

Effect of drinker type on water disappearance of nursery pigs

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ABSTRACT

This study was conducted to evaluate the water disappearance of nursery pigs (from weaning to 6 wk post-weaning; 6.4 ± 1.07 to 22.0 ± 3.39 kg live body weight) using a randomized complete block design to compare two Drinker Type treatments: Nipple vs. Cup. A total of 336 pigs housed in 16 pens with 21 pigs per pen in 2 rooms (8 pens per room) were used. Pens had fully-slatted concrete floors; floor space was $0.32 \text{ m}^2/\text{pig}$ and there was one feeder and one drinker per pen. Pigs were fed corn-soybean-based diets formulated to meet or exceed nutrient requirements. Pigs and feeders were weighed at the start and end of the study. Water disappearance was measured using a water-flow meter fitted to the water pipeline supplying the drinker in each pen. For the overall study period, Drinker Type did not affect ($P > 0.05$) growth performance; however, average daily water disappearance was greater ($P < 0.05$) for Nipple than Cup drinkers (2.74 and 2.25 liters/d, respectively; SEM = 0.139). Water to feed disappearance ratio was greater ($P < 0.05$) for the Nipple than the Cup treatment (5.23 vs. 4.22 liters/kg, respectively; SEM = 0.263). These results suggest that water disappearance from nipple drinkers was greater than for cup drinkers. The lack of an effect of Drinker Type treatment on pig growth performance suggests that the treatment difference for water disappearance was most likely due to greater water wastage for the nipple drinkers rather than any effect on water intake per se.

Key words: Drinker Type, growth performance, nursery, pig, water disappearance

INTRODUCTION

As well as being the major component of the body of the pig (Shields et al., 1983), water is an essential nutrient that has important roles in most, if not all, functions of the animal. However, published research on water consumption by the pig and factors that affect this is extremely limited, certainly in comparison with the extensive body of literature on feed intake. Thulin and Brumm (1991) described water as “the forgotten nutrient” for pigs on the basis of the dearth of science in this area. Unfortunately, that term is still accurate at the present time; published studies addressing key questions related to water consumption are still limited. In part, this deficiency is due to water being relatively inexpensive in many situations and, also, to the general belief that providing the pig with unlimited access will avoid deficiency problems (Patience, 2012a). In addition, water consumption is problematic to measure, particularly under commercial conditions.

However, there are situations where water intake may be limiting animal performance, such as with lactating sows and newly weaned pigs (Fraser et al., 1990). Low feed intake immediately after weaning is a common problem (Dong and Pluske, 2007) and feed and water intake are closely associated (Dybkjær et al., 2006). In support of this concept, Barber et al. (1989) found that, for pigs weaned at 21 d of age, increasing the flow rate to nipple drinkers from 175 to 700 cm^3/min

resulted in increases in water use, feed intake, and growth rate over a 3-wk period following weaning. In addition to any effect on animal performance, estimates of water intake of pigs are needed for delivery of other substances, such as medicines, via the water supply (Little et al., 2019). Most of the estimates of water disappearance for nursery pigs, as well as those for other classes of pigs, are from research carried out many years ago. Given the considerable genetic improvement in growth performance over time (Fix et al., 2010), it is important to re-evaluate water consumption levels in pigs from modern genetic lines under typical commercial conditions.

One of the major factors that has been shown to influence variation in water disappearance of pigs in the nursery and other phases of production is the type of drinker that is used (Torrey et al., 2008). The objective of this study was to quantify water disappearance levels during the nursery period and determine the effect of two commonly used water drinker types, namely, nipples and cups, on water disappearance and growth performance.

MATERIALS AND METHODS

This study was conducted in a wean-to-finish building of the swine research facilities at the University of Illinois. The experimental protocol was approved by the University of

Illinois Institutional Animal Care and Use Committee prior to the initiation of the research.

Experimental Design, Treatments, and Allotment

This study was carried out during the nursery period from weaning [19.0 ± 1.04 d of age; 6.4 ± 1.07 kg live body weight (BW)] to 6 wk post-weaning (22.0 ± 3.39 kg BW). A randomized complete block design was used to compare two Drinker Type treatments (water source within the pen): Cup vs. Nipple. A total of 336 pigs housed in groups of 21 were used. Blocks consisted of two pens of pigs (one of each Drinker Type) with the same weaning date, similar average and CV of weaning weight, and the same gender ratio (barrows and gilts). The study was carried out in two identical rooms of the same building, each room housed 8 pens of pigs, resulting in 8 replicates per treatment. Pigs from two weaning groups were used with each group being placed in one of the rooms. There was a 2-wk interval between the day of weaning for the two groups.

