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The Ash and Iron Content in Apple Juice Concentrate Powder

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Abstract

The results of studies based on 11 batches of Apple Juice Concentrate are reported. The different batches were examined for their Total Ash and Iron Content. The iron Content was determined by spectrophotometric method. Results of the analysis show that the content of iron is directly proportional to the ash content. The brown colored powder showing the lowest, that is 2.45% w/w ash content, shows 0.74%w/w iron Content, whereas, the grayish-brown colored powder, showing 23.95% w/w ash content, seems to be rich in iron Content, which was observed to be equivalent to15.67% w/w.

Keywords: Apple Juice Concentrate, Iron Content, Ash, Spectrophotometry.

Introduction

Many metallic salts are recognized as essential nutrients because they are important components of many enzyme reactions. Iron is an important constituent of haemoglobin molecule which is known as an Oxygen carrier and hence, iron deficiency has an adverse effect on mammal life. The abnormal levels of iron are also toxic to human beings. Many leafy vegetables are rich sources of iron. However, iron in natural products is complicated but well defined in biochemical processes. Iron is a mineral found in every cell of the body. It is considered as an essential mineral because it is needed to make a part of blood cells. Thus, dieticians recommend fortification of many foods with iron. The use of synthetic iron sources in fortification, may show some side effects. It is therefore necessary to establish a new mechanism pathway for the absorption of iron from natural sources. Iron deficiency is wide spread and is mostly due to inadequate iron intake[1,2] and poor availability of iron in the daily diet. Cooking food in iron or stainless steel utensils increases its iron content[3,4] and this iron is bio available[5]. Arora[6] has reported ionisable iron content in some vegetables, which is influenced by cooking in iron utensils. Park and Brittin[7] have reported iron content of a food cooked in iron utensil. Apple sauce has iron content as 0.14mg/100g and applesauce cooked in iron utensil has significantly more apple flavour. It reveals that the increase in the total ionisable iron may be due to the use of citrus fruits in the recipes. The citrus fruits solubilise iron from the pan, and thus increase the iron content in the food along with Vitamin C and other acids.

In addition to a healthy diet containing rich sources of iron, one should also eat foods that help the body to absorb iron better and faster. For example, eating fruits or vegetables, that are good sources of Vitamin C, along with a meal containing non-heme iron. Vitamin C helps the body to absorb the non- heme iron in the food. The food and nutrition board at the Institute of medicine recommends the following regarding iron intake:

Infants and children: Younger than 6 months: 0.27mg/day, 7 months to 1 year: 11mg/day, 1 to 3 years: 7mg/day, 4 to 8 years: 10mg/day.

Males: 9 to 13 years: 8mg/day, 14 to 18 years: 11mg/day, age 19 and older: 8mg/day.

Females: 9 to 13 years: 8mg/day, 14 to 18 years: 15mg/day, 19 to 50 years: 18mg/day, 51 and older: 8mg/day.

Women who are pregnant or producing breast milk may need different amounts of iron.

Vegetables are generally considered as good sources of iron. Motegaonkar and Salunke[8] reported Iron contents in carrot and tomato in Latur variety to be 1.84mg/100g and 0.455mg/100g, respectively. Even, Prasad et al[9] have reported 23ppm iron in canned vegetable curry.

Along with vegetables, fruits are also well known for their contents of vitamins and minerals, including iron. Among fruits, citrus fruits which contain vitamin C, help in the absorption and bio availability of iron. One such citrus fruit is apple. Apple contains 80-85% water, 5% proteins or nitrogenous material, 10-15% of carbonaceous matter, including starch and sugar, and 1-1.5% acids and salts. The sugar content of a fresh apple varies from 6-10% according to the variety. Inspite of the large proportion of water, fresh apple is rich in vitamin C and is considered as a cure for scurvy. All apples contain a varying amount of organic acids like malic acid and gallic acid, and an abundance of salts of both potash and soda, as well as salts of lime, magnesium and iron.

It has been estimated, that 1.7 mg and 2.1mg of iron is present in 100g of sweet apple varieties and sour apple varieties, respectively. But, according to studies carried out by Nwajei et al,[10] excess bio accumulation of iron in fruits and vegetables, is also harmful to some extent.

