

2nd Edition

# TECHNICAL HANDBOOK

Cage-free production systems  
for commercial egg laying hens



**THE 2ND EDITION OF THE TECHNICAL HANDBOOK AIMS TO PRESENT THE NATURAL BEHAVIOR AND NORMAL REPRODUCTIVE PHYSIOLOGY OF EGG LAYING HENS, AND ELUCIDATE THE CRITICAL ANIMAL WELFARE TOPICS ASSOCIATED WITH ROUTINE HANDLING PRACTICES OF LAYING HENS REARED IN CAGE-FREE SYSTEMS.**

Acquiring technical and practical knowledge by poultry farmers and professionals working with cage-free systems is essential.

Work experience in this system is crucial for the productive success and maintenance of the welfare of commercial laying hens.

The experience gained over time is part of the maturation process in the proposed production system. It is critical for developing the necessary skills to assess the daily well-being of the birds and manage practices and indicators related to animal health, behavior and welfare.

**"I HAVE NO SPECIAL TALENT.  
I AM ONLY PASSIONATELY CURIOUS."**

**ALBERT EINSTEIN**

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## Acknowledgments

**We thank those who, in some way, keep an open mind and dedicate their time to learning and evolving with us, enjoying the second edition of this technical handbook. This document provides important information for the day-to-day management of cage-free laying hen production!**

# TECHNICAL HANDBOOK FOR CAGE-FREE PRODUCTION SYSTEMS FOR COMMERCIAL EGG-LAYING HENS – 2ND EDITION

BY ROSANGELA POLETTA, ELISABETE DE MARCO AND CAROLINE CITTA MAZOCCO

**MISSION: Promote knowledge and share information about alternative systems for raising egg-laying hens.**

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# Presentation

The second edition of this handbook serves as a guide on the behavioral profile inherent to laying hens. Understanding this profile forms the basis for the early detection of challenges faced by the birds, as they often manifest issues through abnormal behaviors.

This material was created to provide readers with clear and educational information. We hope that it inspires readers to strive for improved welfare for laying hens and promotes more ethically sustainable production, resulting in higher quality cage-free eggs.

This work is the result of the MIRA Initiative Support Project (Research Incentive Grant 2023/2024), coordinated by Prof. Dr. Rosangela Poletto, PhD, with the collaboration of Elisabete De Marco, an Animal Science undergraduate student, and support from MSc. Caroline C. Mazocco.



# Preface

Dear reader,

We are pleased to present the second edition of this handbook! Productivity is influenced by numerous factors within various production systems for laying hens. Alternative systems are increasingly offering new opportunities and challenges conventional beliefs on egg-laying hen farming. The proper knowledge and management of these systems are key to the success of husbandry practices for cage-free hens.

Conversations with producers and over a decade of experience in the field have shown us that hens raised with proper nutritional, environmental and health, particularly on disease prevention and care of individual hens and not just the flock as a whole, exhibit lower mortality rates and higher egg production. Altogether, this leads to a positive financial return for the operation. This reality encourages future poultry farmers to dispel the myth that cage-free systems are unsustainable and unprofitable.

To achieve these outcomes, ongoing training and guidance in animal husbandry management are essential. Technical expertise and a practical understanding of daily management practices are fundamental for achieving positive outcomes. Everyone involved in the handling of birds must be familiar with the system and equipped to identify any potential challenges that may compromise the welfare of the hens at an early stage. Our mission with this handbook is to facilitate this process by providing a technical foundation in a clear and practical manner, serving as a tool for continuous and effective training for those responsible for the care of the animals!

**Happy reading!**  
**Prof. Rosangela Poletto, PhD**

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# Table of Contents

<b>Behavioral Profile of Hens</b> .....	11
Daily behavioral profile of hens .....	12
Egg-laying behavior.....	13
Nest-seeking and occupancy behavior.....	16
Egg drying after laying.....	17
<b>Reproductive Formation</b> .....	18
Hen's reproductive system.....	19
Relationship between a healthy hen and yolk pigmentation.....	20
Relationship between a sick hen and yolk pigmentation.....	21
How to detect unproductive hens?.....	22
Segregating unproductive hens.....	23
Humane euthanasia of hens with no chance of recovery.....	24
<b>Health</b> .....	25
Disease prevention and vaccination.....	26
Preventive measures against health challenges.....	27
Coccidiosis.....	28
Endoparasitosis in birds.....	29
Endoparasites affecting birds.....	30

Lice and mites.....	31
Bumblefoot.....	32
Receiving chicks.....	33
Thermal environment.....	34
Brooder and heating.....	35
Feather loss in hens.....	36
Infrared beak treatment.....	37
<b>Nutrition</b> .....	38
Acidification of hens´ drinking water .....	40
Weighing during laying.....	41
Bromatological analysis of feed .....	42
Mycotoxins.....	43
<b>Egg quality</b> .....	44
Relationship between hen age and egg quality.....	45
Shell thickness.....	46
Calcium´s role in egg quality.....	47
Shell cleanliness.....	48
Shell quality and heat stress.....	48
Risk factors for egg laying in the substrate.....	49
<b>Biosecurity</b> .....	50
Use of specific footwear, disposable shoe covers, and footbaths.....	52
Waste disposal and specific bins.....	53
Compost management.....	54
Storage of medications and chemical products.....	55

