

The Effects of *Ascophylum Nodosum* Swine Performance and Carcass Characteristics

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ABSTRACT

The objective of this study was to observe the effects of Tasco (*Ascophylum nodosum*) on swine growth traits and carcass characteristics. Tasco was fed to sows, piglets, and finishing pigs to determine the effects on various production traits and carcass merit. All sows in the study were from crossbred genetic lines and were represented by Yorkshire, Hampshire and Duroc breeding. The study was divided into three stages: lactation (n=48 for sows), (n=335 for piglets), finishing and carcass (n= 117). There were no differences for soundness or body condition score, yet sow weight loss showed a difference in favor of the Tasco group. The sows receiving Tasco had a trend less feed intake, less body condition loss with no affect on soundness while there was an advantage in less weight loss. Birth weight of the piglets was not different, yet piglets from the sows supplemented with Tasco were heavier at weaning (P< 0.0001). There were no differences for performance in the finishing phase of the study and for carcass cutability traits. Tasco fed pigs were significantly higher for marbling (P< 0.001), and firmness of lean (P< 0.05). Data showed no differences for lean color. Consequently, Tasco has a positive effect on weaning weight for piglets and enhanced pork quality.

KEY WORDS: performance, carcass, swine, pork quality

INTRODUCTION

Tasco is adried and ground marine seaweed (*Ascophylum nodosum*) product that has shown many promising results in the cattle industry. Application of Tasco has been shown to significantly increase immune function in steers being grazed on endophyte-infected fescue pastures (Allen et al., 2001). Tasco increased serum cholesterol levels back to normal in steers being grazed in infected fescue pastures (Allen et al., 2001). In addition, Tasco demonstrated antioxidant characteristics. Steers that grazed on infected fescue pastures and were fed Tasco showed an increased amount of Vitamin E in the liver and decreased amount of Vitamin E in the serum (Montgomery et al., 2001). Tasco has been shown to increase a variety of plant antioxidant compounds when applied to forage grasses like superoxide dismutase (Ayad, 1998; Zhang and Schmidt, 1999). Brangus cow calf pairs were studied that were grazing infected fescue pastures during the summer and early fall months. Cows that were supplemented with Tasco showed decreased respiration rates and rectal body temperatures (Evans et al., 2001). Tasco offers many benefits to the cattle industry, yet the exploration of similar benefits and research is merited for the swine industry and its effects on pork production. Therefore, the objective of this study was to observe the effects of Tasco on performance traits and carcass characteristics.

EXPERIMENTAL PROCEDURE

This study was conducted at the Tarleton State University swine unit, Stephenville, TX. The objective of the study was to observe the effects of Tasco (*Ascophylum nodosum*) on swine performance. Tasco was fed to sows, piglets, and finishing pigs to determine the effects on various growth traits, production traits and carcass merit. All sows in the study were from crossbred genetic lines and were represented by Yorkshire, Hampshire and Duroc breeding. There were three stages of production (farrowing, nursery, and finishing) that were observed.

Farrowing Study. Thirty days prior to farrowing, sows and gilts were randomly sorted and assigned to two groups (treatment (Tasco) and control). All sows were fed four pounds of a corn/soybean meal basic gestation diet. Treatment sows were fed one ounce of Tasco, as recommended by Acadian Agritech, as a top-dress, in addition to their daily feed during the 30 day time period. During lactation, all sows were fed ad libitum. The treatment group was fed two ounces of Tasco daily, as a top-dress, during the regular feeding regime. Control sows were fed ad libitum along with two ounces wheat bran as a placebo. Table 1 shows the nutritional values of both the gestation and lactation diet.

Table 1: Nutritive Value of Sow Diets

	Gestation	Lactation
Crude Protein (%)	12.7	15.9
Lysine (%)	0.71	0.98
Calcium (%)	0.89	1.22
Phosphorus (%)	0.78	0.88
Fat (%)	3	2.8
Metabolizable Energy (Kcal/day)	1475	1453

Approximately two weeks prior to their farrowing date, sows and/or gilts were weighed as well as given a subjective body condition score by a three-member panel of swine professionals. The body condition scoring system utilized was a Likert type scale from one to nine (1 signifying very thin and 9 signifying very fleshy/fat). In addition, a soundness score was assessed by the same team of professionals. Soundness was evaluated on a scale of one to five (1 representing very restricted and 5 representing very mobile). These figures reflect the pre-farrowing observations. Likewise at weaning, weight, body condition score, and soundness scores were obtained. During lactation several factors were recorded to observe differences in performance for those fed Tasco versus control fed sows.

