International Journal of Science and Research Archive
eISSN: 2582-8185
Cross Ref DOI: 10.30574/ijsra
Journal homepage: https://ijsra.net/

(Research Article)

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Development and pre-testing of chick and chicken transportation coop (box), at Arba Minch agricultural research center, Arbaminch, SNNPR, Ethiopia

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International Journal of Science and Research Archive, 2023, 08(02), 420–428

Publication history: Received on 12 October 2022; revised on 01 April 2023; accepted on 04 April 2023

Article DOI: https://doi.org/10.30574/ijsra.2023.8.2.2022.0212

Abstract

This chick and chicken transportation cage technology was designed, produced and pretested as a creative innovation on its structure and convenience for traditional poultry producers who exist on rural areas of the country where there is no access to get plastic chick/chicken transportation cage. The data on this particular work was row materials, measurements of the cage parts, construction challenges, and opportunities on the hand of local carpenters/wood workers. In my opinion there will be many works in near future on modification of cage design, size, component number, row material and comparative evaluation based on suggested areas and with other cage technologies. At day old age which is very risky age for management, 94% of the chicks survived from AMARC cage and 98.7% from Plastic/Purchased type during phase 1 study. During phase 2 study, 99.7% of the chicks survived from AMARC cage and 100% from Plastic/Purchased type. Causes for the death of the chicks were management problem. For Matured chickens transportation, the current study clearly showed that using both cages resulted about 100% of the transported chickens survived.

Keywords: Cage; Transportation; Chicken; Plastic

1. Introduction

Chicken population in Ethiopia is estimated to be about 57 million including cocks, cockerels, pullets, laying hens, non-laying hens and chicks. Most of the poultry are lying hens (34.26 percent), followed by poultry are chicks (32.86 percent), Pullets are estimated to be about 6.47 million in the country. Cocks and cockerels are also estimated separately, and are 6.38 million and about 3.27 million, respectively. The others are non-laying hens that make up about 4.59 percent (2.61 million) of the total poultry population in the country. With regard to breed, 78.85 percent, 12.02 percent, 9.11 and percent of the total poultry were reported to be indigenous, hybrid and exotic, respectively (1).

Chicken production in Ethiopia can be categorized into three major production systems based on some selected parameters such as breed, flock size, housing, feeding, health care, bio-security and other technologies. These are backyard chicken production system, small scale/semi intensive chicken production system and commercial chicken production system (2).

The transport of chicken is considered as a critical point in the production chain Dam (3) and which is given the possible implications for chicken welfare (4). During transport handling, chicken are exposed to stressful conditions that can persist and even intensify throughout transport from the farm to the target area. Usage of vehicle, such as vibration, impact and road noise have been correlated with yield losses at slaughter [5; 6; 7) and factors related to the long-term water and feed deprivation, also represent considerable sources of stress Mitchell MA(8) with consequent losses of yield parameters.

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In addition, variations in climatic conditions during transport, such as changes in temperature, relative humidity and air flow inside the coop, are important stressors for chickens Mitchell MA(9) and are not fully controllable in the vehicles current used to chicken transportation. Climatic conditions during transport can influence the microclimate of shipments. High environmental temperature and high humidity promote changes in chicken behavior to assume a better body position for improved heat transfer. The chicken stretches its wings, opens its mouth, lowers it head and tries to touch its breast to the floor. In addition, it changes its body metabolism to increase respiratory rates in an attempt to reduce the adverse effects of heat stress (10; 11).

This physiological response (increased respiratory rates) increases the temperature and humidity in the microclimate and makes it even more difficult to lose body heat through panting. High temperature and high humidity can be sufficiently dangerous to cause pH disequilibrium with respiratory alkalosis due to marked elimination and can ultimately cause death (12). Inevitably, the heat produced by chicken metabolism is retained (at least partially) in the load, and its displacement dynamics depend directly on the speed and intensity of the air flow inside the coop (13).

