5A-101: Improving sow reproductive output through dietary manipulation in late lactation (2D-121)

Report prepared for the Co-operative Research Centre for High Integrity Australian Pork

By

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Executive Summary

This research project addressed the problem of inadequate lactation feed intake by sows resulting in sub-optimal subsequent reproductive performance. We know that sows place the highest priority on milk production during lactation & will normally attempt to maximise the output of milk nutrients for their offspring regardless of maternal nutrient intake. Hence, in many situations lactating sows are compelled to rapidly mobilise maternal tissue to provide substrates for milk production to compensate for deficiencies in lactation feed intake. Even so, in many first lactation sows the rate at which they catabolise their own body reserves is not fast enough to prevent reductions in milk nutrient output. The literature suggests that those sows that are forced to mobilise maternal tissue at or near the maximum rate are most at risk of reproductive failure post-weaning (see Thaker & Bilkei, 2005). This effect is particularly noticeable in late lactation when the quality (& possibly number) of oocytes to be released at the post-weaning ovulation is determined. This study asked two questions:

- How can nutrient intake be increased in late lactation when the sow would normally already be on an *ad libitum* or high allowance regimen?

- Will any additional nutrient intake in late lactation actually be partitioned to maternal tissue (hence benefitting oocyte development & quality) or will it simply enhance late lactation output?

A single experiment was conducted used 36 sows allocated to one of three treatments – (a) 4 kg/day of a standard lactating sow diet throughout a 24 day lactation, (b) 4 kg/day of a standard lactating sow diet throughout lactation plus a daily supplement of 1 kg/d of a top dressing (comprising a mixture of glycerine, sugars, starches, oils & quality proteins) given over the last 7 days of the lactation & (c) 6 kg/day of a standard lactating sow diet throughout lactation. To assess the impact of the feed intake & dietary supplement on the sow's lactation, milk samples were collected from each sow on days –7, -3 & -1 pre-weaning. On the same days milk output was assessed using a weigh-suckle-weigh technique. After weaning all sows were checked twice daily for oestrus in the presence of a boar & the first 8 sows to show oestrus in each treatment group were slaughtered & oocytes harvested from their ovaries. The size of the presumptive ovulatory follicle pool was counted and the oocytes aspirated from these follicles were matured in vitro to assess their developmental competence and ability to progress through the early stages of embryonic development.

The results from this experiment suggested that either oocyte developmental competence, as measured by blastocyst formation in vitro, is impaired by high level feeding during late lactation or alternatively, that blastocyst development is not impaired by restrictive feeding.

We conclude that either feeding level in late lactation does not affect litter size via changes in oocyte development, or that the current measure of oocyte development is not appropriate.

Given these findings we conclude that this study failed to identify commercial value for supplementary feeding of sows in late lactation. In view of this, it was decided to conclude the project at this stage.

Table of Contents

1. Introduction

Both sow reproductive performance (conception/farrowing rate & litter size) & sow longevity are significantly lower in Australian herds than they are in those of our competitors (e.g. USA, Canada, Denmark & The Netherlands). While some of this may be due to genotype differences there seems little doubt that much of the problem lies with the nutrition & management of Australian sows.

There is now a wide body of evidence to show that sows place the highest priority on milk production during lactation & will normally attempt to maximise the output of milk nutrients for their offspring regardless of maternal nutrient intake (see Pluske et al, 1998; Smits et al, 2008). Hence, in many situations lactating sows are compelled to rapidly mobilise maternal tissue to provide substrates for milk production to compensate for deficiencies in lactation feed intake. Even so, in many first lactation sows the rate at which they catabolise their own body reserves is not fast enough to prevent reductions in milk nutrient output. The literature suggests that those sows that are forced to mobilise maternal tissue at or near the maximum rate are most at risk of reproductive failure post-weaning (see Thaker & Bilkei, 2005). However, it is still unclear whether or not this effect is modified on the basis of the sow's actual tissue status at weaning. For example, while Smits et al (2008) were able to demonstrate a positive effect of lactation energy intake on sow post-weaning performance in the apparent absence of a change in milk output (as measured by litter weaning weight) in heavy gilts at first farrowing, our own studies suggest that increasing sow protein reserves at farrowing or increasing lactation protein intake both fail to alter sow reproductive performance as the sow simply uses the extra protein to maximise the output of milk nutrients.

