



Fish Health and Nutrition

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USFWS

ABERNATHY FISH TECHNOLOGY CENTER

LONGVIEW, WA

Early feeds 1920s-1930s

Wet feeds: early salmonid feeds made from beef liver, slaughterhouse byproducts, fish products and other materials available to the hatchery

Early feed formulas:

Diet 1

48% ground scrap fish

28% liver

24% salmon eggs

Diet 2

47.5% fresh liver

47.5% canned carp

5% dried brewer's yeast



Credit USFWS

Pacific Northwest Early Feeds

Frozen salmon carcasses from adult spawners, ground, were also fed to juvenile salmonids in hatcheries

However:

Disease, such as BKD, transmission was an issue

Feed development

- As aquatic feeds were developed nutritional diseases were seen.
- Research done to determine specific nutritional needs for each species.
- Some of the first formulated West Coast diets: Oregon Moist Pellet (1950s) and the Abernathy Dry Diet (1960s)



Credit NCTC Archives/Museum

The Importance of Good Nutrition



Proteins

How much? What kind?
Source?



Carbohydrates

Intolerances by
carnivorous species



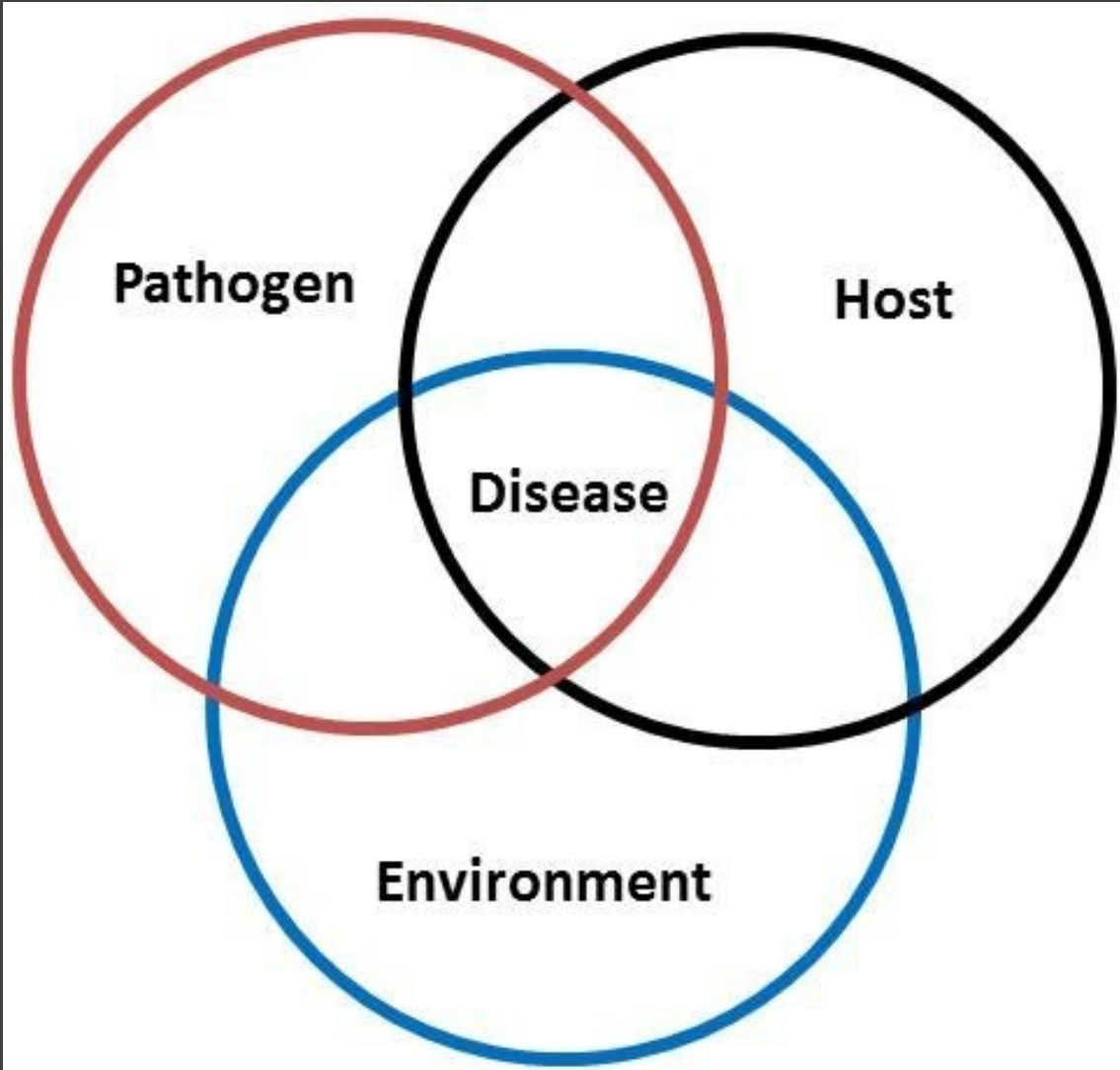
Lipids

Provide much more than
just energy



Micronutrients

Nutritional pathologies



Epidemiological triad (*Snieszko 1974*)

Factors defining the host:

- Fish species
- Age
- Population
- Nutritional status

Fish are sick / dying



Parasites, Bacteria, Viruses



No causative agent found



Water quality?



Nutrition



Difference between nutrient requirements and recommendations

Requirement

Under ideal conditions, what is needed to survive and not show signs of deficiency?

Recommendation

Higher than requirement, considers situational need.

MINIMIZE STRESS

➤ When stressed, fish require more nutrients!

Nutritional pathology

COMMON SIGNS

- No appetite
- Darkening of skin
- Poor growth

→ Caused by numerous nutrient deficiencies



STARVATION

- Weight loss
- Morphological change
 - Pinheading
- Darkening of skin
- At necropsy—pallor (anemia) and no IP fat

Nutritional pathology



...is the deficiency, excess, or improper balance of the components present in a fish diet (Snieszko 1972)

