

## Swine Species

**W337 Anti-obesity effect of ethanol extract of seed sprouts in porcine preadipocytes.** M.-Y. Lee<sup>1</sup>, J.-J. Lee<sup>1</sup>, H.-J. Lee<sup>2</sup>, and S.-H. Oh<sup>\*3</sup>, <sup>1</sup>Department of Food and Nutrition, College of Natural Sciences, Chosun University, Gwangju, Chonnam, South Korea, <sup>2</sup>Department of Nutrition and Culinary Science, Hankyong National University, Ansong, Gyeonggi, South Korea, <sup>3</sup>Department of Animal Sciences, North Carolina A&T State University, Greensboro.

This study was performed to investigate the anti-adipogenic effect of ethanol extract of various seed sprouts, such as broccoli, alfalfa, barely, rapeseed, red radish, red brussels, Chinese cabbage and buckwheat on porcine preadipocytes in vitro. Anti-obesity effects of various seed sprouts were investigated by measuring proliferation and differentiation in porcine preadipocytes. In addition, triglyceride (TG) level, lipoprotein lipase (LPL) activity and the gene expression of LPL, as indicators of lipid accumulation in cultured porcine preadipocytes, were also examined. The preadipocytes were isolated from the backfat of newborn female pigs by collagenase digestion. Data were analyzed with ANOVA in SAS 8. Fifty µg/ml of the ethanol extracts of broccoli, rapeseed, barley and buckwheat sprouts were able to both reduce TG concentration and retard differentiation of cultured porcine preadipocytes compared with control group ( $P < 0.05$ ). The inhibitory effects of seed sprouts ethanol extracts on proliferation of preadipocytes were small, compared to the effects on differentiation. Anti-obesity effects of barley sprout ethanol extracts were the highest among the seed sprout ethanol extracts. The inhibitory effects on differentiation of porcine preadipocytes were higher in the barley, broccoli, buckwheat and rapeseed sprouts ethanol extracts treated groups than in the alfalfa, red radish, red brussels and chinese cabbage sprouts ethanol extracts treated groups ( $P < 0.05$ ). These results suggest that the ethanol extract of seed sprouts may have potential to reduce the fat accumulation and obesity.

**Key Words:** porcine preadipocytes, seed sprouts, anti-obesity

**W338 The relationship between ammonia concentration in the farrowing room and liver enzymes of sows exposed during lactation: A preliminary study.** G. Rocha-Chavez<sup>\*1</sup>, J. M. Tapia-Gonzalez<sup>1</sup>, M. A. Pinto<sup>2</sup>, A. Sepulveda-Montes<sup>1</sup>, S. Hernandez-Gutierrez<sup>1</sup>, O. D. Montañez-Valdez<sup>1</sup>, and M. Sanchez-Fabian<sup>1</sup>, <sup>1</sup>CUSUR Univ de Guadalajara, Cd Guzman, Jalisco, Mexico, <sup>2</sup>Private practice, Guadalajara, Jalisco, Mexico.

Ammonia and other noxious gases are always present, in greater or lesser degree depending on type of ventilation, inside pig barns. In animals, these gases can cause stress and respiratory or liver damage that can later impair the health of individuals. Previous studies have demonstrated a close relationship between liver enzyme levels and reproductive problems. The objective of this work was to determine the existing relation between levels of ammonia in the farrowing room and plasmatic levels of two hepatic enzymes of sows exposed during lactation. A total of 20 air samples were obtained in summer and winter from farrowing rooms of a farm in southern Jalisco Mexico using a suction pump connected to an indicator tube. Ammonia measures were done two times a day for 5 consecutive days on both seasons. At the same time, blood samples were collected from 10 lactating sows that were kept in the farrowing room for at least 18 d. Plasmatic levels of glutamic-oxaloacetic transaminase (GOT) and glutamic-pyruvic transaminase (GPT) were determined. Ammonia concentration was higher than expected in both seasons (see Table) and much higher than recommended levels (25 ppm). Hepatic enzymes were also slightly increased ( $P > 0.05$ ) but no correlation was found between both parameters ( $r = 0.04$ ).

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**Table 1. Ammonia levels in the farrowing room and its relationship with plasma concentration of liver enzymes in lactating sows.**

Season	Ammonia (ppm)	GPT (iu/ml)	GOT (iu/ml)
	Avg	SD	
Summer	49.2	6.4	29.5 ± 4.7
Winter	51.7	8.9	23.6 ± 5.2

Ref value for GPT: 9-17, for GOT 8- 21. No significative difference was found ( $P > 0.05$ )

**Key Words:** ammonia, liver enzymes, sows

**W339 Variation in backfat depth and its relations to testicular hypertrophy and reproductive development in boars.** D. O. Umesioibi<sup>\*</sup>, Field of Animal Reproductive Physiology, School of Agriculture and Environmental Sciences, Central University of Technology, Bloemfontein, South Africa.

The aim of this study was to determine the effectiveness of the use of backfat depth (P2) as a selection model for the determination of lifetime reproductive capacity in boars. Forty eight Large White boars were selected at the onset of puberty (20 wk of age) and evaluated until 60 wk of age. Sixteen boars were randomly assigned to each of the three treatment combinations based on their P2 at selection and designated as: (1) lean group = 8 to 10 mm (L); (2) moderate group = 11 to 13 mm (M); and (3) fat group = 14 to 18 mm (F). At 60 wk of age, the M boars had a greater paired testes weight ( $463.1 \pm 9.6$  g) than L ( $338.3 \pm 4.6$  g) and F ( $295.5 \pm 6.2$  g) groups. Boars in M group had 15% greater daily sperm production per gram testicular parenchyma (DSP/g) than L ( $40.7 \pm 0.3$  vs  $34.6 \pm 0.02 \times 10^6$ ) and 10% greater than F ( $40.7 \pm 0.3$  vs  $36.63 \pm 0.3 \times 10^6$ ) groups, respectively. Total daily sperm production (DSP) was 25% and 10% greater ( $P < 0.05$ ) for M boars than L ( $25.3 \pm 0.4$  vs  $19.0 \pm 0.6 \times 10^9$ ) and F ( $25.3 \pm 0.4$  vs  $22.8 \pm 1.7 \times 10^9$ ) boars. Boars in the M group from 20 wk to 60 wk of age had 30% greater ( $P < 0.05$ ) caput-corporis epididymal sperm reserves than L and 38% than F boars. The caudal epididymal sperm reserves were significantly ( $P < 0.05$ ) higher compared to those of L and F boars. The M boars produced semen with highest sperm motility ( $92.2 \pm 1.9\%$ ), sperm concentration per ml ( $285.6 \pm 12.3 \times 10^6$ ), sperm concentration per ejaculate ( $56.4 \pm 1.1 \times 10^9$ ) and normal acrosome ( $95.4 \pm 2.1\%$ ). We conclude that the rate of fat deposition seems to be one of the determinants of reproductive development in boars. Thus, selection of males with medium fat deposits appears to enhance the reproductive traits and genetic progress in a breeding herd.

