ABSTRACT

Five brands of soft drinks were analyzed for benzoic acid and caffeine content by using simultaneous estimation method. The soft drink includes Thums up, Limca, Coca cola, Sprite and Mountain dew. The result shows that the pH of soft drinks ranges from 1.8 to 2.8. The amount of benzoic acid and caffeine is determined by using simultaneous estimation method. In this process, it was found that amount of benzoic acid was low in Mountain dew. The caffeine content in soft drinks was only found in Thums up, Coca cola and Mountain dew and remaining other samples the presence of caffeine absorbance under UV spectrophotometry are not detected.

KEYWORDS: Soft drinks, Benzoic acid, Caffeine, Simultaneous equation, UV Spectrophotometry.

INTRODUCTION

A soft drink is a drink that typically contains carbonated water, a sweetener and a natural or artificial flavoring. The sweetener may be sugar, high-fructose corn syrup, fruit juice, sugar substitutes (in the case of diet drinks) or some combination of these. Soft drinks may also contain caffeine, colorings, preservatives and other ingredients.

Benzoic acid and its salts are used as a preservative, represented by the E-numbers E210, E211, E212 and E213. Benzoic acid inhibits the growth of mould, yeast and some bacteria. It is used either directly or as its sodium, potassium or calcium salt.
Caffeine which is chemically known as 1,3,7-Trimethylpurine-2,6-dione. Caffeine is a central nervous system (CNS) stimulant, having the effect of temporarily warding off drowsiness and restoring alertness.

It increases calcium permeability in sarcoplasmic reticulum, inhibiting phosphodiesterase promoting accumulation of cyclic AMP. The most prominent is that it reversibly blocks the action of adenosine on its receptor and consequently prevents the onset of drowsiness induced by adenosine. Caffeine also stimulates certain portions of the autonomic nervous system.

![BENZOIC ACID](image1)

![CAFFEINE](image2)

**MATERIALS AND METHODS**
The materials used are Hydrochloric acid (Molychem), Distilled water, Caffeine (Spectrum % purity: 98.5 %), Benzoic acid (Merck % purity: 99.9%). Which are brought from the local store of Siri scientific, Rajahmundry.

**Preparation of solutions**

**Preparation of stock solution of benzoic acid**
Weigh 0.010 gm of benzoic acid and transferred with DI water in a 500ml volumetric flask. It may be difficult to get the solid to dissolve, so you may want to start by putting the solid in a 500ml Erlenmeyer flask (not a volumetric flask), adding about 400ml of water, and heating on a heat plate. You will then have to make a quantitative transfer of the entire solution to the volumetric flask. Once the solid is dissolved in the volumetric flask, fill the flask to the mark with DI water.

**Preparation of stock solution of caffeine**
Prepare a stock solution of caffeine by dissolving~0.022gm caffeine (accurately weighed and transferred) with DI water in a 500 ml volumetric flask (you will probably want to use the
Sonicator to help dissolve the caffeine). Once the solid is dissolved fill the flask to the mark with DI water.

**Preparation of sample solutions:** (Thums up, Limca, Sprite, Mountain dew, Coca cola) Pour exactly 20 ml of sample into a 125 ml Erlenmeyer flask, then Sonicator the sample for 5 minutes to remove dissolved CO₂. Using the micro pipette (with a new tip) take 2 ml of sample in 50 ml volumetric flask and make up the volume with 0.01M HCl.

**RESULTS AND DISCUSSIONS**

**THUMS UP**

![Graph](image)

Fig no 1: Determination of caffeine and benzoic acid in Thums up.

λ for benzoic acid : 227

λ for caffeine : 272

Table no 1: λ max an absorbance values for caffeine and benzoic acid in Thums up.

<table>
<thead>
<tr>
<th>WAVELENGTH</th>
<th>CAFFEINE</th>
<th>BENZOIC ACID</th>
<th>THUMSUP</th>
<th>A⁻¹¹cm CAFFEINE</th>
<th>A⁻¹¹cm BENZOIC ACID</th>
</tr>
</thead>
<tbody>
<tr>
<td>227</td>
<td>0.093</td>
<td>0.311</td>
<td>0.463</td>
<td>93</td>
<td>311</td>
</tr>
<tr>
<td>272</td>
<td>0.398</td>
<td>0.016</td>
<td>0.636</td>
<td>398</td>
<td>18</td>
</tr>
</tbody>
</table>

\[ C_1 = a_2\lambda_2A_1 - a_2\lambda_1A_2 \div b(a_1\lambda_1a_2\lambda_2 - a\lambda_1a_1\lambda_2) \]
\[ C_1 = 18 \times 0.463 - 398 \times 0.636 \div 93 \times 18 - 398 \times 311 \]
\[ = 8.334 - 253.128 \div 1674 - 123778 = 0.002 \]
\[ C_1 = 20 \text{ mg} \]

\[ C_2 = a_1\lambda_1A_2 - a_1\lambda_2A_1 \div b(a_1\lambda_1a_2\lambda_2 - a\lambda_1a_1\lambda_2) \]
=93\times 0.636 - 311 \times 0.463 ÷ 93 \times 18 - 398 \times 311 \\
=840.845 ÷ 122104 = 0.0069; \quad C_2=69\text{mg}

**SPRITE**

![Fig no 2: Determination of caffeine and benzoic acid in sprite.](image)

