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INFLUENCE OF ORGANOLEPTIC PROPERTIES OF THE FEED AND NURSERY DIET COMPLEXITY ON PREWEANING AND NURSERY PERFORMANCE[1]

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Summary

Two experiments were performed to determine the effects of adding an enhanced feed flavor to the creep feed on the proportion of piglets consuming creep feed within litters and preweaning performance (Exp. 1) and the interactive effects of preweaning exposure to the flavor, nursery diet complexity, and flavor addition to nursery diets on postweaning performance (Exp. 2).

In Exp. 1, 50 sows (PIC 1050) were blocked according to parity and date of farrowing and allotted to 2 experimental treatments in a randomized complete block design. Treatment 1 was a creep diet with no flavor (negative control), and treatment 2 was the negative control diet with the enhanced milky flavor (Luctarom) included at 1,500 ppm (3 lb/ton). Both creep diets contained 1.0% chromic oxide and were offered ad libitum from d 18 until weaning on d 21. In Exp. 2, 480 weanling pigs (PIC, 14.5 lb and 20 ± 2 d) from Exp. 1 were blocked by initial weight and allotted to 1 of 8 treatments in a randomized complete block design with preweaning exposure to the flavor (exposed vs. unexposed), nursery diet complexity (complex vs. simple), and flavor addition to the nursery diets (with vs. without flavor) as treatment factors.

In Exp. 1, no differences in weaning weight ($P > 0.53$), total gain ($P > 0.77$), and ADG ($P > 0.77$) were observed between litters or pigs fed creep with and without the flavor. Flavor added to the creep feed did not influence total ($P > 0.66$) or daily ($P > 0.66$) creep feed intake of litters or the proportion of creep feed eaters ($P > 0.41$) in whole litters. In Exp. 2, a tendency for a 3-way interaction for ADG from d 5 to 10 ($P < 0.11$), d 10 to 28 ($P < 0.09$), and d 0 to 28 ($P < 0.06$) was observed. Postweaning ADG of pigs exposed to the flavor in creep feed and pigs fed flavored complex diets was greater than that of pigs in any other treatment combination. Increasing diet complexity improved ($P < 0.01$) ADG and ADFI during both phases. Adding flavor in the creep feed had no effect on F/G ($P > 0.34$) and pig BW ($P > 0.45$) in both periods postweaning. Adding Luctarom to starter diets tended to improve ADFI ($P < 0.06$) during d 0 to 5.

In conclusion, adding Luctarom to the creep feed did not affect litter creep feed intake, proportion of piglets consuming creep feed, and preweaning performance when creep was provided for 3 d before weaning. Preweaning exposure to Luctarom improved postweaning daily gain of pigs fed complex diets supplemented with the same flavor but did not influence performance of pigs fed simple diets.

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Introduction

Maximizing pig performance immediately postweaning is essential in improving lifetime growth efficiency and productivity. The weaning event, however, is usually characterized by a period of low feed intake caused by physical, physiological, and behavioral challenges that typically affect postweaning growth rates. Recent studies on creep feeding have shown that "eaters," which are piglets in a litter positively consuming creep feed, have better initial postweaning feed intake and growth performance than piglets that do not consume creep feed. Increasing creep feed consumption and the proportion of piglets consuming creep feed in whole litters may elicit positive effects on nursery performance. Nondietary factors, such as creep feeding duration and creep feeder type, have been shown to affect the proportion of creep feed eaters within a litter. Dietary factors can be investigated by using this model.

Organoleptic properties of feed may be a factor in improving the proportion of piglets consuming creep feed. Feed flavors are commonly used in piglet diets to improve diet acceptance and stimulate intake; however, the proportion of the litter actually consuming creep feed with the flavor or whether there is a difference in the proportion of creep feed eaters created compared with an unflavored creep diet have not been determined. Preweaning exposure to the flavor may also enhance postweaning responses when the same flavor is added to the nursery diets; however, evidence of this in piglets is limited. Some studies have shown an innate preference for flavored diets during changes in dietary regimes, especially at weaning or during the starter period. Reducing differences in performance between pigs fed complex and simple nursery diets through the use of feed flavors may have potential economic benefits.

Therefore, the objectives of this study were to determine (1) the effects of organoleptic properties of feed with an enhanced flavor (Luctarom) on the proportion of creep feed eaters within a litter and preweaning performance (Exp. 1), (2) the effects of diet complexity (complex vs. simple) on response to the inclusion of an enhanced flavor in nursery pig performance (Exp. 2), and (3) the effects of preweaning exposure to the enhanced flavor and flavor addition to nursery diets on postweaning performance (Exp. 2).

