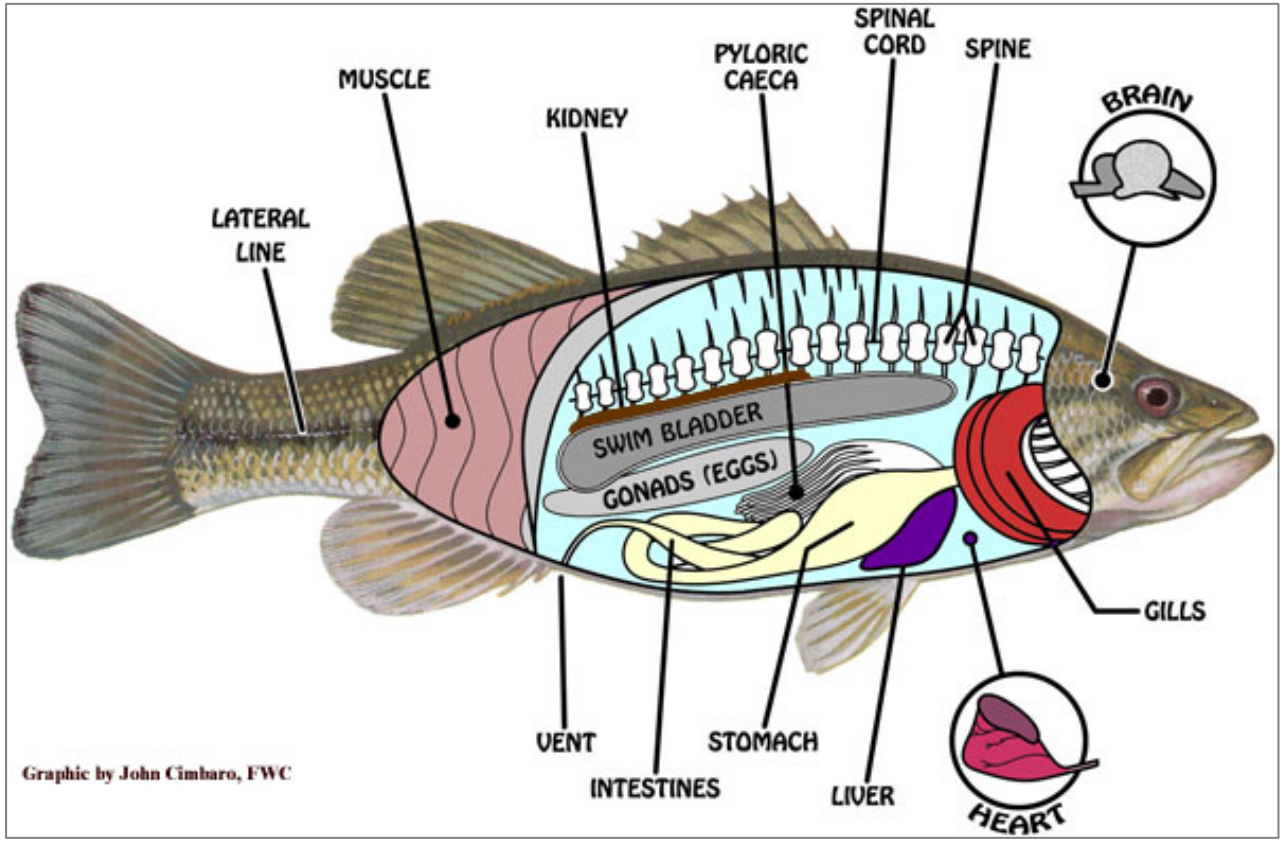

Biology of fish larvae and fry gut and enzyme development

Functions of the gut and intestine

- Digestion and absorption of nutrients
- Excretion of waste material-digesta, metabolites & toxins (entero-hepatic route)
- Osmoregulation-water and electrolyte balance (Ca, P, Na, k & Mg balance)
- Possible endocrine role (gastrin)
- Barrier to infection-anti-microbial & gut mediated immunological function
- Vitamin synthesis e.g. B12 & PABA

Fish internal anatomy



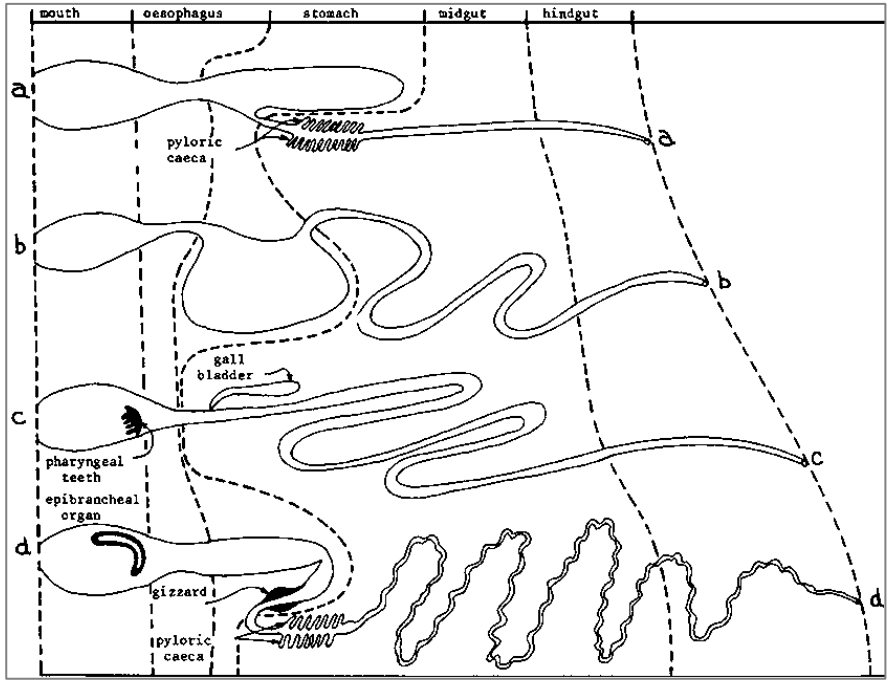
Gastrointestinal tract is a system integral to whole animal function and homeostasis involving complex humoral and neurological mechanisms

