poultry

Review

Effects of Perching on Poultry Welfare and Production: A Review

Ramesh Bahadur Bist, Sachin Subedi, Lilong Chai *, Prafulla Regmi, Casey W. Ritz, Woo Kyun Kim and Xiao Yang

Department of Poultry Science, College of Agricultural and Environmental Sciences, University of Georgia, Athens, GA 30602, USA
* Correspondence: lchai@uga.edu

Abstract: Perching is one of the essential natural behaviors for avian species. Providing an optimal perching design (e.g., shape, dimension, and materials) for commercial poultry production is critical for maintaining bird health, welfare, and production efficiency. This review paper summarized poultry perching studies and discussed the relationship between perch design, bird welfare, and production efficiency. Providing perches at an early stage may ensure optimum use during adulthood, reduce perching accidents, and lower the risk of floor eggs in cage-free (CF) hen houses. Therefore, a perch space of 15 cm per bird is recommended for the CF hen house. Similarly, rectangular perches are preferred to circular perches as the rectangular perch provides hens with an excellent tendon-locking mechanism to prevent slipping. In addition, perches with softer materials such as polyurethane and rubber coverings are recommended to increase the contact surface on the chicken's toes. Perching behavior (PB) promotes a musculocutaneous system and reduces the incidences of footpad dermatitis and lesions. Generally, providing perching may reduce aggression and stress in birds and improve welfare and production efficiency. In the case of broilers, it is found that the broiler perches less during the latter stage of their lives because they are comparatively heavier and exhibit a more inactive lifestyle. Studies have investigated the effect of the surface temperature of the perch on broilers' welfare. Perches with lower temperatures help improve performance and welfare by relieving heat stress and leg issues. Overall, PB is required to improve bird health and welfare.

Keywords: poultry production; animal housing system; perching behavior; perch design; animal health and welfare

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1. Introduction

The anti-predator behavior of roosting on the elevated structure shown by the ancestor of the domestic fowl (jungle fowl) has been seen in domesticated avian species even after they were reared in the indoor housing system [1,2]. The avian species, including the domestic fowl, exhibit the tendon-locking phenomenon, which allows them to express behaviors such as perching with minimal muscular effort [3,4]. Using aerial (raised) perches is considered a priority for laying hens [5,6] and broiler breeders [7]. Early studies explored perch use as an escape route from dominant birds, which are aggressive and peck the vent of the subordinate birds [8,9]. In addition, during the daytime, subordinate hens were found to use more perches and nest boxes to escape from dominant birds, while dominant hens perched more at night, especially for roosting [9,10]. Even in a commercial environment, perching is one of the most common behaviors observed in cage-free (CF) laying hens at night [5]. EU directives (1999/74/EC) mandated that CF (Figure 1) laying hens be provided with litter and perches [11]. In CF houses, perches can be defined as elevated structures that offer a view of surveying surroundings [12]. Studies suggested that perches should be provided starting from day 7 to ensure optimal perch use in adult birds [13–15]. It was found that a perch of wide rope was used by chicks during the first

week, especially for resting or sleeping [16]. Wide ropes give more grip and provide a broader surface area for chicks to stand on to promote early perching behaviors (PB). During the daytime, PB often changes for many reasons, such as housing systems, environmental management, and social interaction among birds [17]. Birds perch more often during the scotophase (dark period) compared to the photophase (light period), while the perch use during photophase is determined by multiple factors such as the perch height, perch length (space for each bird), and age of the birds [13,18,19]. Perching is less common in broilers due to their fast growth rate and heavy body weight (BW) [20,21]. However, increasing animal welfare concerns for broilers suggest providing perching and other enrichment to increase locomotive and other behaviors [22,23].

Figure 1. Perching behavior shown by laying hens using a round and elevated perch in an aviary housing system.

The main objectives of this literature review were to (1) identify the correlation between PB and animal welfare, health, and production parameters in CF laying hens, broilers, and breeders (broilers or table-egg); (2) analyze the effects of perch design, dimension, and materials on welfare and production indicators; and (3) discuss the potential methods for improving perch design and animal welfare.

2. Early Perching Behaviors in Chickens

Perching behavior is most common in birds with both egg-laying and meat strains. As a bird sits on a perch, it folds its legs and contracts the leg muscles, which causes the tendons of the phalanges to contract and thus curl and grasp the perch [24–26]. Many studies have been conducted on pullets, layers, broilers, and breeders (broiler and table-egg; Table 1). According to Skanberg et al. [16], pullets started to use perches from the first week of age (WOA), especially for sleeping or resting purposes. Similarly, the pullet perched early from day 3 and increased onward [27] (Figure 2). Pullets perch more frequently on a wide rope during the first WOA [16]. However, early perching depends on the guidance of the mother hen. The domesticated chicks with brooded hens were found to perch earlier than those without a mother hen [1]. According to Gunnarsson et al. [28], when pullets were reared without early access to a perch, it impaired the spatial cognitive skills of hens which might affect later perching ability and long-term hen welfare. Similarly, laying hens that were denied an opportunity to perch tend to be frustrated [5] and thus increase vent pecking, leading to cannibalism [29].

Figure 2. Pullets showed early perching behavior in the cage-free research facility from the first week of age.

