoring agents that has also shown to reduce *Salmonella* colonization in crop and cecal tonsils with out affecting water consumption in chickens (Jarquin *et al.*, 2007; Wolfenden *et al.*, 2007).

Trailers and chickens: A series of 3 trials were conducted with 128 trailers that included a total 655,717 market age broiler chickens from a commercial-cross broiler line of two integrated poultry companies in the central region of Mexico. The studies were conducted during summer, fall and winter of 2006 and data of mortality during transportation and condemnation at the processing plant were recorded by the companies. A forth trial was conducted during summer of 2006 where a sub population of 48 female broilers from two paired chicken houses of 17,800 were use to evaluate individual difference in carcass shrinkage.

Trial 1: Trial 1 was performed during summer 2006. OA was administered according to manufacture's directions continuously during 10 hours of FW in commercial chicken houses of market age broiler chickens (50 days of age). A total of 18 trailers with an average of 5,184 broilers per trailer received the OA (93,316 chickens) and were compared against same marked age chickens from 9 trailers with an average of 5,622 chickens per trailer of non-treated paired control chicken houses that also received 10 hours of FW (50,600 chickens). Trailers were weighted at the farm and upon arrival to the processing plant to determine carcass shrinkage average. The transit time from these chicken houses to the processing plant was 1.30 h.

Trial 2: Trial 2 was performed during fall 2006. OA was administered according to manufacture's directions continuously during 12 hours of FW in commercial chicken houses of market age broiler chickens (52 days of age). A total of 45 trailers with an average of 5,303 broilers per trailer received the OA (238,625 chickens) and were compared against same marked age chickens from 35 trailers with an average of 5,219 chickens per trailer of non-treated paired control chicken houses that also received 10 hours of FW (182,680 chickens). Trailers were weighted as in trial 1. The transit time from these chicken houses to the processing plant was 3 h.

Trial 3: Trial 3 was performed during winter 2006. OA was administered according to manufacture's directions continuously during 7 hours of FW in commercial chicken houses of market age broiler chickens (56 days of age). A total of 12 trailers with an average of 4,264 broilers per trailer received the OA (51,17 chickens) and were compared against same marked age chickens from 9 trailers with an average of 4,369 chickens per trailer of non-treated paired control chicken houses that also received 7 hours of FW (39,326 chickens). Trailers were weighted as in trial 1. The transit time from these chicken houses to the processing plant was 5 h.

Trial 4: Chickens within two paired houses for each experiment were compared. One of the houses was selected to provide OA during 9 h of FW and the other house was used as a control house with no treatment during the 9 h of FW. Within each house, a 5×5 m wire panel pen was assembled, with additional small mesh wire across the bottom of each panel. Panels were assembled with cable ties and placed in a single row along the center aisles of the houses, 48 broiler chickens were placed in each pen. Each pen was equipped with a single 20-L drinker. Broilers were tagged and weighed at the farm and upon arrival to the processing plant to determine carcass shrinkage average. The transit time from these chicken houses to the processing plant was 3 h.

Data analysis: Data was collected at market age for mortality during transportation from the farm to the processing plant and the trailers were weighted in truck scales at the farm and upon arrival to the processing plant to determine average carcass shrinkage. Data collected were subjected to one-way analysis of variance for carcass shrinkage during transportation and significant differences between means were further separated using Duncan's multiple range test. (SAS Institute, 1988). Mortality and condemnation data were analyzed through the chi-square test of independence (Steel and Torrie, 1960). Statistical significance was considered at $p<0.05$. Estimation of cost benefits (Cents/kg live broiler) was performed by formulas used by one of the broiler operation.

Results and Discussion

The transport of live animals has important implications in both economic and welfare areas (Grandin, 1993). Economic losses during transport are due to mortality, particularly of pigs and poultry, carcass bruising and shrinkage (loss of weight) and reductions in meat quality (Warriss, 1996). In the present report, the effect of this OA product during FW on mortality, shrinkage and carcass condemnation during transportation to the processing plant were determinated. Table 1 shows the effect of this OA product administered during FW of broilers on mortality during transportation and carcass condemnation to the processing plant. In each of the three trials, a significant reduction ($p<0.05$)% in carcass condemnation at the processing plant was observed in chickens which received the OA when compared with their respective control non-treated groups. In trial 3, a significant reduction in mortality during transportation was observed in the chickens that received the OA

