

**Engineering/Science/Technology** **Chemical Engineering/ Mechanical Engineering**

# Portrayal of Red Pigments Extracted From Red Beet (Beta Vulgaris, L.) And its Potential Uses as Antioxidant and Natural Food Colourants

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## GRAPHICAL ABSTRACT



## ABSTRACT

Red shades removed from red beet (*Beta vulgaris*, L.) were distinguished for real constituents by utilising HPLC, these shades were utilised as option common red colourants in some handled nourishments, i.e. jam and ice sherbets. Additionally, the impact of utilising red beet remove as the characteristic cancer prevention agent on corn oil was contemplated. The outcomes demonstrated that red beet had 380 mg betalain/100g on crisp weight. The major constituents of red beet shades were betalain and iso betalain by investigating with HPLC. The best transporters for red beet shades were dextrin trailed by solvent starch, lactose and glucose, individually. Then again, shading and higher colour solidness of betalain shades extricated from red beet were at pH ran between 3.0 to 7.0 and temperature went between 40.0 to 50.0<sup>o</sup> C. Then, the corruption of red shades were 82.0% of the aggregate colors after 180 min at 90<sup>o</sup> C. Cell reinforcement action of red beet concentrates were evaluated by measuring peroxide esteem in corn oil amid 7 days at 60<sup>o</sup> C corn oil contained 1000 ppm could bring down the peroxide esteem than utilizing 200 ppm engineered cancer prevention agent butylated hydroxyl toluene (BHT). Investigation of fluctuation for tactile assessment of arranged jam and ice sherbets demonstrated that jam tests containing 0.30% and ice sherbets containing 0.20% red beet shades were given the most astounding scores of shading, taste and general adequacy comparable with manufactured shading carmine.

**Keywords:** Betalain, natural red colourants, a natural antioxidant, jelly, ice sherbets, red beet.

## 1. INTRODUCTION

Shading is a standout amongst essential properties of nourishments, being considered as a quality marker and deciding regularly their acknowledgement. Numerous actually hued sustenances, for example, natural product items, are submitted to shading misfortunes amid handling, requiring the utilisation of colourants to reestablish their shading. Characteristic colourants have numerous hindrances when contrasted with engineered ones, incorporating higher expense being used and bring down soundness. Be that as it may, individuals have progressively dodged engineered colourants, leaning toward common shares, which are thought to be innocuous or even solid. Betalains are not found in plants containing anthocyanin shades based on their atomic structure. Henritte (2009). Betacyanins by and large seem red to red-violet in shading they ingest in the 535-550nm territory - henceforth our decision of the channel in the colorimeter) Betaxanthins for the most part seem yellow in shading (retain in the 475-480nm range). They cause shading in both blossoms, foods are grown from the ground vegetative organs. They are found in the vacuole and they are water-dissolvable.

Betanins or betalains are characteristic colours extricated from various leafy foods. They are to a great extent utilised as nourishment colourants as a part of sustenance items like yoghurts, dessert and different items (Zhong et, al. 2005) and (Stintzing et,al. 2002). Late studies have demonstrated that betaines have cancer prevention agent, antimicrobial and antiviral action (Pedreno and Scribing, 2001). Beetroot (Beta vulgaris) is the fundamental wellspring of common red colour, known as "beetroot red". Betaine is the principle segment of the red colourant extricated from Beta vulgaris. Promptly after extraction, betaine is presented to debasement. The shade

