# Harnessing Omega-3 Fatty Acids: Optimal Use for Health and Disease Management

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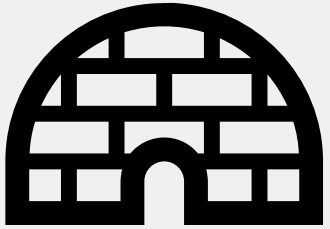
# OVERVIEW

- Introduction
- Applications
- Principles of Use
- Medical Conditions
- Limitations
- Take-Home Messages
- Questions

# INTRODUCTION

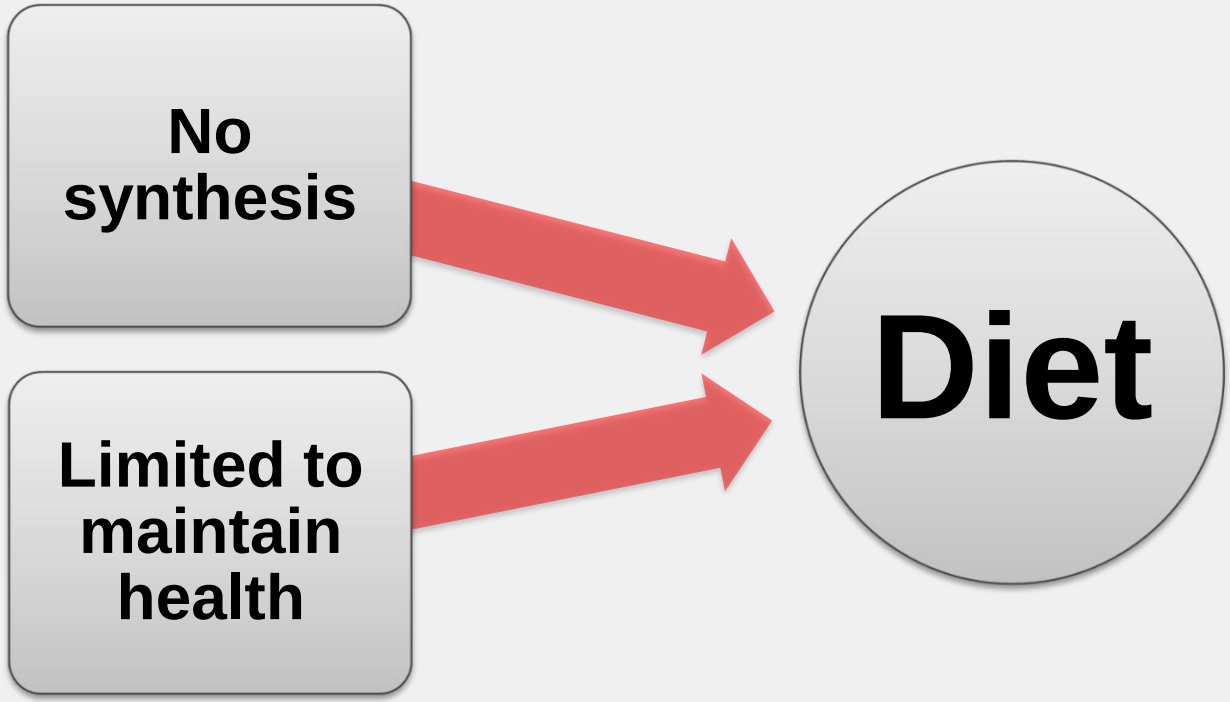
- 1782 → Dietary fish oil → Rheumatism
- Eskimos
  - Carnivorous → meat and fish
    - ↓ triglycerides
    - ↓ VLDL
    - ↓ ischemic heart disease



(Percival, 1782; Krogh and Krogh, 1914; Bang et al., 1980; Burr et al., 1989)

