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The Glowing Pickle and Other Vegetables

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Abstract

The phenomenon known as the glowing pickle was investigated. Voltages ranging from 80-140 Volts AC were placed across a variety of vegetable specimens, both fresh and soaked in several salt solutions. The glowing was caused by electric arcing across a steam-filled cavity in the specimen. The emission spectra showed lines indicating the presence of potassium and sodium ions in the fresh specimens. In the specimens soaked in salt solutions, emission spectra matching the salt ions were observed.

Introduction

Recently a phenomenon known as "the glowing pickle" has become popular with certain groups, as evidenced by the number of videos present on the internet. A pickle will glow with a yellow light when a high enough voltage is placed across it. This occurs due to electrical arcing between one of the electrodes and the pickle.

Electrical arcing occurs when a high enough voltage across a gas-filled cavity ionizes the gas and allows an electric arc to jump the gap. This is a simplified version of the process that causes lightning. The length of the arc which can occur is dependent on the difference in voltage across the gap and the medium that the arc must penetrate[1].

The spectrum of the light emitted is related to the emission spectra of the atom that has been ionized by the electric arc. The use of different salts when soaking cucumbers results in the emission spectrum of that salt ion being observed[2]. The yellow light that is observed when using commercial pickles is characteristic of sodium, an element found in a pickle due to the table salt used[1].

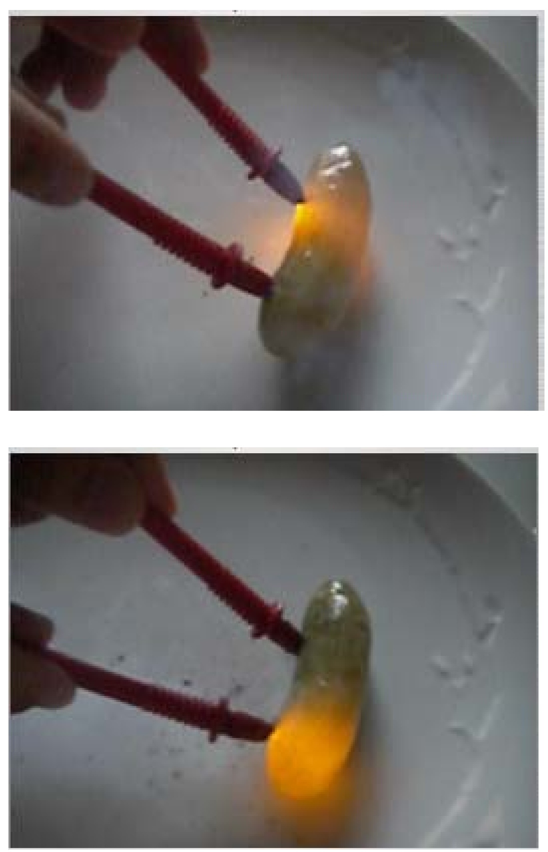

Figure 1 Arcing inside the pickle causes it to glow. Arcing can occur at either electrode.

Methods

A variety of fruits and vegetables were tested raw, and after being soaked for three days in saturated solutions of sodium chloride, copper sulfate, and potassium chloride. A Howie's dill pickle was also tested. An alternating current variac was connected to two electrodes, which were inserted into the vegetables.

Voltages ranging from 80 to 140 volts were used. The spectra of the light emitted by the electric arcing were studied using a Red Tide Emission Spectrophotometer.

Results and Discussion

Arcing

When the power supply was turned on, the specimen initially started to steam at the electrodes, indicating strong heating at the probes due to the electric current. Steam was produced more quickly in pickled and salted specimens than in the raw specimens. This indicates much higher currents and better conductivity in the salted specimens. The heating creates a steam-filled cavity surrounding the electrode. The electric arc occurs across this cavity. The light from the arc in the center of the pickle causes the pickle to glow. The arcing jumps between the probes as the steam surrounding the probes and the contact between the probe and the specimen changed as shown in Figure 1. The body of the specimen also burns, creating large cavities in the specimen where the body had been burned.

