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Optimising annual output per sow by increasing the number of viable piglets



Key external stakeholders:

Pig producers, the Teagasc pig advisors, agricultural consultants, pig breeding companies, pig veterinarians, feed industry personnel and associations, animal nutritionists other researchers and DAFM

Practical implications for stakeholders:

1. Over feeding sows during gestation will reduce born alive and lactation feed intake
2. L-carnitine (CAR) and sugar beet pulp (SBP) should be fed to gilts during gestation to increase progeny growth to slaughter
3. Feeding CAR to multiparous sows should increase sow litter size and offspring muscle development.
4. Feeding salmon oil in lactation diets should increase sow milk yield and piglet pre-weaning growth
5. Increasing dietary energy density during lactation should increase lactation energy intake
6. Use of nurse sows either 7 or 21 days into lactation are an effective way to manage large litters
7. Minimising cross fostering will improve piglet growth rate to weaning

Main results:

Key results are

- Excessive back-fat deposition during gestation reduced born alive and lactation feed intake.
- Feeding L-carnitine (CAR) to gilts during gestation increased the live weight, carcass weight, and muscle depth of progeny at slaughter.
- Feeding a high sugar beet pulp (SBP) diet to gilts increased live weight and carcass muscle depth of progeny at slaughter.
- Feeding CAR to multiparous sows increased sow litter size and muscle maturity in offspring.
- Substituting soya oil with salmon oil in lactation diets improved sow milk yield and litter gain during the suckling period.
- Increasing the energy density of lactation diets increased energy intake in sows.
- Nurse sows either 7 or 21 days into lactation were equally effective in rearing piglets, with no negative implications for sow welfare or subsequent performance.
- Cross fostering piglets had a negative impact on growth, and this was greater for larger piglets.

Opportunity / Benefit:

Litter sizes in Ireland are steadily increasing year on year, which poses significant challenges with regard to sow and piglet management, and subsequent pig performance. The data generated here can be immediately used by producers as it provides objective information regarding the advantages that various dietary strategies have for gestating and lactating sows. The work on piglet management strategies has provided answers about how to optimize survival and performance in piglets from large litters.

Project team:

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1. Project background:

Sow output in Ireland is below that in more efficient pig producing countries. If an Irish 500 sow unit could increase output to that achieved in The Netherlands (26.5 pigs/sow/year), net profit p.a. would increase by €35,650. This would further stimulate growth of the national herd. Welfare and ethical concerns mean that genetic selection for hyper-prolificacy has received negative publicity in Denmark where large litters of light, marginally viable pigs are associated with increased mortality. Hence, increases in sow output in Ireland should be achieved in a more sustainable manner. The objective of this project is to increase sow output by: 1. Improving sow nutrition (feed allowance, L-carnitine, L-arginine, fish oil, vitamin D supplementation, fermentable substrates) to maximise the sows' genetic potential for large litters while also increasing viability of the additional pigs born; 2. Improving colostrum quality to reduce piglet mortality; 3. Implementing pre-weaning interventions (nurse sows, rescue decks and energy supplementation) to keep weak piglets alive. Archived databases from sow nutrition studies will be mined and animal experiments conducted. Best practice guidelines for optimisation of sow output will be prepared and results will be disseminated effectively to enable prompt adoption by stakeholders with the aim of realising Harvest 2020 targets.

2. Questions addressed by the project:

- Is there a relationship between sow parity, live-weight and back-fat depth and sow productivity?
- Can nutritional supplements for gestating sows increase the number of piglets born and/or piglet birth-weight, and improve their lifetime growth?
- Does energy density and the oil type provided to sows during lactation impact piglet vitality and growth, and the ability of the sow to maintain condition during lactation?
- Are nurse sow strategies effective in rearing piglets without compromising their welfare, and does the timing of nurse sow allocation affect sow performance?
- Is artificial rearing a viable alternative to nurse sow strategies with regard to piglet welfare and performance?
- Can energy supplementation on the first day of life improve the survival chances of piglets?

3. The experimental studies:

The overall objective of this project was to sustainably increase the number of pigs produced/sow/year to levels achieved in the most efficient pig producing countries by using nutritional and management strategies.

Association analysis of sow parity, live-weight and back-fat depth as indicators of sow productivity: The objective of this study was to quantify the association between sow parity, live-weight and back-fat depth during gestation with subsequent sow reproductive performance. Records of 1058 sows and 13 827 piglets from 10 trials on two research farms between the years 2005 and 2015 were analysed. Variables that were analysed included total born (TB), born alive (BA), piglet birth weight (BtWT), pre-weaning mortality (PWM), piglet wean weight (WnWT), number of piglets weaned (Wn), wean to service interval (WSI), piglets born alive in subsequent farrowing and sow lactation feed intake.