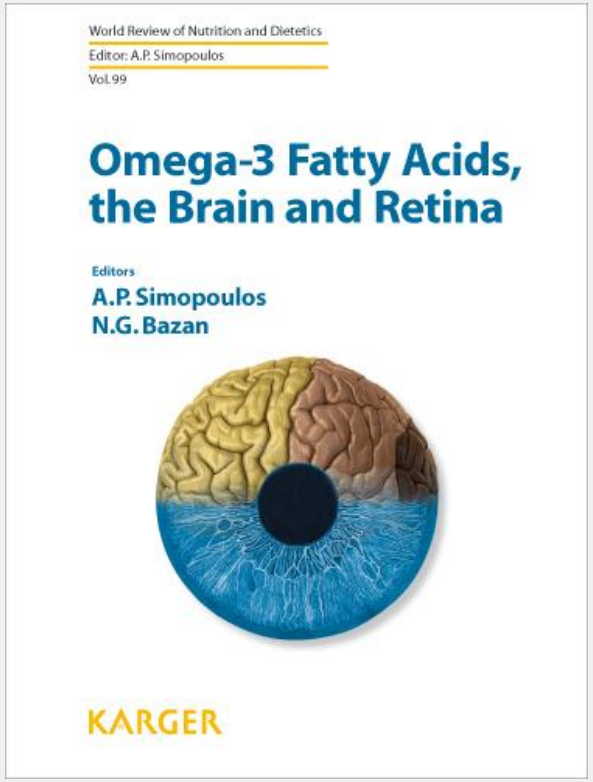
# INTRODUCTION

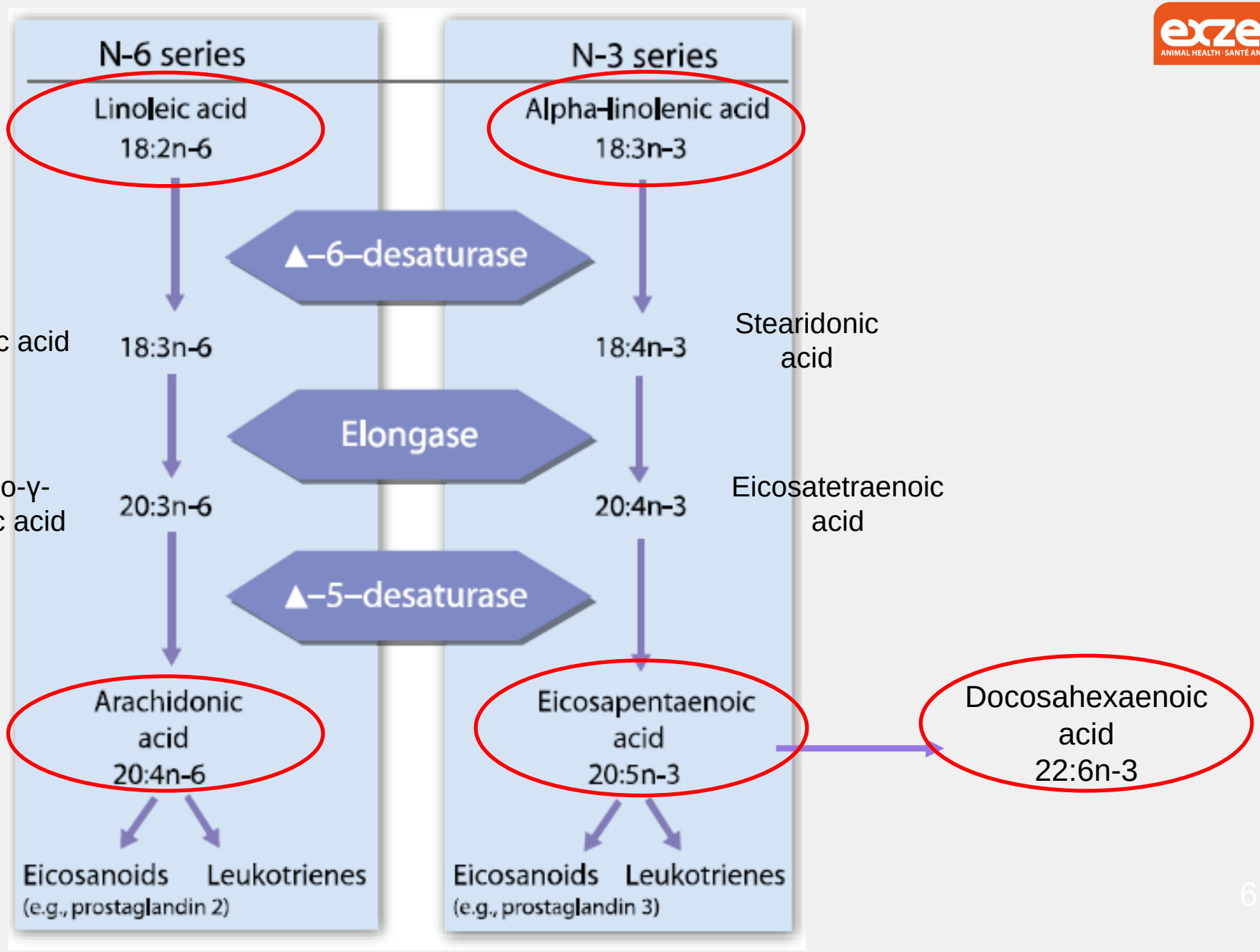
- Omega-3 → **Essential** fatty acids (EFAs)



# IMPORTANCE FOR HEALTH

- Cell membrane fluidity
- Skin health
- Retina and brain development






(Gross et al., 2010)

## Minimum Requirements of Essential Fatty Acids in Grams/1000 kcal[2,8]

| | DOGS (Growth) | DOGS (Adult Maintenance) | CATS (Growth) | CATS (Adult Maintenance) |
|---|---|---|---|---|
| **Total Fat** | | | | |
| NRC RA | 21.3 | 13.8 | 22.5 | 22.5 |
| AAFCO | 21.3 | 13.8 | 22.5 | 22.5 |
| **Linoleic Acid** | | | | |
| NRC RA | 3.3 | 2.8 | 1.4 | 1.4 |
| AAFCO | 3.3 | 2.8 | 1.4 | 1.4 |
| **Arachidonic Acid** | | | | |
| NRC RA | 0.08 | ND | 0.05 | 0.015 |
| AAFCO | ND | ND | 0.05* | 0.05* |
| **Alpha-linolenic Acid** | | | | |
| NRC RA | 0.2 | 0.11 | 0.05 | ND |
| AAFCO | 0.2 | ND | 0.05 | ND |
| **Eicosapentaenoic Acid + Docosahexaenoic Acid** | | | | |
| NRC RA | 0.13 | 0.11 | 0.025 | 0.025 |
| AAFCO | 0.1 | ND | 0.03 | ND |