Table 1: Effect of a commercial organic acid product administered during feed withdrawal of broiler chicks on mortality during transportation and carcass condemnation at the processing plant

	Control			Treated		
Trial No.	Number of chickens	Mortality During transportation (%)	Condemnation at the processing plant (%)	No. chicks	Mortality During transportation (%)	Condemnation at the processing plant (%)
1	50,600	177 (0.35)[a]	207 (0.41)[a]	93,316	327 (0.35)[a]	56 (0.06)[b]
2	182,680	548 (0.30)[a]	365 (0.20)[a]	238,625	716 (0.30)[a]	262 (0.11)[b]
3	39,326	256 (0.65)[a]	63 (0.16)[a]	51,170	205 (0.40)[b]	51 (0.10)[b]
Total	272,606	981 (0.36)[a]	635 (0.23)[a]	383,111	1,248 (0.32)[b]	369 (0.10)[b]

[a,b]Different superscripts within rows indicates significant ($p<0.05$) % differences

Table 2: Effect of a commercial organic acid product administered in the drinking water during feed withdrawal on carcass shrinkage during transportation from de farm to the processing plant

		Control				Treated			
Trial #	Market age	Number of chickens	Avg. BW/ Chick at farm (Kg)	Avg. BW/ Chick at processing plant (Kg)	Avg. Shrinkage/ chick (Kg) during transportation (%)	No. chicks	Avg. BW/ Chick at farm (Kg)	Avg. BW/ Chick at processing plant (Kg)	Avg. Shrinkage/ chick (Kg) during transportation (%)
1	50d	50,600	2.530	2.450	0.080 (3.16)	93,316	2.565	2.522	0.043 (1.68)
2	52d	182,680	2.730	2.665	0.065 (2.38)	238,625	2.707	2.648	0.059 (2.18)
3	56d	39,326	3.341	3.256	0.097 (2.90)	51,170	3.377	3.297	0.080 (2.37)
Total		272,606	2.867	2.790	0.077 (2.68)	383,111	2.883	2.822	0.061 (2.11)

Table 3: Effect of a commercial organic acid product administered during a 9 hour feed withdrawal period on individual carcass shrinkage during transportation from the farm to the processing plant and water intake during the feed withdrawal period

	Avg. BW (g)±SE[1]			
Treatments	Farm	Processing plant	Shrinkage (g)	Water intake (mL)
Control	2,090.42±27.35[a]	1,977.50±28.88[a]	-112.92±8.07[b]	62.50
OA	2,051.91±22.58[a]	1,977.45±21.91[a]	-74.47±3.63[a]	72.90

[1]Values presented as mean±SE. Means presented represent the body weight gain mean of 48 chicks per treatment group, [ab]Different letters within rows of experimental columns indicate significant differences between treatments ($p<0.05$)%

product when compared with the control non-treated broilers (0.40% *vs.* 0.65% respectively). The effect of this OA product administered in the drinking water during FW on carcass shrinkage during transportation from the farm to the processing plant are summarized in Table 2. Carcass shrinkage was numerically reduced in all 3 trials in the broilers that received the OA product when compared with the control non-treated birds (2.11% *vs.* 2.68% respectively). This reduction was the effect of both numerically better average body weights of the chickens at the farm, perhaps due to increased water consumption during FW and also numerically better average body weights of the chickens at the processing plant in all 3 trials in those birds that received the OA product during FW as compared with control non-treated chickens (Table 2). Table 3 summarizes the effect of administration of this OA product during FW on individual carcass shrinkage during transportation from the farm to the processing plant and water intake during the FW period. In Table 3, a significant reduction in carcass shrinkage was observed in the chickens that received the OA when compared with their respective control non-treated groups (-74.47±3.63g *vs.* -112.92±8.07g respectively), with a range of shrinkage of 0 to 120 grams in the treated birds *vs.* a range of 0 to 240 grams in the control non-treated birds (data not shown). Water intake was also numerically higher in treated birds when compared with non-treated birds (72.9 mL *vs.* 62.5 mL). Economic estimates provided by the integrators suggested that use of this OA product saved 0.57% of body weight/broiler. Estimation of the cost benefits using this product during FW by the integrators suggested a ten-fold return on investment after deducting the cost of the OA product. Data used for these calculations were not made available to the authors. In areas where there are regulatory and consumer issues with *Salmonella* contamination of carcasses, there may be an additional advantage to some OA products. This product has shown to decrease *Salmonella* in market age broilers when administered during the pre-slaughter FW period (Jarquin *et al.*, 2007; Wolfenden *et al.*, 2007). Previous research has suggested that administration of lactic acid during the pre-slaughter FW period could lead to carcass shrinkage (Byrd *et al.*, 2001). While this evidence was shown when using lactic acid alone, the product evaluated in the present study was developed as a combination of organic acids used in combination at low individual concentrations so that water consumption was not discouraged (Jarquin *et al.*, 2007). Flavoring agents claimed by the manufactures have not been released or evaluated. Organic acids are a readily available energy source for both the chicken and the bacteria; therefore, it is important that the organic acids be administered in high enough concentrations to be bactericidal and low enough concentrations to be voluntarily consumed by the birds. In the present study, birds that received the OA product consumed more water than the control non-treated birds. This increase in water consumption may explain the reduction in carcass shrinkage and increase in average body weights at the farm and at the processing plant by increase in hydratation of the birds, which also decreased mortality during transportation and reduced condemnation at the processing plant.

