Chapter 1: Nutrition

**Nutritional problems**

Stock require a nutritionally balanced diet in order to maintain good health and growth. A nutritionally balanced diet must contain all the essential amino acids, fatty acids, vitamins, minerals and energy required by the stock in order to prevent nutritional deficits from becoming a problem. The diet must also be given at a high enough ration for the stock to gain sufficient nutrients / energy not only for maintenance but also growth.

This section will cover the following:

- Identifying nutritional problems
- Proteins
- Lipids
- Carbohydrates
- Vitamins
- Minerals
- Summary
- What do you think?
- Glossary

**Identifying nutritional problems**

Unfortunately for aquaculturalists many of the signs exhibited by stock can be attributed to several causes. This makes it extremely difficult to determine the exact cause of a nutritional problem.

When attempting to determine whether the stock nutrition is adequate a farmer must examine a range of signs in order to assess whether the stock is healthy or not.

The most obvious sign that the nutrition is wrong is a poor growth rate. This can be caused by a lack of any of the nutrients as well as poor water quality or health problems. Farmers should monitor the stock on a regular basis, not only to determine the growth rate but also to examine the external appearance of the stock and their behaviour.

Signs that a farmer may look for include:

- poor growth
- changes in colouration
- deformities
- changes in body shape
- fin erosion
- skin lesions
- swimming behaviour, and
haemorrhaging.

Often poor nutrition can also lead to a suppression of the immune system and therefore the stock may become more susceptible to disease problems. If this occurs then the disease may mask the underlying cause (poor nutrition).

Proteins

The protein content (amino acids) of the diet is an important aspect of nutrition. A diet with a low amino acid content will cause problems in the growth rate, and a lack of certain amino acids may cause specific nutritional problems. In rare cases a very high level of amino acids may also cause problems in the stock.

<table>
<thead>
<tr>
<th>Symptoms caused by a lack of certain amino acids in the diet</th>
<th>Symptoms caused by excessive amounts of amino acids in the diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor growth rates</td>
<td>A metabolic imbalance</td>
</tr>
<tr>
<td>High FCR's</td>
<td>Reduced growth</td>
</tr>
<tr>
<td>Low SGR's</td>
<td>Toxic shock (under certain conditions)</td>
</tr>
<tr>
<td>Eye lesions, cataracts or cloudy eyes (methionine deficiency)</td>
<td></td>
</tr>
<tr>
<td>Lordosis/scoliosis or cartilage abnormalities (tryptophan deficiency)</td>
<td></td>
</tr>
</tbody>
</table>

Lipids

A lack of essential lipids will cause reduced growth and survival rates.

Certain essential fatty acids (linolenic) may result in a range of conditions, including:

- fin erosion
- skin discolouration
- cardiac myopathy
- irritability
- liver problems.

An imbalance of n-3 / n-6 fatty acids can cause not only low hatching rates, but also reduced growth and survival rates in juvenile fish. Poor storage of diets may lead to the fats in the diet becoming rancid. Rancid fats within the diet can cause a range of problems, including anaemia and liver damage.
Carbohydrates

The carbohydrate content of the diet rarely causes problems, however there are a few rare cases.

Excessive dietary glucose (a form of carbohydrates) has been shown to inhibit amino acid transport and absorption across the intestinal membrane in Rainbow Trout (*Onchorynchus mykiss*). This may also cause problems in other species.

Excessive amounts of digestible carbohydrates can also cause liver problems.

Vitamins

Vitamin problems in aquaculture have been well documented. Unfortunately, the nature of the symptoms exhibited by the stock usually do not point to an obvious cause, as many symptoms of hypovitaminosis (a lack of vitamins) are similar for a range of vitamin deficiencies.

The following table shows some of the symptoms that may be displayed by stock suffering from the following vitamin deficiencies.

<table>
<thead>
<tr>
<th>Vitamin</th>
<th>Hypovitaminosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>• Poor growth</td>
</tr>
<tr>
<td></td>
<td>• <strong>Exophthalmos</strong></td>
</tr>
<tr>
<td></td>
<td>• Fin and skin <strong>haemorrhage</strong></td>
</tr>
<tr>
<td></td>
<td>• Skin <strong>depigmentation</strong></td>
</tr>
<tr>
<td></td>
<td>• Anorexia</td>
</tr>
<tr>
<td></td>
<td>• Fin erosion</td>
</tr>
<tr>
<td>B₁</td>
<td>• Poor growth</td>
</tr>
<tr>
<td></td>
<td>• Nervous disorders</td>
</tr>
<tr>
<td></td>
<td>• Lethargy</td>
</tr>
<tr>
<td></td>
<td>• Muscle <strong>atrophy</strong></td>
</tr>
<tr>
<td></td>
<td>• Cataracts</td>
</tr>
<tr>
<td></td>
<td>• Discolouration</td>
</tr>
<tr>
<td>B₂</td>
<td>• Poor growth</td>
</tr>
<tr>
<td></td>
<td>• Fin and skin <strong>haemorrhage</strong></td>
</tr>
<tr>
<td></td>
<td>• Dark colouration</td>
</tr>
<tr>
<td></td>
<td>• Cataracts</td>
</tr>
<tr>
<td></td>
<td>• Fin erosion</td>
</tr>
<tr>
<td>B₃</td>
<td>• Poor growth</td>
</tr>
<tr>
<td></td>
<td>• Fin and skin <strong>lesions</strong></td>
</tr>
<tr>
<td></td>
<td>• Tetany</td>
</tr>
<tr>
<td></td>
<td>• Anaemia</td>
</tr>
</tbody>
</table>
### Minerals

Minerals can be absorbed not only from the diet but also from the surrounding water column. The use of manufactured diets has mostly eliminated mineral problems in stock, but there are a few common mineral deficiencies that can be observed in stock from time to time.

A deficiency in zinc can cause cataracts in stock, as well as fin erosion. Bone problems can often indicate a phosphorus deficiency, in particular scoliosis, or a calcium deficiency, which can lead to poor growth.

If nutritional problems are suspected then the farmer should take immediate steps to rectify the problem. Farmers almost always purchase the feed for the stock from a
manufacturer or supplier. These diets are often tailored to meet the nutritional requirements of the stock being fed. If nutritional problems become apparent when using a purpose formulated diet then there may be a problem with the storage of the diet. Diets that are not stored in optimum storage conditions can lose their nutritional value and cause problems.

**Summary**

Nutritional problems can cause devastating effects on stock. It is important to maintain a nutritionally balanced diet for your stock to ensure good growth and health.

Appropriate storage is also an important consideration, as poorly stored feed can deteriorate and lose important nutrients.

**What do you think?**

Have a think about these points:

- What levels of nutrient deficiencies would cause serious problems with stock? How would this differ for different nutrients?
- What kind of storage conditions would be optimum?
- Do different species or age groups require a different nutritional content in their diet?

You can also post your ideas to **Discussions** and talk about them with your fellow students.
Glossary

Anaemia: A condition where there is a lack of red blood cells causing problems such as lethargy.

Atrophy:

Cardiac myopathy:

Depigmentation:

Dystrophy:

Exophthalmos:

FCR’s: Food conversion ratio. This is a measure of how efficient the diet given to the stock is and is often expressed as a number. FCR is calculated by dividing the amount of food given to the stock by the weight increase gained by the stock.

Haemorrhaging/Haemorrhage: Bleeding from the blood vessels.

Immune system:

Lesions:

Lordosis:

Lordosis:

n-3 / n-6 fatty acids:

SGR’s:

Scoliosis:

Tetany:

White muscle: