Housing Conditions Determine Pigs Welfare

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Humans who care for pigs prefer an environment that not only allows the pigs to express their natural behaviors but also limits the development of aggression and stereotypes. Most of the behavioral and health problems encountered by pigs in barren, conventional conditions are solved by alternative housing systems.

pigs welfare health

1. Behavioral Needs of Farmed Pigs

To ensure the high welfare of animals, it is important to understand their biological, physiological, and behavioral needs. Pigs are highly intelligent and social animals, the social status of which is determined by their age, body weight, and physical strength [1]. Among their natural behaviors, rooting seems to be very important and related to multiple roles. Pigs perform rooting in order to forage and to explore, while sows also root to build a nest prior to farrowing [2].

Pigs housed in barren environments often exhibit signs of boredom and frustration [3]. Environmental enrichments clearly improve the welfare of pigs by allowing them to express natural, species-specific behaviors and thus play a crucial role in the development of a welfare-friendly farm environment. On the other hand, the real effect of enrichments on pigs depends on many factors, including the type of enrichment, its adequate quantity, location, maintenance, and safety. Not all additives to barren farm environments are suitable enrichments for pigs [4]. Enrichments provided to pigs should be edible, chewable, safe, and frequently replaced or renewed so that the animals do not lose interest in them [5]. According to the Commission Recommendation (EU) 2016/336 [5], straw, green fodder, miscanthus, and root vegetables may be ‘optimal’ materials for pigs. When used as bedding, these materials promote rooting behavior, serve as a comfortable resting area, and absorb excreta [6]. Unfortunately, in light of African Swine Fever outbreaks in Europe, virus-infected straw, green forage, or hay have been identified as potential sources of the disease [7]. Furthermore, the use of natural enrichments, such as straw, is limited in some parts of the world due to higher production costs (including additional costs for straw and labor) compared to housing based on slatted floors. Moreover, housing systems with slatted floors may involve problems with slurry system management when substrates are used as environmental enrichments [8]. As suggested by Nannoni et al. [9], in no-bedding systems, pigs should be at least provided with hay or silage in racks placed above the floor. According to the Commission Recommendation (EU) 2016/336 [5], straw provided in racks, peanut shells, fresh wood, corn cobs, natural ropes, shredded paper, and pellets are ‘suboptimal’ enrichments for pigs. Though the deep-bedded systems based on straw appear to be welfare-friendly, they are not free from welfare and health problems. Studies analyzing the relationship between the use of straw as bedding and hygienic problems and

development of pathogens have yielded contradictory results [8]. Moreover, pigs' preference of floor type (deep-bedding vs. slatted floor) depends on the thermal conditions, as when temperatures are high, the animals will choose to lie on concrete floors to cool off [10]. With the exception of hot weather conditions, pigs prefer straw to concrete floors; however, substrates such as peat and compost are preferred by pigs over straw [8].

It has been demonstrated that the housing system determines the behavioral activity (e.g., time spent on rooting, lying down, inactive) of all groups of pigs. Piglets reared outdoor are more active compared to those housed on slatted floors [11]. Allowing piglets to express their play behavior improves their social skills and their ability to cope with adverse situations later in life [12]. Extensive outdoor systems enable pregnant sows to express nest-building and nursing behaviors [13]. All groups of pigs given access to outdoor runs exhibit wallowing, which is associated with multiple functions such as thermoregulation, protection against sunburn, elimination of skin parasites, and expression of social and sexual behaviors [14].

