

## **The Effects of Feeding Ractopamine Hydrochloride To Show-type Gilts On Growth Characteristics and Reproductive Performance**

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### **ABSTRACT**

Often, the swine industry in Texas is re-populated each year with replacement gilts which were fed and shown for county livestock shows. During this time of feeding, many of these gilts have been fed additives to enhance muscle development for a market look in the show ring. However, there is limited data regarding the subsequent reproductive performance of these gilts. A study was conducted to evaluate subsequent reproductive performance in 40 show-type gilts fed Paylean during their finishing stage. Gilts were assigned to either control or treatment groups (18 g/ton; n=20 per treatment). Age at first estrus (n=34) was not affected by Paylean treatment. Services per conception (n=24) were 1.41 and 1.17 for control and Paylean treatments, respectively, and were not affected by treatment. Number of piglets born alive (10.5 and 7.3 for control and Paylean, respectively; n=21) and number of piglets weaned (9.5 and 6.8 for control and Paylean, respectively; n=21) were significantly greater for control than Paylean treatment ( $P<0.05$ ). Number of piglets born dead, average birth-weight, and twenty-one day piglet weight were not affected by treatment. These data are based on a small number of experimental units and further data is needed to verify the results.

**KEYWORDS:** Gilt, Ractopamine Hydrochloride (Paylean), Reproductive Performance, Piglet

### **INTRODUCTION**

Consumer demand for pork has never been higher and is continuing to rise. American producers have continued to incorporate high-quality management practices in order to maximize production. In Texas, some of these pigs being raised are sold for the

show ring, not commercial production. Show pigs are raised to compete in local, county, and state-wide stock shows. These swine are fed to market weight, exhibited and then harvested similar to commercial swine. Certain venues allow gilts to be exhibited and subsequently kept for breeding and reproductive purposes. These gilts are then used to produce barrows and gilts for shows in upcoming years. Thus, exhibitors and breeders strive to use above-average management practices and up-to-date technology to produce the winning show pig. The diet fed to finishing swine is a very important consideration to produce high quality lean pork. Studies continually test new feed additives, such as Paylean<sup>®</sup>, to promote leanness in swine. It is unknown whether this increased leanness will affect gilts that are kept to produce future show pigs.

Ractopamine Hydrochloride (Paylean<sup>®</sup>) is a  $\beta$ -adrenergic agonist that is marketed under the trade name of Paylean<sup>®</sup> (Elanco Animal Health, Indianapolis, IN). Paylean<sup>®</sup> has been shown to decrease fat deposition and increases lean muscle formation in swine (Watkins et al., 1990; Schinckel et al., 2002a; Mills et al., 2003). This repartitioning agent was first registered for commercial use as a feed additive for finishing swine only, by the United States Food & Drug Administration (FDA) in December 1999 (Sillence, 2003). Paylean<sup>®</sup> is chemically classified with compounds known as phenethanolamines (Watkins et al., 1990). Paylean<sup>®</sup> acts on target tissues with  $\beta$ -receptors to replicate the functions of naturally occurring catecholamine in the body of swine (He et al., 1992). This exogenous substance alters the manner in which nutrients are directed toward muscle enlargement and fat deposits (Watkins et al., 1990). Feeding Paylean<sup>®</sup> quickly results in increased retention of nitrogen, improved growth performance, increased feed efficiency, and increased lean carcass content (Crome et al., 1996; Stoller et al., 2003; Williams et al., 1994). Paylean<sup>®</sup> is commonly fed to finishing swine in confinement operations and to various types of show pigs, but is not approved for breeding animals. The feeding of Paylean<sup>®</sup> in Texas has become very prevalent in show-type hogs and especially show-type gilts that are exhibited in numerous local and county market swine shows. Many recent studies have proven that Paylean<sup>®</sup>, when fed at 10 to 20 ppm (9 to 18 grams/ton, respectively), has improved average daily gain (ADG), feed conversion efficiency, carcass leanness, and dressing percentage (Marchant-Forde et al., 2003; Watkins et al., 1990). The objective of this study is to compare the effects of Paylean<sup>®</sup> on growth characteristics and reproductive performance in show-type swine. Comparisons will be observed for weight gain, back fat, age at first estrus, conception rate, litter size, birth weights, litter size weaned, 21-day litter weights, and return to estrus after first weaning.