Procedures

Experiment 1. A total of 50 sows (PIC 1050) and their litters were used in this study conducted at the Kansas State University Swine Research and Teaching Center farrowing facility. Sows used in this experiment were from 2 batches of sows farrowed in November and December 2007; 25 experimental sows from each batch were included in the study. Sows were blocked according to parity and date of farrowing and allotted to 2 experimental treatments in a randomized complete block design. Cross-fostering was performed within 48 hours postfarrowing to standardize litter weights and litter size (> 10 pigs). The sow or litter was the experimental unit; there were 25 replicates per treatment group.

There were 2 experimental diets in this study. Treatment 1 was a creep diet with no flavor (negative control), and treatment 2 was the negative control diet with the enhanced milky flavor (Luctarom) included at 1,500 ppm (3 lb/ton). Both creep diets were formulated to contain 1,586 kcal ME/lb and 1.56% standardized ileal digestible (SID) lysine (Table 1). Chromium oxide was added to both diets at 1.0% to serve as a fecal marker. The creep diets were in pellet form (2-mm pellets) and offered ad libitum from d 18 until weaning on d 21. A single lactation diet (1,585 kcal ME/lb, 0.97% SID lysine) was used in the experiment. Sows were allowed free access to feed throughout lactation. Water was made available at all times for sows and their litters through nipple drinkers and bowls, respectively.

Table 1. Composition (as-fed basis) of creep diet for Exp. 1[1]

Ingredient	%
Corn	6.05
Soybean meal (46.5% CP)	2.32
Spray-dried animal plasma	6.00
Select menhaden fish meal	6.00
Spray-dried whey	25.00
Lactose	5.00
Extruded soy protein concentrate	10.00
Pulverized oat groats	30.00
Choice white grease	5.00
Monocalcium phosphate (21% P)	0.35
Limestone	0.45
Salt	0.30
Zinc oxide	0.38
Vitamin premix	0.25
Trace mineral premix	0.15
L-Lysine HCl	0.15
DL-Methionine	0.15
Antibiotic	1.00
Acidifier	0.20
Vitamin E, 20,000 IU	0.05
Chromium oxide	1.00
Total	100.00
Calculated analysis	
SID[2] Lysine, %	1.56
SID Lysine:ME ratio, g/Mcal	4.47
SID Isoleucine:lysine ratio, %	0.59
SID Methionine:lysine ratio, %	0.31
SID Met & Cys:lysine ratio, %	0.57
SID Threonine:lysine ratio, %	0.62
SID Tryptophan:lysine ratio, %	0.19
SID Valine:lysine ratio, %	0.71
ME, kcal/lb	1,585
Protein, %	23.88
Total lysine, %	1.69
Ca, %	0.81
Available P, %	0.55
Lactose, %	23.00

[1] Supplemented without (Control) and with Luctarom at 1,500 ppm (3 lb/ton)
[2] Standardized ileal digestible.

Piglets were weighed individually at d 0 (birth), 18, and 21 (weaning). The amount of creep feed offered was weighed daily. Creep feed that was not consumed at the time of weighing was collected and weighed back. Fecal samples from all piglets were taken using sterile swabs twice between 3 and 12 h before weaning for all treatments. The color of each fecal sample was visually determined. Piglets were categorized as "eaters" when the fecal sample was colored green at least once on any of the two samplings. Piglets that tested negative on the first fecal sampling were resampled 9 to 12 h after the first sampling.

Sows were weighed postfarrowing and at weaning. Weekly feed intake of the sows was recorded to calculate total feed intake and ADFI. In this study, 1 sow from treatment 2 was removed from the test because of very low feed intake. General health of the piglets was checked daily, and use of medication was monitored. Temperature in the farrowing facility was maintained at a minimum of 20°C, and supplementary heat was provided to the piglets by using heat lamps when needed.

Periodic and cumulative ADG and creep feed intake were calculated for each treatment group. Data were analyzed as a randomized complete block design by using the PROC MIXED procedure of SAS. The effect of the enhanced milky flavor on percentage of eaters was analyzed by using the chi-square test in SAS.

Experiment 2. A total of 480 weanling piglets (PIC, initially 14.5 lb and 20 ± 2 d) from Exp. 1 were allotted and blocked by initial weight to 1 of 8 treatments as a 2 × 2 × 2 factorial using a randomized complete block design. Treatment factors were preweaning exposure to the flavor (exposed vs. unexposed to the flavor), nursery diet complexity (complex vs. simple diet phase feeding), and flavor addition to the nursery diets (with vs. without flavor). Each treatment had 6 pigs per pen and 10 replications (pens). Each pen contained 1 self-feeder and 1 nipple drinker to provide ad libitum access to feed and water. Pigs were housed in the Kansas State University Swine Teaching and Research Center nursery facilities.