However, once the lactation curve is set it seems likely that changing nutrient input will have little or no impact on milk nutrient output. Under these conditions it would be expected that the nutrient balance of the sow would be significantly improved prior to weaning. This would be expected to improve sow longevity through a faster return to oestrus & lower anoestrus rate. Perhaps more importantly, improving the net nutrition of the sow in the approximately two week period leading to the post-weaning oestrus & ovulation, rather than just the 4-7 day weaning-to-oestrus period, would almost certainly improve the quality (& possibly number) of oocytes at ovulation thus improving conception rates & embryo survival rates & litter size (see Zak et al, 1997; Koutsotheodorus et al, 1998; Ashworth et al, 1999; Almeida et al, 2000; Foxcroft & Town, 2004). It is also possible that this change in oocyte quality may result in a shorter weaning-to-oestrus interval & a higher ovulation rate (Quesnel et al, 2005; Quesnel et al, 2007).

This raises two questions:

1. How nutrient intake can be increased in late lactation when the sow would normally already be on an ad libitum or high allowance regimen?

2. Will any additional nutrient intake in late lactation actually be partitioned to maternal tissue (hence benefitting oocyte development & quality) or will it simply enhance late lactation milk output?

It is likely that increasing nutrient intake in late lactation may be achieved by provision of a daily supplement of a high nutrient density top dressing for the last 7 days of the lactation. Hence, this study was established to identify the impact of additional nutrient intake in late on (1) output of nutrients in milk (measurable via collection of milk samples & use of a piglet weigh-suckle-weigh technique) & (2) oocyte development & quality as measured by number of ooctes ovulated at the post-weaning oestrus & the ability of these oocytes to fertilise & develop through to normal blastocysts.

2. Methodology

Animals and treatments

This study was performed in accordance with the Australian code of practice for the care and use of animals for scientific purposes (National Health and Medical Research Council, Canberra 1997) and with the approval of The University of Adelaide Animal Ethics Committee (Animal Ethics Number: S-2010-011). All animal work was conducted at The University of Adelaide's Piggery, Roseworthy, South Australia. The study involved 36 Large White x Landrace primiparous sows divided into three treatment groups (n = 12 sows/treatment) and was conducted in three blocks between May and August. Throughout lactation sows were fed a standard lactation diet (Table 1), and received either 6 kg per day (HIGH), 4 kg per day (RES), or 4 kg per day until the last week of lactation (7 days prior to weaning) when 1 kg per day of a specially designed supplement (Table 2) was added to their daily 4 kg ration (SUPP). Sows were stratified according to liveweight at farrowing shed entry and liveweight loss from day 1 post-parturition to day -7 relative to weaning, and randomly allocated to each treatment.

Management, housing and feeding

Three days prior to farrowing, sows were moved to the farrowing house and allowed to farrow naturally. Within 24 hours of farrowing litters were standardised to 10 piglets per sow through cross-fostering. This litter size was maintained throughout the entire lactation. During lactation, the amount of feed offered each day was increased gradually, reaching either 4 kg (RES and SUPP) or 6 kg/day (HIGH) by day 5 of lactation, and was fed over three meals per day. Sows in the SUPP treatment received 1 kg/day of the experimental supplement spread across each of their three daily meals. Water was freely available to both the sows and piglets throughout the entire experimental period, and maternal milk was the only feed

source provided to the piglets. Sows were weaned on day 26.7 ± 0.16 post-parturition (where day 0 = first 24 hours post-farrowing). Post-weaning, sows were housed in groups of 4, and fed 3 kg per day of the standard lactation diet (Table 1). Three days after weaning, all sows were slaughtered at a commercial abattoir, and the reproductive tracts collected.

