Seasonal variation study for the accumulation of Cu, Pb and Mn in Kidneys, liver and Muscles of different edible fish from River Jhelum, Punjab, Pakistan.

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Abstract: Polluted water inhabitant fishes accumulate metals in their body tissues; mainly accumulation depends upon different factors, like way of uptake, temperature, time of exposure etc. Different metals show different affinities to fish tissues for accumulation. Liver and kidney have relatively high metal accumulation as compare to muscles. The present study was carried out to determine the bioaccumulation of heavy metals into different organs of fish collected from four sampling stations of river Jhelum. Three metals Cu, Pb and Mn were examined by using Shimadzu AA 6200 atomic absorption spectrophotometry and the results were as ug/g dry wt. Seasonal variations regarding metal accumulation in kidney, liver and muscles of edible fishes from river Jhelum was also observed. We observed that seasonal variations affect the bioaccumulation of metals in body tissues. Cu, Pb and Mn were higher in summer season as compared to winter season in kidney of fishes. But in the case of liver concentration had opposite affects and had highest concentrations of these metals during winter. While in muscles Cu was significantly (P<0.01) higher in summer, Pb was non significantly higher in summer and Mn was non significantly higher in winter in the case of muscles.

Keywords: bioaccumulation, seasonal variations, liver, kidney, muscles.

INTRODUCTION

The contamination of rivers with different types of pollutants and wide range of metals has become serious concerning matter from last few decades [1-4]. The rivers and fresh water entities are being polluted with heavy metals and pollutants of other types released from industries and anthropogenic activities [5,6].

Contamination caused by heavy metals may have very detrimental effects not only on the ecological balance of recipient environment but also on the living fauna of aquatic environments[7-9].

Among all animal diversity of river, fishes are the inhabitants which cannot escape from the devastating effects of these contaminants[10-12]. Fish are used as bioindicator to check the fresh water ecosystem health, because pollutants transfer through food chain are responsible for damaging and adverse effects on the river ecosystems [13,14].

The present studies was carried out on various fish organs that how heavy metals effects biochemical parameters and physiological changes in different tissues [15,16]. The damaging effects of heavy metals like Cu, Pb and Mn have reviewed, like bioaccumulation [17-21]. Fishes tries to develop a defense against the detrimental effects of both essential and non-essential xenobiotics that may cause damage like oxidative effects in body[22,23]. Edible fishes in river Jhelum are very popular in the people living around it; different types of edible fishes were selected due their adoption in the most polluted points. The basic purpose of this research was to quantify the amount of heavy metal accumulation in different body tissues of edible fishes from river Jhelum.

MATERIALS AND METHODS

River Jhelum famous river flows both in Pakistan and India. It is one of the five rivers and largest river of Punjab. It flows through the Jhelum district as name shows. It is the tributary of Chenab and is about 813 km long. It is populated with various types of fish fauna.
There were some basic criteria for selection of fishes as bioindicator, according to Wittig [29] and Markert[30]. It was that particular fish type must be present in large amount all over the sampling stations. And sampling should be easy for these particular types of fishes and must not be problems to identify.

Ediblefishes collected for this research study was collected from the four selected sampling stations of river Jhelum. The selected sites were Khushaab, Muhammad wala, 8.R.D Barrage, and Rasool Barrage. The selected fishes Wallagoattu, Rittarra and Mystusseeenghala are equally present in the selected sites. Samples of fishes are taken from these sites during end December, January 2010 (winter collection) and end May, June 2011 (summer collection).

After sampling wet acid digestion were carried out for all tissues by using Mehra and Juneja [24] after few changes in this method.

Concentrations of heavy metals are analyzed by using atomic absorption spectrophotometer (Model# AA.6300 SHIMADZU “Japan” AAS flame type).

RESULTS
Seasonal Variations for the accumulation of metals among four sampling stations for Kidney in Fresh water Fishes.

- **Seasonal variations regarding Copper (Cu) Concentration.**
  Overall mean value of copper in summer seasons remained as 29.11±29.76 ug/g. While overall mean value of Copper during winter seasons remained 19.90±13.70 ug/g. During summer seasons accumulation of Copper in kidney was higher.

- **Seasonal variations regarding Lead (Pb) Concentration.**
  Concentration of lead was none significantly higher in kidneys of Fresh water fishes in summer as compared to winter seasons at all sampling stations. Overall lead mean value of lead in summer remained as 21.08±32.32 ug/g.

- **Seasonal variations regarding Manganese (Mn) Concentration.**
  Concentration of Manganese (Mn)was non significantly higher in summer seasons samples at all sampling stations on overall basis in kidneys of fresh water fishes.

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Season</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>SE</th>
<th>t-value</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cu</td>
<td>Summer</td>
<td>36</td>
<td>29.11</td>
<td>29.76</td>
<td>4.96</td>
<td>1.69NS</td>
<td>0.096</td>
</tr>
<tr>
<td></td>
<td>Winter</td>
<td>36</td>
<td>19.90</td>
<td>13.70</td>
<td>2.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pb</td>
<td>Summer</td>
<td>36</td>
<td>21.08</td>
<td>32.32</td>
<td>5.39</td>
<td>1.63NS</td>
<td>0.108</td>
</tr>
<tr>
<td></td>
<td>Winter</td>
<td>36</td>
<td>11.69</td>
<td>12.26</td>
<td>2.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mn</td>
<td>Summer</td>
<td>36</td>
<td>27.73</td>
<td>39.12</td>
<td>6.52</td>
<td>1.61NS</td>
<td>0.111</td>
</tr>
<tr>
<td></td>
<td>Winter</td>
<td>36</td>
<td>16.21</td>
<td>17.40</td>
<td>2.90</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NS = Non-significant (P>0.05); * = Significant (P<0.05); ** = Highly significant (P<0.01)

![Fig-1: Comparison between Summer and Winter regarding different minerals for Kidney](http://scholarsbulletin.com/)

Table-1: Comparison between Summer and Winter regarding different minerals for Kidney.
Seasonal Variations for the accumulation of metals among four sampling stations for Liver in Fresh water Fishes.

