Chemistry in Commercial Products
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Treasure from the Sea　海底奇藻

Introduction

Nowadays, more and more people are concerned about their health and in order to meet the public's needs, various kinds of health product, like spirulina pills and tablets, can be found in the market. However, these kinds of product are expensive and not everyone can afford them. Kelp is a kind of algae, which can be found in the shallow sea areas. Due to its high availability, it is hoped that it can be a substitute for expensive spirulina. We have 2 aims in our experiment:

1. To investigate the different nutrient and mineral content in dried raw kelp and dried cooked kelp.
2. To develop a series of commercial products that is healthy, convenient and economical.

Experiments

Part 1A - Juice Extraction

25 cm^3 distilled water was added to 25.0 g fresh kelp and the mixture is grinded with a blender. The mixture is then filtered by suction to give a clear solution.

Part 1B - Ashing of kelp sample

1-3 g of dried kelp samples are put inside the crucibles and are heated with Bunsen burner in the air until they turn into ash. Organic constituents inside the samples are burnt away, leaving the minerals in the form of oxides, sulphates, phosphates, chlorides and silicates.

Part 1C - Preparing kelp jelly (Our Product)

1g of dried kelp powder, 2g gelatin and 125 cm^3 of hot water were mixed and stirred until homogenous. The mixture is then poured into a mould and allowed to cool down to room temperature. The cooled mixture was put into the refrigerator for 2 hours.

Part 2A - Determination of Calcium Content

5 cm^3 of concentrated hydrochloric acid is added to the ashed sample and boiled for 5 minutes. Then the pH of the solution is adjusted to 4 with dilute ammonia solution. Excess solid ammonium oxalate, around 0.1 g, was added to the solution and boiled for 30 minutes. The solution was allowed to cool down to room temperature and the precipitate was collected by suction. Precipitate was dissolved in dilute sulphuric acid and the solution was heated to above 60^oC. The solution was then titrated with 0.005M potassium permanganate solution immediately until a permanent pink color was obtained.

Part 2B – Determination of Iron Content

A. Preparation of standard iron solutions:

5 cm^3 of standard ammonium iron (II) sulphate was titrated with sodium citrate using bromophenol blue as indicator. 5 cm^3 of standard ammonium iron (II) sulphate was pipetted to volumetric flasks (50 cm^3, 100 cm^3, 250 cm^3, 500 cm^3, 1 dm^3, & 2 dm^3). The recorded amount of sodium citrate, 1 cm^3 of hydroxylamine hydrochloride and 3 cm^3 of ortho-phenanaline were added into the volumetric flasks. The solutions turned red. Solutions were made up to the graduation mark and the percentages of transmittances were recorded. A standard calibration curve was plotted after taking the readings.

B. Preparation of sample solution

5 cm^3 of concentrated hydrochloric acid was added to ashed sample and boiled for 5 minutes. The solution is then diluted and made up to 50.0 cm^3 with a volumetric flask. The steps for preparing standards were repeated to make up a red sample solution and the percentage transmittance was recorded.

Part 2C – Determination of Phosphorus Content

A. Preparation of standard phosphorus solutions:

0.00, 5.00, 10.00, 20.00, 30.00, 40.00 & 50.00 cm^3 of *diluted standard phosphorus solutions* were pipetted into 7 different 100.0 cm^3 volumetric flasks and 8.0 cm^3 mixed complexing agent (sulphuric acid, ammonium molybdate, vitamin C solution) were added and mixed well. The mixtures were allowed to stand for 10 minutes and made up to 100.0 cm^3 with distilled water. The percentage transmittances of the solution were recorded.

B. Preparation of Sample solution

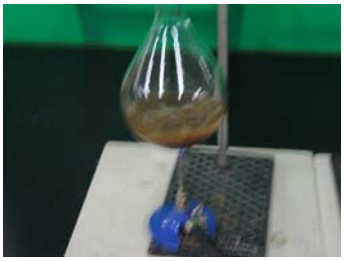
5.0 cm^3 of concentrated hydrochloric acid was added to the ash sample and made up to 40.0 cm^3. The mixture was then heated for 5 minutes and was allowed to cool down. A few drops of sodium hydroxide solution were added to the mixture until the pH of the mixture was 7.0. The mixture was then make up to 50 cm^3 and 8 cm^3 complexing agent was added. The solution was then made up to 100 cm^3 and percentage transmittance of the solution was recorded.