Lenox (2016)

# DHA FOR PUPPIES

- 48 puppies → after weaning
- Diets
  - Low-DHA
  - Moderate-DHA
  - High-DHA
- ↑ cognitive, memory, and psychomotor responses

Zicker et al., 2012

# DHA FOR PUPPIES

Time

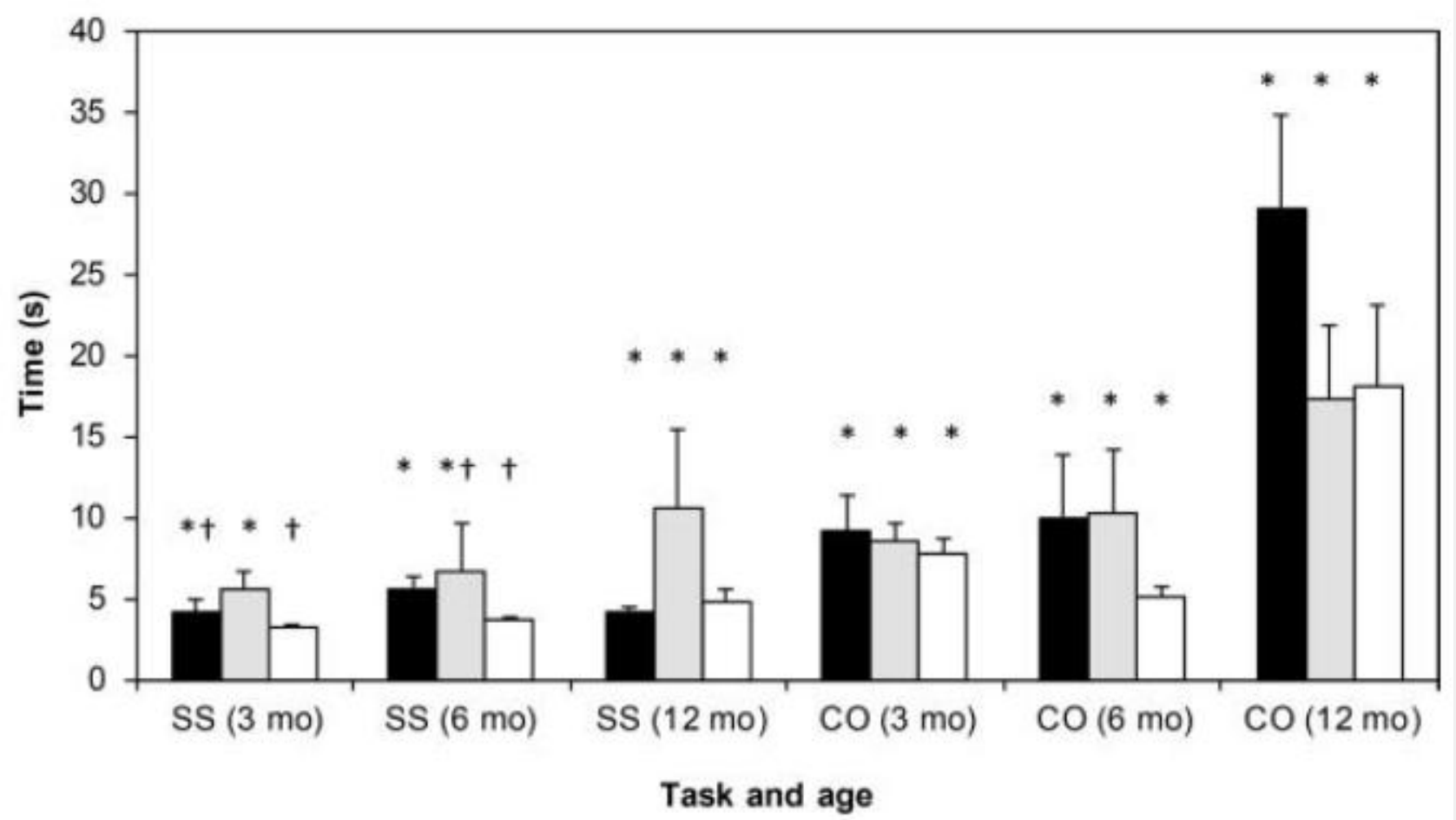
x

Tasks

■ Low

