

White Paper

Effective Scalding



This document outlines the essential factors for achieving effective scalding in poultry processing without causing product damage that leads to costly downgrades. It delves into the physiological mechanisms that keep feathers anchored in the follicles and explores the factors that affect feather release. By understanding these elements, processors can optimize scalding conditions, improve efficiency, and maintain product quality.

Key considerations for
optimal feather removal

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Introduction



The process of scalding and defeathering poultry has been a fundamental part of bird processing for centuries. Despite its long history, modern processors continue to face daily challenges in achieving effective feather removal while preserving product quality, skin integrity, and yield performance.

Striking the right balance is not easy. It requires a deep understanding of both the biological characteristics of the birds and the technical parameters of the equipment. Factors such as bird size, age, feather development, stunning method, water temperature, and line speed all play a crucial role in determining the outcome.

In this document, we explore the most critical considerations for obtaining effective scalding while protecting quality.

The Art of Loosening Feathers

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The feathers grow from follicles in the skin. The follicle is a complex tubular structure that prevents the feather from falling out. Inside the follicle, the feather is stuck to the papilla where it was created, but connective tissue, muscles and other structures also hold the feather firmly inside the follicle.

Scalding at the Right Temperature

Heat treatment of the skin immediately after killing is the most effective way to reduce the Feather Retention Force (FRF), and hot water has the ability to penetrate deep into the follicles, bringing the heat to the feathers' surrounding structure thereby loosening the feather. However, hot water can be harsh on product quality.

If the temperature is too high for too long, there is a risk of denaturation of the underlying muscle proteins, producing the so-called cooked-fillet appearance, and the removal of the epidermis can result in discoloration of the skin during subsequent air chilling. Thus, finding the right balance between loosening the feathers and damaging the product quality becomes paramount in daily poultry processing.

Factors Influencing Feather Release

Several physiological and environmental factors influence the ability to remove the feathers from the follicles.

Bird age: The age of the bird determines the feather development stage. Growing feathers have a blood supply, with an artery entering and a vein leaving the feather base. This increases the FRF and pulling out developing feathers may result in red spots on the skin caused by blood in the follicles. Fully developed feathers have no blood supply.

Rigor mortis and stress conditions: The postmortem chemical change called rigor mortis results in a stiffening of the body muscles, including the muscles that help to hold the feathers in place. Rigor mortis onset is relatively fast in broilers. The earlier the onset of rigor mortis, the more difficult the picking process will be. Therefore, the time between killing and the end of the picking process should be kept to a minimum.

Broilers are homoeothermic animals meaning their body temperatures range from 40.5–41.5°C and they do not have sweat glands to regulate body temperature. In a high-temperature environment, broilers find it difficult to release their body heat, triggering acute heat stress that causes glycogen breakdown of the muscles. The total energy content left in the bird (glycogen) and the accumulation of lactic acid (stress conditions) affect the rigor mortis development – faster development complicates the picking process. Therefore, broilers must be maintained in a thermo-comfortable zone that does not disturb the physiological processes of the birds. Good ventilation in the lairage area eliminates excessive heat and ensures a proper supply of oxygen to the animals.



Ensuring Uniform Scalding

Complete bird immersion and strong water agitation in the scalding tank are essential to prevent dry spots, especially in areas with dense feather coverage. This helps ensure consistent feather loosening across the entire carcass.

The Art of Loosening Feathers



Stunning method: The bird's neurological system is involved in holding the feathers and any neurological manipulation will affect the FRF. Therefore, defeathering is more critical with CO₂ stunning, especially regarding soft scalded products, where temperatures usually should be increased with 0.5-1.0 °C to be able to reach the same defeathering result.

The main reason is the rigor mortis development, which is different in electrical stunning than CO₂ stunning. When applying CO₂ stunning the challenging areas are the tail feathers, the tail feather shafts, shoulder areas and sometimes the wing tip feathers. Consequently, BAADER recommends implementing a tail feather puller immediately after the scalding process when stunning with CO₂.