Part 2D – Determination of antioxidant content

Prepared kelp juice was titrated with potassium permanganate and the volume of permanganate used was recorded.

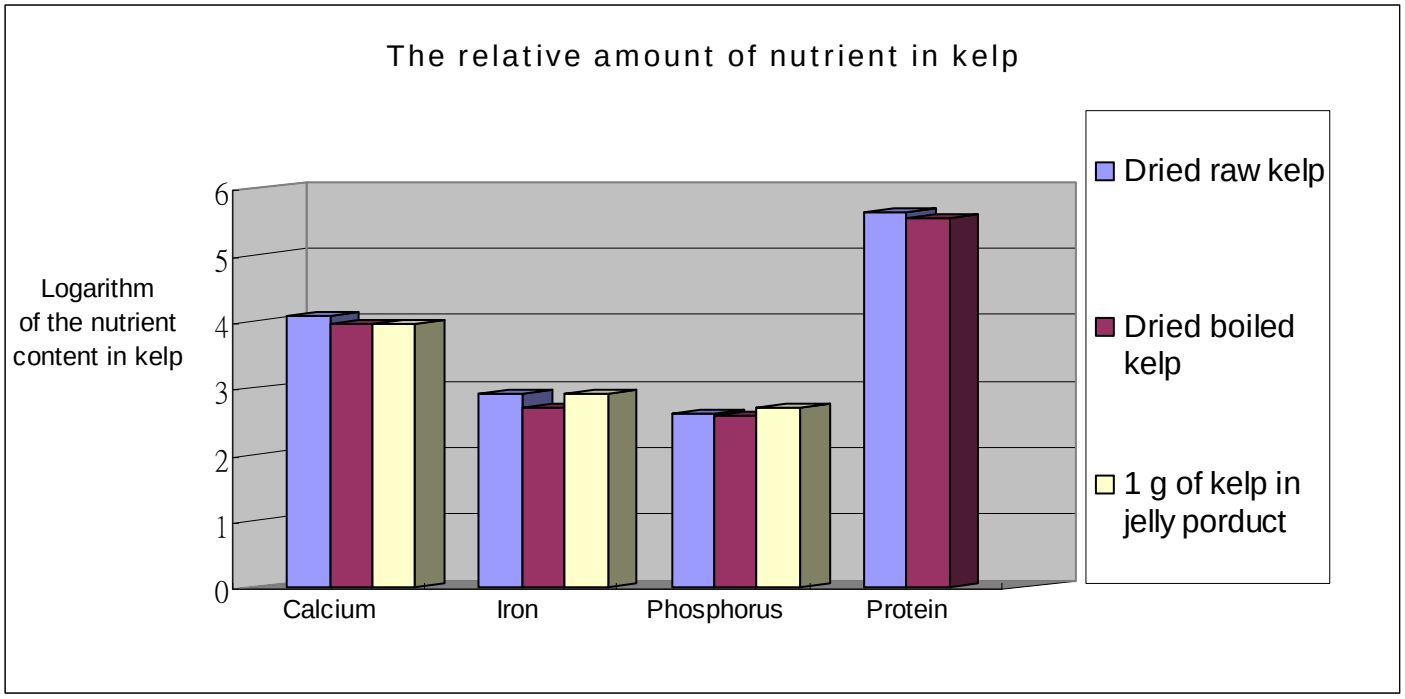
Part 2E – Determination of protein content

