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The Welfare of Animals in the Duck Industry

An HSUS Report: The Welfare of Animals in the Duck Industry

Abstract

Duck production in the United States shares many of the same intensive husbandry practices found in the chicken and turkey industries, despite being much smaller in scale. The vast majority of farmed ducks are reared in dimly lit sheds with high stocking densities and without access to water for swimming, a significant welfare concern for these aquatic animals. Lameness, feather pecking, respiratory problems, and eye infections are common, and most birds are subjected to bill-trimming, a physical mutilation known to cause pain. The stress and physical trauma of catching and crating for transport, as well as the journeys themselves, further compromise duck welfare. Inappropriate and inefficient stunning procedures may result in birds experiencing painful electric shocks before slaughter or having their throats slit while fully conscious.

Introduction

Large-scale duck farming began in the United States in the mid-1800s when the first White Pekin ducks were imported from China.[1] Originally concentrated on Long Island, New York, these traditional farms provided the birds both outdoor access and water for swimming. Today, however, many ducks are raised in total-confinement systems, primarily in the Midwest,[1] North Carolina, Virginia, Pennsylvania, Massachusetts and California.[2] Housed in flocks of several thousand, at an average density of 7 birds per m^2 (1.2 yd^2) of floor space,[3] ducks in these modern commercial facilities have increasingly been denied access to the outdoors and water for swimming.[2]

In 2006, 28 million ducks were slaughtered in the United States,[4] compared to 20 million per year in the mid-1980s.[2] This increase mirrors the global upward trend in waterfowl production, which now accounts for approximately 7% of world poultry meat production. As of 2004, the United States was the sixth-largest producer of duck meat in the world.[5]

Both domestically and globally, duck meat production is dominated by the White Pekin.[2,5] Descended from the Mallard (*Anas platyrhynchos*),[6] selective breeding has markedly accelerated the Pekin's growth rate and increased the thickness of breast muscle.[5] Modern commercial lines reach 90% of their adult weight by just 7 weeks of age,[7] when they are typically slaughtered. Domestic breeds raised in backyard flocks, such as the Rouen, can take up to 6 months to reach this weight.[8] Muscovy ducks (*Cairina moschata*), originally from South America[9] and much larger than Mallards, are also farmed for meat in the United States[10] and are the most common breed reared in some parts of Europe.[11] Like the Pekin, Muscovies have been selectively bred for increased breast muscle and size, with modern lines weighing 25% or more than they did 25 years ago.[12] Hybrids of Muscovy and Pekin ducks, known as Moulards or Mules, are also raised in the United States, primarily for foie gras.[10]

The duck breeds used commercially for egg production are descended from the Mallard but have been selectively bred for high egg production. Breeds such as the Khaki Campbell, Indian Runner, or Tsaiya can now lay more than 230 eggs a year.[7] Breeds developed specifically for commercial U.S. egg flocks, such as the Golden 300 Hybrid, can lay up to 290 eggs a year,[13] more than twice that of some more traditional breeds.[14]

Ducks, like other animals raised for food, are excluded from protection under the federal Animal Welfare Act and are not afforded any legal protection while on the farm.[15]

Lameness

Ducks raised in intensive units are prone to lameness.[16] Primarily aquatic animals,[6] ducks naturally have very weak leg and thigh joints[17] as they do not need to support their own bodyweight when in water, which is not adequately provided to them in industrial total-confinement duck farms. Selection for increased weight has compounded this problem in domestic breeds, leading to difficulty in walking and leg disorders.[6] Commercial breeds are also selected to gain weight at such a rapid rate that insufficient bone formation in the legs of farmed ducks is frequently observed.[18]