**Key Words:** boar, backfat thickness, reproductive capacity

**W340 Performance of weanling pigs consuming varying levels of a genetically modified corn expressing an alpha-amylase.** K. L. Price<sup>\*1</sup>, A. F. Harper<sup>1</sup>, M. E. Persia<sup>2</sup>, and J. Escobar<sup>1</sup>, <sup>1</sup>Animal & Poultry Sciences, Virginia Polytechnic Institute and State University, Blacksburg, <sup>2</sup>Syngenta Biotechnology, Inc., Research Triangle Park, NC.

The increased demand for renewable fuels has lead to the development of a genetically modified corn that expresses high levels of alpha-amylase, an enzyme required for dry grind ethanol production. Although this corn was developed specifically for ethanol production, it is not known if this enzyme-containing corn would also be effective

when fed to growing pigs. Thus, the objective of this experiment was to quantify growth performance in weanling pigs consuming varying levels of corn containing alpha-amylase. Pigs were weaned at 21 days of age ( $6.6 \pm 0.2$  kg), blocked by weight and randomly assigned to one of four dietary treatments in a 28-day experiment. There were 3 pigs per pen and 7 pens per treatment. Pigs were fed a 3-phase nursery diet protocol (Phase 1, 0 to 7 days; Phase 2, 8 to 21 days; and Phase 3, 22 to 28 days) and had ad libitum access to water and feed. All diets were formulated to meet or exceed NRC (1998) nutrient requirements. For each phase, a basal diet was prepared that contained all ingredients with the exception of 15% experimental corn. This basal diet was then mixed with both alpha-amylase corn and an isogenic corn to obtain 0 (control), 5, 10, or 15% inclusion of alpha-amylase corn. At the end of the 28-day growth trial overall ADFI ( $P = 0.64$ ), ADG ( $P = 0.29$ ), final BW ( $P = 0.40$ ), and G/F ratio ( $P = 0.75$ ) were not different among treatment groups. Furthermore, the growth performance of pigs consuming alpha-amylase corn diets was not different from that of pigs fed the control diet: ADFI,  $P = 0.85$ ; ADG,  $P = 0.58$ ; final BW,  $P = 0.67$ ; and G/F ratio,  $P = 0.38$ . Although the alpha-amylase corn is efficacious under high temperature conditions in ethanol production, the present results demonstrate that there are neither adverse nor positive effects on growth performance of weanling pigs when fed alpha-amylase corn.

**Key Words:** weanling pig, corn amylase, growth performance

**W341 A survey of North American sow farm reproductive management.** R. Knox<sup>\*1</sup>, T. Safranski<sup>2</sup>, D. Levis<sup>3</sup>, and W. Singleton<sup>4</sup>, <sup>1</sup>University of Illinois, Urbana, <sup>2</sup>University of Missouri, Columbia, <sup>3</sup>University of Nebraska, Concord, <sup>4</sup>Purdue University, West Lafayette, IN.

Responses from 115 Midwest (74%) and Canadian farms (14%) showed farms were segregated as breed-wean (68%). Inventory in >85% was 500-4000 sows. Weaning age was 18-21 d in >70%. Feeding in lactation was by gradual increases and ad libitum. Labor varied from 1 person:10-400 sows in breeding/gestation with most hours spent on estrus and AI, then on feeding, moving sows, animal health, and cleaning, and then on records and equipment repair. People influenced fertility in >70% and training was valued on 67% of farms. Boar exposure began at weaning and as late as day 4. Most checked for estrus in AM (>75%), but varied from 1-2X/d. Duration of boar contact varied (1-4 min), as did method of boar control, boars used/sow, and alternate boar use. Semen was supplied by studs (>80%) in multiple deliveries/week of 10-60 doses/shipment. Semen was stored at 17 C and rotated daily. AI was consistent among farms occurring with a boar present (87%), double AI, and catheter left in post-AI (76%). AI timing was based on estrus (85%), but varied from within minutes (49%) to the next AM/PM (31%) and whether adjusted on wean to estrus interval (53%). Farms required boar exposure (88%), back pressure (93%), flank rubbing (79%) and gravity semen flow (79%) during AI and did not squeeze semen into the uterus (64%). Farms did not warm semen before AI, use IUI, or add hormones to semen. Gestation management was mixed; some relocated sows 1-3 times, while others prohibited this. Sows were moved only within the first week (19%) or only after four weeks (58%) post-breeding. Pregnancy was diagnosed with real time ultrasound (75%), and culling varied by rebreeding attempts (1-2) and weeks from open diagnosis to culling (1-5 weeks). Infertility in Jul-Aug was reported on most farms, with reduced estrus and increased returns. Yearly production was consistent for sows bred within 7 days of weaning (>80%), not in pig (<5%), farrowing rates (>80%), and liveborn pigs (10-12, >70%). These outcomes suggest consistencies and variation in management, but uncertainty as to which may be advantageous for achieving reproductive efficiency.

**Key Words:** reproduction, swine, management

**W342 Combined *Acanthopanax senticosus* extract and inulin improves growth performance, diarrhea and intestinal morphology in weaned piglets.** X. Wu<sup>1</sup>, Y. Yin<sup>\*1</sup>, F. Yan<sup>1</sup>, X. Kong<sup>1</sup>, R. Huang<sup>1</sup>, T. Li<sup>1</sup>, and L. Chen<sup>2</sup>, <sup>1</sup>Laboratory of Animal Nutritional Physiology and Metabolic Process, Institute of Subtropical Agriculture, the Chinese Academy of Sciences, Changsha, Hunan, China, <sup>2</sup>Guang An Biological Technique Company, China.

