



# Enhancement of Iron Absorption in Black Strap Molasses Using Vitamin C - an Invitro Study

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**Abstract** — Blackstrap molasses is the black viscous liquid obtained as a byproduct from the third boiling of the sugar syrup of sun ripened sugarcane. Beet molasses and black strap are two major waste streams of the sugar industry. In comparison to refined sugar it is a concentrated source of nutrients. Apart from sugars like glucose, fructose, and sucrose it contains minerals and some water soluble vitamins. This natural vegetarian food source is rich in iron content and devoid of oxalates. Iron is an important trace element for the production of hemoglobin and helps to maintain healthy RBC which is vital for oxygen transport. Black strap molasses contain high amounts of sucrose and minerals making them suitable substrates of nutritive value. A comparative invitro study on black strap, with 100 µg and 200 µg of vitamin c doses in enhancement of iron absorption at various time intervals was conducted. The results of the study indicated that the level of iron absorption was enhanced with both the doses of vitamin C at 15 minutes interval.

**Keywords:** Vitamin C, Ioyrn, Invitro study, Molasses, Minera

## I. INTRODUCTION

Blackstrap molasses, or simply blackstrap, is a dark, viscous liquid remaining after maximum extraction of sugar from raw sugar cane. It has a bitter –sweet taste and it is used in the manufacture of ethanol for industry and as an ingredient in cattle feed [1]. The third boiling of sugar syrup yields blackstrap molasses. The majority of sucrose from the original crystallizes through this process, though the calorie content of blackstrap molasses is still mostly due to the small remaining sugar content [2]. However, unlike refined sugars, it contains significant amounts of vitamin B6 and minerals, including calcium, magnesium, iron, and manganese; one tablespoon provides up to 20% of the recommended daily value of each of those nutrients. Blackstrap is also a good source of potassium [3]. It is sometimes used in baking.

Low iron is the most common nutrient deficiency in the India and a leading cause of anemia. Fortunately, iron deficiency is usually treatable by dietary changes,

supplements or a combination. Blackstrap molasses is made from the final boiling of sugar syrup [4]. Compared with other molasses, it contains high concentrations of vitamins and minerals. It is rich in iron and can be incorporated into many recipes and meals. Ironically, molasses is the byproduct or “waste” from processing sugar cane into unhealthful table sugar. Refined table sugar creates blood sugar and insulin instability while providing no nutrients. Once sugar canes are harvested, machines are used to press the juice out of the cane. Sugar cane roots go very deeply into the soil, often 15 feet down or more. That’s enough to bypass nutritionally depleted topsoil, which has become the norm with monoculture and chemically induced agriculture. That juice is boiled then put through centrifugal machinery to extract the sugar crystals. Sun ripened sugar cane is processed without using sulphur, which is less than ideal for human consumption [5].

A third boiling necessary to extract table sugar from sugar cane produces a thick dark substance known as blackstrap molasses, which is the most nutrient dense of all. It is well established that synthetically derived or composed mineral supplements are not as beneficial as nutritionally dense whole food sources. Enzymes and minerals are even more important than vitamins for health. Blackstrap molasses has a low glycemic index. This means the glucose and carbohydrates are metabolized slowly, demanding less insulin production and stabilizing blood sugar. This results in less lipids or fats being stored in the liver while reducing diabetes 2 risk factor. Because of its high iron content, many use blackstrap molasses to holistically overcome anemia. Iron is essential to creating red blood cells. In addition to iron, blackstrap molasses contains folate, a natural source for folic acid, along with some other B vitamins, which all combine to form the synergistic mix that promotes red blood cell production [6].

Black strap molasses is rich in magnesium, calcium, copper and zinc, along with iron. Magnesium is important for balancing calcium for bone production and energy. It is necessary for the smooth function of our nervous system. The mineral is essential to over 300 metabolic processes and the synthesis of almost all the other minerals and vitamins. Magnesium is also helpful

for maintaining heart health. Insufficient magnesium levels can result in muscle spasms, including the heart muscle, which of course relates to arrhythmia or even heart attacks.

