Bioenergetics

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4- Energy Balance in Fish 1

Energy Balance in Fish

Energy flow in fish is similar to that in mammals and birds

fish are more efficient in energy use :

1- energy losses in urine and gill excretions are lower in fish because 85% of nitrogenous waste is excreted as ammonia (vs. urea in mammals and uric acid in birds)

2- heat increment (increase) as a result of ingesting feed is 3-5% ME in fish vs. 30% in mammals

3- maintenance energy requirements are lower because they don't regulate body temp

4- they use less energy to maintain position

Gross Energy of Feedstuffs

Fats (triglycerides) have about twice the GE as carbohydrates

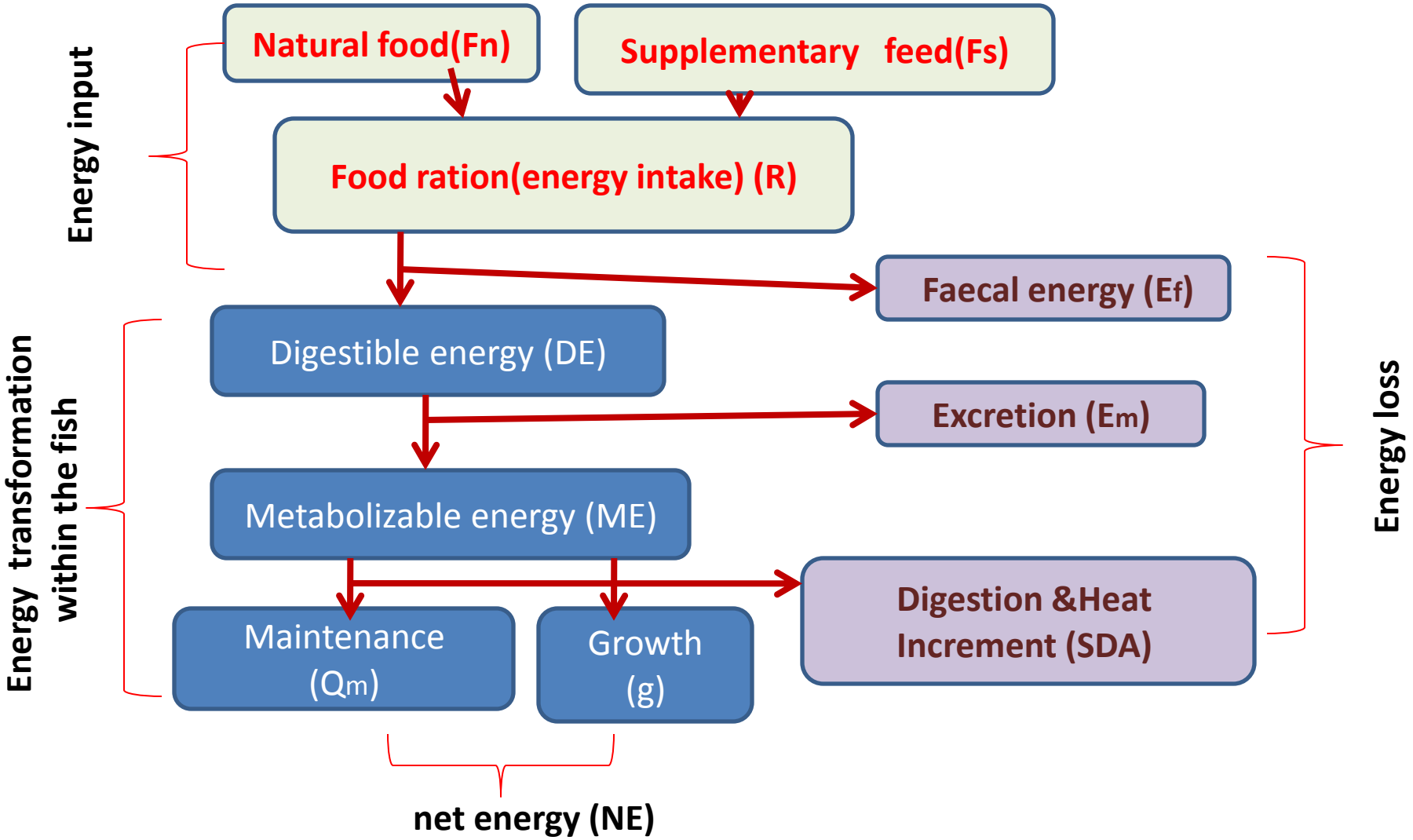
this is because of the relative amounts of oxygen, hydrogen and carbon in the compounds

energy is derived from the **heat of combustion** of these elements: C= 8 kcal/g, H= 34.5, etc.

typical heat of combustion of fat is 9.45 kcal/g, protein is 5.45, COH is 3.75

The balance of energy

In the transformation of food energy to net energy (for metabolism growth) a considerable portion is lost, some loss is unavoidable, it should be minimized , by studying and estimate this loss.



