Level of organochlorine pesticides in fish species from Lake Hawassa in the Ethiopian Rift-Valley (2009–2010) and implications in dietary exposure

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Introduction

Fish are a lean source of protein and contain vitamin D, selenium, and omega-3 fatty acids, which may reduce the risk of developing heart disease and other medical problems (Mozaffarian and Rimm, 2006). However, human beings can be exposed to organochlorine pesticides by the consumption of contaminated fish (Han et al., 2000; Svensson et al., 1995).

Material and methods

The reference dose (RfD), drawn from the USEPA potential health risk assessment guidelines was used to assess the health risk posed by OCPs exposure (USEPA 1996). Consumption of contaminants in food was calculated based on its concentration in the fish, and on an estimate of the fish consumption rates. The lifetime exposure dose (LED) (mg kg⁻¹ day⁻¹) was obtained, and the hazard indices (HI) for each age class were estimated.

\[
\text{LED} = \frac{\text{Residue concentrations in fish tissue sample (mg/kg) x fish consumption rate (kg/day)}}{\text{body weight (kg)}}
\]

\[
\text{HI} = \frac{\text{Estimated dose}}{\text{Reference dose}}
\]

Results from this study were compared with the oral RfD values in mg kg⁻¹ day⁻¹, obtained from USEPA’s Integrated Risk Information System.

Results and discussion

Comparison between the estimated dose and the reference dose of organochlorine pesticides (ΣDDT and ΣEndosulfan) in general, showed that pesticide levels in Barbus intermedius in Lake Hawassa exceeded the safe limit (Table 1). Use of B. intermedius as food for children therefore has a potential for systemic toxicity. However, consumption of the other fish species (Oreochromis niloticus and Clarias. garipienus) does not pose a direct hazard to human health, based on the current recommendations. In the Hawassa area, the
species, *O. niloticus* and *C. gariepinus* are more preferred for consumption than *B. intermedius*, probably because of the high infections with tape worms encountered in *B. intermedius* which make this fish species more unpleasant to eat by the local people. Moreover, *B. intermedius* is also much more bony than the other species, without much fillet; making it less attractive for consumption (Destá et al. 2007). However, the fish fillet is still prepared and served as soup by the local fishing families. For those who eat fish more or less daily and much more than the estimated mean Ethiopian daily consumption (0.027 kg per day), the OCPs intake will be considerably higher. Therefore, children from the fishing families may be the most exposed and vulnerable group among the local people.

Table 3. Estimated dose values and hazard indices of ΣOCP exposures in fish at different trophic levels (*O. niloticus*, *C. gariepinus* and *B. intermedius*) sampled in L. Hawassa (bold numbers indicate hazard indices greater than one).

<table>
<thead>
<tr>
<th>OCPs</th>
<th>Fish species</th>
<th>RfD (μg kg⁻¹ day⁻¹)</th>
<th>Estimated dose (μg kg⁻¹ day⁻¹) Hazard index</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0-1yrs</td>
<td>1-11yrs</td>
</tr>
<tr>
<td>ΣDDT</td>
<td><em>O. niloticus</em></td>
<td>0.5</td>
<td>0.281</td>
</tr>
<tr>
<td></td>
<td><em>C. gariepinus</em></td>
<td>0.5</td>
<td>0.274</td>
</tr>
<tr>
<td></td>
<td><em>B. intermedius</em></td>
<td>0.5</td>
<td>1.121</td>
</tr>
<tr>
<td>ΣChloridane</td>
<td><em>O. niloticus</em></td>
<td>0.06</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td><em>C. gariepinus</em></td>
<td>0.06</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td><em>B. intermedius</em></td>
<td>0.06</td>
<td>0.010</td>
</tr>
<tr>
<td>ΣEndosulfan</td>
<td><em>O. niloticus</em></td>
<td>0.05</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td><em>C. gariepinus</em></td>
<td>0.05</td>
<td>0.011</td>
</tr>
<tr>
<td></td>
<td><em>B. intermedius</em></td>
<td>0.05</td>
<td>0.116</td>
</tr>
</tbody>
</table>

The HI values in bold are values those exceed the safe limit.

**Conclusion**

Consumption of large fish from the higher trophic level (e.g. *B. intermedius*) from L. Hawassa may expose consumers to possible health hazards. Children and pregnant women of the local community, especially the local subsistence fishermen and their families are the most vulnerable population sub-group.

**References**


