Effect of different catching practices during manual upright handling on broiler welfare and behavior

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ABSTRACT The aim of this study was to identify the influence of different catching practices during manual upright handling on broiler welfare and behavior. Catching was examined in a total of 4,595 Cobb broilers with average live weight of 3.2 kg and 42 days old. Six catching practices were evaluated: shed curtain position, loading time, catching method, catching team, height of the crates from the floor, and placement of the bird in the crate. Behavioral welfare indicators were defined as follows: 1) broiler agitation in the catcher's hands, measured when the birds flapped their wings, kicked, or wriggled in the hands; 2) broiler striking the crate entrance as it was being placed in the crate, measured when the birds get the head, wings, or legs, hit at the crate entrance; and 3) broiler agitation in the crate, measured when birds flapped the wings or jumped inside the crate for 3 s or more after placement in the crate. A logistic regression model was used to calculate the chance of occurrence of each behavioral welfare indicator due to the handling factors. All catching practices evaluated in the present study influenced the birds' welfare and behavior. Thus, some procedures during broiler catching potentially improved their behavior, making them less prone to accidents, and consequently improved their welfare. The catching process should be performed with the curtains in the closed position, carrying one broiler per catcher in an upright position while containing its wings, carefully placing the birds inside the crates, and with the crates being positioned at a height of at least 21 cm from the ground. Additionally, it was concluded that more attention should be given to the broiler catchers, since the position of the curtain, loading time, and position of the crate during handling can influence the work done by them, affecting the welfare and behavior of both humans and birds.

Key words: poultry, stockperson, pre-slaughter handling, human–animal relationship

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INTRODUCTION

Catching birds for slaughter is one of the most stressful stages in broiler production and can cause suffering and stress to the animals (Queiroz et al., 2015; Kittelsen et al., 2018). It also causes economic problems due to fractures and lesions (Moran and Berry, 1988; Gregory and Wilkins, 1990; Queiroz et al., 2015). Countries such as the Netherlands and Belgium use automatic methods to carry out this management (Delezie et al., 2005). In most countries, including Brazil, catching is done manually.

Manual catching involves taking the birds in the hands and placing them in transport crates or containers (Leandro et al., 2001; Delezie et al., 2006). According to international animal welfare recommendations (DEFRA, 2002; OIE, 2017), broilers should be caught and loaded while the birds are in an upright position, but it is common to catch birds by legs and carry them in an inverted position or, less commonly, they are caught by the neck, which is not recommended (Paranhos da Costa et al., 2017).

In Brazil, most of the companies that produce broilers require the upright catching method because it reduces bird agitation and results in lower condemnation of the carcasses (Leandro et al., 2001). Studies comparing mechanical vs. manual catching, upright catching vs. catching by a leg, upright catching with neck

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catching and catching the birds by one or both legs revealed that, depending on the type of catching method used, there is variation in agitation, number of injuries, and mortality, which directly reflects on animal welfare (Carvalho, 2001; Leandro et al., 2001; Schilling et al., 2008; Langkabel et al., 2015). Additionally, Kittelsen et al. (2018) found that catching the broilers around the abdomen, in an upright position, improved broiler welfare in terms of mortality and reduced fractures.

Although there are many studies on catching method, there is a lack of studies taking into account factors such as the position of the shed curtain during handling and hence the amount of ambient light, the time of the loading of the birds from the start of catching, and the position of the transport crates during the catching process, all of which could potentially affect the quality of the handling, the behavior of the birds, and consequently their welfare. According to Gregory and Bell (1987), factors such as excessive sunlight, inadequate equipment, and loss of eye contact with other birds may contribute to increased agitation in broilers during the pre-slaughter stages and compromise their welfare. Higher light intensity can make the animals more active, while dark environments decrease activity, agitation, and escape behavior (Kristensen et al., 2006; Adamczuk et al., 2014).

Other factors such as the catchers working conditions and the individual characteristics of the catchers, such as their behavior and attitudes, can directly influence handling practices (Hemsworth and Coleman, 2011). Previous experience and training of the staff can also influence the quality of animal handling (Pilecco et al., 2013). In this way, it is possible to observe that when workers receive training in good animal handling practices, they present more positive attitudes, and are able to better identify the risks related to the handling procedures (Grandin, 2010, 2018; Ceballos et al., 2018).

