Quantitative Analysis of Iron, Calcium and Oxalate Content in Dry Fruits

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Abstract : Dry fruits like almonds, walnuts, dates, raisins etc. are traditionally known to be a powerhouse of nutrients. These dried fruits have the same benefits as fresh fruits. The present investigation aimed to assess the nutritional value of Fig, Almond, Cashew nut, Groundnut, Walnut, Raisins and Dates. The present study is focused on the estimation of iron, calcium, oxalate and moisture content of these dry fruits. Dates is found to be rich in iron compared to other dry fruit samples followed by Raisins, Figs, Nuts and the least comes for Almond. It was found that Fig is rich in calcium compared to other samples. It was found that walnut is rich in oxalate whereas cashew nut contains less amount of oxalate. Moisture content is also varying from sample to sample.

Index Terms :- **Nutrients, iron content, calcium content, oxalate content, moisture content**

1. INTRODUCTION

Dry Fruits are the way to healthy life. Dry fruits like almonds, walnuts, dates, raisins etc. are traditionally known to be a powerhouse of nutrients. These dried fruits have the same benefits as fresh fruits but with an added advantage- easy transportation, festivals, gatherings and celebrations all call for a customary gift box of dry fruits[1,3,5]. Iron is the fourth most abundant element in the earth but its deficiency in the body is very common. It is a component of haemoglobin present in the ubiquitous red blood cells (RBCs) in the body that conveys oxygen throughout the body. Without iron, the body cannot make healthy RBCs, thus it is an essential micro mineral [2,4,7]. Calcium is an essential mineral required for diverse physiological and biochemical functions in the human body. Calcium makes the major element of bones and teeth. It also participates in muscle contractions, conduction of nerve impulses and cell membrane permeability. Nearly 99% of calcium in the body is present in the skeleton. Calcium deficiency results in oesteomalacia. In osteoporosis serum calcium level is normal but body store is reduced. Osteoporosis causes because of calcium deficiency. In this condition nervous changes occurs and impairment of memory takes place. Depression, irritation, loss of hairs and nails, roughness of the skin etc. are the symptoms of these conditions.

Oxalic acid is one of the abundant organic compound acts as an anti-nutrient present in dry fruits in various quantities. It is found as salts of insoluble complexes with divalent cations, minerals and trace elements. Oxalates react with calcium to precipitate calcium oxalate and accumulation of oxalates in the body prevents the absorption and utilization of calcium; which in turn causes calcium imbalance and osteomalacia. Human urine always contains small levels of calcium oxalate; excess oxalates in body can trigger to increase urinary oxalates that may be deposited in the kidneys as common form of kidney stones. Sometimes it can cause acute renal failure. About 75% of all kidney stones are composed primarily of calcium oxalate and hyperoxaluria is a primary risk factor for this disorder. Restriction of dietary oxalate intake has been proposed to prevent the formation of calcium oxalate kidney stones [6,9].

Carbohydrates are an essential source of energy for the body to perform its normal functions. Having a diet that does not contain carbohydrate can lead to muscle breakdown, ketosis and dehydration. This can be prevented by taking 50 to 100 grams of carbohydrate per day. Compared to fresh fruit, dried fruit is lower in water content, higher in calories, higher in sugar, higher in carbohydrates, and higher in fibre. So consumption of too much of dried fruit is not good for health[11].

Consequently, there is a need to measure the amount of iron, calcium, oxalate and carbohydrate content in the food products to estimate which food sources are rich in iron and calcium and low in oxalate content so that they may be consumed during iron and calcium deficiency[8, 10-13]]. In view of its medicinal importance, the present study has been initiated to evaluate the nutritive potential of dried fruits like

- Quantitative analysis of iron content through colorimetric method and its comparison with a common iron tablet
- Quantitative analysis of calcium through complexometric titration
- Quantitative analysis of oxalate content through permanganometric titration
- Determination of moisture content
- Quantitative analysis of carbohydrate

2. MATERIALS AND METHODS

2.1 Sample Collection

Dry fruit samples were selected from the local market of Mala. The selected samples were: Cashew nut, Groundnut, Raisins, Dates, Walnut, Almond and Fig. All the reagents used in this study were of analytical grade.

