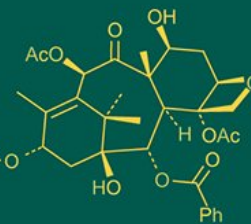
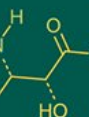
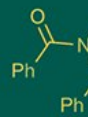
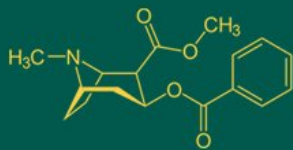


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Welfare challenges in broiler and layer production systems: A review

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Abstract

In recent years, advances in commercial poultry production systems have greatly improved the production traits such as egg production, growth rate and overall efficiency. These developments have enhanced the economic viability of poultry products. However, along with these advancements, concerns related to animal welfare have also increased. The two principal outputs of the poultry industry are eggs from layer chickens and meat from broilers. These sectors form the foundation of global poultry production and contribute significantly to the agricultural economy. Despite their importance, both broiler and layer sectors face several welfare issues associated with intensive production systems. Animal welfare in poultry is not solely determined by the type of production system alone. But also, by factors such as nutrition, environment, and health status. Therefore, a comprehensive approach is required to properly assess and improve welfare in poultry production. This review discusses the recent advancements in poultry production systems and the major welfare issues faced by broilers and layers.

Keywords: Poultry welfare, production systems, welfare challenges, broilers, layers

1. Introduction

Poultry farming is one of the rapidly growing sectors in Indian agriculture. It plays an important role in the livestock economy and provides an affordable source of animal protein (Ricky, 2024) ^[57]. India has shown immense growth in poultry production and has excelled in both egg and meat production. India is also one of the leading producers of poultry meat globally. According to BAHS statistics (2025) ^[3], India produced 149.11 billion eggs and 10.50 million tonnes of meat during 2024-25, with poultry contributing about 49% to 51% of the total meat production. In recent years, India has witnessed significant advancements in the production of poultry eggs and meat, which is mainly due to the rising demand and the modernisation of production systems. However, the rapid industrialisation of poultry production to meet the increasing consumer demand has raised concerns regarding animal welfare (Sassi *et al.*, 2016) ^[7]

In poultry production, animal welfare refers to ensuring that both broilers and layers are housed in environments that support their physical and emotional health. In contemporary poultry farming, maintaining a balance between humane treatment and production efficiency has become more challenging. Several factors influence the poultry welfare, which include genetics, hatching conditions, housing systems, management practices, transportation, slaughter techniques and the attitudes and care standards of stockpersons (Nicol *et al.*, 2013) ^[40]. Even though humans and chickens are very different, it is believed that hens can also experience emotions like pain or frustration. Therefore, proper ethical considerations and management strategies are essential to ensure the welfare of poultry farming in large-scale production systems.

2. Concept of Animal Welfare in Poultry Production

Animal welfare refers to a "state" which includes many complex aspects of the animals, such as biological, psychological and ethical components. Over time, the concept of animal welfare has evolved. It now considers not only the biological functioning, but also the experiences and behaviour of the animals. Therefore, animal welfare assessment should include the animal's physical and emotional well-being as well as how it interacts with its

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Surroundings (Carenzi and Verga 2009) ^[13].

One of the most widely accepted frameworks to assess animal welfare is the concept of the Five Freedoms. These freedoms have strongly influenced international animal welfare standards. They integrate behaviour, health status, and subjective experiences into a single framework (Mellor, 2016) ^[35]. The Five Freedoms were first proposed in 1965 by the Brambell Committee in the United Kingdom, as a foundation for farm animal welfare regulations (Fernandes *et al.*, 2021) ^[23].

The five freedoms propose the broad guidelines that should be provided to the animals to prevent suffering and other harms and promote well-being (Clark *et al.*, 2006) ^[15]. This includes:

1. Freedom from hunger and thirst - Availability of fresh water and a diet to sustain optimal health and vitality
2. Freedom from discomfort - by providing a suitable surrounding that includes a comfortable place for rest and shelter.
3. Freedom from pain, injury, and diseases- by early detection, prompt diagnosis, and treatment of diseases.
4. Freedom from fear and distress - by ensuring circumstances that prevent mental suffering.
5. Freedom to exhibit their normal natural behaviour - by providing the animal sufficient space, appropriate facilities, and the companionship of its own kind.