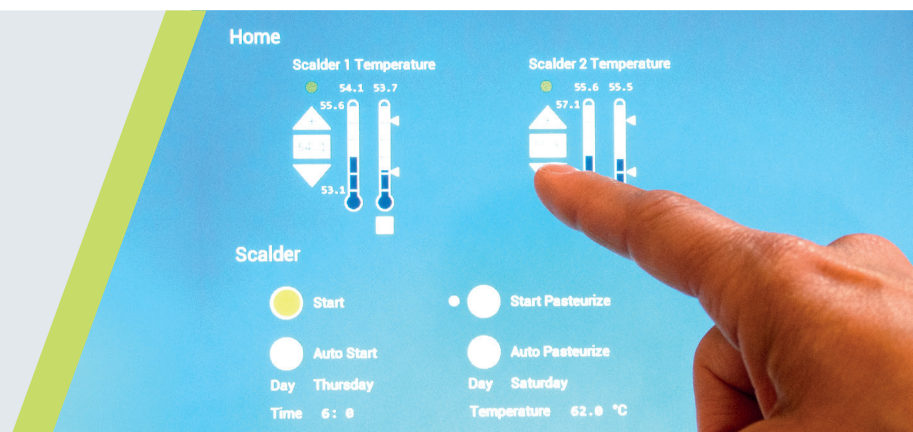
Scalding time and temperature: Scalding time

and temperature determine the degree of protein denaturation of the skin and muscle proteins, including the proteins in the feather follicle muscles. The higher the temperature and the longer the scalding time, the higher the degree of protein denaturation. If proteins are fully denaturated, they cannot return to their original structure.

Irreversible scalding is usually the case with hard scalding (>56°C) and therefore the picking process is less critical. With lower temperatures like medium scalding (53-57 °C) and soft scalding (50-54°C) the picking process often becomes more complicated, due to the lower degree of protein denaturation. On the other hand, the benefit of lower scalding temperatures is a reduced risk of whitening the meat.

Easy Control

Water level and temperature should be easily adjustable via a touch panel or remotely, ensuring constant control. Operators must conveniently select from multiple preset recipes on the touchscreen to align with the production schedule.



The Art of Loosening Feathers



Feather location: Not all feathers are subject to the same FRF. While the FRF of primary and secondary wing feathers is easily reduced by the penetration of hot water, the wing feathers are easily scalded. The tail feather follicles are deeply embedded in fat tissue and consequently, the hot water takes a long time to penetrate and has limited effect. Tail feathers are therefore difficult to pick, especially when applying soft or medium scalding.

Water movement method: When the bird enters the scalding tank, it should be fully immersed in the hot water, and the water movement inside the scalding tank should help open up the feather package and give the hot water access to the skin. Different methods can facilitate this ruffling of feathers: air bubbles that break the surface of the water and agitate the water, or a powerful water flow that opens up the feather package.

Water viscosity: The hardness of the water inside the scalding tank determines the viscosity and thereby the immersion time. Soft water has a lower density and birds will immerse faster. The water contamination level, e.g. faeces and blood, affects water density and viscosity.

The time between scalding and feather removal: The heat absorbed by the birds during scalding must be preserved as much as possible during the transfer from the last scalding tank to the first picking machine or the follicles can start to close. This evaporative temperature decline is most critical for low-scalded products.



Proper Feather Pack Opening

Regardless of the scalding method used, it's essential that heat reaches the skin where the follicles are located. This requires thoroughly opening the entire feather pack to allow effective heat penetration.

Quality Losses Due to Poor Scalding and Picking

Avoid Downgrades

Poor scalding can lead to significant losses, depending on the severity of issues like feather retention, skin damage, or contamination. These problems not only affect product quality but also reduce profitability by increasing downgrade rates and processing costs.

Cooked breast: The breast meat represents approximately 19% of the whole bird weight and is normally well paid for, so any damages to the breast meat will cause severe economic losses. When scalding temperatures are too high it leads to denaturation of the meat protein and a 'cooked' appearance, which in retail is not accepted.

Broken wings: Each wing represents approximately 4.5% of the whole bird weight and broken or dislocated wings have no or limited value to the poultry processor. If scalding is not effective, more aggressive picking is needed to remove the feathers which increases possible wing damages.