At weaning, each pig was weighed and given a uniquely numbered ear tag. For the allotment, outcome groups of two pigs were formed of the same gender and of similar weight, and pigs were randomly allotted from within outcome group to one of two adjacent pens in the same room. This process was repeated until both pens within the block had 21 pigs of similar mean BW, similar CV of BW, and the same gender ratio. The two pens within each block were randomly allotted to one of the two Drinker Type treatments.

Animals, Housing, and Management

Pigs used in the study were the progeny of Genetiporc Fertilis 25 sows mated to the G-performer line sires (PIC; Hendersonville, TN). Pens had fully-slatted concrete floors with divisions of vertical metal bars. Pen dimensions were 1.83 by 3.66 m, giving a total floor space of 6.70 m² (0.32 m²/pig). Each pen was equipped with a 2-hole dry box feeder (Farmweld, Teutopolis, IL) attached to the front gate of the pen. There was one water drinker per pen which was located in the middle of the division between two adjacent pens. Drinkers were installed prior to the start of the study, with one of each of the two Drinker Types being randomly allotted to adjacent pens. The nipple drinker used was an Edstrom Piglet Nipple (Avidity Science, Waterford, WI), and the cup drinker used was a Farmweld DRIK-O-MAT Wean-to-Finish Cup (Farmweld, Teutopolis, IL).

Ambient temperature in each room was maintained using heaters, evaporative cooling cells, and fan ventilation as needed. During the study period, room temperature averaged $28.4 \pm 1.40^\circ\text{C}$ and relative humidity averaged $30.3 \pm 5.81\%$. During the first 2 wk post-weaning, each pen was equipped with an infrared heat lamp suspended over an insulated mat. Management during the study period was according to standard unit protocols, which were in line with commercial practices. The facility was illuminated via ambient and artificial lighting. Security lighting was provided 24 h each day, with additional lighting provided while investigators were working with the animals. Natural light via windows was present during daylight hours. All scales used for measurement of pig weight were validated for accuracy using certified

check weights that approximated the expected weight of the pigs at the time of weighing.

Pigs had ad libitum access to standard corn-soybean meal-based diets formulated to meet or exceed [NRC \(2012\)](#) recommendations ([Table 1](#)); all diets were in meal form. Pigs had ad libitum access to water throughout the study period. Feeders and waterers were checked daily for proper function and cleaned as necessary. Pigs were checked twice daily, and any requiring intervention was treated in accordance with the recommendations of the attending veterinarian. No health challenges were experienced during the study period. Three pigs were removed from the study for morbidity or mortality. The causes of the losses, determined by the attending veterinarian, were not related to the study treatments.

MEASUREMENTS

Water disappearance was measured utilizing water flow meters (Assured Automation ½-inch water meter, model WMP-P-050; Assured Automation, Roselle, NJ). One meter was installed in the pipeline supplying water to the drinker in each pen. The reading on each meter was recorded once each day at 0700 h. All water meters were validated for accuracy at the start of and every second week during the study period. For this validation, a total of 22.7 liters of water was

Table 1. Ingredient and calculated composition of the diets used during the study period

Item	Dietary phase ^a			
	1	2	3	4
Ingredient, % of diet by weight				
Corn	30.76	46.84	57.4	69.41
Soybean meal (dehulled)	20.24	23.69	31.18	27.21
Dried whey	25.00	20.00	5.00	–
Lactose	10.00	–	–	–
Plasma	7.50	3.00	–	–
Fat	3.00	3.00	3.00	1.00
Limestone	1.14	1.09	0.90	0.96
Dicalcium phosphate	0.63	0.85	1.35	0.92
Antibiotics (ASP-250)	0.50	0.50	0.50	–
Antibiotics (Tylan)	–	–	–	0.05
Zinc oxide	0.40	0.26	–	–
Copper sulfate	–	–	0.08	–
Trace mineral salt	0.35	0.35	0.35	0.35
Salt	0.10	0.10	–	–
Vitamin premix	0.20	0.20	0.20	0.10
L-Lysine HCl (98%)	0.04	0.05	0.02	–
DL-Methionine (99%)	0.14	0.07	0.02	–
Total	100.00	100.00	100.00	100.00
Calculated composition				
Crude protein, %	21.10	20.00	20.20	18.50
Lysine, %	1.45	1.25	1.15	1.00
Available phosphorus, %	0.45	0.40	0.35	0.24
Calcium, %	0.85	0.85	0.80	0.61
Metabolizable energy, kcal/kg	3428	3414	3430	3370

^aPhase 1, fed during the first wk of study period; Phase 2, fed during weeks 2 and 3; Phase 3, fed during weeks 4 and 5; Phase 4, fed during week 6 (end of study period).

collected; 3.8 liters directly from the drinker and 18.9 liters from the water line between the meter and the drinker. Meter readings were taken at the start and end of the collection, and the difference between these readings was compared to the measured quantity of water collected. If the error (i.e., the difference between the meter readings and the amount of water collected) was greater than 5%, the meter validation procedure was repeated. If the error continued to exceed 5%, the meter was replaced and the validation procedure was carried out on the replacement meter.

Prior to the start of the study, the flow rate to each drinker was set according to manufacturer recommendations (0.7 liters/min for nipple drinkers and 1.0 liters/min for cup drinkers). In addition, the flow rate to each drinker was measured every 2 wk during the study period by collecting and measuring the amount of water delivered from each drinker over a 1-min period; flow rates were adjusted if needed.

The height of the cup drinkers was not adjustable and was set at the manufacturer's recommendations for wean-to-finish pigs (102 mm from the floor to the lip of the cup). Prior to the start of the study, the height of the nipple drinkers (distance from floor to lowest point of the drinker) was set at 50 mm above the shoulder height of the smallest pig in the pen, based on the recommendations of Li et al. (2005). Shoulder heights were calculated according to the equation of Petherick (1983): Shoulder height (mm) = $150 \times (\text{BW in kg})^{0.33}$. Drinker heights were adjusted for each pen every 2 wk during the study period based on the most recent pig weights.

Pigs were weighed using a digital scale (Digi-Star model SW4600EID scale; Digi-Star LLC, Fort Atkinson, WI; accurate to 0.2 kg) at the start (weaning; 21 d of age) and end (end of week 6 post-weaning) of the study and every 2 wk during the study. All additions of feed to the feeders were recorded, and feeders were weighed each time pig weights were collected to calculate feed disappearance.

STATISTICAL ANALYSIS

The pen of pigs was the experimental unit for all measurements. The PROC UNIVARIATE procedure of SAS (SAS Inst. Inc., Cary, NC) was used to verify normality and homogeneity of variances of the residuals. All variables conformed to the assumptions of normality and homogeneity and were analyzed using the PROC MIXED procedure of SAS as a randomized complete block design with repeated-measures (Littell et al., 1996). The model used accounted for the fixed effects of Drinker Type, week or 2-wk period, the interaction, and the random effect of block. A REPEATED statement was included for week or 2-wk period and pen was the subject term. For the REPEATED type, the TOEP(1) covariance structure was used as it resulted in the lowest (most favorable) BIC values. Differences between least-squares means were separated using the PDIFF option of SAS and were considered significant at $P \leq 0.05$ and were considered a trend or tendency at $P \leq 0.10$. P -values were adjusted using a Tukey's adjustment for multiple comparisons.

In addition, regression analyses were conducted to determine the change in average daily water disappearance (ADWD) with increases in either days post-weaning or BW, and the change in water:feed disappearance ratio with increases in BW. The PROC REG procedure of SAS was used, with models including Drinker Type as a categorical independent variable, and days post-weaning or BW as the independent variable

(as first-, second-, and third-order terms) and all interactions with Drinker Type. Second- and third-order terms and the interactions with Drinker Type were removed from the model if the P -values exceeded 0.10.

RESULTS AND DISCUSSION

Least-squares means for the effect of Drinker Type on growth performance and water disappearance of pigs from weaning to 6 wk post-weaning are presented in Table 2. There was no effect ($P > 0.05$) of Drinker Type on BW, average daily gain (ADG), average daily feed disappearance (ADFD), or gain to feed ratio (G:F) for the overall study period or any of the interim periods. However, pigs on the Nipple compared to the Cup treatment had greater ($P < 0.05$) ADWD for the overall study period and all interim 2-wk periods (Table 2). Similarly, water:feed disappearance ratio (W:F) was greater ($P < 0.05$) for the Nipple than the Cup treatment for the first 2 wk and the overall study period, and there was a tendency ($P = 0.09$) for this measurement to be greater in the period from weeks 2 to 4 of the study (Table 2).

Relatively, few studies have evaluated the effects of drinker type on the growth performance for nursery pigs, and the majority of these studies compared nipple and bowl drinkers. Bowls provide a reservoir of water for the pigs to drink from and, in that respect, can be considered to be similar to the cup drinker used in the current study. The majority of studies comparing nipples and bowls found similar results to those of the current study, with no effect of these drinker types on pig growth performance (Phillips and Phillips, 1999; Magowan et al., 2007; Torrey et al., 2008). In contrast, Bøe and Kjelvik (2011) reported that ADG was greater (16%) for nursery pigs, given access to a nipple compared to a bowl drinker. However, that study was carried out over a relatively short time period (14 d) in pigs weaned at 32 to 35 d of age, and there was no effect of drinker type on ADFD or G:F. Gill (1989) also found that, compared to a bowl drinker, nursery ADG was greater with a nipple drinker of one design but not of three other designs. Collectively, the results of previous research and those of the current study suggest a limited effect on nursery growth performance of providing pigs weaned at 3 wk of age access to water from either a nipple, bowl, or cup drinker.

In the current study, overall ADWD was 18% lower for the Cup than the Nipple drinker (Table 2). Other studies that have compared similar drinker types have also found that water disappearance during the nursery period was greater from nipple drinkers than from bowls (Torrey and Widowski, 2006; Bøe and Kjelvik, 2011). However, some studies have shown that differences in water disappearance between nipples and bowls depend on the specific design of drinker as well as factors such as the location of the drinkers within the pen. For example, Gill (1989) found that water disappearance for nursery pigs (from 3 to 6 wk of age) from bowls was similar to that from three designs of nipple drinker but was 36% lower when compared with a fourth design of nipple drinker. Similarly, Magowan et al. (2007), in a study with nursery pigs from 4 to 10 wk of age, showed that differences in water disappearance between nipple and bowl drinkers depended on the design of the nipple drinker in question, as well as the drinker placement. With two drinkers of the same design in each pen, water disappearance was lower for bowls compared to nipples when the bowls were located 2 m apart, but not

Table 2. Least-squares means for the effect of Drinker Type on growth performance and water disappearance of nursery pigs

Item	Drinker Type ^a		SEM	P-value
	Nipple	Cup		
Number of pens	8	8	–	–
Number of pigs	168	168	–	–
Live body weight, kg				
Start of test (weaning)	6.1	6.1	0.06	0.99
End of week 2 post-weaning	8.2	8.1	0.11	0.39
End of week 4 post-weaning	13.6	13.4	0.21	0.51
End of test (end of week 6 post-weaning)	21.8	21.4	0.26	0.33
Average daily gain, kg				
Wk 1 and 2	0.18	0.17	0.011	0.44
Wk 3 and 4	0.39	0.38	0.011	0.70
Wk 5 and 6	0.59	0.57	0.011	0.39
Start to end of test	0.38	0.37	0.006	0.25
Average daily feed disappearance, kg				
Wk 1 and 2	0.24	0.24	0.018	0.83
Wk 3 and 4	0.63	0.61	0.018	0.35
Wk 5 and 6	1.02	1.02	0.018	0.75
Start to end of test	0.63	0.62	0.012	0.40
Gain:Feed ratio, kg:kg				
Wk 1 and 2	0.724	0.695	0.0187	0.28
Wk 3 and 4	0.610	0.620	0.0187	0.71
Wk 5 and 6	0.571	0.560	0.0187	0.67
Start to end of test	0.635	0.625	0.0108	0.52
Average daily water disappearance, liters				
Wk 1 and 2	1.61	1.09	0.182	0.01
Wk 3 and 4	2.87	2.32	0.182	0.01
Wk 5 and 6	3.74	3.33	0.182	0.05
Start to end of test	2.74	2.25	0.139	0.0001
Water:Feed disappearance ratio, liters:kg				
Wk 1 and 2	7.71	5.73	0.346	<0.0001
Wk 3 and 4	4.55	3.88	0.346	0.09
Wk 5 and 6	3.43	3.05	0.346	0.34
Start to end of test	5.23	4.22	0.263	<0.0001

^aNipple, the water source within the pen was a nipple drinker; Cup, the water source within the pen was a cup drinker.

when they were located side-by-side in the pen. Magowan et al. (2007) suggested that this result was likely due to differences in pig behavior and associated water wastage.

In contrast to most other studies, Phillips and Phillips (1999) found that pigs given access to bowls that were cleaned daily had greater water disappearance in the first 4 d after weaning (approximately 15%) than those given access to nipples. However, in that study, water disappearance was lower (by approximately 8%) for bowls that were not cleaned compared to those that were. This highlights one of the potential problems with bowls, in that they can become contaminated with excreta or feed, which could limit water intake. It is clear that the effect of drinker type on water disappearance could

depend on the specific designs of the drinker types evaluated as well as factors such as the placement of the drinkers in the pen and the cleanliness of the bowls. However, there has been no systematic evaluation of the effect of these factors on water disappearance.

In the current study, growth performance was similar for the Nipple and the Cup treatments, which suggests that the difference in ADWD between these treatments was most likely due to greater water wastage for the nipple drinkers. The relatively limited number of studies that have measured water wastage in the nursery period have generally found that levels are greater for nipple than bowl drinkers. However, these studies have also shown that wastage can be relatively high for both drinker types, and, in addition, estimates of the amount of wastage vary considerably among studies. Phillips and Phillips (1999) found that water spillage on day 4 after weaning from nipples accounted for 57% of water disappearance compared to 19% and 39% for two different designs of bowls. Wang et al. (2017) reported that wastage for bowls, bite nipples, and swing nipples was 15%, 25%, and 18% of water disappearance, respectively. Torrey et al. (2008) also found that water wastage was greater for nipples than bowls; however, the relative difference varied depending on the design of the bowl (19%, 39%, and 56% for push-lever bowl, float bowl, and nipples, respectively). These results suggest that the specific design of the drinker can be as important as drinker type in determining water wastage.

One factor that can influence the extent of water wastage and, therefore, estimates of disappearance is the water flow rate to the drinker. The flow rates used in the current study (1.01 ± 0.124 and 0.87 ± 0.269 liters/min for Cup and Nipple drinkers, respectively) were in accordance with the manufacturers' recommendations, and within the range recommended for nursery pigs (Patience, 2012b), but were relatively high compared to those used in most other studies. However, the only studies that have evaluated the effect of flow rate on water disappearance have been carried out with nipple-type drinkers. Nienaber and Hahn (1984), in a study carried out over a 4-wk period with pigs weaned at 4.5 wk of age, found that water disappearance from nipple drinkers increased from 1.57 to 5.20 liters/d as flow rates increased from 100 to 1,100 mL/min, with no effect on growth performance. On this basis, the authors suggested that increasing flow rate increased water wastage but not intake. Similarly, Barber et al. (1989) found that water disappearance from nipple drinkers over a 3-wk period following weaning at 21 d of age increased from 0.78 to 1.63 liters/d with increases in flow rate from 175 to 700 mL/min. However, in that study feed intake and growth rate increased with flow rates between 175 and 450 mL/min, suggesting that the increase in water disappearance across this range was due, at least in part, to greater water intake.

Barber (1992) suggested that recommendations for water flow rates are not generally based on the results of research but rather on subjective observation. Unfortunately, this situation has not changed; the limited number of studies with nipple drinkers summarized above have produced contradictory results, and there are no published studies with other drinker types such as bowls. In addition, suggested water flow rates differ considerably between commercial designs of the same drinker type (Schulte et al., 1990; Magowan et al., 2007). Further research is needed to clarify the relationship

between water flow rate and water consumption and wastage for the range of drinker types available to the industry.