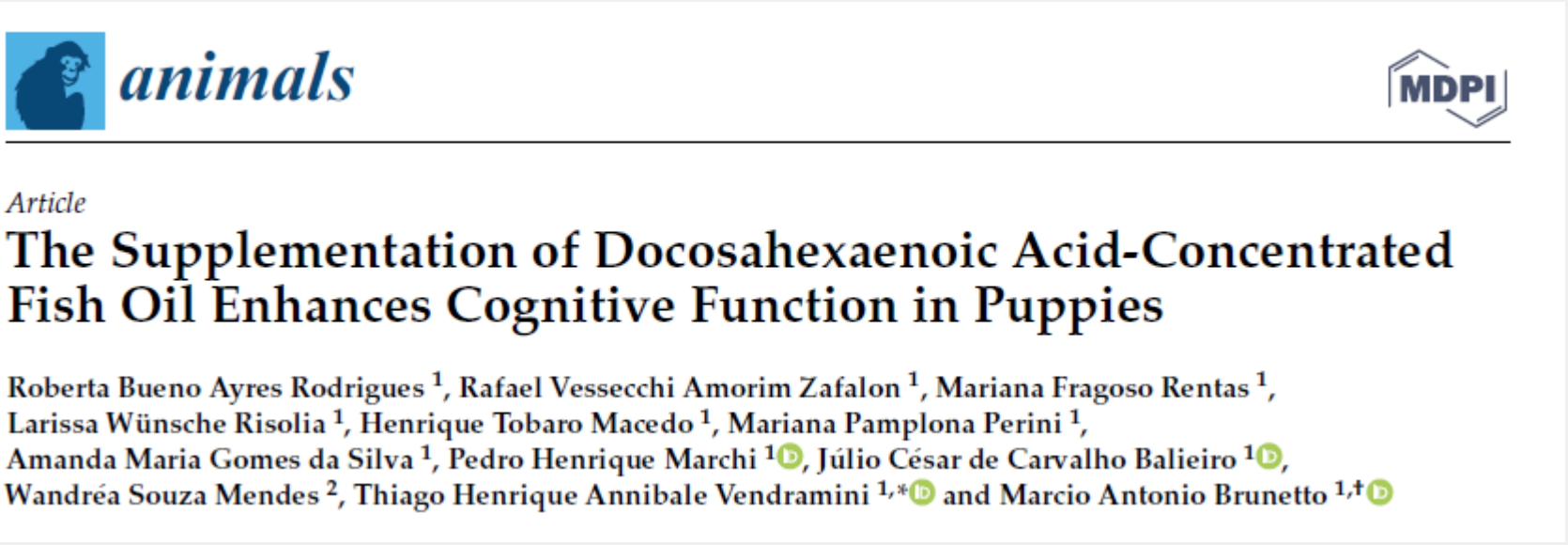
▒ Medium

❑ High




Zicker et al., 2012

# DHA FOR PUPPIES



animals

MDPI

*Article*

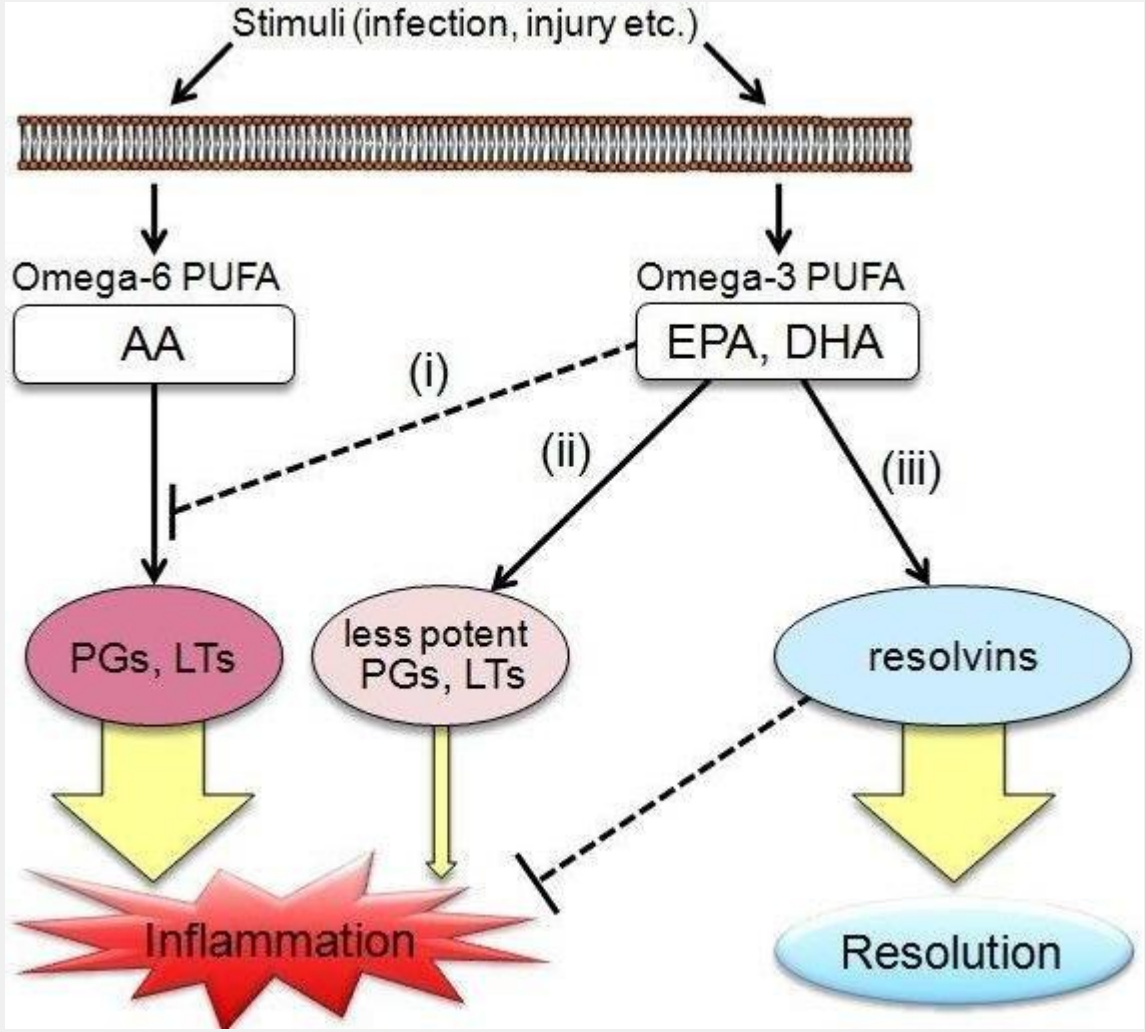
## The Supplementation of Docosahexaenoic Acid-Concentrated Fish Oil Enhances Cognitive Function in Puppies

