Fish Oil Omega-3 Fatty Acids in Companion Animal Practice

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Omega-3 in Companion Animals
Outline

• Background
  – Types of fatty acids; Nomenclature; Sources

• Metabolic Health Benefits
  – Tissue Balance
  – Organ Function
  – Puppy Development

• Therapeutic Use and Dosages
  – Dogs
  – Cats
What are omega-3s?

Omega-3s are polyunsaturated fats they contain more than one double bond

Called omega-3...

because the first double bond counting from the methyl end of the fatty acid is located at the third carbon atom
Fatty Acid Omega Nomenclature

A:Bn-C

# of carbon atoms

position of first double bond from methyl end

# of double bonds

18:3n-3

Alpha-Linolenic acid (omega 3)

18:2n-6

Linoleic acid (omega 6)
Omega Fatty Acids

“Good Fats”

**Omega -6**
- LA (18:2n6)
- AA (20:4n6)

Good, but we usually get enough

**Omega -3**
- ALA (18:3n3)
- EPA (20:5n3)
- DHA (22:6n3)

Good & need to make sure to get enough

Particularly important for brain & visual development
Sources of Fatty Acids

Omega-3 - natural sources (EPA and DHA)

- Oily cold-water fish
  - herring, tuna, sardines, anchovies, salmon, and cod fish
- Algae synthesis (fish eat the algae)

- ALA (18:3n3; vege omega-3) is found primarily in flaxseed oils, certain vegetable oils, and some green leafy vegetables
  - Not a reliable source of EPA & DHA for humans
  - Not a predictable source of EPA & DHA for dogs
  - May not convert to EPA & DHA in cats

Omega-6

- LA (18:2n6) is found primarily in seeds, nuts, grains, and legumes, present in our diet as vegetable oils (e.g. corn oil) and seed oils (e.g. sunflower oil), and animal fats
- GLA (18:3n6, gamma-linolenic) acid found in borage oil, evening primrose oil, black currant seed oil
What are the benefits to companion animals?
Cognitive Visual Inflammation Cardiovascular

Source of Energy
Some conversion to EPA; Low conversion to DHA

DHA  EPA  ALA

Omega-3
Benefits of DHA/EPA Omega-3 Fatty Acids for Dogs (all based on actual dog studies)

- Cognitive function
- Visual development & function
- Tissue balance
  - Anti-Inflammatory
- Trainability
- Healthy skin/haircoat
- Heart, Kidney, G.I. health
- Hyper TGemia
- Osteoarthritis, joint health
- Cancer Therapy? Cognition/Aging?
Omega Balance for Inflammation

Omega-6 Fatty Acids

Omega-3 Fatty Acids

MORE inflammatory substances
PG2, TX2, LT4

LESS inflammatory substances
PG3, TX3, LT5
Omega-6
- LA (Linoleic Acid)
  - ARA (Arachidonic Acid)

Efficient

Omega-3
- ALA (Alpha-Linolenic Acid)
  - EPA (Eicosapentaenoic Acid)
  - DHA (Docosahexaenoic Acid)

Inefficient

Diet Sources Needed

Pro-inflammatory

Tissue Balance

Conversion

Anti-inflammatory
Tissue Balance and Anti-Inflammatory

Omega-6
- LA (Linoleic Acid)
- ARA (Arachidonic Acid)

Efficient

Omega-3
- ALA (Alpha-Linolenic Acid)
- EPA (Eicosapentaenoic Acid)
- DHA (Docosahexaenoic Acid)

Inefficient

Diet Sources Needed

Pro-inflammatory

Anti-inflammatory

Tissue Balance
Benefits of DHA/EPA (LC omega-3) Fatty Acids for Dogs

- Tissue balance and Inflammatory effects reduced in normal dogs
- Anti-inflammatory effects
  - Skin, Atopy, Dermatitis
    - Itchy/red skin improvement
  - Arthritis ---
    - Pain reduction in arthritis
    - Improved weight bearing
  - Improved Immune Function
Benefits of DHA/EPA (LC omega-3) Fatty Acids for Dogs