2. Effects of Housing Conditions on the Welfare of Sows and Piglets

The housing system has been reported to strongly influence the maternal behaviors of sows. Freedom of movement promotes the expression of farrowing behaviors, such as nest-building [15]. It is also well known that environmental conditions determine the behavior of sows and piglets in the preweaning period and that an undesirable environment may increase the incidence of agonistic behaviors [16][17]. Prior to farrowing, sows exhibit nest-building behaviors such as foraging, rooting, and pawing [18]. If not provided with appropriate environmental conditions, they will redirect their nesting behaviors to head shaking, sham-chewing, drinker-playing, and drinking excessive amounts of water [19]. Such abnormal behaviors are mostly observed among sows that are raised under intensive housing conditions [20]. Furthermore, it has been proven that prepartum environmental stimuli (such as the presence of nesting material) promote nest-building behaviors in sows. Provision of a suitable substrate has a positive impact on the duration of nest-building behaviors and the amount of rooting observed prepartum [21]. Rosvold et al. [22] compared different nesting materials provided to sows before farrowing and observed that sows provided with straw and wood shavings expressed a higher number of total nest-building behaviors and nest-building elements (i.e., pawing, rooting, pushing, carrying and arranging material) compared to groups provided with peat and wood shavings and wood shavings only. Based on their results, the authors stated that both straw and peat promoted nest-building behaviors in comparison to no provision of these substrates.

Research data also underline that the housing system combined with suitable breed determines the maternal behavior in pigs. Free-range sows always check the bedding for the presence of piglets before laying down and move away from the piglets that are too close [23]. This behavior prevents piglet crushing, which is one of the major causes of mortality in litters [24][25]. **Table 1** summarizes the effects of housing systems on sows' health, behaviors, and performance based on the reviewed literature.

Table 1. Effect of housing system on sows' health, behaviors, and performance.

Authors	Environment and Housing Conditions	Affected Traits
Estienne et al. (2005)	Area: Virginia, USA Season: October, November, December Animals: Gilts at first gestation Factor: Individual gestation stalls vs. group housing (3 gilts/gestation pen) Gestation pens (3.1 × 1.7 m; 5.27 m^2) partially slatted concrete floor; located in a mechanically ventilated building; mean high temperature was 22.4 °C and mean low temperature was 17.6 °C. Gestation stalls (0.6 × 2.0 m; 1.2 m^2) with partially slatted concrete floor, located in a curtain-sided building; mean high temperature was 19.8 °C and mean low temperature was 15.8 °C.	Effect: Pens vs. stalls; final body weight 170.6 vs. 166.3 kg, $p < 0.01$; change in body weight 11.0 vs. 6.7 kg, $p < 0.01$; lesions score greater in stalls No effect on: backfat thickness, lameness score; display of stereotypies
Szulc (2011)	Area: Poland Season: - Animals: Złotnicka Spotted, a Polish native breed Factor: Outdoor vs. indoors on shallow bedding	Effect: Outdoor pens compared to indoors: later age of first farrowing, longer farrowing interval, lower litter size at birth No effect on: number of piglets raised till 21st day postpartum was similar
Szulc (2012)	Area: Poland Season: - Animals: Złotnicka Spotted, a Polish native breed Factor: Conventional housing conditions vs. organic outdoor farm	Effect: Organic vs. conventional; number of piglets born alive 9.42 vs. 8.87, $p < 01$; mortality of piglets 16.03% vs. 9.96%, $p < 0.01$ No effect on: age at first farrowing, intervals between litters, number of piglets reared till day 21 postpartum
Kim et al. (2016)	Area: Republic of Korea Season: - Animals: crossbred sows (Landrace×Yorkshire) in their 3–4 parities Factor: Individual gestation stalls vs. group housing Gestation stalls (2.20 × 0.65 m) with fully slatted concrete flooring. Group-housed sows were kept in pens (10.4 × 5.4 m), 16 sows/pen. All sows were moved to farrowing crates (2.2 × 0.65 m) on day 109 of gestation.	Effect: Gestation stalls compared to group housing; lower backfat thickness at 1 day of lactation ($p = 0.03$); smaller backfat thickness change in 1–21 days of lactation ($p = 0.04$); lower feed intake ($p = 0.04$), shorter weaning-to-estrous interval ($p = 0.04$); lower number of weaned piglets ($p = 0.03$); lower growth rates (kg/d) in piglets ($p = 0.01$); lower average daily gain ($p = 0.04$); less time walking during gestation ($p = 0.01$); less time eating during the farrowing period ($p = 0.03$) No effect on: Number total born and born-alive piglets, birthweights of piglets; time spent on: ventral