Experimental diets were the combinations of either complex or simple and with or without the flavor for both phases (Table 2). For phase 1, simple diets were mainly composed of cornmeal and soybean meal with 2.5% fish meal and 10% dried whey. The complex diets contained 30% pulverized oat groats, 25% dried whey, 6% spray-dried porcine plasma, 6% fish meal, and lower levels of cornmeal and soybean meal. Lactose content was 7.2 and 18% for the simple and complex diet, respectively. For phase 2, the simple diet was mainly cornmeal and soybean meal. The complex diet was also composed of cornmeal and soybean meal but also contained 4.5% fish meal and 10% dried whey. The simple and complex diet contained 0 and 7.2% lactose, respectively. For both phase 1 and 2 diets, the simple and complex diets were isocaloric and were formulated to the same essential amino acid specifications (NRC, 1998). Diets with the flavor were supplemented with Luctarom at 1,500 ppm (3 lb/ton) in phase 1 diets and 1,000 ppm (2 lb/ton) in phase 2 diets. Phase 1 diets were in pellet form and fed from d 0 to 10. Phase 2 diets were in meal form and fed from d 11 to 28. Pigs and feeders were weighed on d 5, 10, and 28 following weaning to calculate ADG, ADFI, and F/G. Results were analyzed as a randomized complete block design with a 3-way factorial treatment structure by using the PROC MIXED procedure of SAS with pen as the experimental unit. Least squares means were evaluated by using the PDIFF and STDERR options of SAS and adjusted using the Tukey test.

Results and Discussion

Experiment 1. Performance of lactating sows used in this study is shown in Table 3. Sows had an average parity of 2.3 ± 0.3 and lactation length of 20.5 ± 0.3 d. There were no differences in postfarrowing weight ($P > 0.88$), weaning weight ($P > 0.80$), and lactation weight loss ($P > 0.17$) between the treatments. Likewise, litter size after fostering, at d 18, and at weaning were similar ($P > 0.50$) between the two treatments. There were also no differences ($P > 0.68$) between treatments in total and ADFI of sows throughout lactation.

Overall, differences in litter weaning weights ($P > 0.94$), total gain ($P > 0.77$), and daily gain ($P > 0.77$) between litters fed creep with and without the enhanced milky flavor were not significant (Table 4). For individual pigs, differences in weaning weight ($P > 0.53$), total gain ($P > 0.89$), and ADG ($P > 0.89$) between the two treatments were also not significant. Likewise, addition of the enhanced milky flavor to the creep feed did not influence total ($P > 0.66$) or daily ($P > 0.66$) creep feed intake of litters (Figure 1) or the proportion of creep feed eaters ($P > 0.41$) in whole litters (Figure 2).

These results may be explained by (1) the duration of creep feeding, (2) the maximum proportion of creep feed eaters within litters, and (3) the role of feed flavors in diets of suckling pigs. The duration of creep feeding may be important, and a minimum period of exposure to the flavor is required to see appreciable effects. However, our previous study on varying creep feeding durations showed that creep feed intake is more related to the maturity of piglets than to the period of induction of creep feeding. More importantly, most U.S. pig producers provide supplemental feed for only 2 to 7 d prior to weaning; thus, any effect of flavor addition should be observed in a short feeding duration. It is still undetermined whether dietary changes can increase the proportion of piglets consuming creep feed over the rate determined in previous studies. The highest rate of creep feed eaters achieved in our previous studies was 70% when non-dietary factors were manipulated. Any effect of dietary factors on the proportion of piglets consuming creep feed remains to be demonstrated.

Results may also be due to the role taste and olfactory cues play in stimulating higher intakes by suckling pigs. Few studies have evaluated the effect of feed flavors on stimulating creep feed consumption; most have evaluated flavor exposure prenatally or flavors through the lactation feed. Some of these studies suggest that creep feed consumption can be stimulated when piglets are acquainted with specific flavors associated with the sow's milk or diet. When flavors are added to the creep feed, results have been consistent. In one study, the addition of 5 g/kg of monosodium L-glutamate (MSG) to the creep feed led to a significant increase in creep feed intake from d 18 postfarrowing; however, no differences in weaning weights were observed despite the increase in intake. Monosodium L-glutamate is the principal source of the umami taste, which increases the intensity and acceptability of inherent flavors of food. In a follow-up study, addition of MSG to an associated commercial flavor in the creep feed did not elicit any effect on creep feed intake or preweaning performance. Results of the current study agree with these previous findings.

