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Betalian pigments extracted from the red beet and its potential uses as natural dyes in new food product development

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Abstract

Color is one of the most important properties affecting the consumer's acceptance of food. Natural colors are pigments made by living organisms and the three most important being tetrapyrrols, tetraterpenoids and flavonoids. The terms "pigment" and "dye" are often used interchangeably. Betalian is the main coloring compound present in red beetroot. Historically, it has imparted additional color to wines. The colorings responsible for the red hue of red beet juice are a group of molecules called *betaines*. This group of pigments contains the red and yellow pigments known as *betacyanins* and *betaxanthins*, respectively. Beets contain a major amount of vitamins A and C and also calcium, iron, phosphorus, potassium, protein and carbohydrates. They are also high in folate, dietary fiber and antioxidants and have high betaine which is used to lower toxic levels of homocysteine (Hcy) which contributes to the development of heart disease, stroke and peripheral vascular disease. The present study have characterization of red pigments and identified all pigments present in beetroot by HPLC chromatography And Extraction of red pigments (natural dyes) are used in food product in cup cake.

Keywords: Natural Color, Beets, Betalian pigment, *Beta vulgaris* and Coloring Dye

Introduction

Several naturally colored foods, as like fruit products, which are submitted to color losses during processing, requiring the use of colorants to restore their color. Natural dyes have many disadvantages when compared to synthetic ones, including higher cost in-use and lower stability. Though, people have increasingly avoided synthetic colorants, preferring natural pigments, because they are very harmless or even healthy.

Betalains (*Beta vulgaris*) pigments only found in beetroot but most of pigments are present in maximum plants as like anthocyanin pigments based on their molecular structure. Henritte (2009) [1]. Betacyanins generally seems red and red violet in color they are absorb in the 535-550nm range - hence our optimal of filter in the colorimeter) Betaxanthins generally appear yellow in color (absorb in the 475-480nm range). They cause color in both flowers, fruits and sometimes vegetative organs. They are present in the vacuole of the beetroot cells and they are water-soluble. Betanins or betalains are natural dyes extracted from different fruits and vegetables. Which is mostly used as food colorants in food products like yogurts, ice cream and different products. Current studies have shown that betaines have antioxidant, antimicrobial and antiviral activity. Beetroot is the major source of natural red pigments, known as "beetroot red". Betaine is the main pigments of the red colorant which are extracted from *Beta vulgaris*. They are after extraction, betanine is showed to degradation. The pigment stability is influenced by factors such as enzymes, temperature, oxygen and pH. Betalain pigments extracted to red beet roots provide an original alternative to synthetic red dyes. Betalains have been fruitfully used in commercial food coloring operations for a number of years and continue to be an important source of red color in the food industry. Betalains are derivatives of betalamic acid and can be classified into two groups: the red-violet betacyanins (BC) and the yellow betaxanthins (BX). These differ by conjugation of a relieved aromatic nucleus to the 1, 7-diazaheptamethinium chromophore, which is present in betacyanin. Betalains are water-soluble nitrogen-containing pigments, which are produced from the amino acid tyrosine into two structural groups: the red-violet betacyanins and the yellow-orange betaxanthins. Their change of color when heated so can only be used in ice-cream, sweets and other confectionary, but it is cheap and has no known allergic side-effects. Beetroot color is used a common salad ingredient – when cooked, vinegar is added to the water to lower the pH. Betalains have several uses in foods, such as desserts, confectioneries, dry mixes, dairy and meat products.

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The main objective of this research work was to find out of identification and characterized the pigments obtained from the red beetroot and their use as alternative food color in few foods and sensory evaluation was determined in cupcake after Applying the red beet extract as food dye.

Material and Methods

Materials

Red beets (*Beta vulgaris* L.) were purchased from local market, Katra, Allahabad.

Chemicals- Ethyl alcohol.

Analytical methods

Extraction of Red pigments from beetroot

The red beetroot 200 g was mixed in blender and added 1 liter of ethanol (acidified with 2% citric acid) for 15 min at room temperature and leave for 24 hours. The extract were filtered and concentrated under vacuum through a rotary vacuum evaporator at 40 °C. as reported by Francis (2000).

Selection of suitable carrier

Betalains pigments which are concentrated and adsorbed on many supports applied different ratios up to 7:1 (pigments: matrix (carrier) namely dextrin, and water soluble starch, anhydrous glucose and lactose and lately dried in oven at 40 °C for 24 hours.

Identification of Betalains pigments by High performance Liquid Chromatography (HPLC).

The recognized of betalains pigments by HPLC Merck Pump L- 7100 according to the method reported by using a LC18 column (250 mm, 4.6 mm, I'd). The flow rate was 1.0 ml / min., the elutes were monitored by visible spectrometry at 538nm and 476nm for betalain. Identification was performed within a standard sample as described by the same author.

Properties of Betalains

Effect of pH

The preliminary study was conducted to test the stability of betalain pigments in different pH media that ranged from 2.0 to 10.0 for 30 min and then percentage of color loss was calculated.