Calcium is one of the mineral rich in blackstrap molasses. Calcium ions play a central role in the control of the regulated pathway of exocytotic secretion in eukaryote cells.  $\text{Ca}^{2+}$  is a ubiquitous second messenger that plays key roles in the regulation of cellular processes such as gene expression, secretion and apoptosis [7].

Potassium is another mineral abundant in blackstrap molasses. A deficiency in potassium results in weak muscles and is considered a factor in causing arthritis. Potassium also helps maintain a calmly functioning nervous system and boosts heart health. Manganese, a trace mineral, is very high in unsulphured blackstrap molasses. Manganese ions function with a number of enzymes, and are essential to combating unusual free radicals. Like magnesium, manganese also supports cellular absorption of nutrients, and is beneficial to the nervous system.

All the minerals and nutrients of unsulphured blackstrap molasses are in their natural, balanced form to create a bio-accessible, nutritional synergy unavailable from supplements that are not food.

#### Composition of Blackstrap Unsulphured Molasses

Sodium	:	10 mg
Potassium	:	297 mg
Carbohydrate	:	11g
Sugars	:	11g
Vitamin A	:	20%
Calcium	:	20%
Iron	:	20%

Other minerals that appear in abundance are copper and zinc. Copper plays an important role in iron metabolism. Copper deficiency impairs iron absorption, and anemia accompanies severe copper deficiency. Ceruloplasmin, the major protein in plasma, has a ferroxidase activity that oxidizes ferrous iron to the ferric state prior to its binding by plasma transferrin [8]. It is well known that zinc is essential for the growth of man and many animals. Supplemental zinc in a diet can accumulate markedly in the livers of animals [9]. Zinc, accumulated in the liver cells, causes an increase in metallothionein in the cytosol of liver cells [10]. It is uncertain, however, whether zinc taken up by liver binds to the subcellular organelles and affects the cellular metabolic systems. Working with zinc, copper helps eliminate oxidation damage.

The study aimed to incubate various doses of vitamin C with unsulfured black strap molasses and to study the influence of vitamin C on iron absorption- An in vitro study.

## II. MATERIALS AND METHODS

### i) Mineral profile study in Black strap molasses:

The following kits were purchased from Coral diagnostics Pvt. Ltd, Goa.

- Estimation of calcium by OCPC method.
- Copper by Di –Br – PAESA Method.
- Zinc by NITRO PAPS Method.
- and Iron was estimated by Di pyridyl method using colorimeter.

### ii) In vitro study of iron absorption with vitamin C in Black strap molasses:

10 microlitre of black strap molasses samples were taken and the iron level measured by dipyrindyl method at 540 nm. 0.5 ml Black trap molasses diluted with 5 mL of distilled water.

Set 1: To the measured iron levels 100  $\mu\text{L}$  of vitamin C are added and incubated for 5 min, 10 min, 15 min, 20 min and 30 min and iron levels are measured after incubation.

Set 2: To the measured iron levels 200  $\mu\text{L}$  of vitamin C are added and incubated for 5 min, 10 min, 15 min, 20 min and 30 min and iron levels are measured after incubation.

Note: Vitamin C concentration is 1mL contains 1 mg.

(Concentration: 100 $\mu\text{L}$  contains 10  $\mu\text{g}$ )

## III. RESULTS AND DISCUSSION

In the present study, we observed that the concentration of calcium was found to be increased when compared to copper, iron and zinc in black trap molasses, Fig.1.