2.2 *Quantitative Analysis of Nutrients in Dry Fruits*

2.2.1 Estimation of iron

Dry fruits were washed well and dried in sun light. It was crushed into fine powder.1g of each dry samples were taken in a crucible and heated the crucible over Bunsen burner until the sample reduced completely to ash. After cooling the sample 5ml of 2N HCl was added and digested for 5min. 5ml of distilled water was added and filtered, transferred the contents to 100ml std flask and was made up to the mark. 20 ml of this solution was pipetted into 100ml standard flask. 5 ml 4N $HN0_3$ and 10ml 20% ammonium thiocyanate was added and made up to the mark. Estimation was done by colorimetric analysis.

2.2.2 Estimation of Calcium in Dry Fruits

5g of sample was weighed out and heated in a crucible and made to ash. 5ml dil. HCl was added and transferred to 50ml std flask it was made up to the mark. Calcium content was estimated by Complexometric titration.

2.2.3 Estimation of Oxalate Content in Dry Fruits

1g of each sample was heated with 20ml dil H_2SO_4 in a beaker. Oxalate content was determined by Permanganometry

2.2.4 Estimation of total carbohydrate in Dry Fruits

In the present work quantitative estimation of total carbohydrate present in different dry fruits were observed using phenol sulphuric acid method. Phenol sulphuric acid method is the most reliable and easiest method among the quantitative assays for carbohydrate estimation[14]. Dry fruits were crushed in pestle and mortar, from this 1g weighed and taken in boiling tube. Boiling tubes were kept in water bath for 3hrs and then removed from water bath and cooled to room temperature. After cooling it was neutralized by adding solid sodium carbonate until effervescence ceases. Then final volume was made to 100ml by adding distil water and centrifuged . Supernatant was used as sample in further process.

2.2.5 Determination of Moisture Content

0.5 g of the substance is taken in a preheated china dish. Weight of the china dish with and without the substance is measured. It is kept in kept in oven for approximately 1 hour. After that weight of the china dish is measured. From the difference between the values moisture content of each sample can be determined.

3. RESULT AND DISCUSSION

The estimation of iron, calcium, oxalate and moisture content of dry fruits- Fig, Almond, Cashew nut, Groundnut, Walnut, Raisins and Dates was done and is shown in the Table 1.

Table 1: Iron, calcium, oxalate and moisture content of dry fruits

SI NO.	Sample	Iron Content (mg/g)	Calcium content (mg/g)	Oxalate content (mg/g)	Total carbohydrate (mg/g)	Moisture content (%)
1.	Fig	0.333	0.781	56.6385	192.263	0.14
2.	Almond	0.289	0.240	28.0052	165.813	0.03
3.	Cashew nut	0.388	0.220	19.2943	346.892	0.05
4.	Groundnut	0.333	0.521	38.5886	170.547	0.04
5.	Walnut	0.289	0.220	63.4888	136.956	0.07
6.	Raisins	0.388	0.080	57.2607	758.864	0.22
7.	Dates	0.444	0.460	62.2444	786.321	0.09