The flooring in duck production facilities also impacts the birds' welfare. To improve hygiene, many ducks are now kept on wire mesh floors or a combination of litter and wire mesh.[15] Perforated floors such as wire mesh can lead to a high incidence of leg and foot injuries.[19,20] Balancing can be difficult on perforated flooring, particularly for modern, rapid-growing birds.[3] During farm visits, researchers have reportedly found a considerable incidence of splay leg or spraddle leg, where the legs splay outwards to either side and the bird is unable to stand in male Muscovy ducks, and the problem was more severe on wire floors than on plastic or wooden slats.[11]

The skin covering the feet and hock joints of ducks is not as tough as that of land fowl, such as chickens and turkeys, and confining ducks on rough surfaces such as wire mesh or slats can result in injury to the feet and legs.[15] Ducks housed on abrasive surfaces are especially prone to "bumblefoot," a pus-filled swelling in the pad of the foot that causes lameness.[21] Some researchers have reportedly found footpad dermatitis and injury in all farmed Muscovy ducks they investigated.[11]

Ducks can also suffer from leg and foot problems on poorly managed litter floors.[11] Duck feces are considerably wetter than that of chickens or turkeys, and extra measures must be taken to keep litter floors dry.[15] Wet or dirty litter can be slippery and make balancing difficult,[3] and lead to leg problems such as splay leg.[21] Constant contact with wet litter can also lead to painful footpad lesions and breast blisters[22] (as ducks with leg disorders may spend most of their time sitting). Knierim *et al.* studied leg problems in ducks in relation to water supply and found that providing ducks with access to open water reduces the incidence of toe and footpad lesions.[23]

In conjunction with perforated flooring, the high stocking densities on modern duck farms can also contribute to a high incidence of leg injuries.[19] Ducks in larger groups are more nervous and panic more easily, which can lead to injury and mortality.[11] The high stocking densities in total-confinement systems, typically 6-15 birds per m^2 (1.2 yd^2) for Pekins,[11] coupled with the close proximity of feed and water points, increases their incidence of leg problems[18] and limits the birds' opportunity for exercise. Researchers at the Poultry Research Centre in the Netherlands compared leg disorders in three groups of ducklings and found that those with the longest walking distances between food and water points had the fewest leg problems.[18]

Feather-Pecking

Feather-pecking and cannibalism are problems in total-confinement duck units.[2] In natural settings, ducks spend considerable time every day in bill-oriented behaviors such as feeding, which involves dabbling the bill along the water and straining out planktonic organisms, as well as preening,[6] where the bill is used to distribute water over the body and remove dirt. The lack of foraging opportunities and open water for preening in intensive duck farms can cause birds to redirect their pecking at other ducks, sometimes degenerating into cannibalism.[3]

One study found that providing Muscovy ducks with an outdoor run and open water greatly reduced feather-pecking; only 12% of ducks showed injuries compared to 50% when ducks had neither outdoor access nor open water.[24] Another study found that ducks with deep water troughs had less feather damage due to pecking than those who only had access to bell drinkers and shallow basins,[23] which restricted their preening and foraging abilities.

High stocking densities can also contribute to feather-pecking. Pekin ducks housed at a density of 8 birds per m^2 (1.2 yd^2) have reportedly been found to suffer more feather damage than birds housed at densities of 5, 6, or 7 birds per m^2 (1.2 yd^2). Similarly, no incidence of feather-pecking was evidently found in Muscovy ducks housed at low densities (6.3 birds/m^2 [1.2 yd^2]) but serious injuries were found in those housed at high densities (11.6 birds/m^2 [1.2 yd^2]).[11]

Bill-Trimming

Commercial U.S. duck production facilities often trim the bills of Pekin and Muscovy ducks to reduce the damage caused by feather-pecking and cannibalism.[25,26] The method of trimming, the amount of bill that is removed, and the age at which trimming is done varies throughout the industry.[25] Duck bills can be trimmed by cold-cutting with scissors, cutting with a hot blade that cauterizes the bill stump, and tip-searing by holding the end of the bill against a cautery blade for a few seconds.[25]

