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Evaluation of Nutritional Fact and Study of Various Physico-chemical Parameters of Black, Green and Red Grapes Samples in the Local Fruit Market

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Authors' contributions

This work was carried out in collaboration among all authors. Author PPN designed the study, performed the statistical analysis, interpretation of results and wrote the first draft of the manuscript. Authors AAA and ZAR and managed the protocol, analyses of the study. Author ASA managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aims: Aim of our study was to analyze various nutritional fact of three types of grape fruits and compare their facts in terms of consumption. The grape is one of the most edible fruit with high amount of nutritional and medicinal properties.
Study Design: Physico-chemical analysis by using various chemical analysis and instrumental methods for analysis of various grape samples.
Place and Duration of Study: Department of Applied Sciences, Chemistry section, University of Technology and Applied Sciences, Muscat, Oman. The study was performed during the May 2018 – December 2018.
Methodology: We have selected three different grapes samples from the local market for the analysis (Green grapes, Red grapes and Black grapes). Our research study includes testing of various physico-chemical parameters for nutritional fact of fruit, such as water, carbohydrates, proteins, fat, vitamin C, and different minerals. We analyzed various physic-chemical parameters.

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Results: We found that pH in the range of 3.775 – 4.14, conductivity 1.39 MS/cm – 1.553 MS/cm, titratable acidity was measured in terms of tartaric acid was found 0.712 g/100ml - 1.065 g/100ml and Brix% value 9.5% - 15.5%. Amount of water in berry was 77.964 % – 80.146 %, Ash in the range of 0.72 – 3.911 %. Protein 6.245 g/100ml – 7.928 g/100ml, Fiber content 1.112 % – 1.143% and good amount of potassium, magnesium, calcium, iron and zinc.

Conclusion: Analysis of three types of grapes we found, acidity of green grapes was highest. It might be depending upon ripening stage of berry. That are correlated to sugar (^{0}Brix). Fiber value was very close to each other. Iron was highest in red grapes and then green grapes. Potassium, magnesium, calcium and zinc was found to higher in green grapes. Based on this green grape looks batter nutritional value.

Keywords: Grape analysis; physic-chemical analysis; nutritional value; red; black; green grapes; Vitis vinifera.

1. INTRODUCTION

Grape (*Vitis vinifera*) is one of the world's largest cash fruit crops, its coming under family Vitaceae and genus Vitis. Grape is one of the most commonly consumed fruits in the world both as fresh fruit (table grape) and processed fruit such as, wine, grape juice, molasses, and raisins. Department of Agriculture, Sri Lanka, recommended that there are mainly five local grape varieties, namely, Israel Blue, Cardinal, Black Muscat, which are table varieties; Muscat MI, which can be used as both table and wine variety and French MI which is a wine variety [1,2].

The grape belongs to the berry family, which is attached to stem in the form of cluster or bunch of grapes. The grape is one of the most edible fruit, having many established nutritional and medicinal properties for consumers [3]. The production of grapes increased in tropical and subtropical countries such as Bolivia, Brazil, Colombia, Peru, Guatemala in South America, Madagascar, Namibia, Tanzania in Africa and Vietnam, China and India in Asian countries [4].

Quality and type of wine produced from grapes depends on climatic condition of cultivation. Grape cultivation, most often warm climate and cool climate are distinguished. The chemical composition of grapes is different in different conditions, the fruit grown in cold season has a lower content of sugars and its acidity may be too high [5].

Egyptians used the grapes for wine, and later the technology was developed in various western countries like Spain, France and Germany etc. Grapes are divided mainly in two groups; with seed and without seed i.e. seedless grapes [6]. The fruits of Israel Blue grapes are dark blue or black in color with a round to oval fruit shape and cylindrical bunch shape [7].