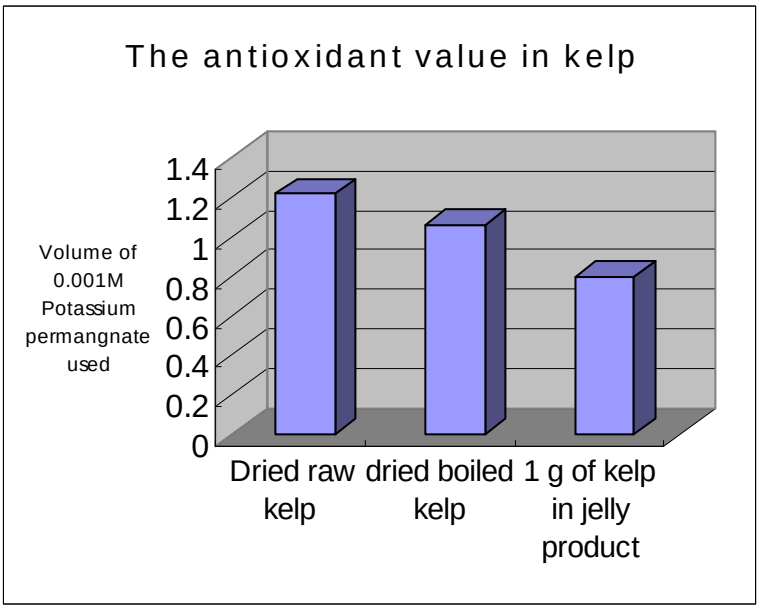
10.0 cm^3 of concentrated sulphuric acid, about a spatula-load of anhydrous sodium sulphate and solid potassium permanganate were added to a conical flask containing 0.5 g kelp. The mixture was then boiled until the charred sample turned clear and was allowed to cool to room temperature. 100 cm^3 of distilled water was added and the mixture was transferred to a 800 cm^3 long-necked boiling flask and anti-pumping stones were added. 60 cm^3 of sodium hydroxide was transferred to the tap funnel. Then the solution was heated to boiling and Ammonia driven off was absorbed by 25.0 cm^3 of 0.5 M hydrochloric acid. The distillation was continued until half of the solution has distilled over. The excess hydrochloric acid was titrated against standard 0.5 M sodium hydroxide in the burette, using methyl orange as indicator.



Result

	Calcium	Iron	Phosphorus	Protein	Antioxidant (vol. of 0.001 M $KMnO_4$ used)
Dried raw kelp	12.3 mg	0.81 mg	0.398 μg	0.429 g	1.22 cm^3
Dried boiled kelp	8.91 mg	0.49 mg	0.38 μg	0.356 g	1.06 cm^3
1 g of kelp in jelly product	8.91 mg	0.83 mg	0.51 μg		0.8 cm^3





Conclusion and Application

After conducting all the experiments, we can see that kelp is highly nutritious; especially rich in minerals like calcium, iron and phosphorus. These minerals are important in the normal functioning of our body: calcium is important in bone formation and blood clotting; iron is essential in the formation of haemoglobin, which is an oxygen-carrier in our body; phosphorus is important for the formation of ATP, an energy-rich compound which acts as an energy-carrier in cells for metabolic activities. It also contains some protein and antioxidant, which is essential in tissue formation and prevents damage of body cells respectively. Therefore, eating a suitable amount of kelp can help us maintain good health.

Because of kelp's highly nutritional value, we have made a product, kelp jelly, from it. We found that the nutritional value of kelp jelly is similar to kelp, showing that most of the nutrients can be preserved after food processing. We hope that our kelp jelly can serve as a kind of nutrient supplement, especially for Hong Kong people who live a busy life and do not have much time to care about their health. By eating kelp jelly, they can obtain sufficient essential minerals.

It is recommended to take around 5g of dried kelp each day, which provides our body with the essential nutrients and is good to our health. Besides making kelp jelly, kelp can be used to make different kinds of dishes. For instance, the green bean and kelp sweet soup is a famous Chinese desert. It can help to lower the blood pressure. In Korea, people use kelp to make soup and it is believed that the kelp soup is good for postnatal women due to its high nutrient content.

Hong Kong people like to have mineral tablets, why don't we try some natural food like kelp instead?