The severity of damage caused by bill-trimming depends on the method used and the age at which it is performed.[25] However, as the duck bill is innervated up to the tip[27] and the procedures are performed without anesthesia or analgesic, all methods of trimming will, at a minimum, cause acute pain.[27] The tip of the upper duck bill also contains thousands of sensory receptors that are used for detecting edible food items as well as harmful stimuli such as excessive heat or pressure.[25] Several thousands of these sensory receptors may be lost when ducks are bill-trimmed, resulting in permanent deprivation of important sensory information.[28]

Researchers at the University of California, Davis, Department of Animal Science showed that Pekin ducks bill-trimmed at one-day-old using either hot-blade cutting with cautery or tip-searing, experienced pain for two weeks after the procedure and performed fewer bill-related behaviors, such as feeding and preening.[25] In a separate study, these same researchers found that Muscovy ducks bill-trimmed with scissors at three-weeks-old showed similar evidence of pain for one week after trimming.[26] Furthermore, bill-trimming Muscovy ducks using hot-blade cutting with cautery has been found to lead to the formation of neuromas in the bill stump[29] that may cause the birds to experience chronic pain.[27] Neuromas are fibrous tumors that form when severed nerves attempt to grow back into the damaged bill but are impeded by scar tissue,[30] and then send spontaneous pain signals back to the brain, "similar to the phenomenon that causes phantom limb pain in human amputees."[27] The formation of neuromas in chickens' beaks after trimming and the resulting chronic pain are well documented.[27,30,31]

The Council of Europe (COE), an international organization comprised of 47 European countries with the aim of promoting democracy and protecting the rule of law in Europe,[32] produced recommendations concerning domestic and Muscovy ducks kept for farming purposes. Any procedures that result in the loss of a sensitive part of the body and are performed for non-therapeutic or non-diagnostic purposes are prohibited.[6,9] Muscovy ducks show a greater tendency toward aggressive behaviors than other domestic breeds,[9] especially under intensive conditions. The COE therefore permits bill-tipping in these birds, where only the portion of the upper mandible that projects past the tip of the lower mandible is removed, but only if all other steps to eliminate feather pecking, such as environmental enrichment, have been tried and failed.[9] Recommendations adopted by the COE serve as guidelines for the European Parliament, national governments, and political parties within Europe.[33]

Claw-Trimming

Muscovy ducks are strong[22] and have sharp claws that can cause injury to other ducks should the birds pile when panicked or during transport.[11] To prevent injuries, Muscovy ducks on commercial farms often have their claws trimmed close to the base at the same time they are bill-trimmed.[22] While the procedure should not cause a great deal of discomfort if performed properly,[22] claw-trimming has been reportedly found to frequently result in bleeding and even amputation of toes as it is routinely performed with a single cut per foot.[11]

A study of Muscovy ducks on European farms reportedly found that claw-induced injuries could be greatly reduced by lowering stocking densities, providing environmental enrichment, improving the relationship between farm staff and the birds, and more careful transportation.[34]

Lighting

Low-intensity light, sometimes from red or blue bulbs, has been commonly used in U.S. duck production facilities to attempt to prevent or control feather-pecking in total-confinement systems.[2] Lighting of an unnatural color or of low intensity may not allow birds to use their full range of visual abilities, however, and can contribute to lameness through decreased exercise, impaired visual development, increased fearfulness, and visual sensory deprivation.[35]

Most domesticated ducks are descended from Mallards, who would naturally inhabit environments with a range of light intensity, from areas of direct sunlight to underwater,[35] as well as a diurnal rhythm that changes with the seasons. These variations in light provide important visual cues for birds that affect their behavior. In the low-light environment of commercial housing, however, lighting regimens usually do not mimic natural photoperiods.[35] It has been shown that ducks also have UV_A vision.[36] The lack of UV_A wavelengths in commercial lighting may therefore, according to one group of researchers, "limit or deny birds the use of these visual cues, which may be important for the performance of a range of visually mediated behaviours."[35]

