Bioenergetics

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Pattern of deposition of nutrients

- Proportionally constant protein and lipid depositions will result in little change in the protein content (expressed as % of body weight) of the fish carcass
- but very significant increase in the lipid content (also expressed % of body weight).

Pattern of deposition of nutrients

- The protein content of growing salmonid is determined solely by fish size,
- lipid level is affected by both endogenous (fish size, growth rate) and exogenous (dietary, environmental) factors and that ash content is homeostatically controlled.
- The protein or ash contents of the whole body appear to vary little with growth of a given species of fish
- whole body lipid and energy contents vary considerably over time.

Pattern of deposition of nutrients

- There are three to six grams of water associated with each gram of protein tissue deposited .
- When lipid is deposited in tissues, it generally substitutes water.
- Consequently, protein gain generally results in significant live weight gain whereas lipid gain generally results in little or no weight gain.
- It is apparent from this that understanding of growth of fish resides in understanding of pattern and factors affecting protein deposition.

Pattern of deposition of nutrients

- Severe feed restriction can result in significant alteration of the protein to lipid deposition ratio in fish.
- Protein deposition has, in general, priority over lipid deposition.
- Several studies have shown a linear relationship between DE and carcass protein and lipid gains (Figure 12).

Pattern of deposition of nutrients

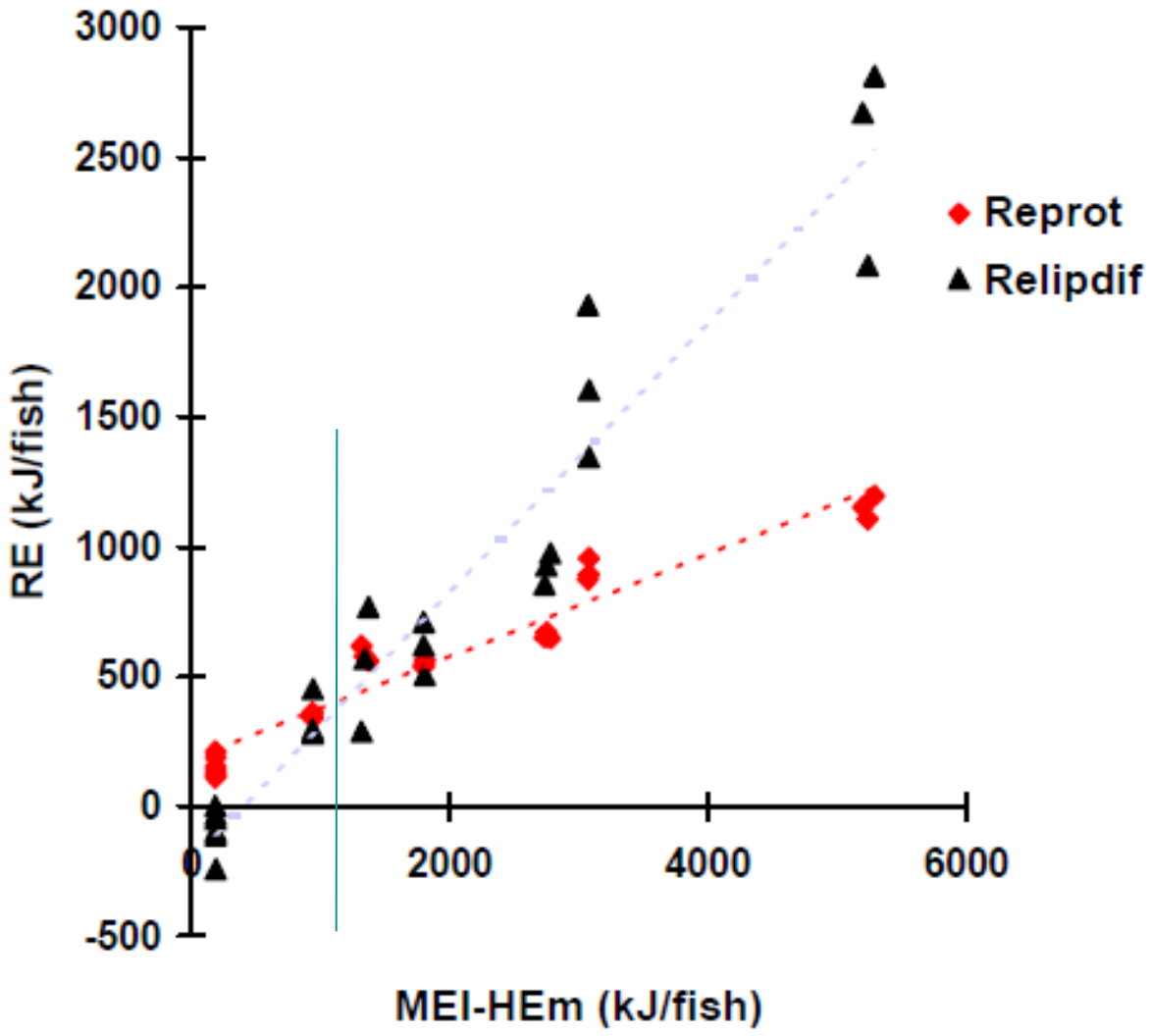

Figure 12. Energy gain (RE) as protein (Reprot) and lipid (Relipdif) as a function of metabolizable energy intake above maintenance (ME-HEm).

Pattern of deposition of nutrients

However, at zero energy gain (maintenance), both protein deposition and live weight gain are positive. Fish fed a maintenance ration
(ration resulting in zero energy deposition), catabolize non-protein energy yielding nutrients of the diet and mobilize carcass lipids to support protein deposition and, consequently, live weight gain.

Pattern of deposition of nutrients

- The relative importance of protein and lipid deposition depends upon a great number of other nutritional factors.

1) The balance of the available amino acids, particularly essential amino acids, in the dietary protein,
2) The digestible protein to digestible energy ratio in the diet are the major factors.
3) Proteins of high biological value may promote greater protein deposition than those of lower value.
4) High energy and low protein intakes result in the deposition of a larger proportion of lipid.
5) Seasonal changes in body composition, in relation to specific physiological stages or endocrine status are also known to occur.

Pattern of deposition of nutrients

- There are also considerable inter-specific differences in lipid deposition and tissue distribution.
- Nutrient deposition and temporal changes in body composition of fish,
- and effect of all the factors mentioned above, should be examined more closely.

Pattern of deposition of nutrients

- Energy gain, (or recovered energy, RE) has been used as a measure of nutrient deposition and growth in most feed requirement models and as proven very useful. However, RE is not always a quantitative measure of weight gain because deposition of lipid reduces the water content of the body thus changing the energy value per unit weight of the living animal. The great difference in the energy value of lipid and protein also exaggerates the difference in the energy content of body weight gain. However, RE remains a useful and simple measure of growth and nutrient deposition provided one recognize its limitations.

Energy Utilization

The maintenance of life processes (integrity of the tissues of the animal, osmoregulation, respiration, circulation, swimming, etc.) and the buildup of body components (and the utilization of nutrients to achieve this buildup) have costs in terms of nutrient and feed energy. This cost is frequently expressed as energy cost. This type of approach is not perfect but is used for simplicity sake.