Authors	Environment and Housing Conditions	Affected Traits
		laying, sitting, standing, and drinking during gestation
Angermann et al. (2021)	Area: Brandenburg, Germany Season: January and June 2018 Animals: Danish genetic Factor: Two housing systems during gestation, existing system based on stable groups with restrictive feeding regime vs. dynamic groups with Sow-Welfare-Optimized-Feeding (SWOF) Existing system, sows were kept in a stable group (average 48 pigs) in a pen (7.70 × 17.50 m) divided by the trough in the middle into two groups of 18–25 sows (pen size of 3.63 × 17.50 m per group); no functional area; fully slatted floor; negative pressure ventilation. SWOF system, sows were kept in large dynamic groups (average 105 sows); partially slatted floor; functional areas (activity and lying area, ad libitum liquid feeding areas; negative pressure ventilation.	Effect: Stable groups compared to SWOF system; lower injury index No effect on: lameness; litter birthweight; number of born piglets; piglets born alive; stillborn; mummified piglets
Luo et al. (2020)	Area: Wageningen, the Netherlands Season: - Animals: Pigs (Tempo × Topigs 20) Factor: Barren housing system vs. enriched; part of pigs switched between systems at 47 days of age Barren system 8.6 m^2 pens; solid floor and a small slatted area; toys: Enriched system; 17.1 m^2 pens; the enriched part contained 1.7 kg of straw, 300 L of sawdust, and 270 L of peat as substrates on the floor; toys.	Effect of barren system: - Behaviors at 3 weeks of age: less time spent on exploring, more pen-directed exploring, less chewing, more pen-directed chewing, aggression, more manipulation; - Behaviors at 47 days of age: more time inactive, less exploring, more pen-directed exploring, less chewing, more pen-directed chewing, more manipulation and mounting; Effect of enriched system: - Behaviors of pigs at 3 weeks of age: less time spent on exploring, more pen-directed exploring, less chewing, more pen-directed chewing, aggression, more manipulation; - Behaviors at 47 days of age: more time inactive, less exploring, more pen-directed exploring, less chewing, more pen-directed chewing, more manipulation and mounting; Effect of housing system: - before and after the switch on body weight gains on days 109–130; - after the switch on body weight gains on days 46–130.

Authors	Environment and Housing Conditions	Affected Traits
		No effect on: inactivity, social behaviors and mounting at 3 weeks of age; play and aggression at 47 days of age.

3. Effect of On-Farm Environment on the Welfare of Growing Pigs and Fatteners

Housing pigs in indoor pens at high stocking densities can lead to health and behavioral problems [26][27]. Unlike conventional pig farms, organic farms focus on the well-being of animals as well as the environment, and therefore, meat production on organic farms is perceived as more ethical compared to commercial production [28]. Furthermore, pigs reared on organic farms are allowed to express species-specific behaviors, including the formation of social groups and social interactions, environment exploration, feeding through rooting, or wallowing in mud [29]. These animals are also more active and spend more time walking, playing, and laying, compared to pigs reared under intensive conditions [30]. Moreover, research indicates that harsh climatic conditions can affect the growth performance of pigs and suggest that crossbreeding can help overcome this issue [31][32]. The direction and significance of the effect of housing conditions on the growth and slaughter performance of pig fatteners are inconsistent. Some studies have reported that the housing system does not have an impact on most of the traits related to fattening performance and slaughter value [33]. On the other hand, some have concluded that the housing system influences only some characteristics of fattening performance [34], while some have pointed out the relationship between the housing system and performance of pig fatteners [9][35]. These inconsistent findings seem to indicate that there may be other factors interacting with the housing environment, mitigating the environmental impact on the performance of pigs.

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