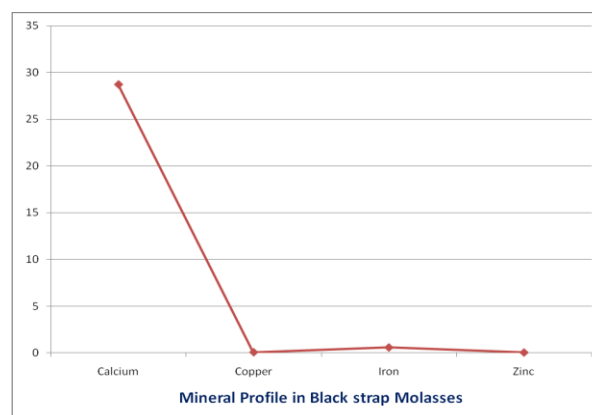


FIG.1 MINERAL PROFILE IN BLACK STRAP MOLASSES

We also observed that the enhancement of iron absorption in the invitro study at 5 minutes, 10 minutes, 15 minutes, 20 minutes and 30 minutes interval at the concentration of 100  $\mu$ L and 200 $\mu$  L using vitamin C. It was found that, the absorption of iron in black strap molasses with vitamin C was higher at 15 min time interval with both the concentration of vitamin C, Fig 2 and Fig 3.

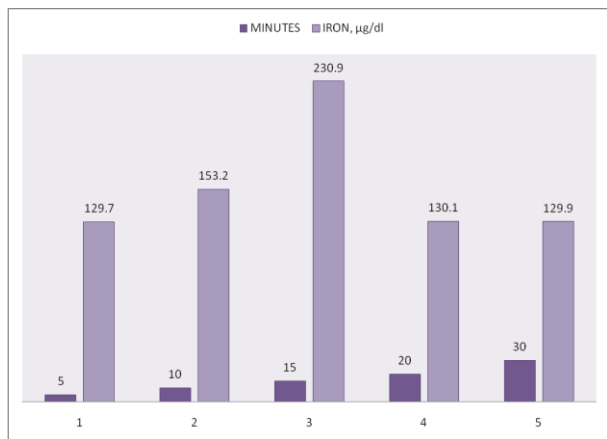


FIG.2 IRON ABSORPTION AT DIFFERENT TIME INTERNAL USING 100 MICROLITRE OF VITAMINC

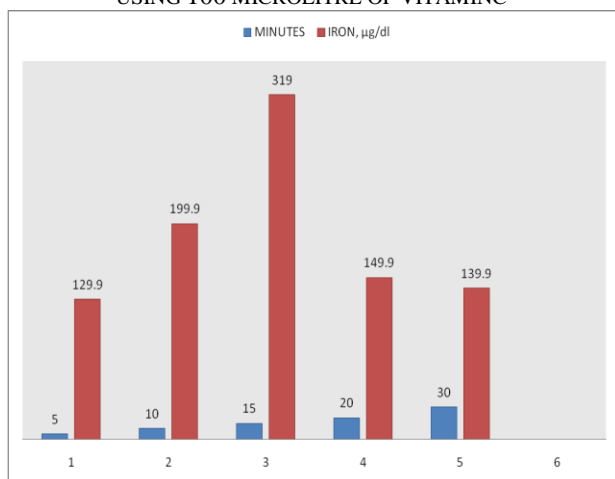


FIG.3 IRON ABSORPTION AT DIFFERENT TIME INTERNAL USING 200 MICROLITRE OF VITAMINC

The key role of vitamin C in iron enhancement was due to the conversion of ferric to ferrous form of iron [11]. It also prevents the formation of insoluble iron compounds. A rich source of iron, blackstrap molasses is of great significance to menstruating women, who are at higher risks of iron deficiencies. Iron, being an integral component of hemoglobin, helps in transporting oxygen from lungs to all body cells [12]. Additionally, iron is also significant for energy production and metabolism. Blackstrap molasses fulfills the daily requirement of iron in lactating mother and growing children.

## IV. CONCLUSION

Vitamin C helps your body absorb iron from plant sources of iron such as blackstrap molasses. Eat foods high in vitamin C alongside blackstrap molasses. Citrus fruits and juices, cantaloupe, strawberries, sweet red peppers, tomatoes, cabbage and broccoli are all good choices. Foods high in calcium may interfere with body's ability to absorb iron. Avoid using milk and other calcium-rich foods along with blackstrap molasses. Take calcium supplements at a different time of day to avoid this interaction. The influence of vitamin C in iron enhancement is proportional to the quantity of vitamin C concentration and time optimization of concentration and time are the important factors that influence iron absorption.

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