Thus, following these freedoms help in minimising the stress, health problems, and behavioural issues. This is significant for maintaining the welfare of poultry, including laying hens in traditional production systems.

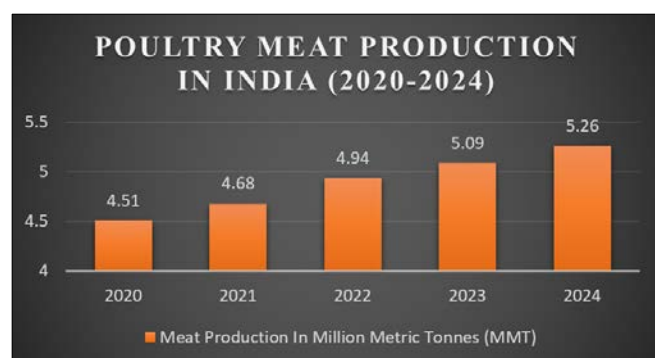


Fig 1: Trends in poultry meat production in India from 2020 to 2024 (in million metric tonnes)

2.1 Welfare-Productivity Relationship

The relationship between production and welfare is more complex. It is commonly assumed that high production will inevitably lead to high welfare. However, this relationship is not always coherent.

In some cases, welfare and production are positively correlated. For example, in certain backyard or village settings, hens may exhibit natural behaviour. However, if they suffer from illness, parasitism, or malnourishment, their general welfare may decline. Addressing these welfare concerns will improve productivity. Similarly, acute or chronic stress will result in decreased productivity. This will lead to a drop in egg production when the hens are transferred from pens to cages. Likewise, long-term stress can weaken the immune system, increase disease incidence and death, and eventually lower productivity.

In some situations, production and welfare are negatively correlated. Intense genetic selection for production traits negatively affects flock health. For example, broiler chickens chosen for extremely rapid growth rates suffer from leg disorders and lameness. Likewise, laying hens selected for high egg production may develop more skeletal problems. Feed restriction in broiler breeder flocks is another example. Although it is used to maintain reproductive performance, it can cause chronic hunger and reduced welfare.

These examples demonstrate the complexity of the relationship between productivity and welfare. In some cases, by improving welfare, we can increase productivity. In other cases, high production can negatively affect animal welfare (Surati *et al.*, 2022) ^[52].

3. Welfare Challenges in Modern Broiler Production

3.1 Advances in Broiler Productivity

Due to rising per capita consumption and population growth, there has been a significant increase in the demand for poultry meat over the past few decades (Organisation for Economic Co-operation and Development, 2022) ^[42]. This increasing demand has led to the development of meat-type birds.

The growth of meat-type birds is mainly due to genetic and genomic selection. As a result, the growth rate, meat yield and feed efficiency all have increased significantly (Carney *et al.*, 2022) ^[14].

Over the years, broiler chickens have been selected extensively for rapid growth, feed efficiency, and meat production. Broilers can reach slaughter weight within a short period of time, with a very low feed conversion rate. Zuidhof *et al.* (2014) ^[58] reported that between 1957 and 2005, the growth rates in broilers increased by more than 40%, while the feed conversion ratio decreased by 50%. This implies that it takes only 38 days for broilers to reach a body weight of 2.5 kg.

Almost 85-90% of these improvements are attributed to genetic selection. However, these rapid gains have also led to several welfare concerns. Intense genetic selection is also associated with immune system impairment, metabolic disorders, and leg abnormalities, which in turn negatively affects welfare and health of the birds (EFSA, 2010) ^[22].