- **Seasonal variations regarding Copper (Cu) Concentration.**

  Seasons exerted significant effect on copper accumulation in liver. It remained higher during summer than winter.

- **Seasonal variations regarding Lead (Pb) Concentration.**

  Concentration of lead was significantly higher in liver of Fresh water fishes in winter as compared to summer seasons at all sampling stations. Overall mean value of lead in winter remained as 19.52±18.20 ug/g.

- **Seasonal variations regarding Manganese (Mn) Concentration.**

  Concentration of Manganese (Mn)was significantly higher in winter seasons samples at all sampling stations on overall basis in livers of fresh water fishes.

### Table-2: Comparison between summer and Winter regarding different minerals for Liver.

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Season</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>SE</th>
<th>t-value</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cu</td>
<td>Summer</td>
<td>33</td>
<td>20.55</td>
<td>23.09</td>
<td>4.02</td>
<td>-0.01**</td>
<td>0.992</td>
</tr>
<tr>
<td></td>
<td>Winter</td>
<td>36</td>
<td>20.6</td>
<td>16.05</td>
<td>2.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pb</td>
<td>Summer</td>
<td>33</td>
<td>10.61</td>
<td>5.30</td>
<td>0.92</td>
<td>-2.71**</td>
<td>0.009</td>
</tr>
<tr>
<td></td>
<td>Winter</td>
<td>36</td>
<td>19.52</td>
<td>18.20</td>
<td>3.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mn</td>
<td>Summer</td>
<td>33</td>
<td>7.7</td>
<td>11.03</td>
<td>1.92</td>
<td>-4.53**</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>Winter</td>
<td>36</td>
<td>24.78</td>
<td>18.87</td>
<td>3.14</td>
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</tr>
</tbody>
</table>

NS = Non-significant (P>0.05); * = Significant (P<0.05); ** = Highly significant (P<0.01)

### Table-3: Comparison between Summer and Winter regarding different minerals for Muscles.

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Season</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>SE</th>
<th>t-value</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cu</td>
<td>Summer</td>
<td>36</td>
<td>27.92</td>
<td>22.29</td>
<td>3.72</td>
<td>2.91**</td>
<td>0.005</td>
</tr>
<tr>
<td></td>
<td>Winter</td>
<td>36</td>
<td>15.64</td>
<td>12.02</td>
<td>2.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pb</td>
<td>Summer</td>
<td>36</td>
<td>9.82</td>
<td>5.64</td>
<td>0.94</td>
<td>-1.15NS</td>
<td>0.256</td>
</tr>
<tr>
<td></td>
<td>Winter</td>
<td>36</td>
<td>12.65</td>
<td>13.67</td>
<td>2.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mn</td>
<td>Summer</td>
<td>36</td>
<td>22.71</td>
<td>30.95</td>
<td>5.16</td>
<td>0.20NS</td>
<td>0.845</td>
</tr>
<tr>
<td></td>
<td>Winter</td>
<td>36</td>
<td>21.55</td>
<td>16.85</td>
<td>2.81</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NS = Non-significant (P>0.05); * = Significant (P<0.05); ** = Highly significant (P<0.01)
DISCUSSION

Present study was carried out to assess the metallic ions toxicity in various tissues of edible fishes of River Jhelum stretch from Muhammedwala to Rasool barrage. We have taken the following organs from these edible fishes kidney, liver and fish muscles, among 4 sampling stations. In our studies we observed seasonal variations for the accumulation of heavy metals for different body tissues of fishes collected from four sampling stations. In our studies seasons affect bioaccumulation of metals in body tissues. Over all bases these three metals Cu, Pb and Mn were higher in summer season as compared to winter season. The reason could be Deposition of these metals into the body tissues of fishes increase during summer. The levels of metals were nearly equal across seasons according to Nwude1 and Anthony [25]. So our results disagreed with Nwude1 and Anthony [25].

The mechanisms by which temperature affects accumulation and toxicity of metals are not yet fully understood. May be increase in water temperatures results in increasing gill ventilation rates and to higher oxygen demand for metabolic activities and decreasing oxygen dissolved in the water [26-28].

During winter elimination from the excretory organs increase the uptake of metals, leading to decreasing metal concentrations in liver and kidney [31].

For all these three organs all heavy metals were present highest in amount in kidneys of fishes. The reason may be the major detoxifying organ it is.

Kidney showed highest concentration of Copper (Cu) than both of other organs like liver and muscles. And it showed Non-significant (P>0.05) difference for the accumulation of copper during summer season. Similarly Lead (Pb) and Manganese (Mn) were greatest in kidney during summer. Above results indicate heavy metals like Cu, Mn and Pbdefinitely effects in the river fauna of fishes. Hence scientific method to detoxify these metals is very essential to improve the health of these edible fishes.

REFERENCES


