Spectrophotometric Determination of Iron, Vitamin-C and Carbohydrate Contents in Concentrated Prune Juice

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Abstract

In this research work, the prune juice was collected from Loikaw, Kayah State for chemical analysis. Iron, carbohydrate and vitamin C contents in prune juice were determined by spectrophotometric method. The absorbance of sample solution was measured and the iron content in prune juice was calculated. Ascorbic acid (Vitamin-C) content in prune juice was quantitatively determined by spectrophotometric method, using of potassium chromate diphenylcarbazide. Iron content in prune juice was determined by spectrophotometric method, using of 1,10- phenanthroline complex. Carbohydrate content in prune juice was determined by colorimetric method, using of phenol-sulphuric acid.
Keywords: iron, vitamin C, carbohydrate, prune juice, spectrophotometric method

Introduction

Prunes, also known as dried plums, are pulverized and dissolved in hot water to make prune juice. This plant is widely cultivated in Myanmar. Prune juice is healthy for the overall well being of a person. It is a viable source of iron. Prune juice is also very good for the skin as it is a natural fibre-packed fruit juice with the goodness of vitamins, minerals and is free from any harmful ingredients. Prune juice is believed to contain minerals such as iron, calcium, magnesium, phosphorus etc. which fight any mineral deficiency in the body and give a glowing healthy skin. Prune juice is rich in vitamin A and C. They are believed to alleviate stress, and traditionally for anti-fungal, anti-bacterial, anti-ulcer, and anti-inflammatory purposes. Hence a glass of prune juice will boost body with vitamins and will no longer need to rely on taking any extra vitamin supplements. An 8-ounce glass of canned prune juice, or the equivalent of a 1-cup serving, provides 182 calories, 1.56 grams of protein, a negligible amount of fat and just under 45 grams of carbohydrates, of which 2.6 grams are fiber and about 42 grams are natural sugars, according to the U.S. Department of Agriculture. This juice is exceptionally high in antioxidant phenolic compounds, including anthocyanins and neochlorogenic and chlorogenic acids. This juice is also an excellent source of heart-protective antioxidants (Ei Kay Thwe, 2014). Therefore, in this research, the prune juice was selected for chemical analysis.

Botanical Description

Scientific name	:	*Ziziphus jujube* (L.)
Family name	:	Rosaceae
English name	:	plum
Myanmar name	:	Zee-thee
Part used	:	prune juice of plum

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Figure 1. Dried *Ziziphus jujube* (L.) (Plum)

Medicinal Uses

Prune juice is a rich source of vitamins such as vitamin B, vitamin C etc. which are very good for the health of hair and skin. These components strengthen hair follicles from the roots and prevent breakage and damage. It is relatively high in calories, providing 182 per cup. It is also rich in potassium, a mineral that normalizes blood pressure and reduces risk of hypertension. The juice's significant against iron deficiency anemia. Prune juice is a great source of energy and hence works well when include it in weight loss diet. Prune juice is also used as a vatural colouring agent by many people all over the world (Ei Kay Thwe, 2014).

Materials and Methods

Determination of Iron Content

Sample Collection and Preparation of Stock Sample Solution

The sample prune juice was collected from Loikaw, Kayah State. For sample, 1 g of sample was weighed exactly. Then the weighed sample was digested with 4 mL of 2 M sulphuric acid in a 500 mL volumetric flask. Then about 250 mL of distilled deionized water was added into the volumetric flask containing sample solution. Then the volumetric flask was filled with distilled deionized water to the mark and shaken well (Ei Ngon Sue Khaing, 2013). The stock sample solution was prepared freshly just before the measurement of absorbance.

Preparation of Standard Solutions

0.015 M solution of 1, 10-phenanthroline, 1.22 M solution of sodium acetate, 1.4 M solution of hydroxylamine hydrochloride and 2 M solution of sulphuric acid were freshly prepared just before the measurement of absorbance (Nann Yu Ma, 2014).

The Conformity of Iron-1, 10-Phenanthroline Complex to Beer's Law

In order for iron-1, 10-phenanthroline complex to conform to Beer's law, the measured absorbances at various concentrations and fixed 508 nm wavelength are given in Table 1.

