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A review: aggression concerns with group-housed sow well-being

Abstract

The global trend toward housing gestating sows in group-pens is primarily driven by welfare concerns associated with the use of individual gestation stalls. Despite transition toward group-housing systems, no housing system has scientifically been identified as being better than another based on current notions of sow well-being. Both benefits and drawbacks are associated with housing gestating sows either individually or in groups. The main concern associated with group-housing is increased sow aggression that occurs at mixing and around limited resources, including feed and water. Aggression is inevitable and unavoidable upon mixing of unfamiliar sows, but is necessary for establishment of social hierarchy, which helps reduce overall aggression and tension among the group. Unfortunately, if aggression is intense and prolonged it may lead to stress and compromised sow well-being. With few differences in sow well-being identified between gestation housing systems, it seems plausible that the consequences on sow well-being is not only about the stall or the pen the sow is confined to, but the interactive effects of other housing components. In pens, some of the most critical factors to consider include space allowance, group size, time of mixing, and feeding systems/strategies which may directly or indirectly affect various welfare metrics (e.g., lesion scores, aggressive behavior, reproduction). It is imperative to minimize aggression among grouped sows and feeding and management strategies are viable options that can be used to reduce aggression among group-housed sows, but not eliminate aggressive encounters. Therefore, the focus of this review is to examine the different feeding and management strategies that can be used to mitigate the drawbacks of grouping housing sows, while improving performance, productivity, and well-being.

Keywords: behavior, gestation, group-pens, physiology, sows, stress, welfare

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Introduction

The use of the gestation stall, within in the US, has become increasingly controversial due to consumer and legislative pressure to transition to alternative group-housing systems. Legislative and ballot initiatives have limited the use of the individual stalls in some US states, whereas, in the European Union and other countries across the globe the use of the individual stall has been eliminated. There are both plusses and minuses associated with sows being housed either individually or in groups and limited data indicate an improvement in sow well-being, in any system.[1,2] Group-housing systems are extremely complex, and difficult with which to come to grips, simply because there are so many factors that must be considered. Animal accommodations are not jigsaw puzzles, meaning the pieces do not necessarily fit together perfectly or even acceptably. Yes, group-pens facilitate social living and freedom of movement, but not without welfare tradeoffs or consequences.

The major welfare concern associated with managing sows in groups is increased aggressive interactions, especially at mixing and during feeding, which results in more skin lesions and injuries, and variability in body condition scores, which may negatively impact sow well-being. Aggression is inevitable among unfamiliar sows for establishment of social hierarchy which helps reduce overall aggression and tension within the group. However, if aggression is intense and prolonged, it can lead to stress and compromise animal well-being. Sows housed in group-pens experience acute stress, but some sows may experience chronic stress caused by ongoing social stress and variable feed intake. Moreover, other housing components such as feeding method, floor-space allowance, group size, and behavioral management—just to name a few—may exacerbate the impact on sow well-being. In fact, when a group-keeping system fails to work well, some sows inevitably experience a poor state of wellness.[3,4] The focus of this review is to discuss the effects of stress on animal welfare and to examine few of the potential housing and management strategies that may be used to mitigate the drawbacks of group-sow housing, especially in terms of minimizing aggression, and maintaining good welfare.