The lack of effect in suckling pigs may suggest age-related differences or greater individual variation in palatability perception. In a previous creep feeding study, increased physiological need for nutrients driven by restricted feeding of lactating sows did not stimulate litters to consume more creep feed or increase the proportion of creep feed eaters. This suggests that changing the flavor properties of the creep feed may not be sufficient to positively affect preweaning feed intakes.

In conclusion, addition of the enhanced milky flavor to the creep feed did not affect litter creep feed intake, the proportion of piglets consuming creep feed, or preweaning performance. The benefits of flavor addition preweaning should be assessed on the basis of effects on postweaning intake and performance.

Experiment 2. The interactive and main effects of flavor in the creep diet, diet complexity, and flavor in the nursery diets on postweaning performance are shown in Tables 5 and 6, respectively. Results showed tendencies for a 3-way interaction for daily gains from d 5 to 10 ($P < 0.11$), d 10 to 28 ($P < 0.09$), and d 0 to 28 ($P < 0.06$). No 3-way interaction was observed for pig weights ($P > 0.13$), daily feed intake ($P > 0.27$), or F/G ($P > 0.13$) in any period. Generally, postweaning ADG of pigs exposed to the flavor in creep feed and fed flavored complex diets was greater than that of pigs fed any other treatment.

Increasing diet complexity improved ($P < 0.01$) ADG and ADFI during both phases (Table 6). Pigs fed starter diets with greater complexity were heavier ($P < 0.0001$) than pigs fed simple diets at d 5 (+0.8 lb), 10 (+1.5 lb) and 28 (+3.3 lb). Feed efficiency was also improved ($P < 0.0001$) in pigs fed complex diets from d 0 to 5 and d 0 to 10 but not from d 5 to 10 ($P > 0.58$). However, pigs fed complex diets were less (6.0%; $P < 0.0001$) efficient from d 10 to 28 than pigs fed the simple diets. Overall (d 0 to 28), pigs fed the diets with greater complexity had poorer (2.3%; $P < 0.0001$) F/G than pigs fed simple diets.

These results agree with previous studies evaluating the effects of diet complexity on weanling pigs. Most previous studies showed marked improvements in early postweaning ADG, ADFI, and F/G when pigs were fed diets with greater complexity. However, the effect of diet complexity on pig growth and efficiency decreases with increasing time postweaning, which may help explain the poorer feed efficiency from d 10 to 28 observed in this study for pigs fed the complex diets. Though some studies have demonstrated the ability of certain feed flavors to mask less palatable ingredients, the negative effect of feeding the simple diets seen in this study may be too great for the effect of flavor to overcome. However, the benefit of feeding starter diets with greater complexity on weanling pig performance should be weighed against the additional feed consumption and the higher unit cost of the feed.

Exposing pigs to Luctarom in the creep feed did not affect daily gains ($P > 0.27$), feed efficiency ($P > 0.40$), or pig weights ($P > 0.45$) in all periods postweaning. Daily feed intake was also unaffected ($P > 0.29$), except for d 5 to 10 when pigs exposed to the flavor preweaning tended to have lower ($P < 0.07$) daily feed intake than unexposed pigs. Supplementing the starter diet with the enhanced flavor tended to improve daily feed intake (5.9%; $P < 0.06$) and numerical differences in daily gains (6.3%; $P < 0.15$) during d 0 to 5. However, no differences in daily gain ($P > 0.20$), daily feed intake ($P > 0.42$), or feed efficiency ($P > 0.35$) were observed between pigs fed starter diets with and without the flavor in all succeeding periods. Pig weights were also unaffected ($P > 0.35$) by flavor addition in all periods.

These results show that the addition of flavor in the nursery diet helped achieve modest gains in feed intake and weight gains early postweaning; however, the benefit of flavor addition was not seen throughout the rest of the starter period. In one recent study, addition of the enhanced milky flavor to the starter diet improved daily gains and feed intake numerically only in one trial; another study showed a significant improvement compared with pigs fed unflavored diets during d 0 to 14. Overall (d 0 to 28), both of the previous trials showed higher daily gains for weanling pigs when the enhanced milky flavor was added to nursery diets, which is in contrast to the result of the current study. This suggests that the effect of the enhanced milky flavor is variable and may depend on the composition of the diet

In conclusion, preweaning exposure to Luctarom improved postweaning daily gains and feed intake of pigs fed complex diets supplemented with the same flavor but did not influence performance of pigs fed simple diets.