The consequences of microclimatic factors are almost always described as a function of chicken performance at slaughter, such as carcass yield (quantity of meat) Vieira FMC *et al* (14) and Arikan M *et al* (15) and carcass quality (e.g., presence of bruises) (16). However, with a focus on animal welfare, these analyses must also consider and evaluate the degree of compromise of the thermal comfort of chicken chickens during transportation (17; 18). This could be used as a criterion for choosing and improving common practices during pre-slaughter handling, such as the critical time for catching and loading, determination of the density of chickens per crate and wetting of the cargo.

Animal welfare during transport is difficult to measure and interpret. Thus, indirect measurements of animal welfare are needed and one way to proceed with these measurements is using animal-based performance variables such as bruises. Bruises on the carcass are considered an important tool to indicate animal welfare Huertas SM, (19) and recording bruises (bruises data) can improve transport conditions and reduce economic losses on future coop. Carcass bruises can occur during chicken catching or during transport, when the birds are exposed to social changes (such as mixing chickens with different groups from those established during the rearing period) Girardin P, (20); Bejaei M, (21) and to microclimatic factors that culminate in the crowding of birds in the transport crates (22). Therefore, transport distance and duration as well as climatic conditions during transport can interfere with chicken welfare and behavior Ulupi N, (23) and, ultimately, with their performance (15;24).

Losses from chicken transport are economically significant for the industry. The number of dead chickens recorded on arrival at a slaughterhouse is estimated to be associated with the dynamics of temperature and humidity inside the coop and the duration and distance of transport (25). A high mortality rate and greater body weight loss have been observed in loads that travelled long distances with long transport periods (26; 27; 28). However, studies have been carried out mainly in temperate countries, with few references showing the thermal profiles of loads in a tropical climate Filho JADB, (17) or correlating potential losses with the location of the chickens within the truck trailer.

Studies aiming to elucidate the dynamics of bioclimatic variables within chicken shipments are necessary. The degree of compromise of the thermal comfort of chickens due to environmental conditions and factors such as transport distance, duration and comfort is a crucial point in the explanation of yield losses at slaughter. Thus, the objective of this study was to develop new transportation coop which is more convenient for local chickens for high productivity and safe transportation from place to place and to develop new transportation coop technology that utilizes simple and locally available materials.

2. Material and Methods

2.1. Description of the Study Area

The design, production and demonstration was conducted at Arbaminch Agricultural Research Center, Arbaminch Town, Gamo Zone, SNNPR, Ethiopia.

Arba Minch Town is found 505 km away from Addis Ababa and lies between 5°59′ and 6°40′N and 36°31′ and 37°36′Elatitude and longitude ranges, respectively. The district is characterized mostly by flat and undulating land features with an altitude ranging from 1000 up to 1500 m.a.s.l and minimum and maximum temperature 20°C and 25°C, respectively; while average annual rainfall is 1000-1400 mm/year. The town is totally bordered with Abaminch zuria district. It also shares portions of two lakes and their islands, Abaya and Chamo, Nechisar National Park is located between these lakes.

2.2. Coop Design and Building Strategy

The thought of the technology, designing, prototype development and materials type was selected and produced by the inventor of the technology, Mr. Mekete Manjura.

The newly designed transportation coop (AMARC coop) has a rectangle shape like other transportation coops; this transportation coop does not require any sophisticated material to build. The coop made of a simple locally available material in rectangle form. It is under covered by plastic or any strong and durable material as a floor. The floor of AMARC Coop should be made durable, smooth materials and easy to clean and disinfect. There is a narrow ventilation opening for air transition.

Table 1 Measurements of the Coops

Materials	Unit	For Chicks	For Chickens
wall(length)	cm	70	100
wall (width)	cm	50	80
floor(length)	cm	70	100
floor(width)	cm	50	80
Sorting joint	cm	15	-
Joints	cm	13	-
Ventilation opening	cm	2	-

The construction and management of the AMARC coop have been well conceived, operationalized and monitored.

