

SUPPLEMENTARY MATERIAL

Risk analysis of critical control points of *Staphylococcus aureus* in layer farms and chicken egg distributors

Aminah Hajah Thaha,^{1,2} Ratmawati Malaka,¹ Wahniyati Hatta,¹ Fatma Maruddin¹

¹Faculty Animal Science, Hasanuddin University, Makassar City, South Sulawesi; ²Faculty of Science and Technology, Alauddin State Islamic University, Makassar City, South Sulawesi, Indonesia

Correspondence: Ratmawati Malaka, Faculty Animal Husbandry, Hasanuddin University, Jalan Perintis Kemerdekaan Km. 10 Tamalanrea, Makassar City, South Sulawesi, 90245, Indonesia.

E-mail: malaka_ag39@yahoo.co.id

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Supplementary Table 1. Implementation of sanitation hygiene in laying chicken farms.

No	Observation Aspect	Value Weight (%)	Gowa Farm	Bulukumba Farm	Sidrap Farm
A	Livestock Worker Sanitation Hygiene				
1	Regular health status checks of workers (at least once a year)	7.5	0.0	0.0	0.0
2	Workers wear clean work clothes and boots	5.0	0.0	0.0	0.0
3	Workers do not wear jewelry in the cage area (bracelets, rings, watches, etc.)	2.5	0.0	0.0	2.5
4	Workers behave cleanly/hygienically	5.0	5.0	5.0	5.0
5	There is regular training for each worker related to biosecurity, hygiene and sanitation	5.0	0.0	0.0	0.0
	Total I	25.0	0.0	0.0	2.5
B	Visitor/Guest Hygiene-Sanitation				
1	There is supervision of visitors/guests	5.0	5.0	5.0	5.0
2	Visitors/guests follow the rules regarding biosecurity, hygiene and sanitation	2.5	2.5	0.0	2.5
	Total B	7.5	0.0	0.0	2.5
C	Cage Sanitation				
1	Emptying the coop of previous period chickens (all-in all-out)	2.5	2.5	2.5	2.5
2	Clean the cage from all types of dirt from the previous period (for example: feces, chicken feathers, dust) and apply insecticide to eradicate cage lice, disinfect it using a sprayer, then whitewash the cage base.	5.0	5.0	5.0	5.0
3	The base of the brooder cage after being sprinkled with disinfected husks	2.5	2.5	2.5	2.5
4	Disinfect cage equipment (feeding containers, drinking containers, etc.).	5.0	0.0	0.0	0.0
5	Maintain the cleanliness of the environment around the cage by spraying disinfectant regularly.	2.5	2.5	0.0	2.5
	Total C	17.5	7.5	7.5	7.5
D	Egg Storage Warehouse				
1	Has a building structure that supports egg sanitation hygiene	2.5	2.5	2.5	2.5
2	There are hand washing facilities equipped with clean water, liquid soap, tissue/hand dryer, closed rubbish bins	2.5	2.5	2.5	2.5
3	The humidity of the egg storage warehouse is not more than 80%	2.5	2.5	2.5	2.5
4	The temperature in the egg storage warehouse is between 12-15°C	2.5	2.5	2.5	2.5

No	Observation Aspect	Value Weight (%)	Gowa Farm	Bulukumba Farm	Sidrap Farm
	Total D	10.0	10.0	10.0	10.0
E	Feed Warehouse				
1	Has a building structure and food hygiene-sanitation facilities	2.5	2.5	2.5	2.5
2	The humidity of the feed warehouse is not more than 40%	2.5	2.5	2.5	2.5
3	The temperature in the feed warehouse is between 12-15°C	2.5	2.5	2.5	2.5
	Total E	7.5	7.5	7.5	7.5
F	Egg Handling Hygiene				
1	There is a separation between dirty/cracked eggs and good eggs	5.0	5.0	5.0	5.0
2	Handling dirty eggs is not washed, only wiped	2.5	0.0	0.0	0.0
3	Eggs are stored in a new egg tray/crate	2.5	2.5	2.5	2.5
4	The crate or egg tray is stored on a clean and well-maintained plastic pallet	2.5	0.0	0.0	0.0
5	Distribution of eggs in closed box cars	2.5	2.5	0.0	0.0
	Total F	15.0	5.0	5.0	5.0
G	Livestock Sanitation				
1	The water used meets clean water requirements	7.5	7.5	7.5	7.5
2	Water is checked in the laboratory regularly (at least once a year)	5.0	5.0	0.0	5.0
3	Garbage and chicken feces are collected regularly	5.0	5.0	5.0	5.0
	Total G	17.5	17.5	12.5	17.5
	Total Value of Sanitation Hygiene Implementation	100.0	47.5	42.5	52.5

Source: Results of 2023 Research Data Analysis

Supplementary Table 2. Implementation of sanitation hygiene at wholesalers of laying chickens.

