Organochlorine Pesticide Residues in Sheep and Buffalo Meat Products in Punjab

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ABSTRACT

In the present study, commonly available seven different kinds of buffalo and sheep meat products were analyzed for organochlorine pesticide residues. DDT and endosulphan residues were found in all kinds of products, whereas HCH were only encountered in samples of sheep meat balls. Highest level of DDT was found in mutton kababs (0.186 mg kg\textsuperscript{-1}), followed by buffalo patties (0.179 mg kg\textsuperscript{-1}). Similarly, highest amount of endosulphan was found in sheep patties (1.022 mg kg\textsuperscript{-1}).

Keywords: Gas chromatography, OCP, meat products, Punjab

Introduction

Widespread use of pesticides in the production systems in agriculture and allied sectors, persistence in the environment and their varying toxicity make pesticides a major component of public health consideration. In India, 51% food commodities were reported to be contaminated with pesticide residues and out of these, 20% had pesticide residues above the maximum residue limits (MRLs) (Gupta, 2004). Food of animal origin is the most contaminated by pesticides followed by leafy vegetables and garden fruits (Rathore \textit{et al}., 1996). Most commonly encountered residues of pesticides in food are organochlorines, followed by organophosphates and carbamates (Kulkarni and Mitra, 1990). These synthetic pesticides are fat soluble, which are absorbed and rapidly stored in tissues, but slowly excreted (Hansen and Lambert, 1987). Dipping and spraying of chemicals for vector control in animals or feeding of feedstuffs contaminated with these chemicals are important reasons for high residues of pesticides in the tissue (Darko and Acquaah, 2007). Keeping in view the public health significance of pesticide residues, safety of consumers and legal restrictions on export, the present study was proposed to monitor the organochlorine pesticide levels in sheep and buffalo meat products available in the markets of Punjab or Ludhiana.

Materials and Methods

A total of 30 samples including 3 samples each of sheep patties, buffalo meat ball, buffalo meat nuggets, buffalo meat patties, sheep meat balls and sheep meat nuggets and 12 samples of mutton kababs were screened for residues.

Hundred gram of a sample was collected and brought to laboratory under chilled condition and a representative sample of 10 g was processed in duplicate. The solvents were glass distilled before use. All the chemicals were of analytical reagent quality and obtained from M/s E Merck (India) Ltd. Pesticide standards were imported from M/s Dr. Ehrenstorfer GmbH, Augsburg, Germany.
The samples of sheep and buffalo meat products were analyzed by procedure as described by Bedi et al. (2004) with some modifications. Briefly, 10 g sample was extracted by Soxhlet apparatus at 45°C for 8 h in 200 ml hexane-acetone (1:1, v/v) mixture. Then liquid partitioning was done by using acetonitrile saturated with hexane. Clean up of the samples was performed by florisis column chromatography and the samples were eluted with 40 ml of 20% dichloromethane and hexane (v/v). Elute was concentrated to 2 ml for determination of residues by GC equipped with an electron capture detector (ECD, Ni ⁶³) and gas column of 2 m length x 3 mm dia packed with 1.5% OV-17+1.95% OV-210, Support-Chromosorb WHP 80-100 mesh. The temperature of injection port, oven and detector were 230°C, 210°C and 240°C, respectively. Confirmation of residues was done on an alternate glass column packed with 3% DEGS (2 m x 3 mm dia) on chromosorb WHP, 80-100 mesh. Seven different types of meat products were analyzed for pesticide residues.

**Results and Discussion**

**Buffalo meat balls**

Four DDT metabolites were observed with highest value of pp' DDT as 0.023 mg kg⁻¹. Only β-endosulphan and endosulphan sulphate was detected among cyclodiene with 0.01 mg kg⁻¹ of β-endosulphan and 0.216 mg kg⁻¹ of endosulphan sulphate. Average levels of DDT and endosulphan in buffalo meat balls were 0.053 and 0.226 mg kg⁻¹, respectively.

**Buffalo meat nuggets**

Among DDT metabolites op' DDT and pp' DDT were found with equal level of contamination of 0.015 mg kg⁻¹. β-endosulphan was detected in all the products except buffalo meat balls. Average levels of DDT and endosulphan were 0.03 and 0.386 mg kg⁻¹, respectively.

**Buffalo Patties**

Buffalo meat patties exhibited contamination by op' DDT, pp' DDE and pp' DDD among DDT metabolites with mean level of total DDT as 0.179 mg kg⁻¹.