The grapes are higher in nutritional and medicinal properties. The grape is a good source of water (82%), carbohydrates (12–18%), proteins (0.5–0.6%), and fat (0.3–0.4%), it also contains significant amounts of potassium (0.1–0.2%), vitamin C (0.01–0.02%), and vitamin A (0.001–0.0015%) and also has a small amount of calcium (0.01–0.02%) and phosphorus (0.08–0.01%) [3]. Different studies have shown that grapes contain large amounts of antioxidant phytochemicals, Including phenolic, flavonoids, anthocyanin's, resveratrol and carotenes [8,9]. The grape is source of unique natural products for the development of valuable medicines and various industrial products. It is well established that the grape is a major source of several phytochemicals. The main biologically active constituent from the grape are known for various medicinal properties in human diseases [3].

2. MATERIALS AND METHODS

2.1 Preparation of Juice Concentrated from Grape

There are various types of grapes available in the market. The different types of grapes varieties are cultivated in different part of world. Most of the grapes available in Oman are imported from India, Srilanka, Egypt, Lebanon and some European countries. We choose three different types of grape fruits from the local market. We choose red grapes, black grapes and green grapes for our study. We washed properly grapes, dried and took the weighed amount of grape in a fruit juicer and blend. Then transfer whole and passed through a small size sieve.

Then collected and stored these juice samples in the glass bottles in refrigerated for further use [10]. We changed our juice sample after every 3 days. We used these juice sample in various preparation for analysis of various physico-chemical parameters.

We have tested juice sample for measurement of pH, conductivity, total titratable acidity, viscosity, water content, ash, sodium, potassium, sugar, iron, zinc, magnesium, calcium, protein, fiber and reducing sugar. We used simple techniques of analysis. Routine laboratory instruments, methods and chemicals were used for the analysis.

pH meter and conductivity meter were used for measurement of pH and conductivity of the sample. We have measured two different concentrations of juice i.e. 25% and 65% diluted solutions. The titratable acidity of the samples were measured by titration juice (2 g of grape in 100 ml) sample with previously standardized sodium hydroxide solution and phenolphthalein as an indicator. The acidity of the samples was calculated in terms of tartaric acid. Viscosity and density of the grape juice was measured by using viscosity meter and 25 ml picnometer.

Water contents in the grape berry and juice both were calculated. Two berry of all three types grapes were weighed and kept in the previously weighed crucible and then heated in an oven according to AOAC (2005) method [10]. The same way 5 ml sample of grape juice of all types were used. Then the difference in the weights before heating and after heating was calculated. Ash was determined by AOAC (2005) method [10]. Measured quantity of grape sample was crushed in previously heated and weighed crucible. Samples then burn in electric burner and then combustion takes place in furnace at 550^0C for 5 hours. Then cooled and weighed as ash of sample.

Protein content was determined by colorimetric method with the help of biuret reagent as a color forming complex. These purple colored complex was measured in a colorimeter at 540nm. Standard protein solution was prepared and both sample and standards were heat at 37^0C for 10 min to develop a color [11]. Fiber content was measured by giving treatment of dilute sulphuric acid and dilute sodium hydroxide step by step. Measured quantity of grape was crushed and then treated with dilute sulphuric acid (digested) then filtered, washed and treated with dilute sodium hydroxide and again filtered, washed. At the end washed with ethanol [12]. Reducing sugar was determined using benedicts reagent.

2.2 Mineral Analysis

Different minerals were analyzed by using different instrumental methods. All samples were converted in to ash and ash was digested in HCl and HNO_3 acid mixture. Then it was filtered and diluted in 100 ml volumetric flask with DI water. This sample solution was used for analysis of different minerals. Sodium and potassium was determined by using flame photometry. Standard solution of sodium and potassium was prepared by using NaCl and KCl salt. Calibration graph was obtained and using calibration curve equation used for calculation of Na & K.

Iron, Calcium, Magnesium and Zinc was determined by using AAS (Atomic Absorption Spectrophotometer) according to [10] AOAC (2000). Standards of Fe, Ca, Mg, and Zn were used from standard provided with the instrument and diluted to the required concentration of each mineral. Absorbance of standard and samples were obtained from the AAS. Then the calibration curve was obtained and equation of straight line obtained used for the final amount of all minerals per 100gm of grape sample.

