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**Omega 3 fats from fish oil
increases lifetime performance of
SOWS**

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Project 2F-102

**A collaboration between
The Pork CRC, Rivalea Australia
and Dr Megan Mitchell of The University of Adelaide**

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Seminar Outline

- ▶ **Omega 3 fatty acids and what they do**
- ▶ **Outline of the project design**
- ▶ **Results**
- ▶ **Outcomes and implications**
- ▶ **Future areas of research**

Omega 3 fatty acids – why are they important?

- ▶ All animals require some intake of fats for cellular function
- ▶ Fats used for
 - ▶ Energy
 - ▶ Fat soluble vitamin source (Vit. A and E), sources of retinol, B-carotene and α -tocopherol antioxidants
 - ▶ Cell membrane component
 - ▶ Synthesis of prostaglandins and a reproductive role
 - ▶ Formation of compounds associated with inflammatory responses, immune function and general health

Reproduction role

- ▶ Long-chain omega 3 fatty acids essential for production of prostaglandins including PGF and PGE
- ▶ PGF cause luteolysis (stops pregnancy maintenance role of the ovary). Lutalyse™ and Prostapar™ are exogenous PGF_{2α} analogues.
- ▶ PGE is critical for placental development and possibly early embryo development
- ▶ Progesterone synthesis role

Project design

- ▶ Experiments in gilts investigating duration and level of fish oil supplementation on gilt fertility
- ▶ Experiments in mature sows supplementing fish oil in lactation and up to mating and assessing embryo survival
- ▶ Lab studies to look at possible mechanisms of action on fertility
- ▶ Large field study evaluating fish oil supplementation on culling and sow longevity over parity 0 and 1

Gilt Studies

- Effect of feeding duration during puberty
 - ▶ +/- Fish oil and Fish oil for long (6 weeks) or short period (3 weeks) prior to mating (Expt. 1)
 - ▶ +/- Fish oil and Fish oil at 3 or 10 g/kg from 24 weeks of age (Expt. 2)

Gilt study #1

Treatment	Age at mating (d)	Number mated	Farrow rate (% mated)	Litter size born live	Litter size total
Control	213 ^a	154	84.4	10.5	11.6
Fish oil long	218 ^b	147	87.1	11.0	11.9
Fish oil short	215 ^{ab}	154	88.3	10.7	11.6
Significance	*	NS	NS	NS	NS

■ Conclusions

- ▶ Fish oil affected age at mating indicating a dietary effect on ovarian activity
- ▶ Farrowing rate and litter size not significantly improved
- ▶ Numerical advantage in litter size when feeding fish oil for longer

Gilt study #2

Treatment	Number mated	Pregnancy rate (% mated)	Ovulations (CL's)	Viable Embryos	Embryo survival (% of CL's)
Control	76	88.2	16.9	13.7	81.8
Fish oil - 3g/kg	74	84.3	15.9	14.1	88.9
Fish oil – 10 g/kg	78	91.4	16.8	14.1	84.3
Significance	NS	NS	NS	NS	NS (P=0.070)

■ Conclusions

- ▶ Fish oil has no effect on gilt conception, ovulation rate
- ▶ Numerical advantage in embryo survival when feeding fish oil at 0.3%
- ▶ Highly fertile gilts may not benefit from fish oil
- ▶ Feeding fish oil n-3's at 3 g/kg optimized response

Sow study #1

- Response to fish oil in lactating sows
- ▶ **180 lactating multiparous sows (parity 5-9)**
 - - Control (n=90)
 - - Fish oil (n=90) 3 g/kg
- ▶ **Treatment diets offered to appetite during lactation 27 days**
- ▶ **Treatments continued post-weaning to re-mating**
- ▶ **All sows fed the same un-supplemented diet post-mating**
- ▶ **Measures – Lactation performance, feed intake, WOI, pregnancy rate, ovulation rate, embryo number post-implantation, embryo survival**

Sow study # 1

Treatment	WOI (d)	Pregnancy rate (% mated)	Ovulations (CL's)	Viable Embryos	Embryo survival (% of CL's)
Control	5.3	56.7	22.2	13.6	61.5
Fish oil - 3g/kg	5.0	63.3	22.2	15.5	70.2
Significance	NS	NS	NS	*	*

■ Conclusions

- ▶ Fish oil at low levels did not affect lactation performance (1.7 kg litter gain/d) or intake (7.7 kg/d)
- ▶ No effect on resumption of oestrous or ovulation rate
- ▶ When embryo survival is poor (older parities), fish oil n-3's beneficial

Sow study #2

- Response to fish oil over parity 0 and 1
- ▶ **1,958 mated gilts**
 - - Control (n=984)
 - - Fish oil (n=974) 6 g/kg gestation, 3 g/kg lactation
- ▶ **Treatment diets offered over two consecutive parities**
- ▶ **Treatments continued post-weaning to re-mating (skip a heat)**
- ▶ **Measures – Lactation performance, WOI, farrowing rate, 1st and 2nd parity litter size, cause of sow mortality& culling**

Effects on longevity

Treatment	Gilt farrow rate (%)	Gilt live born	Parity 1 farrow rate (%)	Parity 1 subs live born	Retention over two parities (% of mated gilts)
Control	90.8	10.8	84.0	12.1	72.6
Fish oil - 3g/kg	91.6	10.8	84.4	12.2	75.8
Significance	NS	NS	NS	NS	NS (P=0.137)