*Acanthopanax senticosus* (AS) is used widely in eastern Asia as a tonic and sedative Chinese herb to enhance overall well-being. Inulin is used increasingly in feed because it has unusual nutritional characteristics. Combination of AS extracts (ASE) and inulin were tested as possible alternatives to antimicrobial growth promoters for early weaned pigs on growth performance, diarrhea and intestinal morphology. A total of 96 Duroc×Landrace×Yorkshire piglets weaned at 21 days of age with an average initial body weight of  $5.64 \pm 0.18$  kg were randomly assigned to one of 3 groups with 4 replicate pens per treatment. The piglets were fed a basal diet (BD), BD+ASEI (ASE 1 g/kg and inulin 25 g/kg), and BD+antibiotics (10% bacitracin zinc 400 mg+15% carbadox 300 mg), respectively for 14 days. On d 21, eight piglets per group (two piglets per pen) were slaughtered for evaluation of small intestinal morphology. Results showed that ASEI and antibiotics improved ADG by 18.05 and 19.78% ( $P < 0.05$ ), decreased F/G by 19.79 and 21.39% ( $P < 0.05$ ), respectively, compared with the control group. However, there was no difference between the ASEI and antibiotic groups ( $P > 0.05$ ). Compared to the control group, both ASE and antibiotics decreased ( $P < 0.05$ ) the incidence of diarrhea by 52.7 and 55.0%, respectively. The villus height of jejunum and ileum increased by 13.41, and 14.00% ( $P < 0.05$ ), respectively, in response to the dietary supplementation with ASEI. These findings suggested that dietary supplementation with the combination ASE and inulin could decrease diarrhea occurrence resulting from weaning stress, and improve health of intestinal morphology in weanling piglets instead of antibiotics.

**Key Words:** *Acanthopanax senticosus* extracts, inulin, weaned piglets

**W343 Microarray analysis of genes in small intestine of IUGR piglets.** R. Chen, Y. Yin<sup>\*</sup>, J. Pan, Y. Gao, and X. Song, *Key Laboratory of Animal Nutritional Physiology and Metabolic Process, Institute of Subtropical Agriculture, the Chinese Academy of Sciences, Changsha, Hunan, China.*

In this study, Affymetrix porcine GeneChips were used to explore differentially expressed genes in the small intestinal mucosa of IUGR (Intrauterine growth restriction) and NBW (normal birth weight) piglets. Five NBW (birth weight:  $1503 \pm 310$  g) and five IUGR (birth weight:  $806 \pm 35$  g) piglets were killed 21 days after birth by jugular puncture after anesthesia. Samples were immediately placed in liquid nitrogen and stored at  $-80$  °C. cDNA synthesis, microarray hybridization, microarray slide washing, and array scanning were performed following Affymetrix protocols. Standard post-hybridization washes and double-stain protocols were used on an Affymetrix GeneChip Fluidics Station 450. Arrays were scanned on an Affymetrix GeneChip Scanner 3000. Statistical analysis of array data was analyzed using GeneChip Operating Software. The dividing point of the genes relative expression level was 2-fold. There were 561 differentially expressed genes in the small intestine from IUGR compared to NBW piglets. Compared with age-matched NBW piglets, mRNA levels for 255 genes were reduced in the small intestine of IUGR piglets, whereas 306 genes were increased. For example, the expression levels of the argininosuccinate synthetase 1 and cytochrome P450 3A29 genes were 6-fold and 4-fold higher in tissues of the IUGR

piglets than those of NBW piglets, respectively; whereas the expression level of the metallothionein and urate transporter channel protein genes were reduced 10-fold and 5-fold in the IUGR piglets, respectively. Our results not only provide new insights into the molecular mechanisms of small intestinal mucosa in IUGR piglets, but also serves as a valuable resource to researchers investigating IUGR piglets.

**Key Words:** IUGR, piglet, microarray

**W344 Conjugated linoleic acid (CLA) isomers and its effect on proliferation of CD4 and CD8 T lymphocytes of pigs.** J. R. Peralta-Quintana, S. Y. Moya-Camarena, J. Hernández, M. Reséndiz, V. Mata-Haro, and A. Pinelli-Saavedra\*, *Centro de Investigación en Alimentación y Desarrollo A.C., Hermosillo, Sonora, México.*

In several studies CLA has been shown to enhance some aspects of immune response. Most pig studies have focused in pro-inflammatory cytokines, immunoglobulin production, using a mixture of isomers. The aim of this study was to evaluate the effect of individual isomers of CLA and a mixture of them (1:1) on proliferation of CD4 and CD8 T lymphocytes. Peripheral blood mononuclear cells (PBMC) ( $5 \times 10^6$ ) from 9 conventional pigs (25 d of age) dyed with carboxyfluorescein succinimidyl ester (CFSE) were stimulated with phytohaemagglutinin (PHA) ( $5 \mu\text{g/mL}$ ), supplemented *in vitro* with CLA. Cells were incubated at  $37^\circ\text{C}$  under atmosphere controlled with 5%  $\text{CO}_2$  for 72 h, and with monoclonal antibodies (mAb) anti-CD4 or anti-CD8 labelled with phycoerythrin (PE). Analysis was by flow cytometry fluorescence activated cell sorting (FACS) Calibur. Treatments were as follows: A. non-stimulated; B. PHA; C.  $10 \mu\text{M}$  9*cis*-11*trans*; D.  $10 \mu\text{M}$  10*trans*-12*cis*; E.  $10 \mu\text{M}$  mixture; F.  $100 \mu\text{M}$  9*cis*-11*trans*; G.  $100 \mu\text{M}$  10*trans*-12*cis*; H.  $100 \mu\text{M}$  mixture. Data were analysed by one way ANOVA using NCSS2005 package. Our results showed that  $100 \mu\text{M}$  9*cis*-11*trans*-CLA decreased significantly ( $P < 0.05$ ) the proliferation of PBMC. In contrast, no effect was found with 10*trans*-12*cis*-CLA and the mixture irrespective of the amount used. Regarding the proliferation of CD4 and CD8 T lymphocytes, it was not affected ( $P > 0.05$ ) for any isomer nor the mixture of them, irrespective of concentration used. However,  $100 \mu\text{M}$  9*cis*-11*trans*-CLA tended to reduce the proliferation ( $P = 0.06$ ) of CD8 T lymphocytes. Our results suggest that CLA is isomer specific, but CLA does not appear to affect CD4 lymphocytes.

