

Ingestive Behavior in Swine

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Abstract

Pre-weaned piglets listen to the cues from their dam to know when it is time to gather and when it is time to suckle. Interruptions within phases of the nursing cycle can lead to negative correlations in milk consumption and production. Natural weaning is a slow and gradual process that causes the least amount of discomfort and abnormal feeding behaviors in piglets compared to abrupt separation. Artificial weaning at young ages psychologically stresses piglets, which results in fasting periods and reduced initial intakes of feed and water. Designs in feeders and water dispensers must accommodate efficient accessibility for each animal, maintain sanitation, minimize wasted resources, and allow pigs to ingest water using natural sucking motor functions. Swine have preferences for feed that come in certain physical forms and formulations that with high palatability and physiochemical properties, such as fiber, can satisfy hunger in pigs fed on restricted diets.

Introduction

Swine are omnivorous creatures and when reared in free-ranging environments, exhibit relatively defined cyclic patterns early in life. Subsequent to birth, piglets become settled in the nest that the sow has constructed and remain there for approximately 10 days, in which they will rejoin the mother's group of females (Jensen et al., 1993). Suckling milk from the dam is a highly complex sequence of physical activity and vocal commands from sow to offspring. Within the first few days of life, piglets establish their own rankings in the litter, which generally determines the individual's rate of survivability.

Natural weaning is a gradual process that involves piglets starting to become familiarized in rooting and grazing within the first few weeks of life. Complete weaning occurs typically after 7 weeks of age. Commercial weaning, on the other hand, is usually abrupt and can be as early as 2 to 3 weeks of age, with the majority of operations weaning at 3 to 4 weeks (Widowski et al., 2007). Young piglets forcibly separated from the dam tend to fast for varying lengths of time and develop other abnormal behaviors, such as belly nosing. Creep feeding has been observed to cushion some of the impacts from physical and psychological stress, but is not yet fully defined, as similar consequences are still being explored (Souza and Zanella, 2007).

Confined swine operations also influence ingestive behaviors of growing pigs, sows and boars. Poorly designed feeders and water dispensers can affect overall performances due to lack of accommodation in feed palatability or accessibility, and muscular motor

motions for drinking water. Even established social hierarchies and disruptive noises can induce certain feeding behaviors to pigs of all ages.

Pre-Weaned Piglets

Within minutes of birth, the piglets are already beginning to establish their place called a "teat order". Although the sow normally has teats for each of her offspring, some teats offer more milk, whereas others provide milk of higher quality. Piglets fight over teats that can last anywhere from a few hours to up to 10 days, where those with higher birth weights normally succeed (De Passille and Rushen, 1989).

Once the entire teat order has been established, a nursing cycle subsequently begins with 5 defined phases. In Phase 1, the sow grunts for up to a minute in duration, signaling her litter that it is time to gather and nurse (Bels, 2006). The piglets then massage the udder in Phase 2, which activates the oxytocin hormone to secrete and initiate the flow of milk to the teat. Phase 3 involves slightly rapid grunts from the sow with 20 to 30 second durations that tell the piglets to begin suckling slowly. Once milk flows through and out of the teat, piglets suckle at a much faster pace for about 10 to 20 seconds in Phase 4. Lastly, in Phase 5, the massaging of the udder commences again for a few seconds to up to ten minutes where piglets will then restart the suckling cycle (Jensen, 1988).

Milk intake is internally regulated by how satisfied offsprings are with the amount consumed. Gastric loading involves the stomach being filled up to the point where the animal no longer has feeding motivation (i.e. hunger). Hormones that are secreted due to gastric loading, such as peptide hormone cholecystokinin (CCK), send messages to the brain in regard to the level of satiety. CCK in particular has been seen in piglets as young as 2 days old (Baranyiova and Hullinger, 1999). However, piglets still participate in suckling motor behaviors even after hunger has subsided (Fry et al., 1981).

Possible disturbances within the nursing phases can come from loud or unnatural noise sources, such as from mechanical appliances in confinement operations. Disruptive sounds can distract the sow or inhibit the pigs from hearing her. Grunts from the dam are important in signaling the time for transitioning into the next phase in the cycle. Without these signals, the sow and piglets can succumb to decreased milk production and ingestion respectively (Algers and Jensen, 1991).