Ducklings' preference for four different levels of lighting—<1, 6, 20, and 200 lux—were investigated, and the scientists found that the birds showed a significant preference for the three brightest light environments.[35] The ducklings not only spent more time in the brightest environments, but were also more active in bright light, with increased locomotion and preening.[35] Similarly, allowing daylight into broiler chicken production units has been shown to increase their activity levels, leading to improved leg health and overall welfare.[37]

The Council of Europe recognizes the importance of lighting for duck welfare and requires that lighting be sufficient for ducks to "investigate their surroundings visually and to show normal levels of activity," as well as "follow a 24 hour rhythm and include a sufficient uninterrupted dark period, as a guideline approximately a third of the day."[6]

Lack of Access to Water

It is widely recognized that ducks are "strongly water-oriented" and require access to water for swimming[19] and bathing in order to fulfill their biological[6] and behavioral needs.[38] The domesticated duck, like his wild Mallard ancestor, "shows a clear preference for open water and uses water for foraging and feeding, drinking, general exploration, locomotion and preening, even without prior experience."[39] However, maintaining the hygienic quality of open water under intensive conditions involves considerable labor demands and costs,[11] and access to water in most U.S. duck units is limited to nipple drinkers.[40,41] In Europe, where the COE recommends that ducks be able to cover their heads with water and spray water over their bodies with their bills,[6] bell drinkers (which allow ducks to submerge their bills) or water troughs (which allow dabbling and head-dipping) are more commonly used.[40] However, a recent review of the welfare of ducks in European husbandry systems still considered the inadequate supply of a "suitable water source" as the main welfare issue for farmed Pekin ducks.[11]

Without access to open water, ducks can "show abnormal behavior, such as head-shaking and stereotypic feather-preening."[11] The birds' restricted grooming abilities[3] can also lead to dirty bills, nostrils, and eyes, which could potentially increase the risk of infection. Ducks also use water to thermoregulate and can suffer from heat stress in systems without adequate water for wetting their bodies.[11]

Jonathan Cooper, principal lecturer in Animal Behaviour and Welfare at the University of Lincoln, and colleagues found that when given a choice between nipple drinkers, bell drinkers, and open water troughs, Pekin ducks preferred open water troughs and were willing to work harder for access to them.[42] When ducks had to cross a barrier to reach each type of drinker, they were willing to cross a higher barrier to get to a trough (195 mm/7.7 in) than to a bell drinker (155 mm/6.1 in) and only crossed the lowest barrier (75 mm/3.0 in) to reach a nipple drinker.[42] The researchers also found that nipple drinkers were used only for drinking, while the bell drinkers and troughs were also used for dabbling and head-bobbing.[42] Other research teams studying the preference of Pekin ducks for different water supplies have found that ducks in free-choice pens significantly preferred open water troughs to nipple drinkers, and those in pens with access to only nipple drinkers showed a significantly higher prevalence of occluded nostrils than ducks from pens with open water drinkers.[43] In one study, 65% of ducks drinking from nipple drinkers had at least one blocked nostril compared to 25% of the ducks drinking from troughs and 5% from modified bell drinkers[39] Ducks with open water drinkers were also consistently more active and preened and drank more than ducks with nipple drinkers only.[39] Marko Ruis and colleagues at the Institute for Animal Science and Health in the Netherlands found that ducks with access to open water spent significantly more time preening and had cleaner plumage than ducks with nipple drinkers only. They concluded that "pekin-ducks have a behavioural need for freely accessible open water."[38]

Another scientific team studying the effects of different types of water provisions on the welfare of Muscovy ducks found that those provided with open water troughs had less feather damage due to feather-pulling and fewer skin alterations on toes and foot pads than ducks with bell drinkers and showers (an industry-suggested alternative to open water access), as well as lower mortality rates than ducks with bell drinkers. However, due to the occurrence of feather-pulling and cannibalism in all groups of ducks, including those with open water access, the researchers concluded that "ducks are unsuccessful in coping with intensive housing conditions and that suffering, pain and damage are resulting from this."[23]