3. RESULTS AND DISCUSSION

All parameters were tested in triplicate form and the mean of three observations were used for further calculation. The result obtained during analysis of three types of grapes juice extract was compared with standard value available. The results of all physico-chemical parameters are summarized in table 1. pH obtained of three samples were found in the range of 3.775 (green grape) – 4.14 (red grape). The variable in pH is mostly due to ripeness of the berry of the grape. More ripen berry has more pH value. Conductivity of the samples were found in the range of 1.39 MS/cm (red grape) – 1.553 MS/cm (black grape).

The total titratable acidity was measured in terms of tartaric acid. It was found that 0.712 g/100ml in red grapes and highest 1.065 g/100ml in green grape sample. Also the ^{0}Brix value was measured and it was found that 9.5 in green grapes while highest in 15.5. If we correlate the pH, titratable acidity and ^{0}Brix value of three samples it was found that green grape sample was less pH (more acidic), highest acidity value

and ^{0}Brix (sugar content) is less. While red grapes found higher pH (less acidic), less titratable acidity value and higher ^{0}Brix. Mostly acidity in grapes due to tartaric acid and maleic acid present in the grapes. As the berry get ripen the concentration of maleic acid becomes less and acidity is due to tartaric acid.

Water content was measured in both berry of grapes and juice extract. Amount of water in berry was found in the range of 77.964% (red grape) – 80.146% (black grape). Amount of water in juice extract was found less than berry samples due to its intact structure. Ash% represents total oxides present in the sample after complete combustion of organic matter in furnace. It was found that ash value was found in the range of 0.72 – 3.911%.

The protein content was in the range 6.245 g/100ml (black grape) – 7.928 g/100ml (green grape). Calibration equation obtained with standard protein solution was y = 0.0113 x – 0.0045 and R^2 was 0.9986. Fiber content was found in the range of 1.112% (red grape) – 1.143% (black grape). The amount of reducing sugar was found in the range of 0.61% (black grape), 0.69% (green grape) and 0.8% (red grape).

Table 1. Result of three varieties of grape extract sample

Sample / Parameter	Black Grapes	Red Grapes	Green Grapes	Reference value [13]
pH	4.08	4.14	3.775	-
Conductivity (MS/cm)	1.553	1.39	1.419	-
Acidity (g/100ml)	0.75	0.712	1.065	-
Viscosity	12.6	26.1	24.8	-
Density (g/ml)	1.0087	1.0949	1.0777	-
Water content (Berry)	80.146	77.964	79.624	80
Juice %	83.352	80.441	82.769	-
Sugar (% Brix)	13.5	15.5	9.5	15.48
Ash %	2.123	3.911	0.72	0.7 – 1.0
Protein (g/100ml)	0.6247	0.7364	0.7928	0.72
Fiber %	1.143	1.112	1.142	0.9 - 3
Reducing Suger (%)	0.61	0.8	0.69	-
Sodium (mg/100ml)	5.5	37.6	14.8	2
Potassium (mg/100ml)	29.3	45.3	46	191
Iron (mg/100ml)	0.22	0.3	0.28	0.36
Zinc (mg/100ml)	0.1594	0.0302	0.137	0.07 – 0.1
Magnesium (mg/100ml)	2.151	1.869	2.376	7
Calcium (mg/100ml)	7.943	5.463	10.04	10