Skin damages: As in the case of wing damages, aggressive picking can cause skin damages, which can be a challenge when producing skin-on products. Similarly, scabby hips and skin scratches from the farm can cause further damage, as they may tear during picking. Furthermore, the risk of contamination increases when the skin is torn.

Unwanted epidermis removal or unwanted epidermis retention: High scalding temperatures effectively loosen the feathers from their follicle ; , but hard scalding is also harsh on the skin as the outer layer, the epidermis, becomes loose and is later removed during picking. Too high scalding temperatures in combination with harsh picking can result in unwanted epidermis removal. The missing epidermis results in a brown discoloration of the skin if it is dehydrated during subsequent air chilling. Water spraying in the chilling area can (partly) reduce the brown patches. In other cases, the epidermis has to be completely removed. Complicated areas for epidermis removal are the bird's sides, hocks and shoulder area. Incomplete epidermis removal sometimes results in an unwanted product appearance, as is the case for the Latin American 'pollo pintado' which requires full removal of the epidermis for effective attachment of the yellow colour. This is also the case when marinating birds.

Track Quality Loss

Damage incurred during scalding is irreversible, often leading to costly downgrades and lost profits. Effective quality control is essential. BAADER offers both easy screen-based registration to eliminate paperwork and automated vision control after picking to identify root causes and enable immediate corrective actions.



Quality Losses Due to Poor Scalding and Picking

Product contamination: The water temperature inside the scalders highly determines the degree of cross-contamination during the process. A common perception is that scalding is a dirty process; however, the water temperature will kill most of the microbes and the bacterial load. If the processor needs to pick the birds aggressively, the extra pressure on the bird can cause faecal contamination, which can lead to condemnation with associated economic losses. Scalding temperatures below 50°C are a microbiological threat to the products as pathogenic bacteria like salmonella, campylobacter and E.coli in the scalding water can grow during the scalding process. Daily pre-production pasteurization will eliminate risk of cross-contamination from the previous day.

Yield loss during scalding: Yield losses occur in different ways during scalding:

- / Direct yield loss: Due to the high temperature inside the scalding tank, the subcutaneous fat starts to dissolve. The melting temperature of the fat depends on a combination of factors, including diet, genetics, and activity levels.
- / Indirect yield loss: Proteins lose their ability to bind the water molecules when denatured (over-scalding). The result is a yield loss in the final product weight.

Whitenings or burns: ‘Pockets’ of very hot water in the scalding tank can result in meat whitening or burns. To avoid these hot spots it is important that the heated water is evenly distributed in the scalding tank, and also that the product cannot come into direct contact with the heating elements inside the scalding tank.

Bacteria

Bacteria	Temperature (C°)
Salmonella typhi	5 - 45
Campylobacter jejuni	30 - 45
E.coli 0157	4 - 45

Table: Temperature range for bacteria growth



Bacteria Control

Fighting bacteria is essential in poultry production to ensure food safety, product quality, and consumer health. Bacterial contamination can lead to serious health risks, product recalls, and financial losses. Strict hygiene, temperature control, and monitoring at every stage are critical to maintaining a safe and efficient production process.

Be in Control of the Scalding Process



Control Scalding Outcome

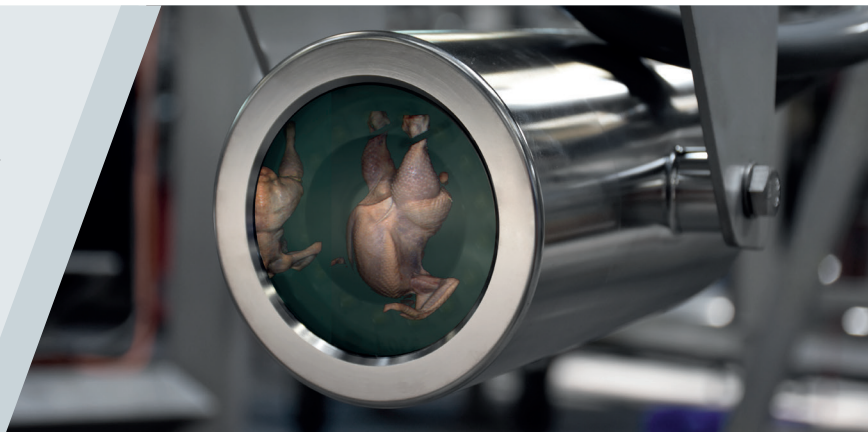
To best facilitate feather removal and avoid the above-mentioned quality issues, the scalding process must be controlled at all times. As effective heat transfer to the skin is the purpose of scalding, controlling the water temperature and receiving notifications about unintentional temperature deviations are paramount in any modern poultry slaughterhouse.