No	Observation Aspect	Value Weight (%)	Gowa Wholesale	Bulukumba Wholesale	Sidrap Wholesale
A	Environmental Hygiene				
1	The shelter complex is surrounded by a fence, so dogs, cats or other animals cannot pass through	2.0	0.0	0.0	0.0
2	Trash cans are closed and cleaned regularly every day	2.5	1.0	1.0	1.0
3	Environmental cleanliness is maintained, there is no rubbish scattered around	2.5	1.0	1.0	1.0
	Total A	7.0	2.0	2.0	2.0
B	Storage Warehouse				
1	The egg storage warehouse building is permanent	2.5	1.0	1.0	1.0
2	The floor is made of strong, flat material, easy to clean and disinfect, there are no crevices that can be flooded	2.5	1.0	1.0	1.0
3	The walls are made of strong material, easy to clean and disinfect	2.0	1.0	1.0	1.0
4	The ceiling is clean, not peeling, no cobwebs	2.0	1.0	1.0	1.0
5	Sufficient lighting, provided with a protector (the protective material for the lamp is not made of glass)	2.0	1.0	1.0	1.0
6	Air circulation is good and not stuffy	2.0	1.0	1.0	1.0
7	Hand washing facilities are available, equipped with clean water, soap, disinfectant/hand sanitizer, tissue or hand dryer, kept clean	2.0	1.0	1.0	1.0
8	Covered trash cans are available	2.0	1.0	1.0	1.0
9	Plastic pallets available	2.0	0.0	0.0	0.0
10	There are no chemicals stored in the egg storage warehouse (disinfectants, cleaning agents, etc.)	1.5	1.0	1.0	1.0
11	In the egg storage warehouse there is no unused (junk) equipment or furniture.	1.5	1.0	1.0	1.0
12	There are no domestic animals or other animals in the egg storage warehouse building	2.5	1.0	1.0	0.0
	Total B	24.5	11.0	11.0	10.0
C	Egg Sorting				
1	The egg sorting process is carried out to separate damaged, broken or dirty eggs	5.0	1.0	1.0	1.0
2	Sorting is done as soon as the eggs arrive from the farm	2.0	1.0	1.0	1.0
	Total C	7.0	2.0	2.0	2.0
D	Handling Broken or Dirty Eggs				

No	Observation Aspect	Value Weight (%)	Gowa Wholesale	Bulukumba Wholesale	Sidrap Wholesale
1	Broken or dirty eggs are separated in an egg tray or special place	5.0	1.0	1.0	1.0
2	Eggs that are broken or dirty are immediately processed further, not stored	2.0	1.0	1.0	1.0
	Total D	7.0	2.0	2.0	2.0
E	Egg Storage and Distribution/Delivery				
1	Eggs are not washed or scrubbed	2.5	1.0	1.0	1.0
2	Eggs that have been sorted are stored in clean egg trays, placed on plastic pallets	2.5	1.0	1.0	1.0
3	Storage of eggs at room temperature does not exceed 7 days	3.0	1.0	1.0	1.0
4	Product storage follows a first in first out (FIFO) system	2.0	1.0	1.0	1.0
5	Eggs are distributed in clean plastic egg trays using box vehicles where the cleanliness of the inside of the box is always guaranteed	2.0	1.0	1.0	1.0
6	The inside of the vehicle box is cleaned and disinfected after egg delivery	2.0	0.0	0.0	0.0
	Total E	14.0	5.0	5.0	5.0
F	Egg Packaging				
1	Packaging is carried out to prevent damage and contamination of the eggs	1.0	0.0	0.0	0.0
2	Egg packaging materials are made from non-toxic materials, do not cause contamination, are easy to clean and disinfect	1.5	0.0	0.0	0.0
	Total F	2.5	0.0	0.0	0.0
G	Employee Hygiene				
1	All employees are guaranteed health, there is a health check program at least once a year	3.0	0.0	0.0	0.0
2	There are no wounds (open, not covered with waterproof plaster) on the skin of employees who handle eggs	3.0	1.0	1.0	1.0
3	Wear clean work clothes	2.5	1.0	1.0	1.0
4	Wash your hands using soap and disinfectant/hand sanitizer before and after work, and keep your hands clean	3.0	1.0	1.0	1.0
5	Use a mask to cover your mouth and nose	2.0	0.0	0.0	0.0
6	Short nails are clean and unpainted	1.5	1.0	1.0	1.0
7	Do not smoke while working	1.5	1.0	1.0	1.0
8	Do not eat or drink or do activities that can cause contamination while working	1.5	1.0	1.0	1.0
9	Employees receive training regarding hygiene and sanitation in handling eggs	2.0	0.0	0.0	0.0