2.3. Transportation and Handling of birds

The experiment was conducted at the poultry farm of Arbaminch Agricultural Research Center. A total of two thousand forty koekoek chicken breed was used for the trial, from which one thousand two hundred was a day-old and eight hundred forty matured chickens. Day old chickens are directly transported from Debrezeit, which is almost 450 km far from Arbaminch and takes up to 10 hr to reach to Arbaminch. Matured chickens were transported to Melokoza, Melokoza is 380 km far from Arbaminch and it takes up to 8hr to reach to Melokoza from Arbaminch. During transportation bruise or damage on chicken is recorded based on its sign on body.

2.4. Data collection

Data was collected on construction and purchasing cost, distance covered during transportation, number of transported chicks, number of died chicks during transportation and percentage of survived chicks.

2.5. Data Analysis

The Collected data was stored into Microsoft excel spreadsheet and analyzed using SPSS version 20.

3. Results and Discussion

3.1. Model AMARC Transportation Coop Construction and Specification

AMARC transportation coop is not using any sophisticated material for building. The transportation coop comprises of a simple rectangle box made of wooden planks, plastic/wooden floor, ventilation parts on the side and wire mesh enclosing a box. For chick transportation coop, one side walls of the coop should be made of two 5cm wide wooden planks (during construction there is free ventilation area of 2 cm open area is left between the two wooden planks on the wall during construction). The floor of the coop was made of plastic/wooden planks and it is durable, smooth and easy to clean and disinfect. For matured chicken transportation, half inch wire-mesh tightly stretched on the sides of wall to prevent escaping of chicken and it keeps the wooden planks to stay on the roof and wall for long time. The body/four side of the wall is made of 8- wooden frame with 5cm wide and a roof (50 cm width and 70 cm length for chicks and 80cm width and 100cm length for mature chicken).

The coop is easy to construct and modify with the use of locally available skills and materials. The following pictures illustrate the model coop.

Figure 1 Chick and chicken coops

3.2. Measurements of Each Part of the Coop

3.2.1. How to made or prepare the floor part of the coop?

Cut the wood planks in 50 cm width and 70 cm length for chicks and 80cm width and 100cm length for mature chicken (approximately 40-50cm wide wood plank). see Figures (the right side is coop of chicken and the left side is coop of chick).

Figure 2 Floor part of the coop

3.2.2. How to made or prepare the wall part of the coop?

Wall of the coop, which is 13cm up from the floor of the brooder and built as seen the picture.

Figure 3 Wall part of the coop

3.2.3. Fully completed transportation coop

For chicks

The height of the coop is 13cm, the measuring starts from the floor of the coop. Floor of the coop, which have 50 cm width and 70 cm length. But for the purpose of sorting there are 4 wood planks with 15cm (2 in each length part) and 2 in wood planks with 15cm(1 in each width part). The other box have 4 wood planks with 15cm (2 in each width part) and 2 in wood planks with 15cm(1 in each length part)

The wall is made of two 5cm wide wood planks with 2cm gap between the wood planks for ventilation. Which are prepared by cutting 5cm wide wood plank in same measurement with the floor (50 cm width and 70 cm length).

For chicken

Height of the coop is 30cm, the measuring starts from the floor of the coop. Floor of the coop, 80cm width and 100cm length. The floor of the coop should be made durable, smooth and easy to clean and disinfect.

There are six wood planks of 80cm for width part and four wood planks of 100cm for length part. There are eight joints, each of them are 30cm height.

The other part of the coop including wall is made up of wire-mesh netting with an opening to the door that is arranged to take chickens out and in.