Significance of larval fish gastrointestinal development in aquaculture

Ingestion of food induces stomach development- enzyme secretion and establishment of commensal bacterial population

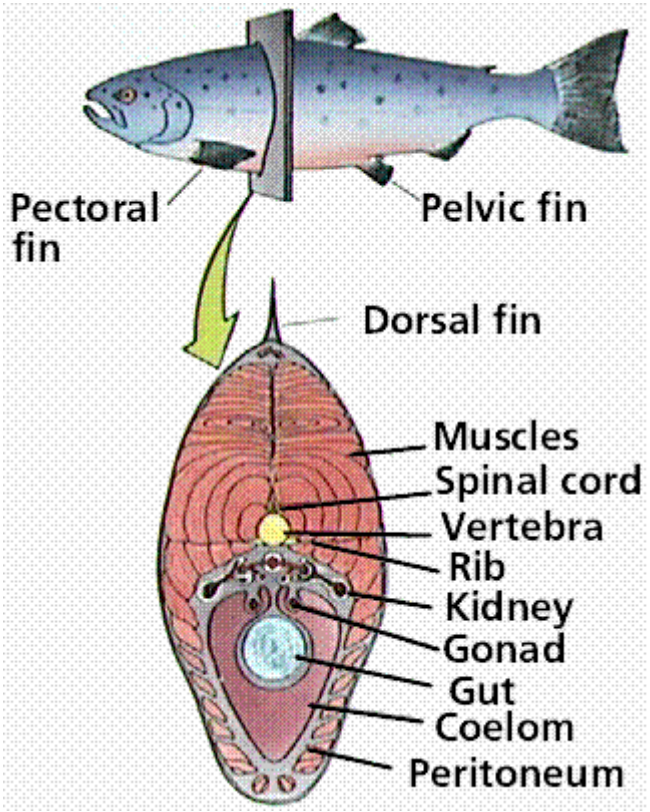
Critical phase in fish development and establishment of innate and specific gut immunity

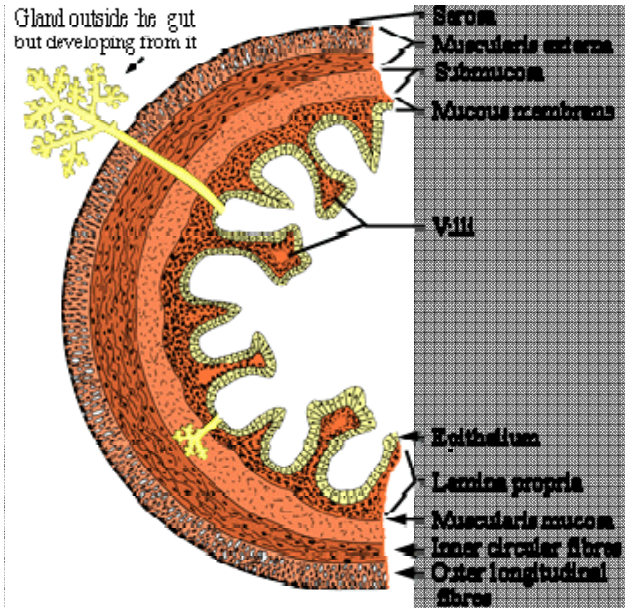
Diversity in gut form and morphology is evident in fish



Development of intestine relates to trophic level: Presence of stomach, pyloric caecae & intestinal length varies significantly between carnivores, ominivores, herbivores & detritivores