Vision Technology for Quality Control

Advanced vision technologies play a crucial role in monitoring product appearance after feather removal, helping identify any quality issues. The AI-powered ClassifEYE vision system is specifically trained to detect defects post-picking and alert operators to potential damage caused by poor scalding. The system provides real-time feedback through an intuitive dashboard, where alerts are customized with adjustable thresholds to suit specific processing requirements, ensuring proactive quality management and minimizing product losses.

Vision Technology

Vision technology can detect scalding and picking issues, providing real-time alerts to prevent further profit loss and ensure consistent product quality.

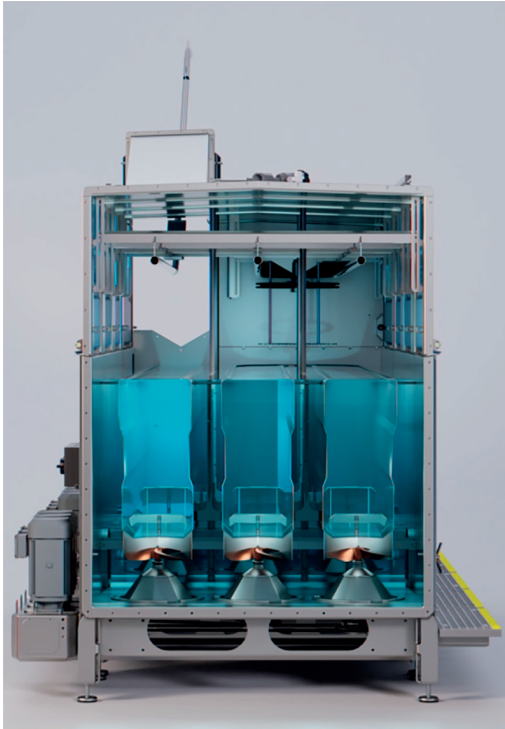


Be in Control of the Scalding Process

Solutions to the Scalding Challenge

BAADER offers two immersion scalding techniques: the Turbo Scalding 1070 and the AirJet Scalding 1050. Both techniques use full immersion in hot water to

loosen the feathers, while the water circulation inside the tub differs. The two scalding models perform a uniform and effective scalding and can be used individually or in combination.



The Turbo Scalding 1070 applies a powerful downwards water flow to ensure fast immersion and effective opening of the entire feather pack to facilitate water penetration.



The AirJet Scalding 1050 uses air to agitate the water inside the tub, which effectively reduces the water density and causes the product to immerse while the air bubbles ruffle the feathers and allow the hot water to penetrate.



Learn more

Visit the BAADER website to learn more about the two scalding techniques and explore them in detail: www.BAADER.com