Calibration curve or the Beer's law standard curve which is plotted the absorbance versus concentration, is given in Figure 2.

Table1. Results for the Measured Absorbances at Various Concentration of Iron-1, 10-phenanthroline Complex Solution

No.	Concentration (mgL^{-1})	Absorbance	a (cm^{-1} mgL^{-1})
1	12	2.210	0.184
2	10	1.845	0.185
3	8	1.455	0.182
4	6	1.120	0.186
5	4	0.762	0.190
6	2	0.360	0.180
Mean value			0.184

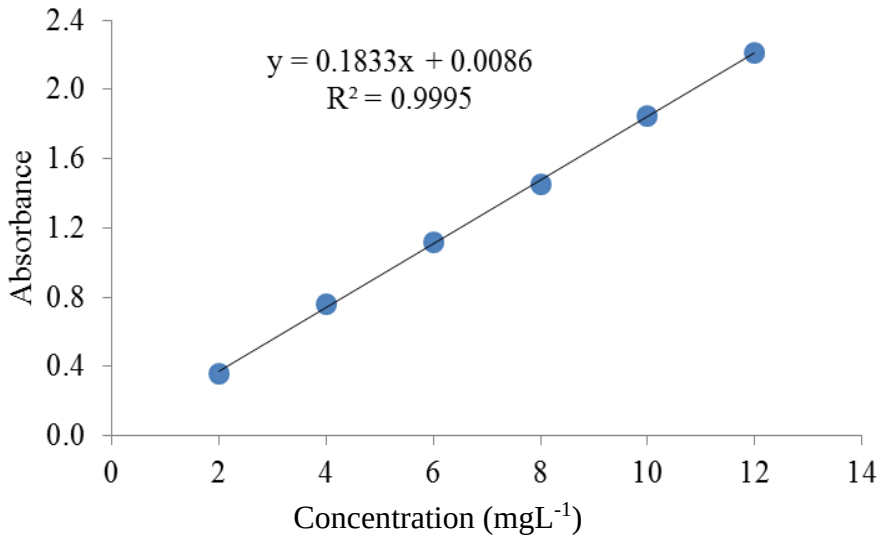

Figure 2. Calibration Curve, Beer's Law Standard Curve for Iron-1, 10-Phenanthroline Complex

Since the curve is found to be linear which is passing through the origin, the iron-1, 10-phenanthroline complex with 2-12 mgL^{-1} concentration range obey the Beer's law. From the measured values of absorbance, the values of absorptivity index are almost nearly constant and the mean value obtained is 0.184 $cm^{-1}mgL^{-1}$. In addition, the value of absorptivity index from the slope of calibration curve is also found to be 0.1833 $cm^{-1}mgL^{-1}$.

Measuring the Absorbance of Iron Content in Sample Solution

The sample solution used to measure the absorbance was initially prepared as follow.

The suitable volume of a stock sample solution was shifted to a 100 mL volumetric flask. Then, 1.5 mL of 1.4 M hydroxylamine hydrochloride solution, 10 mL of 1.22 M sodium acetate solution and 10 mL of 0.015 M 1, 10- phenanthroline solution were added into it. Finally, the distilled water was filled to the mark and shaken well.

The absorbance for each freshly prepared solution was measured on TRIUP 754 UV-Visible spectrophotometer (Khin Phyoe Latt Thu, 2007). In this case, the spectrophotometer was also calibrated before measuring the absorbance of solution.

Determination of Ascorbic Acid Content in Prune Juice

Ascorbic acid content in prune juice was determined by using UV- visible spectrophotometer.

Procedure

5 mL of standard ascorbic acid and sample solution were pipetted into 25 mL volumetric flask and 5 mL of 5.2 µg/mL standard chromate ion in 0.8 M HNO_3 solution was added. After mixing, 4 mL of diphenylcarbazide solution was added and solution was diluted to the mark with distilled water. Absorbance of violet color of Cr-diphenylcarbazide complex was measured at 548 nm using UV-Vis spectrophotometer (Noroozifar and Khorsani, 2003).