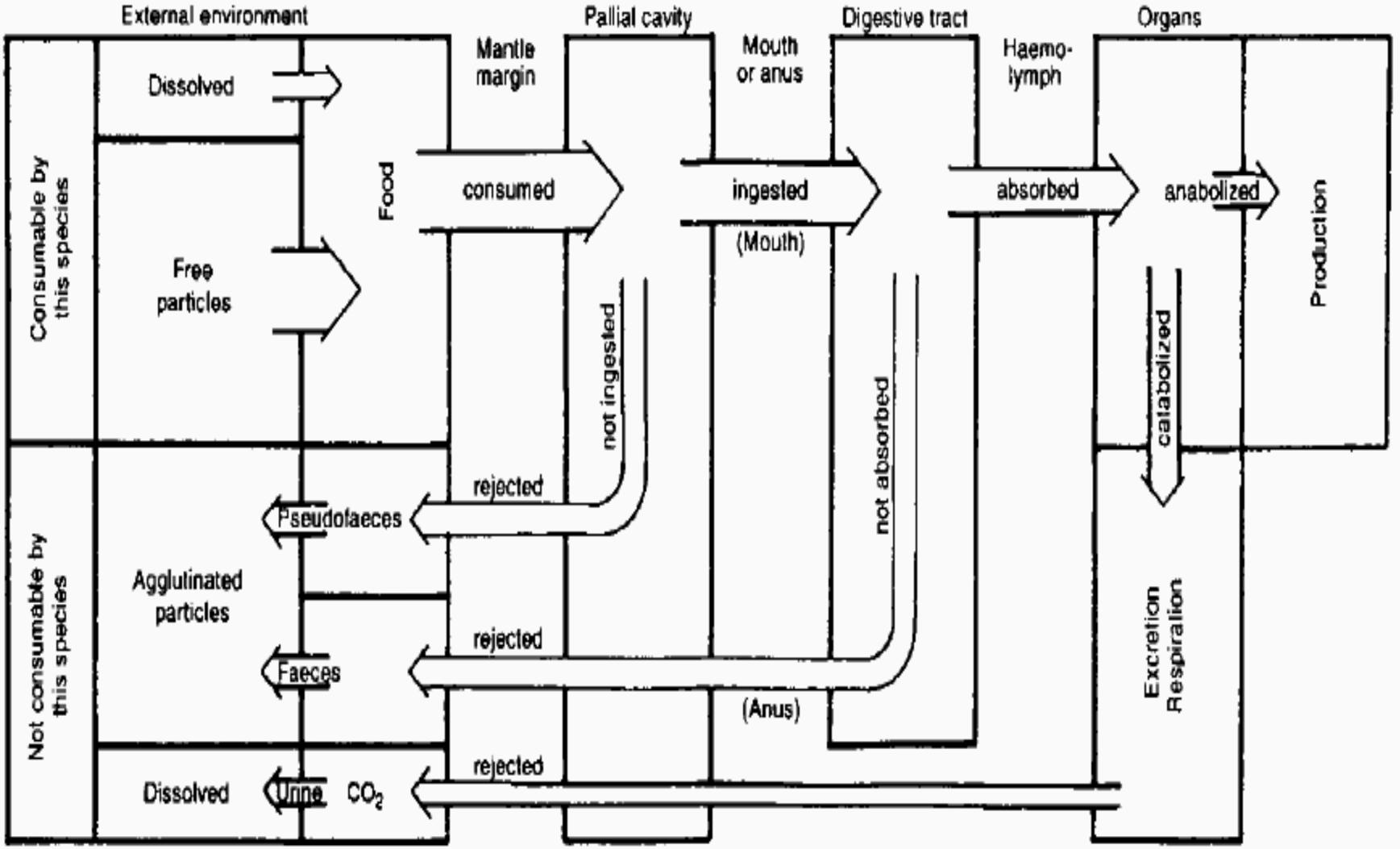


Diagram showing fish food pathways

Terrestrials vs. Aquatics

a major difference in nutrition between fish and farm animals is the amount of energy required for protein synthesis

protein synthesis refers to the building of proteins for tissue replacement, cell structure, enzymes, hormones, etc.

