



Ovulatory effects of omega-3 polyunsaturated fatty acids

Tenika Eardley

Dr. K. Shane Broughton

Background

- Ovulation is best characterized as an inflammation reaction
- Role of prostaglandins
 - 5 1° PGs
 - PGE₂, PGF_{2α}, PGD₂, PGI₂, TXA₂
 - Three of these involved in ovulation
 - PGE₂ Enhance inflammatory reaction
 - PGF_{2α} and PGD₂ Activate theca cell fibroblasts
 - **PGI₂ (prostacyclin) → ↑ blood flow → ↓ Blood clot → ↓ Stroke**
 - **TxA₂ (Thromboxane) → ↑ Blood Clot → ↑ Stroke**

Fatty Acid Metabolism

Can originate from dietary linoleic acid (LA), our essential fatty acid, that is desaturated and elongated to arachidonic acid (AA)

Primarily from AA obtained directly from the diet.

- LA (18:2n6) plants



AA (20:4n6) meats, poultry
oil

*AA is a substrate for PGs

- LNA (18:3n3) plants



EPA (20:5n3) fish / fish



DPA (22:5n6)



DHA (22:6n3) " " "

PROSTAGLANDINS

Linoleic acid (LA) from plants



Arachidonic acid (AA) or from meat



CYCLOOXYGENASE (Cox – 1 and **Cox – 2**)

↓ Aspirin

Prostanoids (Prostaglandins) 2 Series

PGE₂

Immune Regulation

Cancer

Headaches

Promotes Arthritis

Regulates ovulation

PGF_{2α}

Regulates ovulation

PGE₂

- [High]
 - administered prior to ovulation in hamsters and rats → **reduced ova production**
 - immunosuppressant
- [Low]
 - Enhance ovulation at
 - improve immune response
- [Very low]
 - suppresses ovulation

PGF_{2α}

- [normal to high]
 - Promotes ovulation
- [Low]
 - ↓ ovulation

Linolenic acid (LNA) from plants **DHA**



Eicosapentaenoic Acid (EPA) from fish



CYCLOOXYGENASE (Cox - 1 and Cox - 2)



Prostanoids (Prostaglandins) 3 Series

PGE₃

Immune Regulation

Ovulation

Cancer

Headaches

Indirectly Regulates ovulation

PGF_{3α}

Regulates

PGE_3

- Less biologically active or inactive compared with PGE_2
- Ovulatory effects are indirect

$\text{PGF}_{3\alpha}$

- Same effects as seen with $\text{PGF}_{2\alpha}$
 - Promotes Ovulation

When EPA/DHA fed

- EPA/DHA
 - ↓ tissue AA incorporated into tissue phospholipids

Result:

- ↓ AA for PGE_2 → Suppresses Ovulation
- PGE_3 blocks E_2 action by blocking receptor
- ↓ AA for $\text{PGF}_{2\alpha}$ → Promotes Ovulation

When Supplemented EPA

- $\text{PGE}_3 \rightarrow$ No direct effect on ovulation
Blocks PGE_2 action
- $\text{PGF}_{3\alpha} \rightarrow$ Promotes ovulation (like $\text{PGF}_{2\alpha}$)

What did we do?

- Dams of known pregnancy (14 days) were divided into two separate groups;
 - Control diet; no n3 at all...
 - Omega-3 PUFA diet; ~1:1 n3 (EPA/DHA):n6 (LA) diet
- Pups exposed to high n3 diet in utero
- ♀ Pups were injected at 24 days with PMSG to stimulate follicular maturation
- ♀ Pups were injected 48 hours later with HcG to stimulate ovulation
- 6 hours post HcG 1/2 pups were euthanized and PGs were evaluated
- 15 hours after the other 1/2 got HcG injection, pups were euthanized and ova counted

Results

	Control	N-3 PUFA
Avg. Egg number	14.6	18.7

Implications for Women

- Increase chances of ovulation in women with PCOS
- Improve fertility in women with reproductive issues (including PCOS)
- Potential reproductive capability post menopause

Implications for Agriculture

- Increase offspring number in multiparity animals Eg. Swine

Unanswered questions and Future Research

- Result in multiple offspring that correlates with egg number?
- Are secondary oocytes maturing into primary oocytes? (new research)
- How does this affect menopause?

Thank you to my Collaborators

- Jemilla Retta
- Derek Redinger
- Matt Dooper
- Lea Steiner

And BIG thanks to Dr. Broughton!!!