4. Experiment. Analysis of minerals in food product

Objective: Small quantities of sodium can be determined by flame atomic spectroscopy. Sodium content can also be atomic emission spectroscopy. In this experiment, soda and chips will be analyze for their sodium by Beer's Lambert Law and by standard addition. The sodium content will be determine by part per million and then compared to the food nutrition label.

Equipment		Chemicals	
Various beakers	50-mL Grad cylinder	HCl concentrated	Potato Chips
500-mL Elm flask	Hot plate	Distilled water	Uncola Soda
250-mL elm flask	#1 Whatman filter paper		
100-ml vol flask			
25-ml vol flask			
pipette	AA240 Atomic Absorption Spectrometer		

Safety and Waste Disposal

Check all glassware for stress, stars, or fatigue before performing this experiment.
Use safety goggles, lab jacket, latex gloves for this experiment.

Discussion:

Sodium is a part of everyone's diet, but how much is too much? Under ideal conditions, the minimum sodium requirement is about 1,500 milligrams (mg) of sodium each day. This is les than 1 teaspoon of table salt. The maximum recommended level of sodium intake is 2,300 mg per day. Sodium intake is one factor involved in the development of high blood pressure, otherwise known as hypertension. Hypertension tends to develop as people age. Some individuals are "salt sensitive," so reducing intake of sodium helps to reduce blood pressure levels. A high intake of sodium early in life might weaken genetic defenses against developing high blood pressure. Experts recommend not to wait and see if you develop hypertension, but to reduce sodium intake while blood pressure is still normal. This may decrease your risk of developing hypertension.

Other important considerations are healthful eating, maintaining ideal body weight, physical exercise and the amount of mono- and polyunsaturated fatty acids in the diet. Foods rich in calcium, magnesium and potassium are strongly recommended as protective measures against hypertension.

For people who already have hypertension, following an overall eating plan called DASH (Dietary Approaches to Stop Hypertension) and restricting sodium intake to 1500mg per day may be useful for lowering blood pressure. Recommended by the American Heart Association and the National Cancer Institute, the DASH diet is lower in fat, saturated fat, cholesterol, and sodium, and higher in potassium, magnesium, and calcium than the typical American diet. For more information about the DASH eating plan or diet and hypertension in general see fact sheet 9.318, Diet and Hypertension.

Sodium has an important role in maintaining the water balance within cells and in the function of both nerve impulses and muscles. Any extra sodium is excreted by the kidneys. Consuming excess sodium may lead to edema or water retention. Women who consume excess sodium may be at higher risk for developing osteoporosis even if calcium intake is adequate. Some evidence suggests that for each teaspoon of salt (2,000 mg of sodium) consumed, considerable calcium is excreted in the urine. Athletes and heavy laborers are sometimes concerned about not getting enough sodium to replace what is lost through perspiration. However, salt tablets are not recommended. They may increase dehydration and actually lower performance. Sodium losses are easily replenished at the next meal.

Many people think of salt and sodium as being the same thing, but they are not. Table salt is 40 percent sodium and 60 percent chloride. It is the sodium portion of salt that is important to people concerned about high blood pressure. Keep in mind some sodium is naturally present in most foods. See Table 1.

Most of the sodium in processed foods is added to preserve or flavor them. Salt is the major source of this sodium. Salt is added to most canned and some frozen vegetables, smoked and cured meats, pickles and sauerkraut. It is used in most cheeses, sauces, soups, salad dressings and many breakfast cereals. It is also found in many other ingredients used in food processing. The food industry is trying to find ways to decrease sodium while ensuring food safety.

Watch out for commercially prepared condiments, sauces and seasonings when preparing and serving foods for you and your family. Many, like those in Table 1, are high in sodium.