The living tunnel





Nutrient absorption is complex and varied in fish

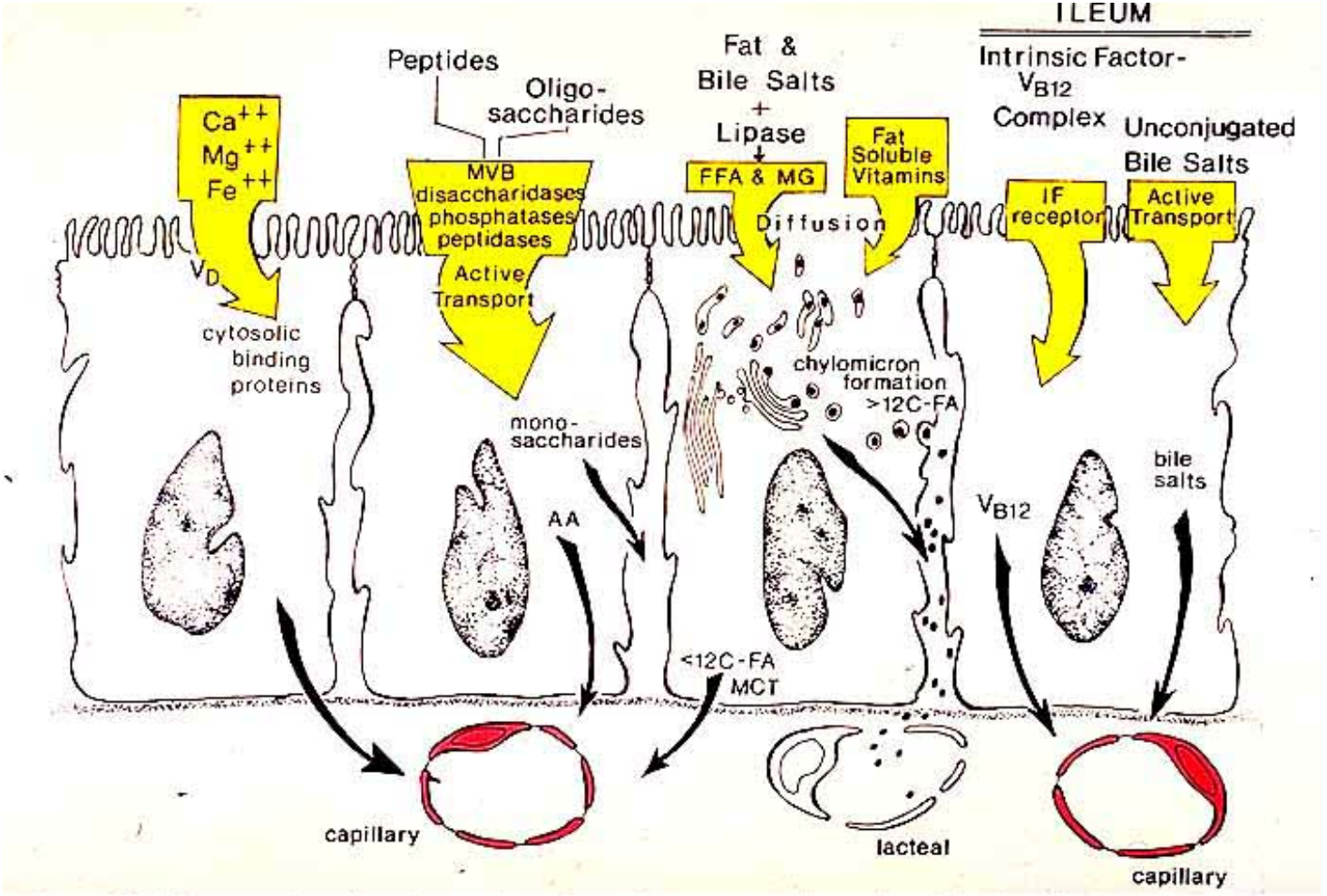
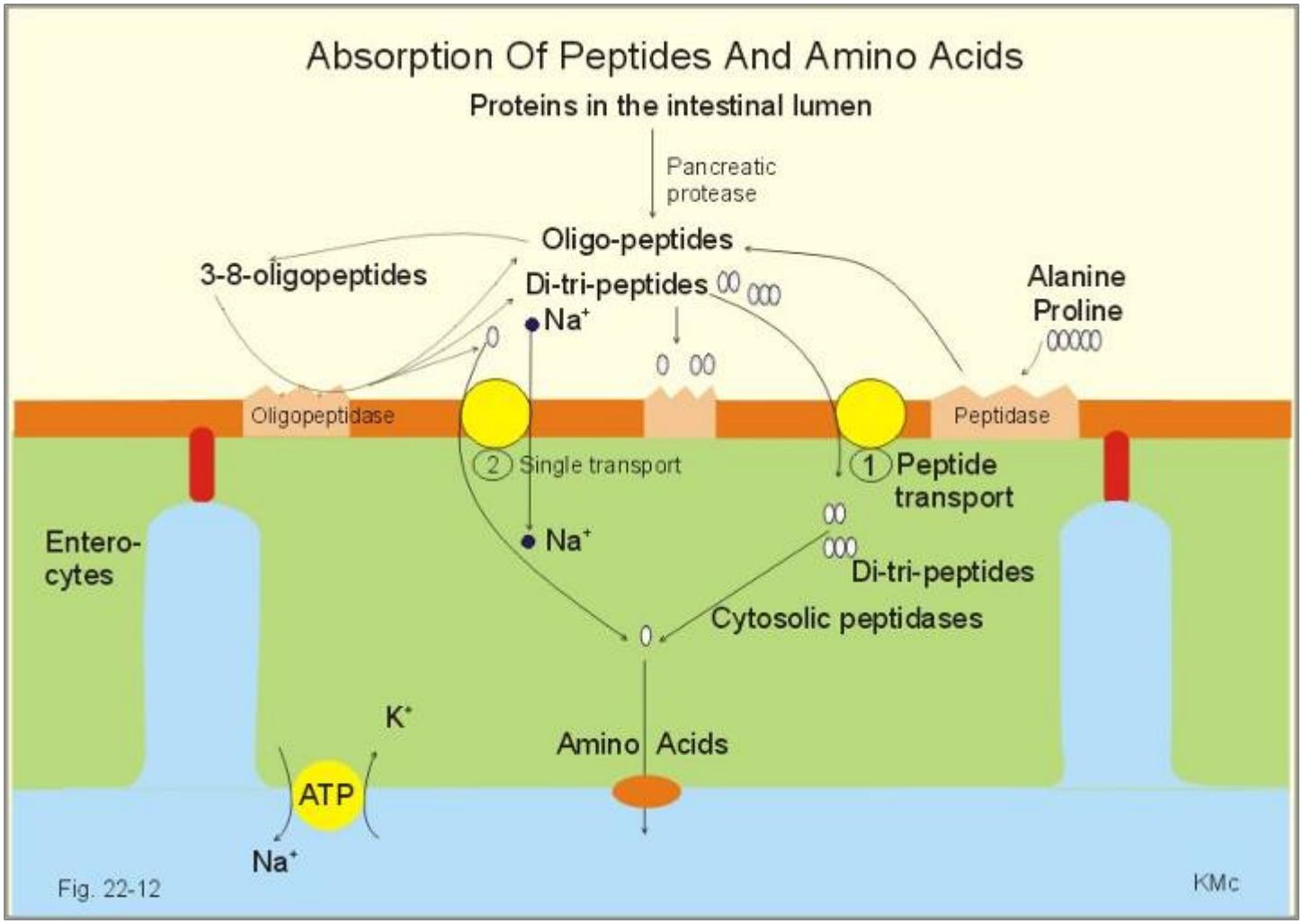