Additional body function traits such as respiration rate were observed at day 14 post parturition two hours post feeding. A resting respiration rate was recorded on the sows in order to determine any stress of the sows. Also, birth and adjusted 21 day piglet weights were recorded in order to interpret the relative milking ability of the sows for those being fed Tasco or control. Finally, post weaning return to estrus was detected.

Nursery Study

Piglets were weaned between 18 and 28 days of age using an all in all out system of management. At weaning, the piglets were allotted to the same diet treatment

as their respective dams. Piglets were placed in one of eight nursery pens where 8-10 pigs were placed per pen. Thus, pigs from each treatment and control groups were placed in four different pens each to represent four replications per farrowing. There were five different farrowings throughout the study.

Piglets were fed a three phase nursery diet. The feed was available ad libitum. The first diet (22 % crude protein) was continued until the pigs reached approximately 15 pounds. The second ration (20 % crude protein) was then fed until the piglets weighed 25 pounds. Finally, a third ration (19 % crude protein) was fed for the duration of the nursery study. Table 2 shows the nutritive value of the nursery rations.

Table 2: Nutritive Value of Nursery Diets

	PreStarter 10-15 (lbs)	PreStarter 15-25 (lbs)
Crude Protein (%)	22	20
Lysine (%)	1.5	1.35
Calcium (%)	0.9	0.9
Phosphorus (%)	0.7	0.7
Fat (%)	6.5	5

Piglets were fed and observed in the nursery for 30 days. The Tasco group was fed the same diet to that of the control group except that Tasco was mixed by hand at a rate of one pound of Tasco per two hundred pounds of feed (10 pounds per ton or 0.5% of the feed).

Piglets feed intake was measured by each pen group. The nursery pigs were kept in the nursery for approximately 30 days. Initial weights and ending weights were obtained at the beginning and end of the 30 days. From the data collected, average daily gain, weight gain, and feed conversion ratio were calculated.

Growth Study. At the end of the nursery phase, piglets were given a two week warm up period on the finishing floor without Tasco supplementation. This allowed the piglets to acclimate to the new environment as well as to the new diet. The piglets were once again allotted to the same treatment as they received in the nursery. Pigs were started on a three stage finishing schedule that was available ad libitum and contained Tasco. The initial feed was fed until the pigs reached approximately 110 lbs. The second ration was then started and maintained until the pigs averaged 160 lbs. The third ration was then started once the pigs reached approximately 160 lbs. Table 3 on the next page shows the relative nutritional value of the three rations that were fed as controls to the pigs on the finishing floor.

Table 3: Nutritive Value of Finishing Floor Diets.

	Ration #1 (50-110 lbs)	Ration #2 (110-180 lbs)
Crude Protein (%)	16.2	14.4
Lysine (%)	1	0.85
Calcium (%)	1.07	0.87
Phosphorus (%)	0.69	0.6
Fat (%)	2.8	2.9

The Tasco group was supplemented at a rate of 0.5% of Tasco (10 pounds per ton) in their diet. The pigs were fed to average 180 lbs. At that time, ending weights were recorded to determine total gain and average daily gain for the finishing phase of the study. Birth weight was used to calculate weight per day of age.

Finishing and Carcass Study. A randomly selected number of pigs (usually 20-30 per feeding period) remained in the study at 180 lbs to be fed and harvested for carcass data. These pigs continued to be fed and grew to an average of 260 lbs. The pigs were kept on the same diet while the treatment group was fed Tasco at a rate of 0.5% of the ration. Once the pigs reached the desired weight they were weighed at the Tarleton State University Swine Unit and shipped to a commercial meat packing plant in Dallas, Texas.

Upon arrival at the packing plant, they were harvested within six hours. Twenty-four hours post mortem, standard carcass measurements were obtained on all of the carcasses. Measurements such as: Carcass length (anterior edge of the aitch bone to the anterior edge of the first rib) and ham circumference were measured. Ham circumference was measured using a soft measuring tape and anatomically identifying reference points to produce consistency. The researcher used the center of the stifle joint as a reference point on the ventral side of the ham and a point two inches above the anterior edge of the aitch bone was used as a reference point on the dorsal side of the ham.