In addition, broilers are generally reared in large groups, often comprising thousands of birds in each group. Slower-growing strains, used in organic broiler production, may be raised for 49- 70 days, whereas conventional broiler chickens are slaughtered at around 30 days of age (Vissers *et al.*, 2019) ^[53]. This indicates that broilers are slaughtered at a very young age, before reaching full behavioural maturity. Thus, while productivity has increased significantly, it has also led to several welfare challenges that need to be addressed.

3.2 Major Welfare Issues in Broilers

3.2.1 Leg disorders and lameness

One of the most important welfare concerns in broilers is leg disorders and lameness. These problems are mainly associated with rapid muscular growth and an underdeveloped skeletal system. Broilers are highly prone to bone, joint, and ligament disorders due to rapid muscle growth. As a result, they are often affected with leg abnormalities and lameness (Whitehead *et al.*, 2003) ^[56].

Severe leg issues restrict their movement and can cause pain (Danbury *et al.*, 2000) ^[17].

Lameness in broilers is commonly assessed using the Bristol Gait Score. It is a 6-point score ranging from 0 to 5. A significant proportion of broilers suffer from lameness, especially at the end of their growing period. Granquist *et al.* (2019) ^[26] reported that 19% of birds in a flock had a gait score of three or above.

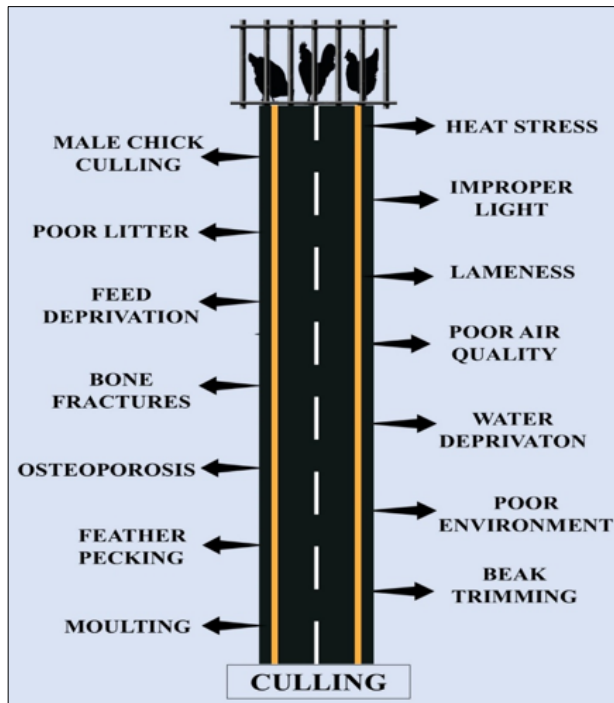


Fig 2: Various welfare issues faced by broilers and layers

The main cause of lameness is rapid growth due to genetic selection (Kestin *et al.*, 2001) ^[28]. However, other factors such as infections, age, genetics, housing, environment and diet also contribute to lameness (Bradshaw *et al.*, 2002) ^[9]. In severe cases, birds may be unable to move between feeders and drinkers. This leads to reduced feed intake and poor body condition (Berg and Butterworth, 2021) ^[8]. Lameness not only causes pain but also decreases the ability to exhibit normal behaviours. This, in turn, increases fear due to their inability to escape from perceived threats (Granquist *et al.*, 2019) ^[26].

3.2.2 Stocking density

Stocking density is defined as the number of birds per unit of floor space. It shows how closely the animals are crowded together. Stocking density is expressed as the number of birds housed or as the live weight in kg per square meter of floor space at the end of the growing period. Broiler behaviour and welfare are influenced by stocking density in floor systems (Buijs *et al.*, 2011) ^[12]. High stocking density is considered to be one of the major welfare concerns in poultry production.

High stocking density can lead to reduced feed intake, increases in lameness, breast blisters, foot-pad dermatitis, hock burn, infections and elevated corticosterone levels. All of these are regarded as signs of diminished welfare. Also, high housing densities in poultry have been associated with higher mortality. In general, broilers or layers form in hierarchical social groupings. Dominant individuals in a dominance hierarchy have priority access to food, water,

and other resources, while the subordinate birds have less access to these resources (Estevez, 2002) ^[59].