No	Observation Aspect	Value Weight (%)	Gowa Wholesale	Bulukumba Wholesale	Sidrap Wholesale
	Total G	20.0	6.0	6.0	6.0
H	Pest Control Program (Rodentia and Insects)				
1	Have an effective pest control program	2.0	0.0	0.0	0.0
2	Each entrance to the holding room is equipped with a plastic curtain.	1.0	0.0	0.0	0.0
3	Each air hole (ventilation) in the holding room is equipped with a wire mesh to prevent insects from entering, and to keep it clean	1.0	1.0	1.0	1.0
4	There are no large trees around (radius 5 meters) the egg storage building	1.0	1.0	1.0	0.0
	Total H	5.0	2.0	2.0	1.0
I	Sanitation and Waste Management				
1	Cleaning and disinfection facilities and equipment are available to maintain the sanitation of the egg storage warehouse and the cleanliness of the environment	3.0	1.0	1.0	0.0
2	Disinfectants/sanitizers are available for vehicles, equipment, which are stored in a special warehouse/room separate from egg storage, clearly labeled	3.0	0.0	0.0	0.0
3	Cleaning materials (cleaning agent, detergent, soap) are available for vehicles, equipment, which are stored in a warehouse/special room separate from egg storage, clearly labeled	3.0	0.0	0.0	0.0
4	Broken eggshells or eggs that have been damaged should be separated and stored in plastic bags	2.5	1.0	1.0	1.0
5	Burning or burial of damaged eggshells or eggs is carried out	1.5	0.0	0.0	0.0
	Total I	13.0	2.0	2.0	1.0
	Total Value of Sanitation Hygiene Implementation	100.0	32.0	32.0	29.0

It is known that the implementation of sanitation hygiene at the retailer level selling eggs originating from Gowa, Bulukumba and Sidrap Regencies ranges between 41.5% - 55.5% (Table 2). This is based on 9 indicators, including environmental cleanliness, storage warehouse, egg sorting, handling broken or dirty eggs, egg storage and distribution/delivery, egg packaging, employee hygiene, pest control program (rodents and insects), and sanitation and waste handling.

Supplementary Table 3. Implementation of sanitation hygiene at retailer level.

No	Observation Aspect	Value Weight (%)	Gowa Retailer	Bulukumba Retailer	Sidrap Retailer
A	Environmental Hygiene				
1	The shelter complex is surrounded by a fence, so dogs, cats or other animals cannot pass through	2.0	0.0	0.0	0.0
2	Trash cans are closed and cleaned regularly every day	2.5	0.0	0.0	0.0
3	Environmental cleanliness is maintained, there is no rubbish scattered around	2.5	2.5	2.5	0.0
	Total I	7.0	2.5	2.5	0.0
B	Storage Warehouse				
1	The egg storage warehouse building is permanent	2.5	2.5	2.5	2.5
2	The floor is made of strong, flat material, easy to clean and disinfect, there are no crevices that can be flooded	2.5	2.5	2.5	0.0
3	The walls are made of strong material, easy to clean and disinfect	2.0	2.0	2.0	2.0
4	The ceiling is clean, not peeling, no cobwebs	2.0	2.0	2.0	0.0
5	Sufficient lighting, provided with a protector (the protective material for the lamp is not made of glass)	2.0	2.0	2.0	2.0
6	Air circulation is good and not stuffy	2.0	2.0	2.0	2.0
7	Hand washing facilities are available, equipped with clean water, soap, disinfectant/hand sanitizer, tissue or hand dryer, kept clean	2.0	0.0	0.0	0.0
8	Covered trash cans are available	2.0	0.0	0.0	0.0
9	Plastic pallets available	2.0	0.0	0.0	0.0
10	There are no chemicals stored in the egg storage warehouse (disinfectants, cleaning agents, etc.)	1.5	1.5	1.5	1.5
11	In the egg storage warehouse there is no unused (junk) equipment or furniture.	1.5	1.5	1.5	1.5
12	There are no domestic animals or other animals in the egg storage warehouse building	2.5	2.5	2.5	2.5
	Total B	24.5	18.5	18.5	14.0
C	Egg Sorting				
1	The egg sorting process is carried out to separate damaged, broken or dirty eggs	5.0	5.0	5.0	5.0
2	Sorting is done as soon as the eggs arrive from the farm	2.0	2.0	2.0	2.0
	Total C	7.0	7.0	7.0	7.0