Figure 23. Diagram showing absorption of nutrients across the micorvillus border.

Peptide & amino acid absorption mechanisms



Andy Foey (2008)

The gut mucosal epithelium: So much more than just absorption!

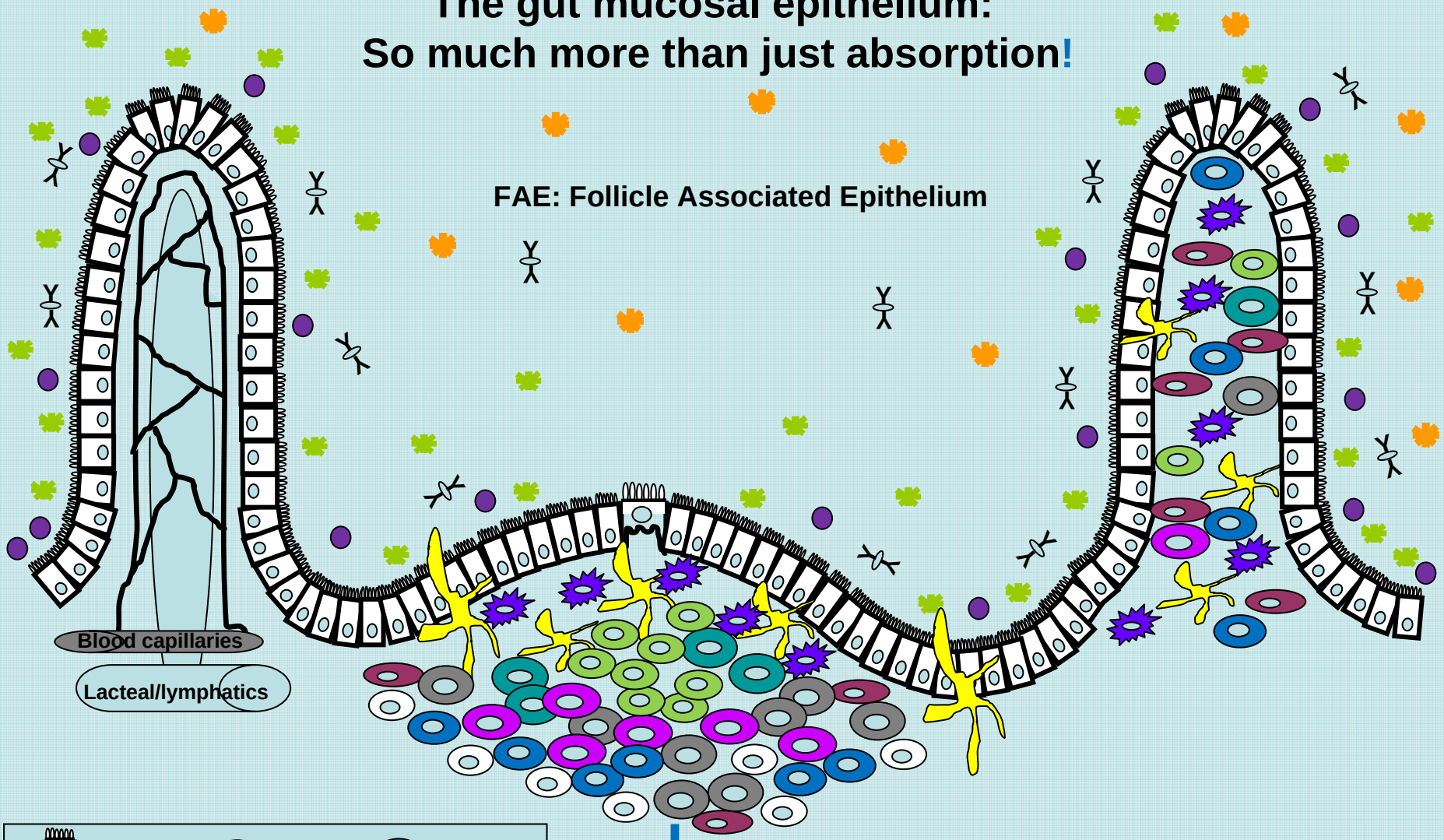


Figure adapted from: Brenchley & Douek, 2008. Mucosal Immunology 1(1): 23-30.