Effect of temperature

A preliminary study was conducted for test heat tolerance of betalains pigments at various temperature ranging from 40 to 100°C for 40 min and then percentage for color loss was calculated.

Thermal stability

The red colorant (Betalian pigments) at 80 °C and 90 °C was extended for 180 min through min through which they were removed each 30 min and cooled immediately in an ice bath followed by measuring absorption spectra of the solution at 535nm.

Technological Methods

Preparation of cup cake-

Cup cake was prepared in laboratory by adding all contents should be mixed very well and prepared batter then fill up in mold and after take it microwave oven for baking set temperature on 100 °C and time 40 minutes.

Table 1: The formulation of cup cake

| Ingredients | % |
|---------------------------------------|----------|
| Sugar | 42 |
| Milk | 3.0 |
| Butter | 31.20 |
| Wheat flour | 60.0 |
| Baking powder | 1.0 |
| Red beet pigments (natural red color) | 0.10-0.5 |

These contents should be mixed very well and heated at 90 degree C for 15 min. cooling until reaches 80 degree C and the put in polyethylene pouches and placed in deep freezers at-18 degree C.

Sensory evaluation

Sensory evaluation was carried by 20 panelists were asked to evaluate the color, taste odor and overall acceptability for prepared cupcake according to the method described by (Reitmeier and Nonnecke 1991).

Statistical analysis

Data were statistically analyzed to facilitate comparing the least significant differences (LSD) between means of different values according to (Snedecor and Cochran 1973).

Results and Discussion

Extraction and Identification of betalains from red beet:

The results are found finally of the beetroots, extraction of betalains pigments (red beet) indicate that, the pigments of total betalains pigments was 380 mg / 100 g on fresh weights. The result obtained in general were in according the (Zakharova and Petrova. 1997), they are found that, the total betalain content of red beet were 250 to 850 mg/100g on fresh weight while (Delgado et al. 2000) [8] found that, red dyes content in red beet could reach 500 mg /100g on fresh weight.

Identification of betalains extracted from red beet:

Separation and recognized of betalain pigments from red beet, which are done through HPLC. Three components were identified through HPLC, and the major constituent of red beet were Betalain 83.00% keep on through isobetalain 11.50% and vulgaxanthin 1.35% respectively. These results are coinciding with that of (Wybraniec, 2005), who are mentioned that most of the components of pigments in red beet are betalain and isobetalain.

Table 2: Identification of red beet pigments

| Retention time (min) | Relative abundance area % | Identified pigments |
|----------------------|---------------------------|-----------------------|
| 11.0 | 1.35 | Vulgaxanthin |
| 23.2 | 83.0 | Betalain |
| 25.9 | 11.50 | Isobetalain |
| 29.0 | 5.0 | Unidentified pigments |

Sensory evaluation of cupcake

Sensory properties of cupcake with adding different level of betalain extracted from red beet as natural colorants compared with other products prepared with 0.10% synthetic red color. Analysis of variance showed mostly significant differences in color, taste odor and overall acceptability for cupcake as control or prepared by different levels of natural red color in the range 0.1 to 0.5%. The addition of natural red color from red beet with different levels significantly affected color, taste, odor and overall acceptability.

Table 3: Sensory Evaluation of Cupcake Prepared With Different Level of Natural Red Colorants From Red Beetroot.

| Treatments | Color | Taste | Odor | Overall acceptability |
|-------------------------|-------------------|-------------------|-------------------|-----------------------|
| Control | 9.90 ^a | 9.80 ^a | 9.90 ^a | 9.60 ^a |
| 0.1% betalain pigments | 7.50 ^c | 7.30 ^c | 7.30 ^c | 7.10 ^c |
| 0.20% betalain pigments | 8.60 ^b | 8.30 ^b | 8.20 ^b | 8.40 ^b |
| 0.30% betalain pigments | 9.70 ^a | 9.80 ^a | 9.60 ^c | 7.80 ^c |
| 0.40% betalain pigments | 8.80 ^b | 8.40 ^b | 8.40 ^b | 8.30 ^b |
| 0.5% betalain pigments | 7.00 ^c | 7.10 ^c | 7.00 ^c | 7.00 ^c |

Conclusion

In this research work finally found that extraction of Betalian pigments followed by thermal stability. The Betalian pigment should be consumed as a natural food dye. The coloring responsible for the naturally present red pigments (molecules) not any harmful chemicals. Beets contain a large amount of nutrients also.

The cupcake prepared by adding betalain extracted from red beet 0.2%, by adding 0.30, 0.10, 0.40 and 0.50% respectively. Thermal stability of betalain pigments retained 180 min at 90 °C, while the corresponding degradation rate 19.0, 360,460 and 57.0% after exposure at 70, 80, 90 and 100 °C respectively.

In general, consumer perception has been that natural food colorant ingredient would be safer, healthy and considered as potential food colorants for preparing cup cake.

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