2.27 Protein Quality

Proteins can be classified as either complete or incomplete. Complete proteins provide adequate amounts of all nine essential amino acids. Animal proteins, such as meat, fish, milk, and eggs are good examples of complete proteins. Incomplete proteins do not contain adequate amounts of one or more of the essential amino acids. For example, if a protein doesn’t provide enough of the essential amino acid leucine it would be considered incomplete. Leucine would be referred to as the limiting amino acid, because there is not enough of it for the protein to be complete. Most plant foods are incomplete proteins, with a few exceptions such as soy. The table below shows the limiting amino acids in some plant foods.

Table 2.271 Limiting amino acids in some common plant foods

<table>
<thead>
<tr>
<th>Food</th>
<th>Limiting Amino Acid(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bean &amp; Most Legumes</td>
<td>Methionine, Tryptophan</td>
</tr>
<tr>
<td>Tree Nuts &amp; Seeds</td>
<td>Methionine, Lysine</td>
</tr>
<tr>
<td>Grains</td>
<td>Lysine</td>
</tr>
<tr>
<td>Vegetables</td>
<td>Methionine, Lysine</td>
</tr>
</tbody>
</table>

Complementary Proteins

Even though most plant foods don't contain complete proteins, it doesn't mean that they should be sworn off as protein sources. It is possible to pair foods containing incomplete proteins with different limiting amino acids to provide adequate amounts of the essential amino acids. These two proteins are called complementary proteins, because they supply the amino acid(s) missing in the other protein. A simple analogy would be that of a 4 piece puzzle. If one person has 2 pieces of a puzzle, and another person has 2 remaining pieces, neither of them have a complete puzzle. But when they are combined, the two individuals create a complete puzzle.

Figure 2.271 Complementary proteins are kind of like puzzle pieces

Two examples of complementary proteins are shown below.
Measures of Protein Quality

How do you know the quality of the protein in the foods you consume? The protein quality of most foods has been determined by one of the methods below.

Biological Value (BV) - \( \frac{\text{grams of nitrogen retained}}{\text{grams of nitrogen absorbed}} \times 100 \)

Protein Efficiency Ratio (PER) - \( \frac{\text{grams of weight gained}}{\text{grams of protein consumed}} \)
This method is commonly performed in growing rats.

Chemical or Amino Acid Score (AAS) - \( \frac{\text{Test food limiting essential amino acid (mg/g protein)}}{\text{needs of same essential amino acid (mg/g protein)}} \)

Protein Digestibility Corrected Amino Acid Score (PDCAAS) - \( \text{(Amino Acid Score) x Digestibility} \)
This is the most widely used method and is preferred by the Food and Agriculture Organization and World Health Organization (WHO) \(^4\).

The following table shows the protein quality measures for some common foods.

Table 2.272 Measures of protein quality \(^4\)

<table>
<thead>
<tr>
<th>Protein</th>
<th>PER</th>
<th>Digestibility</th>
<th>AAS (%)</th>
<th>PDCAAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egg</td>
<td>3.8</td>
<td>98</td>
<td>121</td>
<td>100*</td>
</tr>
<tr>
<td>Milk</td>
<td>3.1</td>
<td>95</td>
<td>127</td>
<td>100*</td>
</tr>
<tr>
<td>Beef</td>
<td>2.9</td>
<td>98</td>
<td>94</td>
<td>92</td>
</tr>
</tbody>
</table>
How do I find out the protein quality of what I’m eating and identify complementary proteins?

Nutrition Data is a useful resource for determining protein quality and identifying complementary proteins. To use the site, go to www.nutritiondata.com, type in the name of the food you would like to know about in the search bar and hit Enter. When you have selected your food from the list of possibilities, you will be given information about this food. Included in this information is the Protein Quality section. This will give you an amino acid score and a figure that illustrates which amino acid(s) is limiting. If your food is an incomplete protein, you can click "Find foods with a complementary profile". This will take you to a list of dietary choices that will provide complementary proteins for your food. You can read more about this option in the link below.

Web Link

Nutrition Data: Protein Quality

References & Links

Links
NutritionData - http://www.nutritiondata.com/