**Table no 2: $\lambda_{\text{max}}$ and absorbance value for caffeine and benzoic acid in sprite.**

<table>
<thead>
<tr>
<th>WAVELENGTH</th>
<th>CAFFEINE</th>
<th>BENZOIC ACID</th>
<th>SPRITE</th>
<th>$A^{1%}_{1\text{cm}}$ CAFFEINE</th>
<th>$A^{1%}_{1\text{cm}}$ BENZOIC ACID</th>
</tr>
</thead>
<tbody>
<tr>
<td>227</td>
<td>0.093</td>
<td>0.311</td>
<td>0.421</td>
<td>93</td>
<td>311</td>
</tr>
<tr>
<td>272</td>
<td>0.398</td>
<td>0.018</td>
<td>0.039</td>
<td>398</td>
<td>18</td>
</tr>
</tbody>
</table>

**COCO-COLA**

![Fig no 3: Determination caffeine and benzoic acid in coco-cola.](image)
Table no 3: $\lambda_{\text{max}}$ and absorbance values for caffeine and benzoic acid in coco cola.

<table>
<thead>
<tr>
<th>WAVELENGTH</th>
<th>CAFFEINE</th>
<th>BENZOIC ACID</th>
<th>COCACOLA</th>
<th>$A_{1% 1cm}^{\text{CAFFEINE}}$</th>
<th>$A_{1% 1cm}^{\text{BENZOIC ACID}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>223</td>
<td>0.093</td>
<td>0.311</td>
<td>1.427</td>
<td>93</td>
<td>311</td>
</tr>
<tr>
<td>272</td>
<td>0.398</td>
<td>0.018</td>
<td>0.673</td>
<td>398</td>
<td>18</td>
</tr>
</tbody>
</table>

**MOUNTAIN DEW**

![Graph of determination of benzoic acid and caffeine in mountain dew.]

Table no 4: $\lambda_{\text{max}}$ and absorbance values for caffeine and benzoic acid in mountain dew.

<table>
<thead>
<tr>
<th>WAVELENGTH</th>
<th>CAFFEINE</th>
<th>BENZOIC ACID</th>
<th>MOUNTAIN DEW</th>
<th>$A_{1% 1cm}^{\text{CAFFEINE}}$</th>
<th>$A_{1% 1cm}^{\text{BENZOIC ACID}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>227</td>
<td>0.093</td>
<td>0.311</td>
<td>0.625</td>
<td>93</td>
<td>311</td>
</tr>
<tr>
<td>272</td>
<td>0.398</td>
<td>0.018</td>
<td>0.346</td>
<td>398</td>
<td>18</td>
</tr>
</tbody>
</table>

**LIMCA**

![Graph of determination of benzoic acid and caffeine in Limca.]

Fig no 5: Determination of benzoic acid and caffeine in Limca.
Table no 5: \( \lambda \) max and absorbance values for caffeine and benzoic acid in Limca.

<table>
<thead>
<tr>
<th>WAVELENGTH</th>
<th>CAFFEINE</th>
<th>BENZOIC ACID</th>
<th>LIMCA</th>
<th>( A_{1%1cm}^{%1cm} ) CAFFEINE</th>
<th>( A_{1%1cm}^{%1cm} ) BENZOIC ACID</th>
</tr>
</thead>
<tbody>
<tr>
<td>230</td>
<td>0.093</td>
<td>0.311</td>
<td>0.486</td>
<td>93</td>
<td>311</td>
</tr>
<tr>
<td>270</td>
<td>0.398</td>
<td>0.018</td>
<td>0.051</td>
<td>398</td>
<td>18</td>
</tr>
</tbody>
</table>

Benzoic acid and Caffeine

Table no 6: Amount of benzoic acid and caffeine in soft drinks.

<table>
<thead>
<tr>
<th>Company</th>
<th>Benzoic acid concentration (mg/l)</th>
<th>Caffeine concentration (mg/l)</th>
<th>Company standards for benzoic acid(mg/l)</th>
<th>Company standards for caffeine (mg/l) [24 25 26 27 28]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thumsup</td>
<td>20.0</td>
<td>69</td>
<td>70</td>
<td>52</td>
</tr>
<tr>
<td>Mountain dew</td>
<td>10.3</td>
<td>13.2</td>
<td>54</td>
<td>54</td>
</tr>
<tr>
<td>Limca</td>
<td>11.9</td>
<td>0.09</td>
<td>70</td>
<td>0</td>
</tr>
<tr>
<td>Coca-cola</td>
<td>19.8</td>
<td>31.2</td>
<td>46</td>
<td>46</td>
</tr>
<tr>
<td>Sprite</td>
<td>10.6</td>
<td>0.33</td>
<td>70</td>
<td>0</td>
</tr>
</tbody>
</table>

CONCLUSION

The analytical determination of benzoic acid and caffeine is not only important for quality assurance purpose but also for consumer interest and protection. This work used is simple, fast, and accurate UV-Visible spectroscopic method for the simultaneous determination of benzoic acid and caffeine in five marketed samples of soft drinks Coca-cola, Thums up, Sprite, Mountain dew, Limca. The results showed that the benzoic acid was found in all the five soft drinks which are within the company standards. Whereas caffeine was found only in Coca-cola, Thums up and Mountain dew which are also in company standards. So regular checking of soft drinks should be done.

REFERENCES


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