Table 2. Composition (as-fed basis) of phase 1 and 2 diets for Exp. 2

	Phase 1 diets[1]		Phase 2 diets[2]	
Ingredient, %	Simple	Complex	Simple	Complex
Corn	42.40	11.60	57.75	54.40
Soybean meal (46.5% CP)	35.90	13.25	36.70	26.50
Spray-dried animal plasma	---	6.00	---	---
Select menhaden fish meal	2.50	6.00	---	4.50
Spray-dried whey	10.00	25.00	---	10.00
Pulverized oat groats	---	30.00	---	---
Soybean oil	5.00	5.00	1.00	1.00
Monocalcium P (21% P)	1.45	0.20	1.60	0.75
Limestone	0.60	0.58	0.95	0.65
Salt	0.30	0.25	0.35	0.30
Zinc oxide	---	0.38	---	0.25
Vitamin premix	0.25	0.25	0.25	0.25
Trace mineral premix	0.15	0.15	0.15	0.15
L-Lysine HCl	0.33	0.20	0.30	0.30
DL-Methionine	0.20	0.17	0.14	0.15
L-Threonine	0.15	0.05	0.11	0.13
Neo-terramycin	0.70	0.70	0.70	0.70
Acidifier	---	0.20	---	---
Choline chloride	0.05	0.05	---	---
Total	100.00	100.00	100.00	100.00
Calculated analysis				
SID[3] Lysine, %	1.51	1.51	1.35	1.35
SID Lysine:ME ratio, g/Mcal	4.29	4.25	4.06	4.05
SID Isoleucine:lysine ratio, %	60	55	63	59
SID Leucine:lysine ratio, %	116	112	127	122
SID Methionine:lysine ratio, %	36	33	33	36
SID Met & Cys:lysine ratio, %	58	58	58	58
SID Threonine:lysine ratio, %	62	62	62	62
SID Tryptophan:lysine ratio, %	17	18	18	17
SID Valine:lysine ratio, %	65	68	69	66
ME, kcal/lb	1,596	1,613	1,508	1,513
CP, %	23.6	23.1	22.4	21.4
Total lysine, %	1.66	1.66	1.49	1.48
Ca, %	0.84	0.84	0.80	0.80
Available P, %	0.52	0.52	0.42	0.42
Lactose, %	7.2	18.0	---	7.2

[1] Supplemented without (Control) and with Luctarom at 1,500 ppm (3 lb/ton); diets in pellet form.
[2] Supplemented without (Control) and with Luctarom at 1,000 ppm (2 lb/ton); diets in meal form.
[3] Standardized ileal digestible.

Table 3. Sow performance (Exp. 1)[1,2]

Treatment	Enhanced Flavor: No	Enhanced Flavor: Yes	SED[3]	Probability, $P <$
No. of litters	25	24	---	---
Average parity	2.3	2.3	0.3	0.94
Lactation length, d	20.7	20.4	0.3	0.35
Sow weight, lb				
Postfarrowing	525.7	528.6	19.2	0.88
Weaning	505.9	501.2	18.8	0.80
Change	-19.8	-27.7	5.6	0.17
No. of pigs/litter				
Postfostering	11.1	11.1	0.3	0.98
d 18 (start creep)	10.3	10.2	0.3	0.74
d 21 (weaning)	10.3	10.1	0.4	0.50
Lactation feed intake, lb				
Total	269	264	13.3	0.68
ADFI	13.0	13.0	0.7	0.94

[1] Two groups of sows (total = 50, PIC 1050) were blocked according to day of farrowing and parity and allotted to 2 treatments.
[2] Creep feed with 1.0% chromium oxide supplemented without (No) and with Luctarom (Yes) at 1,500 ppm (3 lb/ton); offered ad libitum from d 18 to weaning (d 20).
[3] Standard error of the difference.