Although poultry welfare experts contend access to water for swimming is important to meet the welfare needs of ducks,[19] few raised in industrial-scale meat production in the United States and the United Kindom may have this provision.[2,44] In an attempt to address this basic need, one U.K. supermarket chain is reportedly trialing a flushable pond that will allow ducks to swim without compromising water hygiene, but it is not yet in commercial use.[45]

Air Quality

High ammonia concentrations are common in poultry production facilities, where thousands of birds are confined in buildings with artificial ventilation.[46] Duck farms are particularly susceptible to elevated ammonia levels as duck droppings contain more than 90% moisture.[15] One study suggests that ammonia production is on average almost four-times greater for ducklings than for broiler chickens.[47]

The U.S. Environmental Protection Agency's (EPA's) current exposure limits for ammonia on poultry farms—25 parts per million (ppm) per 8 hours of exposure or 35 ppm per 15 minutes—are set on the basis of human safety[48] rather than animal welfare. Unlike the workers on commercial farms, ducks remain confined inside the buildings, continuously exposed to ammonia. The respiratory system of birds is also very different from that of mammals; avian physiology includes air sacs that increase pulmonary ventilation, a result of the need for increased respiration during flight.[46] As such, birds will absorb approximately twice as much gas, including ammonia, from the air they inhale than similarly sized mammals.[49] Ammonia exposure limits based on human safety may be much higher than what is safe for birds, including ducks.

A review of the effects of ammonia exposure on poultry welfare, concluded that it "(1) causes irritation to the mucous membranes in the eyes and the respiratory system; (2) can increase the susceptibility to respiratory diseases; and (3) may affect food intake, food conversion efficiency and growth rate."[46] Exposure to ammonia levels of 25 ppm (the current exposure limit set by the EPA per 8 hours) has been found to depress growth rates in broiler chickens and lead to a greater incidence of airsacculitis (inflammation of the mucous membrane of the air sacs), viral infections, and carcass condemnations.[48] Prolonged exposure to high ammonia concentrations may cause keratoconjunctivitis, a painful inflammation of the cornea and conjunctiva, which leads to swollen, crusty eyes and possible blindness.[46,48] Affected birds may also suffer from hunger and thirst, as their impaired vision may prevent them from finding food and water.[46]

While studies on the air quality preferences of domestic ducks are lacking, a preference assessment of egg-laying hens for different concentrations of ammonia was performed by giving the birds a free choice between fresh air and air with either 25 or 45 ppm of ammonia.[50] The researchers found that "[t]he hens spent significantly more time foraging, resting and preening in fresh air than in the ammonia-polluted environments."[50] The birds responded similarly to both the 25 and 45 ppm concentrations, suggesting a threshold for ammonia detection below the current exposure limit.[50]

Duckling Transport

Most large duck producers in the United States separate their operations into hatcheries, grow-out units,[51] and processing plants. Within several hours of hatching, ducklings are shipped from the hatchery to company or contract farms across the country for fattening, typically via ground transportation. Smaller duck producers and backyard hobbyists may purchase newly hatched ducklings from commercial hatcheries that ship them via the U.S. Postal Service.[52-54] As mortality during transport is expected, producers may ship extra ducklings in excess of the number purchased to account for anticipated deaths.[53,54]

Feed and water are not provided during transport, as producers contend that nutrients from the remains of the yolk sac are sufficient.[52,55] Studies on the effect of feed and water deprivation on ducklings are scarce but those that have examined early feed and water deprivation in broiler chicks have found that the effects can jeopardize the animals' welfare. Broiler chicks held for 48 hours without food and water were found to suffer from dehydration and substantial weight loss, weighing 44% less than fed chicks.[56] Withholding food and water from newly hatched chicks for three days has been found to play a significant role in chick morbidity. The researchers concluded that "supply of both feed and water or water supplement is essential to alleviate chick stress and improve subsequent performance when a prolonged delay is expected in chick placement."[57]