Also, backfat measures were recorded from the first rib, last rib, and the last lumbar vertebrae and an average backfat was calculated. These measurements were collected from the right side of the carcass. Next the left side of the carcass was ribbed between the 10th and 11th rib. Loin eye area and 10th rib backfat were measured. Additionally, color, firmness, and marbling scores were obtained based on the National Pork Board Pork Quality Standards. Dressing percentage was also calculated using a hot carcass weight determined at the plant and using a standard 1% drift subtracted from the weight at the TSU farm. In addition average daily gains were calculated for the entire growing and finishing phases of the study.

Statistical analysis was conducted by using the Mixed Procedure SAS (SAS Inst. Inc., Cary, NC). For all groups, the model contained the effects treatment, group and the treatment \times group interaction. Pen was included as the random variable. When significant differences were noted ($P < 0.05$), the PDIFF option of the LSMEANS statement was used for mean separation.

RESULTS AND DISCUSSION

Although more research is warranted to verify results; the supplementation of Tasco positively affected seven variables in the production of farrow to finish swine. In coordination with the experimental procedure, results will be reported according to lactation, nursery, and finishing/carcass performance trials.

Lactation. Table 4 indicated differences for both the treatment and control groups at parturition and throughout lactation. Variables reported were sow weight, body condition score, and soundness score (three days pre-farrowing and at weaning), respiration rate at 14 days post partum, sow feed intake during lactation, and return to estrus after weaning for all sows. Performance changes were calculated for sow weight, body condition score,

and soundness. Furthermore, birth and 21-day weights were recorded for the piglets during each trial farrowing.

Table 4. Effects of Tasco on Sow Performance at Parturition and Lactation.

Variable	Control	Standard Error	Tasco	Standard Error	P value
Sow Farrowing Weight (lbs.)	554.9	13.16	515.4	12.62	0.0356
Sow Weaning Weight (lbs.)	485.9	12.2	469.3	11.7	0.3311
Lactation Weight Loss (lbs)	69	5.82	46.16	5.58	0.0068
Farrowing Body Condition Score ^a	6.37	0.19	6.6	0.18	0.3915
Weaning Body Condition Score ^a	3.97	0.19	4.76	0.18	0.005
Lactation Body Condition Score Change	2.39	0.21	1.84	0.21	0.0705
Farrowing Soundness Score ^b	3.93	0.14	3.92	0.14	0.943
Weaning Soundness Score ^b	3.46	0.13	3.64	0.12	0.3115
Decrease in Soundness Score	0.47	0.2	0.28	0.19	0.4671
Respiration Rate ^c	44.57	1.46	48.48	1.4	0.0589

Control (n=23) Tasco (n=25)

^aBody Condition Score (1-9) 1 = Thin 9 = Fat

^bSoundness Score (1-5) 1 = Unsound 5 = Very Sound

^cRespiration Rate (respirations per minute)

There were no differences for soundness or body condition score, yet sow weight loss showed a difference in favor of the Tasco group. The treatment sows only lost 46.6 lbs ($P < 0.01$) while the control sows lost 69 lbs during the lactation time period. The treatment group had an advantage of 22.84 lbs less weight loss than the control group. During this period, there was a tendency for the Tasco sows to have less body condition loss as well. There was no difference reported for respiration rate. A study by Leonard et al. (2001) reported that steers received either 0.5% or 1% supplementation of seaweed extract (*Ascophyllum nodosum*) had respirations rates that were about the same but the steers that received 1% of the seaweed extract had lower respiration rates than steers that received 0% supplementation. Williams et al. (2009) found that there was no difference between minimum and maximum respirations rates between cattle receiving Tasco and those who did not. Williams et al. (2009) also found that there was no difference in respiration rates between cattle that were exposed to different periods of thermoneutral temperatures followed by a period of heat load conditions

Three hundred thirty-five piglets were observed for weight gain during the lactation phase of the study. Birth weight of the piglets for both groups were not different, yet piglets from the sows supplemented with Tasco were .88 lbs heavier (13.71 versus 12.99) at weaning ($P < 0.0001$). Also, weight gain from birth to weaning was higher for the treatment pigs by .76 lbs (10.2 versus 9.44), ($P < 0.0001$), Table 5.

Table 5. Effect of Tasco on Piglet Growth Traits During Lactation.

