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Poultry welfare essentials:
Heat stress, nutrient needs, and data collection

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Agriculture & Natural Resources | Livestock

Fact Sheet EXT-01-2025

Animal welfare and heat stress

What is animal welfare?

Animal welfare is an animal's state as it attempts to cope with its environment. Poultry welfare is dependent on several factors including, but not limited to, good animal husbandry, safe housing, and the ability to perform motivated behaviors.

Good husbandry

Ensuring poultry welfare requires good day-to-day husbandry and interaction with your flock. Examples include:

- **Regular observation and maintenance:** Observe your flock and their housing at least two times per day. Look for signs of poor health or injury, changes in behavior, and equipment issues. Make sure to keep detailed records.
- **Positive interactions:** Poultry that have more interaction with their caretaker are less stressed and produce more eggs.

Safe housing

Poultry housing serves several essential functions related to poultry welfare, including protection from predators, protection from weather events, and an area for them to perform motivated behaviors. If possible, housing should be:

- enclosed and lockable
- elevated or on high ground
- able to withstand weather events
- accessible to birds and people.

Ability to perform motivated behaviors

Poultry species are highly motivated to perform certain behaviors, such as feeding, drinking, foraging, dustbathing, preening, perching, and nesting.

- **Feeding, drinking, and foraging** are all natural behaviors that should not be deprived. Deprivation of these essential behaviors can affect a bird's welfare. If birds are not eating, for example, whether from lack of appetite or a situation where food is too dirty or unavailable, it can lead to sickness or death.
- **Dustbathing** is a grooming behavior that is commonly performed by poultry to remove parasites from their feathers as well as oils and skin cells. Sand is most common substrate for dustbathing, but peat, untreated earth, oat hulls, and other loose, friable substances can also be used.
- **Preening** is a behavior that controls parasites, straightens and cleans feathers, and assists in thermoregulation.
- **Perching** is when poultry rest upright on an elevated structure that allows them to survey their environment off of the ground and alert the rest of the flock of predators. Perching helps poultry feel safe and secure at night.
- **Nesting** is a natural behavior of hens of finding a safe,

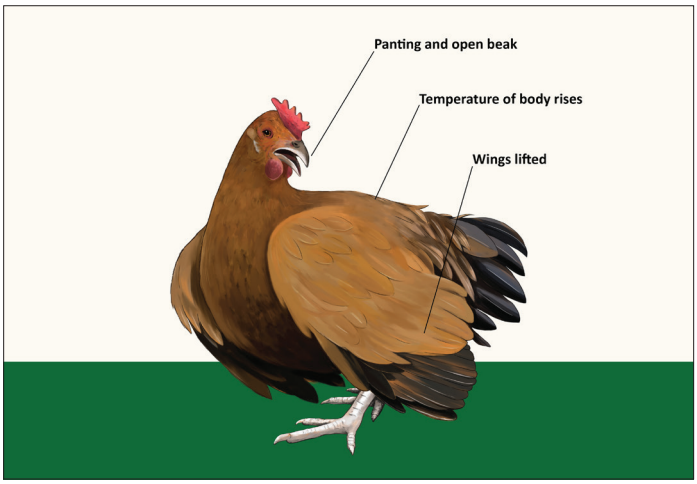

Figure 1. Indicators of heat stress in poultry.
Illustration by Conrad Calma

comfortable area to lay and sit on their eggs. Nesting areas should be provided that are enclosed as much as possible, and straw bedding is preferred over wood shavings and peat. Nests on end spaces are often preferred, which may lead to gregarious nesting.

What is heat stress?

Heat stress occurs when the body cannot get rid itself of excess heat. Poultry are vulnerable to heat stress due to their lack of sweat glands.

Signs of heat stress (see Fig. 1) include:

- visible panting
- increased water intake
- decreased feed intake
- lower activity levels than normal
- spreading of wings
- decreased egg weight, egg production, and eggshell quality (Lara & Rostagno, 2013).

Impacts of heat stress

High temperatures may lead to decreased appetite in poultry, which can impact growth rates.

Excessive panting due to heat stress may also cause physiological issues, such as a condition in which the intestines become permeable to toxins. Toxins can then leak into the bloodstream, disrupting feed digestibility and nutrient absorption (Rostagno, 2020) and resulting in slower growth rates, decreased performance, and higher mortality rates.

The intestinal leakage can also create an acid-base imbalance (Allaherdi et al., 2013), which further reduces the calcium carbonate deposition for eggshells, decreasing egg quality and production.