According to Schrader and Muller [6], height is considered an important factor compared to the shape of the perch in performing PBs. Chicks tend to choose the lowest height during their early stage. As they grow older, perch height preferences differ. The PB of the laying hen increases with age [30,31], and they prefer lower heights during the daytime while choosing the highest height at nighttime [32,33]. However, broilers show different PBs and perch height preferences than pullets and laying hens, except for broiler breeders. Broiler breeders perched at higher heights during the nighttime [7,34]. The broiler breeders provided with perches lay fewer eggs on the floor than the birds restricted to perches [35]. However, recent research shows that perch treatment did not significantly affect the number of floor eggs [36]. Similarly, the broilers showed the highest PBs at 5 WOA and declined afterward (after 6 WOA) because BW began to increase rapidly during the latter stages of the growth, i.e., when it reached a marketable age [20,21]. The heavy weight of the broiler at the latter stages impairs the movement. However, their activity increased when the broiler was lifted with a harness [37], which might be due to physical handling and the absence of pressure from the heavy weight on their foot. Similarly, fast-growing broilers use an elevated perch less frequently during the day than slow-growing broiler chickens [38,39]. This was caused due to a reduced walking ability in the former [40]. Moreover, faster-growing or marketable-aged broilers were often seen with lameness, which might be associated with decreased activities [40] and reduced PBs [20].

Table 1. Early perch usage and preferences of poultry breeds based on perch space or diameter.

Poultry Breeds	Perch Space/Diameter Parameters	Early Perch Usage and Preferences	References
Domestic fowl	Varies by authors	➢ Nighttime roosting is guided by the mother hen. ➢ Domesticated chickens with a brooded hen do not start to perch earlier than chicks without a mother hen do.	[14] [1]
Hybrid LSL Classic	Diameters Narrow rope = 1.8 cm, Braided wide rope = 4.5 cm, Narrow flat wood = 1.5 × 1.5 cm, Wide flat wood = 6.7 × 0.58 cm, Narrow round wood = 1.5 cm, Wide round wood = 3.5 cm.	➢ The wide rope was used more during the first week. ➢ An increase in chicks sleeping or resting on the perch after the first week. ➢ Sleeping or resting is more on the wide rope than on wide, round, flat perches, and narrow ropes. ➢ Wide rope and flat perches show more PBs.	[16]
Lohmann White (LW) laying hens	Perches were overcrowded with a perch of 15 cm/hen	➢ Perch space occupied: • Dark > Light • Peak lay > other age points	[33]
ISA Brown hens	The average width when standing is 15 cm, and sitting is 18 cm	➢ Perching birds at night spend about 81% of their time sitting (average bird width 17.4 cm) ➢ They prefer about 5 cm between themselves.	[41]
LSL commercial chicks of a laying strain	Perch length = 28 cm/bird Or, Perch length = 14 cm/bird at height 20 cm, and Perch length = 14 cm/bird at height 40 cm	➢ One chick had begun using the perches before the end of the observation period at six weeks old.	[42]

Table 1. *Cont.*

Poultry Breeds	Perch Space/Diameter Parameters	Early Perch Usage and Preferences	References
Fast-growing (Ross), Dual-purpose strain (Lohmann Dual), Ayer strain (LB)	Plastic grids area = 30 cm × 90 cm Mushroom-shaped perch area = 270 cm × 6 cm	➢ Use of elevated structures: • Dawn > Light > Dusk > Dark (Increase of bird activity 1 h before and after sunrise) • Nighttime was low during the first WOA. • Decreases from the 3rd to the 4th WOA at dawn. • Decreases from the 4th to the 5th WOA during the light period. • Increases perching by Ross chickens until slaughter. ➢ More frequently with increasing age by Dual and LB chickens.	[43]
Ross	Perch length (cm/bird) 5, 10, 14, and 20	➢ Number of perching birds: • It decreases with age. ➢ Perch length per bird influences PB: • More in 10 cm perch length compared with 5 cm. • More birds with 14 cm than with 10 cm. ➢ Relatively low at night.	[7,34]

LB, Lohmann Brown; LSL, Lohmann Selected Leghorn; and ISA, Institut de Selection Animale.

3. Perching Preferences

3.1. Guidelines on Perch Uses

The increasing awareness of bird welfare made the transition from caged to CF housing [27,44,45]. The CF housing provides freedom and opportunity to perform their natural behavior, such as perching. Adequate space is needed to perform the perching activity, with minimum disruptions from pecking and aggressive behavior from the other birds. Therefore, a minimum of 6 inches (15 cm) of usable perch space per bird in CF housing is recommended. The provision of a perching space of 15 cm/hen is recommended based on the hen's body size to ensure that all hens are adapted to perching [46]. According to UEP [47], it is recommended that 20% perch of the total perch space should be elevated at least 40 cm above the poultry house floor and maintain a minimum of 20 cm horizontal distance away from the adjacent walls and adjacent perches. In addition, a horizontal distance from one perch to another of at least 30 cm should be provided [32]. Similarly, perches positioned at different heights and levels can encourage behavioral differentiation [48]. Birds kept in houses with higher heights perched show a higher incidence of keel bone injuries and deformities [49]. Injury increases when birds jump or try to reach or leave a perch distance of more than 80 cm horizontally, vertically, or diagonally and between 45 to 90° from the horizontal plane [50–52]. Perches should be constructed so birds can quickly wrap their toes around the perch for proper balancing [25]. Therefore, a suitable perch is recommended to increase PB and decrease the associated injuries and deformities.