Stress and allostasis

Assessing stress is often challenging because animal factors including genetics, age, physiological state, and social relationships affect the biological response(s) to the stressor and the biological consequence to animal well-being.[5] In general, when confronted with a stressor, an animal elicits a biological response(s) in attempt to cope with stress, and if the appropriate response is initiated, often the biological cost is minimal in terms of animal well-being. Conversely, if an animal is unable to cope with a stressor, its' life expectancy and productivity may be compromised.[6] In short, once the threat to homeostasis is perceived, the hypothalamic-pituitary-adrenal (HPA) axis is activated upon the release of corticotropin releasing factor which in turn causes the release of adrenocorticotropic hormone which leads to the secretion of glucocorticoids, primarily cortisol.[7,8] Glucocorticoids regulate basal activity of the HPA axis and terminates the stress response via negative feedback. Hence, activation, modulation, and termination of the HPA axis is essential for adaptation and homeostasis in the short term; however, in the long-term, repeated stress or prolonged stress can lead to high cortisol levels and once the animal fails to cope with the stressor it may experience distress ("bad" stress). Well-being is often compromised when animals experience distress because nutrients must be diverted from other biological functions (e.g. growth, reproduction) in attempt to mitigate and cope with the stressor.[5] Stress can be defined as "a real or interpreted threat to physiologic or psychologic integrity of an individual organisms that evokes physiological and/or behavioral responses," to achieve a state of equilibrium.[9] Homeostasis refers to the re-establishment of an internal set point by initiating the appropriate physiological adjustment that enables the organism to achieve internal equilibrium.[10]

Whereas, allostasis is a process that supports homeostasis and stability is achieved through change.[11] In general, homeostasis applies to those physiological systems that are essential for life, while allostasis applies to those physiological systems that change as environment(s) and other life history stages change.[10,11] It has been proposed that the allostasis is better concept to assess animal well-being since the capacity to change is crucial to good health and good animal welfare.[12] The mediators of allostasis (e.g., glucocorticoids, catecholamines) are protective and adaptive, thus increasing survival and health, however too much can also be damaging. At times animals may fail to successfully habituate to repeated challenges, fail to shut-down the physiological response, or fail to initiate an adequate response to mitigate the challenge, this animal is experiencing an allostatic overload and well-being is compromised.[10] It is also important to recognize that other factors may influence the biological response evoked and the biological cost to the animal, including type (physical or psychological) and duration (chronic or acute) of the stressor as well as physiological status of the animal.[13] For example, Salak-Johnson et al.[14,15] found that gestating sows housed in group-pens at different floor-space allowances or in individual stalls initiate different behavioral and immunological responses in attempt to cope with the constraints of their specific housing environment. The authors concluded that different housing environments evoked different biological response(s), which enable them to cope with the constraints of each environment, hence these responses did not compromise sow well-being in terms of performance, productivity, or health. More specifically, these data imply that if the appropriate biological response is initiated, animal adapts, thus minimal consequences (if any) on sow well-being.

Aggression welfare concern

Increased aggression at mixing and around limited resources, such as feed and water is a major drawback associated with group-housed sows. Aggression among group-housed sows is evitable and necessary to establish social hierarchy within the group, which often reduces aggressive encounters later-on.[16,17] Despite an established hierarchy, aggression may still occur, especially during feeding, with higher-ranked sows displacing lower-ranked sows, thus resulting in sows that are either too thin or too fat.[18,19] Moreover, food deprivation leads to an increase in cortisol and if prolonged, animals can lose body weight, experience reproductive failure,[20–22] and affect embryonic development (i.e. decrease embryonic cleavage rate).[23] More recently, Pacheco & Salak-Johnson[24] found that dominant sows engaged in more aggressive encounters and that over-time they may experience chronic stress which may cost them in terms of performance and productivity. It is plausible, that welfare tradeoff in terms of reproductive performance may be greater for dominant sows in some group-housing systems than submissive sows.

Sow social rank tends to be related to parity, meaning higher parity sows are often the more dominant sow within the group.[25] Higher parity sows are involved in more and longer aggressive encounters than lower parity sows,[26] and pregnant gilts that are housed in mixed parity group-pens tend to avoid aggressive encounters[14] while housing only gilts together higher-ranked gilts show more aggression and lower-ranked gilts receive more aggression.[27] When group-housed sows are fed individually, social rank influences the order that the group of sows consume feed, with highest-ranked animals entering feeding area first when housed in pens with an electronic sow feeding system or the first feeding stall when a stall system is used.[25,28] Moreover, when sows are floor-fed, the higher-ranked sows will "guard" feed by staying in the center of the feed pile, thus lower-ranked sows only have access to feed on the outer-edge of the pile.[18] Dominant sows also displace submissive sows from the feeder, resulting in higher-ranked sows consuming more feed than lower-ranked sows,[19,29] thus higher-ranked sows gain more body weight during gestation than lower-ranked resulting in greater variability in body condition scores among the group. Sows that consume more than their daily feed allotment tend to be heavier and obese, while those sows that consume less tend to be lighter. It is apparent that the biological cost to the sow in terms of well-being may be dictated by social rank within the group as well.