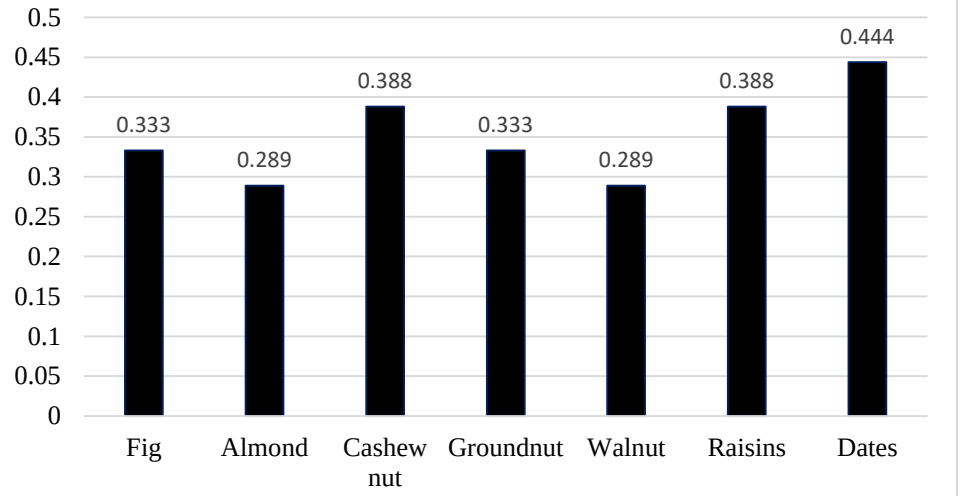
3.1 Estimation of Iron

Iron is a mineral that our body needs for many functions. For example, iron is part of haemoglobin, a protein which carries oxygen from our lungs throughout our bodies. Iron is an essential element for blood production. Iron deficiency is the most common nutritional deficiency and leading cause of anaemia. It can be due to the increased need for iron by the body or a decreased absorption or amount of iron taken in. So we should have knowledge about the iron containing dry fruits. It helps our muscles store and use oxygen. It has been scientifically proven that infants and children need it for a healthy brain development. Iron helps to preserve many

vital functions in the body, including general energy and focus, gastrointestinal processes, the immune system, and the regulation of body temperature. If there is more iron in the body than necessary, the body will save it for future use. And so including Dates in your diet will increase the iron content in the body.

. To estimate this colorimetric analysis using the principles of spectrophotometry was done. In our study we found that iron content present in eight samples ranged from 0.289-0.644mg per g of the sample. It clearly indicates that among these samples Dates has maximum iron content i.e., 0.444mg of iron and the least iron content is for Almond and walnut i.e., 0.289mg. So instead of having Iron tablet, eating of diets is enough for avoiding iron deficiency.

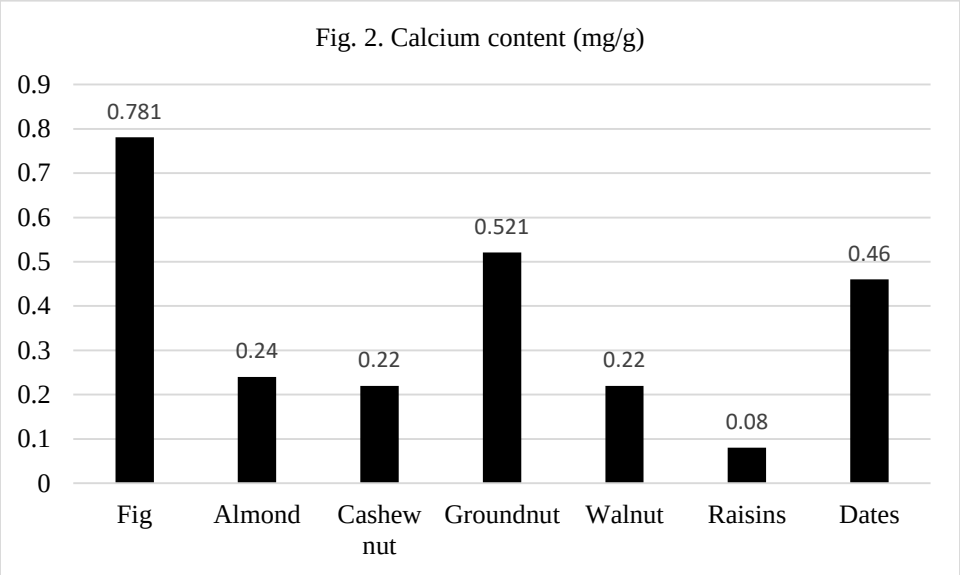
Fig. 1 Iron Content(mg/g)