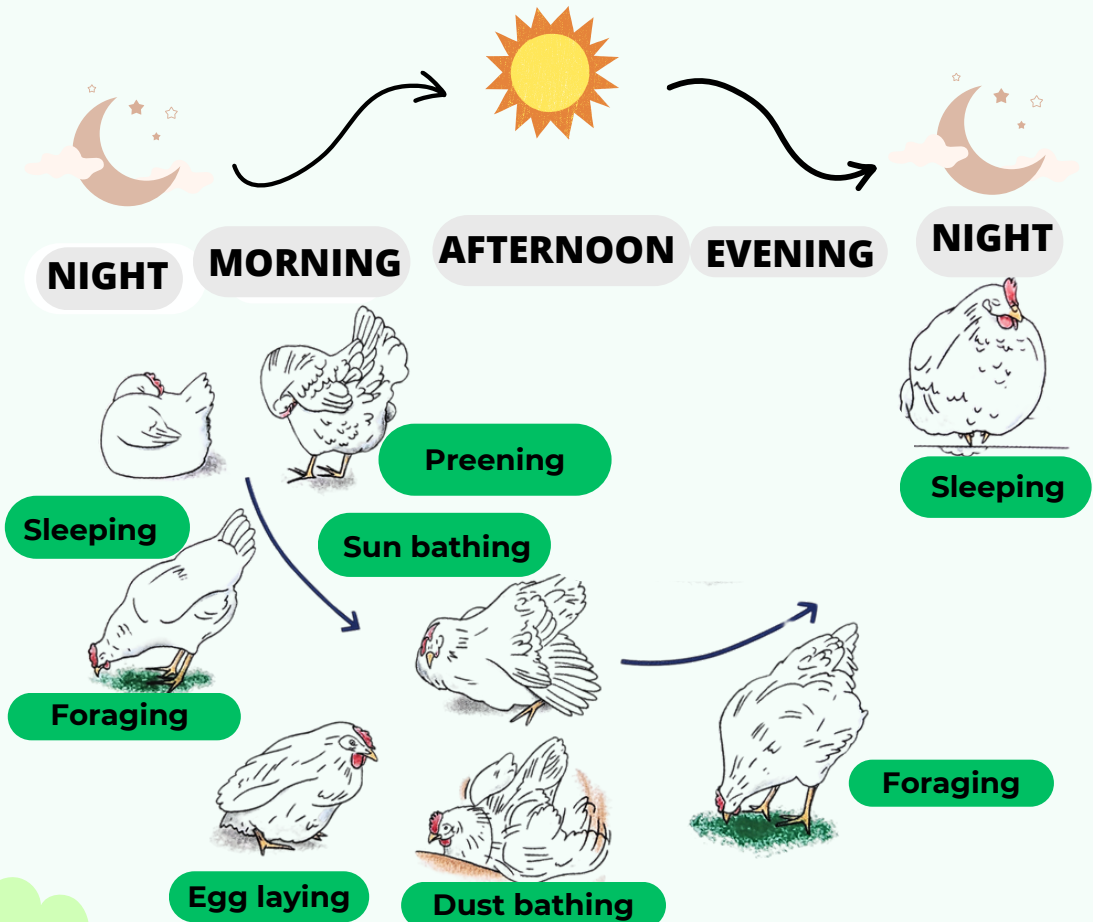
# BEHAVIORAL PROFILE OF HENS

CORRECT BEHAVIOR,  
PROPER PRODUCTION



# Daily Behavioral Profile of Hens

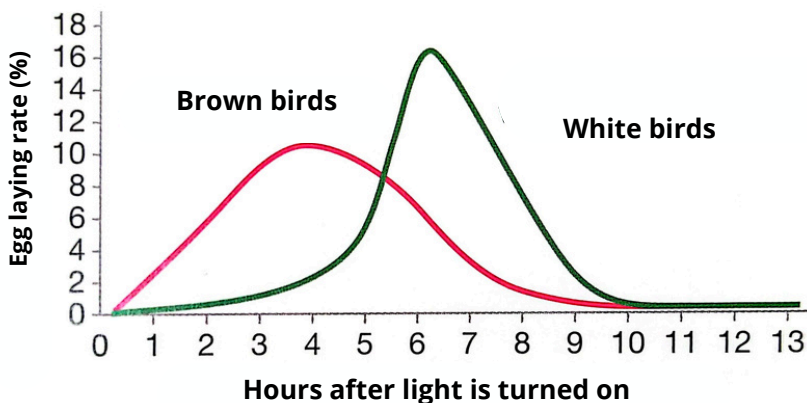
Hens follow a natural daily behavioral routine. They begin their day by feeding and exploring their environment, followed by dust bathing and egg laying. These behaviors repeat throughout the day, and in the evening, they roost for the night's rest.



Source: Adapted from Simons, P. Egg Signals, A Practical Guide to Improving Egg Quality, 2017.

# Egg-laying Behavior

**Egg laying behavior is influenced by the duration and intensity of light, with variations in laying times between white and brown hens.**



White hens visit the nest boxes approximately eight times a day, spending a total of 50 to 65 minutes in them daily. They remain in the nest longer after laying compared to brown hens.



Photo: Mazocco C.C.

Brown hens move directly to the nests when the lights are turned on to lay their eggs in the morning. Their peak laying time is typically around 4 hours after the lights are turned on in the house.



Photo: C. C. Mazocco

Source: Adapted from Simons, P. *Egg Signals, A Practical Guide to Improving Egg Quality*, 2017.

# Nest-Seeking and Occupancy Behavior

1- Hen seeking a nest box.

2- When a nest box is already occupied, the hen continues searching available ones.

3- The hen reaches the back of the house and still hasn't found a nest box to lay her egg in.

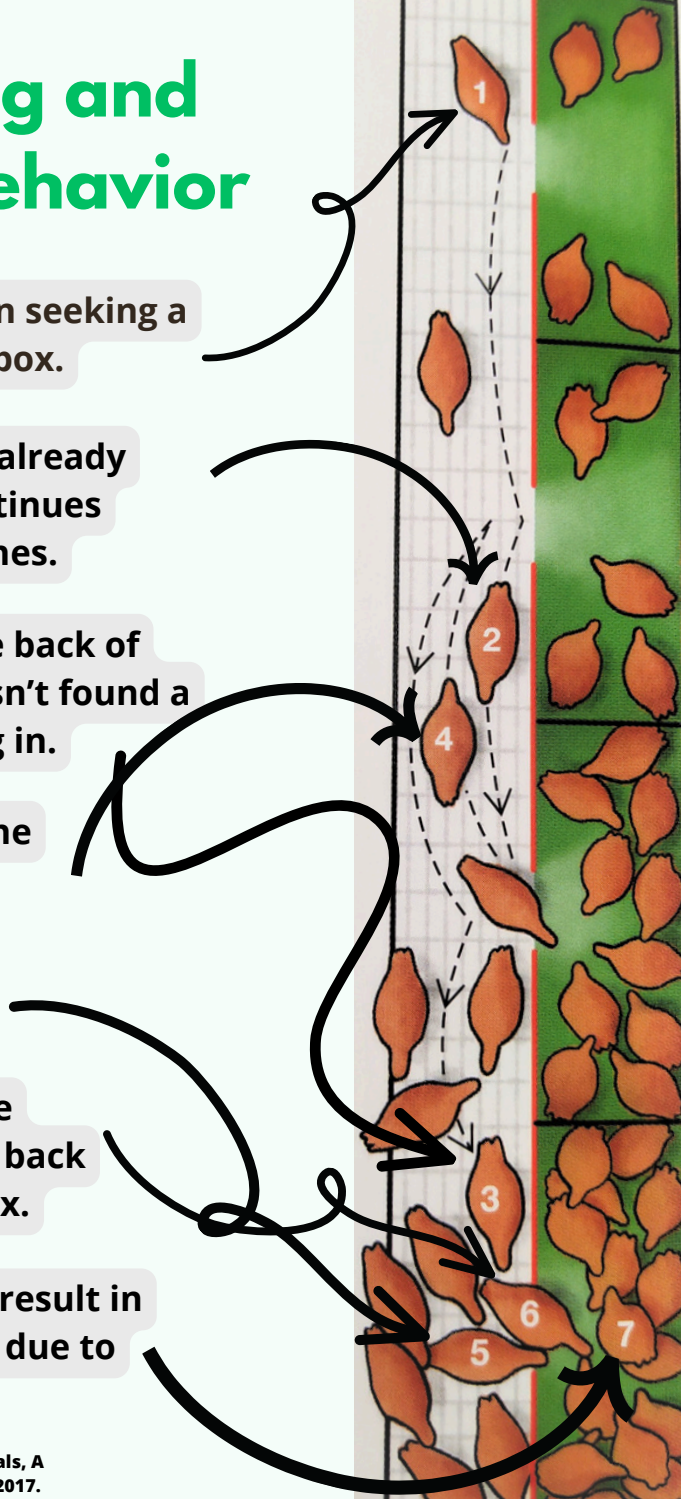
4- Other hens follow the same pattern.