In this context, the aim of this study was to evaluate the influence of the shed curtain position, loading time, catching method, catching team, height of the crates from the floor, and the placement of the bird in the crate during the catching process on broiler welfare and behavior and, from this evaluation, to suggest how better handling procedures could improve the catching process.

MATERIALS AND METHODS

This research study was carried out in accordance with Brazilian legislation and was approved by the Committee for the Ethical Use of Animals at the Faculty of Agricultural and Veterinary Sciences of São Paulo State University, Jaboticabal-SP, Brazil (Protocol n. 004707/18).

Location and Organization of the Study

The study was carried out in 3 broiler chicken commercial farms, with open-sided sheds fitted with blue wall curtains and an average flock size of 14,654 (±1327) birds, in the municipality of Chapecó-SC, Brazil. Water and feed was provided ad libitum during rearing. Feed was withdrawn from all birds for 6 to 8 h before transport to the slaughterhouse and they had free access to water until the catching process started. Catching in a total of 4,595 Cobb mixed-sex broilers with average live weight of 3.2 kg and 42 days old was examined. A catching team was randomly selected by the slaughterhouse for evaluation. The team was composed of 9 workers (1 woman and 8 men) with, at least 3 mo of experience in catching and they usually worked together. They received 4 h of theoretical good animal husbandry and handling practices training before the study started.

Data were collected during the loading of all birds at each farm for 3 consecutive days, totaling 14 trucks, with on average 320 (± 48.85) catches evaluated per truck (10.2% of the total loaded birds per truck). The trucks had 432 transport crates and the duration of the loading procedure was 1 h per truck, calculated from the time of the catchers began the unloading of the empty crates until the end of the loading of all the crates filled with birds. It takes around 5 h to finish loading all the birds from the shed per day. The evaluation occurred in the morning during daylight conditions, with an average external temperature of 26°C. The transport crates (manufactured by Pisani Plásticos, Rio Grande do Sul, Brazil) were fitted with 2 sliding lids and an opening area of 31 cm length, 44.5 cm width (1379.5 cm^2). All transport crates were taken from the trucks and taken into the broiler shed, where they were used to encircle the animals and divide them into subgroups to facilitate loading. The distance to carry the broilers to the crates was less than 1 m. The internal measurements of the crates were 73 cm length, 53 cm width (3,869 cm^2) and 21 cm height. The density per crate was between 7 and 8 birds (57.9 to 66.2 kg/m^2). All the crate handling was done by hand. The catchers had no break intervals during the loading procedures, except for short periods of time (15 min) when the drivers were manoeuvring the truck to position it at the broiler shed door.

A previously trained person filmed the moment the catchers took 1 or 2 birds from the floor of the shed holding it/them around the abdomen and carrying it/them in an upright position while containing the wings and placed them inside the transport crates. The manoeuvres were videotaped (Nikon camera, model coolpix p610), recording 3,462 videos of the handling catches. The videos were evaluated by a previously trained observer using the Media Player Classic software, and the observations were carried out retrospectively using a continuous sampling method, throughout the catching period.

Catching Practices

Six different catching practices were considered during catching. 1) *Shed curtain position*, identifying 2

Table 1. Distribution of catching methods used by each worker assessed with the number of catches.

	Catcher ID						
Catching method	1	2	3	4	5	6	7
One bird in an upright position (CM1)	602	150	157	279	625	176	340
Two birds in an upright position (CM2)	-	306	144	165	20	262	236

Two workers were responsible for the stacking the crates on the trucks and, therefore, were not observed.