Ways to mitigate heat stress for poultry

- **Provide shade.** While shade helps to block the heat, be mindful that excessive natural shade (for example, papaya trees, banana trees, tall grass, and bushes) may cause other unintended issues, such as blocking airflow, which can lead to bacterial/fungal growth, or providing an environment for pests and attracting unwanted wild animals. Using artificial materials, such as a tarp, provides a shaded environment that can be controlled and cleaned easily (Lara & Rostagno, 2013).
- **Increase airflow.** Provide ventilation, even if only minimal airflow, particularly at the peak of daytime temperatures, which is typically between noon and 4 p.m. (Lara & Rostagno, 2013).
- **Provide electrolytes.** Providing cool water is ideal, and adding ice, if possible, is a cheaper alternative to buying electrolytes (Lara & Rostagno, 2013).
- **Supplement feed with antioxidant-rich herbs.** Herbs like lavender, mint, oregano, parsley, and thyme can help alleviate heat stress in poultry when added to their feed.
- **Avoid feeding during the peak heat of the day.** Caretakers should also avoid entering the housing during the peak heat hours to minimize bird movement and reduce heat production.

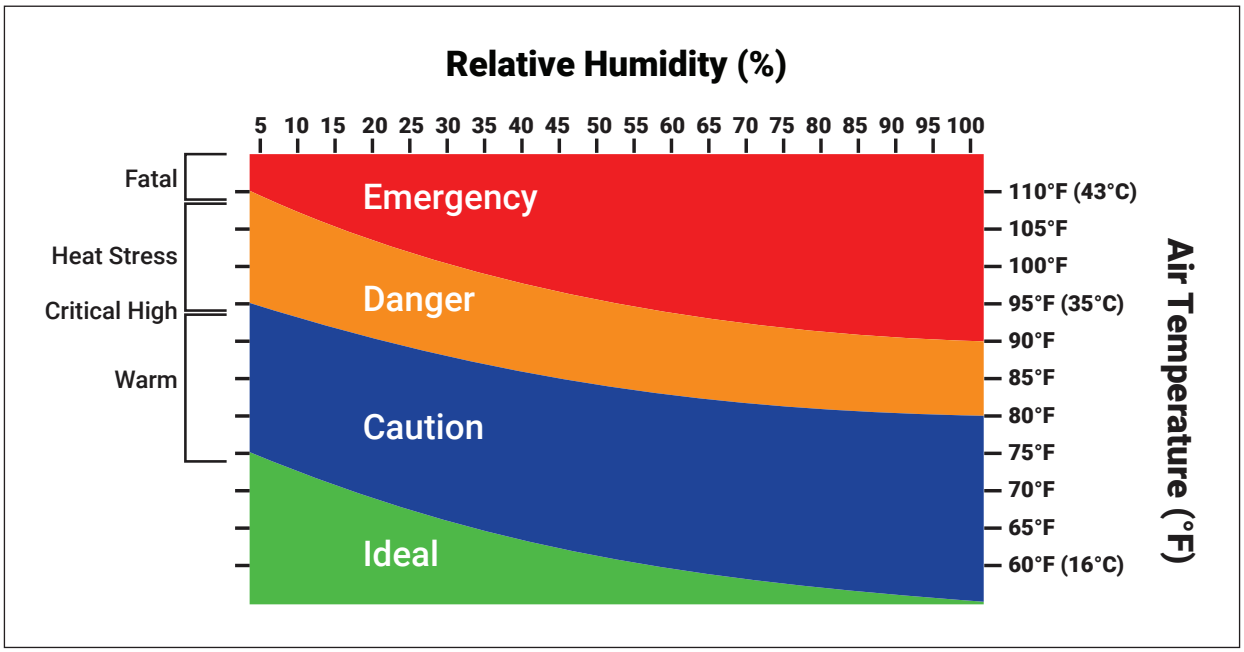

Figure 2. Heat stress zones in poultry according to temperature and humidity (Shahzad et al., 2021)

Australian Langshan
Source: https://www.breedslist.com/australian-langshan-chicken.htm

Dominique
Source: https://gilmoresinc.com/dominique-chickens-pilgrim-fowl-about

Plymouth Rock
Source: https://breeds.okstate.edu/poultry/chickens/plymouth-rock-chickens.html

Rhode Island Red
Source: https://www.myerspoultry.com/product-rhode-island-red

Figure 3. These breeds are generally more heat tolerant, as they have fewer feathers, large combs and wattles, exposed earlobes, and long, exposed legs.