3.2 Estimation of Calcium

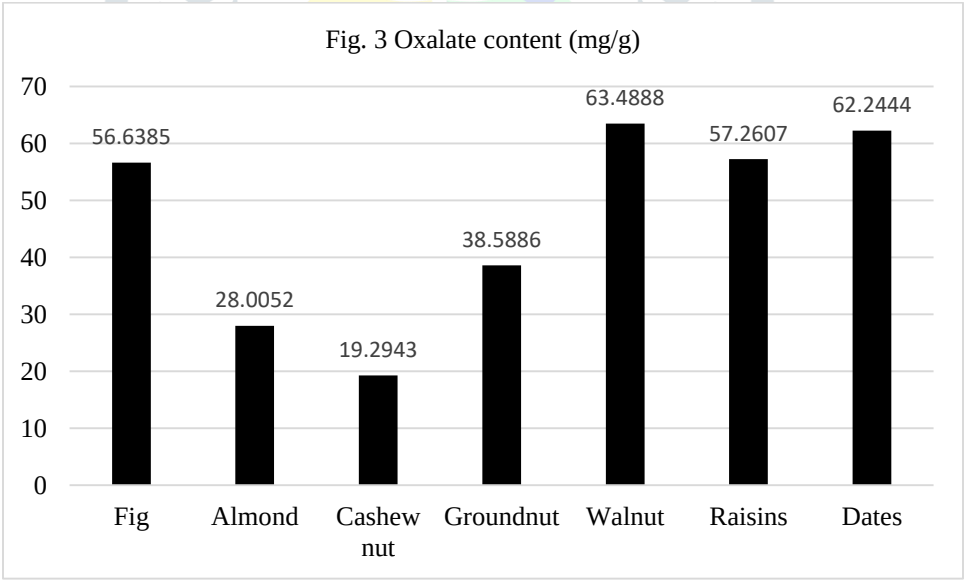
Calcium is a chemical element that is essential for living organisms, including humans. It is the most abundant mineral in the body and vital for good health. The body needs calcium to maintain strong bones and to carry out many important functions. Almost all calcium is stored in bones and teeth, where it supports their structure and hardness. The body also needs calcium for muscles to move and for nerves to carry messages between the brain and every body part. Taking more amount of calcium daily can increase the chance of having serious side effects, such as blood levels of calcium that are too high and milk-alkali syndrome, a condition that can lead to renal stones, kidney failure and death.

From our study it's clear that calcium content present in the 7 samples ranged from 0.008-0.078g/100g and it clearly indicates that among these samples Fig has maximum calcium content i.e., 0.0781 and least is for Raisins i.e., 0.0080g/100g. Figs are a good source of calcium, which can ward off osteoporosis as well as other health issues. There is also concern that supplemental calcium can increase the risk of heart attack. It's more likely to consume dry fruits specially Fig which is rich in calcium content. But people with poor kidney function, stroke are recommended not to consume calcium rich foods, and so its better for them to avoid dry fruits like Fig, Groundnut, Dates etc.