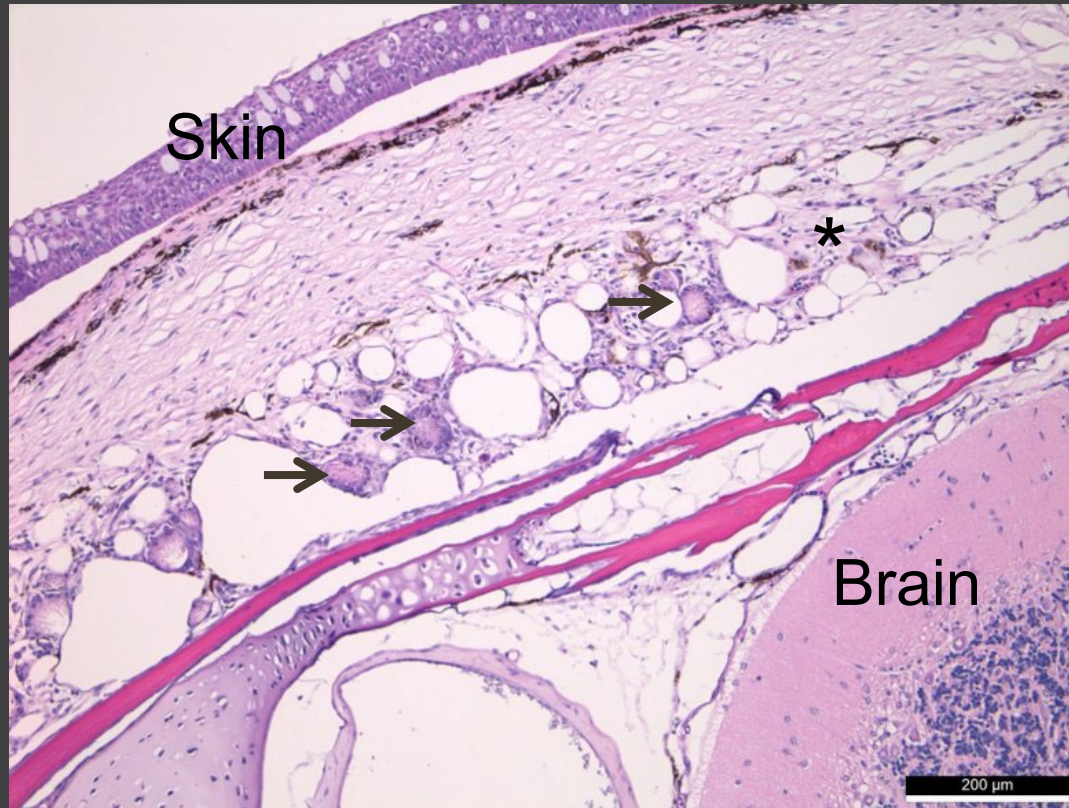


...also includes the presence of noxious or toxic components within the food, or endogenous antinutrient factors (DeSilva and Anderson 1994; Jauncey 1998)



...can be caused by starvation. Then all nutrients are deficient.

Dermatosis/Steatitis Sunburn?



Balmer & Nelson, WADDL

→ Inflammation of fatty tissue, steatitis on the head of the fish. *Subcutaneous fat

- Loss of vitamins during storage
- Rancid lipids



Ethoxyquin, an antioxidant to protect oils

June 2017 EU suspended the use of ethoxyquin due to an impurity, p-phenetidine, a mutagen.

August 2022 Use of ethoxyquin was denied by the Committee on Plants, Animals, Food and Feed in the European Commission.

What does this mean for us? Manufacturers of fish meal and oil may not want to use ethoxyquin so they can sell overseas. Or US clients of feed companies don't want it in their feed.