**Key Words:** conjugated linoleic acid, CD4 and CD8, pigs

**W345 Dietary requirement of true digestible lysine for growing pigs.** Y. Zhang<sup>\*1,2</sup>, Y. Yin<sup>1</sup>, J. Li<sup>1</sup>, R. Huang<sup>1</sup>, and Y. Chen<sup>1,2</sup>, <sup>1</sup>*Key Laboratory of Subtropical Agro-ecology, Institute of Subtropical Agriculture, The Chinese Academy of Sciences, Changsha, Hunan, The People's Republic of China*, <sup>2</sup>*The Graduate University of Chinese Academy of Sciences, Beijing, The People's Republic of China.*

Sixty healthy growing pigs (Duroc $\times$ Landrace $\times$ Yorkshire) with an average BW of  $21.6 \pm 1.1$  kg were used to determine the true digestible lysine (TDL) requirement of growing pigs on the basis of growth performance and lysine digestibility. Pigs were assigned randomly to one of five dietary treatments (12 pigs/diet), representing five levels of TDL (0.72, 0.82, 0.92, 1.02 and 1.12%). There were three replications per treatment, with four pigs (2 barrows and 2 gilts) in each replication (2 pigs/pen). A randomized-block design was used, with pen as the experimental unit. Experimental diets were formulated to provide the 5 TDL levels offered

to pigs at 5% BW during the experimental period. The results show that: the ADG of pigs was affected by dietary TDL levels as described by Equation 1:  $y_1 = -3217.9x^2 + 6117.1x - 236.2$  ( $R^2 = 0.9435$ ,  $y_1 = \text{ADG, g/d}$ ;  $x = \text{dietary TDL, \%}$ ). The ADG/BW<sup>0.75</sup> of pigs was affected by dietary TDL levels as described by Equation 2:  $y_2 = -429.79x^2 + 808.86x - 326.97$  ( $R^2 = 0.9589$ ,  $y = \text{ADG/BW}^{0.75}$ ,  $g$ ;  $x = \text{dietary TDL, \%}$ ). The F/G of pigs was affected by dietary TDL levels as described by Equation 3:  $y_3 = 33.071x^2 - 62.781x + 32.534$  ( $R^2 = 0.9957$ ,  $y = \text{F/G}$ ;  $x = \text{dietary TDL, \%}$ ). When dietary TDL level was 0.950%, ADG was highest (511 g/d). When dietary TDL level was 0.941%, ADG/BW<sup>0.75</sup> was highest (53.60 g). When dietary TDL level was 0.949%, F/G was lowest (2.74). The results above indicated that growth performance of growing pigs was most improved when dietary TDL was 0.947%. The digestible nitrogen, nitrogen digestibility and nitrogen retained values were highest when dietary TDL was 0.92%. The ileal true digestibility of amino acids was highest when dietary TDL was 0.92%. Collectively, these results indicate that the optimal TDL requirement of growing pigs is 0.92%-0.95% of the diet.

**Key Words:** requirement, growing pigs, true digestible lysine

**W346 Effect of diet enriched with rapeseed or sunflower oil on fatty acid profile of backfat and intramuscular fat in gilts.** G. Battacone\*, A. Nudda, M. G. Manca, C. Dimauro, and G. Pulina, *Dipartimento di Scienze Zootecniche, Università di Sassari, Sassari, Italy.*

An experiment was carried out in order to study the fatty acid profile in the backfat and intramuscular fat from carcasses of gilts fed diets enriched with either rapeseed or sunflower oils for the last 4 weeks before slaughter. Twenty Landrace  $\times$  Large White crossbred gilts were allotted to one of two experimental diets obtained by adding either rapeseed oil (RSO) or sunflower oil (SFO) to the commercial feed (at 2%). Fatty acid composition of Longissimus muscle (Lm) and backfat (Bf) of each carcass was quantified. Both tissues of RSO pigs had a higher percentage of C18:3n3 (1.15 vs 0.95%;  $P < 0.01$ ) and a lower n6/n3 ratio (13.9 vs 15.9;  $P < 0.01$ ) than those fed SFO. On the contrary, the fat of pigs fed SFO had a higher content of C14:0, C16:0 and C16:1 ( $P < 0.05$ ). The dietary oil did not affect ( $P = 0.38$ ) the CLAc9,t11 content in both tissues (0.11 vs 0.10% in RSO and SFO, respectively). The content of MUFA was higher in Lm than in Bf (48.0 vs 42.1%;  $P < 0.01$ ), due to its higher concentration of C18:1c9 and C16:1. The CLAc9,t11 concentration was higher in Bf than in Lm (0.12 vs 0.09%;  $P < 0.05$ ). The PUFA content was higher in Bf than in Lm (21.0 vs 15.0%;  $P < 0.01$ ). Our data confirmed that: i) it is possible to modify the fatty acid composition of pork meat by altering the source of fat in the diet; ii) the adipose tissues from Lm and Bf of pig differ for their fatty acid composition.

**Key Words:** swine carcass, fatty acid, backfat and intramuscular fat

**W347 Mechanisms for transcellular transport of glucose in swine small intestine.** M. Al-Rammahi<sup>\*1</sup>, A. Moran<sup>1</sup>, D. Batchelor<sup>1</sup>, E. Coulter<sup>1</sup>, N. Jones<sup>1</sup>, C. Ionescu<sup>2</sup>, D. Bravo<sup>2</sup>, and S. Shirazi-Beechey<sup>1</sup>, <sup>1</sup>*Department of Veterinary Preclinical Sciences, University of Liverpool, Liverpool, UK*, <sup>2</sup>*Pancosma SA, Geneva, Switzerland.*

Dietary glucose is transported across the luminal membrane of intestinal absorptive cells (enterocytes) by the  $\text{Na}^+$ /glucose cotransporter, SGLT1. Glucose exits the cells across the basolateral membrane into the systemic system by the  $\text{Na}^+$ -independent monosaccharide transporter, GLUT2.