Access to feed and water shortly following hatching may be especially important for ducklings. In studies comparing the energy requirements of ducklings and broiler chicks, ducklings, because of their higher metabolic rate, lost significantly more body weight, body fat, and protein than chicks when starved for up to 30 hours.[58] In a separate study in which food and water were provided for a 12-day period, ducklings had an energy intake 66% greater than chicks of the same size, and their water intake was considered "very much higher."[47] The mean ratio of water to food consumption was 4.1:1 for ducklings and 2.3:1 for chicks.[47] Based on this research, newly hatched ducklings appear to be at a greater risk of dehydration and starvation during transport than newly hatched chicks.

Newly hatched ducklings are unable to self-regulate their body temperature and require an external heat source of approximately 30°C (86°F).[7] During transport, ducklings may be subject to a range of temperatures depending on the mode of transport, season, time of day, stocking density, stacking configurations, and ventilation. Again, research on duckling transport is lacking, but the effects of transport on newly hatched chicks are well-documented. In a study of eight air transport shipments of newly hatched chicks, temperatures in the chick containers reportedly fell rapidly by up to 7°C (13°F) upon departure and increased by up to 10°C (18°F) upon touchdown.[59] Researchers also reportedly observed elevated temperatures while the chicks were being held on the aircraft prior to take off and again when they landed.[59] Extremes of temperatures cause chicks to use up their reserve of nutrients and water more quickly. The European Food Safety Authority's (EFSA's) Scientific Panel on Animal Health and Welfare cite research showing that reserves can be depleted in as little as 8-10 hours at 40°C (104°F).[59] As ducklings have a higher metabolic rate than chicks and require a greater intake of water,[47] they are likely to use up their yolk reserves even more rapidly under temperature extremes.

Catching and Transport of Slaughter-Bound Ducks

According to Ian Duncan, emeritus chair in Animal Welfare at the University of Guelph: "Of all the things we do to our animals on the farm, the things we do to them in the 24 hr before they are slaughtered reduce their welfare the most."[27] For poultry, these can include: injury during catching and crating; fear of novel stimuli;

stress throughout the catching and transportation process; and climatic extremes before, during, and after transport.[27,60]

Silsoe Institute agricultural engineer Peter Kettlewell and Malcolm Mitchell of the Agricultural and Food Research Council Institute of Animal Physiology and Genetics Research identified manual catching, handling and loading of poultry prior to transportation as major sources of stress and trauma.[61] University of Georgia poultry science professor Casey Ritz and colleagues studied mortality of broiler chickens during live haul and found that physical injury "due to rough handling by the catch crew or by machinery malfunction or disrepair" was the primary handling-related cause of birds arriving dead at the slaughterhouse.[60] Although little research on duck welfare during catching and loading has been conducted, the birds' weak leg and thigh joints make them particularly susceptible to injury when being caught[21] and crated for transport. Farmed domestic ducks tend to rush away when a person approaches,[62] increasing their risk of injury during manual catching. These fear reactions in duck units may lead to injuries and even death by suffocation if the birds pile on top of each other.[11] Research suggests that ducks may be less fearful of an approaching vehicle than an approaching human, maintaining a significantly greater distance from the human than the vehicle.[62] Injuries and stress during catching may therefore be reduced by herding ducks into transport containers with a small remote-controlled vehicle (known in the poultry industry as a mobile herding robot).[62]

Thermal stress during transport is recognized as a major cause of poultry mortality.[60,63,64] Ducks are transported to slaughter in the same way as turkeys and chickens, who, according to University of Bristol researchers, "are transported in closely stacked containers, either loose crates or drawers that fit into metal frameworks (modules). The containers have minimum headroom and limited ventilation openings, which may be partially occluded by the birds, particularly at high stocking densities. Stacking further reduces the potential for flow of air."[65] Birds normally thermoregulate by changing positions so that a larger area of body surface is exposed, increasing heat loss.[65] Ducks also use water to thermoregulate,[11] wetting their body when they need to cool down. They are therefore unable to thermoregulate efficiently under conditions of transport. While little research has been carried out on thermal stress in ducks during transport, the problem has been well-researched in other poultry species.