positions: *open curtain*, which allowed the entry of natural light, external air movement, and the possibility of seeing the movements of people and trucks outside the shed, and *closed curtain* with the catching process being carried out with low light intensity inside the shed, the only light coming from the open door, and preventing the visualization of external movements. 2) *Loading time*, considering the time to load all birds in 5 trucks over 1 working day. It was divided into 5 intervals of 1 h (1 hour per truck loaded), defined as ollows: first hour, from the beginning of loading to the first hour of catching; second hour, time between first and second hour; third hour, time between second and third hour; fourth hour, time between the third and fourth hour; and fifth hour, the time between the fourth hour and the end of the loading. 3) *Height of the crates from the floor (Hcrate)* during handling, defined for 3 situations: position 1, with the crate positioned on the litter of the broiler shed (**Hcrate1**); position 2, with the crate positioned above a crate in position 1, with the bottom 21 cm above the floor (**Hcrate2**); and position 3, with the crate on the top of a stack, that is, positioned above a crate in the position 2 and with the bottom 42 cm above the ground (**Hcrate3**). 4) The broiler placement in the crates (**BP**), when the worker placed the broiler inside the crate while holding it in the hands (**BP1**), or when he threw or dropped the broilers in the crates (releasing the birds from a distance of approximately 20 cm or more from the crate opening—**BP2**). 5) *Catching team*, identifying 7 of the 9 catchers of the catching team individually, who carried out the loading process, since 2 workers were responsible for stacking the crates in the trucks and, therefore, were not observed. 6) *Catching methods* (**CM**) used during the data collection (without altering the management routines), evaluating the catching and holding one broiler around the abdomen and carrying it in an upright position while trying to contain its wings (**CM1**) and catching 2 broilers, at the same time, around the abdomen and carrying them in an upright position with 1 bird in contact with the other and trying to contain their wings (**CM2**). Most of the catchers used both ways to catch the broilers during the handling, with the exception of the catcher 1, who only used the catching of a single bird (Table 1).

Behavioural Welfare Indicators

Three behavioral variables were evaluated during the catching: broiler agitation in the catcher's hand (hand agitation—**HA**), recording for each catch whether there was no wing flapping, wriggling, and leg kicking, no wing escaped the catcher's hands, no failure by the catcher to contain the wings in the first place, when the broiler was in the catcher's hands (**HA1**), or whether one or more of those features occurred (**HA2**); broiler agitation in the crate (crate agitation—**CA**), recording the situations in which one or both birds did not flap and did not jump inside the crate for 3 s after being placed in the crate (**CA1**) and when these behaviors occurred (**CA2**); and part of the broiler striking the crate entrance as it was being placed in the crate (crate entrance—**CE**), recording the moment that the animal passed through the opening area when the broiler did not strike or hit any part against the crate entrance (**CE1**) or when they hit their head, wings, or some part of the body against the crate entrance (**CE2**). The lids of the crates were not closed between each bird placement, and birds that jumped out of the crate were not included in the analysis.

A summary with the characterization of all variables (catching practices and behavioral indicators) is presented in Table 2.

Statistical Analyses

A logistic regression model was used to calculate the odds ratio (**OR**) of birds presenting the worst behavioral score (broiler agitation in the catcher's hand—HA2, broiler agitation in the crate—CA2, and striking into the crate entrance—CE2) as a function of the catchers' handling variables: shed curtain position, loading time, catching method, catcher, height of the crates from the floor, and placement of the bird in the crate. The analysis was done with the PROC GENMOD procedure in SAS (version 9.3, SAS Institute Inc., Cary, NC), with binomial distribution for the response variables (HA, CA, and CE) and logit link function. Each variable response was evaluated independently, considering in the model: shed curtain position, loading time, CM, catcher, Hcrate and BP as fixed effects.

The results were expressed in ORs calculated by exponentiating the regression coefficients (β). The OR refers to the number of times the odds of HA2, CA2, and CE2 increases or decreases for each independent variable category, compared to a reference category with OR = 1. ORs with 95% confidence intervals, and P-values were estimated for shed curtain position, loading time, catching method, catcher, height of the crates from the floor, and placement of the bird in the crate.

Table 2. Summary of the variables used to evaluate the catching practices and indicators of birds behavior and animal welfare.