Alternatively, a furnished cage or enriched colony (EC) can be another popular replacement for a conventional cage (CC), where it combines the benefits of improving welfare, such as CF housing, and increasing production benefits, such as a CC [53]. A minimum perch space of 15 cm per hen for the EC cages was required [32]. In addition, the legislation requires the highest perch height in an EC cage to be at least 45 cm high from the lowest end to ensure sufficient head space for comfortable perching. When hens were provided a reduced height from 55 to 45 cm, hen's perching preferences changed from using the highest perch height to a lower perch height [54]. Thus, perch–roof distance and floor–perch distance directly impact PBs and perching preferences.

3.2. Perch Dimension

Perches of various dimensions and materials have been used in previous research. Chicks use wide-rope perches for sleeping and resting, but flat wooden perches are preferred for preening behavior [16]. Perches with a clearance height of a minimum of 5 cm high are chosen by hens [55]. Regarding the perch's height, laying hens prefer lower perches during the daytime (primarily for standing and walking) while higher perches are preferred for sitting and sleeping at nighttime [48]. However, laying hens are highly motivated, with the perches at the highest height used at night [56]. Therefore, the cages at higher heights are advisable to maintain perch-to-roof and floor-to-perch distances of about 19–24 cm and 21–45 cm, respectively [48]. In addition, the United Egg producers' guideline recommends a perching space of 1 square foot per hen for laying hens and 55% of the total perch space available to perch simultaneously [47]. A perch width between 3 and 6 cm is recommended to reduce balancing movements (BM) and peak force on the keel bone and the footpads [57]. A round perch with rubber is needed to increase the balancing movement. The perching preferences above the litter area are elicited by scenarios based on the expert view that requires a maximum height of 120 cm or 200 cm and can be a single high perch, ladder design, or A-shape design, as mentioned in Table 2 [32,56]. The perch height on the slatted floor is recommended to have a low height of 7 cm and medium height perch of 50 cm. Similarly, the perches (bar perch) provided in a broiler house are poorly used and do not help to improve welfare [21]. Instead of a bar perch, platform perches are more widely used and improve PBs in broilers. Platforms provide more stable and less balancing force and can adjust their heavyweight easily [19].

Table 2. Perching preferences with height and diameter are elicited by scenarios based on the expert view.

Perch Height		
Perch's Placement	**Height of Perches**	**Perch Type**
Perches on the slatted floor	Low height above slatted floor	✓ No additional perches ✓ Wider bars on the slatted floor ✓ Low perch (7 cm) ✓ Medium perch (50 cm)
Perches above the litter area	Maximum height 120 cm or 200 cm	✓ Single high perch ✓ Ladder design ✓ A-shape design
Perch diameter		
Perch dimensions	**Materials of perch**	**Measurements**
Diameter	Round plastic materials with/without a rubber layer	✓ 3 cm to 6 cm

3.3. Perching Duration

Perch arrangement plays an integral role in perching duration for laying hens. During the daytime, the perching time for the rear perches was found to be lowest (20%) compared to the front perches (85%) [58]. Hens show predominant activities on rear perches for preening and resting while use the front perches for feeding and drinking. Hens spend the longest time on round perches with a bigger diameter (up to 10.5 cm) than a smaller diameter (1.5 cm) [59]. In addition, hens did not show perch width and diameter preferences during the nighttime [3,33]. However, during the nighttime, due to increased perch use, the roosting period may vary between the front or rear perches (60 to 72%) and long perches (72 to 78%) [58]. Perches with a greater diameter or width offer more stable and balanced footing than round perches [56,57]. However, wider surfaces always favor the impairment of digital tendon interlocking, jeopardizing balanced footing and movement. Therefore, the perching duration depends on the types of perch used in the poultry housing.

3.4. Strain Preferences

The genotype of the birds has been known to influence PBs [55,60,61] and is found to be more than 80% of the PB when provided with a longer perch length [62]. Different breeds of bird show different PBs (Table 3). According to Faure and Jones [55], White Leghorns exhibited the highest PB, whereas Lohmann Browns possess the lowest PB compared with the other strains (Lohmann White, Rhode Island Red, and Light Sussex cross). Among birds raised in furnished cages, the Lohmann Selected Leghorn (LSL) resulted in higher PBs at nighttime compared to Lohmann Browns (LB), while Hy-line Brown hens show a longer perching time than Hy-line White hens [61]. In the research conducted by Scholz et al. [60], the PBs of LSLs resulted in a higher proportion of safe landings than the Lohmann tradition (LT) and LB. The detailed relationship between the bird strain and PBs is explained in detail in Table 3 below.

Table 3. Various types of perching behaviors reported based on strain or genotype.