The effect of diet on intestinal morphology

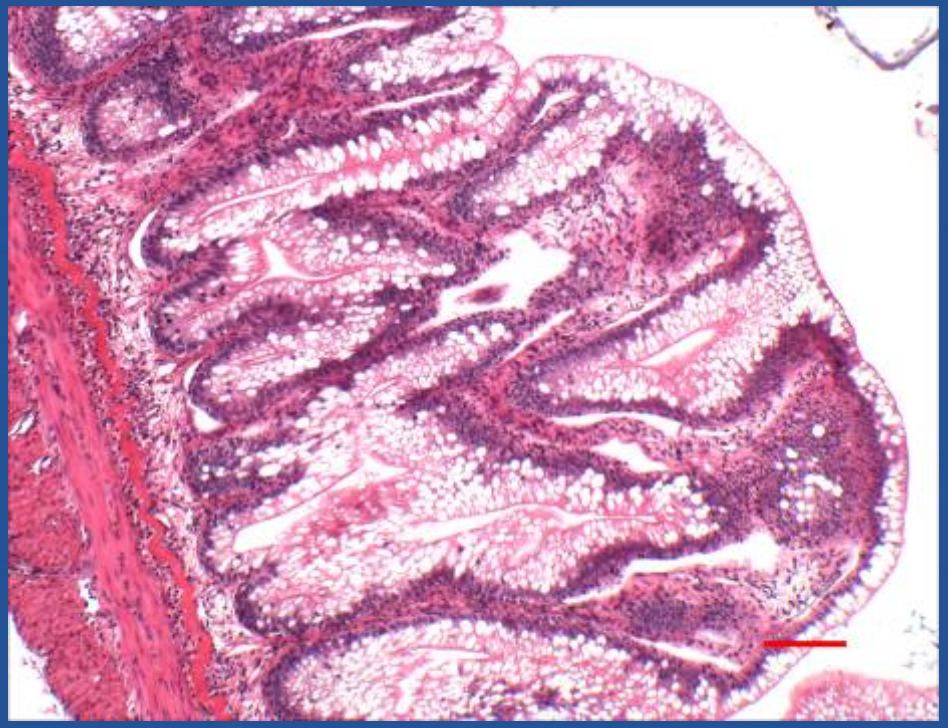
Control, no soybean meal

Normal villi of distal intestine.

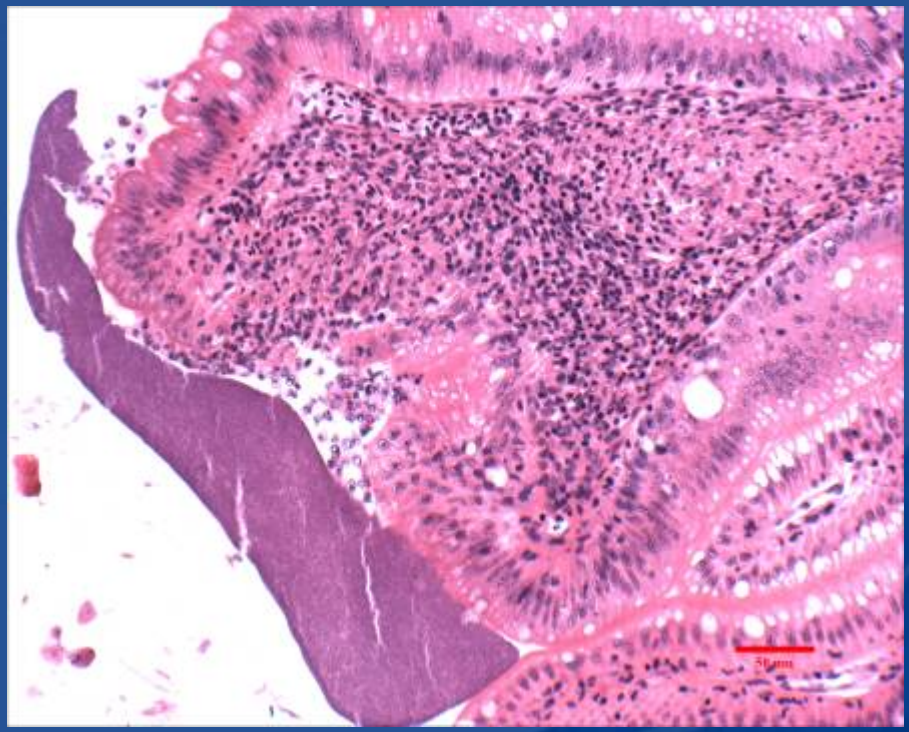
35% ESE- Soybean meal

Abundance of apical vacules in muccosal epithielium

The effect of diet on intestinal morphology, 35% soybean meal

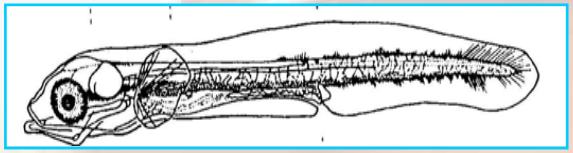


Fusion of intestinal villi, and inflammation



Necrosis and ulceration of mucosal epithelium. severe leucocytic inflammation of lamina propria and central stroma