- Heart health
  - Improves arrythmias such as atrial fibrillation
  - Decreases premature contractions

- Kidney health
  - Reduces blood pressure, a cause of kidney failure
  - Reduces inflammation

- Potential to reduce bowel inflammation
Benefits of DHA/EPA in Puppy Development

• **Conditionally Essential for Puppies**
  – Supports growth and development (ALA omega-3 is less effective)
  – Dogs fed LC omega-3 before whelping and during lactation
    • Increases tissue concentration
    • Respond to light more quickly
    • Improves visual performance
    • Improves sensitivity to dim light
• **Improved trainability**
Puppy Development and Learning
Electroretinography

- **a-wave**, measure of photoreceptor function
- **b-wave**, response of retinal cells that are post-synaptic to photoreceptors
- a- and b-wave implicit times, time to response after stimulus
- ä - extent of neural cascade activation

**ALSO:**

* Threshold Intensity = intensity at which a-wave is first detected
## Results – Puppy ERGs

<table>
<thead>
<tr>
<th>DIET</th>
<th>Response strength (a-amp)</th>
<th>Response Time ((a_i))</th>
<th>Extent of neural cascade activation ((\dddot{a}))</th>
<th>Dim light response ((I_t))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lo n-3</td>
<td>31.6(^a) (\mu V)</td>
<td>6.1(^b) (ms)</td>
<td>1.8(^a)</td>
<td>6.2(^b)</td>
</tr>
<tr>
<td>36 eyes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mod Fish</td>
<td>24.6(^a) (\mu V)</td>
<td>5.6(^{ab}) (ms)</td>
<td>1.6(^a)</td>
<td>5.8(^{ab})</td>
</tr>
<tr>
<td>26 eyes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hi Fish</td>
<td>49.5(^b) (\mu V)</td>
<td>4.4(^a) (ms)</td>
<td>2.5(^b)</td>
<td>5.3(^a)</td>
</tr>
<tr>
<td>20 eyes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hi Flax</td>
<td>43.5(^b) (\mu V)</td>
<td>5.0(^{ab}) (ms)</td>
<td>1.9(^{ab})</td>
<td>5.9(^b)</td>
</tr>
<tr>
<td>30 eyes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Summary: Puppy Vision Development

- DHA diet during gestation/lactation and/or perinatal period
  - Improves visual function
  - Increases retinal sensitivity in dim light
- Preformed marine DHA is more effective than vegetable ALA
- Puppies appear to convert ALA during suckling but not after weaning. So supplement important after weaning
- 0.2 % DM DHA needed using fish oil. Or 325mg EPA +DHA/Kg0.75 [6kg puppy receives ~4 ml of fish oil daily]
- Controls were healthy but DHA was not optimized: In this case 33 mg EPA+DHA/Kg0.75 was sufficient for a clinically healthy puppy
- Puppies provided DHA enriched diets had improved trainability (Zicker et al, data not shown)
Therapeutic Uses of Fish Oil

• Dosages based on Metabolic Body Weight using a multiplication factor ($A$)

\[
\text{Dosage}_{(\text{EPA+DHA})} = A (Wt_{kg})^{0.75}
\]
<table>
<thead>
<tr>
<th>Clinical disorder</th>
<th>Metabolic Body Weight Factor (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idiopathic hyperlipidemia</td>
<td>120</td>
</tr>
<tr>
<td>Kidney disease</td>
<td>140</td>
</tr>
<tr>
<td>Cardiovascular disorders</td>
<td>115</td>
</tr>
<tr>
<td>Osteoarthritis</td>
<td>310</td>
</tr>
<tr>
<td>Inflammatory or immunologic (atopy or IBD)</td>
<td>125</td>
</tr>
<tr>
<td>NRC recommended allowance</td>
<td>30</td>
</tr>
<tr>
<td>NRC safe upper limit</td>
<td>370</td>
</tr>
</tbody>
</table>
# Dosages of EPA+DHA for Clinical Conditions of Dogs*