Figure 4 Chicken transportation coop

3.3. Survivability of chicks/chickens during transportation and cost of building materials

Acceptance of both coops by participant farmers was due to their usefulness in dramatic change in chick mortality as compared to transportation without coops. As shown in Table 1 and 2, at day old age (which is very risky age for management) chicks are transported from Debrezeit to Arbaminch with 10 hrs duration on the road, which is 450km. At this transportation 94% of the chicks survived on AMARC coop and 98.7% on Plastic/Purchased type during phase

1 study. During phase 2 study, 99.7% of the chicks survived from AMARC coop and 100% from Plastic/Purchased type .Causes for the death of the chicks were management problem.

Matured chickens transportation is takes place from Gamo zone of Arba Minch to Melokoza district of Gofa zone with 8hr duration on the road and which is about 380 km and the current study clearly showed that using plastic/purchased coop resulted about 100% of the transported chickens survived and similarly using ARARC coop showed that 100% of the transported chickens survived. This survivability rate was high and promising for replacement of fabricated material by locally available materials.

This is less than DOA results reported by Nijdam *et al*. (29) about 0.46% of chicks died during transportation, Alshawabkeh and Tabbaa (30) said 0.40% and Fries and Kobe (35) said 0.41. It is, however, a higher value than those reported by Gregory and Austin (34) and Warriss *et al*, (33) Investigating mortality during transport to the slaughterhouse, Fries and Kobe (35) reported mortality averages of 0.41, 0.35, 0.65, 0.14, 0.67, and 0.29% from individual flocks. Causes of trauma in broilers arriving dead at poultry processing plants were investigated by Gregory and Austin (34), birds sent to the plants, 0.19% were DOA. Chou *et al.* (32) suggested that transportation of chicks for distances higher than 50 km (a fasting period of more than 1 h and stress of transportation) results in higher mortality rates (1.2 vs. 1.4%) during the first week of the grow out period. For journeys lasting less than 4 h, the incidence of dead birds was 0.156%; for longer journeys, the incidence was 0.283%.

Cost preference was influential factor during comparison and showed that due to the difference of building materials of those brooders, AMARC coop of chicks costs 150 - 360 birr and Plastic/Purchased coop of chicks costs 720 - 1800 birr so AMARC coop fetched lower cost. Similarly AMARC coop of matured chicken’s costs 420 - 630 birr and Plastic/Purchased coop of matured chicken’s costs 2000 - 25000 birr so AMARC coop again fetched lower cost. This indicated AMARC transportation coop has a reduced cost of purchase by one fifth as compared to Plastic/purchased coop. This showed that poultry producers could minimize their cost by using AMARC coop with a similar result of chicken survival rate as compared to Plastic/purchased coop. Bruises on the carcass are considered an important tool to indicate animal welfare.

Table 2 Phase 1 transportation data of chicks

Coop types	CPC (birr)	DC(km)	Duration(hr)	NTC	NDCDT	PSC	Bruises
AMARC coop 1	150	450	10	100	0	100	no
AMARC coop 2	150	450	10	100	12	82	yes
AMARC coop 3	150	450	10	100	0	100	yes
Purchased coop 1	720	450	10	100	0	100	no
Purchased coop 2	720	450	10	100	4	96	no
Purchased coop 3	720	450	10	100	0	100	yes

CPC is Construction and Purchasing Cost, DC is distance covered, NTC is Number of Transported Chicks, NDCDT is Number of Died Chicks During Transportation and PSC is Percentage of Survived Chicks

Table 3 Phase 2 transportation data of chicks

Coop types	CPC (birr)	DC(km)	Duration(hr)	NTC	NDCDT	PSC	Bruises
AMARC coop 1	360	450	10	100	0	100	no
AMARC coop 2	360	450	10	100	0	100	no
AMARC coop 3	360	450	10	100	1	99	no
Purchased coop 1	1800	450	10	100	0	100	no
Purchased coop 2	1800	450	10	100	0	100	no
Purchased coop 3	1800	450	10	100	0	100	no

CPC is Construction and Purchasing Cost, DC is distance covered, NTC is Number of Transported Chicks, NDCDT is Number of Died Chicks During Transportation and PSC is Percentage of Survived Chicks