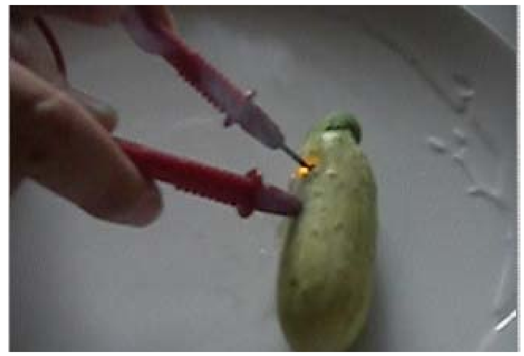

Figure 2 Electrodes must be closer together for arcing to occur in raw vegetables and the light intensity was significantly lower.

For the raw specimens, the electrodes needed to be closer together in order to get arcing as shown in Figure 2, due to the higher resistivity. The arcing only occurred across very narrow gaps. No arcing occurred for electrode separations greater than 20 mm. Raw cucumber, eggplant, and zucchini all started arcing at between 90-100 volts. The intensity of the light emitted was very low. At 100 volts, raw apple and banana would not arc, but they did arc strongly above 130 volts.

The specimens soaked in sodium chloride and potassium chloride behaved similarly to the pickle. The arcing occurred when the probes were placed as much as 10 cm apart. The arcing occurred over large gaps and produced very bright light.

The specimens soaked in the copper sulfate solution produced weak arcing with low light intensity. The light from these specimens was slightly green as shown in Figure 3, indicating excitation of the copper ion. It is not understood why the copper sulfate specimens were less conductive and emitted light of lower intensity than the other salted specimens.

Figure 3 Apple soaked in copper sulfate produced weak arcing with low intensity light. The light had a slight greenish tinge

Emission Spectra

The emission spectrum of the glowing pickle showed a single strong line at 590 nm, clearly indicating that the light was produced by the excited sodium ion as shown in Figure 4. All the specimens soaked in sodium chloride emitted similar spectra due to the presence of the sodium ion.

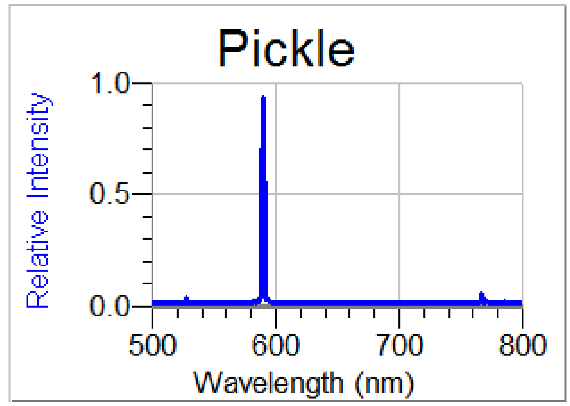

Figure 4 The emission spectrum of a glowing pickle showed a single line at 590 nm

The specimens soaked in potassium chloride showed a doublet at 767 and 770 nm along with a less intense line at 590 nm. Light of 767 and 770 nm is just beyond the visible spectrum and is not included in most published emission spectra. A flame test was performed on potassium chloride, which produced only a doublet at 767 and 770 nm. This shows that the doublet in the emission spectra in all the specimens was produced by the excitation of the potassium ions. The line at 590 nm was produced by the naturally occurring sodium in the specimens.

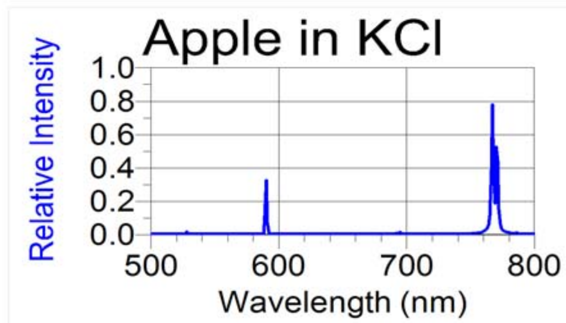

Figure 5 Apple soaked in KCl solution showed a line at 590 nm and a doublet at 767 and 770 nm.