References

Benibo, B.E. and A.J. Farr, 1985. The effects of feed and water withdrawal and holding shed treatments on broiler yield parameters. Poult. Sci., 64: 920-924.

Byrd, J.A., B.M. Hargis, D.J. Caldwell, R.H. Bailey, K.L. Herron, J.L. McReynolds, R.L. Brewer, R.C. Anderson, K.M. Bischoff, T.R. Callaway and L.F. Kubena, 2001. Effect of lactic acid administration in the drinking water during preslaughter feed withdrawal on *Salmonella* and *Campylobacter* contamination of broilers. Poult. Sci., 80: 278-83.

Denton, J.H., 1985. Four-hour maximum urged for feed/water withdrawal. Feedstuffs Dec., 30: 8-10.

Duke, G.E., B. Maureen and N. Sally, 1997. Optimum Duration of Feed and Water Removal Prior to Processing in Order to Reduce the Potential for Fecal Contamination in Turkeys. Poult. Sci., 76: 516-522.

Grandin, T., 1993. Introduction: management and economic factors of handling and transport. In Livestock Handling and Transport. Ed T. Grandin. Wallingford, CAB International, pp: 1-9.

Hargis, B.M., D.J. Caldwell, R.L. Brewer, D.E. Corrier and J.R. DeLoach, 1995. Evaluation of the chicken crop as a source of *Salmonella* contamination for broiler carcasses. Poult. Sci., 74: 1548-1552.

Jarquin, R.L., G.M. Nava, A.D. Wolfenden, A.M. Donoghue, I. Hanning, S.E. Higgins and B.M. Hargis, 2007. The Evaluation of Organic Acids and Probiotic Cultures to Reduce *Salmonella enteriditis* Horizontal Transmission and Crop Infection in Broiler Chickens. Int. J. Poult. Sci., 6: 182-186.

Russell, S.M., 2003. The effect of airsacculitis on bird weights, uniformity, fecal contamination, processing errors and populations of *Campylobacter spp*. and *Escherichia coli*. Poult. Sci., 82: 1326-1331.

Sams, A.R., 2001. First processing: Slaughter through chilling. Pages 19-34 in Poultry Meat Processing. A. Sams, Ed. CRC Press LLC, Boca Raton, FL.

SAS Institute Inc., 1988. SAS user's guide: statistics. SAS Institute Inc., Cary, N.C.

Steel, R.G. and J.H. Torrie, 1960. Principles and procedures of statistics. McGraw-Hill, New York.

USDA, 1993. Poultry Slaughter, National Agricultural Statistics Service, Washington, DC.

Veerkamp, C.H., 1986. Fasting and yield of broilers. Poult. Sci., 65: 1299-1304.

Warriss, P.D., 1996. The welfare of animals during transport. The Veterinary Annual, 36: 73-85.

Wabeck, C.J., 1972. Feed and water withdrawal time relationship to processing yield and potential fecal contamination of broilers. Poult. Sci., 51: 1119-1121.

Wolfenden, A.D., J.L. Vicente, J.P. Higgins, R. Andreatti, S.E. Higgins, B.M. Hargis and G. Tellez, 2007. Effect of organic acids and probiotics on *Salmonella enteritidis* infection in broiler chickens. Int. J. Poult. Sci., 6: 403-405.