

### **Housing Chickens: How Much Space is Enough?**

Poultry production, mainly chicken, is a major industry in the U.S. The USDA does not consider an operation to be a large producer unless they have at least 3,000 birds at a time (USDA). These producers have multiple different options for housing their birds. The most common housing techniques are to allow the chickens to roam around in an enclosed area, socializing with each other, or to cage their chickens either individually or in small groups (Lay et al., 2011). However, for both cage and floor operations, there does not appear to be any agreement on just how much space a chicken needs to be comfortable and healthy while producing quality food products for consumers (Lay et al., 2011).

The intensification of poultry production began in the 20<sup>th</sup> century, but indoor confinement of birds was not successful due to a vitamin D deficiency resulting in leg weakness. Once it was discovered that the vitamin could be supplemented into their feed, chickens were able to be kept indoors for their entire lives (Boyd, 2001). This new production practice was adopted worldwide and sparked a multitude of research studies to be conducted on topics such as animal confinement, space allowances, flooring types, air quality, and animal behavior (Fraser, 2008).

As more information on these topics became available, consumers and producers began to disagree on how animals should be raised for food, resulting in general confusion and vague guidelines for animal housing conditions (Horgan and

Gavinelli, 2006). Poultry producers aim to keep their birds healthy in order to create a product that will allow them to make a profit, while working as efficiently as possible in order to maximize that profit. Some consumers desire reasonable retail prices for poultry products such as meat and eggs but are also somewhat concerned with how the birds are handled and raised. The chickens themselves, like all animals, are concerned for their own safety and wellbeing, and survive the best they can in the conditions they are given. These varying viewpoints create an interesting conflict that has no current official compromise and continues to be analyzed and debated by animal welfarists while legislation regarding animal protections constantly change (Horgan and Gavinelli, 2006).

### **Animal Handling vs. Stocking Density**

One perspective on poultry being kept in confinement is that animal handling practices are actually more important to bird health than stocking density, the measurement of how many animals are present in a given enclosed area. (Stamp Dawkins et al., 2004). While many people are concerned that poultry producers are overcrowding their birds in order to maximize efficiency, there is some evidence that chicken welfare can be greatly improved with better animal handling practices and increased housing quality instead of just lowering the stocking density (Stamp Dawkins et al., 2004). Better animal handling practices would include interacting with the birds in a way that causes the least amount of stress possible while still being able to work efficiently with them. Increasing housing quality without increasing the available space

would involve including enrichment for the birds that stimulate more natural behaviors such as bedding that they could scratch through or dust baths that they could use (Simsek et al., 2009). For example, free-range chickens maintained high levels of production at 2,000, 10,000, and 20,000 hens/ha, possibly because they had access to the outdoors and were able to engage in natural behaviors such as foraging (Campbell et al., 2017). This extra physical activity also allowed these chickens to maintain a level of health and muscle quality that is superior to that of indoor-only chickens (Campbell et al., 2017).

Slow-growing chicken breeds were shown to have increased yield and nutrition in their meat as opposed to traditionally raised, fast-growing indoor birds (Evaris et al., 2019). These chickens were allowed access to the outdoors as well, which increased their physical activity level. As a result, these chickens had a lower level of fat on their muscle and higher quality meat (Evaris et al., 2019). Furthermore, the food that the birds found while foraging reduced the amount of feed that they required, lowering feed costs and making up for the additional time needed to raise the chickens to a proper market weight.

### **Stocking Density and Performance**

In addition to animal handling practices, there has been research on stocking density by itself. Layer chickens have been shown to lay good quality eggs at stocking densities up to seven birds/m<sup>2</sup> of floor space indoors (Geng et al., 2020). Any higher and performance was decreased, possibly due to stress and conflict over resources (Geng et

al., 2020). On the other hand, stocking density of broiler chickens has no measurable effect on the quality of their breast meat, meaning that the meat was still of high quality even when the chickens were kept at high stocking densities (Goo et al., 2019). This factor is beneficial for poultry meat producers, as they are able to keep many birds in a small amount of space and still get a marketable product (Goo et al., 2019). Non-producers concerned with animal welfare, such as consumers, however, could see this crowding as concerning. Overly high stocking densities, depending on housing quality, have shown increased levels of negative activity such as aggression and stress, but these behaviors can be alleviated by lowering the stocking density, providing the birds with more space to perform their natural behaviors without interruption from others (Barnett and Hemsworth, 2003). The birds in this study did not show any significant quality change in their meat with added stress and aggressive behavior, these behaviors are just of concern when it comes to the welfare of the live animals.

Foot pad dermatitis, or lesions on the bottoms of the feet, has shown to be a problem that affects performance in chickens, and dermatitis severity seems to increase with stocking density when it goes above 40kg live weight/m<sup>2</sup>, or about 12 birds/m<sup>2</sup> (Dozier et al., 2005). However, frequency and severity of these foot injuries have been demonstrated as having a stronger link with litter/floor quality and humidity, with moist or wet litter being the hardest on their feet. (Jones et al., 2005, Meluzzi et al., 2008). This problem can be solved in floor-based systems by ensuring proper ventilation of the area and by avoiding the use of cooling devices such as misters that would introduce additional moisture.