The light emitted by the specimens soaked in copper sulfate was observed to have a slight greenish tint. However, the emission spectra showed no significant emission lines characteristic of published copper ion spectra.

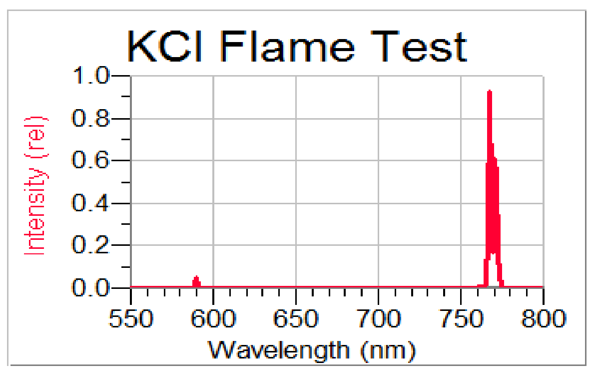

Figure 6 The KCl flame test showed a doublet at 767 and 770 nm, with the first being more intense.

All of the raw specimens tested showed an emission spectrum with both sodium and potassium lines, with the potassium doublet slightly more intense. The zucchini was unusual because it showed almost no sodium. Published nutrition data[3,4] of the amounts of potassium and sodium contained in the raw specimens was compared to the emission spectra. The ratio of nutritional sodium to potassium was compared with the ratio of the intensity of the 590 nm sodium line to the intensity of the 770 nm potassium line, as shown in table 1. It can be seen that there is low correlation between the amount of potassium and sodium in the specimen and the relative intensities of the sodium and potassium lines in the emission spectrum. The reasons for this are unclear.

Specimen Type (Raw)	Relative Nutritional Content (Na/K)	Relative Intensity of Emission Lines (Na/K)
Cucumber	0.01	0.71
Eggplant	0.02	0.37
Zucchini	0.01	0.08

Table 1 Comparison of relative Na/K content and emission intensity.

When 140 volts was applied across the specimens, a black body curve was produced in addition to the sodium and potassium line spectra as shown in Figure 6. Although this phenomenon was not studied in depth, it is suggested that the increase in temperature of the specimen due to the higher voltage was the cause of the black-body spectrum.

It is suggested that further research be done investigating the absence of the copper lines and the lack of correlation between the concentrations and the relative intensity of the emission lines. The arcing behavior at a wider range of voltages could also be investigated.

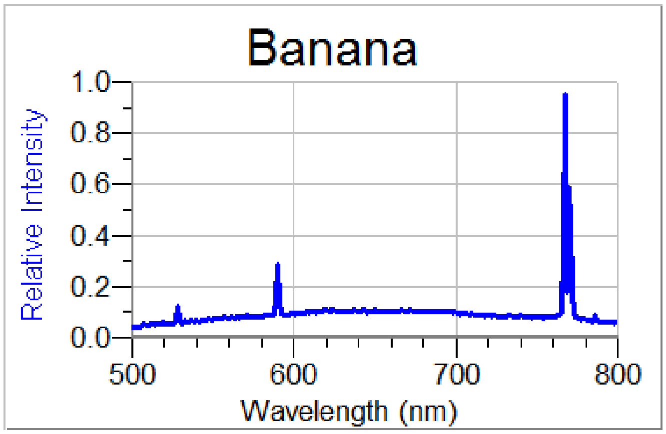

Figure 7 Raw banana with 140 V applied across it showed a blackbody spectrum in addition to the sodium and potassium lines.

Conclusion

The light in the glowing pickle is caused by electric arcing across a steam filled cavity inside the pickle. Any specimen will glow given a high enough field strength (in volts per meter). The emission spectrum indicates the presence of sodium and potassium ions but not the presence of copper ions. The relative intensity of the emission lines in the raw specimens was found to be unrelated to the relative concentration of the respective ions. At high voltages the emission spectrum includes a black body curve.

References

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