Strain	Perching Behavior	Reference
LSL, LT, LB	➢ White LSLs resulted in a higher proportion of safe landings than Brown shell layer LBs and LTs. ➢ No significant difference between LBs and LT layer lines was found in a safe landing.	[60]
LSL, LB, Hy-line White, Hy-line Brown	➢ LSLs show higher PBs at night in furnished cages compared to LBs. ➢ The Hy-line Brown hen perches for longer than the Hy-line White hen.	[61]
LSL, Shaver	➢ The Shaver breed highly uses low perches but there was no significant difference for higher perch use.	[63]
LW, LB	➢ Perch use was greater than 80% with longer perch lengths. ➢ Nesting behavior was reported in Brown hens.	[62]
ISA brown hens	➢ Spent about 25% of the daytime and about 85% of the nighttime perching. The bird prefers a slightly rough surface for perching.	[64]
White Leghorn pullet	➢ Higher perches are preferred compared to lower perches. ➢ Vigilance decreases with increasing group size on the high perches.	[2]
White Leghorn, Rhode Island Red × Light Sussex cross, Brown Leghorn	➢ The hens preferred lower perches more. ➢ PB: White Leghorn > Rhode Island Red × Light Sussex cross > Brown Leghorn (High perches were almost entirely ineffective). ➢ Among male and female birds, no significant difference in PB was found.	[55]
Arbor Acres × Arbor Acres (Broiler Breeder)	➢ Flightiness is reduced in birds provided with a perch. Perches also help to escape from socially dominant birds.	[35]

LSL, Lohmann Selected Leghorn; LT, Lohmann tradition; LB, Lohmann Brown; LW, Lohmann White; ISA, Institut de Selection Animale; and PB, perching behavior.

4. Perch Design: Structure and Materials

4.1. Perch Design Considerations

The perch design determines the PB. When designing a perching system, the perch should be reasonable, easy to clean, and attractive to birds [59]. A perch's design should have good accessibility to fly or jump to a higher level without restriction [48]. Balancing movement is the most sensitive indicator when identifying an appropriate perch type, and the results thereby support the use of flat perches for young chicks [57]. Keel bone damage or deformities (KBD) and fractures were associated with an unsuitable perch design and unstable footing [60]. The perch should be placed at suitable angles (depending on the perch design) and should not be placed too far horizontally or vertically from another perch. Ideally, a perch design should be constructed to reduce poor landings or KBD at a significant level [65].

4.2. Perch Height

The perch height has several benefits that allow hens to avoid disturbances, escape from predictors, environment monitoring, and improve thermoregulation [32]. Perch usage in laying hens was found to be increased as the height increased up to 90 cm [65]. In addition, the height of the perch may be a crucial factor affecting a bird's roosting preference before the dark period and may have less influence during the nighttime. Pecking behavior increases in CF housing [66]. Wechsler and Huber-Eicher [29] state that feather pecking and

damage decrease as the perch height increases. The authors reported more pronounced feather damage and pecking behaviors in hens that did not use high perches (45 cm or 70 cm above floor level). The perch helps to develop PBs, which allow birds to escape from pecking behavior by other birds, thus helping to reduce the high risk of vent pecking and preventing birds from cannibalism or death through pecking behaviors [67].

4.3. Perch Shape and Diameter

Birds (caged) prefer rectangular perches to round ones as circular shapes are pretty slippery, have more foot damage, and do not have edges to grips [58]. Therefore, there is less preference for round-type perches, which hens are less likely to land on [16]. Oval and round perches provide a smaller contact surface and higher peak force on the keel bone and foot pad than square or rectangular perches (sharp edges) [57]. Therefore, sharp-edge perches affect PBs compared to round perches [57]. Certain scientific findings have found that the sharp-edged perch may lead to severe footpad disorder (bumble foot and toe hyperkeratosis) [68]. That is why the EU Directive requires perches to have no sharp edges [11]. More stable and balanced footing is seen in perches with larger diameters or widths [56], providing a greater surface area for keel bone and footpad attachment. A perch's width and shape will impact the usage and perch balance for young chicks. To promote early perch use, increase general usage, and improve perch balance, the desirable perch choices for laying hen chicks are flat wooden perches (e.g., 1.5 to 6.7 cm width) or a braided rope shape (e.g., 4.5 cm in diameter, Table 4).

Table 4. Effects of perch shape and diameter on bird's health, behavior, and welfare status.

Perch Shape	Perch Diameter (cm)	Breeds	Housing System	Health, Behavior, and Welfare Indicators	Result	References
Narrow rope, Wide braided rope, Narrow flat wood, Wide flat wood, Narrow round wood, Wide round wood	1.8, 4.5, 1.5 × 1.5, 6.7 × 0.8, 1.5, and 3.5	LSL Classic	Floor raised housing	Perch usages, BM behaviors, Preening behaviors	➢ Flat wooden perches or braided ropes (4.5 cm diameter) showed increased perch usage and improved BM behaviors. ➢ Preening behaviors were more observed on flat wood than on flat shaky rope.	[16]
Bars, ramps, and platforms	300 × 4 54 × 122 240 × 60	Ross 308 broilers	Floor raised housing	Perch preference (PP)	➢ Broilers prefer platform perches instead of bars or ramps.	[69]
Steel, wood, and plastic Rectangular and round	3.0 5.0	Hyline Brown Laying hens	CC layers	PP, Comfortable behaviors such as preening (CB), Pecking behaviors	➢ Rectangular and wood perches result in more preferred and comfortable behaviors than round perches. ➢ Broad perches increase pecking behaviors.	[70]
Steel mushroom-shaped plastic, prototype soft surface material	Varying diameter	LSL, LT, and LB	Experimental CF layer rooms	KBD, landing behavior	➢ Prototype perches have a higher proportion of safe landings while the least are on steel perches. ➢ Reduced keel bone injuries in a prototype perch.	[60]
Metal round perch	-	White Leghorn pullet of Hy-Line W36 strain	CC pullet housing	Stress parameter	➢ Hypothesized perch reduced stress, but pullets never exposed to perches showed no signs of being stressed.	[71]
Galvanized steel Round and circular with a smooth surface	3.2	White Leghorns	CC pullet and layer housing	Musculoskeletal health, Keel bone fractures (KBF), and deviation	➢ Muscle deposition and bone mineralization were increased at 71 WOA. ➢ Higher incidence of keel bone deviation and fractures at the end of the laying phase.	[30]

Table 4. *Cont.*

Perch Shape	Perch Diameter (cm)	Breeds	Housing System	Health, Behavior, and Welfare Indicators	Result	References
T-shaped plastic perch, Rubber-coated circular metal pipe, and Wooden perch	4.5 3.7 3.5	LSL White, Lohmann Brown (LB), and Lohmann Brown parent stock (LBPS) hens	Commercial aviary system	KBD	➢ Rubber-coated metal perches had fewer normal and more moderate but severe KBD than plastic perches ➢ Deformities increase during the laying period.	[72]
Rectangular Circular	-	ISA brown hens	CC	Footpad dermatitis (FPD)/Damage	➢ Foot damage was less with a rectangular perch than with a circular perch	[58]
Wood, metal, wire mesh, square shaped	Varying shape and diameter (cube, perch with hardboard covering, and wooden dowels)	White Leghorn, Rhode Island Red × Light Sussex cross, Brown Leghorn	Floor pens housing	PB	➢ Square perches were preferred to other shapes. ➢ Low perches were preferred more.	[55]

LSL, Lohmann Selected Leghorn; LT, Lohmann tradition; LB, Lohmann Brown; LW, Lohmann White; ISA, Institut de Selection Animale; PB, perching behavior; and BM, balancing movement.

4.4. Perch Materials

Commercial perches used in the poultry industry are available in different materials such as softwood, hardwood, metal, plastic, vinyl-padded, and polyurethane (Table 5). Wood is often used as a perching material as it is relatively inexpensive, but it is difficult to clean thoroughly and harbors more red mites than other materials since mites tend to hide in cracks and crevices [73]. Metal and plastic perches are easier to clean than wood materials and are less likely to harbor red mites if the joints are sealed. Softwood and vinyl-padded perches provide the most efficient grip for the hen's feet and are preferred over plastic perches, which can be slippery [48,74]. Polyurethane perches are less slippery and enhance footing stability in hens, as indicated by the increased perching time on soft perches covered by polyurethane and rubber than metal and plastic perches [56,57]. Furthermore, perches made from polyurethane material reduce the footpad lesions in hens by dropping the accumulation of manure and moisture on the perch surfaces.

Table 5. Effect of perching material on perching behavior, health, and welfare in different laying hens' or broilers' housing systems.

Perch Material	Breeds	Housing System	Health, Behavior, and Welfare Indicator	Result (Due to Perch Use)	References
Metal	Lohmann LSL-Lite	Enriched Colony (**EC**) cage, Aviary, caged	PP, and collision	➢ Aviary-reared hen perches higher than the cage-reared hens when moved to an EC. ➢ Aviary-reared hens show less collision experience than caged reared.	[75]
Metal	LW layers	Non-cage Aviary laying hens	Leg bone strength, nighttime perching, stress, and PP	➢ Increased bone strength, nighttime perching. ➢ Stress levels increased when perching was restricted	[33]
Metal	LSL, LB, Hy-line White, Hy-line Brown	Conventional battery cage	Nighttime perching and nesting behavior	➢ LSLs show higher PBs at night in furnished cages compared to LBs. ➢ Hy-line brown hens perch for a longer time than Hy-line White hens.	[61]
Narrow rope, wide rope, narrow braided rope, narrow flat wood, wide flat wood, and round wood	Hybrid Lohmann selected leghorn classic	Research pens	PP	➢ Prefer wide rope (4.5 cm) for laying chicks. ➢ Use wide rope for sleeping and resting at 1 WOA.	[16]
Wood	Rose 308 hybrid	Broiler breeder house	Nighttime perching, mortality, KBF, breast blisters, pododermatitis, and plumage quality	➢ More nighttime perching was observed with a perch length of 14 cm. ➢ During hot temperatures, mortality was lower in houses with perches.	[34]
Wood	Arbor Acres × Arbor Acres	All-litter blackout housing	Freedom of movement (FM)	➢ Perches reduce flightiness and provide space to escape from socially dominant birds.	[35]

Table 5. *Cont.*

Perch Material	Breeds	Housing System	Health, Behavior, and Welfare Indicator	Result (Due to Perch Use)	References
Wood, steel, and rubber cover	LSL hen	Commercial breeder cage house	Nighttime perching, comfort behaviors, and BM.	➢ A steel perch shows a longer resting time/nighttime perching but shorter standing position. ➢ BM was found least in rubber perches compared to wood and steel.	[56]
Wood and plastic	LSL White	Conventional and furnished cage layers	Plumage, KBD, and footpad dermatitis	➢ Cages with a plastic perch at 55 and 71 WOA indicate a higher incidence of bumblefoot (BF) than wood perches.	[76]
Hardwood, plastic, and rubber layer	Hybrids white Dekalb XL, LSL layers, Shaver, ISA (Institut de Selection Animale) Brown	CC layers and get-away cage	BF, keel bone lesions, foot cleanliness, toe pad hyperkeratosis, and claw length	➢ No significant difference in the perch design on toe pad hyperkeratosis, BF, or keel bone lesions. ➢ The plastic perch had more bumble foot incidences than the hardwood perch.	[63]
Softwood, hardwood, textured metal, smooth plastic, and padded vinyl	ISA brown hens	The caged layer housing system	Daytime perching, nighttime perching, PP, claw and sole damage, and egg breaking strength	➢ Birds spend the most time on softwood perches (25 to 30%) and least on plastic perches (13 to 23%). ➢ Bird's perch 25% at daytime and around 85% at nighttime. ➢ Less sole damage and long claws with perches. ➢ The cracked egg was 1.4% with wide cages.	[64]

LSL, Lohmann Selected Leghorn; LT, Lohmann tradition; LB, Lohmann Brown; LW, Lohmann White; ISA, Institut de Selection Animale; PB, perching behavior; BM, balancing movement; and KBD, keel bone deformities.

5. Poultry Perching: Well-Being and Production

Over the past decades, many studies have investigated perch usage and its effects on the birds' health, behavior, welfare, and production performance [48,73]. For example, providing perches to laying hens showed several benefits, including musculoskeletal development [21,77,78], abdominal fat deposition reduction [78], and improved welfare by reducing fearfulness and aggression [21,79,80].

5.1. Musculoskeletal System

Perches play a significant role in improving birds' health, behavior, and welfare by increasing the leg bone strength through continuous movements along the perch, thus improving foot health and cleanliness [21,81,82]. Compared to other poultry research, birds' access to 7.5 and 15 cm perch heights showed increased tibia weights in broilers [83]. Those perch heights were set up to make birds pass over the perch to perform their feeding and drinking behaviors. Hens housed with access to perches tend to have greater bone strength than those birds without access to perches [84]. The early use of perches helps to promote skeletal development [71] and muscle growth [30]. Although there was no significant difference in BW, leg muscle weight (LMW), or bone mineral content (BMC) in 3 and 6 WOA pullets provided with perches, an increase was found in BW, LMW, and BMC when pullets reached 12 WOA [85]. Hester et al. [30] found that perch use from the pullet stages can increase muscle deposition and bone mineralization at 71 WOA in laying hens. However, at the end of the laying period, it was found that bone mineralization is not enough to prevent keel bone fractures.

The CC hens without access to the perch were usually at a high risk of bone-related abnormal conditions such as osteoporosis (due to lack of exercise), while the hens raised in housing with perches resulted in a very low incidence of osteoporosis and showed improved bone strength [30,77,86,87]. In addition, the tibia-breaking strength increased significantly in a cage with perches [58]. During the pullet and laying phases, the perch access increases bone mineralization of the keel bone but not enough to prevent KBD at the end of the lay period [30]. According to Jiang et al. [78], hens provided with perches as pullets were found to have reduced abdominal fat deposition during the laying period. The main goal of today's poultry industry is to decrease abdominal fat pad deposition, improve egg laying, increase carcass yield, and improve meat quality. Similarly, a shorter production cycle in broilers may contribute to lower perch use, but perch use has many benefits reducing floor stocking density, minimizing leg problems (footpad lesions), and decreasing aggression [21,88].

5.2. Production Basis

Perches help to improve production. Bodyweight and body condition scores were increased using perches in commercial laying hen flocks without adversely affecting the egg-quality parameter, feather coverage, proportion of floor eggs, and egg-laying by hens [80]. The number of eggs laid in elevated nest boxes was more observed by chicks provided with perches before 8 WOA than by hens reared without perches [89]. Moreover, an experimental study where hens were given access to perches at 8 WOA or later showed a higher prevalence of floor eggs than those provided with perches at 4 WOA. Hence, it concluded that an early experience with perches helps to decrease the incidence of floor eggs laying during the latter stages [89]. In the wintertime, it has been reported that warm perches with circulating water at 30 °C could decrease cold stress and thyroxine conversion rates and increase the eggshell thickness during the third week of cold exposure [90], since the eggshell thickness is an important factor in determining egg quality; the thicker the eggshell, the better the egg quality. However, eggs with thin eggshells negatively affect the egg quality because the eggs are very porous and can promote intense evaporation compared to a thick eggshell [91]. In addition, thin eggshells have less protective power and are more likely to be contaminated with bacteria [92]. In summer, the airflow below the

perches assists in the thermoregulation of broilers, alleviating the heat stress conditions and promoting the uniform distribution of broilers within the pen space [20]. Using cold perches can reduce heat stress and improve overall performance by increasing BW gain ($p < 0.05$) and feed conversion efficiency ($p < 0.01$) regardless of the broiler stocking density [31,93]. Similarly, a high stocking density negatively affected footpad health and leg fluctuating asymmetry [94]. Providing a perch as a barrier had shown a great improvement in footpad health, while it did not positively reduce fearfulness.