Roberta Bueno Ayres Rodrigues [1], Rafael Vessecchi Amorim Zafalon [1], Mariana Fragoso Rentas [1], Larissa Wünsche Risolia [1], Henrique Tobaro Macedo [1], Mariana Pamplona Perini [1], Amanda Maria Gomes da Silva [1], Pedro Henrique Marchi [1], Júlio César de Carvalho Balieiro [1], Wandréa Souza Mendes [2], Thiago Henrique Annibale Vendramini [1,*] and Marcio Antonio Brunetto [1,†]

- ↑ frequency of correct responses

# IMPORTANCE DURING DISEASE

- Cell membranes
  - ↓ inflammation




(Seki et al., 2010)

# PRINCIPLES OF USE

- Evidence
- Dosage → **dogs**

| Clinical disorder | Dosage (mg/kg$^{0.75}$)* | Approximate EPA and DHA dose for a 10-kg (22-lb) dog (mg)† |
|---|---|---|
| Idiopathic hyperlipidemia | 120 | 675 |
| Kidney disease | 140‡ | 790 |
| Cardiovascular disorders | 115 | 645 |
| Osteoarthritis | 310‡ | 1,745 |
| Inflammatory or immunologic (atopy or IBD) | 125 | 700 |
| NRC recommended allowance[22] | 30 | 170 |
| NRC safe upper limit | 370 | 2,080 |



Bauer (2011)

# HOW TO CALCULATE – PART 1

- Dog, 10 kg, idiopathic hyperlipidemia
- Metabolic BW = $10^{0.75}$ = 5.62 kg
- Dosage for hyperlipidemia = 120 mg x 5.62 = **<u>674.4 mg EPA+DHA</u>**
- Diet 1
  - EPA+DHA = 200 mg/100 kcal
  - Daily calorie intake = 550 kcal/day
  - Daily EPA+DHA intake = 200 x 5.5 = **<u>1,100 mg EPA+DHA/day</u>**

***<u>Supplement not necessary!</u>***

# HOW TO CALCULATE – PART 2

- Dog, 10 kg, idiopathic hyperlipidemia
- Metabolic BW = $10^{0.75}$ = 5.62 kg
- Dosage for hyperlipidemia = 120 mg x 5.62 = **674.4 mg EPA+DHA**
- Diet 2
  - EPA+DHA = 80 mg/100 kcal
  - Daily calorie intake = 550 kcal/day
  - Daily EPA+DHA intake = 80 x 5.5 = **440 mg EPA+DHA/day**