Other things to be mindful of

- **Genetic influence.** Some poultry may be more tolerant to heat stress than others. Typically, these genetic lines will show fewer feathers (Cahaner, 2019), large single combs (for cooling) and/or big wattles, exposed earlobes, and long exposed legs. Example breeds include Asil, Australian Langshan, Dominique, Plymouth Rock, Rhode Island Red, and White Leghorn.
- **Larger combs and wattles are vital for cooling chickens.** Due to the lack of sweat glands, birds transfer heat from their bodies to their skin surface, enabling heat loss from areas like wattles, combs, shanks, and featherless spots (e.g., under wings) to the surroundings. Combs and wattles aid in blood circulation and provide increased surface area for heat loss, which may then lead to lower respiratory and pulse rates due to enhanced cooling efficiency. (Adedeji et al., 2015). (See Table 1.)
- **Age of animal.** Animals in early life stages can withstand higher temperatures before showing signs of heat stress. Generally, older and larger animals are more vulnerable to heat stress compared to younger and smaller animals. The meta-analysis examined two age groups: 1 to 21 days old and over 21 days old. Broilers respond differently to temperature variations based on their growth stages. As they age and gain weight, they become more sensitive to heat due to a smaller heat dissipation area (Ribeiro et.al., 2018). Most studies on performance and high temperatures focused on broilers aged 21 to 42 days (Andretta et al., 2021).

  Newly hatched chicks require a warm environment to maintain their body temperature, as they lack full feathering and have limited ability to regulate their body temperature. As chickens grow and their feather development progresses, it provides better insulation. Adequate ventilation becomes increasingly important to prevent heat stress, especially as birds grow and produce more metabolic heat.

Nutrition and water

High-quality feed ingredients, a balanced diet, and access to clean water are required for maintaining poultry health and welfare.

Water

Clean, high-quality water is essential for poultry health and productivity. Ensure your flock has continuous access to clean, high-quality water. Consider implementing a water nipple system for hygiene and ease of management. Regularly clean and sanitize water dispensers to minimize contamination risks.

Energy

Energy feed for poultry is crucial for meeting their metabolic needs, supporting growth, and maintaining overall health and productivity. Corn is the primary energy source in poultry diets due to its high starch content. It provides energy for metabolic functions. It is essential to formulate poultry feed with a balanced combination of energy sources to meet the specific nutritional requirements of various production stages.

Protein

Protein feed for poultry is essential for their growth, health, and productivity. Poultry require a balanced diet that includes sufficient protein to support muscle development, feather growth, egg production (in laying hens), and overall metabolic functions. Severe protein deficiencies may result in slower growth performance, underperformance in egg production, lower egg quality, increased liver fat, and low blood serum albumin levels.

Variable	Obs	Rectal temp (T°C)	Pulse rate (beats/min)	Respiratory rate (breaths/min)	Heat Stress Index
Overall means		41.04±0.04	47.50±0.51	44.39±0.64	0.84[a]
Wattle length (cm):					
1	102	41.03±0.07	49.43±0.81[ab]	47.35±0.95[a]	0.86[a]
2	42	41.10±0.08	49.26±0.88[ab]	46.52±1.37[a]	0.84[a]
5	24	40.98±0.12	46.25±1.12[bc]	42.08±1.86[ab]	0.81[b]
6	48	41.02±0.88	43.39±0.99[c]	39.46±1.14[b]	0.81[b]
7	6	41.12±0.36	37.17±3.18[d]	36.00±0.03[b]	0.87[a]
8	6	41.27±0.19	50.67±2.32[a]	36.00±4.13[b]	0.63[c]
Wattle width (cm):					
1	18	41.11±0.13	53.67±1.34[a]	49.50±2.40[a]	0.83[ab]
2	11	41.03±0.06	48.68±0.74[b]	46.56±0.85[a]	0.86[a]
3	12	41.13±0.14	49.58±1.03[b]	48.75±3.11[a]	0.88[a]
4	18	40.89±0.14	49.22±1.42[b]	45.00±1.81[ab]	0.82[ab]
5	12	40.98±0.16	47.33±1.65[b]	40.58±2.24[bc]	0.77[b]
6	42	41.06±0.08	41.40±0.82[c]	38.26±1.25[c]	0.83[ab]
7	12	41.19±0.19	43.92±2.77[c]	36.00±2.43[c]	0.73[b]

Table 1: Mean values of physiological parameters as affected by chicken wattle size. (Adedeji, 2015)

Laying hens require different amounts of protein in their diet at different ages:

- Baby chicks (6 weeks): Starter feed with 18-20% crude protein
- Pullets (7-20 weeks): 15-16% crude protein
- Pol hens (20-40 weeks) 16-18% crude protein
- Laying hens: At least 17% crude protein and 3.0-4.5% calcium for strong eggshells
- Post-peak production (40+ weeks): At least 15% crude protein.