Enzyme development in sea bass



trypsin
aminopeptidase
phosphatase

chymotrypsin
esterase
amylase

lipase

PEPSINE

0 5 15 20 30

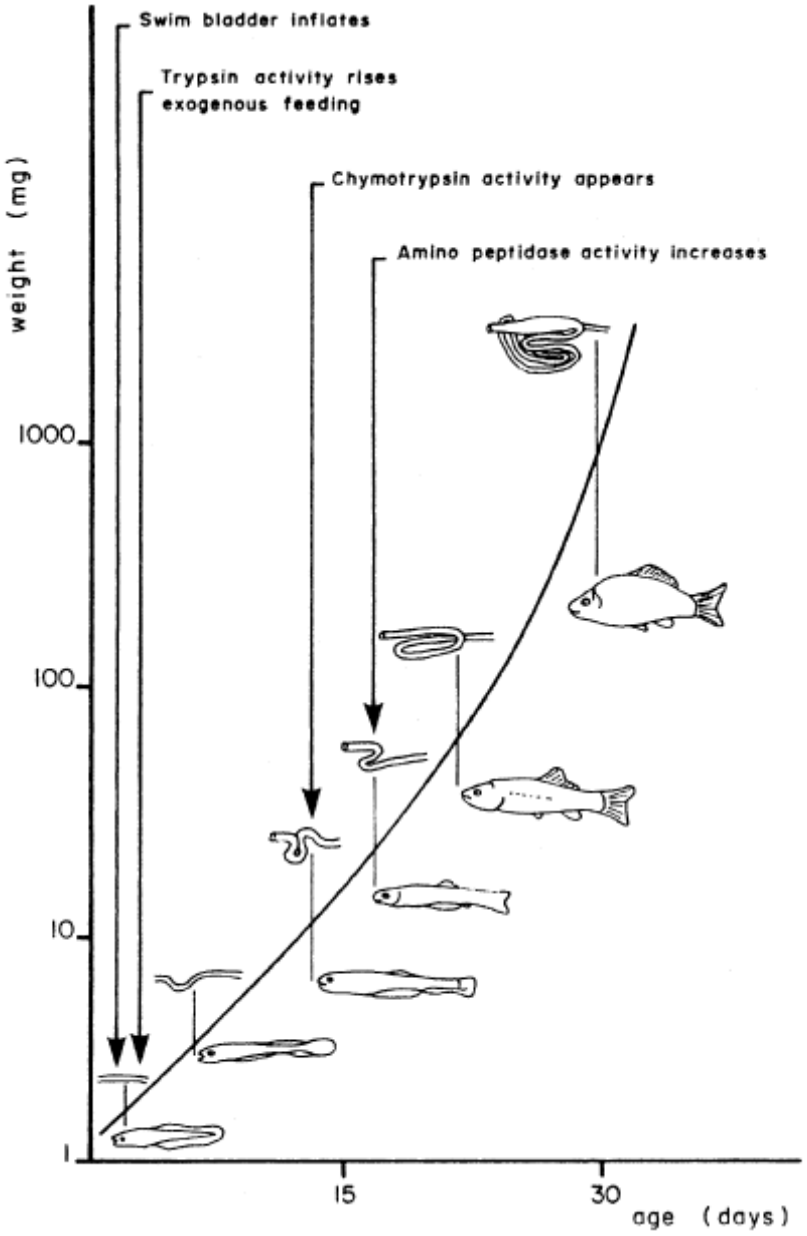
days post-hatch

Hatching

First feeding

Commence Co feeding

Metamorphosis



Ontogenetic development of the digestive tract of cyprinid fish

(Dabrowski, 1984)

DIGESTIVE SYSTEM:

length

- differentiation
- enzymes: quantity - quality

- **highly digestible feed**
  - ↖ protein quality (max. digestibility)
  - ↖ oligopeptides
  - ↖ lipid digestibility enhancers
- **exogenous enzymes**


Start Feeding – Live feed

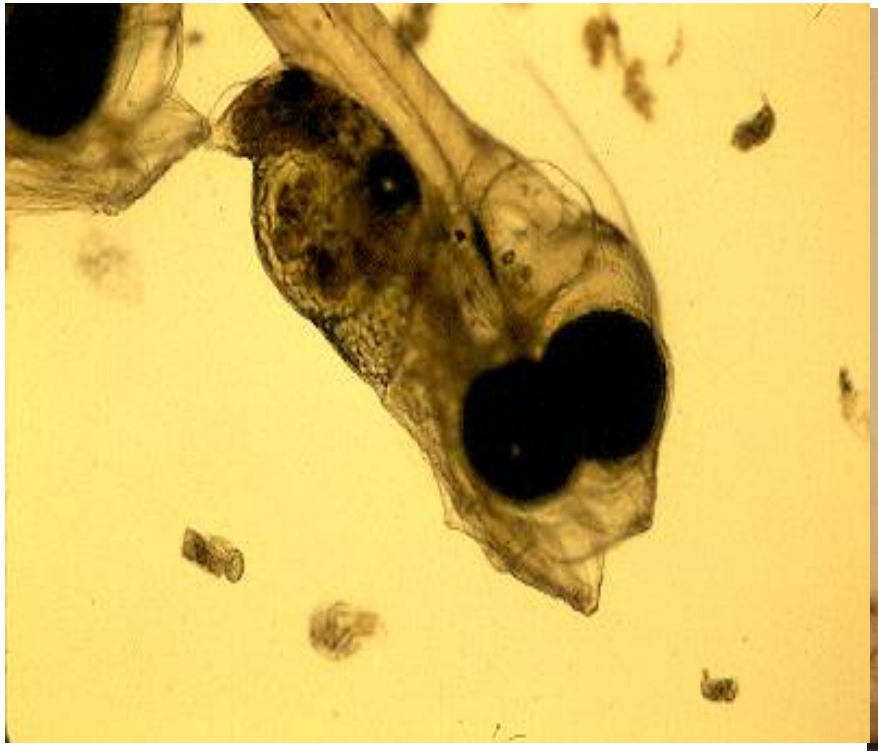
Larvae mouth size in relation to prey size