Other housing components impact welfare

Many other factors, such as group-size, floor-space allowance, and type of feeding system may also affect aggressive behavior and well-being of group-housed gestating sows either independently or interactively. When comparing groups of 5, 10, 20, and 40 sows per pen, aggression increased as group size increased,[30] while Hemsworth[31] found less injuries among sows housed in groups of 10 compared to housing sows in groups of 30 or 40. Moreover, they found that as space allowance increased from 1.4m² to 3.0m² per sow, aggression during feeding was reduced. Similarly, Salak-Johnson[14] demonstrated that sows allotted to pens at 1.4m² of floor-space per sow had greater lesion scores and lower body condition scores compared to sows that were allotted at 2.3m² or 3.3m² of floor-space per sow. Also, total lesion severity scores were higher for sows kept at 1.7m² as opposed to 2.3m² of floor-space per sow.[32] Anil[33] found that sows managed dynamically in pens with an electronic sow feeding system had higher injury scores compared to sows maintained in static groups or only mixed twice. Similarly, sows managed in a static group of 35-40 sows per group had less lesions than if sows were managed in a dynamic group with more than 100 sows per pen.[34] In addition, the type of feeding system used affects aggressive behavior and sow body condition score, with greater aggression and injuries when sequential feeding systems (e.g. electronic sow feeder) are used compared to simultaneous feedings systems (e.g. trickle-feeding system).[35,36] Yet, more sow displacement occurs in the latter system leading to greater variability in body condition scores because some sows eat more feed than other sows.

The time of mixing post-breeding can affect aggressive encounters and reproductive performance. Mixing sows at 35days post-breeding resulted in less aggressive encounters, lesion scores, and cortisol concentrations than if sows were mixed prior to day 35.[26,37] Conversely, Knox[38] found that mixing sows 13 to 17days post-breeding resulted in less bouts of fighting compared to sows that were mixed at 3 to 7days or 35days post-breeding. Often times mixing sows before

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implantation can negatively impact reproductive performance, such that farrowing and conception rates are reduced among sows that were mixed prior to day 9 post-breeding.[34,38]

Managing aggression group-housing feeding strategies

In In general, some believe that stereotypic behavior equates to compromised sow well-being, while others believe that these behaviors serve as coping mechanisms and/or are part of pre- and post-feeding behavioral sequences. Sekiguchi & Koketsu[39] found that sows perform more sham-chew behavior and far rowed less piglets compared to sows that did not perform this behavior; yet, other reproductive performance measures were not different. Stereotypic behaviors may serve as a coping mechanism in a stressful environment[40,41] or develop due to lack of satiety among limit fed sows.[42] Terlouw[43] reported that gilts fed 2.2kg per day displayed an increase in activity, chain manipulation, and pre-feeding sham-chewing compared to those gilts that were fed 4.0kg per day and sows fed 2.5kg per day also performed more oral-nasal-facial behaviors compared to sows fed 4.0kg/day.[44]