From the perspective of the producers, a high body weight and low feed intake rate are desirable to increase efficiency (Bottje and Carstens, 2009). This means that the chickens would need less feed in order to achieve the desired market weight (Bottje and Carstens, 2009). Stocking density has been linked to feed intake and growth rate, suggesting that chickens kept at lower stocking densities will eat less feed and still grow faster and larger than chickens that are kept at higher stocking densities (Tong et al., 2012). The stocking densities that were observed in this case were higher, the lowest being 12.5 adult birds/m<sup>2</sup> which was much greater than the previously suggested seven birds/m<sup>2</sup>, so it is not apparent in this case if this stocking density would still result in maximum performance (Tong et al., 2012). It is possible that maximum performance could be achieved at a different stocking density in this scenario if improvements in handling and environment were added.

Conversely, another scenario showed different results, with birds at lower stocking densities eating more feed and growing faster than those of the same breed at higher densities (Thomas et al., 2004). This finding could still benefit producers, as their birds could potentially reach market weight faster (Thomas et al., 2004). It was also found that birds kept at higher stocking densities, such as 15 or 20 birds/m<sup>2</sup>, still had higher rates of illness and foot injury (Thomas et al., 2004). Together, these findings suggest that the stocking density of poultry not only has some effect on performance but is also important in the general physical health of the birds.

## **Behavior and Housing Systems**

Housing systems have a significant impact on the welfare of chickens as well. Broiler chickens that were raised in a floor system, as opposed to cages, showed greater bone health due to having more space for physical activity, and the addition of bedding on the floor provided enrichment for the birds allowing them to scratch and dustbathe (Shields and Greger, 2013). Caged broiler chickens showed lower levels of movement and comfort activities such as preening, dustbathing, and feed pecking when their available space was decreased and their feather condition scores were worse, which may be a sign of stress, decreased health, or aggression between birds (Engel et al., 2019).

Dustbathing is a natural behavior of many bird species and has been discovered to be a pleasant activity instead of one performed out of necessity (Widowski and Duncan, 2000). Dustbathing is activity where the chicken will coat its feathers in dust, dirt, or some other substrate in order to clean excess oils from its feathers (Shields et al., 2004). Floor litter is an acceptable medium for dustbathing, making floor-based systems more advantageous in this regard than cages, which have wire floors. Conversely, Jong et al. (2007) found that chickens had no measurable preference for a dust bath substrate over engaging in dustbathing activity on an empty, wire floor, so it is unclear if there is any real welfare advantage to providing confined chickens with a dust bath or dust bathing substrate as they will do it regardless.

Air quality is another important factor for the health of the birds as well as the health of poultry workers. Poultry housing with caged hens had much lower dust concentrations in the air at less than two mg/m<sup>3</sup> than other housing systems, such as

aviaries, which were four to five times higher (Ellen et al., 2000). Dust and contaminant inhalation in both birds and humans can cause chronic and acute respiratory problems such as coughing and wheezing due to lung irritation; however, poultry workers reported higher levels of these symptoms while working in caged systems as opposed to floor-based systems (Kirychik et al., 2003). This could have been due to the reported higher level of endotoxin and ammonia present in the air in caged systems and/or differing dust particle sizes present in the two different environments. These factors also vary depending on bird age, ventilation, and work activities performed by poultry workers (Kirychik et al., 2003).

In conclusion, proper management is just as important to poultry welfare as stocking density. Stocking density should be thought of as only part of proper management. Some of the findings discussed earlier stated that high stocking densities caused or worsened certain health and production problems in chickens. However, all of the problems listed were also shown to be caused by other factors as well. This means that lowering the stocking density is not sufficient in fixing ongoing problems with these animals, and the bigger picture should be taken into account in order to find the true cause of the problem (Dozier et al., 2005, Engel et al., 2019, Geng et al., 2020, Goo et al., 2019, Jones et al., 2005, Lay et al., 2011, Stamp Dawkins et al., 2004, Thomas et al., 2004, Tong et al., 2012).

For optimum chicken welfare, chickens should be kept in a floor-based or free-range system, outside of cages, and there should be deep litter on the floor to provide enrichment as well as protect their feet from injury (Shields and Greger, 2013). The

litter will allow the chickens to perform natural behavior like scratching and dustbathing. Observation of these activities and looking out for abnormal behaviors in the birds will help improve management by having possible problems and health issues noticed and treated earlier.

If cage-based producers were to transition into a floor-based or free-range system, there would be costs associated, as these systems are slightly more costly when it comes to space and resources. In order to alleviate some of the cost, chickens would have to be kept at higher stocking densities (Evaris et al., 2019). These chickens should be kept around a recommended level of seven birds/m<sup>2</sup> and no more than ten birds/m<sup>2</sup> if the environment and animal handling practices are exceptional (Goo et al., 2019). For the sake of animal welfare, any apparent health issues should be investigated and alleviated immediately, especially at higher stocking densities.

Word count: 2054

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