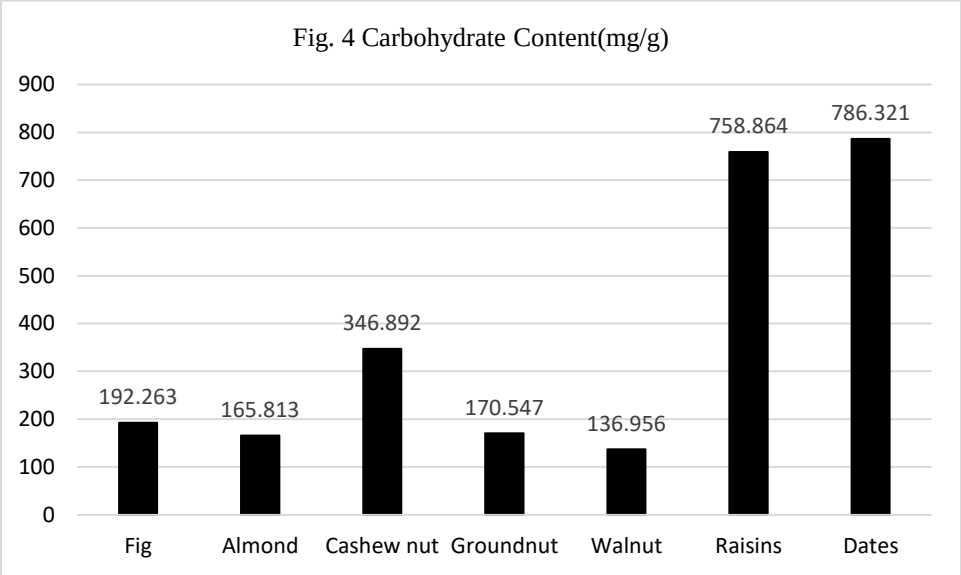
3.3 Estimation of oxalate

Oxalate is a naturally occurring molecule found in abundance in plants and humans. It's not a required nutrient for people, and too much can lead to kidney stones. Oxalic acid occurs in nature sometimes as a free acid, but more commonly as soluble potassium, sodium, or ammonium oxalate or as in soluble calcium oxalate. When oxalic acid containing substance is consumed they cause adverse effect on humans and animals because oxalate binds with calcium and other minerals and they cause stone formation in urinary tract when the acid is excreted in urine. Calcium oxalate crystals are the most common cause of kidney stones hard clumps of minerals and other substances that form in the kidneys. These crystals are made from oxalate a substance found in foods like green, leafy vegetables and Dry fruits combined with calcium. From the result the oxalate content present in the samples range from 19-63mg/g. Oxalate content is maximum for walnut i.e., 63.4888mg/g and minimum for cashew nut i.e., 19.2943mg/g. As a result low oxalate concentration found in "cashew nut" has a beneficial effect on patients with calcium oxalate stones. Moderate oxalate concentration is found in "Raisins, Fig, Almond, Dates, and Groundnut" for. And the highest oxalate concentration is for "Walnut" which causes a negative effect on patients suffering kidney stones.



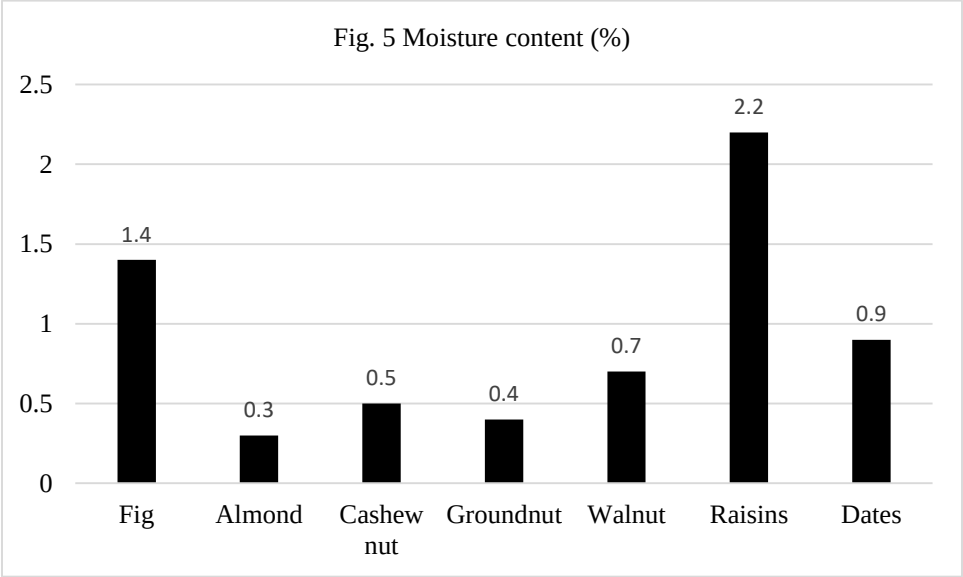
3.4 Determination of Carbohydrate Content

In the present work, quantitative estimation of total carbohydrate present in different dry fruits was done using phenol sulfuric acid method. This is a simple and rapid colorimetric method to determine total carbohydrate in a sample. Concentrated sulfuric acid breaks down all the polysaccharides, oligosaccharides and disaccharides to monosaccharide. Therefore this method determines total sugar present in a sample. In our study, the percentage of total carbohydrate present in different samples vary between 136 – 786 mg/g. Dates is rich in carbohydrate than any other samples. Through dry fruits we can get high calories of carbohydrate to increase the activity level in the body. Thus, by knowing the carbohydrate percentage in different food material we can plan our diet as per requirement.



3.5 Determination of Moisture Content

Moisture content of the samples vary between 0.3 – 2.2% . From the graph and the data given above moisture content was detected more for Raisins and less for almond.



