10.1 Folate & Folic Acid

Folate is a B vitamin that exists in either its reduced form (folate) or oxidized form (folic acid). When folate is used in this section, we are referring to the reduced form, not the vitamin itself. Another key distinction between the 2 terms is that folic acid refers to the synthetic form, while folate refers to the natural form. Folic acid is only found in certain foods because they have been fortified with it, not because they produce it. The structure of folic acid is shown below.

![Figure 10.11 Structure of Folic Acid](image)

Another key difference between folate and folic acid is the number of glutamates in their tails. Notice that glutamate is boxed in the structure of folic acid above. Folic acid always exists as a monoglutamate, meaning it only contains 1 glutamate. On the other hand, about 90% of the folate found in foods are polyglutamates, meaning there is more than 1 glutamate in their tail. Folic acid is more stable than folate, which can be destroyed by heat, oxidation, and light. Table 10.11 summarizes the key differences between folate and folic acid.

<table>
<thead>
<tr>
<th></th>
<th>Folate</th>
<th>Folic Acid</th>
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<tbody>
<tr>
<td>Reduced Form</td>
<td>Oxidized Form</td>
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<tr>
<td>Natural</td>
<td>Synthetic</td>
<td></td>
</tr>
<tr>
<td>Polyglutamate</td>
<td>Monoglutamate</td>
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<td></td>
<td>More Stable</td>
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The bioavailability of folate was believed to be much lower than folic acid. To account for these differences, the DRI committee created dietary folate equivalents (DFEs) to set the RDAs. DFEs are defined as follows:

1 DFE = 1 ug food folate = 0.6 ug food folic acid = 0.5 ug folic acid on an empty stomach

DFE = ug food folate + (ug folic acid X 1.7)
The 1.7 came from research suggesting that folic acid from food was 85% bioavailable, compared to 50% for folate (85%/50% = 1.7). This was established in 1998 by the DRI committee, and it is likely that these conversions & the requirements will change based on the newer evidence suggesting folate's bioavailability from food is higher (80% of folic acid) than previously believed. With this data, the new conversion factor for folic acid would be 1.25 (100%/80%). This conversion factor means that food folate levels are probably contributing more towards our dietary needs than currently being estimated by the DFE, but the DRI for folate/folic acid has not been updated.

Before folate (polyglutamates) can be taken up into the enterocyte, the extra glutamates must be cleaved prior to uptake into the enterocyte by the reduced folate transporter (RFT, aka reduced folate carrier). Folic acid, because it is a monoglutamate, requires no cleavage for uptake before it is taken up through the RFT. Once inside the enterocyte, the monoglutamate form is methylated and transported into circulation through an unresolved carrier. This series of events is depicted in the figure below.

Figure 10.12 The uptake and absorption of folate and folic acid

Thus, the methylated monoglutamate form is the circulating form. This is transported to the liver where it is converted back to the polyglutamate form for storage. Folate is excreted in both the urine and feces.

Subsections:

10.11 Folate Functions
10.12 Folate Deficiency & Toxicity

References & Links