Magnesium Interference in the Determination of Sodium in Biological Material by Neutron Activation Analysis

JAGAT SINGH AND JULIUS W. DIECKERT

Department of Biochemistry and Biophysics, Texas A&M University, College Station, Texas 77843

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Irradiation of MgSO₄ in a neutron flux with a thermal neutrons to fast neutrons ratio of 12.1/1 resulted in the production of 0.65 μg of Na per mg of Mg. Using this constant and the Mg content of the peanut sample the Mg contribution to the observed Na was estimated. Such estimates revealed that in some peanut tissues Mg contribution accounted for as much as 42% of the total observed Na.

Neutron activation analysis for Na in biological material is based (1) on the measurement of 24Na produced from Na by the thermal neutrons through the nuclear reaction 23Na(n,γ)²⁴Na. However, if the sample assayed contains relatively more Mg than Na and the thermal neutron flux employed has an appreciable fast neutron component, it is necessary to correct for the ²⁴Na contributed to the observed ²⁴Na by Mg through (2) the fast neutrons nuclear reaction ²⁴Mg(n,p)²⁴Na. In the analysis of peanut samples for Na by neutron activation analysis we encountered an unusually high Mg/Na ratio and the neutron flux available to us contained a noticeable fast neutron fraction. These experimental conditions necessitated to account for the Mg interference in the determination of trace levels of Na in the peanut products. The technique is reported here.

EXPERIMENTAL

Purified MgSO₄ prepared as reported (3) was used to monitor the ²⁴Mg(n,p)²⁴Na interference reaction. Peanut flour represents the acetone powder of the shelled Virginia jumbo peanuts. Peanut seedlings grown in dark for 7 days at 30° in an aqueous solution of 0.8 mM Ca(NO₃)₂ were

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2 Present Address: Department of Biochemistry, Baylor College of Medicine, Houston, Texas 77025.

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dissected into root, cotyledons and hypocotyl-epicotyl, and the parts were lyophilized. Samples (0.55-2 g) of the peanut products and MgSO₄ along with the Na standards were irradiated for 1-2.5 hr at a neutron flux of 1.2 × 10¹² neutrons per cm² per second. The ratio of the thermal neutrons to the fast neutrons at the irradiation site was 12.1/1. Fifty to sixty hours after irradiation the radioactivity was measured with a γ-ray spectrometer. The apparent Na in the peanut products and the interference monitors was computed by the comparator method (4) using 2.76 MeV photopeak as the measure of ⁴⁰Na activity. The Mg content of the samples was determined by atomic absorption spectroscopy (5). The corrected amount of Na in the peanut products was obtained from: apparent Na in the sample − [Na produced per unit weight of Mg (in MgSO₄ sample) by the interference reaction × Mg in the sample].

RESULTS

Table 1 shows the analysis of peanut flour, peanut seed and individual parts of peanut seedling for Na by neutron activation analysis. It is apparent that a significant proportion of the apparent Na was derived from the tissue Mg by the interference reaction ²⁴Mg(n,p)²⁵Na. The Mg contribution to the observed Na was highest (42%) in the peanut flour and lowest (9%) in the hypocotyl-epicotyl of the seedling. The data included in the table clearly show that whereas each tissue contained abundant amount of Mg, it contained only traces of Na.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Corrected Na content</th>
<th>% of apparent Na from Mg</th>
<th>Mg content</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>µg/g</td>
<td>c.v.</td>
<td>mg/g</td>
</tr>
<tr>
<td>Peanut flour</td>
<td>3.3</td>
<td>4.5</td>
<td>42</td>
</tr>
<tr>
<td>Seed</td>
<td>1.71</td>
<td>9.4</td>
<td>38</td>
</tr>
<tr>
<td>Root</td>
<td>6.67</td>
<td>2.8</td>
<td>12</td>
</tr>
<tr>
<td>Cotyledons</td>
<td>3.29</td>
<td>6.6</td>
<td>26</td>
</tr>
<tr>
<td>Hypocotyl-epicotyl</td>
<td>7.25</td>
<td>2.6</td>
<td>9</td>
</tr>
<tr>
<td>MgSO₄</td>
<td>650</td>
<td>1.3</td>
<td></td>
</tr>
</tbody>
</table>

* Dry weight.

* % Coefficient of variation.

* Through the interference reaction ²⁴Mg(n,p)²⁵Na.

* Seeds were not dried.

* µg of Na produced per g of Mg by the interference reaction.
REFERENCES

5. HOOVER, W. H., unpublished data.