Table 4. Effects of adding an enhanced flavor to the creep feed on pig and litter performance (Exp. 1)[1,2]

Treatment	Enhanced Flavor: No	Enhanced Flavor: Yes	SED[3]	Probability, $P <$
No. of litters	25	24	---	---
Pig weights, lb				
Postfostering	3.22	3.23	0.08	0.91
d 18 (start creep)	12.40	12.72	0.48	0.51
d 21 (weaning)	14.32	14.66	0.53	0.53
Total gain (d 18 to 21), lb	1.92	1.93	0.11	0.89
Daily gain (d 18 to 21), lb	0.64	0.64	0.04	0.89
Litter weights, lb				
Postfostering	33.8	33.2	1.4	0.65
d 18 (start creep)	127.6	127.4	6.4	0.97
d 21 (weaning)	147.2	146.7	7.1	0.94
Total gain (d 18 to 21), lb	19.6	19.3	1.1	0.77
Daily gain (d 18 to 21), lb	6.53	6.43	0.35	0.77

[1] Two groups of sows (total = 50, PIC 1050) were blocked according to day of farrowing and parity and allotted to 2 treatments.
[2] Creep feed with 1.0% chromium oxide supplemented without (No) and with Luctarom (Yes) at 1,500 ppm (3 lb/ton); offered ad libitum from d 18 to weaning (d 20).
[3] Standard error of the difference.

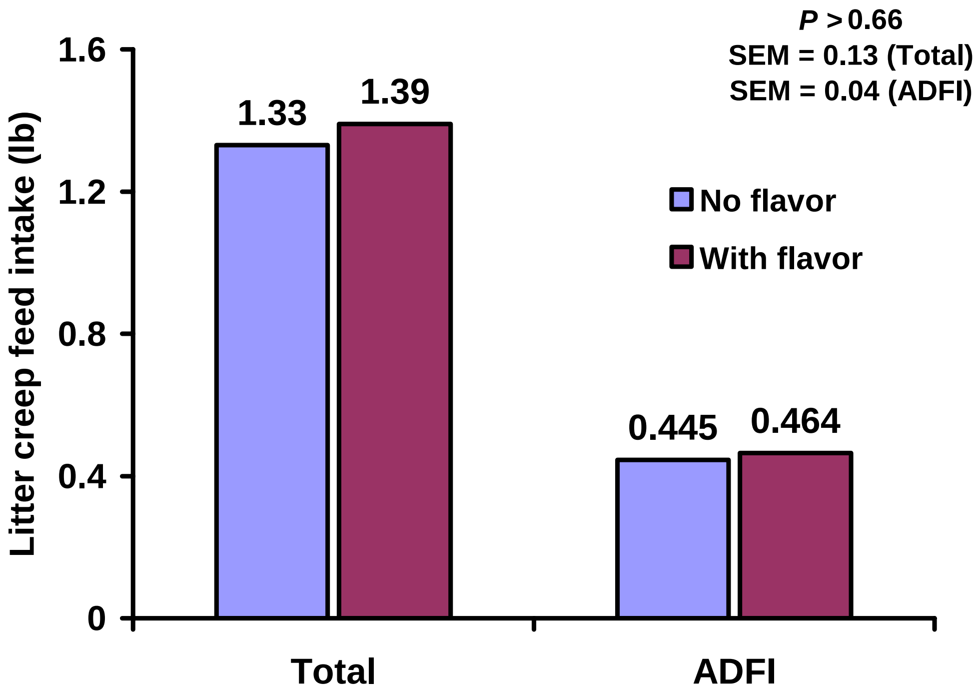

Figure 1. Total and daily creep feed intake of litters fed diets with and without an enhanced flavor.

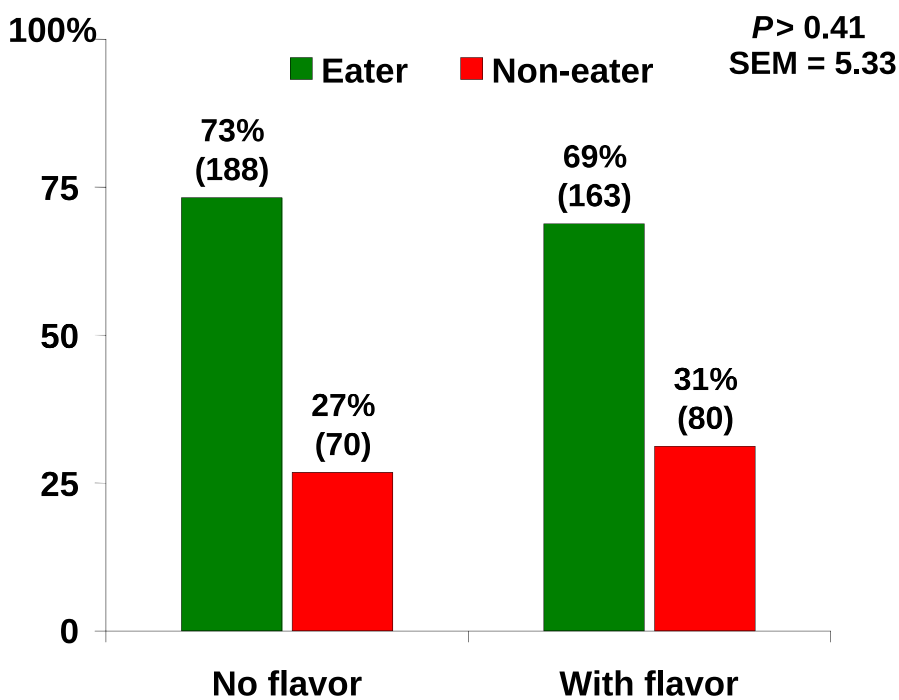

Figure 2. Effect of adding an enhanced flavor to the creep feed on the proportion of eaters in whole litters (no. of pigs in parentheses).

