



Effects of Yeast Culture Supplementation to Gestation and Lactation Diets on Growth of Nursing Piglets

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ABSTRACT : A total of 335 sows at a commercial operation (Hitch Pork Producers Inc, Guymon, OK) was used to determine dietary effects of yeast culture supplementation (XPCTM, Diamond V Mills) on litter performance. Sows were grouped by parity (parity 1 to 12). Pigs within a group were then allotted to treatments. Treatments consisted of: CON (no added yeast culture) and YC (12 and 15 g/d XPC during gestation and lactation, respectively). Sows were housed individually and fed their assigned gestation and lactation diets from d 35 of gestation to d 21 of lactation. Sows were fed 2.0 kg/d during gestation and *ad libitum* during lactation. Voluntary feed intake was measured daily during lactation. At farrowing, numbers of pigs born total and alive were measured. Weights of litters were measured at birth and weaning on d 21 of lactation. Litter weight gain of the YC treatment was 6.9% greater ($p < 0.01$) than that of the CON. However, voluntary feed intake of sows and litter size did not differ between treatments. This study indicates that dietary yeast culture supplementation benefits sow productivity by improving litter weight gain. At present, it is not confirmed if improved litter weight gain was due to milk production, which remains to be investigated. (**Key Words** : Yeast Culture, Sow, Litter Weight Gain)

INTRODUCTION

Sows have been genetically selected to be prolific and to produce lean progeny and thus sows are leaner than before as well (MLC, 1979; 2006). However, these genetic changes also result in sows with a reduced appetite (Kanis, 1990). Limited nutrient intake but with increased demand for milk production to support a large litter often leaves sows under severe catabolic condition and reduces sow longevity for reproduction. Also, milk production of sows with limited nutrient intake does not satisfy the increased demands by piglets (Easter and Kim, 1998; Kim et al., 2005). Sow performance and longevity are key determinants of successful pork production. Thus, proper nutritional management to improve sow productivity has been an important issue in swine production.

Yeast culture is a fermented product containing *Saccharomyces cerevisiae* yeast and the media on which it is grown. Dietary supplementation of yeast culture has been practiced in ruminants to improve milk production of dairy

cows (Putnam et al., 1997; Robinson and Garrett, 1999) and feed intake of beef cattle (Cole et al., 1992). However, effects of yeast culture supplementation in swine diets have not been thoroughly investigated. Pilot and regional studies have been conducted utilizing sows to determine the effects of dietary supplementation of yeast culture on milk production but considering the scale of those studies, more studies need to be conducted.

Considering its beneficial effects on ruminants and from the pilot studies with sows, yeast culture could be beneficial to sows for gestation and lactation performance. Therefore, this study was conducted at a corporate pig operation to investigate the effects of yeast culture supplementation in gestation and lactation diets on the performance of sows and piglets during lactation to generate commercially applicable data.

MATERIALS AND METHODS

Animals and diets

This experiment was conducted from November 2005 to February 2006. Care, handling, and sampling of animals defined herein were approved by the Texas Tech University Animal Care and Use Committee.

This study was conducted at a commercial swine facility of Hitch Pork Producers Inc. (Guymon, OK) using 335

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Table 1. Experimental diets (As is)

Ingredient (%)	Gestation	Lactation
Yellow corn (ground, 7.4% CP)	69.9	47.2
Soybean meal (dehulled, 48% CP)	8.1	28.3
Wheat middlings (16% CP)	15.0	10.0
Wheat flour	0.0	5.0
Meat and bone meal (49.5% CP)	3.5	3.5
Fat	1.0	3.5
Vitamin-mineral premix ^a	2.5	2.5
Total	100.0	100.0
Chemical composition		
CP (%) ^b	13.3	21.0
ME (Mcal/kg) ^c	3.28	3.39
Calcium (%) ^c	0.9	1.0
Phosphorus (%) ^c	0.7	0.7

^a Vitamin-mineral premix provided the following per kilogram of complete diet: 46.7 mg of manganese as manganous oxide; 75 mg of iron as iron sulfate; 103.8 mg of zinc as zinc oxide; 95 mg of copper as copper sulfate; 0.72 mg of iodide as ethylenediamine dihydroiodide; 0.23 mg of selenium as sodium selenite; 7,556 IU of vitamin A as vitamin A acetate; 825 IU of vitamin D₃; 61.9 IU of vitamin E; 4.4 IU of vitamin K as menadione sodium bisulfate; 54.9 µg of vitamin B₁₂; 13.7 mg of riboflavin; 43.9 mg of Dpantothenic acid as calcium panthoate; 54.9 mg of niacin; and 1,650 mg of choline as choline chloride.