No	Observation Aspect	Value Weight (%)	Gowa Retailer	Bulukumba Retailer	Sidrap Retailer
D	Handling Broken or Dirty Eggs				
1	Broken or dirty eggs are separated in an egg tray or special place	5.0	5.0	5.0	5.0
2	Eggs that are broken or dirty are immediately processed further, not stored	2.0	2.0	2.0	2.0
	Total D	7.0	7.0	7.0	7.0
E	Egg Storage and Distribution/Delivery				
1	Eggs are not washed or scrubbed	2.5	2.5	2.5	2.5
2	Eggs that have been sorted are stored in clean egg trays, placed on plastic pallets	2.5	0.0	0.0	0.0
3	Storage of eggs at room temperature does not exceed 7 days	3.0	0.0	0.0	0.0
4	Product storage follows a first in first out (FIFO) system	2.0	2.0	2.0	0.0
5	Eggs are distributed in clean plastic egg trays using box vehicles where the cleanliness of the inside of the box is always guaranteed	2.0	0.0	0.0	0.0
6	The inside of the vehicle box is cleaned and disinfected after egg delivery	2.0	0.0	0.0	0.0
	Total E	14.0	4.5	4.5	2.5
F	Egg Packaging				
1	Packaging is carried out to prevent damage and contamination of the eggs	1.0	0.0	0.0	0.0
2	Egg packaging materials are made from non-toxic materials, do not cause contamination, are easy to clean and disinfect	1.5	0.0	0.0	0.0
	Total F	2.5	0.0	0.0	0.0
G	Employee Hygiene				
1	All employees are guaranteed health, there is a health check program at least once a year	3.0	0.0	0.0	0.0
2	There are no wounds (open, not covered with waterproof plaster) on the skin of employees who handle eggs	3.0	3.0	3.0	3.0
3	Wear clean work clothes	2.5	2.5	2.5	2.5
4	Wash your hands using soap and disinfectant/hand sanitizer before and after work, and keep your hands clean	3.0	0.0	0.0	0.0
5	Use a mask to cover your mouth and nose	2.0	0.0	0.0	0.0
6	Short nails are clean and unpainted	1.5	1.5	1.5	1.5
7	Do not smoke while working	1.5	1.5	1.5	1.5

No	Observation Aspect	Value Weight (%)	Gowa Retailer	Bulukumba Retailer	Sidrap Retailer
8	Do not eat or drink or do activities that can cause contamination while working	1.5	0.0	0.0	0.0
9	Employees receive training regarding hygiene and sanitation in handling eggs	2.0	0.0	0.0	0.0
	Total G	20.0	8.5	8.5	8.5
H	Pest Control Program (Rodentia and Insects)				
1	Have an effective pest control program	2.0	0.0	0.0	0.0
2	Each entrance to the holding room is equipped with a plastic curtain.	1.0	0.0	0.0	0.0
3	Each air hole (ventilation) in the holding room is equipped with a wire mesh to prevent insects from entering, and to keep it clean	1.0	1.0	1.0	0.0
4	There are no large trees around (radius 5 meters) the egg storage building	1.0	1.0	1.0	0.0
	Total H	5.0	2.0	2.0	0.0
I	Sanitation and Waste Management				
1	Cleaning and disinfection facilities and equipment are available to maintain the sanitation of the egg storage warehouse and the cleanliness of the environment	3.0	3.0	3.0	0.0
2	Disinfectants/sanitizers are available for vehicles, equipment, which are stored in a special warehouse/room separate from egg storage, clearly labeled	3.0	0.0	0.0	0.0
3	Cleaning materials (cleaning agent, detergent, soap) are available for vehicles, equipment, which are stored in a warehouse/special room separate from egg storage, clearly labeled	3.0	0.0	0.0	0.0
4	Broken eggshells or eggs that have been damaged should be separated and stored in plastic bags	2.5	2.5	2.5	2.5
5	Burning or burial of damaged eggshells or eggs is carried out	1.5	0.0	0.0	0.0
	Total I	13.0	5.5	5.5	2.5
	Total Value of Sanitation Hygiene Implementation	100.0	55.5	55.5	41.5