## MATERIALS AND METHODS

### Study Design

The study was conducted at the Tarleton State University Swine Center, Stephenville, Texas. Forty show-type, pre-pubertal cross-bred gilts (of Duroc, Yorkshire and Hampshire breeding) were selected for this experiment at random.

#### Gilt Selection

Selection of gilts was made based on structural soundness at 90 kg. Gilt soundness was visually scored on a scale of 1 to 5 with 5 being completely sound on their

feet and legs, and 1 being lame. Soundness scores were established by a committee of three experts. These individuals evaluated all gilts throughout the study and an average score from the committee was recorded. No gilts selected were lame or had a soundness score below 3.0. Gilts were randomly selected from the entire population of gilts of the proper size, age, and soundness and randomly assigned to either the treatment or control group.

#### **Study Replications**

Two replications of this study were conducted at different time periods. Thus, a 4 × 2 factorial design was utilized; comprising two pens of five gilts for each treatment group during each replication. The two trials spanned two 20-week periods. This time span incorporated the treatment period, breeding and farrowing of the gilts; and ended when the piglets were weaned and the sow was observed for estrus. In each replicate, females (n=20) were selected and assigned randomly to one of four fully slatted 10 ft × 30 ft pens. There were two pens of gilts assigned to each treatment group.

#### **Feeding and Weight Gain**

All gilts were fed a complete mixed diet (Table 1).

Table 1. Nutrient analysis of the complete feed ration (Dry matter basis)

Crude Protein, %	16.20
Calcium, %	1.10
Phosphorus, %	0.65
Fat, %	3.00
Lysine, %	0.96
Lysine g/day	12.00
Lys/ME ratio, g/Mcal	2.97

Beginning weights, lameness scores, and ultrasound backfat measurements were recorded when gilts averaged 200 lbs. The manufacturer recommends feeding Paylean<sup>®</sup> for 21 to 30 days prior to slaughter. In this study the gilts were representing show-type animals. The manufacturers recommended feeding levels of Paylean<sup>®</sup> is to substitute one-half pound of supplement that contains 18 grams/ton of Paylean<sup>®</sup> for one pound of feed. Control pens received 5 lbs. of feed per head per day for 21 days. Treatment pens received 4 lbs. with topdressing of 20 ppm (18 grams per ton) per day of Paylean<sup>®</sup>, as directed by labeling instructions, for 21 days. Pigs were fed in group pens to reflect commercial conditions. Treatment amount agreed with studies conducted by Watkins et al., (1990), Stites et al., (1991), Schinckel et al., (2003). The treatment groups received 4 lbs due to labeling recommendations, as well. Gilts were fed with ad libitum access to water. Weights, lameness, and backfat were again recorded at the end of the 21 day feeding period.

#### **Reproduction**

Estrus behavior was visually recorded twice daily after 21 days of treatment until breeding and subsequent pregnancy determinations were made. A mature boar was used to stimulate estrus behavior and detect standing heat. Gilts attain puberty at about 6 to 7 months of age (Tummaruk et al., 2000). Age at first estrus was recorded.

After sexual maturity was reached or approximately two heat cycles (Eliasson, 1991), gilts were artificially inseminated by an experienced technician during a selected two-week period that coincided with Tarleton's typical breeding schedule. Gilts were intended to be bred to farrow at one year of age. No gilts were bred on first estrus. All were inseminated on their second or third estrus cycle. No artificial hormones were used to induce estrus. Gilts were artificially inseminated using semen from boars at random. High quality boar semen was purchased from the same boar stud farm. Estrous behavior continued to be monitored. Remaining gilts were bred during the next breeding schedule, approximately one month later. Gilts were culled if they did not conceive after the second attempt to breed, or did not show any estrus.