Standard Curve for Cr-diphenylcarbazide Complex with Respect to Ascorbic Acid Concentration

The standard curve was constructed using concentrations of standard ascorbic acid solution. Absorbance of Cr-dipenylcarbazide complex was related to standard ascorbic acid. Ascorbic acid concentration was inversely proportional to absorbance of the complex at 548 nm (Table 2 and Figure 3).

Table 2. Concentration of Ascorbic Acid and Absorbance of Cr-diphenylcarbazide Complex

No.	Concentration of Ascorbic Acid ($\times 10^{-4}$ M)	Absorbance at 548 nm
1	2	1.87
2	3	1.62
3	4	1.33
4	5	0.99
5	6	0.76
6	7	0.48

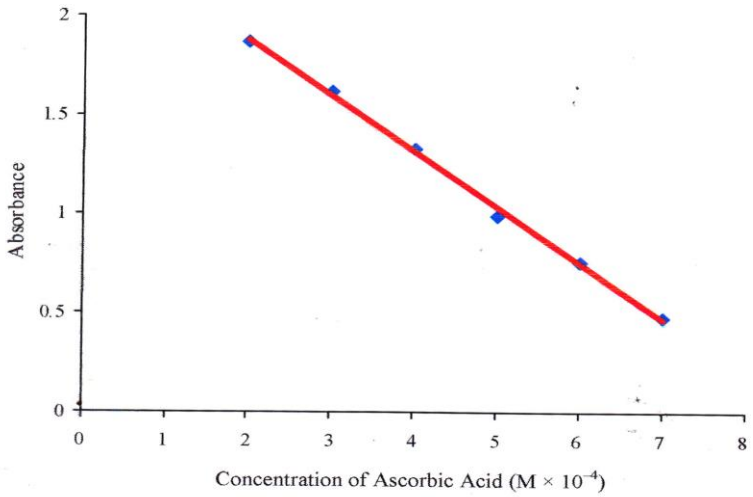

Figure 3. Standard Curve for Cr-diphenylcarbazide Complex with Respect to Ascorbic Acid Concentration

Determination of Carbohydrate by Phenol Sulphuric Colorimetric Method

Preparation of Sample Solution

About 0.1 g of sample was dissolved in 100 cm^3 of hot water and shaken for ten minutes. 1 cm^3 of this solution was then diluted to 10 cm^3 with water and this solution was taken as the sample extract.

Preparation of Standard Sugar Solution

100 µg (0.1 g) of glucose was exactly weighed and dissolved in 100 cm^3 of distilled water. 1, 2, 4, 6, 8 and 10 cm^3 of these solutions were drawn out and put in each 100 cm^3 volumetric flask and diluted to the mark with distilled water. These solutions contained 10, 20, 40, 60, 80 and 100 µg of glucose per cm^3 respectively.

1 cm^3 aliquots of sample solution and six standard solutions containing 10, 20, 40, 60, 80 and 100 µg of glucose per cm^3 were put in each test tube. 1 cm^3 of 5% phenol solution was also added to each test tube and mixed. A blank was also prepared with 1 cm^3 of distilled water instead of sugar solution, 5 cm^3 of 96% sulphuric acid was again added to each tube so that the stream hit the liquid surface directly to produce good mixing. Each tube was agitated during the addition of acid. After ten minutes, the tubes were re-shaken and placed in water bath at 25°-30°C for twenty minutes. The yellow orange colour was stable for several hours. Absorbance was measured at 490 nm using 754 UV-spectrophotometer. A standard curve was plotted by the absorbance of the standard solutions against the concentration in µg per cm^3. Using this standard curve, the concentration of glucose in the sample was calculated. The absorbance of the standard glucose solutions was listed in Table 3 and shown in Figure 4.

Table 3. Absorbance of Standard Glucose Solutions

No.	Concentration of glucose (mg/cm^3)	Absorbance at 490 nm
1.	10	0.115
2.	20	0.150
3.	40	0.324
4.	60	0.404
5.	80	0.572
6.	100	0.752