^b Analyzed. ^c Calculated.

sows of various parities (1 to 12). Parity of sows was recorded. On d 35 of gestation, sows were assigned to one of the following treatments: 1) control group (CON, n = 172) and 2) yeast culture group (YC, n = 163). Sows in YC received 12 g of yeast culture (XPC, Diamond V Mills, Cedar Rapids, IA, USA) daily by top-dressing from d 35 to d 109 of pregnancy and 15 g of yeast culture daily by top-dressing from d 109 of pregnancy to d 21 of lactation. All sows were housed in individual gestation crates until d 109 of gestation. All the sows were fed the conventional gestation and lactation diets which are currently used at Hitch Pork Producers Inc. Both gestation and lactation diets were formulated to meet NRC (1998) recommendations for all nutrients. Gestation and lactation diets contained 13.3 and 21.0% CP (as is), respectively (Table 1). Sows were fed

2.0-kg/d during gestation and *ad libitum* during lactation. Sows were provided water *ad libitum* during gestation and lactation periods. On d 109 of pregnancy, sows were moved to farrowing crates. After farrowing, litter birth weights were measured within 24 h postpartum. Whenever needed, piglets were cross-fostered among sows only within a dietary treatment within 24 h postpartum to standardize litters to approximately 10 pigs. The weights of pigs cross-fostered were recorded. At weaning, litter weights were measured. Voluntary feed intake was measured daily during lactation. After weaning, sows were returned to gestation crates and number of days to estrus was recorded. At 35 d of subsequent gestation, conception rate of sows in each treatment was recorded.

Data analysis

Data were analyzed for statistical evaluation based on a randomized block design with parity as a blocking criterion. Sow or litter was used as the experimental unit. Litter birth weight, litter weight gain, sow feed intake, and days return-to-estrus are compared using the General Linear Model Procedure (Proc GLM) of SAS (version 9.1, SAS Inst., Cary, NC) with the dietary treatment and parity (primiparous vs. multiparous) as main effects. Statistical significance was determined at $p < 0.05$.

RESULTS

Performance of sows and their litters are shown in Table 2. Sows in both treatments had the similar average daily feed intake during 21-d lactation. Primiparous sows had lower ($p < 0.01$) average daily feed intake than multiparous sows during 21-d lactation. However, there was no interaction between the effects of treatments and parity on average daily feed intake of sows. Litter size at birth and at weaning did not differ between the treatments. Primiparous sows had greater ($p < 0.05$) litter size at weaning than

Table 2. Performance of sows fed diets with or without yeast culture supplementation

Parity Treatment	Primiparous		Multiparous		SEM ^c	p-value ^d		
	CON ^a	YC ^b	CON ^a	YC ^b		Par	Trt	Par×Trt
Sows (n)	21	26	151	137				
Lactation feed intake (kg/sow/d)	6.6	6.8	7.9	7.8	0.1	0.001	0.825	0.303
Litter size at birth (pig)	11.6	11.3	11.6	11.7	0.1	0.451	0.924	0.528
Litter size at wean (pig)	10.8	10.8	10.2	10.3	0.1	0.011	0.502	0.693
Litter birth weight (kg)	14.5	14.3	17.2	17.7	0.2	0.001	0.381	0.575
Litter wean weight (kg)	70.0	74.8	65.7	69.9	0.7	0.015	0.004	0.884
Daily litter weight gain (kg)	2.64	2.88	2.31	2.48	0.04	0.001	0.008	0.746
Daily pig weight gain (g)	245.1	267.7	227.9	241.4	3.0	0.006	0.013	0.582
Days return to estrus (d)	5.9	5.7	4.5	5.0	0.2	0.104	0.325	0.619

^a CON: sows in the control group.

^b YC: sows in the yeast culture group (sows were fed 12 g and 15 g yeast culture (XPC, Diamond V Mills, Cedar Rapids, IA, USA) during gestation and lactation, respectively).

^c SEM: Pooled standard error of the means.

^d Par = parity; Trt = treatment; Par×Trt = parity by treatment interaction.

multiparous sows. There was no interaction between the effects of treatments and parity on litter size. Litter birth weight did not differ between the treatments. However, sows fed a diet top-dressed with YC during gestation and lactation had greater litter wean weight ($p < 0.01$), daily litter weight gain ($p < 0.01$), and daily pig weight gain ($p < 0.05$) than sows fed a diet without YC. Primiparous sows had lower ($p < 0.01$) litter birth weight but greater ($p < 0.05$) litter wean weight, daily litter weight gain, and daily pig weight gain than multiparous sows. There were no interactions between the effects of treatments and parity on litter birth weight, litter wean weight, daily litter weight gain, and daily pig weight gain. Days return-to-estrus was similar ($p = 0.325$) between the treatments and between the parities. Conception rate at d 35 post-breeding for the subsequent parity was similar between the treatments (93.4% and 91.0% for CON and YC, respectively).