Table 1: Sodium comparisons.			
Little	Low	More	High
Apple, 1--2 mg	Applesauce, 1 c.--6 mg	Apple pie, 1/8, frozen--208 mg	Apple pie, 1, fast food--400 mg
Low sodium bread, 1 slice--7 mg	Bread, 1 slice, white--114 mg	Pound cake, 1 slice--171 mg	English muffin, 1 whole—203mg
Vegetable oil, 1 tbsp.--0 mg	Butter, 1 tbsp., unsalted--2 mg	Butter, 1 tbsp., salted--116	Margarine, 1 tbsp.--140 mg
Chicken, 1/2 breast--69 mg	Chicken pie, 1, frozen--907 mg	Chicken noodle soup, 1 c.--1,107 mg	Chicken dinner, fast food--2,243 mg
Fresh corn, 1 ear--1 mg	Frozen corn, 1 c.--7 mg	Corn flakes, 1 c.--256 mg	Canned corn, 1 c.--384 mg
Cucumber, 7 slices--2 mg	Sweet pickle, 1--128 mg	Cucumber w/salad dressing--234 mg	Dill pickle, 1--928 mg
Pork, 3 oz.--59 mg	Bacon, 4 slices--548 mg	Frankfurter, 1--639 mg	Ham, 3 oz.--1,114 mg
Lemon, 1--1 mg	Catsup, 1 tbsp.--156 mg	Soy sauce, 1 tbsp.--1,029 mg	Salt, 1 tsp.--1,938 mg
Potato, 1--5 mg	Potato chips, 10--200 mg	Mashed potatoes, instant, 1 c.--485 mg	Potato salad, 1/2 cup--625 mg
Plain yogurt, 1 c.--105 mg	Milk, 1 c.--122 mg	Buttermilk, 1 c.--257 mg	Choc. pudding, 1/2 c. instant--470 mg
Steak, 3 oz.--55 mg	Corned beef, 3 oz.--802 mg	Jumbo burger, fast food--990 mg	Meat loaf, frozen dinner--1,304 mg
Tomato, 1--14 mg	Tomato juice, 1 c.--878 mg	Tomato soup, 1 c.--932 mg	Tomato sauce, 1 c.--1,498 mg
Tuna, fresh, 3 oz.--50 mg	Tuna, canned, 3 oz.--384 mg	Tuna pot pie, 1 frozen--715 mg	Fish sandwich, 1, fast food--882 mg
Peanuts, unsalted, 1 c.--8 mg	Peanut butter, 1 tbsp.--81 mg	Peanut brittle, 1 oz.--145 mg	Dry roasted peanuts, salted, 1 c.--986 mg
Low sodium cheddar, 1 oz.--6 mg	Cheddar cheese, 1 oz.--176 mg	Cottage cheese, 1/2 cup--257 mg	American cheese, 1 oz.--406 mg
Water, 8 oz., tap--12 mg	Club soda, 8 oz.--39 mg	Antacid in water--564 mg	Beef bouillon, 8 oz.--1,152 mg

Figure 1: Part of a nutrition label seen on foods

Nutrition Facts

* 1/4 tsp. salt = 500 mg sodium
* 1/2 tsp. salt = 1,000 mg sodium
* 3/4 tsp. salt = 1,500 mg sodium
* 1 tsp. salt = 2,000 mg sodium

Nutrition and ingredient labels on foods can show you the major sources of sodium in your diet and help you get an idea of your sodium intake. Nutrition labels list the Daily Value (DV) for specific ingredients, including sodium. The DV for sodium is 2,400 mg. The sodium content of the food is listed in mg and as a percent of the daily value. The amount of sodium listed per serving includes sodium naturally present in the food as well as sodium added during processing.

Ingredients for all foods must be listed on the label, including standardized foods. Ingredients are listed in descending order by weight. Salt is the major, but not the only, source of sodium in food products. Any ingredient that has sodium, salt or soda as part of its name (monosodium glutamate, baking soda, seasoned salt) contains sodium. Soy sauce and other condiments used as ingredients also contribute sodium. Example -- INGREDIENTS: Potatoes, vegetable oil, whey, salt, dried milk solids, sour cream, onion salt, monosodium glutamate, dried parsley, lactic acid, sodium citrate, artificial flavors.

This food contains four sodium-containing ingredients (represented in bold above). Salt is the fourth ingredient by weight. Therefore, this product is probably high in sodium. Specific health claims can be made about sodium for food products that meet certain requirements. For example, "A diet low in sodium may reduce the risk of high blood pressure, a disease associated with many factors." In order to make a health claim about sodium and hypertension (high blood pressure), the food must be low or very low in sodium. The following terms describe products that help reduce sodium intake:

* Sodium free: Less than 5 mg per serving.
* Very low sodium: 35 mg or less per serving and, if the serving is 30 g or less or 2 tablespoons or less, per 50 g of the food.
* Low sodium: 140 mg or less per serving and, if the serving is 30 g or less or 2 tablespoons or less, per 50 g of the food.
* Reduced or Less sodium: At least 25 percent less per serving than the reference food.