Handling factors	Description
Shed curtain position	Open
	Closed
Loading interval (hours)	1
	2
	3
	4
	5
Catching and holding method	One bird in an upright position
	Two birds in an upright position
Catching team	1 (woman)
	2 (man)
	3 (man)
	4 (man, team leader)
	5 (man)
	6 (man)
	7 (man)
Height of the crates from the floor	1–crate positioned on the litter of the shed floor
	2–crate positioned 21 cm above the floor
	3–crate positioned 42 cm above the floor
Broiler placement	1–placing the birds inside the crate
	2–releasing the birds from more than 20 cm
Behavioral welfare indicators	
Hand agitation (broiler agitation in the catcher's hand)	1 (= no agitation)
	2 (= agitation)
Crate agitation (broiler agitation in the crate)	1 (= no agitation)
	2 (= agitation)
Crate entrance (broiler striking into the crate entrance)	1 (= no strike)
	2 (= striking into the crate entrance)

The reference classes were automatically defined as the highest values for those categories. A probability level of $P < 0.05$ was chosen as the limit for statistical significance.

Only P-value less than 0.05 was considered significant.

RESULTS AND DISCUSSION

The integrated analysis during catching of broiler chickens showed that different catching practices may influence broiler welfare and behavior. For broiler agitation in the catcher's hand, there was a significant effect ($P < 0.05$) for shed curtain position, loading time, catching method, and different catchers. On the other hand, height of the crates and broiler placement did not have significant effects ($P > 0.05$). For broiler agitation in the crate, there was a significant effect ($P < 0.05$) for shed curtain position, catching method, and broiler placement, but loading time, catching team, and height of the crates had no significant effect ($P > 0.05$). All the catching practices evaluated had a significant effect on the chance of the birds striking into the crate entrance (Table 3).

Shed Curtain Position

The shed curtain position significantly influenced broiler agitation in the catcher's hand, broiler striking into the crate entrance, and broiler agitation in the crate. When the shed curtains were closed, there was less wing flapping in the catcher's hands (OR = 0.27) and striking into the crate entrance (OR = 0.28) relative to open curtain (RC, OR = 1). It was observed that 14.26% more broilers flapped their wings in the hands of the catchers and 19.04% more birds striking into the crate entrance when the curtains were open. According to Knowles and Broom (1990), reduced lighting levels, proper handling, and the conditions of the housing during loading could promote less bird agitation and the results of the present study corroborate these considerations. Control of the lights at these stages, besides reducing broiler agitation, can reduce physical discomfort, bruises, fractures, and negative mental states, such as fear and distress (Kristensen et al., 2006). Similar results were found by Adamczuk et al. (2014) in the slaughterhouse, where the authors observed a reduction of 56% in wing flapping during shackling when replacing the illumination of areas by low light intensity.

However, broilers were less agitated in the transport crates with the shed curtains in open position (RC, OR = 1) compared to closed position (OR = 1.45). Initially, we believed that the environment provided with the curtains closed would favor a reduction in bird agitation in the crates; however, the closed curtains presented 5.65% more birds agitated in the crates compared to the open curtain. Additionally, we also found that catching broilers with the shed curtains in closed position also reduces wing flapping of broilers in the hands of the catchers and decreases the number of birds hitting the crate entrance. Closed curtains not only

Table 3. Variables "broiler agitation in the catcher's hand," "broiler agitation in the crate," and "broiler striking into the crate entrance" and values of the significant effects for the assessed handling factors (Chi-sq; *P*-value).

	Broiler agitation in the catcher's hand		Broiler agitation in the crate		Broiler striking into the crate entrance	
Independent variables	Chi-sq	*P*-value	Chi-sq	*P*-value	Chi-sq	*P*-value
Shed curtain position	205.23	<0.0001	6.86	<0.0088	249.73	<0.0001
Loading time	17.51	<0.0001	4.27	0.3709	127.08	<0.0001
Catching method	177.66	<0.0001	10.78	0.001	79.73	<0.0001
Catching team	72.33	<0.0001	10.25	0.1145	52.37	<0.0001
Height of the crate from the floor	0.61	0.7362	5.93	0.0515	241.66	<0.0001
Broiler placement	0.01	0.9353	23.32	<0.0001	5.16	0.0232

Table 4. Loading time (loading), total number of catching evaluations (Nt), total number of broilers agitated in the catcher's hand and striking into the crate entrance (N and %), odds ratio (OR) with standard error (SE) and confidence interval (CI).