5- High density in the nest box.

6- The hens don't have enough space to turn back and enter the nest box.

7- Condition that may result in suffocation and death due to nest overcrowding.

Source: Adapted from Simons, P. Egg Signals, A Practical Guide to Improving Egg Quality, 2017.



# Egg-laying Behavior

The inherent laying behavior of hens leads to high nest occupancy rate during peak production in the morning hours.

Proper distribution of nest boxes in the coop, whether manual or automatic, and the maintenance of the nest substrate are essential for uniform use of the boxes.

Dark shaded areas, which encourage hens to crowd and lay eggs on the floor, should be avoided in the house by using **homogeneous lighting** across the house.



Photo: R. Poletto

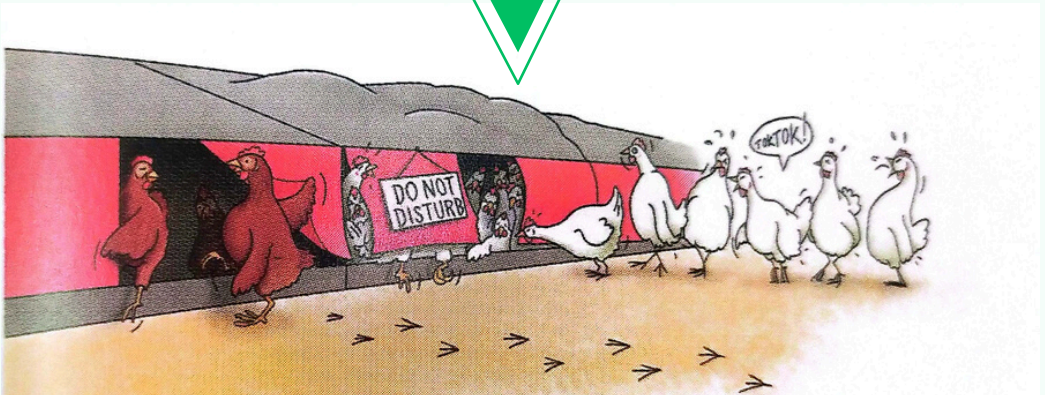


Photo: R. Poletto

**Overcrowded nests and dark areas in the house increase the risk of eggs being laid on litter and suffocation due to overcrowding. Special attention must be given to corners where hens gather to lay their eggs. Removing eggs from these areas as early as the hens start laying helps discourage these undesirable behaviors.**

# Nest-Seeking and Occupancy Behavior

Hens prefer enclosed and quiet NEST BOXES to lay their eggs. Well-maintained nest floor substrate and mats encourage nesting and the use of nest boxes.



Source: Simons, P. Egg Signals, A Practical Guide to Improving Egg Quality, 2017.



Photo: R. Poletto



Photo: Mazocco C.C.

On the left is an automatic nest box with curtains, and on the right is a manual nest box with wood shavings and an open front.



# Egg Drying After Laying

The egg remains for 5 to 15 minutes in the terminal portion of the hen's reproductive tract (vagina).

During this time, the cuticle, a protective outer coating against bacterial entry, is secreted over the egg shell.



Photo: R. Poletto

Wet egg shell, immediately after oviposition.

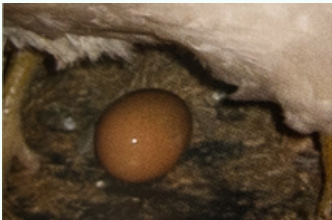
**It is crucial that the wet egg comes into contact with well-maintained surfaces (such as the nest)**

**ATTENTION!**

**Clean nests allow the egg to dry in conditions with a low risk of shell contamination.**

## Drying eggshell...

The high temperature of the egg during oviposition contributes to its drying within a few minutes after oviposition. However, until it is completely dry, the egg is much more vulnerable to damage and contamination.



Wet eggshell immediately after oviposition.



Partially dried eggshell within 5 seconds of oviposition.



Eggshell almost completely dry within 10 seconds of oviposition.

Source: Adapted from Simons, P. *Egg Signals, A Practical Guide to Improving Egg Quality*, 2017.

# REPRODUCTIVE FORMATION

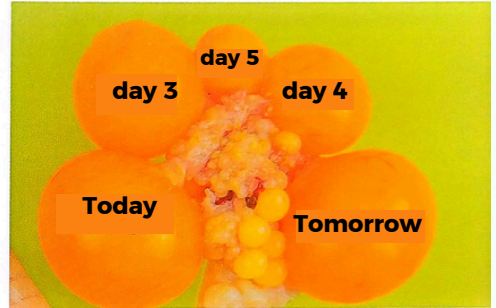
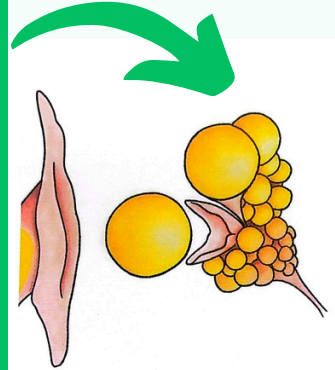
GOOD REARING,  
GOOD PRODUCTIVITY



# Hen's Reproductive System

THE EGG YOLK REFLECTS THE REPRODUCTIVE HEALTH OF THE HEN!

The egg yolk forms and matures in the bird's ovary. When released to form the egg, it maintains the same shape and accounts for about a third of the egg's total weight.



In productive hens, yolks are found at various stages of development in the ovary.

Yolks at different stages of maturation are released in subsequent days of laying.