Table 1. Composition of standard lactation diet (%, as fed basis)

Ingredients	%
Wheat	23.00
Barley	14.70
Triticale	20.00
Peas	5.00
Mill mix	10.00
Canola meal	5.00
Soya bean meal	6.20
Meat meal	4.80
Fish meal	2.00
Blood meal	1.30
Molasses	2.00
Tallow	3.60
Salt	0.40
Limestone	1.10
Lysine sulphate	0.40
Potassium chloride	0.20
Choline chloride	0.02
Sow PMX + Bioplex	0.30
Calculated nutrient composition	**%**
DE	14.21
NE	9.87
Protein	19.80
Fat	6.52
Fibre	4.00
Lysine	1.19
Threonine	0.72
Tryptophan	0.21
Met + Cys	0.73
Alysine	1.03
Methionine	0.36
Calcium	1.01
Phosphorus	0.66
Isoleucine	0.70
Ash	5.60

Table 2. Composition of experimental dietary supplement (%, as fed basis)

Ingredients	%
Groats	25.00
Biscuitmeal (10%)	20.00
Dextrose	10.00
Full fat soya	20.00
Glycerol	6.00
Fishmeal (67%)	10.00
Bloodmeal	3.00
Fish oil	2.00
Vegetable oil	2.00
Limestone	1.00
Dicalphos	1.00
Lienerchrom 400	0.10
L/A HP Breeder + Bioplex	0.28

Calculated nutrient composition	%
DE	17.11
NE	12.29
Protein	21.86
Fat	13.75
Fibre	2.00
Lysine	1.41
Threonine	0.88
Tryptophan	0.27
Met + Cys	0.78
Alysine	1.27
Methionine	0.42
Calcium	1.01
Phosphorus	0.68
Isoleucine	0.86
Ash	5.50

Animal measurements

Liveweight and body composition

Sows were weighed and P2 backfat was measured at entry into the farrowing shed, day 1 of lactation, day -7 relative to weaning, day of weaning and day 3 post-weaning (day of slaughter). P2 backfat was measured over the last rib, 65 mm down from the vertebrae using a 5 MHz linear probe (Aquila Vet, Pie Medical Equipment). Piglets were weighed individually within 24 hours post-parturition, and on days -7, -4 and -1 relative to weaning (w-7d, w-4d, w-1d).

Milk composition
Maternal milk samples were collected from all sows on day -7, -4 and -1 relative to weaning and analysed for fat, lactose and protein content. Samples were collected approximately 45 minutes after removal of the litter following a 1ml intra muscular injection of oxytocin (Ilium syntocin; Troy Laboratories, New South Wales). A 20ml sample of milk was manually extracted from functional teats. One Broad Spectrum Microtab was added to the 20ml sample to preserve the milk and all samples were frozen at -20^{o}C. Fat, lactose and protein concentrations in collected milk samples were measured by infrared spectroscopy using a Bentley 2500 Combi instrument (Bentley Instruments, Chaska, Minnesota, USA). A standardised milk solution was used prior to each assay run to confirm the calibration stability of the instrument readings.

Collection of blood samples
Preprandial blood samples were collected on day 1 of lactation, as well day – 7 relative to weaning, day of weaning and day 3 post-weaning. Samples were collected by jugular venipuncture into 9 ml Lithium Heparin coated collection tubes (Vacuette®, Griener Bio-one, Labortechnik, Austria). Samples were kept on ice, and within an hour of collection were centrifuged for 15 minutes at 2000 g. Plasma was stored in 1.5 ml tubes at -20^{o}C until analysed.