As per the studies carried out by Sahni et al[11] the juice content in the apple variety, Royal delicious was 58.10%. A comparatively higher yield of juice (63-68%) extracted by basket press method was reported by Azad et al[12]. They further reported that the juice yield was almost same in scabbed fruits and did not vary much from the healthy fruits. Furthermore, Doerreich[13] studied that, highest yield of more than 90% was obtained in apples by optimized prepress method which was found superior to total liquifaction of apples. Apple juice contains vitamin C, salts of potassium, magnesium, phosphorus, iron, zinc, citric acid and other organic acids. It is especially beneficial for children and people who have cardiovascular diseases, anaemia, gastritis with low acidity and also liver and kidney diseases. Apple juice concentrate (AJC), prevents the oxidative damage of the brain tissue and contributes to the decline in cognitive performance during normal ageing and neurodegenerative conditions like Alzheimer's disease. It provides a modest boost to our daily diet. Apple juice concentrates drawn at various stages of processing and after heat treatment at 70^0C for 1 hour, were tested for their physicochemical characteristics. Dar et.al[14] worked on processing of apple juice concentrate and concluded that during various processing operations, there was negligible change in pH and remarkable increase in acidity.

Apple juice concentrate can be prepared by drying the water extracts of a variety of clean apples, at about 70°C, under vacuum and then, collecting the concentrate in the form of powder. Concentrated juice has a longer shelf life and is less prone to spoilage and thus, safe for consumers. In terms of nutrition, properly reconstituted juice is nearly as healthy as fresh juice. Hence, now a days, many scientists prefer using AJC as a source of iron in ayurvedic formulations.

Material and Methods

Estimation of Ash Content: 1 to 2g of powdered apple juice concentrate, was weighed accurately, in a clean, dried and previously weighed silica crucible. The sample was first heated on a hot plate at low temperature, and then transferred to a temperature-controlled muffle furnace and the temperature was gradually increased. The sample was ignited to 450°C to 550°C, for 10-12 hours. Standard method[15] was applied to make the ash of the sample. Ash, in the form of residue, was then cooled to room temperature and then weighed. Percentage of ash was calculated by using the following formula:

Ash Content (% w/w) =
=[Weight of the residue (g)/weight of the sample (g)] X 100

Estimation of iron by Spectrophotometric Method: Calibration of Spectrophotometer: Calibration of the spectrophotometer was done by Standard method [16]using Potassium Dichromate Solution.

Reagents used: i. Aqua regia: HCl : HNO_3 (3:1), ii. 0.1 N $KMnO_4$: Dissolve accurately about 3.166g of $KMnO_4$ powder in 100ml distilled water. Warm if necessary, then cool to room temperature and dilute to 1000ml with distilled water. iii. 4M nitric acid: 25% v/v nitric acid, iv. Ammonium thiocyanate solution : A 10%w/v solution of ammonium thiocyanate, v. dilute sulphuric acid : 5.7% v/v sulphuric acid.

Sample Preparation: 1g of Apple juice concentrate powder was accurately weighed in a silica crucible. The sample was then ignited at 450°C to 550°C, for 10-12 hours and cooled to room temperature. The residue was then dissolved in 60-80ml of aqua regia and then boiled and concentrated to 10-15ml, on a hot plate. The solution was cooled to room temperature and diluted to 100ml with distilled water. After shaking the solution well, it was filtered through Whatman filter paper No.1. Now, 5ml of this filtrate was further diluted to 100ml with distilled water (solution A) and 2 or 4ml of solution A was accurately pipetted into a 50ml volumetric flask, for colour development. Blank solution was prepared in a similar manner, by omitting the sample (solution B).

Standard Preparation: About 703mg of ferrous ammonium sulphate was accurately weighed and dissolved in 100ml distilled water and then, 5ml dilute sulphuric acid was added. To this solution, 0.1N potassium permanganate was added drop wise, until a pink color persists. Then, the volume was made up to 1000ml with distilled water. This solution (solution C) was well shaken and left overnight. Next day, 1ml of this solution (corresponding to 0.1mg Iron) was pipetted out accurately for color development. Further dilutions were made as per the table mentioned below.