In intensive systems, broiler chickens are often raised at high stocking densities to improve productivity. However, insufficient space can have detrimental effects on broiler physiology, behaviour, and health. Studies have reported broiler stocking densities ranging from 10 to 50 kg/m² floor space (Meluzzi *et al.*, 2003) ^[36]. When stocking density exceeds 30 kg/m² it results in heat stress, which lowers the growth rate and overall performance of birds (McLean *et al.*, 2001) ^[34].

3.2.3 Metabolic disorders:

The continuous increase in broiler productivity has also resulted in metabolic disorders. Selection programs aim to increase growth rate and improve feed efficiency. However, rapid growth may create an imbalance between energy requirements for production and maintenance (Scheele, 1997) ^[48]. This imbalance can disrupt normal physiological regulation and lead to metabolic diseases.

Rapid growth, effective feed conversion, and an extremely high metabolic rate are the main causes of metabolic disorders. It exerts more pressure on the internal organs. Ascites and sudden death syndrome are the two most common cardiovascular illnesses observed. The hearts and lungs may not develop fully to support the rapid growth of muscle tissue (EFSA 2010) ^[22].

Ascites occurs when the cardiopulmonary system is unable to supply adequate oxygen to body tissues, leading to fluid accumulation in the abdomen and lungs. In some cases, right-side ventricular failure may occur. Ascites have been reported worldwide, but it is more common in birds in high altitudes (Knowles *et al.*, 2008) ^[29]. These disorders not only reduce productivity but also impose serious welfare concerns on the birds.

3.2.4 Heat Stress

One of the major environmental stressors that causes significant economic loss in the poultry industry is heat stress. It causes physiological changes such as oxidative stress, acid-base imbalance, and immunocompetence suppression. These changes, in turn, alter the quality of meat and eggs and increase mortality. It also affects feed efficiency, body weight, feed intake, and egg production (Wasti *et al.*, 2020) ^[54].

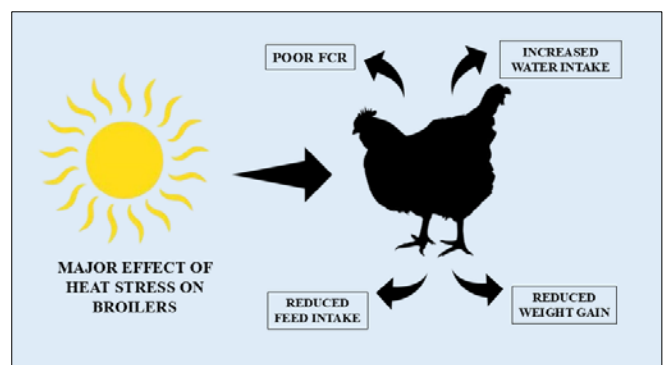


Fig 3: Effects of heat stress on broiler performance

The ideal ambient temperature for broilers to reach the maximum growth potential during the post-brooding period is between 18 and 24 °C. However, the normal body temperature of broiler chickens is between 40.6 and 41.7 °C

(Olanrewaju *et al.*, 2010) ^[41]. Broiler chickens can suffer from severe heat stress when exposed to temperatures above 30 °C (Saracila *et al.*, 2021) ^[46]. In general, fast-growing broilers are more susceptible to heat stress, as they produce more metabolic heat when compared to slower-growing broilers (Jong *et al.*, 2012) ^[19].

Heat-stressed broilers exhibit several behavioural, physiological and immunological responses in an attempt to regulate their body temperature within 40-41 °C (Kumar *et al.*, 2021) ^[31]. They exhibit behavioural changes like reduced locomotion (Branco *et al.*, 2020) ^[10], increased sitting and lying behaviour with wings spread, reduced feed intake and increased water intake (Kumar *et al.*, 2021) ^[31] due to heat stress. They also tend to remain closer to drinkers and to the air inlets. Broilers become lethargic at some point, which eventually results in death when they fail to cope with the heat stress.