Variable	Control	Standard Error	Tasco	Standard Error	P value
Piglet Birth Weight (lbs)	3.56	0.06	3.51	0.06	0.5
Piglet Adjusted 21 day Weight (lbs)	12.99	0.23	13.71	0.23	0.0001
Weight Gained (lbs)	9.44	0.2	10.2	0.2	0.0001

Control (n=180) Tasco (n=155)

The mean number of days post weaning that the sows experienced for return to estrus and daily feed intake are shown in Table 6. The control group averaged 5.44 days for the sows to be observed in standing heat post weaning, while the Tasco group averaged 4.64. However this data was not statistically different. Though not significant, the Tasco sows, on average, consumed 0.6 lbs of less feed than the control group, had significantly less weight loss during lactation and showed a tendency to return to estrus sooner than control sows. They consumed less feed while significantly maintaining a higher body condition score and weaning significantly heavier piglets (Tables 4&5).

Table 6. Effect of Tasco on Return to Estrus Post-Weaning and Sow Feed Intake.

Variable	Control	Standard Error	Tasco	Standard Error	P value
Return to Estrus (days)	5.44	0.3837	4.636	0.3129	0.1104
Sow Feed Intake (lbs)	9.227	0.3648	8.632	0.3533	0.2479

Return to Estrus - Control (n=32), Tasco (n=34)
 Sow Feed Intake- Control (n=25), Tasco (n=26)

Nursery. The nursery study revealed no positive effects in favor of Tasco. While there were no differences in initial weight, final weight, and feed conversion ratio, the control group showed significant advantages in weight gained and average daily gained (Table 7). The control pigs were 1.50 lbs heavier at the end nursery study as compared to the Tasco pigs ($P<0.05$). The control pigs gained 0.8407 lbs per day versus 0.7911 lbs per day for the Tasco pigs ($P<0.05$).

Table 7. Effect of Tasco on Nursery Pig Growth Traits and Feed Conversion.

Variable	Control	Tasco	P value
Initial Weight (lbs)	14.23	14.77	0.1431
Final Weight (lbs)	39.79	38.83	0.2682
Weight Gained (lbs)	25.56	24.06	0.0136
Average Daily Gain (lbs)	0.8407	0.7911	0.0127
Feed Conversion Ratio (lbs)	1.738	1.732	0.919

Control (n=162) Tasco (n=147)

There are no previous studies for nursery age piglets; in cattle, Allen et al. (2001) found that applying Tasco to pastures during grazing season did not affect pasture weight or the weight of the steers when they arrived at the feedlot between those who

grazed infected tall fescue and those who didn't. There also was no compensatory gain for those who grazed the infected fescue in the feedlot therefore; those who grazed the infected fescue remained at a lighter body weight. Allen et al. (2001) found that steers that had grazed pastures treated with Tasco required approximately 0.35kg less feed per kilogram of gain in the feedlot.

Finishing/Carcass. The third phase of the study included the finishing gain data and carcass characteristics. Even though there was a difference for the initial weight ($p < 0.05$), there were no differences for average daily gain, total weight gain, slaughter weight, dressing percentage, or hot carcass weight (Table 8). The data revealed that animal slaughter weights were 251 and 251.8 lbs for control and treatment, respectively, while hot carcass weights were 187.5 and 187.8 lbs. Dressing percentage was not different in that both groups revealed a 74.6. These results concur with Allen et al. (2001) and Braden et al. (2007) who found that hot carcass weights of steers were not affected by Tasco treatment of the pastures.

Table 8. Effects of Tasco on Growth Traits in Finishing Swine.

Variable	Control	Standard Error	Tasco	Standard Error	P value
Live Weight (lbs.)	253.5	2.36	253.6	2.45	0.9055
Slaughter Weight (lbs.)	251	2.31	251.8	2.39	0.9455
Hot Carcass Weight (lbs.)	187.5	1.89	187.8	1.97	0.8344
Dressing Percentage (%)	74.6	0.002	74.6	0.002	0.6063
Initial Finishing Weight (lbs.)	67.12	1.06	64.51	1.1	0.0006
Finishing Weight Gained (lbs.)	186.3	2.34	189.5	2.42	0.0737
Average Daily Gain (lbs.)	1.782	0.026	1.778	0.027	0.7492
Carcass Length (in)	32.15	0.12	32.1	0.12	0.6055

Control (n=62) Tasco (n=55)

Table 9 indicated the data for muscling differences from pigs fed Tasco. Data showed that even though the loin eye area was larger for the Tasco fed pigs, there was no significant difference between the two groups. These results concur with Braden et al. (2007) who found no difference in LM area between cattle supplemented with Tasco and those who were not supplemented with Tasco. Furthermore, there was no difference for carcass length or ham circumference.