5.3. Welfare and Behavioral Basis

The newly hatched chicks have the natural preparedness for normal development when exposed to certain stimuli in their early life. For example, early access to perches is necessary for the chicks to develop cognitive spatial skills (essential for moving around a three-dimensional space) [28] while lowering the risk of floor eggs and cloacal cannibalism in adults [79]. Similarly, perches play an essential role in the physical development of birds and promote their jumping and flying behavior, especially in broiler breeders [32,34]. According to Gebhardt-Henrich et al. [34], the use of perches in hens may affect embryo and consequent chick development by decreasing the stress that the hen experiences during the reproduction cycle (oocyte development). However, the hormones (estrogen, corticosterone, and other metabolic hormones) needed for hen and oocyte development can be affected by stress on hens, so future studies are required to find a close connection between these parameters. Similarly, the use of wide perches helps in successful landings which ensure greater security, higher body conditions, reduced aggression, and lower fear levels in commercial laying hen flocks [16,80]. In addition, the expression of PBs by using perches minimizes the incidence of feather and vent pecking from aggressive and dominant hens, which in turn helps to improve the hen's welfare [9,95]. Although birds housed with perches may show less feather pecking behavior than those without perches, they can still have poorer feather scores, possibly due to the friction between roosting birds [86].

The provision of perches during the rearing or growing phase makes hens use the elevated perch structures [1]. During the daytime, perches are widely used for resting, preening, and retreating for lower-ranking birds to avoid aggressive encounters [9]. According to Donaldson and O'Connell [80], the perched birds show significantly lower aggression levels in cage-free housing provided with slatted and litter floor areas ($p < 0.05$). In addition, perching helps to provide a reduced sense of fear as birds gain a feeling of security [95,96]. Perch use also reduces the stress level in chickens [97,98]. The heterophil to lymphocytes ratio (H/L ratio), often used to indicate environmental stress, was increased in laying hens and broilers without access to perches [97,98].

Several studies were conducted to determine how perches affect the welfare of poultry by examining various indicators, including preening and landing behaviors, egg quality, musculoskeletal health, comfort behavior, and footpad dermatitis (Table 6). The study found that the presence of perches positively impacted most of the indicators evaluated. Specifically, night perching improved skeletal health, while daytime perching was linked to musculoskeletal health and perch preferences [30,85–87]. Additionally, perches were found to be related to positive comfort behavior [70] and landing behavior [60]. The material, shape, height, linear space per bird, and arrangement of perches were all significant factors in improving poultry welfare outcomes, but factors such as temperature and the distance between perches were less important. Overall, the study suggests that providing appropriate perching options in poultry housing can greatly enhance the health and welfare of poultry.

Table 6. Summary of the relationship between perch features and poultry health, welfare, and behavioral consequences.

	Poultry Health, Welfare, and Behavioral Indicators											
Perch Links	**Nighttime Perching**	**Daytime Perching**	**CB (such as Preening)**	**BM**	**Landing Behaviors**	**FM**	**PP**	**Egg Quality**	**Musculoskeletal Health**	**KBF**	**KBD**	**FPD/Burns**
With/Without Perch	***	***	*	**	NS	**	***	*	***	**	NS	*
Material	**	**	*	*	***	NS	*	NS	NS	***	**	**
Shape	**	**	*	*	**	NS	***	NS	NS	*	*	*
Height	***	***	**	NS	**	*	**	*	*	***	***	*
Width/Diameter	*	*	*	**	*	NS	**	NS	NS	**	*	*
Linear space/bird	***	***	*	NS	NS	NS	**	NS	NS	**	NS	*
Temperature	NS	NS	NS	*	NS	NS	***	NS	**	NS	NS	***
Angle Inclination	*	*	*	*	*	**	*	NS	NS	*	NS	NS
Distance spaced between perches	*	*	*	NS	*	***	NS	NS	NS	*	NS	NS
Perch arrangement [A]	***	***	*	NS	*	*	***	*	*	***	NS	**

[A] related to feeders, drinkers, and walls; CB, comfort behavior; BM, balancing movements; FM, freedom of movement; PP, perch preferences; KBF, keel bone fracture; KBD, keel bone deformities; FPD, footpad dermatitis; NS not significant at $p > 0.05$ or no results found; * Significantly related at $p < 0.05$; ** more significantly related at $p < 0.01$; and *** most significantly related at $p < 0.001$). References: [2,7,16,21,30–32,34,41,43,48–51,54,56,57,60,61,64,68–70,76,80,83,90,99–108].

KBD and KBF are the two primary concerns associated with animal welfare. Many researchers in their studies indicated that perch use was associated with high KBD and fracture rates (Table 7) [30,63,72,76]. However, the KBD and fractures were probably associated with an unsuitable perch design which increased the risk of injury caused by unstable footing [60] and the pressure on the footpad [57]. Higher pressure on the footpad increases the chances of unstable footing resulting in increased KBD or KBF [57]. According to Pickel et al. [57], various perch shapes (round, square, and oval), sizes (3.4 cm, 4.4 cm, and 6.0 cm), and materials (wood and steel) had shown various pressure peaks on the keel bone and footpad. Among those perches, the perch with soft, round polyurethane had shown a lower peak force with a larger contact area than others and reduced KBD and KBF significantly ($p < 0.001$). Similarly, the perch provided with ramps showed a lower prevalence of KBD than the perch without ramps [109,110]. In addition, the commercial houses which use steel perches (less stable footing) should be replaced with prototype perches (such as soft, polyurethane surfaces) to decrease the risk of perch-related KBF or KBD [99].

Table 7. Effects of perch type on keel bone disorder.