3.2.5 Light system

Light system greatly influences the welfare, behaviour, health and productivity of broilers (Alvino *et al.*, 2009) ^[2]. It includes factors like light spectrum, intensity, photoperiod, provision of daylight and source of the light. Birds have four types of colour photoreceptors in the eye and are therefore tetrachromatic, whereas humans are trichromatic with three colour photoreceptors (Franco *et al.*, 2022) ^[60]. Because of this, the light spectrum or colour experienced by birds differs from that of humans (Deep *et al.*, 2012) ^[20].

Photoperiod has an influence on broiler growth and welfare. Schwan-Lardner *et al.* (2012) ^[49] reported that shorter day lengths increased the feed conversion ratio, whereas body weights were higher under 17 and 20 hours of light. They also observed that reduced day length improved the welfare indicators like ocular weight, gait scores and footpad conditions (Schwan-Lardner *et al.*, 2013) ^[50]. Providing several hours of darkness during the early life has also been reported to benefit broiler growth and immunity (Magee *et al.*, 2022) ^[33].

Very low light intensities below 5 lux have a predominant detrimental effect on poultry welfare. It leads to reduced behavioural activity due to impaired scotopic vision. Natural light can increase activity, decrease lying behaviour and improve gait scores (Bailie *et al.*, 2013) ^[5]. Light spectra such as the ultraviolet light (UV) can improve the expression of natural behaviours (Rana and Campbell, 2021) ^[61].

3.2.6 Litter Quality

Broilers generally spend their entire life in contact with the litter; hence, the quality of litter material is of great importance for bird welfare. Litter quality influences the environmental conditions within the poultry house by affecting the dust levels, air humidity and ammonia levels, which, in turn, lead to respiratory problems. Moreover, it also has a direct influence on the skin condition of the birds. Wet litter is a major risk factor for contact dermatitis (SCAHAW, 2000) ^[47].

Litter materials such as wood shaving has better litter quality because of their high water-holding capacity when compared to the litter materials with lower water-holding capacity, such as straw (SCAHAW, 2000) ^[47]. Litter management plays a major role in maintaining the health, welfare, productivity and sustainability of the farm (Jong *et al.*, 2012) ^[19].

High litter moisture caused by faecal matter, water leakage, and humidity can increase ammonia production and

bacterial growth. These conditions may lead to hock burns, footpad dermatitis and breast blisters (Jong *et al.*, 2012) ^[19]. The performance of litter depends on several factors, which include particle size, litter depth, texture and source of the material (Diarra *et al.*, 2021) ^[21]. Although reuse of litter is common in commercial production, repeated use may increase the chance of footpad dermatitis and other health problems (Paz *et al.*, 2013) ^[43].

3.2.7 Air Quality

Another key factor that affects the broiler welfare is air quality. Ammonia is considered one of the major pollutants in poultry houses (Kristensen and Wathes, 2000) ^[30]. It is produced when the microorganisms convert the protein in the poultry excreta into ammonia with the help of water and moisture in the litter. High levels of ammonia may lead to respiratory diseases and keratoconjunctivitis.

Dust in broiler houses is made up of small pieces of feathers, skin scales, litter and dried manure. These particles can be classified as inspirable and respirable depending on the particle size. Poor air quality can affect both the health of poultry and the workers in poultry houses.

Birds have a unique respiratory system with air sacs that help ensure the continuous flow of air through the lungs. Consequently, they are particularly sensitive to airborne pollutants. In broiler houses, birds are commonly exposed to ammonia, carbon dioxide, and dust (Adler *et al.*, 2021) ^[1]. Higher concentrations of ammonia above 30 ppm in the air can irritate mucous membranes and conjunctiva, and increase the incidence of coccidia, clostridia and other infections. Recommended levels of ammonia should remain below 20 ppm (Miles *et al.*, 2004) ^[37]. Proper ventilation, good litter management, leak-free drinking systems and appropriate litter materials are important measures for maintaining good air quality in broiler houses.