DISCUSSION

Yeast culture increased litter and pig weight gains. The increases were not attributed to voluntary feed intake of sows. Several potential factors could contribute to the heavier piglets at weaning with YC supplementation. They include but not limited to 1) increased sow milk production, 2) improved milk quality, 3) mobilization of sow body reserves and 4) improved nutrient digestibility. There were limitations to collect these variables as the study was conducted at a large commercial farm. In order not to interfere normal operation procedures, access to sow weights was limited. Also due to the size of the study, individual piglet weights were not able to be recorded. Despite of limited information, results of the study clearly demonstrated the benefits of YC supplementation to sow diets on litter weight gain. Further study is warranted to investigate the mode of action of YC on sow and piglet performance.

The beneficial effects of YC supplementation to gestation and lactation diets on litter weight gain and pig weight gain were greater for primiparous sows than for multiparous sows. When YC was supplemented, improvement in litter weight gain of primiparous sows was greater ($p < 0.01$) than that of multiparous sows (9.1 and 7.3%, respectively). Primiparous sows exhibit lower voluntary feed intake compared with multiparous sows (Easter and Kim, 1998; Han et al., 2000) as was observed in the current study. Voluntary feed intake of multiparous sows was 16% higher ($p < 0.01$) than that of primiparous sows. Lower nutrient input with greater milk production (as shown in higher litter weight gain) in primiparous sows when compared with multiparous sows should cause greater metabolic stress to primiparous sows. Thus, when YC

supplementation improves feed efficiency (Van der Peet-Schwering et al., 2007) and provides potential health benefiting factors, the effects of that supplementation could be greater for the primiparous sows than the multiparous sows. However, actual mechanism remains to be determined.

In nursery pig feeding, yeast products have shown to improve the growth performance (Veum and Bowman, 1973; Kornegay et al., 1995; Mathew et al., 1998), and health (Jung et al., 2004; Kamm et al., 2004; Li et al., 2005). From these studies, it was suggested that yeast cell and cell wall components of yeast could play a role in benefiting animals. Mathew et al. (1998) showed that a live yeast supplementation in nursery diets improved voluntary feed intake and growth of nursery pigs but without affecting intestinal microflora or fermentation products. Beta-glucan from yeast cell wall was shown to improve humoral immunity of pigs (Li et al., 2005) and to possess antiviral effect against swine influenza virus by increasing interferon-gamma and nitric oxide (Jung et al., 2004). When pigs were fed a diet supplemented with a probiotic containing *Saccharomyces boulardii*, neurochemistry of enteric neurons of pig jejunum was affected by increasing expression of calbindin-28k gene (Kamm et al., 2004). However, Van der Peet-Schwering et al. (2007) reported that supplementing cell wall product containing mananoligosaccharide and beta-glucan at a rate of 2 g/kg to a diet containing YC did not show additional benefits to weanling pigs.

Veum et al. (1995) measured digestibility of nutrients when different levels of YC was supplemented to diets for gestating and lactating sows showing no improvement in nutrient digestibility by YC supplementation. However, litter birth weight increased ($p < 0.02$) as the level of YC supplementation increased up to 1.0% in the diets. Except for litter birth weight, there were no improvements in other reproductive performances by YC supplementation (Veum et al., 1995). It was clear that lactation feed intake was not affected by YC supplementation (5.8 vs. 5.9 kg for non-supplemented vs. YC supplemented groups, respectively). However, no difference in lactation body weight loss (12.5 vs. 5.8 kg for non-supplemented vs. YC supplemented groups, respectively) seems to be due to relatively large variations among treatment groups. Mean variation may have been reduced if the data were analyzed by parity (i.e., primiparous vs. multiparous) as done in this study. Inconsistency in the results between Veum et al. (1995) and this study may be due to possible differences in sow genetic potential for milk production and feed intake between early 1990's and mid 2000's, and to the levels of YC supplementation.

In summary, dietary supplementation of YC to sow diets

during gestation and lactation improved piglet performance at weaning under commercial condition. The beneficial effects of YC supplementation were greater for primiparous sow than for multiparous sows. Further investigation is needed to determine the mechanisms on how YC affects body metabolism of sows to increase the litter weight gain.

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