Analysis of plasma samples
Plasma samples were analysed for plasma urea nitrogen (PUN), non-esterified fatty acids (NEFA) and creatinine concentrations.

PUN
The quantitative determination of plasma urea was performed with a Hitachi 912 automated sample system using the UREA BUN assay kit, with the C.f.a.s. Calibrator, and quality controls Precinorm U and Precipath U (Roche Diagnostics, NSW, Australia). The mean coefficient of variation was less than 5%.

NEFA
The quantitative determination of plasma NEFA was performed with a Hitachi 912 automated sample system using the NEFA-C Free Fatty Acid assay kit (Wako, Japan, through NovoChem, Australia) and quality controls QCS 1 and 2 (Bio-Rad, Australia). The mean coefficient of variation was less than 4.6%.

Creatinine
The quantitative determination of plasma creatinine was performed with a Hitachi 912 automated sample system using the CREA assay kit, with the C.f.a.s. Calibrator, and quality controls Precinorm U and Precipath U (Roche Diagnostics, NSW, Australia). The mean coefficient of variation was less than 6%.

Reproductive measurements
All chemicals were obtained from Sigma Chemical Co. (St. Louis, MO, USA) unless otherwise stated.

Collection of ovaries and oocytes
The reproductive tract was recovered with 5 minutes of slaughter. Ovaries were placed in individual tubes containing Phosphate Buffered Saline and maintained at 30^{o}C during transport to the laboratory. Upon arrival at the laboratory, ovaries were weighed, follicle diameter measured (Absolute Digmatic Caliper, Mitutoyo; Japan) and all follicles larger than 4mm were collected into aspiration medium (Hepes (Sigma) buffered TCM 199 with 4mg/mL BSA (Fraction V; Invitrogen Corporation, Auckland, New Zealand), 100 µg/mL streptomycin sulphate (CSL Limited; Parkville, Victoria, Australia) and 100 IU/mL penicillin G (CSL Limited)) using an 18-gauge needle and a vacuum pump (Cook Australia, Queensland, Australia) at a pressure of 25 mm Hg. The time from ovary collection to aspiration was 2 – 3 hours. Follicles measuring 1 – 4 mm were also recorded but not aspirated. Cumulus oocyte complexes (COCs) of equal diameter were recovered using a dissecting microscope and placed into *in vitro* maturation (IVM) medium.

In vitro maturation
In vitro embryo production procedures were similar to those previously outlined (Kelly *et al.*, 2010/in press). Briefly, COCs were washed three times in aspiration medium and twice in maturation medium (sodium bicarbonate-buffered TCM 199 containing 20% (v/v) porcine follicular fluid (pFF), …..mg/mL Sodium Pyruvate, 5 µg/mL FSH (Folltropin; Bioniche), 5 µg/mL LH (Lutropin; Bioniche inc.), 1 µg/mL oestradiol, 10 µg/mL epidermal growth factor (EGF), 100 µM cysteamine, 100 µg/mL streptomycin sulphate and 100 IU/mL penicillin G). They were then matured in culture wells (Nunc Inc., Naperville, IL, USA) containing 600µl of maturation medium covered with 300µl of mineral oil for 44±2 hours in a humidified atmosphere of 5% CO_2 in air at 38.6^{o}C.

In vitro fertilisation
In vitro fertilisation (IVF) was carried out in a modified TRIS medium. Following maturation, COCs were transferred into a 0.1% hyaluronidase solution for 30 seconds to remove the excess cumulus cells leaving corona radiata cells intact. The oocytes were washed three times in the fertilisation medium and transferred to a culture well containing 500µl of the IVF medium, overlayed with 300µl of mineral oil. A proportion of oocytes from each sow were denuded and mounted on a slide in Hoechst 33342 stain (as outlined below). Nuclear maturation status of the oocytes was assessed using a fluorescent microscope (Olympus Optical Co. Ltd., Tokyo, Japan).