steadiness is impacted by variables, for example, compounds, temperature, oxygen and pH (Pedreno and Scribing, 2001). Betalain colours extricated from red beet (Beta vulgaris) roots give a characteristic other option to engineered red colours. Betalains have been effectively utilised as a part of business nourishment shading operations for various years (Goldman et al., 1996) and keep on being a vital wellspring of red shading in the sustenance business. Betalains are subordinates of balsamic corrosive and can be ordered into two gatherings: the red-violet betacyanins (BC) and the yellow betaxanthins (BX). These vary by conjugation of a substituted sweet-smelling core to the 1,7-diazaheptamethinium chromosphere, which is available in betacyanin. Betalains are water-dissolvable nitrogen-containing shades, which are orchestrated from the amino corrosive tyrosine into two auxiliary gatherings: the red-violet betacyanins and the yellow-orange betaxanthins. Beetroot shade is utilised economically as a nourishment colour. It changes shading when warmed so must be utilised as a part of a dessert, desserts and another confectionary, however, it is modest and has no known unfavorably susceptible reactions. Beetroot itself, obviously, is a typical serving of mixed greens fixing – when cooked, vinegar is added to the water to bring down the ph. Betalains have a few applications in sustenances, for example, sweets, candy stores, dry blends, dairy and meat items.

The centralization of unadulterated colour required to acquire the sought tint is moderately little, once in a while surpassing 50 mg/kg, ascertained as betanin (Delgado et al., 2000). As per the (Codex Alimentarius Commission. 2004), betalain - constrained just by great assembling home. The sustenance colourant known as „beetroot red“ removed from beetroots are popularised in the European Union and the USA as nourishment colourant (Castellar et al., 2003). Betanin

(C<sub>24</sub>H<sub>27</sub>N<sub>2</sub>O<sub>13</sub>) makes up 75-95% of the aggregate shading matter found in the beetroot, thusly it is utilised as a characteristic sustenance shading specialist (Azeredo et al., 2007). This shade, as different betacyanins, is very vulnerable to changes prompted by both pH and temperature (Pedreno and Scribing, 2001). As an effective cell reinforcement shade, betanin may give assurance and diminish a danger of cardiovascular illness and disease (Rakin et al., 2007). Betalains are nitrogen-containing plant shades whose hues range from red-violet betacyanins to yellow betaxanthins. They are utilised for shading dairy items, meat and solidified pastries. Betacaine has pulled in extra intrigue in view of their ant oxidative, calming and anti-carcinogenic properties. The principle wellspring of monetarily created battalions is red beetroot, yet selective sources are found in plants from the amarantaceous and Cactaceae families (Dubravko and Marijana 2011). The point of this exploration work was to get recognise and portray the shades acquired from the red beet (*Beta vulgaris* L.) and utilising of these shades as option regular red colourants in some prepared sustenance's (i.e. Jelly and Ice. Sherbet ). Additionally, to explore the cell reinforcement action of the concentrate through the option to oil. Likewise, a tangible assessment was resolved in jam and ice sherbets in the wake of utilising the red beet remove as the nourishment colourant.

### Materials and Methods:

#### Materials

Red beets (*Beta vulgaris* L.) were bought from neighbourhood market, Cairo, Egypt. The dissolvable utilised for ghashtly and HPLC examination was of HPLC evaluation and every other dissolvable were of ACS evaluation. Refined corn oil was gotten from Arma Food Industries tenth of Ramadan.

Engineered cell reinforcements, in particular, butylated hydroxyl toluene (BHT) and manufactured red colourants in particular carmine (album lack of carminic corrosive) were bought from Aldrich Chemical Company, USA.

### Analytical Methods:

#### Extraction and concentration of betalains pigment from red beet:

Around 200 g of red beet was blended in a blender with 1 litre of ethanol (fermented with 2% citrus extract) for 15 min at room temperature and left for 24 hours. The concentrate was sifted and thought under vacuum by a rotating vacuum evaporator at 40 o C. as reported by Francis (2000).The operation of this engine can be arranged by placing the bigger magnet at the centre which is connected to the shaft, thereby this shaft will take the input from either of the motor or I.C Engine etc. to rotate the magnet.

#### Determination of total betalains

The concentrated red beet was weakened with refined water and estimation was done at wavelength of 535 nm and the evaluation was communicated as mg betalains/100g utilising the accompanying condition as dictated by Castellar et al., (2003)

$$\text{Absolute betalains content (mg/100 g)} = A \times DF \times \frac{1000}{MW \times \epsilon L}$$

Where:

A: Absorption esteem at 535 nm thickness.