It has been proposed that in rats fed high carbohydrate diets, GLUT2 may be recruited to the luminal membrane where it can transport either glucose or fructose. In order to determine the expression of monosaccharide transporters in swine small intestine, 28 day old piglets of both sexes were housed in separate pens and were weaned to isocaloric diets containing either 7%, 35.9% or 60.3% digestible carbohydrates. The animals were maintained on these diets for 3 days and had access to water at all times. At the end of the experimental period piglets were sacrificed by giving intravenous pentobarbitone (Approved by the UK Home Office under schedule 1). Intestinal tissue samples were fixed and used for immunohistochemical localisation of SGLT1 and GLUT2 using specific antibodies. The data show that in the intestinal samples of animals on all three diets, SGLT1 protein was expressed on the brush border membrane and GLUT2 on the basolateral membrane of all villus enterocytes. There was no labelling of GLUT2 on the luminal membrane. We conclude that SGLT1 is the major protein responsible for the absorption of monosaccharides across the brush border membrane under all dietary carbohydrate levels.

**Key Words:** Intestine, SGLT1/GLUT2, Glucose Transport

**W348 Expression of sweet taste receptor, gustducin and carbohydrate responsive gut hormones in swine small intestine.** M. Al-Rammahi\*<sup>1</sup>, A. Moran<sup>1</sup>, D. Batchelor<sup>1</sup>, E. Coulter<sup>1</sup>, N. Jones<sup>1</sup>, C. Ionescu<sup>2</sup>, D. Bravo<sup>2</sup>, and S. Shirazi-Beechey<sup>1</sup>, <sup>1</sup>*Department of Veterinary Preclinical Sciences, University of Liverpool, Liverpool, UK,* <sup>2</sup>*Pancosma SA, Geneva, Switzerland.*

We have shown previously that dietary sugars and artificial sweeteners increase SGLT1 expression and glucose absorptive capacity in wild type mice, but not in T1R3-, a subunit of the sweet taste receptor, and  $\alpha$ -gustducin-, the partner G-protein, knockout mice. We proposed that T1R2+T1R3, the sweet taste receptor, expressed on the luminal membrane of villus enteroendocrine cells senses the luminal glucose concentration. Luminal glucose above a threshold level activates, in enteroendocrine cells, a signaling pathway involving T1R2+T1R3, gustducin and other signalling elements. This results in secretion of candidate gut hormones. These hormones bind to receptors on target cells and, through a paracrine mechanism, enhance SGLT1 expression. In this study we determined the expression of T1R2, T1R3, gustducin and the gut hormones in the intestine of 28 day old weaned piglets. Using specific antibodies we show, by immunohistochemistry, that the sweet taste receptor subunits, gustducin and gut hormones are expressed in subpopulations of cells along the crypt villus axis. In contrast, SGLT1 is expressed on the brush border membrane of all villus enterocytes. Furthermore, there was co-expression of T1R2/R3 and gustducin with chromogranin A, a classical marker of enteroendocrine cells. Our data indicate that the sweet taste receptor and other signaling elements are expressed in swine intestinal enteroendocrine cells and that the intestine has the capacity to detect, via T1R2/R3, changes in the concentration of luminal sugars/artificial sweeteners. The findings that gut hormones are expressed in the same cells as those possessing taste receptors indicates that the swine intestine is capable of secreting gut hormones known to be responsive to dietary carbohydrates.

**Key Words:** intestine, sweet taste receptor, gut hormones

**W349 Microbiological and molecular analysis of bacterial community by probiotic mixture in weaning pig *in vivo* intestinal models.**

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Recently, it has been reported that the balance or ratio of the intestinal microbiota resulting from health promoting probiotic bacteria plays an important role in human and animal health. Here, we monitored the dynamic microbial diversity by probiotic mixture including *Lactobacillus acidophilus* 30SC and *Saccharomyces cerevisiae* using *in vivo* feeding trials supplemented with probiotic mixture by traditional plating method and polymerase chain reaction-denaturing gradient gel electrophoresis (PCR-DGGE) techniques. Experimental period was divided into Phase I (14 days) and Phase II (14 days). The Phase I diet contained 3600 kcal/kg ME, 22.6% CP, 1.56% Lys, 0.54% Met, 0.82% Ca, and 0.75% P. The Phase II diet contained 3430 kcal/kg ME, 19.5% CP, 1.30% Lys, 0.47% Met, 0.80% Ca, and 0.55% P. Dietary treatments were; 1) Basal diet (no antibiotics), 2) Basal diet with 0.2% antibiotics 3) Basal diet with probiotics mixture (*ca* 1.0 x 10<sup>9</sup> of *L. acidophilus* and 2.0 x 10<sup>10</sup> of *S. cerevisiae*). Pigs consumed feed and water *ad libitum*. Cr<sub>2</sub>O<sub>3</sub> (0.2%) included diets were supplied from day 12 and day 26 to day 14 and day 28, and feces was collected at the end of each Phase (day 14 and 28). During 28 days administrations using weaning pigs, a specific reduction in coliforms was observed compared to the control, whereas the population of lactobacilli increased. Unexpectedly, supplemental probiotic mixture did not dramatically affect the counts of total aerobes and yeast/mold under standard plating method. In addition, DGGE analysis showed a significant difference in the 16S rRNA gene products by specific-genus target primer sets (eubacterial, lactobacilli, and bifidobacteria groups) on administering probiotic mixture. Selected twenty bands were sequenced and most of them were identified with uncultured bacterium clones or a *Lactobacillus*-like community. Therefore, our study suggests that probiotic mixture including *L. acidophilus* and *S. cerevisiae* could significantly regulate the specific bacteria population such as lactobacilli and coliforms via a dynamic interaction with other microbial communities in the intestinal tract.

**Key Words:** probiotics, DGGE, lactobacillus

**W350 Administration of probiotics influences enterotoxigenic *Escherichia coli* F4 attachment and expression of intestinal cytokines in weaned pigs.**