Features in the sow's life can potentially affect the ingestive intake or behavior of her offspring. As a gilt her birth litter size, season of birth, weaning age and age of first insemination may improve or depress various functions of the piglets. A relationship was examined between feed intake and the size of the sow's birth litter in Sell-Kubiak et al. (2011). If there were extra piglets in the birth litter (i.e. more piglets than the average for the breed), her litter's feed intake as grow-finish pigs

would decrease 4 grams per day. However there are many more aspects either from the sow's life history or the environment that can influence feeding behaviors of piglets.

Newly Weaned Piglets and Growing Pigs

Large commercial weaning ages are much younger than in wild or free-ranged pigs. Majority of operations start at 3 to 4 weeks, but some may go as early as 2 weeks. Early weaning such as this usually results in piglets fasting for various lengths of time. Some may eat feed within 5 hours after weaning, whereas others may eat after 50 hours (Bruininx et al., 2002). Creep feeding does allow piglets to become accustomed to solid feed consumption and can slightly increase intake and weight gain during the early post-weaning period (Bruininx et al., 2002).

Limited access to feeds can be induced from the number of pigs per trough. Larger pig-to-trough ratios have been reported to reduce meal frequencies (number of meals per day) in some animals, but can sometimes increase the size of each meal consumed simultaneously (Bels, 2006). Design of the feeders has also shown similar results; less meal frequencies were observed from difficulties in gaining access to the feeder and higher meal frequencies from difficulties to retain feeding activity. Location of the water source may also increase feeding motivation of pigs if placed near the feeder, thereby increasing the overall meal frequency (Bels, 2006).

Torrey et al. (2008) experimented with 3 different designs of water sources on newly weaned piglets to determine relationships with water intake, water waste, and relationships to belly nosing. The Drink-O-Mat push-lever bowl drinker (PUSH) allows piglets to use their snouts to apply pressure against a water valve. Individuals can then ingest water via sucking motor motion that is also seen when suckling milk during nursing. Aquadish float bowl drinkers (FLOAT) do not have a pressure valve for snouts like PUSH, but still allows piglets to utilize their sucking behavior to drink. Lastly, nipple drinkers (NIPPLE) dispense water directly into the mouth once activated when pigs bite down on the depressed valve.

Observed water consumption increased with the age of the pigs from NIPPLE and PUSH devices. This also increased feed intake over time, as well (Fowler and Gill, 1989; McLeese et al., 1992; Maenz et al., 1994; Torrey et al., 2008). FLOAT, on the other hand, had far less water consumption overall, especially 2 days after weaning. This is due to FLOAT's poor design where water became tainted with urine, feces, and feed shortly after piglets were introduced. Water that was wasted was greater in NIPPLE devices due to less than half of the water used was actually ingested (Torrey et al., 2008). Without the use of sucking motor patterns, more water was spilled out of the mouth. Faster flow rates of water through the valve also contributed to a

higher percentage of spillage. In the case of belly nosing behaviors, PUSH exhibited less events compared to NIPPLE and FLOAT in piglets weaned at 15 days of age due to tactile snout stimulations from the pressure valve (Torrey and Widowski, 2004).

Different forms of feed determine the degree of palatability, which will then determine how much feed is eaten. The feeding rates (grams per minute) in liquid, pelleted and dry meal diets are in order from highest to lowest respectively (Laitat et al., 1999). Liquid diets allow newly weaned and growing pigs to utilize their natural sucking motor motions compared to pellets and dry meal. The mixture of water and feed also reduces interruptions from feeding to drinking and vice versa – improving amount ingested.

Adult Pigs

Within the social hierarchy, confined pigs reared in groups in semi-natural environments with only one feed trough available generally eat less meals per day, but with higher meal sizes (Bornett et al., 2000). When in groups, pigs prefer to eat with other adjacent pigs because they place a higher value on available feeds with a companion than when in solitude (Pedersen et al., 2002), and tend to eat specific feed formulations when observing what other pigs are ingesting (Morgan et al., 2003). Feed intakes in those reared individually observed the opposite, where meal frequencies are higher and meal sizes lower (Bels, 2006).