DF: Dilution volume. L: Path length of the cuvette.

MW: Molecular weight of betalain (550g/mol).

€: The elimination coefficient for betalain 60000 L/mol.

#### Selection of appropriate carrier:

The focused betalains shades were adsorbed on different backings utilising distinctive proportions up to 7:1 (colours: lattice (transporter) in particular

dextrin, dissolvable starch, anhydrous glucose and lactose and of late dried at 40° C for 24 hours.

**Distinguishing proof of betalains colours by High execution Liquid Chromatography (HPLC):**

The recognised of betalains colours by HPLC Merck Pump L-7100 as per the strategy reported by (Stintzing et.al., 2002) utilising a LC18 segment (250 mm 4.6 mm, i.d). The stream rate was 1.0 ml/min., the elutes were observed by obvious spectrometry at 538nm and 476nm for betalain. The recognisable proof was performed inside a standard example as depicted by the same creator.

**Properties of betalains:**

**Impact of pH:**

A preparatory study was led to test the soundness of betalain shades in various pH media that extended from 2.0 to 10.0 for 30 min and after that rate of shading misfortune was ascertained.

**Impact of temperature:**

A preparatory study was directed to test heat resistance of betalains shades at a various temperature going from 40 to 100° C for 30 min and after that rate for shading, misfortune was ascertained.

**Thermal stability:**

Holding red colourant (betalain shades) at 80° C and 90° C was reached out for 180 min through which they were expelled every 30 min and cooled quickly in an ice shower took after by measuring assimilation spectra of the arrangement at 535nm.

**Antioxidant activity:**

**Determination of antioxidant activity:**

Corn oil was utilised as a substrate for oxidant concentrates on .Natural cell reinforcement separated from red beet 10g of dried red beet concentrate and engineered cancer prevention agent butylated hydroxyl toluene (BHT) were

added to oil at 200,500, and1000 ppm on dry weight premise to test their cell reinforcement viability, as per (Matthaus, 2002). Control test without added substances was set up in the same condition. Corn oil with and without cell reinforcement (normal or manufactured) was warmed in 500 ml/g measuring glass at 60° C (in a stove )for 3h day by day, the test proceeded for 7days. The peroxide quality was resolved as cancer prevention agent, for each as indicated by the technique depicted in (A.O.A.C .2000).

**Technological methods:**

**Preparation of jelly:**

Jam was set up in a research facility by including distinctive levels of red beet shades i.e.- 0.10, 0.20, 0.30, 0.40 and 0.50% w/w in a lab utilising the conventional system. The plan of Jelly is appeared in Table (1).

Table 1. The formulation of Jelly

Ingredients	%
Sucrose	81.0
Gelatin	14.0
Citric acid	0.220
Flavoring agent	0.110
Sodium benzoate and potassium citrate	0.06
Ascorbic acid	0.11
Color (red beet pigments extract)	0.12-0.65

Jams were wrapped by polyethene and aluminium thwart and gathered in container packs and were put away at room temperature 25±5°C.The control of jam was set up with 0.10%synthetic shading (carmine).

3) - Ice sherbets:

Ice sherbets were set up in the lab by including diverse levels of red beet shades remove extending from 0.1 to 0.5% (w/w) utilising the conventional

system. The detailing of ice sherbets is appeared in Table (2).

Table 2. The detailing of sherbets.

Ingredients	%
Sugars	15.0
Water	84.20
Citric acid	0.20
Flavoring agent	0.10
Red beet pigments (natural red color)	0.10 - 0.5

These substance ought to be blended exceptionally well and warmed at 90°C for 15 min., cooling until achieves 80°C and afterwards put in polyethene pouches and set in the profound cooler at - 18°C. The control of ice sherbets was set up with 0.10% engineered hues (carmine).