Sperm Preparation
Freshly collected semen from two randomly selected boars was purchased from a commercial AI collection centre (SABOR Pty. Ltd; Clare, South

Australia). Each sample was centrifuged for 5 minutes at 780 g. The supernatant was removed and sperm was resuspended in 5ml of sperm preparation medium (SPM; Hepes synthetic oviduct fluid (SOF) supplemented with 5mg/mL BSA, 50mg/mL caffeine and 20mg/mL heparin). Semen was re-centrifuged at 780 g for 5 minutes before being incubated at 38.6^{o}C for 45 minutes. Following incubation, the sperm were gently mixed and spun again for 5 minutes at 780 g. 100µL of sperm was resuspended in 900µL of SPM. Sperm concentration and viability was determined for each sample. Sperm from the sample with the highest viability was added to the oocytes to give a total sperm concentration of 0.5 x 10^{6}sperm/mL. Sperm were co-incubated with the oocytes in a humidified atmosphere of 5% CO_2 in air at 38.6^{o}C for 6 hours.

In vitro culture

Following incubation, spermatozoa and remaining cumulus cells were removed from the surface of the zona pellucida using a fine bore glass pipette. Presumptive zygotes were washed three times in IVC medium (Hepes SOF supplemented with 4 mg/mL BSA, pyruvate, amino acids at sheep oviduct fluid concentrations (Walker *et al*. 1996), and hypotaurine) and incubated in a culture well containing 600µl of IVC medium covered with 300µl of mineral oil at an atmosphere of 5% CO_2, 5% O_2 and 90% N_2 at 38.6^{o}C. Cleavage rate was recorded 48 hours following fertilisation and oocytes that had not cleaved were removed and stained with Hoechst. Embryo development and blastocyst total cell counts were recorded on day 6 (day of IVF = day 0).

Evaluation of oocyte nuclear status, fertilisation and blastocyst cell numbers with nuclear staining

Oocytes and day 6 embryos were placed on a microscope slide in a drop of glycerol containing 1mg/mL Hoechst 33342 and covered with a coverslip. The nuclear status of the oocytes were assessed as either germinal vesicle (GV), germinal vesicle breakdown (GVBD), meiosis I (MI), anaphase-telophase (A-T) or meiosis II (MII). Blastocyst nuclei were counted using a fluorescent microscope.

Statistical analysis

Data are expressed as mean ± SEM. The data was analysed using Genstat, 11th Edition (VSN International, UK), using either a linear mixed model or general analysis of variance (ANOVA). All dependant variables were checked for normality using histogram plots and checking residuals. Sow was the unit of measurement for determining treatment effects on piglet growth, follicle characteristics, and measures of oocyte developmental potential. The model included block and treatment as fixed effects, with sow liveweight and P2 backfat on day 1 of lactation as co-variates.

3. Outcomes

Piglet weight at birth did not differ between treatment groups (table 3), nor did weight gain from birth to 7 days prior to weaning. Piglets within the HIGH and SUPP treatment groups did experience significantly greater weight gain in the last week of lactation (-7 to -1 days relative to weaning) compared to those within the RES treatment group.

Table 3. Piglet birth weights and weight gain throughout lactation across treatments (mean ± SEM).

	Negative (n=12)	Positive (n=12)	Supplement (n=12)
Day 0 weight (kg)	1.53 ± 0.05	1.49 ± 0.04	1.43 ± 0.03
Weight gain d 0 – w-7d (kg)	4.12 ± 0.11	4.11 ± 0.12	4.19 ± 0.10
Weight gain w-7d – w-1d (kg)	1.43 ± 0.04[a]	1.61 ± 0.05[b]	1.61 ± 0.03[b]
Total weight gain (kg)	5.55 ± 0.13	5.72 ± 0.15	5.79 ± 0.12

*a and b significantly different, $p<0.05$

Farrowing weight of sows within the HIGH and SUPP treatments differed significantly (table 4), however when analysing the data, this was adjusted for. From day 1 of lactation to 7 days prior to weaning, sows in the RES and SUPP treatment groups lost a significantly higher percentage of body weight (9.8% and 7.7% respectively) than those receiving the HIGH ration (3.9%). From the first day of treatment (w-7d) until weaning however, SUPP and RES differed significantly in percentage weight loss with the sows on the RES diet losing 4.7% while those on the SUPP diet lost only 1.3% of their bodyweight. There was no significant difference between treatments in backfat loss throughout lactation.