Treatment	Re-bred after parity 1 weaning (%)	Mortality (%)	Stale (%)	Feet & legs (%)	All Physical (%)
Control	91.3	1.2	1.8	5.2	6.2
Fish oil - 3g/kg	93.1	0.4	3.1	2.8	3.3
Significance	NS	P=0.095	P=0.088	*	*

■ Conclusions

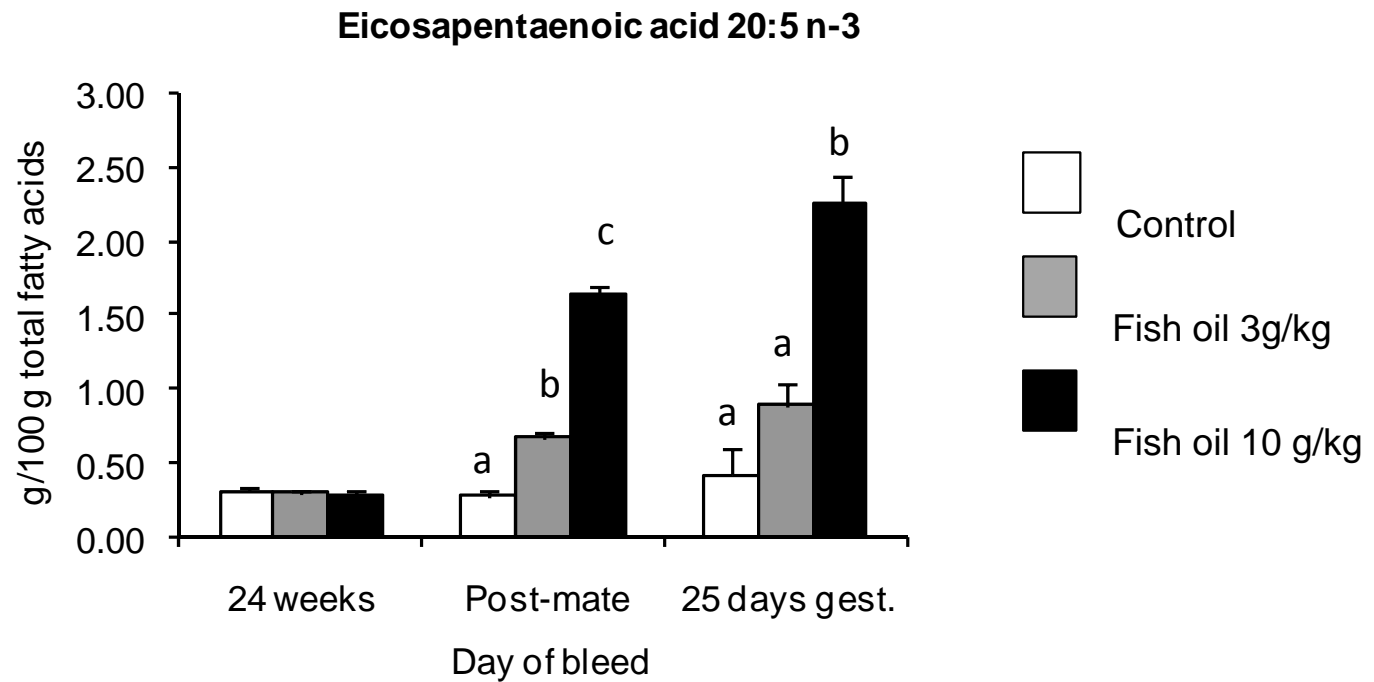
- ▶ Fish oil at low levels reduced physical causes of sow wastage
- ▶ No effect on parity 1 and 2 litter size
- ▶ Tendency for more stales post-weaning needs further assessment

Lab study outcomes

■ Conclusions

- ▶ Fish oil increased follicular fluid EPA and DHA in gilts and sows
- ▶ Changes recorded to follicular development with more medium and large sized follicles in fish oil treatments
- ▶ Activation of genes COX-2 and PR in follicle granulosa cells indicating dietary effect on luteinizing capacity of the CL
- ▶ In-vitro improved embryo development to day 6.

Dietary changes increase plasma levels of long-chain n-3's



Project Outcomes

- ▶ Fish oil n-3's increased circulating levels of EPA and DHA
- ▶ Effects on gilts less pronounced in highly fertile genotypes/conditions
- ▶ Older parity sows are performing below potential due to low embryo survival
- ▶ Fish oil n-3's increase embryo survival in older sows
- ▶ Fish oil n-3's reduce physical wastage probably by acting as an anti-inflammatory nutraceutical

Economics

- Feeding for litter size boost:
- Cost @ 0.3% = \$0.011/kg feed, assuming \$3.65/kg cost fish oil
- \$2.15/sow during lactation and post-weaning
- If 0.25 piglet increase in litter size @\$40/piglet, return \$10/per sow
- Net return \$7.80 per sow
- Feeding for lifetime performance:
- Cost \$8.75/sow/cycle during lactation and post-weaning and gestation
- If 0.25 piglet increase in litter size @\$40/piglet +0.04 replacement sows per cycle @\$440/gilt, return \$17.6 per sow/cycle
- Net return \$8.85 per sow

Future research

- ▶ **New proposal currently with Pork CRC to field test commercial outcomes of fish oil supplementation in multiparous sows in lactating and early gestation**
- ▶ **Dose responses still need to be fully evaluated**
- ▶ **Mechanisms as to how the fish oil n-3's affect reproductive processes still to be fully understood**
- ▶ **N-3's from fish oil differ in reproductive response to n-3's from vegetable oils ?**

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