**Tangible assessment:**

The tangible assessment was completed by ten specialists. The specialists were requested that assess shading, taste, scent and general agreeableness for arranged jam and ice sherbets as indicated by the technique depicted by (Reitmeier and Nonnecke 1991).

**Factual examination:**

Information was actually broke down to encourage looking at the minimum huge contrasts (LSD) between the method for various qualities as indicated by (Snedecor and Cochran 1973).

**Results and Discussion**

Extraction and Identification of betalains from red beet:-

Aftereffects of the extraction of betalains from red beet show that the substance of aggregate betalains was 380 mg/100 g on crisp weights. The outcome got when all is said in done were as per (Zakharova and Petrova .1997), who found that, the aggregate

betalain substance of red beet were 250 to 850 mg/100g on crisp weight while (Delgado et.al., 2000) found that, red shade content in red beet could achieve 500 mg/100g on new weight.

**Identification of betalains extracted from red beet:-**

Partition and distinguishing proof of betalain shades from red beet was finished by HPLC as found in Table (3). Three segments were recognised by HPLC, the real constituent of red beet was Betalain 82.79% took after by iso betalain 11.40% and violaxanthin 1.34% individually. These outcomes are harmonising with that of (Wybraniec,2005), who said that the significant parts of colours in red beet are betalain and iso betalain.

Table 3. Distinguishing proof of red beet shades.

Retention time(min)	Relative abundance area %	Identified pigment
10.50	1.34	Violaxanthin
23.0	82.79	Betalain
25.7	11.40	Isobetalain
28.9	4.47	Unidentified pigments

Total betalains were 380 mg/100g of fresh weight.

**Selection of appropriate carrier:**

The adsorption materials utilised as a bearer for betalain colours separated from red beet are appeared in Table (4). It could be seen that the nearness of betalains with bearers expanded continuously by expanding the level of betalain colours in all tried transporter, however, vanished or turn out to be low by utilising glucose, lactose and solvent starch at 7:1 betalain: transporter (g/100g). Comes about additionally demonstrated that, dextrin had the best adsorbent covered transporter material for betalain colours (at abnormal states) which positioned as the first request took after by solvent starch, lactose and



glucose, were positioned in second, third and fourth requests separately to go about as a bearer for shades of red beet.

Table 4. The distribution pattern of betalains within selected carrier.

Selected carrier	Ratio of betalains to carrier g/100g	Concentration of betalains g/100 g carrier
Soluble starch	7:1	4.34
Lactose	7:1	3.46
Dextrin	7:1	20.63
Glucose	7:1	2.25

**Properties of betalains extracted from red beet:**

**Effect of pH:**

The preparatory study was led to test the dependability of betalains colours got from red beet in various pH media. The outcomes acquired in Table (5) demonstrate that there is a relationship between shading changes and pH variety .Most striking was the impact of on betalains content which was around 93.0 to 100.0 % at pH differed from 2.0 to 7.0, while the debasement of shading came to 21.87 and 50.0 % at pH 8.0 and pH 10.0 individually.

In addition, the corruption of shading does not surpass 7 % in the scope of pH qualities 3.0 to 7.0. For example, the most astounding security stayed at pH 3.0 to pH 7.0 since less betalain debasement were separated from red beet These outcomes are comparable with that of (Castellar et al.,2003). Underneath pH 3.0, the ingestion greatest movements toward lower wavelengths, or more pH 7.0 the change is toward upper ones, out of the pH range 3.0–7.0 the force of the unmistakable spectra diminishes.