Some farmers in Guam choose to feed their poultry coconut meal, also known as copra meal, because it is high in protein and affordable. Copra meal is a byproduct of oil extraction from dried coconut kernels (copra). It is not, however, optimal for poultry diets for the following reasons. Copra meal contains about 18-25% protein, but it is low in lysine and sulfur amino acids, which are needed for egg production and muscle growth. Additionally, its high fiber content, high water retention, and bulkiness will contribute to low feed intake, low digestibility, and poor performance — specifically for poultry and swine.

Some Guam poultry farmers also opt for feeding expired milk formula to their birds due to availability and high protein content. Mammals naturally consume lactose due to milk being the only nutritional source at early stage of life; however, poultry do not share the same mechanism and cannot digest much milk. Substituting feed with milk formula may result in severe diarrhea and weight loss.

Probiotics

Probiotics are microorganisms such as live bacteria, fungi, or yeasts. These microorganisms are ingested as supplements and play a beneficial role in supporting the natural balance of bacteria in the gastrointestinal tract. They help with digestion, nutrient absorption, and immune function. By doing so, they contribute to the overall health and functioning of the digestive system.

Data collection

It is important to keep simple data on your hens' production as a baseline to know if anything abnormal occurs in your birds' health. Daily feed intake, daily egg production (quantity and size), and water intake are all good indicators of sickness or stress.

Use a simple daily log like the one on page 6 to track your hens' health.

°C	°F	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
20	68	63	63	63	64	64	64	64	65	65	65	66	66	66	66	67	67	67	67	68	68
22	72	64	65	65	66	66	66	67	67	67	68	68	69	69	69	70	70	70	71	71	72
24	75	66	67	67	68	68	69	69	70	70	70	71	71	72	72	73	73	74	74	75	75
26	79	68	69	69	70	70	71	71	72	72	72	74	74	75	75	76	77	77	78	78	79
28	82	70	70	71	72	72	73	74	74	75	76	76	77	78	78	79	80	80	81	82	82
30	86	71	72	73	74	74	75	76	77	78	78	79	80	81	81	82	83	84	84	85	86
32	90	73	74	75	76	77	77	78	79	80	81	82	83	84	84	85	86	87	88	89	90
34	93	75	76	77	78	79	80	81	82	83	84	84	85	86	87	88	89	90	91	92	93
36	97	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	93	94	95	96	97
38	100	78	79	81	82	83	84	85	86	88	89	90	91	92	93	95	96	97	98	99	100

Table 2: Temperature and humidity stress index for laying hens. (Braak, 2021)

State	Heat Stress Index	Actions
Comfort State	63 - 69	No special actions are required. Make use of this opportunity to check if all systems are working properly.
Alert State	70 - 75	Be prepared to take necessary cooling measures, increase the ventilation rate, and turn on the cooling fans where applicable. When the humidity levels allow, you can consider using the foggers. Monitor bird behavior for signs of heat stress such as panting, decreased activity and wings hanging. Make sure that plenty of fresh drinking water is available to the flock.
Danger State	76 - 81	Immediate action is needed to safeguard the health and welfare of the flock. Increase the ventilation rate to increase the movement of air over the birds. When humidity levels allow, use evaporative cooling pads and tunnel ventilation when possible. Monitor daily water and feed consumption carefully when feed intake is dropping adjust the nutrient density of the poultry diets. Flush the water lines periodically to allow the birds to cool via drinking fresh and cold drinking water. Closely monitor the behavior of the birds if they respond to the action.
Emergency State	>81	**All the alarm bells should ring now, implement all the advices, and avoid any handling and transfer of the birds during daytime (as this causes stress and therefore extra heat). You can reduce the birds' activity by dimming the lights. Midnight feeding will help to avoid eating during the hottest parts of the day.**

Table 3: Relationship between temperature and relative humidity. (Braak, 2021)

Daily Log: Poultry Care

Year: **Month**:

Date	Watered/ checked water availability	Cleaned water trough/ bowl	Fed/ checked food availability	Number of healthy birds	Number of sick birds	Number of dead birds	Number of birds sold	Number of birds bought	Number of birds hatched	Birds out (# dead + # sold)	Birds in (# bought + # hatched)	Cage check (any rusting or broken pieces?)
Totals this month:												

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For more information on record keeping for swine, contact the Agriculture & Natural Resources office at the University of Guam Land Grant Extension Service

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