Dependent variables	Loading	Nt	N (%)	OR	SE	CI (95%)	Chi-sq	*P*-value
Broiler agitation in the catcher's hand	1	547	129 (23.58)	0.59	0.1569	0.43 to 0.80	11.07	0.0009
	2	854	221 (25.88)	0.64	0.1398	0.48 to 0.84	10.20	0.0015
	3	781	193 (24.71)	0.57	0.143	0.43 to 0.75	15.35	<0.0001
	4	790	230 (29.11)	0.65	0.1391	0.49 to 0.85	9.42	0.0019
	5	490	152 (31.02)	RC	-	-	-	-
Broiler striking into the crate entrance	1	547	179 (32.72)	0.3	0.1482	0.22 to 0.39	66.87	<0.0001
	2	854	334 (39.11)	0.4	0.1299	0.30 to 0.51	50.26	<0.0001
	3	781	335 (42.89)	0.47	0.1312	0.36 to 0.60	33.83	<0.0001
	4	790	460 (58.23)	0.9	0.1299	0.70 to 1.16	0.59	0.4419
	5	490	277 (56.53)	RC	-	-	-	

RC = reference class.

reduced the light in the sheds, but also diminished the possibility of the birds seeing the movement of people and trucks outside the shed.

In dark environments, when birds are placed in the unfamiliar environment of a transport crate they could get agitated and try to escape by flapping their wings. According to Knowles and Broom (1990), the duration of tonic immobility in low light environments is lower than in light areas and the birds could get more agitated during the 3 s after being placed in the crate. Another hypothesis could be that birds caught when the curtains were closed performed less wing flapping before placing them in the crates; consequently, they were less tired and have more energy to increase wing flapping inside the crates.

Loading Time

The chance of the birds being agitated in the catcher's hand and striking the crate entrance increased with loading time as seen in the higher OR value for the fifth hour (Table 4).

In this case, this may have been due to the catchers getting more tired and stressed as the work period progressed. It should be noted that as the work progressed the workers probably wanted to finish the last truck as soon as possible. This would have a direct and negative influence on the quality of handling, leading to changes in broiler behavior that indicated an impoverishment of the birds' welfare, especially during the final hour. Burnett (2014) described that the stress of people working with animals negatively influences decision making with respect to the handling practices adopted, and people considered more stressed tend to ignore good handling practices. This was partially confirmed by Ceballos et al. (2018) when, evaluating the impact of training on the adoption of good handling practices in beef cattle, they observed that throughout the work day there was a deterioration in the quality of handling only for the cowboys who were not aware of good handling practices, resulting in a reduction in positive behaviors and in an increase in negative ones. The loss of quality in the work could be related to fatigue. In interviews conducted in England, broiler catchers have described their work as one of the most difficult to perform in animal production, and that difficult conditions found on farms increase their desire to finish work as quickly as possible (Millman et al., 2017).

In addition, the extended time inside the broiler shed with large movement of people and excessive contact with the birds may have increased the escape behavior and activity of the animals, generating more agitated birds in the hands of the catcher. This assumption is supported by Cransberg et al. (2000), who observed that when the catching team moved quickly in the broiler shed the birds became more agitated, resulting in a higher percentage of deaths and hence poorer animal welfare. Thus, our study indicates that as the loading time increases the number of birds flapping their wings in the catcher's hands and striking into the crate entrance increases. We suggest that this occurs due to the tiredness of the catcher, associated

Table 5. Catching team, total number of catching evaluations (Nt), total number of broilers agitated in the catcher's hand and striking into the crate entrance (N and %), odds ratio (OR) with standard error (SE) and confidence interval (CI).