**Unproductive hens have small, similar-sized egg yolks.**

# Relationship Between a HEALTHY Hen and Yolk Pigmentation

## Healthy hen



Sufficient Carotenoids in Feed

Good Appetite



Carotenoid Consumption

High Absorption



Carotenoids in Blood

High Bowel  
Movement Frequency



Carotenoids in Ovaries



Golden Yolk

Insufficient Carotenoids in Feed

Good Appetite



Carotenoid Consumption

Good Absorption



Carotenoids in Blood

Medium-High Bowel  
Movement Frequency



Carotenoids in Ovaries



Pale Yolk

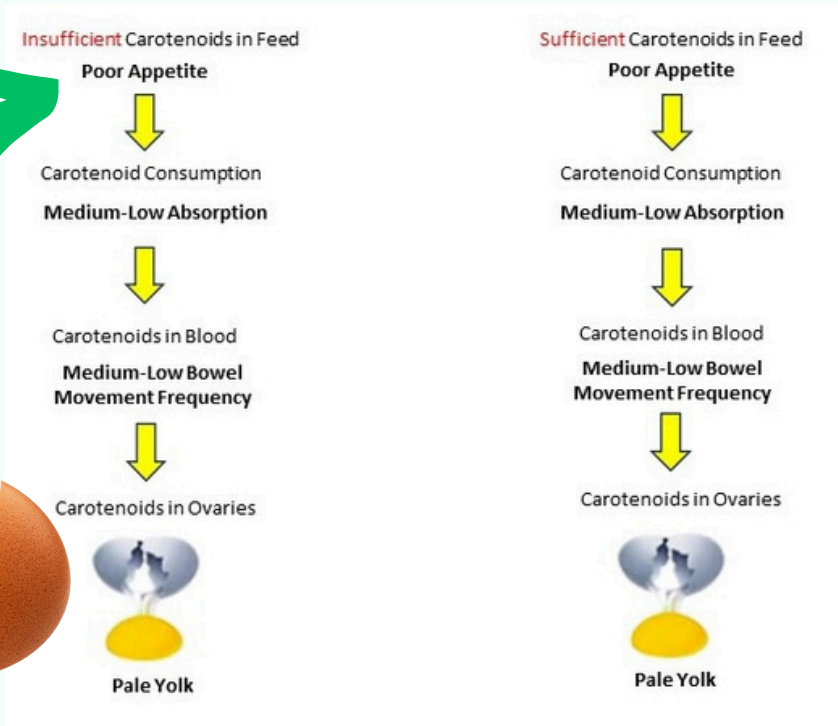
Carotenoids must be ingested and properly absorbed in the hens' gastrointestinal tract, a process that occurs effectively in healthy birds.

They should not be used as replacements for vitamins, which should already be included in the diet.

Source: Adapted from Simons, P. *Egg Signals, A Practical Guide to Improving Egg Quality*, 2017.

# Relationship Between a SICK Hen and Yolk Pigmentation

Sick hen

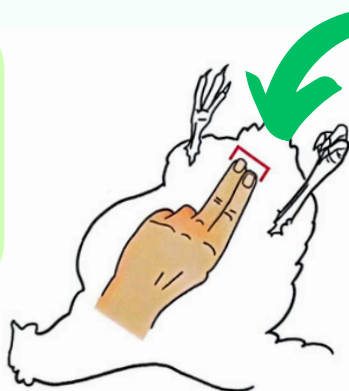


**ATTENTION!**

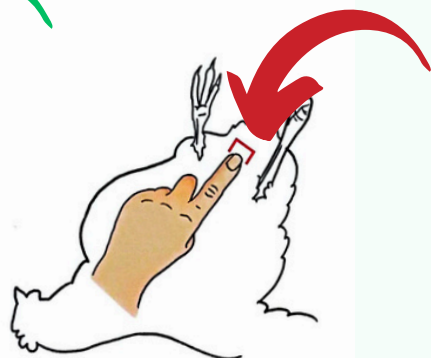
# How to Detect Unproductive Hens?

**PHYSICAL ASSESSMENT: THERE ARE TWO WAYS TO ASSESS IF THE HEN IS **PRODUCTIVE** / **READY FOR LAYING**:**

**1) The distance between the pelvic bones should be 2 FINGERS OR MORE.**

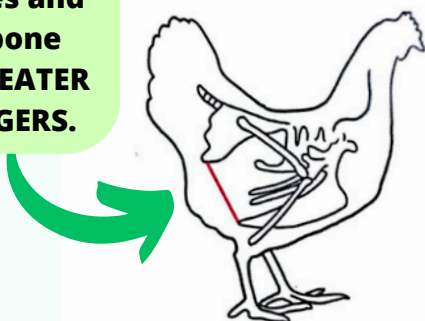


**PRODUCTIVE**

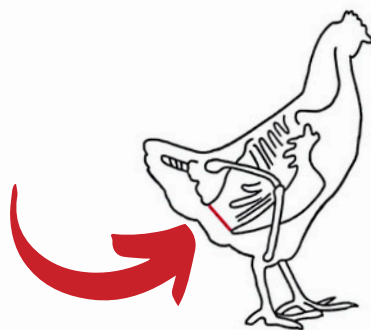


**UNPRODUCTIVE**

**2) The distance between the pelvic bones and the keel bone must be GREATER than 4 FINGERS.**



**PRODUCTIVE**



**UNPRODUCTIVE**

Source: Adapted from Simons, P. Egg Signals, A Practical Guide to Improving Egg Quality, 2017.

# Segregating Unproductive Hens

**BEHAVIORAL ASSESSMENT:** UNPRODUCTIVE HENS, SOMETIMES REFERRED AS “SPENT” HENS, CAN BE IDENTIFIED BY THE FOLLOWING SIGNS:

- **A small, dry and pale comb** compared to the rest of the flock should always be a cause for concern.
- **Signs of feather pecking** in moderate to advanced stages.
- **Roosting on the highest bars of the perches** while most birds are feeding, foraging in the litter, or dust bathing.
- **Staying inside the nest boxes**, especially those with curtains, particularly in the afternoon. They may huddle with other “spent” hens for protection.



Photos: R. Poletto



**ATTENTION!**

**Observe hen behavior! When the feeders are refilled or turned on, the “spent” hens are reluctant to come down from the perches or leave the nest boxes.**



# Humane Euthanasia of Hens With No Chance of Recovery

CERVICAL DISLOCATION IS A HUMANE METHOD OF HEN EUTHANASIA



1. Pick up the bird and wait until it calms down



2. Hold the bird's feet with your non-dominant hand



3. Place your fingers over the bird's neck



4. Tilt the bird's neck at a 90° angle



5. Pull the bird's neck firmly.  
Confirm death before disposal.

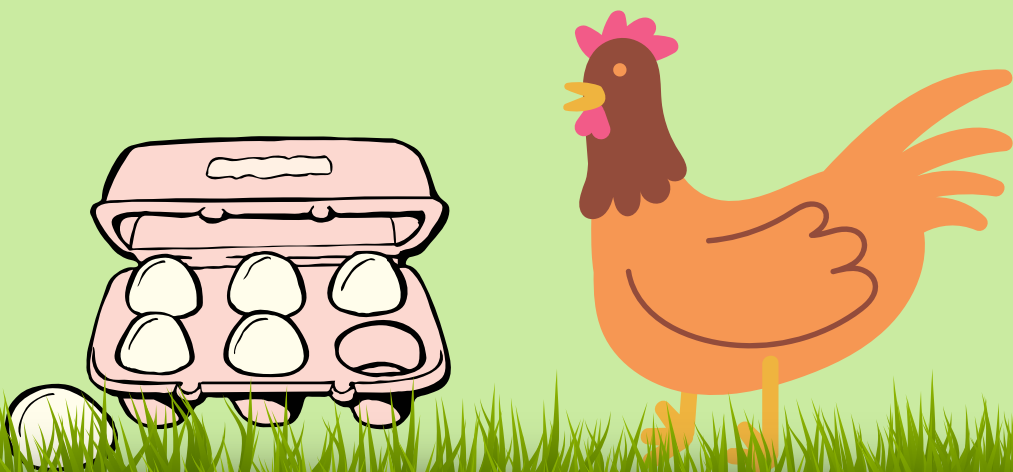


**Only competent individuals trained by a professional should carry out this practice when recovery is not possible.**



# HEALTH

HEALTHY HENS,  
PRODUCTIVE HENS



# Disease Prevention and Vaccination



Vaccination planning is essential when raising laying birds. Incorrect vaccination is as harmful as not vaccinating them when necessary.