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Post-weaning diarrhoea associated with F4-positive enterotoxigenic *E. coli* (ETEC F4) causes important economic losses for pig producers. The use of probiotics as feed additives to prevent such enteric infections and reduce the use of antimicrobial treatments, possibly due to an improved host intestinal health, has recently gained in interest. The aim of this study was to evaluate the effects of two probiotics, *Pediococcus acidilactici* (PA) and *Saccharomyces cerevisiae boulardii* (SCB), on ETEC F4 attachment, colonization and cytokine expression in the ileum of weaned pigs. At birth, different litters of pigs were allocated to the following treatments: 1) control group without antibiotic or probiotic treatment (CTRL), 2) control with antibiotics (aureomycin (110 ppm/kg) and tiamulin (31.2 ppm/kg) added to weaning feed (ATB), 3) PA, 4) SCB, and 5) PA + SCB. During lactation and the post-weaning period, a daily

dose of probiotics ( $1 \times 10^9$  CFU) was orally administered to pigs using disposable pipets. At seven days post-weaning, F4-receptor-positive pigs, thus susceptible for ETEC F4 infection, were orally inoculated with an ETEC F4 strain. The necropsy was performed 24 h after infection and intestinal samples were collected. The immunofluorescence assay, ETEC F4 bacterial counts and real-time PCR analysis for cytokine expression were performed. In the probiotic groups, the attachment of ETEC F4 to the intestinal mucosa was significantly lower than in the ATB group ( $P < 0.05$ ). Moreover, colonization of the ileal mucosa tended to be lower in PA + SCB pigs than for pigs of the ATB group ( $P = 0.07$ ). Finally, proinflammatory cytokines and beta-2 defensin, which are involved in the innate immune defence against ETEC F4, were upregulated in PA and PA + SCB groups in comparison with the CTRL group ( $P < 0.10$ ). Furthermore, IL-6 tend to be upregulated in PA and PA + SCB groups in comparison with the ATB group ( $P < 0.10$ ). These results suggest that administration of probiotics could be an alternative to attenuate ETEC F4 infection in pigs.

**Key Words:** probiotics, *E. coli*, immune response

**W351 Inclusion of live yeast *S. cerevisiae boulardii* (CNCM I-1079) in sow lactation diets: Effects on sows and nest performances.** F. Mariella<sup>1</sup>, A. Agazzi<sup>1</sup>, G. Invernizzi<sup>1</sup>, G. Savoini<sup>\*1</sup>, E. Chevaux<sup>2</sup>, and Y. Le Treut<sup>2</sup>, <sup>1</sup>University of Milan Faculty of Veterinary Medicine, Milan, Italy, <sup>2</sup>Lallemand S.A.S., Blagnac, France.

The aim of the trial was to evaluate the inclusion live yeast (*S. cerevisiae boulardii*, CNCM I-1079) in sow lactation diets on sows and nest performances. A total of 50 sows were subdivided into the following two groups based on parity and date of birth: Control (C = n 20) and Live yeast (LY = n 30). Sows were fed a basal diet with (LY) or without (C) the inclusion of live yeast during lactation. Yeast supplementation started 3 weeks before farrowing at 109 cfu/kg, with an additional  $2 \times 10^{10}$  cfu/d provided upon entrance into the farrowing room, until 2 d after parturition. The following parameters were observed for each sow: rectal temperature and fecal score at entrance into the farrowing room one week before parturition, and at 3, 10, and 28 d after parturition, percentage of live piglets and number of piglets born alive. Rectal temperature, fecal score at birth and 1, 3, 10 d after birth, ADG and weight gain were determined for each piglet. All the parameters were analyzed by a Mixed procedure for repeated measures of SAS (2006) using treatment, parity and sex as fixed effects and sows as random factor. Live yeast led to an increase in number of piglets born alive (12.15 for LY vs 11.80 for C,  $P < 0.05$ ) and percent of live piglets (85.54% for LY vs 76.07% for C,  $P < 0.05$ ); an increase in overall ADG of piglets (183.12 g for LY vs 174.07 g for C,  $P < 0.01$ ), in particular for 2nd-6th parity sows (208.36 g for the LY group vs 175.05 g for the C group,  $P < 0.01$ ); and increased weaning weights (6969.54 g for LY vs 6495.54 g for C,  $P < 0.01$ ). Average piglet rectal temperature was slightly higher for LY than for C (38.65°C for LY vs 38.46°C for C,  $P < 0.05$ ). No difference was noted in sow rectal temperatures or on piglet fecal scores. The inclusion of live yeast in sow lactation diets positively affected their productive performance as shown by increased live litter size and growth of piglets.

**Key Words:** live yeast, sow, nest

**W352 Consumer preferences for U.S. pork in urban China.** D. Ortega<sup>\*1</sup>, H. Wang<sup>1</sup>, and L. Wu<sup>2</sup>, <sup>1</sup>Purdue University, West Lafayette, IN, <sup>2</sup>China Agricultural University, Beijing, P. R. China.

The emergence of China onto the world economic stage has many implications for U.S. hog producers. China is making a transition from a developing economy to a developed one. Its population is becoming wealthier, demanding more goods, and eating more high-quality food. Pork, being the primary meat in Chinese diets, will face a demand surge that will need to be met by increasing domestic production and supply-chain efficiency or increased imports. With a market of 1.32 billion consumers and growing, China offers many opportunities for U.S. pork. The identification of specific factors that influence consumer purchasing decisions regarding imported pork will aid policy makers and companies wishing to enter the growing Chinese urban market. The objective of this research is to assess and evaluate factors which influence consumer demand for U.S. pork in China. The data for this study comes from a survey of urban Chinese consumers that was administered in May 2008. A double-bounded dichotomous question format was used to measure an individuals' willingness-to-pay for U.S. pork. An ordered logit model was then developed to determine the factors that influenced a consumer's willingness-to-pay for U.S. pork. Specifically, this study looks at food safety issues affecting urban consumers, especially their acceptance of the lean-meat additive ractopamine (commonly sold in the U.S. as Paylean). Results from this study show that age, shopping location, and food safety concerns, among other factors, have a significant effect on willingness-to-pay for U.S. pork. Food safety was determined to be an important factor in pork purchasing decisions, making urban consumers reluctant to purchase pork fed with ractopamine. This is an issue tied specifically to a lack of consumer confidence on the Chinese food inspection system due to previous lean-meat additive scares. U.S. hog producers looking to enter the Chinese market should consider either removing ractopamine supplementation to cater to Chinese consumers who prefer fattier pork, or invest in educating the Chinese public that ractopamine-fed pork is safe for human consumption.

**Key Words:** willingness-to-pay for U.S. pork, ractopamine, China

**W353 Gastrointestinal morphology of pigs farrowed in indoor versus outdoor management systems and weaned into an indoor, off-site nursery.** E. Davis<sup>\*1</sup>, C. V. Maxwell<sup>2</sup>, J. D. Spencer<sup>3</sup>, R. L. Moser<sup>3</sup>, J. Rehberger<sup>1</sup>, and T. Rehberger<sup>1</sup>, <sup>1</sup>Agtech Products, Inc., Waukesha, WI, <sup>2</sup>University of Arkansas, Fayetteville, <sup>3</sup>JBS United, Inc., Sheridan, IN.