4. CONCLUSION

- We have estimated iron content in Almond, Groundnut, Fig, Raisins, Dates, Cashew nut, Walnut, and Iron Tablet . Dates is found to be rich in iron compared to other dry fruit samples followed by Raisins, Figs, Nuts and the least comes for Almond. But too much of dates would affect the person having diabetes as it is rich in sugar and so it need to be considered while consuming.
- We have estimated calcium content in dry fruits like Almond, Groundnut, Fig Raisins, Dates, Cashew nut, Walnut through Complexometric titration . It was found that Fig is rich in calcium compared to other samples which can ward off osteoporosis as well as other health issues. And the least calcium content was found out in Raisins. But people with poor kidney function, stroke are recommended not to consume calcium rich foods, and so its better for them to avoid dry fruits like Fig, Groundnut, Dates etc.
- We have estimated the oxalate content in various dry fruits like Almond, Groundnut, Fig Raisins, Dates, Cashew nut, Walnut through permanganometric titrations. It was found that walnut is rich in oxalate whereas cashew nut contains less amount of oxalate. As a result low oxalate concentration found in “cashew nut” has a beneficial effect on patients with calcium oxalate stones. Moderate oxalate concentration is found in “Raisins, Fig, Almond, Dates, and Groundnut” and the highest oxalate concentration is for “Walnut” which causes a negative effect on patients suffering kidney stones.
- To sum up, dry fruits like every other food contain both healthy and harmful effects. Although they are harmful in some aspect their benefits outweigh their risk. Therefore, physicians should advice their patients for using dry fruits in their diet.

5. REFERENCES

1. Altundag, Huseyin, and Mustafa Tuzen. "Comparison of dry wet and microwave digestion methods for the multi element determination in some dried fruit samples by ICP-OES." Food and Chemical Toxicology 49.11 (2011): 2800-2807.
2. Denic S, Agarwal MM, Nutritional Iron deficiency: an evolutionary Perspective. Nutrition 23:pp.603-614, 2007.
3. F.I.Obahiabon and J.O.Erhabor, Nigerian dates: Elemental uptake and recommended dietry allowances, African Journal of Food science, 2010, pp.469-471.
4. Gomber S, Kumar S, Rusia U, Gupta P, Agarwal K.N.and Sharma S., Prevalence and etiology of nutritional anaemias in early childhood in an urban slum, Indian. J. Med. Res., 107, pp.26973 ,1998.
5. Hall HN, Moore S, Harper SB and Lynch JW, Global variability in fruit and vegetable Consumption Am Prev Med 2009;36(5):pp.402-409
6. Holmes, R. Estimation of the oxalate content of foods and daily oxalate intake. Kid Intern, 57(4) April 2000, pp. 1662-1667.
7. Hurrell R and Egli L, Iron bioavailability and dietary reference values, Am. J. Clin Nutr., 91, 1461S-1467S, 2010.
8. K. O. Soetan, C. O. Olaiya and O. E Oyewole, The importance of mineral elements for humans, domestic animals and plants. African Journal of Food Science. 4: pp 200–222, 2010.
9. Kasidas, GP and Rose, GA, Oxalate content of some common foods: determination by enzymatic method, J Human Nutr. 34, pp.255-266, 1980.
10. M.H. Wong, K.C. Chan, C.K. Choy, Environmental Research, 1978, 15(3) pp.342–356.
11. Neeru Agrawal, Divya K. Minj, Khushboo Rani, Estimation of Total Carbohydrate Present in Dry Fruits, Journal of Environmental Science, Toxicology and Food Technology, pp24-27, 2015.
12. NNMB, Technical Report No.22, National Nutrition Monitoring Bureau (NNMB), Prevalence of micronutrient deficiencies, National Institute of Nutrition, Indian Council of Medical Research, Hyderabad, 2003.
13. R. A. Dey. Quantitative Analysis. Jr, A. L. Underwood-prentice Hall of India Pvt. Ltd, New Delhi-110001.
14. Tatsuya Masuko , Akio Minami, Norimasa Iwasaki, Tokifumi Majima, Shin-Ichiro Nishimura, Yuan C Lee, Carbohydrate analysis by a phenol-sulfuric acid method in microplate format, Anal Biochem., pp69-72, 2005.
15. Winiarska-Mieczan and K. Nowak. 2008. Determining the content of some minerals in fruit and vegetable baby juices. J Elementol 13: pp 433-442.