SIZE: small mouth opening

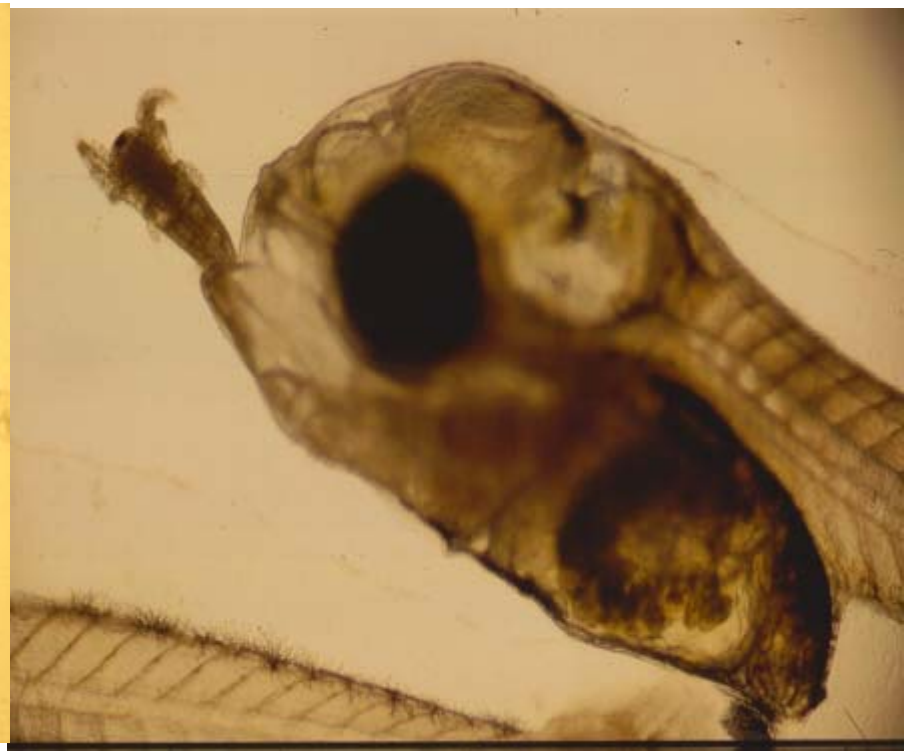
Food particle size small

First feeding ~80-200µm

=> Narrow size distribution



Rotifer



Artemia

Feeding & nutrition during early larval stages

Perceptibility ***(visual, chemo-, mechanoreception)***

Good contrast in water

Triggering movement

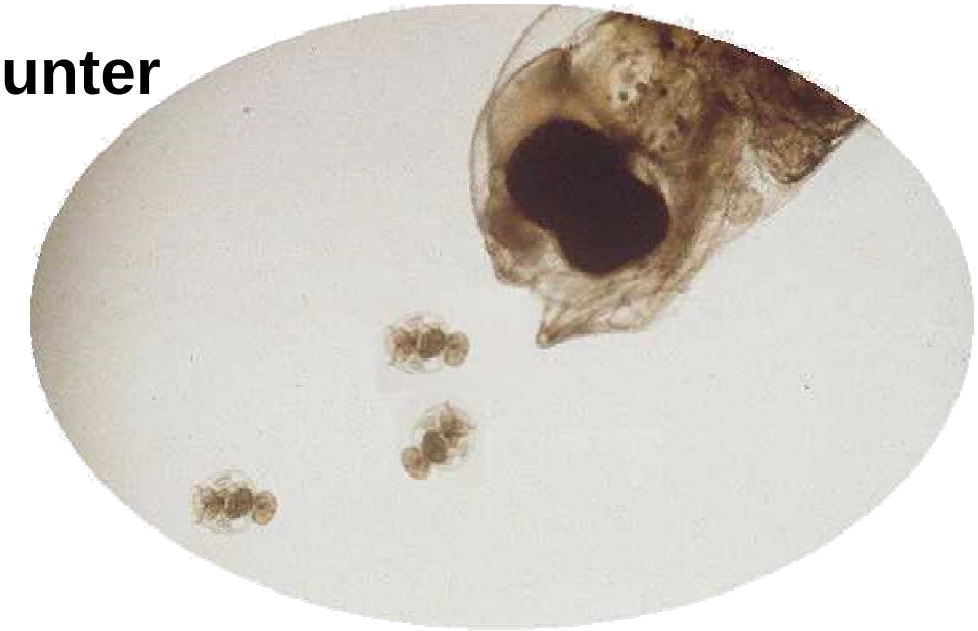
Distribution /encounter

Buoyancy

Water movement

Prey catching

Attractants




Algae (green water)

Algal Production

Algal production costs per m3 (corrected for equivalent cell densities)

Sack culture	**35.2 €**
Bioreactor systems	**8.6 €**
Commercial pastes	**30 to 283 €**