***Supplement necessary!***

# HOW TO CALCULATE – PART 3

- Amount needed = 674.4 – 440 = **<u>234.4 mg EPA+DHA</u>**

- Ograx-3 1000
  - 260 mg EPA + 170 mg DHA (**430 mg**) per capsule

- Amount needed = **<u>1 capsule per day</u>**

# PRINCIPLES OF USE

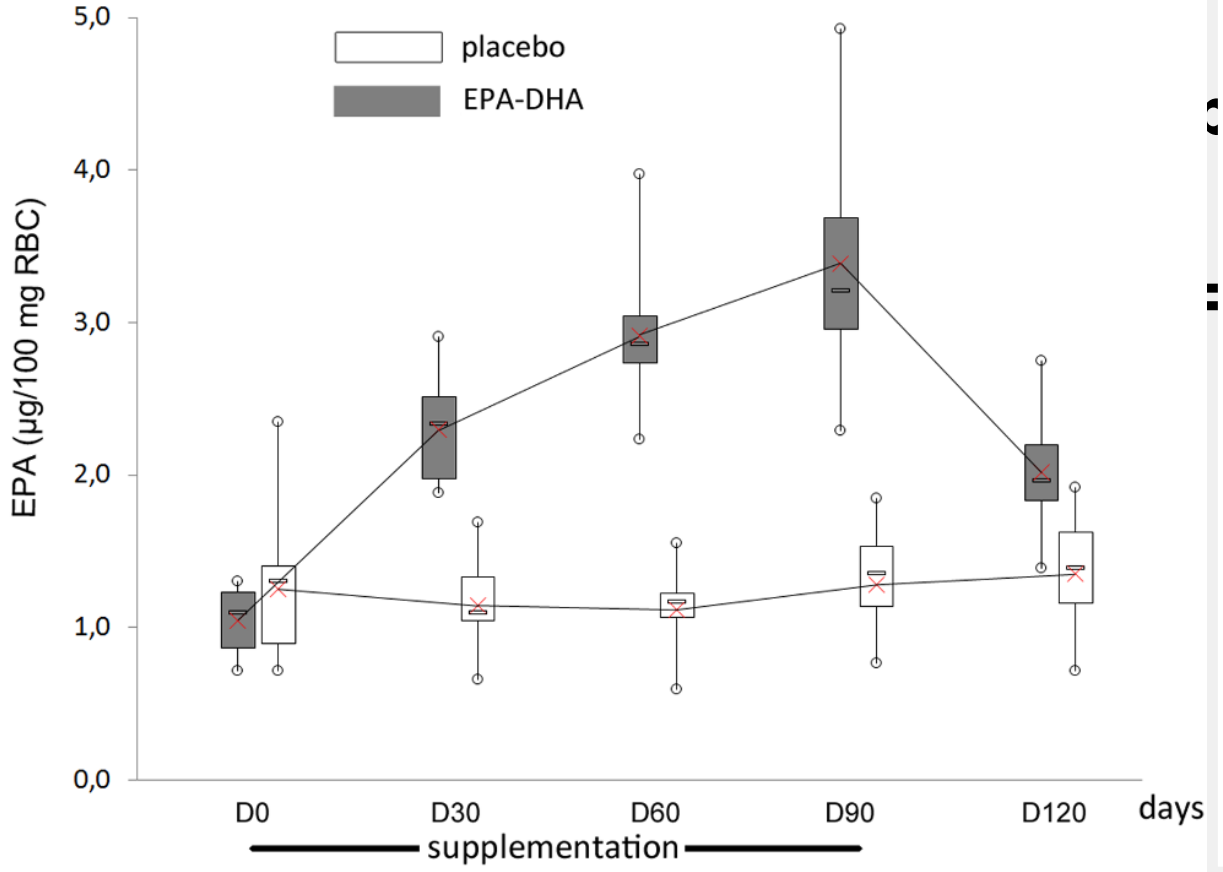
- What supplement to use?
- Specific → EPA+DHA
  - Combinations → ↑ risk with toxic components (vits. A and D, metals)
- Evidence
- Testing
- Type
  - Capsules
  - Liquid → oxidation?