fish/shrimp have a lower dietary energy requirement

Factors Affecting Energy Partitioning

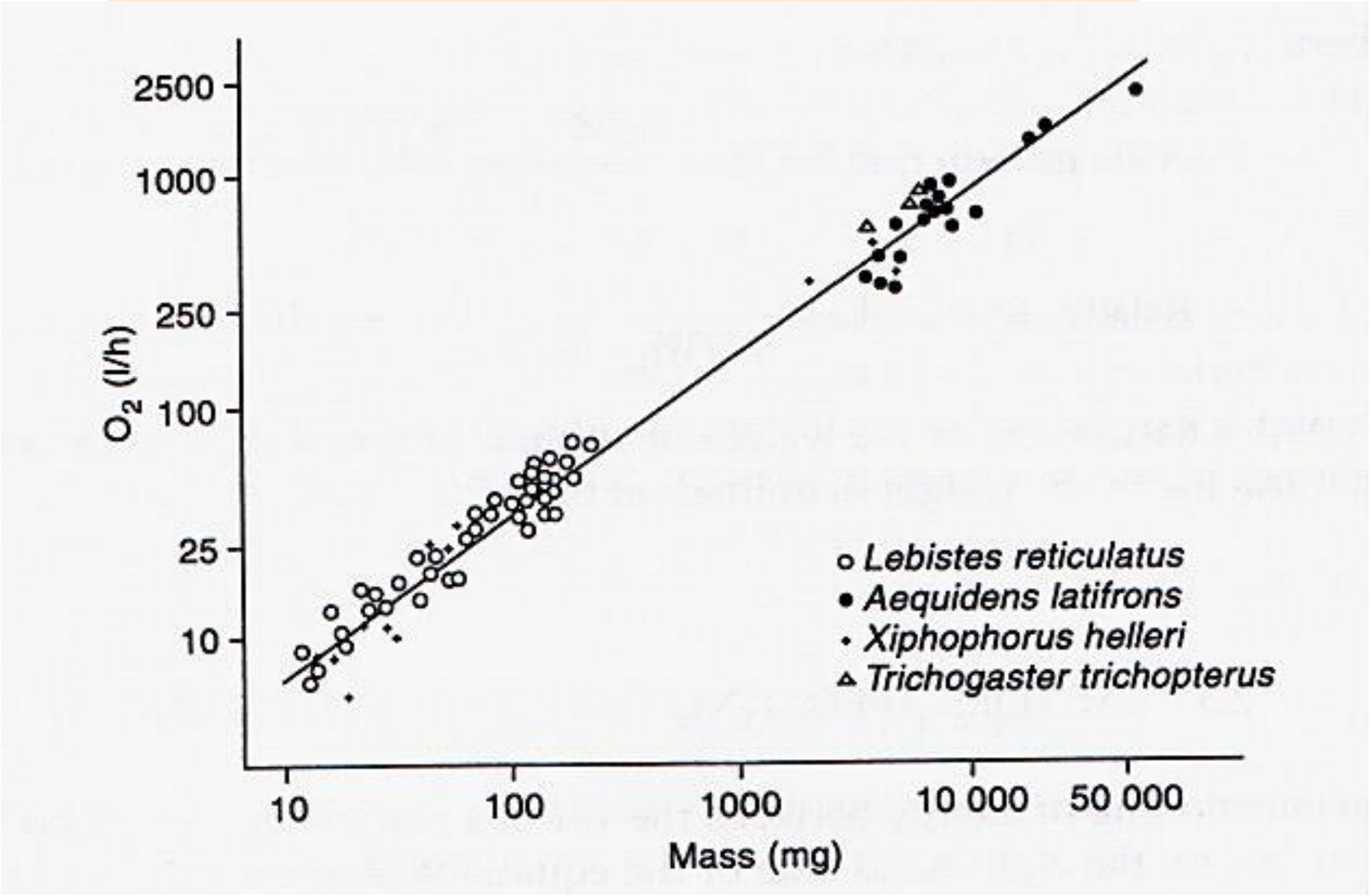
- Factors either affect basal metabolic rate BMR(e.g., body size) or affect other changes.

  Those affecting BMR are the following:

❶**body size:** non-linear, $y = ax^b$, for most physiological variables, b values usually range between 0.7 and 0.8

❷**oxygen availability:** have conformers (linear) and non-conformers (constant until stressed)

O_2 Consumption, by Size



(Fig. 2.1 from De Silva and Anderson)

Factors Affecting Energy Partitioning

❸ **temperature:** most aquaculture species are poikilotherms, significant effect, acclimation required, aquaculture situation may mean rapid temp changes.

❹ **osmoregulation:** changes in salinity result in increased cost of energy.

❺ **stress:** increased BMR resulting from heightened levels of waste, low oxygen, crowding, handling, pollution, etc. (manifested by hypoglycemia).

❻ **cycling:** various animal processes are cyclic in nature (e.g., reproduction, migration)

Factors Affecting Energy Partitioning

Those factors ***not*** affecting BMR are:

❶ **gonadal growth:** most energy diverted from muscle growth into oogenesis, deposition of lipid, can represent 30-40% of body weight.

❷ **locomotion:** major part of energy consumption, varies due to body shape, behavior and size, aquatic vs. terrestrial issues