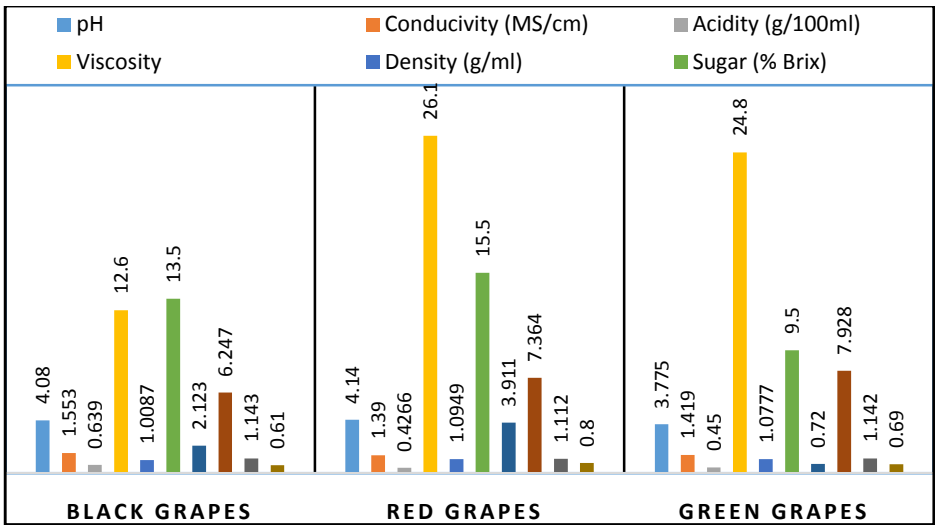

Fig. 1. Different parameters study of three sample

3.1 Mineral Analysis

Minerals are important constituents in grape fruit. Mukesh Y et.al. (2009) mentioned medicinal role of these constituents in human body for various health problem.[3] Sodium and potassium was determined by flame photometer. The emission of standard of sodium and potassium was plotted against concentration and calibration curve obtained. Equation of straight line was obtained with R^2 value 0.9941. The calibration curve is shown in Fig. 2 - sodium, Fig. 3 – iron, Fig. 4 – potassium, Fig. 5 - protein, Fig. 6 – zinc and Fig. 7 – calcium. The amount of sodium was found 5.5 (black), 37.6 (red) and 14.8 mg/100ml of green grape sample. All results of different mineral present in the sample are given in Table 1 and Table 2. While comparison between all minerals in three samples are shown in Fig. 8.