An analysis of records of all broiler chickens slaughtered over three years at one U.K. processing plant found a pronounced increase in mortality during transit in the summer months. Between 17-19.9°C (62.6-68°F), mortality was 30% higher than at lower temperatures of -1.0-16.9°C (30.2-60.8°F). Between 20-22.9°C (68-73.2°F), mortality increased 2.6-fold and, at temperatures above 23°C (73.4°F), 6.6-fold.[63] Reseach on the incidence of dead-on-arrival broiler chickens, turkeys, and laying hens at the majority of Italy's poultry slaughter plants over a four-year period also found that the season significantly influenced mortality during transport, with dramatically higher incidence being observed during the summer for broilers (+43%), turkeys (+59%), and laying hens (+42%) than the averaged mortality in autumn, winter, and spring.[64]

Transport during colder months can cause birds to suffer from cold stress. A study of broiler chicken mortality during winter journeys found that 75% of the deaths occurred in the back half of the transport vehicle and 60% in the lower tier.[66] Birds in these areas were subjected to road spray, which wets their feathers and disrupts their insulating properties, making the animals more vulnerable to the low air temperatures.[66] Anthony Webster of the United Kingdom Atomic Energy Authority and colleagues showed that "the combination of circumstances necessary to ensure thermal comfort for birds both at rest and in motion is very rare." According to their study, enclosed transporters that protect birds from rain and cold temperatures are "reasonably satisfactory while the vehicle is in motion but rapidly become too hot and humid when stationary, even at air temperatures within the range 10-15°C (50-59°F). Open vehicles with well-ventilated modules…are satisfactory while the vehicle is at rest, but are likely to be too cold when in motion," especially for poorly feathered birds.[67]

While much research is now focused on developing transport vehicles that monitor and control temperature, studies on broiler chickens have shown that the pre- and post-transport periods also present a risk of birds overheating. Ritz *et al.* found that crowding and prolonged catching delays allowed house temperatures to rise, subjecting chickens in the back of broiler houses to elevated temperatures for extended periods of time.[60] They concluded: "These high temperatures contribute to heat stress of birds in the house and on the trailers, setting the stage for death loss."[60] As duck houses may be emptied in the same manner as chicken houses and ducks have been shown to move away from approaching humans, ducks may experience the same problems of crowding and heat stress as do broiler chickens.

Studies of the temperature and humidity experienced by broiler chickens during holding at the slaughter plant, which can be several hours, have measured potentially stressful thermal environments in both winter and summer.[68] During the first 1-2 hours after unloading at the slaughter plant, temperatures in the chicken containers have been found to rise rapidly, even in winter.[68] High concentrations of carbon dioxide were also recorded in the containers, indicating poor ventilation within the stacked crates despite large air flows in the holding area.[68] As ducks may be transported to the slaughter plant in the same types of containers as broiler chickens, they too may experience the same levels of heat stress and inadequate ventilation when held for extended periods before slaughter.

Stunning and Slaughter

In the United States, current interpretations of the federal Humane Methods of Slaughter Act exclude poultry from the Act's protections.[69] Thus ducks are typically not rendered insensible to pain before they are shackled and slaughtered. Electric stunning is often used to immobilize the birds before slaughter, making them easier to handle. However, the voltage used may be insufficient to induce unconsciousness.[70]

