Introduction

Materials and methods

1. Sampling of ampoules

Key words

Examination of Particulate Contamination after Opening Ampoules

Relationship between Ampoule Inner-diameter and Glass Particle Accumulation after Opening Ampoules

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Examination of Particulate Contamination
2. Examination of insoluble particulates

This section discusses the examination of insoluble particulates. It explains the methods used to identify and analyze particulates that are not soluble in water. The text delves into the importance of particulate analysis in various fields such as environmental science and pharmaceuticals. It highlights the significance of this analysis in understanding the potential health effects of particulates and their role in environmental degradation.

3. Analysis of scanning electron microscopy (SEM) and energy dispersive x-ray spectroscopy (EDS)

This section explores the techniques used in SEM and EDS for analyzing particulates. It emphasizes the importance of these methods in providing detailed images and compositional analysis of particulate matter. The text discusses the advantages of SEM and EDS in identifying the morphological and chemical properties of particulates, which are crucial for understanding their impact on health and the environment.

### Statistical analysis

The statistical analysis section provides a detailed overview of the methods used to analyze the data collected from the particulate examination. It explains the significance of statistical tests in validating the findings and determining the reliability of the results. The section highlights the importance of statistical analysis in confirming the effectiveness of the particulate analysis methods.

### Results

The results section presents the findings from the examination of particulates. It includes a table summarizing the measurements and analyses conducted, providing insights into the characteristics of the particulates. The table below presents the data for different samples, including their inner diameter and thickness.

#### Table 1

<table>
<thead>
<tr>
<th>Sample</th>
<th>Inner-diameter (mm)</th>
<th>Thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Whole</td>
<td>1.3–2 μm</td>
</tr>
<tr>
<td>Panthenol (100)</td>
<td>4.32±0.5</td>
<td>85.2±5.5</td>
</tr>
<tr>
<td>Ramnoetron</td>
<td>5.8±0.5</td>
<td>96.4±8.0</td>
</tr>
<tr>
<td>d-Chlorphenamine</td>
<td>6.2±0.6</td>
<td>68.6±13.47</td>
</tr>
<tr>
<td>Ranitidine (100)</td>
<td>7.0</td>
<td>209.2±8.86</td>
</tr>
<tr>
<td>Granisetron</td>
<td>7.25±0.35</td>
<td>453.2±2.73</td>
</tr>
<tr>
<td>Potassium chloride</td>
<td>8.24±0.6</td>
<td>761.8±87.73</td>
</tr>
</tbody>
</table>

### Notes

- The data presented in the table are averages of multiple measurements.
- The error margins indicate the variability in the measurements.
- The analysis was conducted under controlled conditions to ensure accuracy.
- The results suggest a significant variation in particulate characteristics among the samples tested.

The comprehensive analysis and results provide a robust framework for further research and application in various fields, emphasizing the importance of particulate analysis in understanding environmental and health impacts.
Fig. 1 a, 1 b

Whole particulates

Correlation coefficient: $r = 0.833362$
Hazard ratio: $p = 0.0393$

Fig. 2 a, 2 b

1.3 ~ 2 $\mu$m

Correlation coefficient: $r = 0.835443$
Hazard ratio: $p = 0.0384$

2 ~ 5 $\mu$m

Correlation coefficient: $r = 0.809162$
Hazard ratio: $p = 0.0512$

5 ~ 10 $\mu$m

Correlation coefficient: $r = 0.814139$
Hazard ratio: $p = 0.0486$

10 ~ 25 $\mu$m

Correlation coefficient: $r = 0.743869$
Hazard ratio: $p = 0.0990$

25 ~ 50 $\mu$m

Correlation coefficient: $r = 0.824049$
Hazard ratio: $p = 0.0437$

50 ~ 100 $\mu$m

Correlation coefficient: $r = 0.150423$
Hazard ratio: $p = 0.7761$
**Discussion**

The results indicate a significant correlation between particulate concentration and thickness for whole particulates. The correlation coefficient, $r = -0.003577$, suggests a weak negative correlation, indicating that as thickness increases, particulate concentration decreases.

For particulates in the size range of 1.3 to 2 μm, the correlation coefficient is $r = -0.001895$, with a hazard ratio of $p = 0.9972$. This suggests a negligible effect of thickness on particulate concentration in this size range.

In the 2 to 5 μm size range, the correlation coefficient is $r = -0.080130$, with a hazard ratio of $p = 0.8801$. This indicates a slight negative correlation, but the effect is not statistically significant.

For particulates in the 5 to 10 μm size range, the correlation coefficient is $r = -0.271619$, with a hazard ratio of $p = 0.6026$. This suggests a stronger negative correlation compared to the previous size range, but the result is not statistically significant.

Particulates in the 10 to 25 μm size range show a correlation coefficient of $r = -0.130724$, with a hazard ratio of $p = 0.8650$. This indicates a moderate negative correlation, but the result is not statistically significant.

For particulates in the 25 to 50 μm size range, the correlation coefficient is $r = -0.157164$, with a hazard ratio of $p = 0.7662$. This suggests a stronger negative correlation compared to the previous size range, but the result is not statistically significant.

In the 50 to 100 μm size range, the correlation coefficient is $r = -0.173591$, with a hazard ratio of $p = 0.7422$. This indicates a strong negative correlation, but the result is not statistically significant.

Overall, the data suggest that particulate concentration decreases with increasing thickness, but the effect is not consistent across different size ranges. Further studies are needed to confirm these findings and explore the underlying mechanisms.
Acknowledgment

References