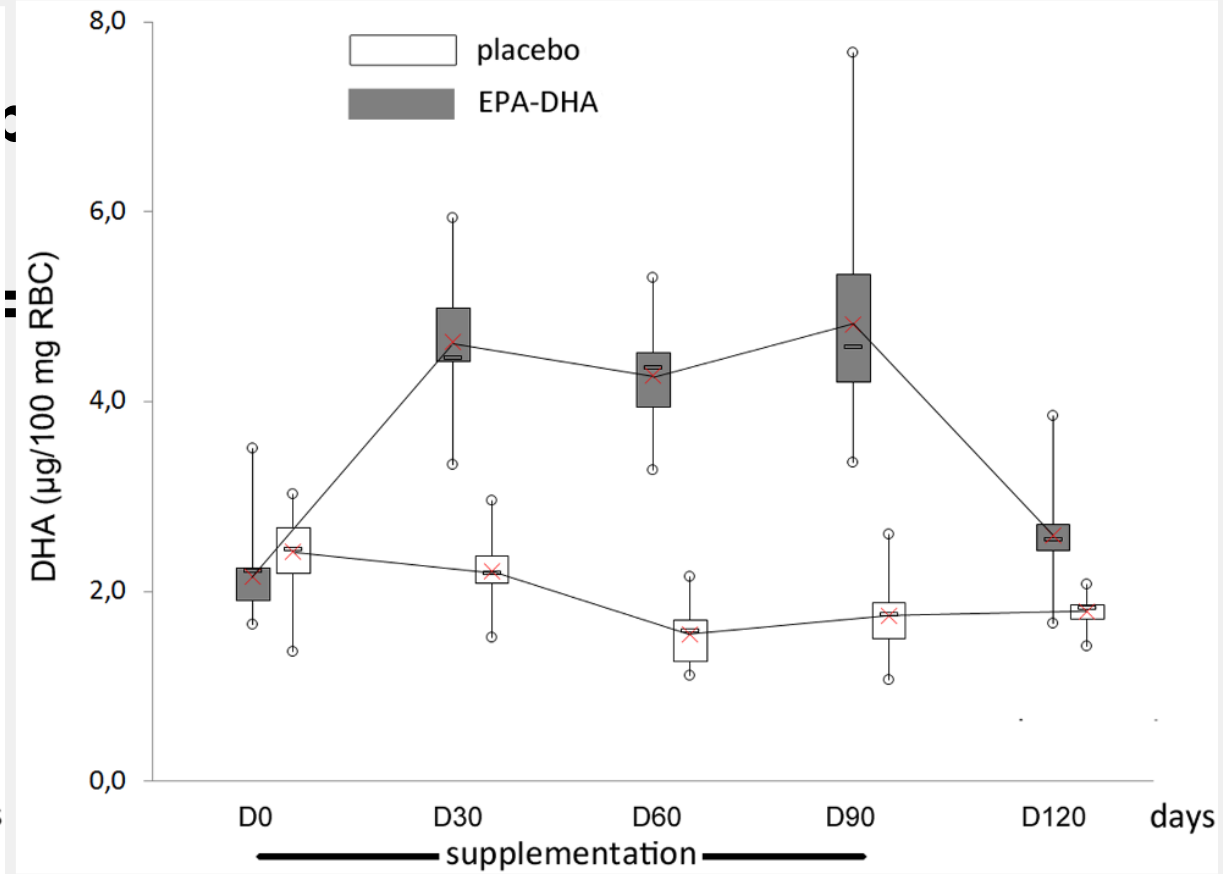
# DERMATOLOGIC CONDITIONS

- 16 dogs – cross-over
  - Idiopathic pruritis, atopy, flea allergy
  - Linoleic acid + γ-linolenic acid = 570 + 50 mg/4.55 kg
  - EPA + DHA = 180 +120 mg/4.55 kg
    - ↓ pruritis, self-trauma
    - ↑ coat character

(Logas and Kunkle, 1994)

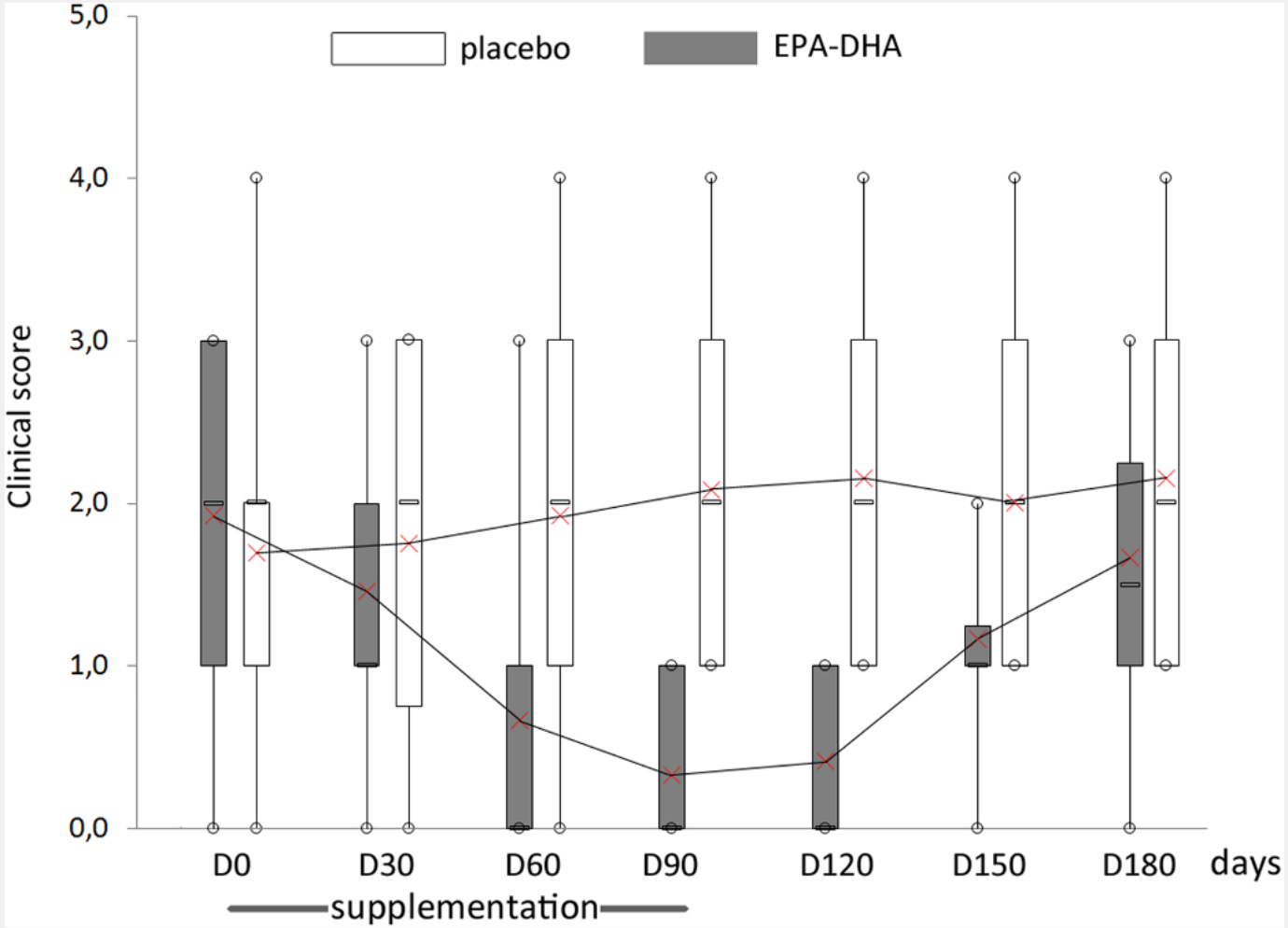
# DERMATOLOGIC CONDITIONS




(Combarros et al., 2020)