4. Welfare Challenges in Laying Hen Productivity

4.1 Advances in Laying Hen Productivity

Over the past few decades, the laying hen productivity has improved due to genetic selection, improved feeding strategies, and better management practices and the use of advanced technologies, which has resulted in increased egg production (Arulnathan *et al.*, 2024) ^[4]. These improvements have increased egg production and efficiency.

Similar to broilers, genetic and genomic selection have contributed to major improvements in laying hens. These benefits include a flatter egg size curve, increased flock longevity without moulting, decreased incidence of metabolic disorders and higher peak production (Preisinger, 2018) ^[62].

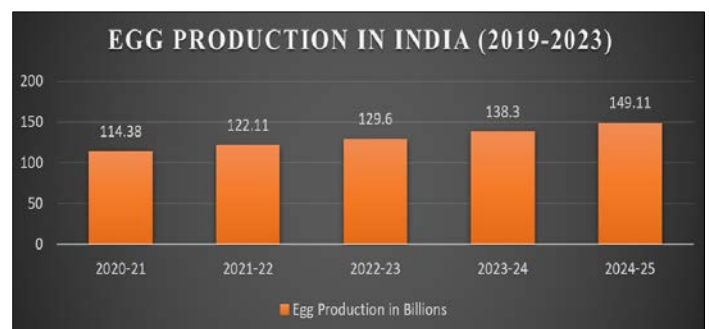


Fig 4: Trends in egg production in India from 2020-21 to 2024-25 (in billions)

Nowadays, laying hens are maintained up to 100 weeks of age in many countries. Each hen can produce more than 500 eggs during the production cycle (Bain *et al.*, 2016; Preisinger, 2018) ^[6, 62]. Modern laying hens maintain more than 90% production between 50-60 weeks of age. Peak production may reach nearly one egg per day. Induced moulting has been used to extend laying cycles. However, this practice remains controversial. (Preisinger, 2018) ^[62]. although it improves production and egg quality, it raises welfare concerns such as starvation, weakened immunity, and increased mortality (NFACC, 2017) ^[39].

4.2 Major Welfare Issues in Laying Hens

4.2.1 Killing of male chicks

In commercial layer productivity, only female chicks are required. Chicks are sexed at hatch, and male chicks are culled. Nearly 50% of the chicks are eliminated as they have no economic value (Buhl, 2013) ^[11]. This raises serious ethical and welfare concerns.

Different methods are used in different regions. The aim is to ensure rapid and humane killing (EFSA, 2005) ^[64]. Common methods include carbon dioxide gas chambers, cervical dislocation, and high-speed maceration. However, these methods may cause distress before death. In order to address this issue, alternative approaches are being explored. These include in ovo sex determination, use of dual-purpose breeds, and rearing of layer cockerels (Haas *et al.*, 2021) ^[18].

4.2.2 Feather pecking and beak trimming:

Feather pecking is a major welfare issue in laying hens and occurs in both cage and non-cage systems. It may be gentle or severe. Severe feather pecking can lead to feather loss, skin damage, wounds, and even cannibalism.

Beak trimming is commonly used to reduce feather pecking and aggressive behaviour. However, this procedure can cause acute and chronic pain due to tissue and nerve damage. It may also impair normal behaviour by reducing the bird's ability to explore and peck (Pickett, 2008) ^[63].

Due to these concerns, beak trimming has been banned in some countries. The age at which trimming is performed influences pain and recovery. Early trimming causes less damage, whereas trimming at older ages may result in chronic pain due to neuroma formation (Hughes and Gentle, 1995) ^[27].