CAR and SBP supplementation of gilts: This study evaluated the effects of CAR and SBP inclusion in gilt gestation diets on gilt live-weight, cortisol concentration, lactation feed intake, and lifetime growth of progeny. Eighty-four pregnant gilts were randomly assigned to treatment at day 38 of gestation until parturition; Control (0% SBP, 0 gCAR), CAR (0.125 g/d CAR), SBP (40% SBP), and SBP plus CAR (40% SBP, 0.125 g/d CAR).

CAR supplementation of multiparous sows: This study aimed to investigate the effect of L-carnitine (CAR) supplementation to sows during gestation and lactation on sow performance, semitendinosus muscle (STM) maturity and lifetime growth in progeny. Sows (N=64) were randomly assigned to treatment on d1 of gestation until weaning; CONTROL (0mg CAR/d), GEST (125mg CAR/d during gestation), LACT (250mg CAR/d during lactation), and BOTH (125mg CAR/d during gestation & 250mg CAR/d during lactation).

Increasing dietary energy density for sows during lactation: The objective of this study was to investigate the effect of increasing dietary energy (DE) density for lactating sows on weight and back-fat changes in sows, milk composition, piglet vitality and growth of progeny. Gestating sows (N=100; Large White x Landrace) were randomly assigned to one of four energy dense diets at d108 of gestation until

service; 13.8 (LL), 14.5 (L), 15.2 (H), and 15.9 MJ DE/kg (HH).

Dietary oil type and energy intake in lactating sows: This study investigated the effect of salmon oil in lactating sow diets and offering lactation diets in a phased dietary regimen to increase the energy density of the diet in late lactation. Sow and piglet productivity to weaning, were the main parameters measured. Multiparous sows (n=100) (LR x LW) were offered dietary treatments from day 105 of gestation until weaning. Dietary treatments (2 x 2 factorial) included oil type (soya or salmon oil) and dietary regimen (Flat 14.5 MJ DE/kg diet offered until weaning or Phased 14.5 MJ DE/kg diet offered to day 14 of lactation then a second diet containing 15.5 MJ DE/kg offered from day 15 until weaning).

The effect of nurse sow strategies on sow and piglet performance and welfare: Two different nurse sow strategies were compared: sows which were either 7 or 21 days into lactation had their own piglets removed, and were assigned day old piglets. Piglets from sows 7 days into lactation were moved onto another sow 21 days into lactation. We also compared the effects of leaving litters intact on their mothers, or cross fostering other piglets into the group. The behaviour and weights of sows and piglets were monitored throughout lactation, as well as stress hormone levels in sows.

The effect of artificial rearing in the milk feeding period on piglet performance and welfare: Seven day old piglets were removed from their mother, and placed in an artificial rearing (Rescue Deck[®]). The growth and behaviour of these piglets was monitored until slaughter, and compared to similar aged piglets which remained with their mother.

Use of energy supplementation to improve piglet vitality and survival: At 3 hours post-partum, piglets weighing under 1.1Kg were either 1: dosed with 2ml of coconut oil, 2: 2ml of a commercial energy supplement, 3: 2 ml of water, or 4: sham dosed. Their survival, growth, temperature and glucose levels were monitored in detail over the first 24h of life, as well as weight and survival to weaning.