Table 4 Phase 1 transportation data of chickens

Coop types	CPC (birr)	DC(km)	Duration(hr)	NTC	NDCDT	PSC	Bruises
AMARC coop 1	420	380	8	70	0	100	no
AMARC coop 2	420	380	8	70	0	100	no
AMARC coop 3	420	380	8	70	0	100	no
Purchased coop 1	2000	380	8	70	0	100	no
Purchased coop 2	2000	380	8	70	0	100	no
Purchased coop 3	2000	380	8	70	0	100	no

CPC is Construction and Purchasing Cost, DC is distance covered, NTC is Number of Transported Chickens, NDCDT is Number of Died Chickens During Transportation and PSC is Percentage of Survived Chicken

Table 5 Survived chicken during transportation (phase 2)

Coop types	CPC (birr)	DC(km)	Duration(hr)	NTC	NDCDT	PSC	Bruises
AMARC coop 1	630	380	8	70	0	100	yes
AMARC coop 2	630	380	8	70	0	100	no
AMARC coop 3	630	380	8	70	0	100	no
Purchased coop 1	3500	380	8	70	0	100	no
Purchased coop 2	3500	380	8	70	0	100	no
Purchased coop 3	3500	380	8	70	0	100	no

4. Conclusion

This chick and chicken transportation cage technology was designed, produced and pretested as a creative innovation on its structure and convenience for traditional poultry producers who exist on rural areas of the country where there is no access to get plastic chick/chicken transportation cage. The data on this particular work was row materials, measurements of the cage parts, construction challenges, and opportunities on the hand of local carpenters/wood workers.

In my opinion there will be many works in near future on modification of cage design, size, component number, row material and comparative evaluation based on suggested areas and with other cage technologies. At day old age which is very risky age for management, 94% of the chicks survived from AMARC cage and 98.7% from Plastic/Purchased type during phase 1 study. During phase 2 study, 99.7% of the chicks survived from AMARC cage and 100% from Plastic/Purchased type. Causes for the death of the chicks were management problem. For Matured chickens transportation, the current study clearly showed that using both cages resulted about 100% of the transported chickens survived.

When comparing AMARC chicken transportation coop with the Plastic coop, AMARC transportation coop have the following advantage and significance, better performance in terms of number of chicks transported at a time and their survival rate, protection of chicks from predators such as birds of prey, pets and wild animals is good. More or less during comparison of coops both coops have significant similarity, advantages and significance

AMARC coop is productive and comfortable as the plastic coop in any size of $\leq$ 100 chicks. Both are portable and expose the chicks to required area in comfortable way. They are simple and could successfully be operated and managed without high level specialized training. AMARC can be modified by local skills to the local situation of climate and available type of construction materials.

After detailed clarification and training the prototype and specification was given to local carpenters/wood professionals to produce the model coop. This new coop technology was designed, produced and pretested as the first innovation on its structure and convenience for rural areas of the country where there is no plastic coop. The data on this particular work was measurements of the coop parts, construction challenges, and opportunities of the brooder on the hand of local carpenters/wood workers. In my opinion there will be many works in near future on modification of coop design, size, component number, row material and comparative evaluation based on suggested areas and with other transportation coops. This would increase small scale poultry production in general and egg and meat productivity in particular.

Recommendation

Based on the above conclusion the following points are forwarded as the recommendation:

- Awareness creation in society about the importance of coop usage during chicken transportation should be performed.
- Adoption and scale-up of transportation coop usage and training package should be given to the extension and development programs in the study area.
- In rural areas poultry farmers still not using purchasable coop because it is costly, So that by providing them economical coop like AMARC chick and chicken transportation coop is compulsory to increases their profitability.

Compliance with ethical standards

Acknowledgments

The authors thank the staff members of South Agricultural Research Institute, Arbaminch Agricultural Research Center for their moral and material support.

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