Procedure

Analysis of sodium in potato chips

1. Prepare an HCl solution by diluting 500 mL of concentrated HCl with 220 mL of water.

2. Prepare sodium standards (by diluting a 100 -ppm solution derived from 1000 ppm) that are 1, 3, 5, and 7 ppm. These standards should be approximately 0.5% HCl by volume.

3. Prepare samples (two or more different foods) by weighing 5 g of each (diced or ground) into 500 -mL Erlenmeyer flasks. Add 50 mL of the HCl solution prepared in step 1 to each. Bring each to a boil on a hot plate, and then simmer for 5 min. Cool and quantitatively transfer the supernatants for each to separate 100 -mL volumetric flasks. Dilute to the mark with distilled water and shake. Filter each through Whatman #1 filter paper into 250 -mL Erlenmeyer flasks. Pipet 1 mL of each of these extracts into other clean 100-mL volumetric flasks, and dilute to the mark with water. Save the original extracts in case more dilutions are needed.

4. Obtain absorbance readings on the AA and plot A vs c. Use a computer if so directed.
5. Calculate the mg of Na per 5 g of samples as follows:

Analysis of sodium in potato chips

1 Prepare 100 mL of a 100-ppm sodium solution from the available 1000 ppm.

2. From the 100-ppm Na stock solution prepare standards of 1,3,5,7, and 9 ppm in 25-mL volumetric flasks. Dilute each solution to the mark with distilled H_2O.

3. Put 1 mL of each soda pop sample into separate 25-mL volumetric flasks and dilute to the mark with distilled water. Shake.
4. Obtain absorbance values for all standards and samples using an AA instrument. Your instructor may suggest using a computer for data acquisition.

5. Plot A vs c and obtain the concentrations of Na in the disputed samples. A computer may be used for this. Multiply the concentration by 25 to get the ppm Na in the soda pop.

Discussion-
The goal of this experiment was to determine the percentage of sodium in the chip and sod in parts per million and in mg per serving. Discuss the benefits and risk of sodium in diet. What role does sodium play to good health. Is the result from your experiment consistent with the literature value. Discuss the standard deviation of the result and how the error analysis provides information to a dietitian based on the table given in the background information.

Due-

Analysis of Sodium in Food Product

Analytical Chemistry 251

#	**CRITERIA** (Tentative point distribution - may change depending on experiment)	pts %
1	Quiz / Homework	0
2	**Introduction and Procedures** A. Introduction • Objective of Expt. • Background information. • Math relationship used in study. B. Procedures • Outline of procedures in Expt. • Flow chart pictorial of procedures. • Procedural changes. • Information (data) to be recorded during expt. (to be presented in Table form.) • Safety and disposal information. **This portion of the report should be turned in before the start of lab class (prelab discussion).**	5
3	**Data, Observe., Results and Calc.** C. Data and Observation • Data in table form. & detailed observation written in the table. All data entry should contain the proper number of significant figures and units. Data should always be recorded in an organize fashion. • Balance chemical equations; all chemical reaction which occurred during an experiment should be written in this section. Then it should also be written in the discussion portion of the report. **This portion of the report should be turned in before you leave the laboratory.**	8
	Calculations & Results D. Calculations • Sample calculation shown • Statistical analysis of data and result (if applicable) E. Results • Result(s) in table form. In this section accuracy of results is very important as well as detailed calculation showing how the result was obtain. "Unknown" will also be included in this section.	12
4	**Discussion / Conclusions and Post-Lab Questions** F. Discussion •A complete discussion should be written in this section. Topics to be discuss can be found at the end of each experimental procedure from the lab manual. Each discussion should include the significance of the result(s) and the meaning of the result of the experiment. All chemical reactions that occurred during the experiment should also be included here. G. Conclusion • Summary of the goal of the experiment and how that goal was achieved in the experiment. H. Post-lab questions from manual or class assignment • Complete well thought-out answers. **This portion (Calculation and Discussion) is turned in at the beginning of class of the due-date**	10
5	**Overall Presentation (of lab notebook)** • Lab technique during experiment; example are, class preparation, safety glasses precautions and leaving the laboratory clean. • Report presentation: examples are the headings of each report that includes name, title, lab partner, date and section #. • Legibility of report. Is the report easy to read or is important information jotted down by small print in the corners of the lab report. The overall impression is important.	5
6	Lab Technique • Safety: wear goggles, handle chemicals with caution, proper handling of lab equipment • Leave lab clean and tidy	5
	Total (This total may be adjusted depending on lab technique and student conduct in the experiment)	100%