Perch Type	Keel Bone Disorder (%)	Results	Reference
Flat (4.0 cm) Mushroom (4.3 cm) Mushroom (5.3 cm) Round (3.4 cm) Prototype (3.3) * Prototype (4.8)	5.90 [a] 6.23 [a] 6.05 [a] 5.89 [a] 4.49 [a] 3.50 [a]	➢ Prototype perch with a 4.8 cm diameter shows less peak force on the keel bone. ➢ Less peak force results in less KBD or KBF.	[57]
Perch with ramps Perch without ramps	19.5 ± 4.4 [b] 58.0 ± 8.1 [b]	➢ Perch with ramp decreases severe KBD.	[109]
Metal perch without soft polyurethane covering Metal perch with soft polyurethane covering	60.2 44.9	➢ Perch with soft material covering results in lower keel bone damages.	[99]
With perch Without perch	59.8 69.2	➢ No difference in KBD but found higher FPD without perch in broiler breeder.	[34]
With perch Without perch	92 83	➢ Significant difference in KBD found during laying phase in conventional cage house.	[30]
With perch Without perch	51.5 48.5	➢ No difference in KBD but found higher FPD without perch in broiler breeder.	[111]
Hardwood perch Hardwood perch with 4 cm rubber layer	-	➢ No significant difference in KBD and FPD	[63]
Control With addition perch Platform Ramps	52.6 [c] 49.4 [c] 34.4 [c] 29.0 [c]	➢ KBF was reduced significantly with using ramps.	[110]

* Prototype—soft, round polyurethane perch; [a] keel bone peak force (N/cm^2); N/cm^2—Newton per square centimeter; [b] Dekalb white hen at 49 weeks with severe dermatitis; and [c] during 60 weeks of age.

6. Discussions

Perches are crucial for poultry, and perches' importance cannot be overlooked as they provide birds with a resting and roosting place. Studies have demonstrated that perches positively impact various welfare indicators, such as skeletal health [30], comfort behavior [70], and landing behavior [60]. Providing perches to poultry is also vital for their cognitive spatial skills development and physical development, promoting their jumping and flying behavior [32,34]. In addition, providing perches at an early stage can ensure

their optimum use during adulthood [27], reduce perching accidents, and lower the risk of floor eggs in cage-free (CF) hen houses [35]. Furthermore, providing perches can decrease aggression and stress in birds [29], leading to improved welfare and production efficiency. However, these perches can negatively impact bird welfare and productivity by causing deformities, fractures, and pain in the keel bone [60,72]. As a result, the KBD can lead to decreased productivity and increased mortality rates, emphasizing the importance of promoting animal welfare, preventing such deformities from maintaining healthy flocks, and minimizing economic losses. To minimize these risks, poultry producers should ensure sufficient space and perching opportunities and monitor bird health and behavior. In addition, perch design can significantly impact welfare and productivity. To achieve optimal welfare outcomes, poultry housing producers should consider several factors such as material, shape, height, linear space per bird, and arrangement. Further research is necessary to evaluate the long-term effects of different perch designs on poultry health and welfare and the economic feasibility of implementing perch options in commercial poultry houses.

One limitation of the study is the lack of a comprehensive analysis of the economic feasibility of perch installation and maintenance costs. Further research is needed to investigate the cost–benefit analysis of perch installation and maintenance, including the optimal perch height and design. Since the installation and maintenance of perches may require additional costs, which may not be feasible for small-scale producers, policymakers and industry stakeholders should collaborate to develop cost-effective perch designs that small-scale producers can easily install and maintain. Another limitation of the study is the variation in perch designs, housing systems, and bird species. While the review paper recommends the provision of perches in all housing systems, different housing systems may require different perch designs and materials. Therefore, further research is needed to investigate the optimal perch design and materials for different housing systems and bird species.

Overall, providing suitable perching options in poultry housing can effectively improve the health and welfare of poultry. Further studies can evaluate the feasibility of implementing perch options in different production systems. They should provide educational programs and training to producers to understand the benefits of perch usage and optimal perch design. Poultry producers should be encouraged to provide an adequate perch space per bird, perch materials and shape, and softer materials such as polyurethane and rubber coverings in their poultry houses.

7. Conclusions

Perching has been identified as one of the chickens' primary natural behaviors, which matters to their production efficiency, health, and welfare. Therefore, providing perches at an early stage is necessary to ensure the optimum use of perches in adults and reduce perching accidents in CF hen houses. For the perch shape, according to reported research findings, rectangular perches are preferred to circular perches as the rectangular perch provides hens with an excellent tendon-locking mechanism to reduce slipperiness. In addition, oval or round perches provide a smaller contact surface and higher keel bone peak force than square or rectangular perches. For materials, softer perches such as polyurethane and rubber coverings are recommended to reduce slipperiness and increase the contact surface on chicken's toes.

Perching behavior has been reported to promote the musculocutaneous system by decreasing foot dermatitis and footpad lesions and accruing more muscle mass around the leg bone. For broilers, birds perch less during the latter stage of their life due to their heavyweight and inactive behavior. However, an increasing market for slow-grow broilers may drive the use of perches in broiler houses. Previous studies investigated the effect of material temperature on animals' welfare in a hot environment and reported that colder perches could improve the performance and welfare status by decreasing animal heat stress

and leg issues. Generally, perching reduces aggression and stress in birds and helps to improve the welfare, production efficiency, and feather conditions of laying hens or broilers.

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