# DERMATOLOGIC CONDITIONS




(Combarros et al., 2020)

# OSTEOARTHRITIS

- 38 dogs → Randomized, double-blinded trial
- Diets
  - Control
  - 3.5% fish oil
- ↓ lameness
- ↑ weight-bearing scores

(Roush et al., 2010)

# HYPERLIPIDEMIA

- 15 healthy dogs → 12 weeks
- Sunflower
- Fish Oil
- Fish Oil + vitamin E

| | *Sunflower Oil Group* | | | *Fish Oil Group* | | | *Fish Oil + E Group* | | |
|---|---|---|---|---|---|---|---|---|---|
| ***Analyte (mg/dl)*** | *Week 0* | *Week 6* | *Week 12* | *Week 0* | *Week 6* | *Week 12* | *Week 0* | *Week 6* | *Week 12* |
| Cholesterol (reference range, 150–240) | 167 ± 25 | 178 ± 21 | 181.2 ± 30 | 169.2 ± 18 | 151.8 ± 17.8 | 147.8 ± 21 | 191.2 ± 37* | 142 ± 16.4† | 149.2 ± 15.3† |
| Triglyceride (reference range, 20–110) | 51.6 ± 8.6 | 43.2 ± 5.2 | 50.8 ± 8.9[b] | 50.4 ± 8.7* | 34.8 ± 1.8*,† | 29.4 ± 5.2†,[c] | 42.8 ± 5 | 43.6 ± 6.7 | 34 ± 3.6[b,c] |

(LeBlanc et al., 2005)

# CARDIAC DISEASE

- Heart failure → ↓ plasma EPA
- 28 dogs
  - Fish oil (EPA+DHA 27+18 mg/kg/d) *vs*. placebo (corn oil)
  - ↓ $PGE_2$, IL-1, cachexia
- 24 dogs → Atrioventricular pacing
  - EPA + DHA 1 g/d
  - ↓ atrial fibrillation

(Freeman et al., 1998; Rush et al., 2000; Laurent et al., 2008)

# RENAL DISEASE

- 21 Dogs → **Induced CKD**
- Diets → 20 months
  - Beef tallow
  - Safflower oil
  - Fish oil (EPA + DHA 760 mg/kg BW^0.75)
    - Renoprotective
    - ↓ UPC

(Brown et al., 1998)

# PROMISING AREAS

- Obesity
  - Humans

**Body Mass Index**



**EPA+DHA**

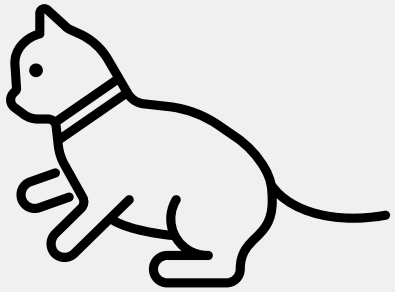
  - Similar n-3 intake → ↓ n-3 index
  - Dogs and cats?

(Micallef et al., 2009; Young et al., 2020)

# PROMISING AREAS

- Cancer
- Cognitive dysfunction
- Inflammatory bowel disease
- Epilepsy

- Cats!



# LIMITATIONS

- Calories!
  - Overweight/obese patients
  - Adjust diet intake
  - 10% rule?
- Fat intolerance
  - Lymphangiectasia
  - *Pancreatitis?*
  - *Hyperlipidemia?*

# LIMITATIONS

- Adverse effects
  - Humans
    - Immune function impairment
    - Platelet dysfunction
    - Altered glucose and lipid metabolism

(Nabavi et al., 2015)

# LIMITATIONS

- Adverse effects
  - Dogs and Cats
    - Altered wound healing
    - Low platelet counts → avoid
    - Aspirin, carprofen, clopidogrel

Omega-3

**n-6:n-3 ~ 1:1**



Omega-6

(Freeman, 2010; Lenox and Bauer, 2013; Westgarth et al., 2018)

# LIMITATIONS

- Adverse effects
  - Dogs and Cats
    - Vomiting/diarrhea
    - Vitamin E → ~~peroxidation~~
    - Toxicities
      - Vitamins A and D → cod liver oil
      - Mercury

(Freeman, 2010; Lenox and Bauer, 2013)

# TAKE-HOME MESSAGES

- EPA+DHA → health and disease
- Amounts in the diet +/- supplement
- n-6:n-3 ratio
- Safety and Quality
- **Strong** *vs*. limited evidence

# EXTRA SLIDE AFTER QUESTIONS

- EPA+DHA dosage for cats with osteoarthritis
  - 1.84 g/1000 kcal
  - 1.88 g/1000 kcal

(Lascelles et al., 2010; Corbee et al., 2013)

- For epilepsy, there is potential to use omega-3s use but no evidence/recommended dose
  - Medium-chain triglycerides (MCTs) remain the best nutritional supplementation (especially refractory cases)

( Larsen et al., 2014; Han et al., 2021)

# THANK YOU!

# QUESTIONS?