Table 9. Effects of Tasco on Muscling Traits in Finishing Swine.

Variable	Control	Standard Error	Tasco	Standard Error	P value
Ham Circumference (in)	30.11	0.12	30.44	0.13	0.3209
Loin Eye Area (in ²)	7.82	0.12	8.16	0.12	0.1639

Control (n=62) Tasco (n=55)

Data reported from Table 10 indicated that there were no differences in any of the measurable backfat indicators. Tasco fed pigs showed a slightly greater amount of backfat of 0.99 versus 0.98 inches of average backfat and 0.67 versus 0.66 inches of backfat at the 10th rib measurement.

Table 10. Effects of Tasco on Backfat in Finishing Swine.

Variable	Control	Standard Error	Tasco	Standard Error	P value
10th Rib Backfat (in)	0.66	0.02	0.67	0.02	0.655
1st Rib Backfat (in)	1.41	0.026	1.44	0.027	0.807
Last Rib Backfat (in)	0.83	0.023	0.85	0.024	0.2727
Last Lumbar Vertebra Backfat (in)	0.69	0.021	0.69	0.022	0.4183
Average Backfat (in)	0.98	0.02	0.99	0.02	0.6143

Control (n=62) Tasco (n=55)

Table 11 revealed the effects of Tasco on pork quality. The data showed that there was no difference for color, yet Tasco fed pigs were significantly better for marbling and firmness of lean. Montgomery et al. (2001) found that color decline with increased days of retail display regardless of treatment. Steaks from steers treated with Tasco seemed to have more a more desirable color than those steaks from steers who did not receive Tasco (Montgomery et al., 2001). Treating pastures with Tasco, improved lean uniformity and decreased lean discoloration of the meat from steers who consumed the pasture treated with Tasco (Montgomery et al., 2001). Less steak browning was in all steers from pastures treated with Tasco (Montgomery et al., 2001). The control group averaged a marbling score of 1.142 and the treatment group averaged a greater amount of marbling with a score of 1.432 ($P < 0.0001$). Allen et al. (2001) also found that the application of Tasco to tall fescue increased the marbling score of steers who grazed the treated pastures versus those who grazed untreated pastures. Braden et al. (2007) found that carcasses from cattle supplemented with Tasco had greater marbling scores than cattle not supplemented with Tasco. There was also a difference for firmness score between the two groups. The control group averaged a firmness score of 3.84 while the treatment group averaged a significantly higher score of 4.04 ($P < 0.05$).

Table 11. Effects of Tasco on Carcass Quality Traits in Swine.

Variable	Control	Standard Error	Tasco	Standard Error	P value
Lean Color Score ^a	2.52	0.066	2.63	0.069	0.3064
Marbling Score ^b	1.142	0.05	1.432	0.05	0.0001
Firmness Score ^c	3.84	0.106	4.04	0.11	0.027

Control (n=62) Tasco (n=55)

^aLean Color (1-6) 1=Pale, 6=Dark Red

^bMarbling Score (1-10) 1=Devoid, 10=Very Abundant

^cFirmness of Lean (1-5) 1=Soft, 5=Firm

SUMMARY

The seaweed product Tasco has shown positive effects to both swine performance and carcass characteristics. It significantly reduced the amount of lactation body weight loss from 69 lbs in the control group to 46.16 lbs in the Tasco group ($P < 0.01$). The Tasco sows weaned a significantly higher body condition score of 4.76 as compared to the control group's 3.97 ($P < 0.01$). In addition, while the sows lost significantly less weight during lactation, they weaned heavier piglets. The Tasco sows weaned piglets averaging 13.71 lbs at twenty-one days, while the control sows weaned pigs averaging 12.99 lbs ($P < 0.001$). The Tasco sow's piglets gained an average of 10.20 lbs throughout lactation, as compared to 9.44 for the control sow's piglets ($P < 0.001$). The Tasco piglets showed lower ending weights in the nursery and gained less during the nursery phase of the study as compared to the control pigs ($P < 0.05$). Tasco also improved several of the pork quality characteristics at the time of harvest. The Tasco group showed a higher marbling score of 1.432, as compared to 1.142 for the control group ($P < 0.001$), as well as, a higher firmness score. Tasco fed carcasses were observed to have a firmness score of 4.04 while the control group averaged a score of 3.84 ($P < 0.05$).

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