Picking without Any Delay

Effective Picking Post-Scalding

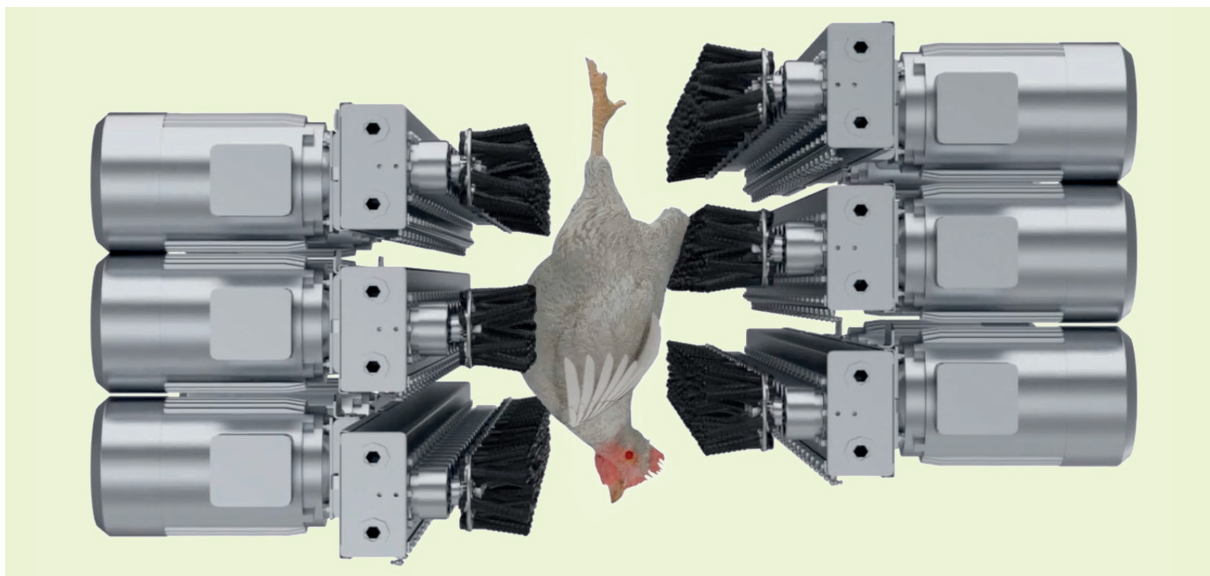
Immediately after scalding, when hot water loosens the feathers from the follicles, efficient picking ensures the feathers are removed, preparing the broiler for evisceration. If there is a significant delay between exiting the last scalding tank and entering the first picking machine, the follicles can begin to close as the skin cools. As the follicles contract, the bond between feather and follicle strengthens, making subsequent feather removal more difficult. This can lead to poor picking performance or skin damage from aggressive removal techniques.

The BAADER Tunnel Picker 284 is a proven picking solution that enables processors to remove feathers efficiently while safeguarding product quality and

preventing fecal contamination from excessive pressure on the bird. Its high level of configurability ensures that the picking line can be tailored to meet specific processing needs.

Adjust to Obtain the Best Quality

Adjustability is crucial for effective picking. Multiple adjustable features ensure peak picking performance while maintaining product quality. Each picking row should be individually angled, and picking banks should be easily adjustable in both height and separation to match the bird's shape. The flexible configuration of picking machines along the line allows for targeted picking at different stages of the process, ensuring efficiency as picking progresses.



Rubber Finger WAVE

Rubber Finger WAVE mounted in our stainless steel finger disc (optionally aluminium).

When the discs are rotating, the rubber fingers are subjected to centrifugal forces and impact the surface of the suspended bird. The wavy ridges on the Rubber FingerWAVE will ensure a multi-directional feather contact during picking.



Innovating Food Value Chains

BAADER is the global partner on food processing solutions with 100 years' experience. We design and engineer innovative and holistic solutions that ensure intelligent, safe, efficient and sustainable food processing in all phases, from the handling of live and raw protein materials to the finished food products.

Through our data capabilities, we use data to make interpretations and forecasts throughout the food value chain. In close collaboration and partnership with our

customers and partners, we are taking further major steps towards greater efficiency, traceability, transparency, profitability and sustainability.

By sharing knowledge and data, together we can succeed in optimising the food value chain in the long term.

Disclaimer

This brochure is current as from the publication date and supersedes all previous versions. The English version is perceived as the master document and all other versions are subject to incorrect translation. The indicated limits of the working ranges and performances may vary as a function of the proportion, quality and nutritional conditions of the products. In order to achieve an optimal result, it is recommended to adjust the machine within the working ranges of the product sizes mainly to be processed. Illustrations and dimensions are approximate and not binding. Subject to design changes in the interest of technical progress. Actual scope of supply is specified in our quotations and order confirmations and may differ from the descriptions and photos in this brochure.

Attention! For the illustration of the technical details the safety devices and protection mechanisms are partly not shown in operative condition. When operating the machine, all corresponding devices and instructions referring to the safety of the machine are to be utilised and/or observed.