Two swine herds of similar genetics (PIC C-22  $\times$  PIC 280) were used to evaluate the effects of indoor and outdoor management on gastrointestinal (GI) morphology during the pre- and post-weaning periods. Pigs were farrowed in a conventional (CONV), confinement facility located in Sheridan, IN or in an outdoor pasture facility in Springfield, CO. Pigs were weaned from both locations simultaneously at  $19 \pm 2$  d of age and averaging 5.5 kg BW, were transported to an off-site nursery facility at the University of Arkansas, and housed in separate rooms. Pigs were blocked by BW and fed common Phase 1 (d 0 to 14), Phase 2 (d 14 to 28), and Phase 3 (d 28 to 42) diets. Six pigs from each group were euthanized and GI tracts sampled to measure GI morphology and goblet cell enumeration at 6, 13, and 18 d of age prior to weaning (d 19) and on d 1, 3, 10, and 24 post-weaning. Duodenal villus height was greater ( $P \leq 0.05$ ) pre-weaning in CONV pigs compared to those farrowed in the outdoor system. However, outdoor reared pigs had greater ( $P \leq 0.05$ ) duodenal villus height the day after weaning compared to CONV pigs, as well as greater ( $P \leq 0.05$ ) duodenal and jejunal crypt depth, villus height, and villus area on d 24 post-weaning. The number

of acidic mucin-producing goblet cells on ileal villi was greater ( $P \leq 0.05$ ) in CONV pigs at 13 d of age and lower ( $P \leq 0.05$ ) at 18 d of age compared to outdoor reared pigs (treatment x day interaction,  $P \leq 0.05$ ). Outdoor reared pigs had a greater ( $P \leq 0.05$ ) number of acidic mucin-producing goblet cells along the duodenal villi on d 3 post-weaning and fewer ( $P \leq 0.05$ ) along the jejunal villi on d 24 post-weaning compared to CONV pigs; however, numbers of goblet cells were similar between treatments on the other post-weaning sampling days (treatment x day interaction,  $P \leq 0.05$ ). These data indicate that pigs farrowed in an outdoor management system and weaned to an indoor facility experience less gut integrity disruption at weaning compared to pigs farrowed in CONV facilities.

**Key Words:** swine, management, weaning

**W354 The relationship between radiated heat loss and feed conversion in grower pigs.** W. Caine\*, L. Holt-Klemic, J. Aalhus, I. Larsen, T. Liu, J. Colyn, M. E. Dugan, W. Robertson, S. Landrey, and A. L. Schaefer, *Agriculture and Agri-Food Canada, Lacombe, Alberta, Canada.*

With all-in-all-out swine marketing systems the uniform grouping of individual pigs within a pen can significantly influence the body weight and carcass index variation at marketing. Excessive weight or index variation can incur economic discounts. The purpose of the present study was to examine whether the non invasive quantification of radiated heat loss from grower pigs could be used to stratify pen mates into more uniform growth efficiency groups such that a given pen would display greater uniformity in target market weights. In a pilot trial, 20 grower pigs balanced by sex (gilts and barrows, Hypor Comp. genetics) were monitored during the grower period (60 to 90 kg live weight) for individual growth efficiency or feed/gain and also for radiated heat loss using infrared thermography. All pigs were individually housed in a thermoneutral environment in pens measuring approximately 2.5 meters  $\times$  1.5 meters and fed a conventional cereal based grower diet which met or exceeded NRC requirements. Feed intake and growth were monitored weekly for individual pigs. Towards the end of the grower period of 90 kg the pigs were scanned on the orbital region (eye) using a FLIR broad range infrared camera (IRT). The feed conversion value for all pigs during the growth phase was  $2.3 \pm 0.2$  (SD) and the thermal radiation value averaged  $33.6 \pm 0.7$  C. Of interest was the observation that the feed conversion ratio and the IRT values displayed a significant Spearman Ranking value ( $P < 0.05$ ). In other words, animals that were more efficient displayed a lower radiated heat loss. For example, the six most efficient pigs displayed a feed conversion value of  $2.1 \pm 0.05$  and an IRT value of  $33.5 \pm 0.7$  compared to the six animals that were least efficient displaying a feed conversion of  $2.6 \pm 0.2$  and an IRT value of  $34.1 \pm 0.7$ . These data suggest that it may be possible to use IRT to stratify pen mates during the growing period so that an all-in-all-out marketing system could create a more uniform growth efficiency and more uniform carcass index values.

**Key Words:** swine, feed conversion, infrared

**W355 The effect of a *Bacillus* based direct fed microbial on the microbiota of grow-finish pigs.** J. Rehberger\*<sup>1</sup>, E. Davis<sup>1</sup>, C. V. Maxwell<sup>2</sup>, and T. Rehberger<sup>1</sup>, <sup>1</sup>Agtech Products, Inc., Waukesha, WI, <sup>2</sup>Department of Animal Science, University of Arkansas, Fayetteville.

MicroSource® "S" is a *Bacillus* based direct fed microbial (DFM) included in the grow-finish diet to improve the decomposition of manure.

In order to determine the effect of MicroSource S on the microbiota of the grow-finish pig, terminal restriction fragment length polymorphism (TRFLP) analysis was performed on gastrointestinal tracts of pigs whose diets were supplemented with MicroSource S at 0.5 g per kilogram of feed or fed a control diet. Gastrointestinal tract samples were taken from five treated and five untreated pigs when their average weight was 36 kg, 68 kg, 91 kg, and 113 kg. After TRFLP was performed, a GLM procedure was used to determine which gastrointestinal TRFs were impacted by the inclusion of MicroSource S in the grow-finish diet. The addition of MicroSource S increased the microbial diversity in the duodenum as indicated by greater incidence ( $P < 0.05$ ) of 15 TRFs identified with BfaI and 41 TRFs identified with MspI when compared to control pigs. Combining the data generated by both enzymes made it possible to putatively assign a genus to some TRFs. There were several putatively assigned species of *Lactobacillus* that were more prevalent ( $P < 0.05$ ) in pigs whose diets had been supplemented with MicroSource S. The incidence of *Ruminococcus* and *Brevibacillus* were greater ( $P < 0.05$ ) in animals that were administered MicroSource S compared to animals that received the control diet. Additionally, TRFs putatively assigned to the phylum Bacteroidetes, possibly from the genus *Bacteroides*, were also more prevalent ( $P < 0.05$ ) among animals that were administered MicroSource S. Evaluation of the TRFLP results indicates that the inclusion of MicroSource S alters the microbiota of the grow-finish pig, as illustrated by the number of TRFs in the duodenum that were more commonly present in animals administered the DFM.