The regression relationship between ADWD (as the dependent variable) and either days post-weaning or BW (as independent variables) for the Drinker Type treatments are presented in Figure 1a and b, respectively. Quadratic regression equations provided the best fit for both relationships. The intercepts for the regression of ADWD on both days post-weaning and BW differed ($P < 0.05$) between Drinker Types by 0.42 and 0.48 liters/d, respectively (Figure 1a and b). However, the linear and quadratic terms did not differ ($P > 0.05$) between Drinker Types for either of these relationships. This suggests that the rate of increase in ADWD with either days post-weaning or BW was similar for the two Drinker Types, but that the difference between Nipple and Cup drinkers remained relatively consistent throughout the nursery period. As previously discussed, the most likely reason for the difference between the drinker types in ADWD was greater water wastage for the nipple drinkers. The similar rate

of increase in ADWD with time and BW for the two Drinker Types implies that the difference in water wastage between the nipple and cup drinkers remained relatively constant over the study period.

Relatively few studies have evaluated changes in water disappearance with increases in time or BW post-weaning. Gill (1989), in a study carried out over a 3-wk period from weaning at 21 d of age, reported a linear increase in water disappearance with days post weaning of between 0.06 and 0.08 liters/d per day and with BW of between 0.17 and 0.34 liters/d per kg. In a similar study, Barber (1992) reported a linear increase in water disappearance with days post weaning of 0.05 liters/d per day. In addition, Laitat et al. (1999), in a study carried out from 6 wk of age to a final live weight of 21 to 27 kg, reported linear increases in water disappearance with days on test of between 0.04 and 0.10 liters/d per day. In the current study, the linear regression of ADWD on days post-weaning and BW (which resulted in relatively high R-squared values of 0.85 and 0.81, respectively) was 0.08 liters/d per