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**Table 1: Levels of pesticide residues in mutton kababs**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Pesticides</th>
<th>No.</th>
<th>Positive samples</th>
<th>Percentage</th>
<th>Range</th>
<th>Mean (mg kg⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>op' DDT</td>
<td>4</td>
<td>4/12</td>
<td>33.3</td>
<td>0.015</td>
<td>0.018</td>
</tr>
<tr>
<td>2.</td>
<td>op' DDE</td>
<td>2</td>
<td>2/12</td>
<td>16.6</td>
<td>0.003</td>
<td>0.004</td>
</tr>
<tr>
<td>3.</td>
<td>pp' DDE</td>
<td>7</td>
<td>7/12</td>
<td>58.3</td>
<td>0.007</td>
<td>0.036</td>
</tr>
<tr>
<td>4.</td>
<td>pp' DDD</td>
<td>2</td>
<td>2/12</td>
<td>16.6</td>
<td>0.016</td>
<td>0.066</td>
</tr>
<tr>
<td>5.</td>
<td>pp' DDT</td>
<td>9</td>
<td>9/12</td>
<td>75.0</td>
<td>0.012</td>
<td>0.062</td>
</tr>
<tr>
<td>6.</td>
<td>Σ DDT</td>
<td></td>
<td></td>
<td></td>
<td>0.186</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>α- HCH</td>
<td>3</td>
<td>3/12</td>
<td>25 %</td>
<td>0.020</td>
<td>0.029</td>
</tr>
<tr>
<td>8.</td>
<td>γ- HCH</td>
<td>3</td>
<td>3/12</td>
<td>25%</td>
<td>0.008</td>
<td>0.060</td>
</tr>
<tr>
<td>9.</td>
<td>Σ HCH</td>
<td></td>
<td></td>
<td></td>
<td>0.089</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>α - Endosulphan</td>
<td>1</td>
<td>1/12</td>
<td>8.3%</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>11.</td>
<td>β - Endosulphan</td>
<td>4</td>
<td>4/12</td>
<td>33.3%</td>
<td>0.008</td>
<td>0.016</td>
</tr>
<tr>
<td>12.</td>
<td>Endosulphan sulphate</td>
<td>2</td>
<td>2/12</td>
<td>16.6%</td>
<td>0.22</td>
<td>0.3470</td>
</tr>
<tr>
<td>13.</td>
<td>Σ - Endosulphan</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
mg kg$^{-1}$ while $\beta$-endosulphan had mean levels of 0.16 mg kg$^{-1}$. Herrera et al., (1994) detected no DDT residues in fresh sausage of beef, pork and poultry but samples were contaminated with HCH the levels being 0.041 mg kg$^{-1}$ in fresh beef sausage. Matsumoto et al (2006) in their review have mentioned the concentrations of organochlorine pesticides in processed beef meat products collected in Osaka, Japan for 15 years (1990-2004). They have reported average levels of HCH as 0.00071 mg kg$^{-1}$ and DDT as 0.0022 mg kg$^{-1}$. Levels of DDT’s were lower than our study. It’s worth mentioning that the levels of HCH were far below than the DDT levels. In our study, no HCH was detected in buffalo products.

**Mutton kababs**

Mutton kababs revealed highest contamination level of DDT with average being 0.186 mg kg$^{-1}$. Levels of op’ DDT, op’ DDE, pp’ DDT, pp’ DDE and pp DDD were 0.018, 0.004, 0.062, 0.036 and 0.066 mg kg$^{-1}$, respectively (Table 1). However levels of op’ DDD were not detected in mutton kababs. Levels of $\alpha$-, $\beta$- and endosulphan sulphate were 0.01, 0.016 and 0.347 mg kg$^{-1}$, respectively with average level of endosulphan as 0.373 mg kg$^{-1}$. Mutton kababs were the only products with significant level of HCH residues. Levels of $\alpha$- and $\beta$- HCH were 0.029 and 0.06 mg kg$^{-1}$, respectively with total HCH as 0.089 mg kg$^{-1}$.

**Sheep meat patties**

Average levels of DDT and endosulphan in sheep meat patties were 0.016 and 1.022 mg kg$^{-1}$, respectively. Level of endosulphan in sheep patties was highest among the products with levels of $\alpha$- endosulphan, $\beta$- endosulphan and endosulphan sulphate as 0.653, 0.039 and 0.33 mg kg$^{-1}$, respectively. op’ DDD and pp’ DDD were the only metabolites of DDT present in sheep patties with equal average level of 0.008 mg kg$^{-1}$

**Sheep meat balls**

pp’ DDD was the only DDT metabolite found in sheep meat balls with average level of 0.015 mg kg$^{-1}$. Average level of total endosulphan was 0.041 mg kg$^{-1}$ with an average levels of $\alpha$- and $\beta$-endosulphan as 0.02 and 0.021 mg kg$^{-1}$, respectively.

**Sheep meat nuggets**

They contained no detectable levels of DDT metabolites. Mean level of endosulphan was 0.223 mg kg$^{-1}$ with respective means of $\alpha$-, $\beta$- and endosulphan sulphate as 0.022, 0.011 and 0.19 mg kg$^{-1}$, respectively.

There is contamination of meat products available in the market with persistent DDT and HCH residues despite complete ban on the use of technical HCH in agriculture and public health programmes and DDT in agriculture. Keeping in view the public health significance of pesticide residues and consequently safety of the consumers, the continuous monitoring of pesticide residues in meat and meat products is required. The use of illegal and extra label use of banned pesticides must be curbed.

**References**