4. Main results:

- **Association analysis of sow parity, live-weight and back-fat depth as indicators of sow productivity:** Heavier sow live-weight throughout gestation was associated with an increase in PWM and reduced Wn and lactation feed intake. Deeper back-fat in late gestation was associated with fewer BA but heavier BtWT, whereas deeper back-fat depth throughout gestation was associated with reduced lactation feed intake. This study showed that sow parity, live-weight and back-fat depth can be used as indicators of reproductive performance.
- **CAR and SBP supplementation of gilts:** Fed separately to gilts, CAR increased the live weight, carcass weight, and muscle depth of progeny at slaughter. Feeding a SBP diet increased fecal consistency in gilts pre-farrowing and increased live weight and carcass muscle depth of progeny.
- **CAR supplementation of multiparous sows:** CAR supplementation during gestation increased litter size at birth without compromising piglet birth-weight. Results also showed that the muscle of piglets born to sows supplemented with CAR during gestation was more mature at birth. However, carcass weight at slaughter was reduced in progeny of sows fed CAR.
- **Increasing dietary energy density for sows during lactation:** Increasing the energy density of lactation diets increased energy intake in sows, without depressing appetite and prevented the excessive mobilisation of maternal body reserves. Feeding a 15.9 MJ DE/kg diet improved piglet muscle tone at birth, whereas feeding a 15.2 MJ DE/kg diet increased litter size at weaning. Inconsistent results were observed for other traits of piglet vitality and for pre-weaning litter growth.
- **Dietary oil type and energy intake in lactating sows:** Substituting soya oil with salmon oil in lactation diets improved sow milk yield and litter gain during the suckling period. Additionally, salmon oil tended to reduce pre-weaning mortality, therefore its use in lactation diets should be further investigated. A phased dietary energy regimen increased sow lactation energy intake, but sow body condition and piglet growth performance to weaning were not improved.
- **The effect of nurse sow strategies on sow and piglet performance and welfare:** No difference was detected between nurse sows and non-nurse sows in body condition or severity of lesions. Although some nurse sows experienced stress at fostering, no long-term effect of the nurse sow strategies was detected on stress levels compared with sows that raised their own litter. The strategies did not appear to compromise piglet growth. However, new-born piglets transferred onto 21 days lactation sows experienced more competition at the udder. Thus transferring piglets onto a sow 7 days into lactation is likely the best option as it minimises the difference between piglet age and sow stage of lactation. Cross fostering had a significant negative impact on piglet growth, especially when heavier pigs were fostered.
- **The effect of artificial rearing in the milk feeding period on piglet performance and welfare:** Artificial rearing (AR) had a negative effect on growth to weaning compared to sow reared piglets, and they also performed more harmful behaviours and were dirtier. Qualitative behaviour assessment also showed a more negative emotional state in AR piglets. Thus AR from 7 days of age should not be

recommended as routine practice.

- **Use of energy supplementation to improve piglet vitality and survival:** There was no overall effect of treatment on any of the parameters measured; a single oral dose of fat-based energy supplement at birth did not improve growth, survival, rectal temperature or vitality of low birth weight piglets.

5. Opportunity/Benefit:

This project is extremely timely, and is of great importance to the industry from both a performance and animal welfare perspective, due to the ongoing and significant increases in litter size across the industry. Effective nutritional and management practices to increase sow productivity and piglet growth have been identified and when implemented at farm level will increase profitability. Additionally piglet management practices were identified which will reduce piglet performance, and should be avoided.

Dissemination:

The work conducted in this project has been successfully disseminated to stakeholders, via scientific publications, oral and poster presentations at research dissemination days, OPTIPIG project meetings, Presentations at national and international conferences as well as three PhD theses and one Masters thesis.

- European Federation of Animal Science, (2016, 2018)
- French Society for Study of the Behaviour of Animals (2018)
- International Society for Applied Ethology (2015, 2016, 2017)
- International Pig Veterinary Society (IPVS) & European Pig Health Meeting (ESPHM) (2016), Dublin
- Teagasc Pig Farmers' Research Dissemination Day (2015, 2016, 2017, 2018, 2019), Horse and Jockey and Cavan.
- Teagasc Pig Farmers' Conferences (2013, 2014), Horse and Jockey and Cavan.
- American Society of Animal Science, Mid-West Section (2019)
- British Society of Animal Science (2017, 2018)
- Teagasc Walsh Fellowship Seminar (2018, 2019)
- Teagasc Farmer Discussion Groups (2016, 2017, 2018)
- European Conference on Precision Livestock Farming (2019)
- Welfare of Animals at Farm and Group Level (2017)

Main publications here

1. Schmitt, O., Baxter, E., Boyle, L. and O'Driscoll, K. 2019. Nurse sow strategies in the domestic pig (*Sus Scrofa*): II. Consequences piglet growth, suckling behaviour, and sow nursing behaviour. *Animal*. 13:590-599
2. Rooney, H. B., K. O'Driscoll, J. V. O'Doherty, and P. G. Lawlor. 2019. Effect of L-carnitine supplementation and sugar beet pulp inclusion in gilt gestation diets on gilt live-weight, lactation feed intake and offspring growth from birth to slaughter. *J. Anim. Sci.* 97(10): 4208–4218.
3. Lavery, A., Lawlor, P.G., Magowan, E., Miller, H.M., O'Driscoll, K. & Berry, D.P (2018). An association analysis of sow parity, live-weight and back-fat depth as indicators of sow productivity, *Animal*. 13:3, pp 622–630.

Popular publications:

- TResearch: Winter 2017 – The piggy in the middle; Autumn 2018 - Supplementation for sows
- Teagasc pig newsletter: 7 articles between May 2015 and September 2018

6. Compiled by: Dr. Peadar Lawlor, Dr. Keelin O'Driscoll and Dr. Laura Boyle