**THE VACCINATION PROGRAM MUST MEET THE HEALTH NEEDS OF THE FARM!**

## EXAMPLE OF VACCINATION PROGRAM FOR LAYERS\*

Age	Disease	Way of Application
1 day (Hatchery)	Marek + Gumboro + Fowlpox	Subcutaneous
7 days	Newcastle (B1) + Infectious bronchitis (H120) + Gumboro	Ocular
35 days	Fowlpox	Wing membrane
35 days	Newcastle (LS) + Infectious bronchitis (H52) + Gumboro	Ocular
50 days	Infectious coryza	Intramuscular
70 days	Newcastle (LS) + Infectious bronchitis (H52) + Gumboro	Ocular
100 days	Avian encephalomyelitis	Drinking water
120 days	Infectious coryza	Intramuscular
135 days	Newcastle + Gumboro + Infectious bronchitis	Intramuscular

\*Diseases and vaccination program may vary according to the region and flock condition.

# PREVENTIVE Measures Against Health Challenges



ATTENTION TO THE  
BIOSECURITY  
MANAGEMENT OF  
THE FARM!

Daily cleaning of  
feeders and  
drinkers

Nest cleaning and  
maintenance

Avoid using  
preventive  
medications

Correct  
vaccination  
program

Proper housing  
stocking density

Effective ventilation and  
litter management

Mineral and vitamin  
supplementation and use  
of alternative additives



# Coccidiosis

Coccidiosis, a parasitic disease caused by several types of *Eimeria*, can cause mild to severe damage to the intestinal track. Clinical signs include diarrhea, the presence of blood in the feces, flock uniformity issues, and increased mortality.



Photo: R. Poletto

The presence of blood in the feces indicates intestinal hemorrhage.

## PREVENTIVE MEASURES



To control coccidiosis, it is essential to begin with proper hygiene and disinfection of the environment, ensuring the empty period is respected.

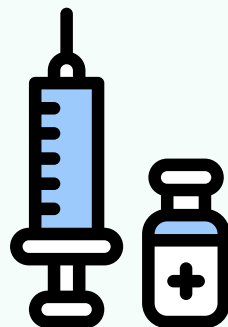
Prioritize vaccination on the first day of the birds' life in the hatchery.



Exercise caution when using anticoccidial additives, as they may inactivate the vaccine.

Source: AVINEWS, Coccidiose aviária: as dificuldades e estratégias no controle, 2021

**The use of essential oils and organic acids is growing as an alternative to antimicrobials for promoting intestinal health and performance.**



# Endoparasitosis in Birds

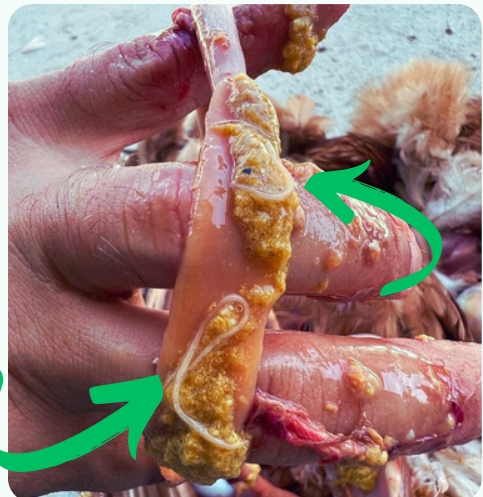
THERE ARE TWO TYPES OF ENDOPARASITES THAT CAN INFECT THE LAYING HENS: NEMATODES AND CESTOIDES.

Nematodes	Location
<i>Ascaridia spp.</i>	Small intestine
<i>Capillaria spp.</i>	Small intestine
<i>Heterakis gallinarum</i>	Cecum
<i>Syngamus trachea</i>	Trachea
<i>Tetrameres americana</i>	Proventriculus

**NEMATODES:** Roundworms that cause significant losses in laying hens. Infection occurs through the ingestion of larvae excreted by other birds (hens or wild birds) or through an indirect cycle that involves an intermediate host, such as insects and mollusks.

The eggs of many roundworms are resistant to cold weather and most disinfectants.

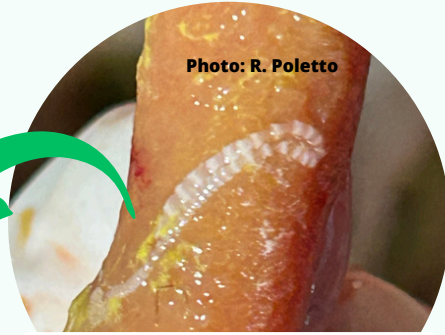
Photo: R. Poletto



Roundworms can be identified in the intestine of a hen during routine necropsy.

# Endoparasitosis Affecting Hens

**CESTODES:** Flatworms that can infect hens, especially in warmer times of the year, when intermediate hosts (mollusks) are abundant.



Flatworms can be identified in the intestine of a hen during routine necropsy.

Cestodes	Primary Host
<i>Davainea proglotina</i>	Hens
<i>Raillietina spp.</i>	Hens, turkeys and other birds
<i>Hymelonepis spp.</i>	Hens, ducks, geese and other birds

## Did you know!?

Flatworms are considered less pathogenic than roundworms.

Parasite infections can be prevented through the use of biosecurity measures, routine diagnostic necropsies, and treatment of infected hens. It is critical to consistently use footbaths and prevent wild birds from entering the houses!



Visual signs such as ruffled feathers, reduced size, paleness of the comb, and "spent" hen behavior should be investigated to rule out parasitic infection.

# Lice and Mites

LICES AND MITES ARE ECTOPARASITES THAT FEED ON THE BLOOD, FEATHERS AND SKIN SCALES OF THE BIRDS!

## HOW TO IDENTIFY LICE AND MITES ON HENS?



Photo: R. Poletto



### BEHAVIOR:

When several birds are simultaneously "preening" or scratching themselves, it may indicate an infestation.

### PHYSICAL ASSESSMENT OF HENS:

Adult chewing lice are found in the feathers, with their eggs on the birds' skin.

Blood-sucking mites are small and visible to the naked eye, moving across the skin of the wings and cloaca.



Photos: R. Poletto

Lice and mites cause weakness, a drop in productivity, and changes in bird behavior.

**Biosecurity is KEY to PREVENTION:** ensure screens and bird cages are up to date, change and disinfect shoes before entering the house, and be cautious with contaminated litter and nest substrate.

Chemical treatment of birds and the environment should be carried out when necessary.