Dependent variables	Catcher	Nt	N (%)	OR	SE	CI (95%)	Chi-sq	*P*-value
Broiler agitation in the catcher's hand	1	602	93 (15.45)	0.58	0.1608	0.41 to 0.78	11.8	0.0006
	2	456	161 (35.31)	0.75	0.1479	0.56 to 1.00	3.77	0.052
	3	301	105 (34.88)	1.03	0.1741	0.73 to 1.44	0.03	0.8634
	4	444	69 (15.54)	0.29	0.1725	0.20 to 0.40	51.81	<0.0001
	5	645	135 (20.93)	0.84	0.1457	0.63 to 1.12	1.38	0.2397
	6	438	144 (32.88)	0.82	0.1543	0.60 to 1.10	1.7	0.1928
	7	576	218 (37.85)	RC				
Broiler striking into the crate entrance	1	602	179 (29.73)	0.55	0.1423	0.41 to 0.73	17.29	<0.0001
	2	456	266 (58.33)	0.93	0.1488	0.69 to 1.24	0.25	0.6196
	3	301	167 (55.48)	1.35	0.1733	0.96 to 1.89	3.03	0.0816
	4	444	159 (35.81)	0.43	0.1511	0.31 to 0.57	31.36	<0.0001
	5	645	265 (41.09)	1.1	0.1341	0.84 to 1.43	0.54	0.4631
	6	438	236 (53.88)	0.9	0.1525	0.66 to 1.21	0.46	0.4963
	7	576	313 (54.34)	RC				

RC = reference class.

with the intent to finish the work as soon as possible, reducing the quality of the handling.

Catching Method

When one broiler was caught at a time around the abdomen and carried in an upright position containing its wings, it was less likely to show agitation in the hand of a catcher (OR = 0.25), less chance of agitation in the crate (OR = 0.57), and less chance of striking the crate entrance (OR = 0.22) compared to catching 2 broilers at the same time around the abdomen and carrying them in an upright position, while holding one bird in contact with the other and containing their wings. This may have happened because when a bird is carried individually in an upright position, the catcher has greater control of the movement of the bird. The catcher can keep the folded wings pressed close to the body of the bird, facilitating the placement of that bird inside the crate, reducing agitation in the hand and crate and the chance of striking the crate entrance. The results of the present study corroborate those from other studies showing that birds that are caught carefully and held in an upright position present less agitation and stress compared to inverted birds that are caught by the leg (Broom and Knowles, 1989; Kannan and Mench, 1996; Carvalho, 2001; Langkabel et al., 2015; Kittelsen et al., 2018).

Catching Team

Although all workers were trained in good broiler handling practices when catching, differences in the behavioral indicators of the birds were observed among the individuals evaluated. The chance of the birds flapping their wings in the catcher's hand and striking the crate entrance was different among the catchers (Table 5).

In the present study, the difference between catchers may have been due to differences in age, knowledge, and number of training episodes regarding good handling practices and animal welfare. It is known that previous experience, age, training of the people, and the type of management received by the animals influence the quality of catching (Cransberg et al., 2000; Pilecco et al., 2013). It is worth mentioning that catchers who prevented agitation in the held birds also prevented the birds from striking the crate entrance (e.g., catchers 1 and 4). However, it is not possible to confirm the cause of this since data on age, level of knowledge, and type of animal welfare training were not collected.

Thus, our study shows that although they work in the same conditions, there are individual differences between the workers when carrying out the handling, directly influencing the behavior and welfare of the birds. Future research should be developed to find out the individual differences (behavioral and attitudes) that influence the standard of handling by the catchers and the effect that it has on the birds' behavior.

Height of the Crates from the Floor

We found that the position of the transport crates on the litter of the shed presented the greatest OR of the broiler striking into the crate entrance (OR = 1.91) compared to the other 2 positions (Table 6).

According to Kettlewell and Mitchell (1994), the crate should be kept clean and intact, without tips or protrusions, in order to protect the chickens from getting more stressed or injured. However, we did not find any study in the literature evaluating the height of the crate from the floor during the catching process. It is possible that the broilers were more likely to strike into the crate entrance when it is on the litter (position 1) because it involves more physical effort by the catchers, lowering themselves to place the birds inside the transport crates. When the crates were on the litter, the catchers were forced to bend over more and maintain a less comfortable body position. Probably, in response to this situation, the handling was done less carefully resulting in more bird striking the crate. According to the literature, when people are stressed their

Table 6. Crate position (Pcrate), total number of catching evaluations (Nt), total number of broilers striking into the crate entrance (N and %), odds ratio (OR) with standard error (SE) and confidence interval (CI).