Table 4. Sow weight and backfat change throughout lactation across treatments (mean ± SEM).

	Negative (n=12)	Positive (n=12)	Supplement (n=12)
Day 1 of lactation			
Farrow weight	199.0 ± 5.1[ab]	205.0 ± 4.0[a]	198.0 ± 4.64[b]
Farrow backfat	20.9 ± 1.2	23.8 ± 1.7	2.4 ± 0.2
Day 1 – w-7d			
Weight loss (%)	9.8 ± 1.1[a]	3.9 ± 0.8[b]	7.7 ± 1.2[a]
Backfat loss (%)	21.4 ± 7.8	19.4 ± 7.3	31.5 ± 3.1
w-7d - Weaning			
Weight loss (%)	4.7 ± 0.4[a]	2.7 ± 0.9[ab]	1.3 ± 0.5[b]
Backfat loss (%)	-11.7 ± 9.8	13.6 ± 9.0	-10.2 ± 8.2

*a and b significantly different, $p<0.05$

The proportion of follicles within each size category did not differ significantly between any of the treatment groups.

Table 5. Proportion of follicles within each size category across treatments (mean ± SEM).

	Negative (n=12)	Positive (n=12)	Supplement (n=12)
Follicles <4mm	30.8 ± 4.4	25.1 ± 4.8	31.4 ± 6.1
Follicles >4mm	28.0 ± 1.3	27.6 ± 1.9	30.9 ± 3.2
4-4.99mm (%)	24.4 ± 5.9	22.3 ± 6.9	21.2 ± 4.5
5-5.99mm (%)	24.7 ± 2.5	24.2 ± 3.4	28.6 ± 4.8
6-6.99mm (%)	26.8 ± 2.6	28.1 ± 3.3	23.4 ± 3.5
7-7.99mm (%)	16.4 ± 3.6	20.9 ± 4.5	18.3 ± 5.2
>8mm (%)	8.3 ± 2.9	4.4 ± 1.8	8.5 ± 3.9

The percentage of cleaved embryos that developed into blastocysts differed significantly between the HIGH and SUPP treatment groups (table 6). SUPP had the greatest percentage develop (74.60), and then RES (71.04) and HIGH had the lowest (53.66).

Table 6. Sow reproductive performance across treatments, including proportion of embryos at each stage of development (mean ± SEM).

	Negative (n=12)	Positive (n=12)	Supplement (n=12)
Oocytes fertilised	14.33 ± 0.69	12.82 ± 1.72	17.33 ± 2.88
Cleaved (%)	63.71 ± 6.85	56.68 ± 8.89	66.47 ± 7.28
Cleaved to blastocyst (%)	71.04 ± 9.34[ab]	53.66 ± 8.28[a]	74.60 ± 5.95[b]
Embryo development			
Early blastocyst (%)	18.20 ± 9.70	35.50 ± 10.90	15.80 ± 6.10
Blastocyst (%)	23.80 ± 7.40	17.00 ± 5.70	20.70 ± 6.70
Expanded blastocyst (%)	50.80 ± 9.90	33.80 ± 9.50	61.20 ± 8.20
Hatching blastocyst (%)	4.49 ± 2.39	*	2.31 ± 1.60
Totally hatched blastocyst (%)	2.62 ± 1.44	*	*

*a and b significantly different, $p<0.05$

Milk fat composition 4 days prior to weaning was significantly higher in the RES treatment group than the SUPP treatment group (table 7). HIGH and SUPP treatments had significantly lower fat content in the maternal milk than the RES treatment group. Over all the measurement days, RES had significantly higher milk fat content than HIGH and SUPP. Milk lactose content was significantly higher in both HIGH and SUPP than RES 4 days prior to weaning and over all measurement days. Milk protein content differed significantly only when pooled across treatments. Milk collected 4 days prior to weaning had significantly lower protein content than milk collected 1 day prior.