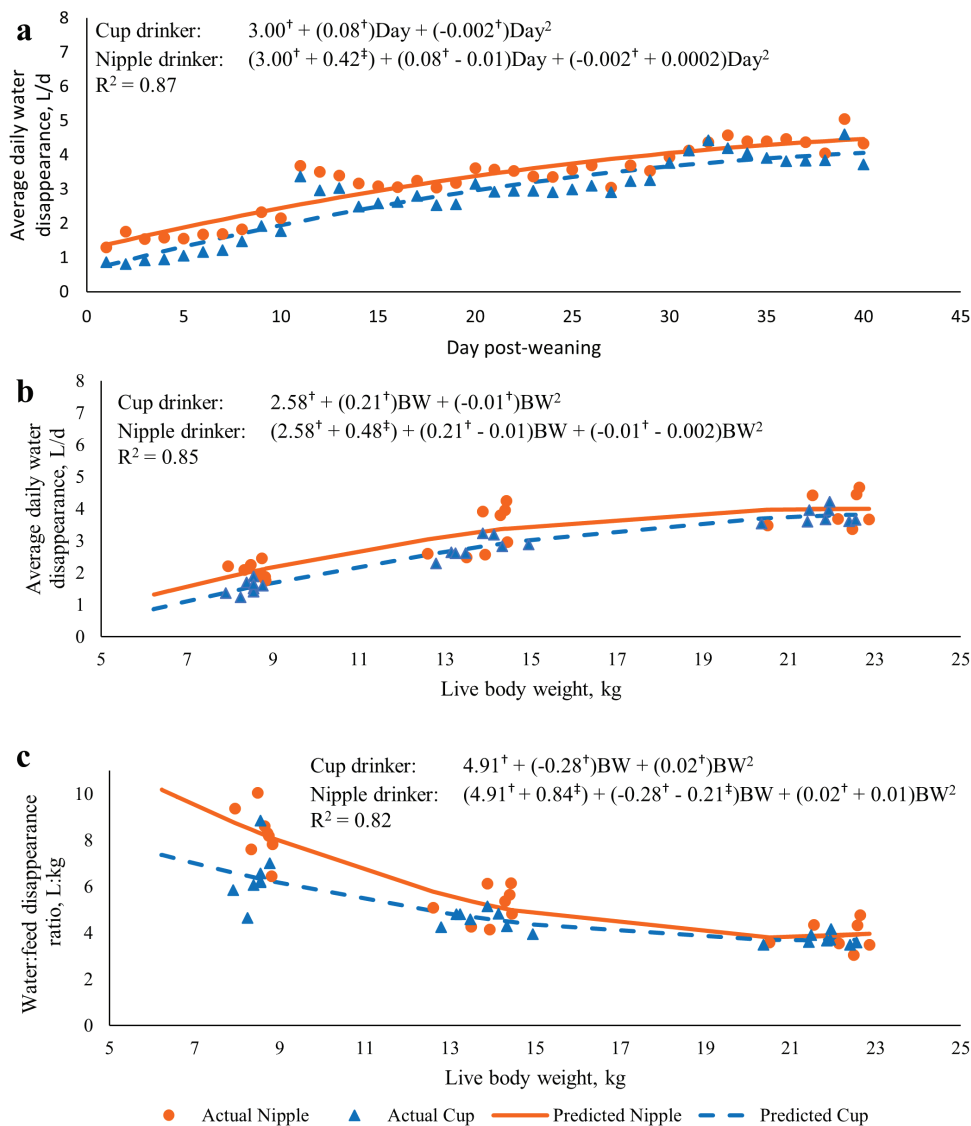


Figure 1. Regression relationships for the Drinker Types¹ between (a) days post-weaning and average daily water disappearance, (b) pig live weight and average daily water disappearance, and (c) pig live weight and water:feed disappearance ratio. ¹Nipple = the water source within the pen was a nipple drinker; Cup = the water source within the pen was a cup drinker. [†]Indicates that the regression coefficient is different ($P \leq 0.05$) to zero. [‡]Indicates that the regression coefficient adjustment is different ($P \leq 0.05$) to zero.

day and 0.19 liters/d per kg, respectively. These estimates are relatively similar to the values reported in the literature discussed above. The rate of increase in water disappearance with either time or BW post-weaning can be affected by factors such as drinker type (Gill, 1989), feed form (pellets compared to meal; Laitat et al., 1999), and the number of pigs in a group (Laitat et al., 1999), as well as by the age and weight range over which water disappearance is measured. In addition, there is evidence that water disappearance can be greater in the first few days after weaning than for the remainder of the first week (Brooks et al., 1984; Torrey et al., 2008). However, Gill (1989) found that water intake in the first 24 h after weaning was lower than subsequently. These contradictory results highlight that changes in water disappearance of pigs during the nursery period are multifaceted and poorly understood.

The quadratic relationship between W:F and BW for the two Drinker Type treatments is illustrated in Figure 1c. The regression curves for the drinker types differed ($P < 0.05$) in intercept and for the linear term, but not ($P > 0.05$) for the quadratic terms. For both Drinker Types, W:F decreased as BW increased; however, the rate of decrease was less at higher BW. In addition, the difference between the two Drinker Types decreased with BW. This is also illustrated by comparison of the treatment means for W:F (Table 2), which were greater ($P < 0.05$) for the Nipple than the Cup treatment during the first 2 wk of the study period, tended ($P = 0.09$) to be greater in the weeks 2 to 4 period, but were not different ($P > 0.05$) in the final 2-wk period. Previous studies have also generally found that W:F decreases with increases in BW; however, absolute values for W:F ratio and for the change with time post-weaning have varied considerably among studies (Gill, 1989; Laitat et al., 1999; Bøe and Kjelvik, 2011). Differences in estimates of W:F are likely due to variation among studies for factors such as pig age and weight, drinker design (Gill, 1989; Magowan et al., 2007), water flow rate (Barber et al., 1989), and diet composition (Brooks et al., 1984). In addition, W:F immediately after weaning may be greater due to the relatively low feed intake that is characteristic of newly weaned pigs (Dong and Pluske, 2007). Relatively high water intake has also been reported in pigs immediately after weaning in a number of studies, particularly for pigs with access to nipples (Torrey and Widowski, 2004). This may be due to the transition from a liquid to a solid diet, and the ingestion of water instead of feed.

In conclusion, this study compared two drinker designs that are commonly used in the commercial swine industry and demonstrated that water disappearance of nursery pigs is greater for nipple than cup drinkers. Relationships were also developed for the two drinker types that can be used to estimate water disappearance for time periods and weight ranges during the nursery period. However, comparison of the results of this study with those of others, most of which were carried out a number of years ago, has also highlighted the considerable variation in estimates of water disappearance. Given the paucity of research in this critical area, there is a need for a systematic evaluation of water intakes in nursery pigs and of the major factors that influence this.

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Conflict of interest statement

The authors declare no real or perceived conflicts of interest.

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