Table 5. Interactive effects of flavor in the creep diet, diet complexity, and flavor in the nursery diets on postweaning performance (Exp. 2)[1,2]

Flavor in creep	No				Yes					Probability, $P <$						
Diet complexity	Simple		Complex		Simple		Complex						Creep ×	Creep ×	Diet ×	Creep × Diet ×
Flavor in nursery	No	Yes	No	Yes	No	Yes	No	Yes	SED[3]	Creep	Diet	Nursery	Diet	Nursery	Nursery	Nursery
Pig weight, lb																
d 0	14.5	14.5	14.5	14.5	14.4	14.5	14.4	14.5	0.26	0.94	0.88	0.88	0.87	0.89	0.88	0.86
d 5	15.7	15.8	16.4	16.5	15.7	15.8	16.4	16.6	0.30	0.83	<0.0001	0.40	0.77	0.78	0.81	0.83
d 10	18.5	18.5	19.8	19.9	18.3	18.2	19.6	20.3	0.40	0.72	<0.0001	0.35	0.26	0.48	0.32	0.38
d 28	37.5	38.1	41.1	40.9	37.7	37.1	40.1	41.4	0.81	0.45	<0.0001	0.52	0.84	0.90	0.50	0.13
d 0 to 5																
ADG, lb	0.25	0.26	0.38	0.40	0.25	0.26	0.39	0.43	0.03	0.70	<0.0001	0.15	0.35	0.76	0.43	0.47
ADFI, lb	0.29	0.31	0.38	0.41	0.29	0.30	0.40	0.42	0.02	0.61	<0.0001	0.06	0.39	0.93	0.59	0.99
F/G	1.36	1.20	1.00	1.04	1.29	1.22	1.05	0.98	0.09	0.77	<0.0001	0.20	0.87	0.89	0.28	0.29
d 5 to 10																
ADG, lb	0.57	0.56	0.68	0.68	0.52	0.49	0.65	0.74	0.04	0.27	<0.0001	0.50	0.04	0.29	0.07	0.11
ADFI, lb	0.57	0.54	0.70	0.69	0.51	0.49	0.66	0.72	0.03	0.07	<0.0001	0.92	0.15	0.23	0.19	0.28
F/G	1.00	0.99	1.03	1.02	0.99	1.01	1.02	0.97	0.03	0.50	0.58	0.35	0.35	0.93	0.25	0.35
d 0 to 10																
ADG, lb	0.41	0.41	0.53	0.54	0.38	0.37	0.52	0.59	0.03	0.58	<0.0001	0.20	0.07	0.35	0.11	0.13
ADFI, lb	0.43	0.43	0.54	0.55	0.40	0.39	0.53	0.57	0.02	0.32	<0.0001	0.42	0.17	0.49	0.22	0.49
F/G	1.06	1.05	1.02	1.02	1.06	1.07	1.03	0.97	0.03	0.78	0.0008	0.35	0.27	0.49	0.23	0.13
d 10 to 28																
ADG, lb	1.06	1.09	1.18	1.16	1.08	1.05	1.14	1.17	0.03	0.57	<0.0001	0.96	0.80	0.90	0.99	0.09
ADFI, lb	1.42	1.43	1.66	1.62	1.41	1.40	1.58	1.63	0.05	0.32	<0.0001	0.88	0.81	0.50	0.94	0.27
F/G	1.34	1.32	1.40	1.40	1.30	1.34	1.38	1.40	0.03	0.44	<0.0001	0.65	0.87	0.14	0.90	0.48
d 0 to 28																
ADG, lb	0.82	0.84	0.95	0.94	0.83	0.81	0.92	0.96	0.03	0.48	<0.0001	0.63	0.68	0.74	0.57	0.06
ADFI, lb	1.07	1.07	1.26	1.25	1.05	1.05	1.21	1.26	0.04	0.29	<0.0001	0.72	0.90	0.43	0.80	0.27
F/G	1.29	1.27	1.32	1.32	1.26	1.29	1.31	1.30	0.02	0.40	0.004	0.93	0.53	0.30	0.77	0.24

[1] A total of 480 pigs (initial BW of 14.5 lb and 21 ± 2 d of age, PIC), with 6 pigs per pen and 10 replications per treatment.
[2] Diets provided without (No) and with (Yes) 1,500 and 1,000 ppm of Luctarom per ton of phase 1 (d 0 to 10) and phase 2 (d 10 to 28) diets, respectively.
[3] Standard error of the difference.