## **Data Analysis**

### **Pre-Farrowing**

Gilts were weighed before and after the 21 day treatment period and data were collected for weight gain or loss. Treatment and control gilts were again visually scored for soundness to determine if any serious lameness had occurred from feeding Paylean®. Age at first estrus (as detected by the teaser boar), services per conception, correlation of backfat to the onset of estrus and conception rates were recorded. Ultrasound backfat data was collected to determine a correlation between fat deposition and estrous patterns in pre-pubertal swine. The CORR procedure of SAS (SAS Inst. Inc., Cary, NC) was used to calculate all correlations.

### **Post-Farrowing**

Farrowing data consisted of litter size (number of piglets born alive and dead), average piglet birth weights, average 21-day piglet weights, and number of piglets weaned. Data will indicate whether or not feeding Paylean® had any effect on litter size and weights. After weaning, the sow's return to estrus was recorded and analyzed.

Effects of Paylean® supplementation on services per conception, age at first estrus, piglet birth data, piglet weights, and number of piglets weaned were analyzed using the MIXED procedure of SAS. The model contained the effects of treatment, group, and the treatment × group interaction.

## **RESULTS AND DISCUSSION**

### **Growth Data**

#### **Average Daily Gain**

As suspected from previous research, ADG at the end of the 21-day treatment period showed to be greater for treatment groups (Table 2). Feeding Paylean® to gilts (200 lbs.) at 20ppm (18 g/ton per day), and containing at least 16% crude protein improved ADG. These findings are in agreement with (Gu et al., 1991) that the ADG of Paylean® fed hogs increased gradually as body weight (BW) increased in the weight ranges of 59 to 100-kg and 73 to 114-kg. BW was found to decline when Paylean® was fed from 86 to 127-kg (Gu et al., 1991), not necessarily the optimal weight range to feed Paylean®. In this study, the average daily gain of the gilts was 1.98 lbs. for treatment and 1.70 lbs. for control groups (Table 2). Total weight gained during the 21 day treatment period was greater ( $P<0.05$ ) for Paylean® fed gilts (41.78 lbs.) than for control (35.32 lbs.). Consequently, the ending weights were higher for the treatment group (Table 2).

Table 2. Weight gain of gilts\*

Treatment	Dietary Treatment	
	Paylean <sup>®</sup>	Control
Beginning Weight, lb	199.8	197.6
Average Daily Gain	1.98	1.70
Weight Gain, lb	41.8	35.3 **
Ending Weight, lb	241.6	233.3

\*n=40 \*\* P<0.05

This indicates that Paylean<sup>®</sup> caused gilts to gain more weight than control gilts. These results agreed with (Crome et al., 1996; He et al., 1992; Herr et al., 2000; Schinckel et al., 2002a; Schinckel et al., 2002b; Stoller et al., 2003; Gu et al., 1991; Watkins et al., 1990; and Weber et al., 2002). No studies comparing the effects of Paylean<sup>®</sup> on weight gain found opposing conclusions. This repetitive data proved that Paylean<sup>®</sup> reacts in show-type gilts similarly to lean type commercial hogs.

According to Watkins et al., (1990), weight gain responses from feeding Paylean<sup>®</sup> may vary depending on genetics or the degree of leanness. Research from Bark et al., (1992) agreed that Paylean<sup>®</sup> increased ( $P<0.01$ ) weight gain in genetically high and low lean tissue genotypes over control groups. However, the degree of improvement was greater in pigs that are genetically leaner (Bark et al., 1992). Our study did not compare specific genotypes, yet coincidentally gilts selected for show usually have high lean tissue potential (Sterle, 2005).

**Soundness**

Gilt soundness scores were recorded following the treatment period. Forty gilts were observed for soundness before and after treatment comparisons. Soundness scores prior to Paylean<sup>®</sup> treatment and after treatment were both non-significant when comparing treatment and control gilts ( $P>0.05$ ) for the first replication (Table 3).