Algal growth curve

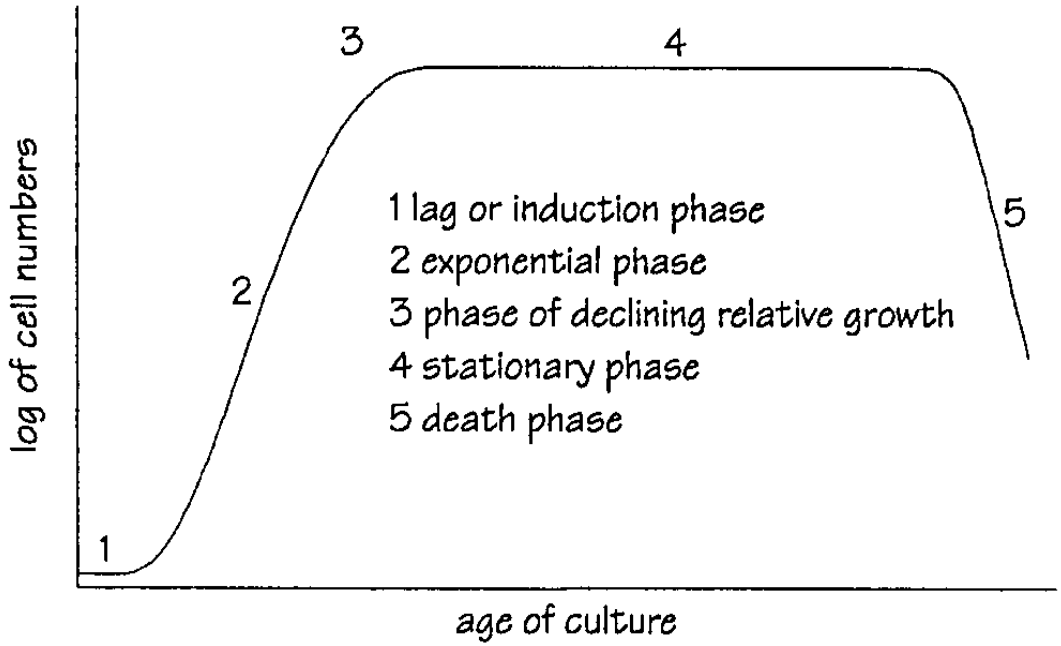
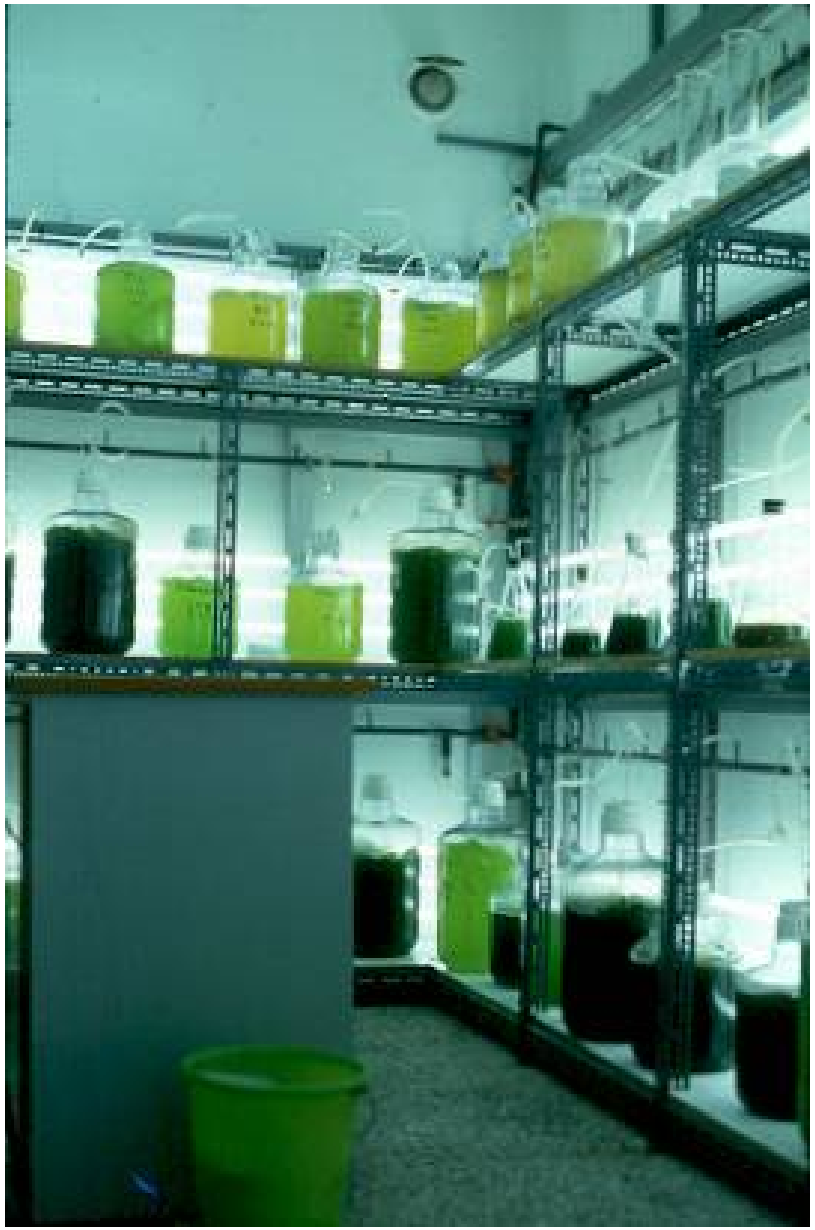


Figure 2.3. Five growth phases of micro-algae cultures

1 litre to 20 litre cultures

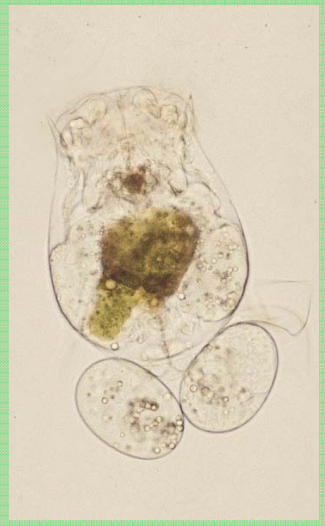


Indoor bag cultures

High density culture systems

Role of algae in the green water larval rearing technique

- An anti-bacterial agent
- In situ biological filter and producer of oxygen
- Light filter
- Promoter in the location of prey organisms
- Stimulation of enzymatic synthesis and onset of feeding in young larvae



Difference between green and clear water culture techniques