Personal protective equipment used as sampling methods to assess exposure to bioburden. An added value to be considered?

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Outline

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1. Background

- Waste from non-biodegradable materials is sorted in waste sorting units to produce dry recyclables raw materials, leading to direct access and exposure of workers to waste and its contaminants.
  
  (Park et al. 2011)

- The organic residues present in waste serve as a substrate for numerous microorganisms, increasing workers’ exposure to microbial contaminants, with previous studies associating health risks with these environments.

In Portugal, mechanical protection gloves (MPG) are of mandatory use.

During their use, sweat is released and, consequently, the humidity of the material increases. Additionally, the temperature inside the glove leads to conditions favorable to the growth of microorganisms.

(Majchrzycka et al. 2016)
This study intends to assess the bioburden present in MPG and discuss the possibility to be consider as potential passive sampling methods to assess occupational exposure to microbial contamination.
2. Materials and methods

<table>
<thead>
<tr>
<th>Workstations</th>
<th>Tasks</th>
<th>MPG number</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMW</td>
<td>Feeding machines with waste</td>
<td>9</td>
</tr>
<tr>
<td>SW</td>
<td>Sorting waste</td>
<td>40</td>
</tr>
<tr>
<td>MI</td>
<td>Machines inspection</td>
<td>10</td>
</tr>
<tr>
<td>MSVO</td>
<td>Machines and special vehicles operator</td>
<td>8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>-------------------</strong></td>
<td><strong>67</strong></td>
</tr>
</tbody>
</table>
Bioburden exposure assessment in 67 MPG

**Bacteria**
- Inoculation in tryptic soy agar (TSA), incubation at 30°C for 7 days
- Inoculation in violet red bile agar (VRBA), incubation at 37°C for 7 days

**Fungi**
- Inoculation in 2% malt extract agar (MEA) with 0.05 g/L chloramphenicol media, incubation at 27°C for 5 to 7 days
- Inoculation in dichloran glycerol (DG18) agar-based media, incubation at 27°C for 5 to 7 days

**Assays performed**
- Azole resistance screening
- Toxigenic fungal strains (*Aspergillus sections Flavi, Versicolors, Circumdati* and *Fumigati*)
- Cell viability was determined in swine kidney (SK) monolayer and hepatocellular carcinoma (Hep G2) cell lines
- Mycotoxins
3. Results - Bacterial contamination

- All MPG samples presented bacterial contamination.

- Total bacteria: only two samples presented no contamination (97.02%); Range (0 to $4.15 \times 10^5$ CFU.m$^{-2}$)

- Gram-: all samples showed contamination (100%); Range ($2.00 \times 10^3$ to $5.04 \times 10^6$ CFU.m$^{-2}$)

- SW and FMW higher prevalence of Gram-bacteria.
3. Results - Fungal contamination

- The fungal contamination in the MPG samples ranged from 0 in both MEA and DG18, to $5.09 \times 10^6$ and $2.75 \times 10^6$ CFU.m$^{-2}$, respectively.

- Seven different fungal species were found in the MPG samples in MEA.

- The most commonly found was *Aspergillus* spp. (50.46%), followed by *Mucor* spp. (37.88%) and *Penicillium* spp. (9.43%).

- Wearing time influence fungal counts on MEA

Aspergillus sections observed in each media (*submitted elsewhere*)
4. Main findings and discussion

The results highlight the occupational concern regarding the exposure to microbiologic agents.

- Employers are obliged to assess and control the risks due to biological agent’s exposure.

- Among the measures that can minimize exposure is the use of appropriate personal protective equipment, such as MPG. (Directive 2000/54/EC)

- The workstations where the workers contact more with waste (FMW and SW) were the ones with increased microbial contamination found on MPG.
Passive methods allow determining the contamination levels of an increased period of time (from weeks to several months), whereas air samples can only reproduce the load from a smaller period of time (mostly minutes).

(Institute of Medicine 2004; Viegas et al. 2019; 2020)

**MPG can be used as:**

- passive methods to assess occupational exposure to bioburden
- screening method to decide what workstations we should start performing personal exposure assessments.
MPG bioburden contamination is mimicking the environment contamination
The results allowed to:

- Occupational Health services to prioritize the workstations where the protection equipment replacement frequency should be increased. (Viegas et al. 2020)

- Inform workers about the results to easier behavior changes for hygienic measures compliance.
5. Preliminary results from different assays

- Aspergillus sections with toxigenic and azole resistance potential were observed.
- Mycotoxins exposure through ingestion route by hand-mouth contact is possible.
- Cytotoxic potential affecting hepatic cells more than renal cells was observed.
- Workers can have health effects due to the contamination found on MPG.
Thanks for your attention!

Acknowledgments
The authors are grateful to FCT – Fundação para Ciência e Tecnologia for funding the project EXPOsE – (02/SAICT/2016 – Project nº 23222) and to Instituto Politécnico de Lisboa, Lisbon, Portugal for funding the Project "Waste Workers’Exposure to Bioburden through Filtering Respiratory Protective Devices" (IPL/2018/WasteFRPD_ESTeSL). The project is co-financed by the Polish National Agency for Academic Exchange (PPN/BIL/2018/1/00231)