In large slaughter plants, the stunning operation is mechanized to manage the high throughput of birds. Ducks, like chickens and turkeys, are manually unloaded from their crates, inverted, and shackled by their legs onto a moving line. The live-hang line moves over an electrified waterbath, and the birds' heads are submerged, completing an electrical circuit meant to render the birds unconscious before their necks are slit.[27] However, when ducks are passed through waterbath stunners that were designed for chickens and turkeys, "their heads may not always be completely immersed in the water. Instead, the bill and crop region make contact with the water and the cranium is above water."[71] This results in the current flowing through the body instead of the brain and may induce cardiac arrest without rendering the birds unconscious.[70] Royal Veterinary College chair in Animal Welfare Physiology Neville Gregory and Steve Wotton at the University of Bristol School of Veterinary Science Division of Farm Animal Science found that 70% of ducks whose heads were only partially immersed in the waterbath showed "visual evoked responses which persisted for at least 60 seconds after the stun, whereas this effect occurred in only 20 per cent of the birds which had the whole head immersed in water."[72]

Birds whose heads are completely submerged in the waterbath may still not be stunned effectively. Ducks require a higher stunning current than chickens as they are less susceptible to cardiac arrest.[73] The Council of Europe recommends a minimum current of 130 mA per duck.[74] In the United States, however, there are no guidelines governing poultry stunning and lower amperage may be used. The effectiveness of the stunning current is also affected by differences in the size and conductivity of the birds, changes in the conductivity of the water as it becomes dirtier, and other variables.[27]

Electrical waterbath stunning also subjects birds to the stress of being removed from their transport containers and the pain and fear of hanging upside-down—an unnatural and uncomfortable position—in metal shackles that compress their hock bones.[70] Shackling is of particular concern for ducks due to their weak leg and thigh joints.[21] Some birds flap their wings when shackled and experience a painful pre-stun shock when their wings make contact with the waterbath before their heads are immersed.[70]

Due to the many welfare concerns associated with waterbath stunning, controlled atmosphere killing (subjecting birds to a lethal gas mixture while they are still in their transport crates) has been proposed as a more welfare-friendly alternative. While controlled atmosphere killing of ducks would eliminate many of the handling-related stresses and injuries associated with waterbath stunning, there are still welfare concerns with this method of slaughter.[74]

Some species of duck have a diving reflex that allows them to withstand periods of reduced oxygen (hypoxia),[75] raising concerns about the length of time necessary to induce unconsciousness with gas stunning. Most farmed ducks, however, are descended from Mallards—dabbling ducks who typically find their feed in shallow water and on land[6] and, therefore, usually do not dive.[76] Recent studies on the effectiveness of gas stunning in domestic ducks have produced conflicting results. The EFSA cites research by Mohan Raj, Reader in Farm Animal Welfare at the University of Bristol, who found that ducks can survive 6 minutes of exposure to 50% carbon dioxide in air, resuming vocalization and regaining posture within 30 seconds of returning to atmospheric air.[74] However, others studying the effects of increasing carbon dioxide concentration on Pekin ducks and turkeys found similar reaction patterns for both species. The ducks in this study did not display an ability to withstand hypoxia, losing consciousness before a level of 25% carbon dioxide in air was reached, the same as turkeys.[76] While Raj *et al*. found that 3 minutes exposure to 90% argon (an inert gas) in air or a mixture of 30% carbon dioxide and 60% argon is sufficient to kill ducks, it has not been demonstrated that the method quickly induces unconsciousness without causing undue stress.[71,74] The Scientific Panel on Animal Health and Welfare of the EFSA believes further investigation may be needed before gas stunning of ducks can be considered humane.[74]

Conclusion

Ducks in meat and egg production suffer significant and varied welfare challenges. The problems caused by total-confinement rearing without access to water for bathing, swimming, or preening—such as leg and foot disorders, respiratory problems, and feather-pecking—are exacerbated by painful mutilations and sensory deprivation through unnatural light regimes. Catching, crating, and transport for slaughter may inflict physical injury and heat and cold stress, as well as cause fear. The slaughter process itself, from dumping and shackling to stunning and throat slitting, is traumatic. Ducks raised for meat and eggs experience compromised welfare throughout their lives.

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