**AVOID THE USE OF PRODUCTS THAT LEAVE RESIDUES IN THE EGGS!**

Source: SAATKAMP et al., *Importância, identificação e controle de piolhos e ácaros em galinhas poedeiras: Perguntas & Respostas*, 2020

# Bumblefoot



Bumblefoot (Ulcerative Pododermatitis) is an inflammation or injury in the hens' feet, causing lameness.

Bumblefoot can occur due to factors such as diet, housing density, resource maintenance. Litter quality, including the type of material used and humidity, is an important factor.

## RECOMMENDATIONS TO PREVENT BUMBLEFOOT:

1. Practice good sanitary management when reusing litter substrate.
2. Include organic microminerals, such as zinc and selenium, in the diet to improve leg and skin health.
3. Use enzymes in the diet to improve digestibility.
4. Prevent physical injuries caused by the environment (e.g., avoid coarse shavings and sharp materials in the house).



Bumblefoot makes walking and perching difficult, causes pain, and affects productivity. The causes must be identified and addressed.

# ATTENTION!



# Receiving Chicks

The vehicle used for transporting chicks must be air-conditioned (with a temperature between 26 and 30°C and relative humidity around 60%), cleaned, and sanitized after unloading the chicks.

Upon arrival, the birds need a heat source, which should be gradually reduced as they grow. The draft shield should be opened between the third and tenth day, with an ideal temperature of 32°C.



Photos: C. C. Mazocco

## ATTENTION!

**Upon arrival of the flock, the following must be checked:**

Omphalitis (navel inflammation, swollen belly, herniated yolk sac).

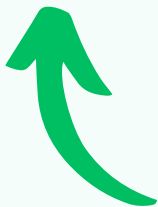
Physical defects (feet, beak, wry neck, blindness).

Source: SILVA, I. J. O., ABREU, P. G.; MAZZUCO, H. Manual de boas práticas para o bem-estar de galinhas poedeiras criadas livres de gaiola. 2020

# Thermal Environment

The thermal environment affects hens' water and feed consumption, which in turn impacts egg production and quality.

Maintaining the proper environmental temperature for the birds is crucial for hen performance and welfare.



To optimize egg production in modern hen strains, it is essential to align nutritional management, environmental conditions, and biosecurity.

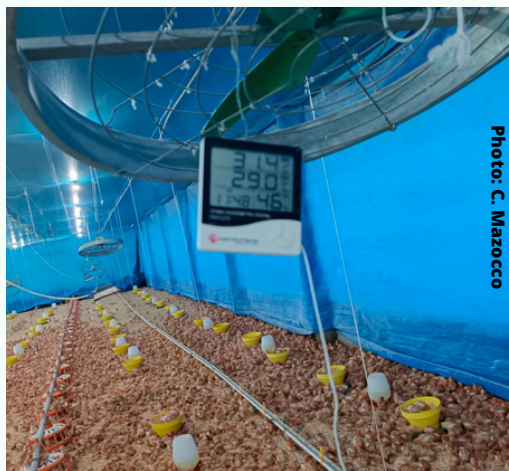
Photos: R. Poletto



Environment: distribution and condition of resources in cage-free houses.

Source: SILVA, I. J. O., ABREU, P. G.; MAZZUCO, H. Manual de boas práticas para o bem-estar de galinhas poedeiras criadas livres de gaiola. 2020

# Brooder and Heating



Permanent monitoring of the temperature (and humidity) in the brooder is essential. Chicks must be evenly distributed throughout the house.

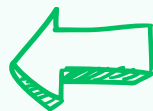
**HEATING KEEPS THE CHICKS' BODY TEMPERATURE STABLE.**

**Ideal temperature:** It should be maintained between 30° and 35°C during the first week of the birds' life and between 21° and 30°C during the second week.

Heating should be provided using a gas or electric brooder or infrared heaters.

## WHICH ARE THE SIGNS OF AN INCORRECT TEMPERATURE IN THE HOUSE?

Chicks with beak and wings half open.  
Gular fluttering.



Feet burn.  
Clumped feces in the cloaca.

Chicks overcrowding.  
Ruffled feathers.



# Feather Loss In Hens

Under natural conditions, hens' feathers are renewed twice during the rearing phase, before the definitive plumage appears.

In layers, moulting only naturally occurs after a long period of production.

When feathers are lost due to pecking, they lose their normal appearance and become frayed. In more severe cases, they appear to have been cut with scissors.



Photos: R. Poletto



## Beak Treatment Why?

The main advantage is to mitigate injuries if abnormal pecking behavior occurs.

Submissive, weak, sick, unproductive hens with lighter feather pigmentation tend to be pecked the most.

**PECKED BIRDS MUST BE SEGREGATED FROM THE FLOCK TO HAVE A CHANCE TO RECOVER.**



Photos: R. Poletto

Source: Abreu, P, G, et al., *Práticas de bicação de poedeiras comerciais*, 2018

# Infrared Beak Treatment

Infrared beak treatment is performed in the hatchery on the first day of the chicks' life, after sexing the birds. It is a procedure accepted by international regulations concerning the welfare of commercial layers.

There is no local cut of the beak nor cauterization, which helps reduce contamination, bleeding, and pain.



## Falling time

Immediately after the infrared treatment, the treated beak remains intact.

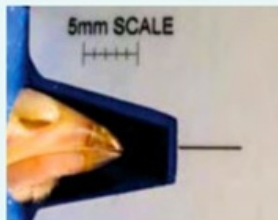
Between 10 to 20 days later, the tip of the beak begins to soften, and both the upper and lower parts progressively fall off.



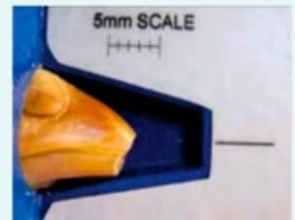
### Beak Progression after Infrared Treatment



One day after treatment, the beak tissue is soft.



Seven days after treatment, the beak tissue turns dark.

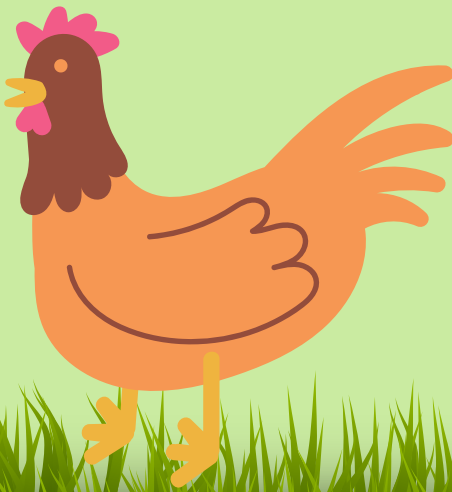


Four weeks after treatment, round beak (not sharp).

Source: Abreu et al., *Práticas de debicagem de poedeiras comerciais*, 2018

# NUTRITION

PROPER DIET  
AND HYDRATION



# Nutrition

As social animals, hens may COMPETE for access to their daily feed, INCREASING their energy needs.

A sudden drop in egg weight or an inability to match the bird's age to the expected egg weight or laying rate is a good indication that more protein may be needed.