Pcrate	Nt	N (%)	OR	SE	CI (95%)	Chi-sq	*P*-value
1	1,129	585 (51.82)	1.91	0.0999	1.56 to 2.32	41.92	<0.0001
2	1,282	548 (42.75)	1.08	0.0963	0.89 to 1.30	0.62	0.4303
3	1,051	452 (43.01)	RC	-	-	-	-

RC = reference class.

Table 7. Broiler placement (BP), broiler was placed inside the crate (BP1), broiler was threw or dropped inside the crate (BP2), total number of catching evaluations (Nt), total number of broiler agitation in the catcher's hand, broiler agitation in the crate and broiler striking into the crate entrance (N and %), odds ratio (OR) with standard error (SE) and confidence interval (CI).

Dependent variables	BP	Nt	N (%)	OR	SE	CI (95%)	Chi-sq	*P*-value
Broiler agitation in the catcher's hand	BP1	3,369	901 (25.74)	0.98	0.26	0.58 to 1.64	0.01	0.9352
	BP2	93	24 (25.80)	RC	-	-	-	-
Broiler agitation in the crate	BP1	3,369	221 (6.56)	0.24	0.27	0.14 to 0.40	28.27	<0.0001
	BP2	93	22 (23.66)	RC	-	-	-	-
Broiler striking into the crate entrance	BP1	3,369	1551 (46.04)	1.75	0.25	1.07 to 2.84	5.03	0.0248
	BP2	93	34 (36.56)	RC	-	-	-	-

RC = reference class.

decision-making is affected and they are more prone to ignore good handling practices (Burnett, 2014). This result emphasizes the importance of considering the ergonomics of catching handling, as indicated by Rui et al. (2011), who suggested that studies should be carried out to evaluate the ergonomics of workers during pre-slaughter procedures.

Thus, our study implies that when the catcher has his/her posture compromised and may experience back discomfort during catching, the number of birds striking into the crate entrance increases.

Broiler Placement

Finally, the way the catcher placed the broilers the crates also significantly affected agitation in the crate and the number of broilers striking into the crate entrance (Table 7).

It was observed that the chance of broiler agitation in the crates was smaller when the catcher placed the birds inside the transport crate (OR = 0.24) compared with throwing or dropping them from 20 cm or more (RC, OR = 1). According to Carvalho (2001), when carrying a bird in the upright position it is possible to have more control of its movements and the birds are expected to move less in the crates. However, the chance of finding a broiler striking was greater (OR = 1.75) when the catcher placed the bird inside the crate (BP1) compared to the handling where he threw or dropped the birds into the crate (RC, OR = 1).

This result is the opposite of what was expected, since we presume that birds would face a higher risk of striking when thrown or dropped into the crate, as we would expect more wings flapping in an attempt to avoid falling. One possibility that might explain such an unexpected result is that it is not easy to place birds into a crate when they are agitated in the catcher's hand, and this might increase the risk of throwing or dropping them into the crate. Additionally, in this situation the birds could be tired or even close to presenting tonic immobility (Gallup et al., 1971), reducing the risk of flapping and, consequently, of striking in the crate lid. Taken together, we conclude that more research is needed to determine the best way of placing broilers inside the transport crates.

CONCLUSIONS

All catching practices examined in this study had an influence on broiler behavior and welfare. The best conditions offered for the broilers, encouraging them to be less reactive during catching, are as follows: 1) when the handling process is performed with closed curtains; 2) carrying one broiler around the abdomen and in an upright position containing its wings; 3) carefully placing the birds inside the crates with the transport crates raised at least 21 cm from the litter, so that the catchers do not have to fully bend over. Additionally, our results indicate that more attention should be paid to the work routine of the broiler catchers since a prolonged loading time without substantial rest periods and the position of the equipment directly influence their welfare, with consequent effect on the birds' behavior and welfare. However, it is necessary to better understand the attitudes and behaviors of each individual catcher, as well as the level of fatigue and stress acquired during a workday in order to understand the individual issues for the handler that can influence his or her catching performance, and hence the birds' welfare. Based on this result, we recommend that individual differences in catching ability should be considered, along with other catching practices that could promote the welfare of both humans and birds during catching.

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