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Dosage</th>
<th>Example: 10 kg dog - amt of (EPA+DHA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idiopathic Hyperlipidemia</td>
<td>120 mg/kg&lt;sup&gt;0.75&lt;/sup&gt;</td>
<td>675 mg</td>
</tr>
<tr>
<td>Kidney Disease</td>
<td>140 mg/kg&lt;sup&gt;0.75&lt;/sup&gt;</td>
<td>~780 mg</td>
</tr>
<tr>
<td>Cardiovascular Disorders</td>
<td>115 mg/kg&lt;sup&gt;0.75&lt;/sup&gt;</td>
<td>646 mg</td>
</tr>
<tr>
<td>Osteoarthritis</td>
<td>310 mg/kg&lt;sup&gt;0.75&lt;/sup&gt;</td>
<td>~1750 mg</td>
</tr>
<tr>
<td>Inflamm/Immune (atopy, IBD)</td>
<td>125 mg/kg&lt;sup&gt;0.75&lt;/sup&gt;</td>
<td>703 mg</td>
</tr>
<tr>
<td>NRC recommended allowance (Healthy Dog)</td>
<td>30 mg/kg&lt;sup&gt;0.75&lt;/sup&gt;</td>
<td>~170 mg</td>
</tr>
<tr>
<td>NRC safe upper limit (Healthy Dog)</td>
<td>370 mg/kg&lt;sup&gt;A0.75&lt;/sup&gt;</td>
<td>~2072 mg</td>
</tr>
</tbody>
</table>

* Bauer, JE. (2011) Therapeutic use of fish oils....JAVMA 239:1441-1451
## Dosages of EPA+DHA for Clinical Conditions of Dogs*

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<th>Disorder</th>
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<th>Example: 10 kg dog - amt of (EPA+DHA)</th>
</tr>
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<tbody>
<tr>
<td>Inflamm/Immune (atopy, IBD)</td>
<td>125 mg/kg(^{0.75})</td>
<td>703 mg</td>
</tr>
<tr>
<td></td>
<td>(125 (10^{0.75}) = 125 (5.62) = 703) mg</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fish Oil Product</th>
<th>Amount</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Product A (175 mg EPA+DHA/ml)</td>
<td>4.0 ml(^*)</td>
<td>700 mg (EPA+DHA)</td>
</tr>
<tr>
<td>Product B (240 mg EPA+DHA/cap)</td>
<td>3 gel caps</td>
<td>720 mg (EPA+DHA)</td>
</tr>
<tr>
<td>NRC recommended allowance (Healthy Dog)</td>
<td>30 mg/kg(^{0.75})</td>
<td>~170 mg</td>
</tr>
<tr>
<td>NRC safe upper limit (Healthy Dog)</td>
<td>370 mg/kg(^{0.75})</td>
<td>~2072 mg</td>
</tr>
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</table>

*1 level teaspoon = 5 ml; ~ 30 ml per ounce
Product Label

- Guaranteed Analysis
- 1 teaspoon = 5.0 mL (4600 mg)
- 1 teaspoon contains:
  - Crude fat (min.).................................99.4%
  - Moisture (max.).................................0.01%
  - Total Omega-3 Fatty Acids* (min.).........31%
    - Eicosapentaenoic Acid (EPA)* (min.)..15%
    - Docosahexaenoic Acid (DHA)* (min.)...9%

Not recognized as an essential nutrient by the AAFCO Dog Food Nutrient Profiles.

Ingredients: fish oil, d-alpha tocopherol (a preservative). No artificial colors or flavors.

4600 mg/5ml = 920 mg/ml

920 mg/ml X 0.15 = 138 mg EPA/ml

920 mg/ml X 0.09 = 82 mg DHA/ml

220 mg (EPA+DHA)/ml
Why use Metabolic Body Weight?
Linear dosing results in overdose > 25 kg

80 mg (EPA+DHA) X (Kg)  
Approx linear dose

310 mg (EPA+DHA) X (Kg)^{0.75}  
Osteoarthritis Dose

370 mg (EPA+DHA) X (Kg)^{0.75}  
Safe Upper Limit
Table format is cumbersome compared to the metabolic equation.