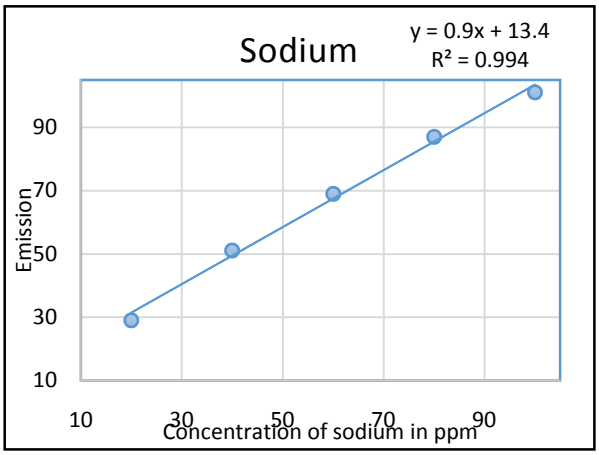

Fig. 2. Analysis of sodium

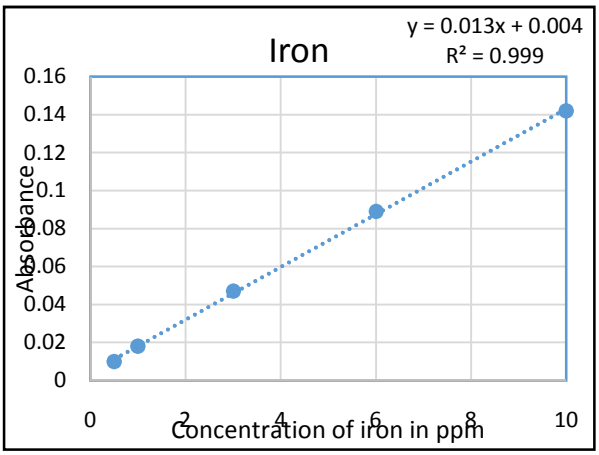

Fig. 3. Analysis of iron

Table 2. Different mineral content in black, red and green grape sample

Sample / Parameter	Black Grapes	Red Grapes	Green Grapes	Calibration equation	R^2
Sodium (mg/100ml)	5.5	37.6	14.8	y = 0.9x + 13.4	0.9941
Potassium (mg/100ml)	29.3	45.3	46	y = 0.675x + 4.9	0.9985
Iron (mg/100ml)	0.22	0.3	0.28	y = 0.0139x + 0.0043	0.9995
Zinc (mg/100ml)	0.1594	0.0302	0.137	y = 0.0449x + 0.00001	0.9966
Magnesium (mg/100ml)	2.151	1.869	2.376	y = 0.3503x + 0.1158	0.9648
Calcium (mg/100ml)	7.943	5.463	10.04	y = 0.1138x - 0.0684	0.9973