Effects on dominance in the hierarchy are not fully defined, as there are some variations in observed feeding behaviors. Hoy et al. (2012) reported dominant boars visiting feeding stations frequently and spending shorter times eating, which lowered feed intakes. Subdominant boars did not visit as frequently, but spent more time feeding. Bels (2006) also reported these findings with barrows showing similar feeding behaviors as subdominant boars. As for aggression sows and boars in group housings exhibit competitions over feed sources, which can especially be seen more prevalent among high-ranking sows (Csermely and Wood-Gush, 1986).

In regards to feeding motivation, the vast majority of swine operations supply restricted amounts of feed for pigs based on their stage of maturity and body condition. Pregnant gilts are generally fed to only meet their body's maintenance and growth needs – approximately 2 kilograms of feed per day. Sows and sexually active boars are usually given about 60% of their *ad libitum* intake amount to satisfy maintenance needs, which may increase the chances of feeding motivation (Bels, 2006).

Purchasing feed is one of the major expenses in any livestock industry. Therefore decreasing feeding motivation can greatly aid in saving money and also improve the welfare of restricted-fed animals. Dietary fibers are well-known to increase satiety in both humans and swine due to certain physiochemical properties. Bulky (water-binding capacity) fibers increase chewing,

saliva production and increases gastric distension from expansion in volume of the stomach, bringing feelings of satiety (Souza da Silva et al., 2012). Viscous fibers and fibers with high fermentability are able to influence digestive activities in the GI tract and increase chewing and saliva production like bulky fibers. Hypotheses of the property of viscosity include delaying gastric emptying of ingesta from stomach to intestine by trapping nutrients in the matrix, thereby slowing down the exiting process and allowing more time for enzymatic digestion (Brownlee, 2011).

Souza da Silva et al. (2012) studied these 3 different physiochemical properties of fibrous diets using lignocellulose (LC) for bulkiness, highly methylated citrus pectin (PEC) for viscosity, and fermentability as resistant starch (RS). LC was confirmed to reduce feeding motivation by at least 1 to 3 hours after a meal, with others reduced by 7 hours regardless of low or high inclusion levels of LC in the diet (Souza da Silva et al., 2012). PEC did not confirm the typical observations of viscous fibers. Increase in hunger increased further with additional inclusions of PEC in the diet, and also resulted in pigs spending more time at feeding stations.

Analogous studies in humans using viscous fibers indicated higher satiety in liquid form than in solid, which was used in Wanders et al. (2011). As a liquid, the fiber is completely hydrated and provides a different appeal that can be palatable to more animals (Kristensen et al., 2011). In RS overall feeding motivation and time spent at feeding stations were reduced throughout relative feeding times. Starch in RS broken down in the GI tract provides additional energy sources, is able to stabilize blood glucose and insulin levels, and can stimulate satiety hormone secretions (Delzenne and Cani, 2005).

Conclusion

Even within minutes after birth, piglets immediately begin utilizing their instinctive feeding motor skills. Throughout life until reaching maturity, pigs will continue to develop ingestive behaviors that can be easily influenced based on genetic backgrounds, surrounding environment, and status within a social hierarchy. Pre-weaned piglets listen to the cues from the sow in order to know when it is time to gather and suckle. Interruptions within the phases of the nursing cycle can lead to decreased milk consumption, and decreased milk production for the sow. Artificial weaning at young ages negatively affects piglets, which can result in fasting periods and reduced initial feed and water intakes. Designs in feeders and water dispensers need to accommodate for efficient accessibility for each animal,

maintain cleanliness, minimize wasted resources, and allow pigs to ingest water (and feed) using natural sucking motor patterns. Swine also have preferences for feed that come in certain forms and formulations. High palatability and physiochemical properties, such as fiber, can better reduce feeding motivation in pigs, especially when fed on restricted diets while also reducing expenses in feed.

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