A hand-sanitizer, by definition, is an alcohol-based liquid that is generally used to decrease the count of infectious agents on the hand. The active ingredient in hand sanitizer, usually alcohol, disrupts the coating of virus and bacteria particles. By damaging the outside of the particle, the virus becomes deactivated. The sanitizer works on contact, meaning it's only effective on the parts of your hands that it touches. That means if you miss a spot between your fingers, there could still be viruses or bacteria in that place. Research shows that alcohol hand sanitizers do not pose any risk by eliminating beneficial microorganisms that are naturally present on the skin. The body quickly replenishes the beneficial microbes on the hands, often moving them in from just up the arms where there are fewer harmful microorganisms. However, alcohol may strip the skin of the outer layer of oil, which may have negative effects on barrier function of the skin. A study also shows that disinfecting hands with an antimicrobial solution results in a greater barrier disruption of skin compared to alcohol solutions, suggesting an increased loss of skin lipids.

**Experiment**

**Research Topic:**
“To experimentally compare the effectiveness of different hand-sanitizers, both commercial and home-made, against bacteria”

**Hypothesis**
1. The effect of different commercial hand-sanitizers against live bacteria is slightly different to one-another.
2. The effectiveness of the home-made solution against bacteria is lesser in comparison to that of commercial hand-sanitizer solutions.

**Variables**

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Brand of hand sanitizer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent</td>
<td>Number of bacteria colonies formed after 48 hours</td>
</tr>
<tr>
<td>Controlled</td>
<td>Volume of sanitizer, temperature, air pressure</td>
</tr>
</tbody>
</table>

**Materials Required**

1. Samples of different commercial hand-sanitizers. For this research, hand-sanitizers of brands Dettol, Wellness Tree, Himalaya, Zuci Junior.
2. 1 sample of homemade hand-sanitizer solution (5/7th 77% isopropyl alcohol + 2/7th aloe vera gel).
3. Sterile discs (1 per hand-sanitizer and 1 for control). Alternatively, disks may be made using a hole punch and filter paper, but they will need to be sterilized in the oven.
4. 1 Nutrient Agar Plate.
5. Sterile cotton-tipped applicator swabs. Alternatively, cotton-tipped swabs from an ew, unopened box may be used.
7. Forceps. Alternatively, tweezers may be used.
8. Permanent Marker.
9. Incubator for bacterial culture plates.
10. Ruler, metric.
Procedure

1. Use the permanent marker to label the sterile discs as per the brand of hand-sanitizer, and then sterilize the discs in a 300°C oven for 30 minutes.

2. Divide the top of the nutrient agar plate into 6 equal sections (5 hand-sanitizer solutions + 1 control (without any solution)).

3. Using a proper sterile technique, inoculate each plate uniformly. Dip a sterile cotton-tipped applicator swab in the K-12 E. coli bacterial solution and gently wipe the swab over the surface of the plate, swabbing in three directions (120° apart) to ensure complete coverage of the plate. Cover the plate and wait at least five minutes for the plate to dry.

4. Hold a single sterile disc by the edge with sterile forceps and dip it into the sanitizer solution to be tested (make sure it matches with the label on the disk). Touch the disk against the side of the container to drain off excess liquid.

5. Use sterile forceps to place a single disinfectant disc in the center of each of the marked sections on your test plates. Use the forceps to gently press each disk against the agar surface to insure good contact. Remember to use the exact same technique for each disk—consistency is very important for this experiment. Make note of which brand sanitizer saturated disc is present in which section of the nutrient agar plate.

6. Incubate the plate, with the nutrient agar on top (inverted), overnight at 37°C or for longer if incubator is set at a lower temperature.

7. Take the plate out of the incubator and examine the zones of inhibition for the different sanitizer solutions.

Observations

<table>
<thead>
<tr>
<th>Hand Sanitizer brand (Commercial/Home-made)</th>
<th>Diameter of Zone of Inhibition (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dettol (Commercial)</td>
<td>0.66</td>
</tr>
<tr>
<td>Wellness Tree (Commercial)</td>
<td>0.84</td>
</tr>
<tr>
<td>Himalaya Pure Hands (Commercial)</td>
<td>0.69</td>
</tr>
<tr>
<td>Zuci Junior (Commercial)</td>
<td>0.78</td>
</tr>
<tr>
<td>70% 77% isopropyl alcohol + 2% aloe vera gel (Home-made solution)</td>
<td>0.51</td>
</tr>
<tr>
<td>No hand-sanitizer (Control)</td>
<td>No inhibitory action</td>
</tr>
</tbody>
</table>

Conclusion

We understand that the anti-bacterial solution with the largest zone of inhibition (measured in terms of its diameter) is the strongest and vice-versa. According to understanding, we can conclude that the strongest hand-sanitizer solution is Wellness Tree whereas the weakest is the home-made anti-bacterial solution.

Wellness Tree > Zuci Junior > Himalaya Pure Hands > Dettol > Home-made hand-sanitizer

As for our hypothesis, we can conclude that both parts are, in fact, correct according to our experiment. The zones of inhibition of the four commercial hand-sanitizers differ slightly and that of the home-made anti-bacteria solution is less than that of its commercial counterparts.
Reference


4. Centres for Disease Control and Prevention (CDC) Show Me the Science—When & How to Use Hand Sanitizer in Community Settings. [(accessed on 7 May 2021)];2019

5. La Fleur P., Jones S. Non-Alcohol Based Hand Rabs: A Review of Clinical Effectiveness and Guidelines. Canadian Agency for Drugs and Technologies in Health; Ottawa, ON, Canada: 2017.


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