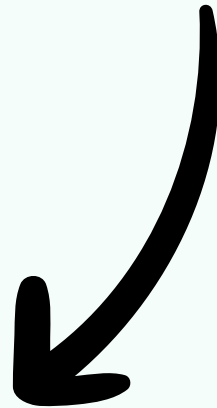
Photos: C. Mazocco, R. Poletto

Source: Simons, P. Egg Signals, A Practical Guide to Improving Egg Quality, 2017

# Acidification of Hens' Drinking Water

Adjusting the pH of the water using additives such as organic and/or inorganic acids reduces the presence of pathogenic microorganisms in the intestinal tract, leading to less inflammation and improved overall performance of the hens.

This also ensures digestive and nutritional efficiency, promoting healthy development of the birds at various growth stages.







# Bromatological Analysis of Feed

Routine bromatological analysis of the feed offered to the birds (such as changes in raw materials, suppliers, or formulation) helps determine whether the diet is consistent with the formulation, and also allows for correlation with the birds' productivity, health, and behavioral outcomes.

Nutritional Composition of Feed	Results of Bromatological Analysis
Dry Matter (DM)	95.1% (4.9% humidity)
Mineral Matter (MM)	9%
Ether Extract (EE)	10.33%
Gross Protein (GP)	20.50%
Gross Fiber (GF)	10.9%
Digestibility	60.84%
Vitamin C	2.73mg

**Source: Konishi et al., Sanitary management and bromatological analysis of feed for laying hens, 2019**

For good productivity, hens need a supply of quality feed that meets sanitary conditions in order to develop properly.

# Mycotoxins

## WHAT ARE MYCOTOXINS?

They are natural toxins produced by molds found in feed or in the raw materials used to produce feed for birds.

They can cause a chronic syndrome.



The most important mycotoxins are aflatoxins, produced by the *Aspergillus* genus, such as *A. flavus* and *A. parasiticus*.

They are more commonly found in corn and peanuts, but they can also be present in other cereals, seeds, and spices.

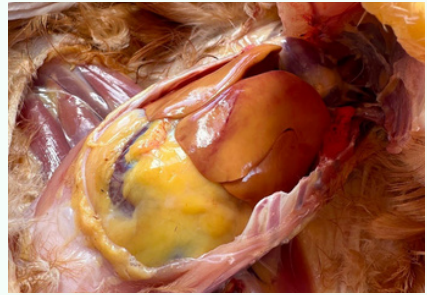


Photo: C. Mazocco

Yellowish aspect of a hen's liver affected by feed contaminated with mycotoxin.



Photos: R. Poletto

Poor quality corn grain contaminated with mycotoxins.

## Did you know!?

Mycotoxins can impair hen reproduction. The use of sequestrants in feed is an important way to prevent sanitary and production problems.

# EGG QUALITY

SMALL DETAILS  
CAN MAKE A DIFFERENCE



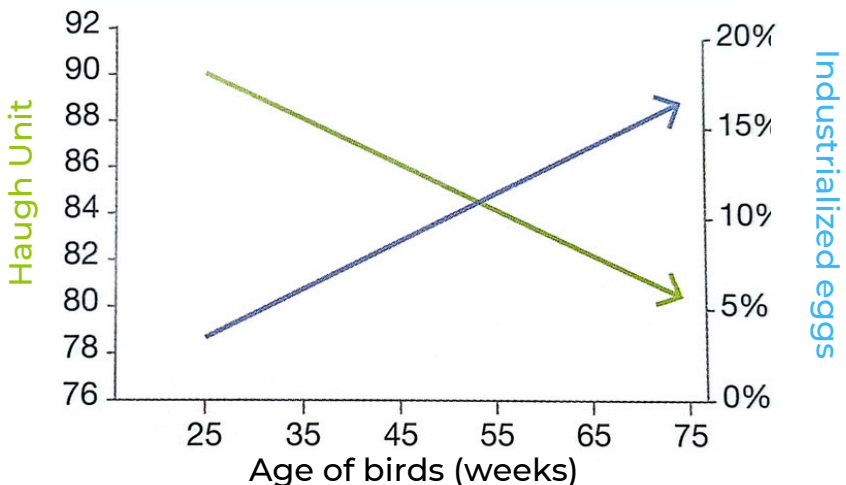
# Relationship Between Bird Age and Egg Quality

As the laying cycle progresses, changes in egg quality can be observed.

**ATTENTION:** The internal and external quality of eggs can be affected by stress, diseases, and deficiencies in feed and water quality.

**USUALLY,** older hens lay larger eggs.  
Shell failures can occur if the diet is not properly adjusted according to hen age.

Relationship between egg quality and hen's age



Source: Simons, P. Egg Signals, A Practical Guide to Improving Egg Quality, 2017

# Shell Thickness

Hens must ingest calcium for proper absorption, which is essential for good bone health and eggshell quality

The particles should be at least 2 mm in size for optimal calcium absorption.

Granulated calcitic limestone is an excellent source of calcium and can be supplied in different ways.

It may be included in the feed mixture or provided in specific feeders.

**Source: Simons, P. Egg Signals, A Practical Guide to Improving Egg Quality, 2017**



Photos: R. Poletto

Calcium can be sourced from the bones or directly from the feed through the bloodstream, which is the most efficient mechanism.

The calcium-to-phosphorus ratio is critical for cage-free hen longevity and eggshell quality.

Eggs with irregular mineral deposits indicates shell quality problem.

## ATTENTION!!

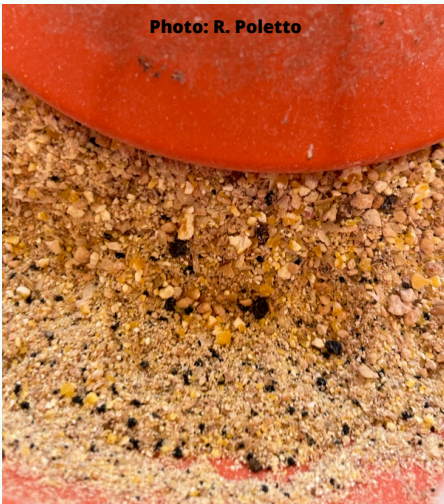
Calcium in the feed must be present as highly soluble (fine limestone) and slowly soluble (coarse limestone).



Coarse limestone used in feed with particle size between 1 and 3 mm.

Photos: C. Mazocco

# Calcium's Role in Egg Quality



Each egg requires between 2.2 to 2.3 g of calcium. Hens must consume twice that amount daily, absorbing in average 60% of the calcium from the diet.

The combination of calcium, phosphorus and exercise ensures adequate absorption of each nutrient.



High calcium intake in the feed reduces the hens' need to extract calcium from their bones to form eggshells.

Hens over 55 weeks of age receiving less than 4% calcium in their feed will increase feed intake, leading to more body fat and eggs with larger yolks.

Coarse calcium should be supplied mixed into the feed or in a specific additional feeder for the birds' free access.