Antioxidants we in the US can use

1. Ethoxyquin (generic term: 1,2-dihydro-6-ethoxy-2,2,4-trimethylquinoline) used at 150 ppm*

*FDA allowed levels in complete feed

2. BHA (butylated hydroxyanisole) used at 200 ppm

3. BHT (butylated hydroxytoluene) used at 200 ppm

4. Tocopherols (vitamin E) + rosemary extract



John Moore Museum

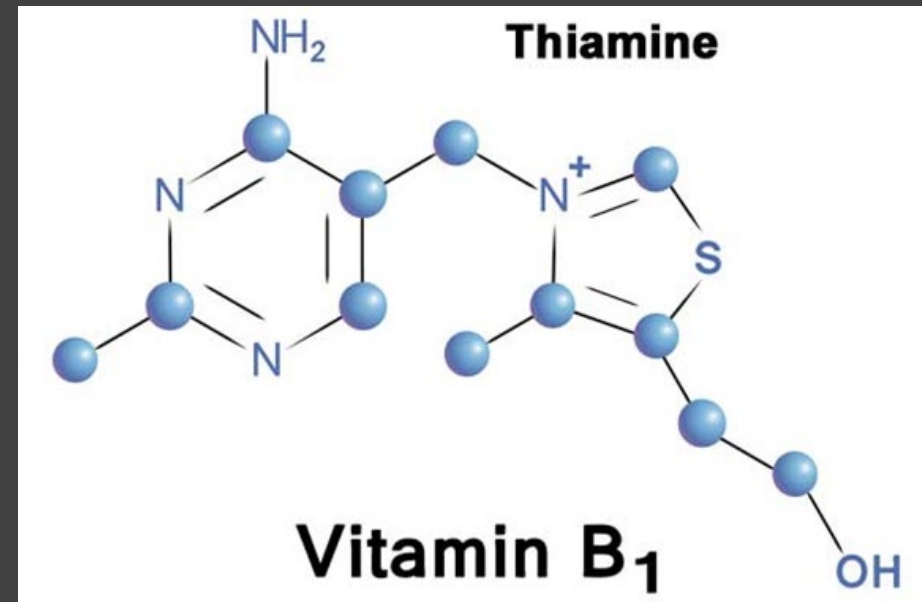
Mycotoxins

- Aflatoxin B1, B2, G1, G2-*Aspergillus* (storage fungi)
- T-2 and Vomitoxin-*Fusarium* (field fungi)
- Mold in feed or ingredients will produce these mycotoxins which can cause immunosuppression, impaired growth and possible tumor growth.



Nutrition issue, not the feed

- Thiamine, B₁, a possible deficiency in returning adults passed on to their offspring
- There are treatments but feed has adequate levels of B₁





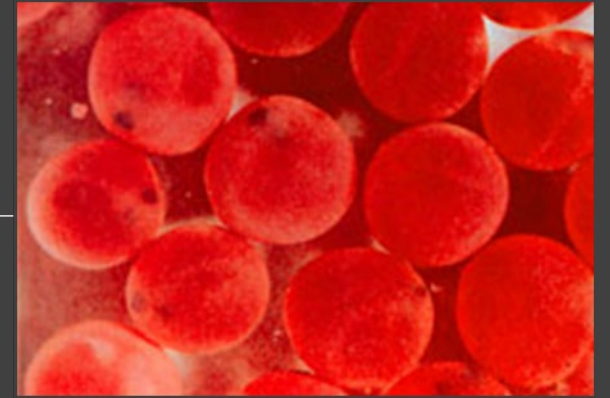
Prey items from Chinook guts 1980s

Recent years, Chinook gut content



(Photos: John Field / NOAA Fisheries, Southwest Fisheries Science Center)

Common signs, Treatment



- Mortality of adults
- Death of swim-up fry-before feed
- Inject adults with thiamine at least 2 weeks before spawning-gets the thiamine into the eggs
- Thiamine bath for the eggs or fry

Has been studied in the Great Lakes for many years because of change in prey (from Ciscos, for example, to Alewives).

Suspect a feed problem?

Question: How long have the fish been on this feed? If over two weeks sample the feed they are getting. If less than two weeks sample the feed they were on before the switch.

Question: Are the fish readily eating the feed? If not, the issue could be feed size or palatability.

Question: When you used another lot of feed was the problem resolved? Could be a problem with the feed but what other factors changed?

Question: Are the fish exhibiting any deficiency signs?



AOAC Official Method 965.16, Sampling of Animal Feed

1. Use slotted single or double tube, or slotted tube and rod, all with pointed ends (a trier).
2. Use this probe to take a sample from ten bags on a randomly selected pallet.
3. Have ten subsamples that are mixed to make one composite while retaining a portion of the ten subsamples.



J. Assoc. Off. Anal. Chem. **33**, 424(1950); **38**, 108(1955); **41**, 223(1958); **48**, 658(1965).

Feed Inspector's Manual (1994) 1st Ed., Association of Feed Control Officials, Inc., Oxford, IN.

Revised: March 2002

Feed Sheet Information

- Facility Name
- Facility Contact Person
- Person Who Collected the Feed
- Collection Date
- Date of Feed Manufacture
- Feed Manufacturer
- Date Feed Received
- Lot Number (if any)
- Type of Feed (for example, BioVita Fry)
- Size of Feed

Getting the feed analyzed by a commercial lab

- Eurofins <https://eol.eurofinsus.com>
- Midwest Labs <https://www.midwestlabs.com>
- New Jersey Feed Lab <https://njfl.com/contact-us/>
- University of Missouri-Columbia Agricultural Experiment Station Chemical Laboratories <https://aescl.missouri.edu/>



Thank you



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