Table5. Retention% of betalain shades separated from red beet as an element of pH qualities.

pH values	% retained of betalain pigments	% degradation of betalain pigments
2	95.00	5.00
3	95.31	4.69
4	98.44	1.56
5	100.00	00.0
6	96.88	3.12
7	93.75	6.25
8	78.13	21.87
9	60.94	39.06
10	50.00	50.0

**Effect of temperature:**

The impacts of temperature on the remained and debasement rates of red beet betalains is represented in Table (6). Drawn out presentation of shade at moderate temperature went somewhere around 40 and 50° C, demonstrated no debsement and comparable soundness were watched, while at above 50° C, the corruption of betalains expanded step by step by expanding temperature. Case in point, the corruption in betalains shades, brought about by its uncovering at high temperature. The higher debasement of betalains was seen at 100° C took after by 90, 80 and 70° C, individually. While the relating corruption rate 19.0, 36.0, 46.0 and 57.0 % after presentation at 70, 80, 90 and 100° C individually.

The corruption rate of betalains expanded bit by bit by expanding the temperature degree. The higher debasement rates of betalains were seen above 70°C and the most reduced rate was 50°C while at 40°C no any corruption for betalains could be watched. Therefore the greatest security of colour could be in the scope of 40°C up to 50°C.

Table 6. The impact of temperature on the debasement rate of betalains separated from red beet at different temperatures for 30 min.

Temperature (°C / 30 min)	% retained of betalains pigments	% degradation of betalains pigment
40	100	0.0
50	98	2.0
60	92	8.0
70	81	19.0
80	64	36.0
90	54	46.0
100	43	57.0

**Thermal stability:**

The Thermal steadiness of betalains on span time at different temperatures went somewhere around 80 and 90°C are clear in Table (7). Results show that the expansion of obliteration happened by expanding of the length time. Then again, the staying of betalains being 18.0% of the aggregate shades subsequent to holding for 180 min at 90°C. Thus, the uncovering red beet betalains to 80 - 90 °C for 120 min created an annihilation came to around 69.0 % of betalains while after 180 min expanded to 82 % of the aggregate betalains colors individually.

However, the temperature is thought to be the most vital component on betalain steadiness amid sustenance handling and capacity as reported by ( Garci et al., 1998).

Table 7. The warm strength of betalains separated from red beet.

Betalain pigments	Temp °C	Tolerance periods I n min					
		30	60	90	120	150	180
Retained	80	64	57	50	42	36	21
Degradation	80	36	43	50	58	64	79
Retained	90	54	41	36	31	26	18
Degradation	90	46	59	64	69	74	82

**Antioxidant activity of red beet extract on corn oil:**

The proficiency of characteristic cancer prevention agent of red beet (betalains ) concentrate was contrasted and manufactured cell reinforcement (BHT) measured by peroxide esteem (PV) and the outcomes are accounted for in Table (8). from the outcomes it could be watched that as the fixation characteristic cancer prevention agent (red beet) expanded there was expansion in the inhibitory impact of ( PV)

Following 7 days of capacity at 60°C, PV estimations of corn oil treated with 200, 500 and 1000 ppm of red beet concentrate were 10.9, 9.4 and 7.80 meq/kg-1, while the PV estimation of corn oil treated with 200 ppm of BHT (engineered cancer prevention agent), was 8.40 meq/kg-1. Then again, the red beet separate (1000 ppm) was more viable for concealment advancement of PV quality than BHT.

From previously stated results, 1000 ppm red beet extricate had a higher impact on controlling the advancement of rancidity in corn oil than that of engineered cancer prevention agent (BHT). Also, the regular cell reinforcement concentrate of red beet concentrates would be favoured over

manufactured cancer prevention agent to minimise the unfavourable wellbeing impacts.

Table 8. The impact of betalains and BHT as cell reinforcements on peroxide esteem (PV) of corn oil amid capacity at 60°C. for 7 days.