Table 3. Average soundness scores of gilts\*

	Paylean <sup>®</sup>	Control
<b>First replication</b>		
Beginning score	3.20	3.40
Ending score	3.10	3.30
Gain/Loss	-0.10	-0.10
<b>Second replication</b>		
Beginning score	3.90	3.60
Ending score	3.20	0.55
Gain/Loss	-0.70	-0.05 **

\*n=40, \*\*P<0.05

Gilts in treatment and control groups showed some decrease in their soundness after treatment (Table 3). There was a significant decrease ( $P<0.05$ ) of soundness for Paylean<sup>®</sup> gilts in the second replication.

### Leanness

Ultrasound backfat scores reflected how Paylean® increased leanness of the gilts (Table 4). Backfat was compared at the end of the treatment period, prior to breeding. The study showed that feeding Paylean® decreased backfat in show-type gilts (Table 4).

Table 4. Ultrasound backfat scores of gilts\*

<b>Second replication</b>	Paylean®	Control
Pre-treatment, in	0.29	0.32
Post-treatment, in	0.26	0.34
Gain/Loss, in	-0.03	0.02
<b>Prior to breeding</b>		
1 <sup>st</sup> replicate, in	0.42	0.40
2 <sup>nd</sup> replicate, in	0.36	0.41
Backfat averaged, in	0.39	0.405

\*n=40 \*\* P<0.05

In the second replication only (Table 4), gilts were scanned after treatment, resulting in a decrease of 0.03 inches for Paylean® gilts and an increase of 0.02 inches for control gilts (Table 4). After the first replication was completed, the researchers decided to add another dimension and observe ultrasound backfat data. Therefore, in the second replication, an ultrasound backfat measurement was observed before and after feeding Paylean® as well as prior to breeding.

### Reproductive Data

#### Onset of Puberty

The onset of puberty is defined as the time of first oestrus and ovulation with a continuation of regular oestrus cycles (Eliasson, 1991). The average age for the onset of puberty in gilts is 182 to 222 days (Tummaruk et al., 2000). The initial hypothesis was that Paylean® would not have any effect on the age at first heat in the gilts. Estrus was not observed for six out of the 40 gilts; three from control and three from Paylean® (Table 5). These gilts were culled from the study. There are no previous studies found to support reasons why some gilts did not show estrus or conceive after breeding. One gilt was culled during the breeding period due to sickness (Table 5). Ultimately, 11 gilts from Paylean® and 12 gilts from control were successfully bred (Table 5).

The onset of puberty was compared between treatment and control groups. The ages of the gilts at first estrus were 220.3 and 225.7 days for control and treatment groups (n=17 per group), respectively (Table 5). Therefore, Paylean® did not significantly ( $P>0.05$ ) affect the age at which the gilts (n=34) first showed signs of estrus (Table 5). Paylean® did not have a subsequent effect on reproductive patterns of estrous behavior.

Also, the onset of puberty was correlated with backfat measurements to determine if there were any effects on estrus, number of cycles prior to breeding, and number of services per conception (Table 6). The evaluation of treatment groups separately indicated no significant ( $P>0.05$ ) correlation between backfat and age at first estrus (Table 6). A follow-up study is suggested to observe greater sample size for backfat and the onset of puberty and conception rate.

Table 5. Number of gilts\* contained in the study.

Treatment	Dietary Treatment	
	Paylean <sup>®</sup>	Control
No Estrus	3	3
No Conception	5	5
Sickness	1	0
Total Culled	9	8
Total Bred	11	12

\*n=33 \*\*  $P < 0.05$

### Services per conception

Services per conception was 1.41 for control and 1.17 for treatment groups (n=23) (Table 6). The differences for these means were found to be non-significant ( $P > 0.05$ ).

Furthermore, there was no significant ( $P > 0.05$ ) correlation between backfat and number of services per conception, age at first estrus, or number of cycles per conception. (Table 6).

Table 6. Correlation of backfat measurements, prior to breeding, of gilts\* with various reproductive traits.