Table 7. Sow milk fat, lactose and protein composition at different measurement days across treatments (mean ± SEM).

	Negative (n=12)	Positive (n=12)	Supplement (n=12)	**Pooled across treatments**
Milk fat composition				
w-7d	7.96 ± 0.31	7.27 ± 0.24	7.45 ± 0.35	**7.56 ± 0.21**
w-4d	8.75 ± .035^{q}	7.80 ± 0.35^{qr}	7.05 ± 0.22^{r}	**7.87 ± 0.49**
w-1d	8.67 ± 0.37^{r}	7.56 ± 0.31^{q}	7.51 ± 0.56^{q}	**7.91 ± 0.38**
Pooled across days	**8.46 ± 0.25^{b}**	**7.54 ± 0.15^{a}**	**7.34 ± 0.14^{a}**	
Milk lactose composition				
w-7d	5.63 ± 0.05	5.65 ± 0.04	5.67 ± 0.04	**5.65 ± 0.01^{x}**
w-4d	5.35 ± 0.06^{q}	5.58 ± 0.05^{r}	5.70 ± 0.03^{r}	**5.54 ± 0.10^{y}**
w-1d	5.56 ± 0.08	5.69 ± 0.08	5.68 ± 0.07	**5.64 ± 0.04^{x}**
Pooled across days	**5.51 ± 0.08^{b}**	**5.64 ± 0.03^{a}**	**5.68 ± 0.01^{a}**	
Milk protein composition				
w-7d	4.03 ± 0.09	4.01 ± 0.07	4.18 ± 0.13	**4.07 ± 0.05^{xy}**
w-4d	3.97 ± 0.14	4.04 ± 0.05	3.99 ± 0.12	**4.00 ± 0.02^{x}**
w-1d	4.04 ± 0.09	4.17 ± 0.08	4.31 ± 0.14	**4.17 ± 0.08^{y}**
Pooled across days	**4.01 ± 0.02**	**4.07 ± 0.05**	**4.16 ± 0.09**	

*a and b significantly different, $p<0.05$
*q and r significantly different, $p<0.05$
*x and y significantly different, $p<0.05$

4. Application of Research

This project set out to identify a cost-effective supplementary feeding system for lactating sows that raised subsequent litter size by 1 piglet via an improvement in the quality of the oocytes shed at the first post-weaning oestrus. Contrary to the available literature, the study actually demonstrated that either oocyte developmental competence, as measured by blastocyst formation in vitro, is impaired by high level feeding during late lactation or alternatively, that blastocyst development is not impaired by restrictive feeding. Hence, at this stage it does not offer a commercialization opportunity. It does, however, require follow-up by suitably qualified people to unravel the underlying complex mechanisms identified in the study.

5. Conclusion

We conclude that either feeding level in late lactation does not affect litter size via changes in oocyte development, or that the current measure of oocyte development is not appropriate.

6. Limitations/Risks

This project failed to verify that additional nutrient intake in late lactation would improve oocyte development & quality, with a consequent improvement in subsequent litter size. Tentatively, the data suggest that the additional nutrient intake simply enhanced late lactation milk output.

7. Recommendation

As a result of the outcomes in this study, it is recommended that pig producers do not attempt to raise subsequent reproductive performance of sows by providing supplementary feeding in late lactation.

8. References

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