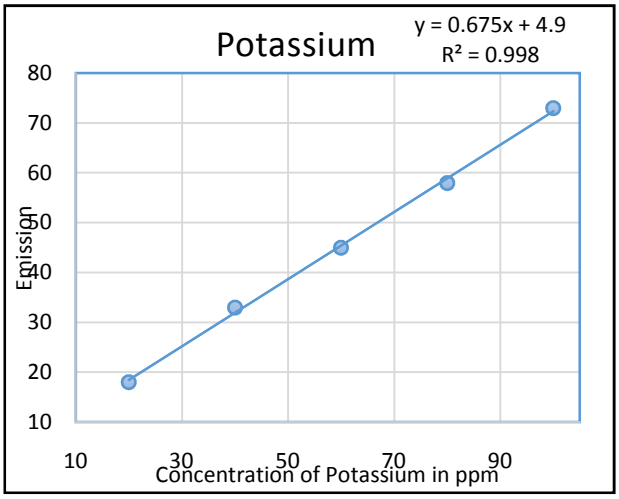

Fig. 4. Analysis of potassium

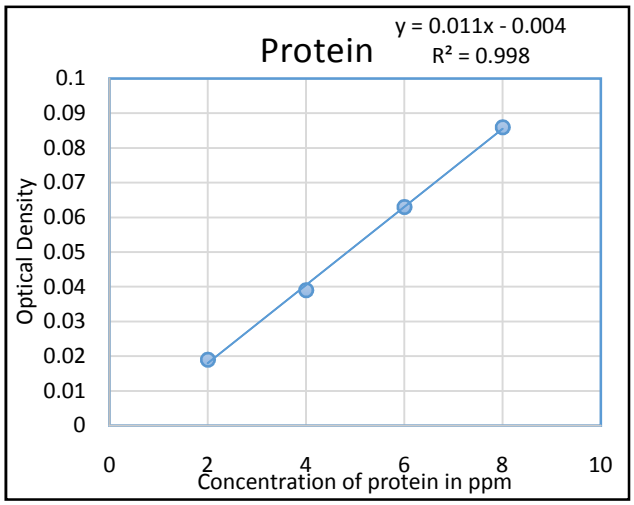

Fig. 5. Analysis of protein

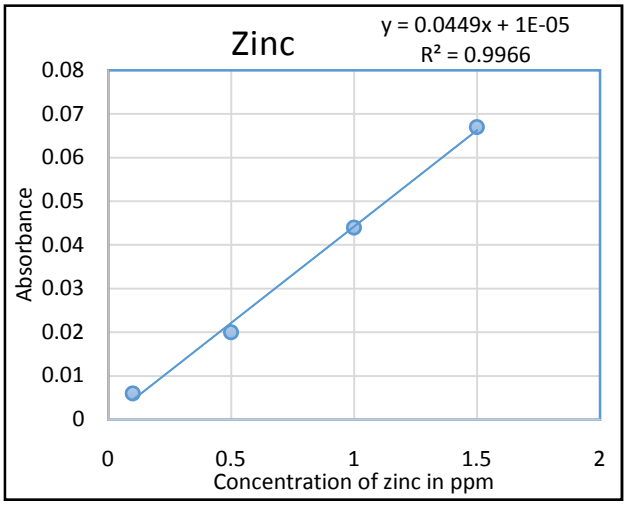

Fig. 6. Analysis of zinc

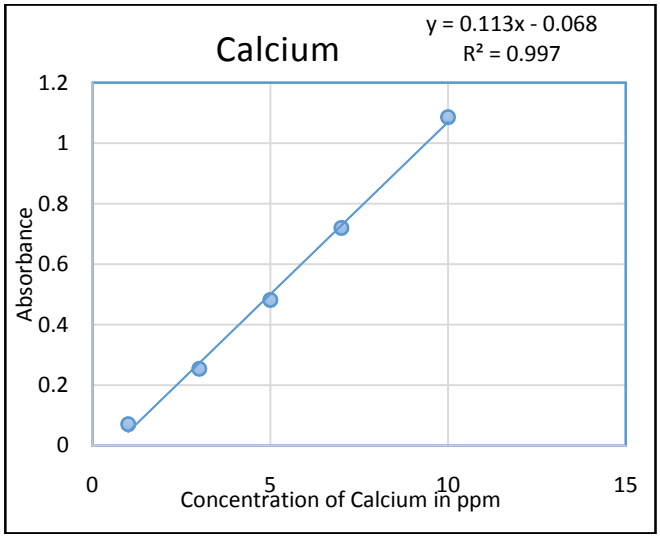

Fig. 7. Analysis of calcium

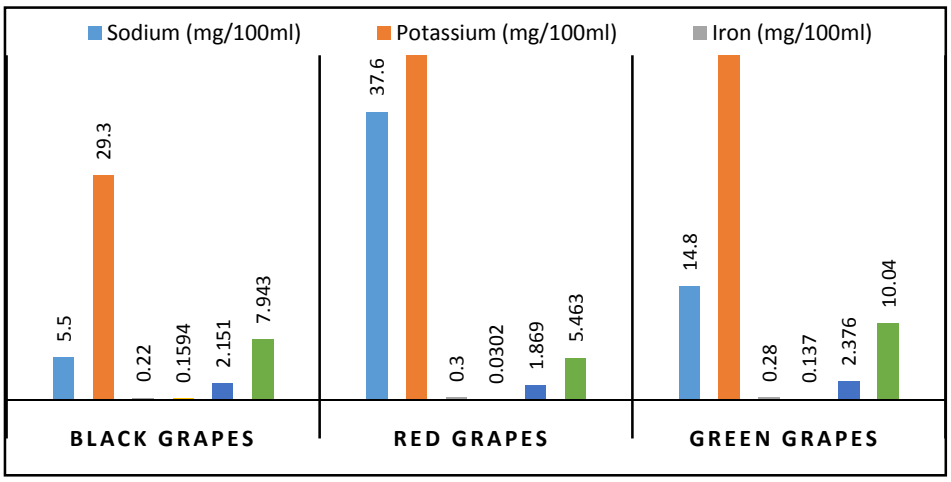

Fig. 8. Minerals content in black, red and green grape samples

Potassium standard obtained a calibration curve with R^2 value of 0.9985 and the equation of straight line y = 0.675x + 4.9 used for the calculation of amount of potassium. It was found good amount of potassium 29.3 mg/100ml (black) lowest and 46 mg/100ml in green grapes with highest amount. Results of all minerals content with calibration curve and R^2 values for each sample is shown in Table 2.

The other four parameters were tested by using AAS instrument. The calibration curve and their R^2 values of Iron, Calcium, Magnesium and Zinc are shown in the following table. By using calibration curve equation and applying dilution factor we calculated actual amount of Fe, Ca, Mg and Zn per 100 ml of sample.

4. CONCLUSION

On the basis of result obtained after analysis of three types of grapes we found that, acidity of green grapes was highest and others are close to each other. It might be depending upon ripening stage of berry. pH of grapes is correlated to sugar (^{0}Brix) and acidity, green grapes was least in sugar content. Fiber value was very close to each other. Iron was highest in red grapes and then green grapes. Potassium, magnesium, calcium and zinc was found to higher in green and then it comes in red grapes. After comparing the result of minerals with standard value of minerals we found that green grapes higher nutritional value.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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