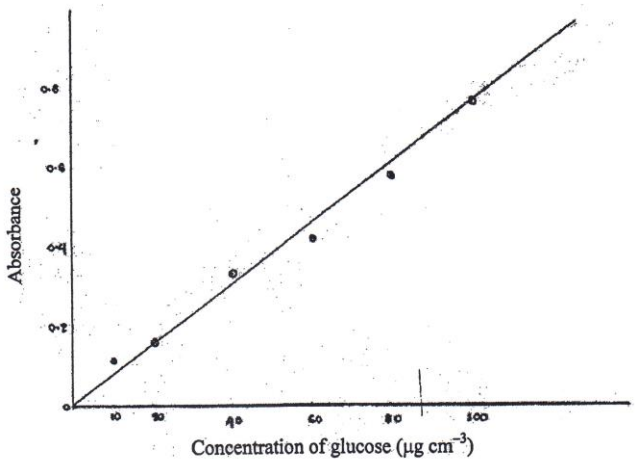

Figure 4. Determination of Carbohydrate by Phenol Sulphuric Colorimetric Method

Results and Discussion

Results for the Determination of Iron Content in the Sample Solution

The absorbance of sample solution was measured with spectrophotometer. This result was described in Table 4.

Table 4. Result of Absorbance for the Sample Solution

No.	Name	Volume of stock solution	Volume of sample solution	Absorbance
1.	Sample solution	25 mL	100 mL	0.158nm

According to the Table 4, the absorbance for the sample solution was measured at 0.158 nm.

Results for the Determination of Iron Concentration of Sample

The concentrations of iron in the prune juice sample were determined by iron-1, 10-phenanthroline complex was given in Table 5.

Table 5. Mean value of Iron Content in Prune Juice

No.	Absorbance	Mean value
1.	0.159	0.158
2.	0.158	
3.	0.157	

According to the Table 5, the mean value of absorbance for iron content in prune juice was 0.158 nm.

Table 6. Results for the Iron Concentration and Iron Content

Sample	Iron concentration (mgL^{-1}) stock	Iron content ($mg\ g^{-1}$)
Prune juice	4	2

According to the results, the prune juice contains iron concentration 4 mgL^{-1} and iron content 2 $mg\ g^{-1}$ respectively. From the above data, prune juice was good source of iron and protect iron deficiency anemia.

Results for the Determination of Vitamin C Content in Prune Juice

Vitamin C content in prune juice was determined by spectrophotometry using potassium chromate-diphenylcarbazide and the result was shown in Table 7.

Table 7. Vitamin C Content in Prune Juice

Sample	Ascorbic acid value (%)
Prune juice	0.067

From the result, it was revealed that the prune juice was good source of vitamin C and it could protect the cancer and diabetes.

Table 8. Water Soluble Carbohydrates Content in Prune Juice

Wt. of sample (g)	Absorbance in sample solution	Wt. of carbohydrate in 1 ml of sample solution (g)	% of soluble carbohydrates
1	0.626	0.25×10^{-3}	82.5

According to the result, the prune juice contains water soluble carbohydrates content 82.5%. Carbohydrates provide main source energy to cells in the body.

Conclusion

Prune juice is widely drunk in Myanmar especially middle region. It is a traditional juice and suitable for aged and children. The prune juice from Loikaw, Kayah State was collected for the research work.

In this research work, prune juice contains high content of carbohydrate (82.5%). Vitamin C content was also found to be 0.067%. In addition, iron content was found to be 2 mg g^{-1}. The greatest portion of iron in humans is in hemoglobin. Our bodies only need about 1 to 1.5 mg of iron per day to replace what is lost. Too little iron or too much iron changes the way we grow, develop and function. People with constipation may find that drinking between half a cup and 1 cup of prune juice in the morning helps stimulate digestion. The vitamin C is essential to a healthy diet as well as a highly effective antioxidant acting to lessen oxidative stress and it is useful for its remarkable antioxidant and anti-aging properties. The upper limit for vitamin C in adults is 2000 mg. Carbohydrates in prune juice are an important part of a healthy diet.

Finally, Myanmar's traditional juice is reported to be suitable for daily intake and consistent with health care system.

Acknowledgements

I would like to express my sincere gratitude to the Rector Dr Thar Tun Maung, Dagon University, for his kind permission to the submission of this paper. I would like to express my sincere thanks to Dr Thidar Kyaw, Professor and Head, Department of Chemistry, Mandalar University and Dr Hnin Hnin Than, Professor and Head, Department of Chemistry, Dagon University, for their encouragement and assistance.

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