S. No.	Reagents	Blank	Standard	Sample
1	Stock Solution (ml)	1ml of Solution B	1ml of Solution C	** 2 to 4ml Solution A
2	4M Nitric Acid (ml)	3	3	3
3	Distilled water (ml)	5	5	5
4	0.1N $KMnO_4$ (drop wise till persistent pink color)	Till persistent pink color	Till persistent pink color	Till persistent pink color
5	10% Ammonium Thiocyanate solution (ml)	10	10	10
6	Distilled water (ml)	Dilute up to 50ml	Dilute up to 50ml	Dilute up to 50ml

'**' in the table above, indicates that the aliquot of sample solution (Solution A) may vary as per the concentration of iron present in the sample.

The final dilutions were made up to 50ml and absorbance readings for sample and standard solutions were recorded at a wavelength of 480nm, after 5 minutes, on previously calibrated suitable spectrophotometer, against the blank solution prepared, as mentioned above. The concentration of iron in each sample was calculated in percentage w/w, using the following formula:
Content of iron (%w/w) =
= (Sample Absorbance/Standard Absorbance) X (0.0001/50) X (100/weight of sample in g) X Dilution factor X 100

Results and Discussion

The ash contents observed in different batches of apple juice concentrate powder were calculated by following the standard pharmacopoeial method and are recorded in table -1.

Table-1

Batch No.	Description	Total Ash (%w/w)	Iron content (%w/w)
1	Greyish-brown colored powder	23.95	15.67
2	Greyish-brown colored powder	22.51	13.68
3	Dark grey colored powder	17.22	7.33
4	Dark brown colored powder	15.16	6.90
5	Grey colored powder	11.18	6.75
6	Grey colored powder	10.47	4.03
7	Brown colored powder	9.44	3.72
8	Grey colored powder	6.12	2.30
9	Light brown colored powder	5.95	1.22
10	Dark brown colored powder	3.07	0.91
11	Brown colored powder	2.45	0.74

Also, the respective iron contents obtained by digesting the corresponding ashes, are recorded in the same table.

It can be clearly observed, from the graphical representation, as shown in figure-1, that the ash content is directly proportional to the content of iron.

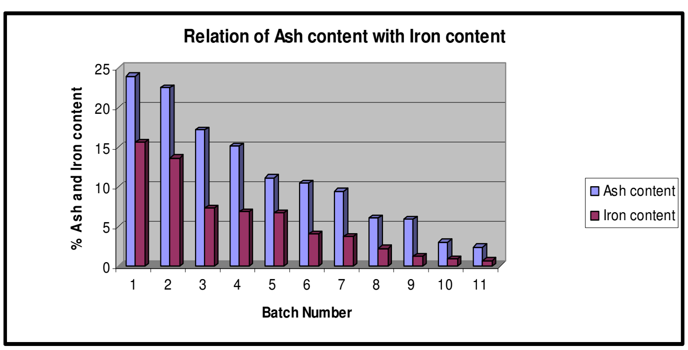

Figure-1

Similarly, Motegaonkar and Salunke[17], studied fruits like jamun and grapes of Latur variety, for ash content and related the same with respective calcium contents.

Conclusion

Results recorded in table-1 and corresponding graphical representation, show that, as the content of ash increases, the percentage of iron in apple juice concentrate increases. The color of the sample also varies as the concentration differs.

Greyish-brown colored sample is found to be the richest source of iron, amongst all the 11 batches that were analyzed, with highest ash content of about 23.95% and a corresponding iron content of about 15.67%, whereas, the lowest ash is found to be about 2.45%, with corresponding iron content of 0.74%.

Since, apple juice concentrate is a natural source, it also contains vitamin C. However, the content of vitamin C may vary from batch to batch, depending on its processing method, from raw apples. But, due to the presence of vitamin C, the bioavailability and absorption of iron increases. Thus, we get additional benefit of using this natural source of iron as a supplement.

Hence, instead of using synthetically prepared chemical forms of iron, as supplements, it is recommended to use apple juice concentrate, which is a natural source of iron, in supplements and medicines.

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