<table>
<thead>
<tr>
<th>Condition</th>
<th>15-22 lb (6.8-11 kg)</th>
<th>22-60 lb (11-25 kg)</th>
<th>60-80 lb (25-36 kg)</th>
<th>&gt;80 lb (&gt;36 kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Maintenance</td>
<td>¼ tsp (293 mg)</td>
<td>½ tsp (585 mg)</td>
<td>¾ tsp (878 mg)</td>
<td>1 tsp (1170 mg)</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>½ tsp (585 mg)</td>
<td>¾ tsp (878 mg)</td>
<td>1 ¼ tsp (1463 mg)</td>
<td>1 ½ tsp (1755 mg)</td>
</tr>
<tr>
<td>Inflammatory/Skin/Immune</td>
<td>½ tsp (585 mg)</td>
<td>1 tsp (1170 mg)</td>
<td>1 ¼ tsp (1463 mg)</td>
<td>1 ½ tsp (1755 mg)</td>
</tr>
<tr>
<td>Renal</td>
<td>¾ tsp (878 mg)</td>
<td>1 ¼ tsp (1463 mg)</td>
<td>1 ½ tsp (1755 mg)</td>
<td>1 ¾ tsp (2048 mg)</td>
</tr>
<tr>
<td>Osteoarthritis</td>
<td>1 ¼ tsp (1462 mg)</td>
<td>1 ¾ tsp (2048 mg)</td>
<td>3 ¼ tsp (3800 mg)</td>
<td>3 ¾ tsp (4388 mg)</td>
</tr>
<tr>
<td>Idiopathic Hyperlipemia</td>
<td>½ tsp (585 mg)</td>
<td>1 ¼ tsp (1462 mg)</td>
<td>1 ¼ tsp (1462 mg)</td>
<td>1 ½ tsp (1755 mg)</td>
</tr>
<tr>
<td>Safe Upper Limit</td>
<td>1.3 tsp (1521 mg)</td>
<td>1.9 tsp (2223 mg)</td>
<td>3.5 tsp (4095 mg)</td>
<td>4.5 tsp (5265 mg)</td>
</tr>
</tbody>
</table>

To be used only under veterinary supervision. Dosages are in teaspoons based on a minimum label guaranteed concentration of 1170 mg EPA+DHA per teaspoon, 1 teaspoon is ~ 5ml).

Amounts shown are for a dog whose body weight lies within each weight range listed.
It is much simpler using

\[ \text{Dosage}_{(EPA+DHA)} = A \ mg/kg^{0.75} \]

Where  \( A = \)

- 120 idiopathic Hyperlipidemia
- 140 Kidney Disease
- 115 Cardiovascular Disorders
- 310 Osteoarthritis
- 125 Inflammatory/Immune/Skin issues
Cats lack enzyme to convert vege-omega fatty acids to longer chain ones

LC omega-3 AND omega-6 both needed esp omega-3 for neural/retinal structure and function

Immune health

Tissue omega-6/omega-3 balance

Skin health
  –Supplements containing LC omega-3 appear to improve inflammatory dermatitis

Obese cats
  –LC omega-3 may improve insulin and blood sugar control
  –Reduces blood pressure, a cause of kidney failure
  –Potential to reduce bowel inflammation
...For Cats

- Fish oil omega-3s especially important...there is little to no conversion of precursors in cats
- Some clinical studies published but other fatty acids in open trial settings also present...less conclusive.
- Small dog dosages are likely safe for dermatitis and renal disorders.
- Better controlled clinical studies needed
- Anti-inflammatory benefit must be weighed against possible immunosuppressive effects esp at high doses.
- Use caution with doses >300 mg (EPA+DHA)/cat/day long term until additional studies are published.
- If feeding a low iodine diet, do not use products in excess of 1.5 µg iodine/1000mg of fish oil daily
Thank you for your attention

Questions?

Many thanks to Blackmores for Sponsoring this Presentation

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