Feeding strategies, such as modified gestational diets, have been feed to sows to improve satiety and reduce stereotypic behaviors. Gestating sows are restricted fed in terms of the amount of fed, but are fed enough metabolizable energy to meet their maintenance and reproductive needs, while preventing obesity. It has been shown that restricted-fed sows develop stereotypies, especially in terms of increased activity in oral-nasal-facial behaviors which may equate to high levels of feeding and foraging motivation.[43–45] In an attempt to limit these behaviors, researchers have fed sows high-fiber gestational diets which are bulkier and increase feeding duration and improves satiety[46,47] and these diets have also been shown to reduce sham-chewing, bar biting, and foraging-like behaviors in sows.[32,42,46] Moreover, feeding fiber to group-housed sows increased time spent lying and decreased aggressive behavior. de Leeuw[48] found that sows fed a high-fiber diet spent less time active and made less frequent postural changes for several hours post-feeding and others reported not only a decrease in general activity but an increase in time spent lying.[49,50] Furthermore, vulva lesion scores were less severe among sows fed a high-fiber diet compared to sows fed a low-fiber diet, which may be partly explained by the decrease in aggression among the group.[32,42] Fiber source and amount of fiber must be considered as well. Robert[49] found that feeding sows wheat bran and corn-cob fiber diet was more effective at reducing stereotypic behaviors and increasing time spent lying compared to feeding sows an oat hulls fiber diet. Thus, some sources of fiber do not affect stereotypic behaviors, such as feeding a supplemented fortified sorghum-soybean meal diet with 25% beet pulp had no effect on oral-nasal-facial behaviors in gilts.[51] Similarly, feeding sows a high fiber diet of corn-soybean meal with 40% soybean hulls had no effect on stereotypic behaviors, however, time spent eating was increased.[52] Moreover, feeding high energy diets to sows can reduce stereotypic behaviors such as sham-chewing and chain manipulation, but this strategy has not been well documented.[43]

The use of feeding partitions may also help reduce aggressive encounters among group-housed sows. When sows are restricted-fed they fight to access feed, thus using feeding partitions provide partial protection for sows during feeding is a good option. Aggressive interactions are reduced during feeding among group-housed sows when partial feeding partitions are used compared to feedings sow on the floor without protection.[53] The length of the feeding partitions is important, aggression and displacement of submissive sows is reduced and time spent eating is increased when full body partitions are used compared to shoulder length feeding partitions.[54] Conversely, sows housed in pens with shoulder length feeding partitions had shorter aggressive encounters during the first 48hours post-mixing and less severe lesions compared to sows housed in pens with full body length feeding partitions,[55] implying that other factors affect the outcome other than length of feeding partition. In fact, it may be a combination of factors such as diet, feeding system, and (or) group size.

Conclusion

Numerous Feeding and management strategies can be used to reduce aggression and stress among group-housed gestating sows, but minimizing these concerns do not necessarily equate to enhance sow well-being in terms of performance, productivity, behavior, or health. With few differences being found among group-housed sows in terms of improved sow well-being, it is likely that the housing system per se may not be the only critical component, but other factors or constraints of the housing system may have greater impact on sow well-being. Data support that other factors are more likely to influence sow behavior, physiology, performance, and overall well-being, more-so, than simply a group pen or level of aggression. Moreover, multiple factors such as floor-space, group size, social status, and feeding system/management can affect not only the level of aggression and stress among the group of sows, but may exacerbate the consequences of group-housing system on sow well-being. For example, we found that social rank, feeding stall length, and dietary fiber interactively affected sow aggression and differentially affected the well-being of dominant and submissive sows.[56] More specifically, submissive sows had improved well-being in terms of reproduction and performance, while dominant sows had compromised litter-performance as evident by higher mortality and lower weaning weights, thus implying the that welfare tradeoffs and biological cost was mainly dictated by sow social rank. These data support that the housing system *per se* as well as level of aggression were not the most critical factors, but it was the constraints of the environment imposed on the dominant sows since we found no differences between treatments when social rank was not considered.[55] Hence, sow social rank exacerbated the negative effects of group-housing and aggression on dominant sow well-being, while improving submissive sow well-being. These findings further supported the theory that if aggression is prolonged and intense it can lead to stress and compromised sow well-being. Thus, managing physical and biological factors within a housing system adequately as well as implementing new strategies (e.g. high fiber diets and feeding partitions) may be viable opportunities to minimize the level of aggression and potential consequences, but reality is improved sow well-being in group-pens is highly dependent upon on other factors, including housing factors, but more importantly sow traits which can interactively affect sow well-being in the short- and long-term.

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Conflict of interest

Author declares that there is no conflict of interest.

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