Table 6. Main effects of flavor in the creep diet, diet complexity, and flavor in the nursery diets on postweaning performance (Exp. 2)[1,2]

	Flavor in creep diet		Diet complexity		Flavor in nursery diets			Probability, *P* <						
	No	Yes	Simple	Complex	No	Yes	SED[3]	Creep	Diet	Nursery	Creep × Diet	Creep × Nursery	Diet × Nursery	Creep × Diet × Nursery
Pig weight, lb														
d 0	14.5	14.5	14.5	14.4	14.4	14.5	0.14	0.94	0.88	0.88	0.87	0.89	0.88	0.86
d 5	16.1	16.1	15.7	16.5	16.0	16.2	0.15	0.83	<0.0001	0.40	0.77	0.78	0.81	0.83
d 10	19.2	19.1	18.4	19.9	19.0	19.2	0.20	0.72	<0.0001	0.35	0.26	0.48	0.32	0.38
d 28	39.4	39.1	37.6	40.9	39.1	39.4	0.41	0.45	<0.0001	0.52	0.84	0.90	0.50	0.13
d 0 to 5														
ADG, lb	0.32	0.33	0.25	0.40	0.32	0.34	0.01	0.70	<0.0001	0.15	0.35	0.76	0.43	0.47
ADFI, lb	0.35	0.35	0.30	0.40	0.34	0.36	0.01	0.61	<0.0001	0.06	0.39	0.93	0.59	0.99
F/G	1.15	1.14	1.27	1.02	1.17	1.11	0.05	0.77	<0.0001	0.20	0.87	0.89	0.28	0.29
d 5 to 10														
ADG, lb	0.62	0.60	0.53	0.69	0.60	0.62	0.02	0.27	<0.0001	0.50	0.04	0.29	0.07	0.11
ADFI, lb	0.63	0.60	0.53	0.69	0.61	0.61	0.02	0.07	<0.0001	0.92	0.15	0.23	0.19	0.28
F/G	1.01	1.00	1.00	1.01	1.01	1.00	0.02	0.50	0.58	0.35	0.35	0.93	0.25	0.35
d 0 to 10														
ADG, lb	0.47	0.47	0.39	0.55	0.46	0.48	0.01	0.58	<0.0001	0.20	0.07	0.35	0.11	0.13
ADFI, lb	0.49	0.47	0.41	0.55	0.48	0.49	0.01	0.32	<0.0001	0.42	0.17	0.49	0.22	0.49
F/G	1.03	1.03	1.06	1.00	1.04	1.03	0.01	0.78	0.0008	0.35	0.27	0.49	0.23	0.13
d 10 to 28														
ADG, lb	1.12	1.11	1.07	1.16	1.11	1.11	0.02	0.57	<0.0001	0.96	0.80	0.90	0.99	0.09
ADFI, lb	1.53	1.51	1.41	1.62	1.52	1.52	0.03	0.32	<0.0001	0.88	0.81	0.50	0.94	0.27
F/G	1.37	1.35	1.32	1.40	1.36	1.36	0.01	0.44	<0.0001	0.65	0.87	0.14	0.90	0.48
d 0 to 28														
ADG, lb	0.89	0.88	0.83	0.94	0.88	0.89	0.01	0.48	<0.0001	0.63	0.68	0.74	0.57	0.06
ADFI, lb	1.16	1.14	1.06	1.24	1.15	1.15	0.02	0.29	<0.0001	0.72	0.90	0.43	0.80	0.27
F/G	1.30	1.29	1.28	1.31	1.30	1.29	0.01	0.40	0.004	0.93	0.53	0.30	0.77	0.24

[1] A total of 480 pigs (initial BW of 14.5 lb and 21 ± 2 d of age, PIC), with 6 pigs per pen and 10 replications per treatment.
[2] Diets provided without (No) and with (Yes) 1,500 and 1,000 ppm of Luctarom per ton of phase 1 (d 0 to 10) and phase 2 (d 10 to 28) diets, respectively.
[3] Standard error of the difference.