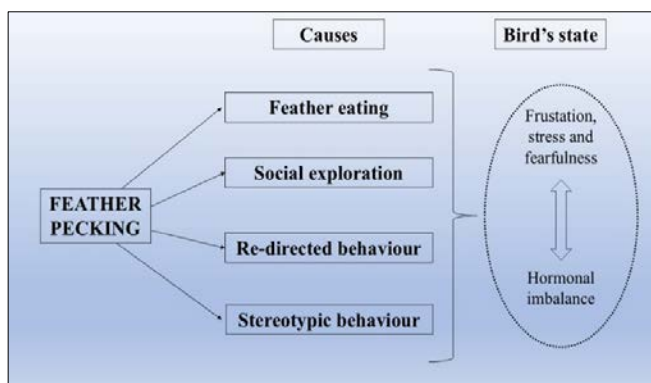


Fig 5: Causes of feather pecking in poultry

4.2.3 Vent Pecking:

Like feather pecking, vent pecking is also an unusual behaviour that can lead to cannibalism. It involves pecking

at the cloacal region of other birds, causing injury and tissue damage (Rodenburg *et al.*, 2004) ^[44]. This behaviour may result in severe injury or death.

Vent pecking can be controlled through proper management. This includes reducing light intensity in nesting areas, providing appropriate perching arrangements, and avoiding the early onset of laying. Birds are attracted to red colour; therefore, injured or prolapsed birds are more prone to pecking (Sirovnik *et al.*, 2018) ^[51].

4.2.4 Skeletal Health

Skeletal problems are one of the major welfare concerns in laying hens, especially in cage systems. Limited movement and high egg production contribute to bone weakness and fractures (EFSA, 2005) ^[64].

Osteoporosis is a major issue characterised by loss of bone mass, leading to fragile bones that are prone to fractures, particularly in the keel, legs, and wings (Fleming *et al.*, 2005) ^[24]. Bone loss begins around sexual maturity and continues throughout the laying period. Nutritional deficiencies in calcium, phosphorus, and vitamin D can further worsen this condition (Webster, 2004) ^[55].

Keel bone fractures are common and may occur due to collisions, poor landings, or handling during depopulation. These fractures cause chronic pain and discomfort. The prevalence of keel fractures is generally higher in cage systems compared to non-cage systems (Nicol *et al.*, 2006) ^[65].

Cage layer fatigue is associated with severe bone weakness and continuous calcium depletion due to high egg production. It leads to paralysis and skeletal deformities. In some cases, recovery is possible if birds are provided with adequate nutrition and allowed movement (Kumar and Sahu, 2017) ^[32].

4.2.5 Moulting

Moulting is a natural process in which birds shed old feathers and grow new ones, accompanied by reduced egg production (Mishra *et al.*, 2022) ^[38]. In commercial systems, moulting is often induced to extend the laying cycle.

In commercial systems, moulting is often induced to extend the laying cycle. This is done by restricting feed, altering light exposure, or both. This results in weight loss, regression of the reproductive system, and temporary cessation of egg production. After moulting, egg production resumes, improving overall productivity.

However, induced moulting raises welfare concerns. Feed restriction causes stress, weight loss, increased aggression, and feather damage. It may also weaken immunity and increase disease susceptibility (Sandhu *et al.*, 2007) ^[45]. Fasting-based moulting practices have been strongly criticised by animal welfare organisations.

Various moulting methods are used, including short-term and prolonged feed withdrawal. However, such practices may increase the risk of infections such as *Salmonella enteritidis* and compromise food safety (Gast *et al.*, 2003) ^[25].

Conclusion

High productivity and rapid growth are the major factors contributing to welfare issues in both broilers and laying hens. Intensive poultry production systems often lead to overcrowding, restricted behaviour, and increased health problems such as lameness, metabolic disorders, and

respiratory issues. Several factors, including stocking density, litter quality, air quality, lighting, feeding, management practices, and genetic selection, influence poultry welfare. The concept of animal welfare extends beyond the Five Freedoms and includes biological, social, economic, and ethical dimensions.

Improving poultry welfare requires a comprehensive approach. Providing adequate space, proper nutrition, and opportunities for natural behaviours such as perching, dust bathing, and foraging is essential. Reducing stress, improving management practices, and ensuring proper veterinary care are also important. Thus, prioritising animal welfare can lead to healthier birds, improved productivity and more sustainable and ethical poultry production systems.

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