INTRODUCTION

Long-lasting insecticidal mosquito nets (LNs) are frequently used around the world to protect people against malaria vectors. As they contain insecticide, laboratory control is needed to check whether the content of the active ingredient is according to the manufacturers or WHO specifications and also whether the LN is still efficient after some time of use. Due to the fact that LNs include a range of polymers for the yarn and use coated or incorporated technologies for the active ingredient, it is a challenge to find a single analytical method to determine the active ingredient in LNs, which takes into account both impregnation technologies. Since LNs efficacy depends a lot on their use in field conditions, questions rise like what happens with the active ingredient when nets are washed and dried in different ways. To answer these questions, experiments were carried out to propose a multi-pesticide residue determination in LNs and to investigate the difference between laboratory hand washing and domestic washing on different bed nets, as well as the effect of the drying process on the release of active ingredient.

MATERIALS AND METHODS

2 Technologies

**Coated**
- Surface of the fiber
- Body of the fiber
- Active ingredient on the net surface
- PermaNet®2.0 (deltamethrin 55 mg/m²)
- Interceptor® (α-cypermethrin 200 mg/m²)

**Incorporated**
- Surface of the fiber
- Body of the fiber
- Active ingredient uniformly incorporated into the fiber and on the surface
- Netprotect® (α-cypermethrin 79 mg/m²)

**PRINCIPLE OF THE PROPOSED ANALYTICAL METHOD**

1. 300 mg of net + 40 mL xylene
2. Reflux for 30 min
3. Filter through Buchner
4. Injection in GC/ECD
5. Extract into GC vial after 10 times dilution
6. Fill up to 50 mL

**WASHING PROCEDURES**

- **Laboratory hand washing simulation**
- **ISO 6330:2000 (Domestic washing procedure)**

**Soap**

- **CIPAC washing solution**
- 8g of soap in deionized water (30°C)

**Process**

- 155 beat/ min (10 min) + 2 rases
  - Gentle cycle of 30°C - washing program

RESULTS AND DISCUSSION

**ANALYTICAL PERFORMANCE**

<table>
<thead>
<tr>
<th>Selectivity/Specificity</th>
<th>Repeatability / Recovery / Accuracy / LOQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spiking levels (µg/kg)</td>
<td>N</td>
</tr>
<tr>
<td>Deltamethrin</td>
<td>0.2 - 2 - 4</td>
</tr>
<tr>
<td>Alpha-cypermethrin</td>
<td>0.5 - 5 - 10</td>
</tr>
<tr>
<td>PermaNet®2.0</td>
<td>54</td>
</tr>
<tr>
<td>Netprotect®</td>
<td>80</td>
</tr>
<tr>
<td>Interceptor®</td>
<td>99</td>
</tr>
</tbody>
</table>

**WASH CYCLES AND CURVE FITTING**

- **Deltamethrin**
  - Linear: \(0.330 + 0.010 x\)
  - Logarithmic: \(0.020 + 0.005 x\)
  - Exponential: \(0.005 \times 0.001 x\)
  - \(R^2\) values: 0.999

- **α-Cypermethrin**
  - Linear: \(0.390 + 0.005 x\)
  - Logarithmic: \(0.020 + 0.005 x\)
  - Exponential: \(0.005 \times 0.001 x\)
  - \(R^2\) values: 0.999

**LABORATORY HAND SIMULATIONVERSUS ISO 6330:2000**

**INDOOR DRYING VERSUS OUTDOOR DRYING**

CONCLUSION

A suitable multi-pesticide residue method was validated for measuring pesticides residues in incorporated and coated long-lasting nets. The total active ingredient in LNs decreases with the number of washes. The wash resistance of incorporated nets is higher compared to coated nets. A strong relationship between the release of the active ingredient from the LNs and the number of washing cycles was found not only for exponential model as can be found in the literature, but for the logarithmic model as well. LNs are proven to be well protected against UV by the way they are produced.