**Key Words:** swine, *Bacillus*, microbiota

**W356 A preliminary comparison of the bacterial communities of foaming and non-foaming swine manure pits.** J. Rehberger\*, E. Davis, A. Baker, T. Parrott, A. Veldkamp, and T. Rehberger, *Agtech Products, Inc., Waukesha, WI.*

The accumulation of foam in manure pits is an emerging problem in the swine industry and effective solutions have not yet been identified. Although the definitive cause of foaming is unknown, microbial activity in the swine manure pit is a likely factor and investigation of the differences in the microbial communities of foaming and non-foaming swine manure pits may provide initial insight on the cause of the problem. In order to examine the difference between the microbial communities in foaming and non-foaming manure pits, terminal restriction length polymorphism (TRFLP) analysis was performed using four restriction enzymes; BfaI, HaeIII, MspI, and BstUI. To analyze the TRFLP data the GLM procedure was used to determine which TRFs were present or more abundant in foaming or non-foaming swine manure pits. When the binary TRFLP data were analyzed, six TRFs were more prevalent ( $P < 0.05$ ) in foaming pits than non-foaming pits. There were also four unique binary TRFs more commonly found ( $P < 0.05$ ) in non-foaming pits than foaming pits. The binary microbial profiles from all four enzymes suggested that there were six operational taxonomic units (OTUs) that differed between foaming and non-foaming swine manure pits. When the quantitative TRFLP data were analyzed, four peaks were found in greater ( $P < 0.05$ ) quantity in foaming pits and twelve TRFs were found in greater ( $P < 0.05$ ) quantity in non-foaming pits. The comparison of the TRF profiles generated by all four enzymes from the quantitative analysis suggested that eight unique OTUs differed between foaming and non-foaming swine manure pits. The analysis of both the binary and quantitative TRFLP data illustrates that there are different microbial communities present in foaming pits and non-foaming pits, suggesting further evaluation of these microbial differences may explain the foaming phenomenon.

**Key Words:** swine, manure, microbiota

**W357 Effects of supplementing piglets post-weaning with an oral rehydration solution or lactic acid on growth and performance.** L. Seefeldt\*, S. I. Kehoe, and G. Onan, *University of Wisconsin, River Falls*.

According to a survey performed in 2000, 2.4% of piglets die before exiting the nursery stage. Of those, 12.6% are due to diarrhea and 13.3% are due to starvation (USDA, 2000). The objective of the first trial was to evaluate the effects of adding an oral rehydration solution (ORS; Tech-Mix BlueLite Swine Formula) to the drinking water (all water sources were well water) of newly weaned piglets (17-21 d of age) on gain and performance. The objective of the second trial was to evaluate whether lowering pH of the drinking water would have any effects on gain and performance. For experiment 1, a randomized complete block design consisted of a treatment of water (W; n=98 piglets) and added oral rehydration solution (ORS; n=111 piglets). For experiment 2, the same design was used with a third treatment using lactic acid (LA; n=55 piglets). The ORS groups were administered the ORS product at labeled rates through their water supply for the first 5 days post-weaning. For each trial, litters were initially sorted at weaning and placed into one of six tubs or one of two floor pens. Piglets were weighed every 2 days for week one and weekly thereafter for the next 3 weeks. Hematocrits, glucose, bodyweights, drinking water and behavior were recorded every 2 days for the first week. Feed intake and body weights were recorded weekly throughout the trial. The Mixed procedure of SAS 9.1 was used with pen as the experimental unit and housing as a covariate. For experiment 1, there were no significant differences in gain per piglet (W:284.86g/d and ORS:299.5g/d), feed intake (W:100.9kg and ORS:114.3kg), water intake (W:195.8L and ORS:110.9L), or blood parameters. For experiment 2, means of water pH at the nipple were 4.5 which were similar to ORS treatment. There were no significant differences in gain per piglet (W:284.86g/d, ORS:299.5g/d and LA:307.54g/d), feed intake (W:101.1kg, ORS:114.7kg and LA:121.6kg), water intake (W:105.7L, ORS:179.5L and LA:133.2L), or blood parameters. This research concludes that supplementation with ORS or lactic acid for the first 5 days post weaning results in little benefit.

**Key Words:** piglets, oral rehydration, weaning

**W358 Comparison of growth performance for pigs raised indoor and outdoor.** T. White\*, I. Martinez, T. Barrios, and S.-H. Oh, *Department of Animal Sciences, North Carolina Agricultural & Technical State University, Greensboro*.

Monitoring the growth patterns of pigs raised in alternative and conventional systems is important in understanding their physiological characteristics and performance. Studies comparing alternative and conventional pig systems have been variable and further studies comparing specific breeds have been limited. Two trials were conducted to compare the feed efficiency and growth output between Landrace and Yorkshire pigs raised under conventional confinement and pasture grazing systems post-weaning. Eight weight measurements were collected in Trial 1 comparable to six weight measurements collected in Trial 2 with each trial lasting 36-days. Custom grow-out feed was weighed and distributed *ad libitum* to calculate feed intake. In Trial 1, a significant difference for feed efficiency between the indoor (0.429) and outdoor (0.553) environments was determined via analysis with Duncan's test. Only mean weights of 21.40 kg and 16.94 kg were significant between indoor and outdoor systems during the second measurement out of 36-days. In Trial 2, Duncan's tests revealed no significant differences for mean weight between breeds, gender, and production system for any of the measurement intervals. There was however, a significant difference in mean weight gain ranging between four litters measuring 19.19, 17.72, 15.45, and 12.44 kg. MANOVA observed an interaction ( $P < .0001$ ) for breed and the number of days allotted for growth effect throughout the 36-day period. The results of this study suggest that breed selection and the amount of days designated for rearing in certain systems are key in determining positive outcomes for optimal growth performance. Further research in this area may help small farm producers decide the optimal time to move pigs out to pasture systems following post-weaning.

**Key Words:** outdoor, growth, pig