Storage time (days)	PV (meq / kg <sup>-1</sup> ) for corn oil treated with				
	Control without antioxidant	*BHT	Red beet extract		
		200 ppm	200 ppm	500 ppm	1000 ppm
0.0	1.18	1.18	1.18	1.18	1.18

1.0	3.52	2.73	3.42	3.28	2.80
2.0	5.40	3.16	4.90	4.28	3.10
3.0	7.30	3.94	5.30	4.60	3.80
4.0	8.25	4.76	6.77	6.12	4.70
5.0	10.33	6.21	8.44	7.11	6.11
6.0	14.65	7.30	9.86	8.78	6.98
7.0	17.40	8.40	10.90	9.40	7.80

\*BHT : Butylated Hydroxyl Toluene

Table 9. Tactile assessment of jam and ice sherbets arranged with various levels of

Treatments	Jelly				Ice sherbets			
	Color	Taste	Odor	Overall acceptability	Color	Taste	Odor	Overall acceptability
Control**	9.80 <sup>a</sup>	9.80 <sup>a</sup>	9.70 <sup>a</sup>	9.70 <sup>a</sup>	9.50 <sup>a</sup>	9.50 <sup>a</sup>	9.50 <sup>a</sup>	9.50 <sup>a</sup>
0.1% betalain pigments	7.40 <sup>c</sup>	7.10 <sup>c</sup>	7.20 <sup>c</sup>	7.20 <sup>c</sup>	7.30 <sup>c</sup>	7.20 <sup>c</sup>	7.20 <sup>c</sup>	7.20 <sup>c</sup>
0.20% betalain pigments	8.40 <sup>b</sup>	8.20 <sup>b</sup>	8.30 <sup>b</sup>	8.30 <sup>b</sup>	9.50 <sup>a</sup>	9.50 <sup>a</sup>	9.50 <sup>a</sup>	9.50 <sup>a</sup>
0.30% betalain pigments	9.80 <sup>a</sup>	9.70 <sup>a</sup>	9.60 <sup>c</sup>	7.60 <sup>c</sup>	8.30 <sup>b</sup>	8.20 <sup>b</sup>	8.30 <sup>b</sup>	8.30 <sup>b</sup>
0.40% betalain pigments	8.50 <sup>b</sup>	8.30 <sup>b</sup>	8.30 <sup>b</sup>	8.30 <sup>b</sup>	7.10 <sup>c</sup>	7.20 <sup>c</sup>	7.20 <sup>c</sup>	7.10 <sup>c</sup>
0.5% betalain pigments	7.10 <sup>c</sup>	7.00 <sup>c</sup>	7.00 <sup>c</sup>	7.00 <sup>c</sup>	6.00 <sup>d</sup>	6.20 <sup>d</sup>	6.10 <sup>d</sup>	6.10 <sup>d</sup>

Common red colourants (betalain) from red beet.

\*values with different letters in the same column are significantly different at P .05.

\*\* control (Prepared with 0.10% carmine as synthetic red colour.

Tangible assessment of jam and ice sherbets:

Tangible properties of jam and ice sherbets arranged with including distinctive levels of betalain separated from red beet as normal colourants contrasted and different items arranged with 0.10% engineered red shading (carmine) are given in Table (9). Examination of fluctuation demonstrated, for the most part, critical contrasts in shading, taste,

scent and general worthiness for both jam and ice sherbets as control or arranged by various levels of regular red shading (red beet) in the extent 0.1 to 0.5%. The expansion of regular red shading from red beet with various levels fundamentally influenced shading, taste, scent and general agreeableness. In any case, ice sherbets arranged with levels of betalains extricated from red beet in focus 0.10, 0.40 and 0.5% furthermore fixations 0.40, 0.50 %



for jam got the most reduced score in all tried quality traits. The jam arranged by including normal shading from red beet at 0.30 % had a most astounding score of examined properties took after by including 0.4 and 0.2 separately. Then again, the ice sherbets arranged by including betalain separated from red beet 0.20% had a most elevated score of examined characteristics took after by including 0.30, 0.10, 0.40 and 0.50% individually. When all is said is done, shopper recognition has been that characteristic nourishment colourant fixing would be more secure, empowering and considered as potential sustenance colourants for getting ready Jellies and ice sherbets.

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