Backfat	Age at first estrus	No. of cycles	Services/conception
Paylean <sup>®</sup>	-0.41	-0.01	0.40
Control	-0.22	0.28	-0.10
Total	-0.30	0.15	0.14

\*n=33 \*\*  
 $P < 0.05$

### Farrowing Data

According to Table 7, Paylean<sup>®</sup> did not affect ( $P > 0.05$ ) the number of piglets born dead, average piglet birth weights, and 21-day piglet weights, but the number of piglets born alive and weaned was significantly greater ( $P < 0.05$ ) for control than Paylean<sup>®</sup>. The number of piglets born alive was 7.3 for Paylean<sup>®</sup> and 10.5 for control. There were no differences for the number of piglets born dead.

The average piglet birth weights were 3.35 lbs. and 3.37 lbs. for piglets in control and Paylean<sup>®</sup> groups, respectively (Table 7). Obviously, with the piglet weights being so close there were no significant difference due to treatment. Therefore, Paylean<sup>®</sup> did not

affect the size of the piglets when they were born. Knowing this makes it less likely for Paylean<sup>®</sup> to affect piglet weight any more after birth. The 21-day weight or standard weaning weight was also not significant ( $P > 0.05$ ). Average piglet 21-day weights were 12.10 lbs. for control and 12.83 lbs. for Paylean<sup>®</sup> (Table 7). Though there were fewer piglets born in a litter for the Paylean<sup>®</sup> group the piglet 21-day weights were not affected significantly.

Table 7. Farrowing data for gilts\*.

Treatment	Dietary Treatment	
	Paylean <sup>®</sup>	Control
Piglets Born Alive	7.30	10.47 **
Piglets Born Dead	0.70	0.97
Piglet Birth Weight (Ave.), lbs.	3.37	3.35
Piglet 21-Day Weight, lbs.	12.83	12.10
No. of Piglets Weaned	6.80	9.52 **

\*n=33    \*\* P<0.05

## CONCLUSIONS

According to this research, feeding Paylean<sup>®</sup> to show-type gilts effects litter size, yet does not have adverse effects for other reproductive traits. Data from this study will allow show-type swine producers to make decisions regarding the feeding of Paylean<sup>®</sup> to gilts and subsequently select replacement gilts to enter the sow herd.

Results on growth data will allow commercial pig producers to continue to feed Paylean<sup>®</sup> to finishing swine to enhance leanness and growth efficiency. According to Houseknecht et al., (1998), animal performance and health will be enhanced by understanding the basic mechanisms that regulate adiposity, feed intake, and energy metabolism. The results of weight gain and leanness on gilts fed Paylean<sup>®</sup> only strengthens this knowledge. Paylean<sup>®</sup> gilts showed to gain more weight than control gilts. Also, soundness was not a concern between treatment and control groups in the first replication, but was a concern for the Paylean<sup>®</sup> gilts in the second replication.

This study provides evidence about and will help answer questions regarding the feeding of Paylean<sup>®</sup> and its effects on inhibiting gilts from showing estrus. Data did not show that Paylean<sup>®</sup> affected gilts' ability to conceive. Answers to these questions could benefit show-pig producers who are interested in saving gilts fed Paylean<sup>®</sup> for replacements. According to this research, there were no significant correlations between backfat and age at first estrus, number of cycles, and services per conception. Producers should not have any problems with retaining the qualities of market swine, except for litter size, while also having the ability to breed any gilt selected from show gilts that have been exhibited for replacements. Gilts can be primed to compete in market shows and still be capable of conceiving and farrowing. Yet, Paylean is not approved and is not recommended by the manufacturer for replacement gilts.

Subsequent reproductive effects of Paylean<sup>®</sup> may consist of decreased litter sizes and therefore decreased numbers at weaning. Data showed the number of piglets born alive and the number of piglets weaned to be greater for control groups. Yet, Paylean<sup>®</sup> did not affect the number of piglets born dead per litter. The piglets' growth abilities were not hindered due to Paylean<sup>®</sup> treatment. Paylean<sup>®</sup> did not affect average piglet birth and 21-day weights. Further research with larger group numbers is needed to validate these findings.



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