**Source: Simons, P. Egg Signals, A Practical Guide to Improving Egg Quality, 2017**

# Shell Cleanliness

Dirty eggs are considered second quality.

At the beginning of the laying cycle, selection is less critical due to the more resistant shells. Later in the cycle, in addition to dirt, color and shine are also evaluated.

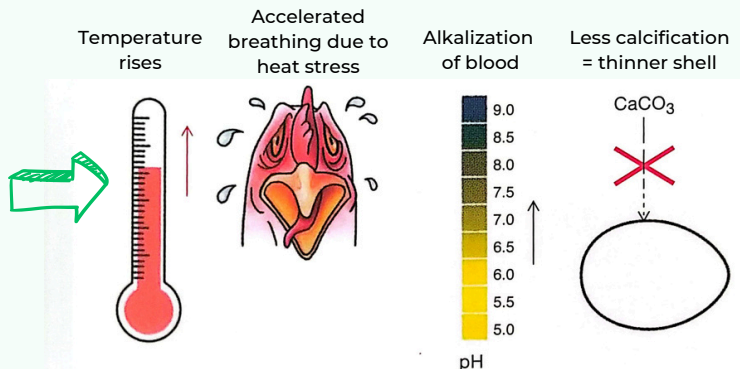


## Shell Quality and Heat Stress

High temperatures and heat stress reduce the birds' food consumption.

The increased respiratory rate causes the exhalation of  $\text{CO}_2$ , and high blood pH results in less calcification, making eggshells thinner.!

Thermal discomfort and shell thickness.



Source: Simons, P. Egg Signals, A Practical Guide to Improving Egg Quality, 2017.

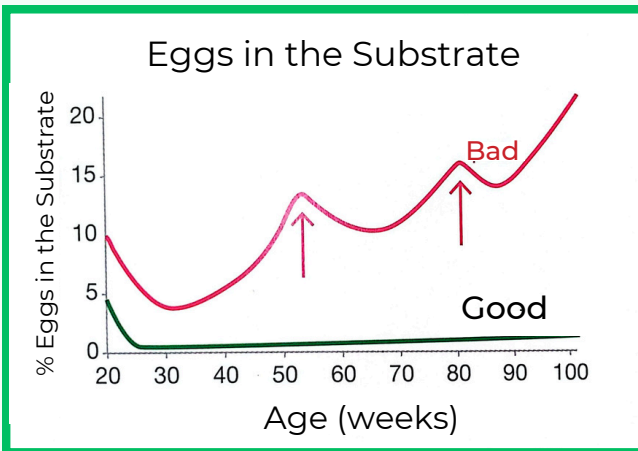


# Risk Factors for Egg Laying in the Floor Substrate

Quickly remove eggs from the floor substrate to prevent other hens from using it for laying as well.



Pay attention to the occurrence of eggs in the substrate at the beginning of the laying cycle. The sooner the problem is addressed, the less likely the hens will continue this behavior.



The incidence of eggs in the substrate should typically be between 2% and 5%.

Hens can learn a lot from good management practices!

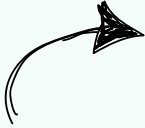
Source: Simons, P. *Egg Signals, A Practical Guide to Improving Egg Quality*, 2017

# BIOSECURITY

PROTECTION, HEALTH  
AND MANAGEMENT



# Biosecurity



Health management includes measures to prevent diseases in birds, applied during housing and between flocks.

This helps to prevent the spread of diseases.



## ATTENTION!

Prohibit unauthorized people from entering the farm, except for maintenance purposes.

For those who are authorized, limit entry access and ensure proper sanitation procedures are followed.



Torn nets and other openings in the house encourage the entry of wild birds, posing a **HEALTH RISK.**

## Flow of people



# Use of Specific Footwear, Disposable Shoe Covers, and Footbaths

Rubber boots or disposable shoe covers can be used.

Disposable materials must be properly disposed of at the end of activities carried out inside the facility.



## Calcium Hydroxide Footbaths



The use of calcium hydroxide in footbaths is a cost-effective practice due to its insect control and disinfectant properties.

It is essential to use calcium hydroxide in footbaths and when managing compost bins.

Calcium hydroxide helps prevent the proliferation of insects and larvae in manure, ensuring protection against infestations.

**Source: Duarte et al., Requisitos básicos de biosseguridade para granjas de postura comercial. Embrapa Suínos e Aves, 2018.**

# Waste Disposal and Specific Bins



Each type of farm waste must be separated into its designated container!

- Organic waste and dead birds must be incinerated or placed in the compost bin.
- Recyclable waste (including plastic, cardboard, paper, and cans) must be stored for recycling after collection.



## ATTENTION!

Be cautious about improper disposal of garbage around the houses and in the service areas.

Source: Duarte et al., *Requisitos básicos de bioseguridad para granjas de postura comercial*. Embrapa Suínos e Aves, 2018.

# Compost Management

1. Properly dispose of carcasses to prevent contamination and the spread of diseases.

2. Composting is a controlled process of organic material decomposition.

3. Under proper conditions, it takes about 90 days, resulting in high-quality organic compost.

Source: Agroceres Multimix.com

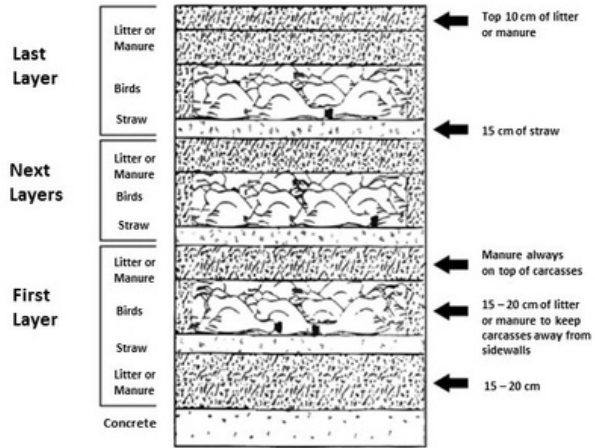


Photo: C. Mazocco



Composting must be managed daily to ensure the disposal of dead animals within 24 hours.

This prevents contamination, the appearance of disease vectors, and other sanitary issues.

Source: Duarte et al., *Requisitos básicos de bioseguridad para granjas de postura comercial*. Embrapa Suínos e Aves, 2018.

# Storage of Medications and Chemical Products

Maintain an adequate medication storage area to preserve effectiveness.

Regularly check the expiration dates, names, and uses of medications, as this affects production.

Avoid sun exposure, as it can alter the properties of the medications.



Store chemicals properly to avoid risks to the birds.

Ensure products are correctly labeled.

Disinfectants and chemicals should be kept away from birds and eggs.



Source: Duarte et al., *Requisitos básicos de biosseguridade para granjas de postura comercial*. Embrapa Suínos e Aves, 2018.

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**“Challenges exist to be overcome. Perseverance, learning, experience, and courage are the tools capable of innovating and transforming the lives of both people and animals.”**

*Royce Lello*

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