Journal of Agricultural Engineering and Food Technology
Print ISSN: 2350-0085; Online ISSN: 2350-0263; Volume 2, Number 2; April-June, 2015 pp. 116-118

http://www.krishisanskriti.org/jaeft.html

Extraction of Natural Pigment from Beet Root & Proper Packaging of That Red Dye: A Review

Tanmay Sarkar[1], Mrinal Kanti Sen[2] and Suman Nihar[3]

[1,2,3]*Ghani Khan Choudhury Institute Of Engineering & Technology, Malda*
E-mail: [1]tanmays468@gmail.com, [2]mrinalsen29@gmail.com, [3]suman.nihar@gmail.com

Abstract—*Beetroot (Beta vulgaris) is the main source for the natural red dye. The main component of this extract is betanine. This study was carried out to investigate the possibility of producing some natural red pigments from roots. The main constraints of using natural pigments in industry is it's cost and lower stability but "beet root red" is cheap and has no known allergic side-effects. The state of art for extraction of betanine from beet root was studied. This red pigment has the potential to be used as an antimicrobial and antioxidant agent in food, pharmaceutical and allied industry.Though very small or no research was done on application of this natural pigment in textile fibre, the potency of betanine in this particular industry is yet to be explored. Packaging and storage is the main point of concern for the natural pigments due to their change in structure with reaction with packaging material or change due to storage condition. Therefore finding of sustainable packaging condition for natural red dye from beet root was another aim of this paper, and it is found that the active packaging technique that is controlled atmospheric packaging or modified atmospheric packaging (MAP) may helpful in this particular case.*

Keywords: *Betanine, Natural red pigments, Packaging condition.*

1. INTRODUCTION

It is well established that the Colour is one of the most important attributes of foods& textile materials, being considered as a quality indicator and determining frequently their acceptance among the majority of consumers. Artificial or synthetic colorants in food are used all over the world but they are not hygienic that is why people have increasingly avoided synthetic colorants. Recently, the new trend in food additives tends to try to use the natural colorants in colouring food instead of artificial ones which may be not quite safe or healthy to human which are considered to be harmless or even healthy. The methods for extraction, identification and utilization of natural colorants from natural plants sources and wastes remaining after processing is the recent trends of research[2]reported that red grapes, strawberry, red carrot and roselle flowers are very rich in red color namely anthocyanin. Betanins are not found in plants containing anthocyanin pigments based upon their molecular structure [4]. Betacyanins generally appear red to red violet in color and they absorb in the 535-550nm range.

Natural dye are known for their use in colouring of food substrate, leather, wood as well as natural fibre like wool, silk, cotton and flax as major areas of application since ancient time. Natural dyes have a wide range of shades that can be obtained from various parts of plants, including roots, bark, leaves, flowers and fruits [1]

Recently there has been revival of the growing interest on the application of non-toxic and eco-friendly natural dyes on natural fibres due to worldwide environmental consciousness [3]

Betanins or betalains are natural dyes extracted from different fruits and vegetables. They are largely used as food colorants in food products like yogurts, ice cream and other products [2] and[1].And it can be applied on natural textile fibre also. Natural dyes with very few exceptions are non-substantive, but must be used in consumption with mordants, nearly all-natural dyes with a few exceptions require the use of mordants to fix them on to the fabric substrate. While dyeing, a substantial portion of the mordant remains unexhausted in the residual dye bath and may pose serious effluent disposal problem.

Recent studies have shown that betanines have antioxidant, antimicrobial and antiviral activity [5]. Beetroot (Beta vulgaris) is the main source of natural red dye, known as "beetroot red". Betanine is the main component of the red colorant extracted from Beta vulgaris. Immediately after extraction, betanine is exposed to degradation. The pigment stability is influenced by factors such as enzymes, temperature, oxygen and pH [4]. Betalain pigments extracted from red beet (Beta vulgaris) roots provide a natural alternative to synthetic red dyes. Betalains have been successfully used in commercial food colouring operations for a number of years [2] and continue to be an important source of red colour 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 substituted aromatic nucleus to the1, 7-diazaheptamethinium chromophore, which is present in betacyanin. Betalains are water-soluble nitrogen-containing pigments, which are synthesised from the amino acid tyrosine into two structural groups: the red-violet betacyanins and the yellow-orange betaxanthins. Beetroot pigment is used commercially as a food dye. It changes colour 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 itself, of course, is a common salad ingredient – when cooked, vinegar is added to the water to lower the pH. Betalains have several applications in foods, such as desserts, confectioneries, dry mixes, dairy and meat products.

2. EXTRACTION PROCEDURE

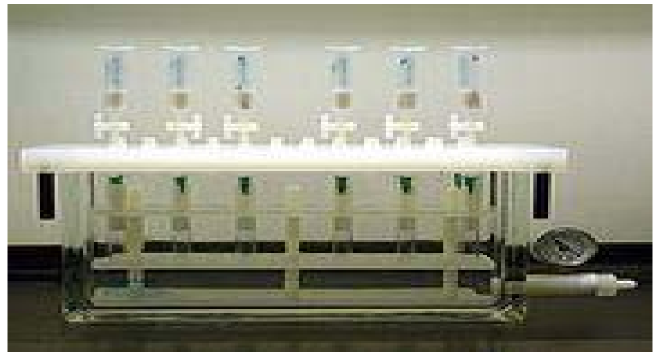
Natural red pigments were extracted from red carrot roots processed wastes remaining after production of jam by the following methods to fix the efficiency of extraction: 1 – Extraction using acidified water (2 % citric acid). 2 – Extraction using acidified water (3 % citric acid). 3 – Extraction using acidified water (4 % citric acid). 4 – Extraction using distilled water alone. In each extraction about 300 gms of the wastes were mixed with 1 L of solvent at 4o C and left for 24 hours. All filtered extracts were concentrated under vacuum by a rotary evaporator at 50^{o} C applied by Francis (2000). All previous natural red pigments concentrates were preserved at 4^{o} C till analysis.

According to Aura 2004 commercially available beetroot was used as extraction material. The vegetable material was cut into slices having approximately 21 mm length, 5 mm width and 1-2 mm height. The following solvents were used in the first series of experiments: 1 – distilled water and the following aqueous solutions: 2 –citric acid solution 1%, 3 – citric acid solution 0.5%, 4 –citric acid solution 0.2%, 5 – ascorbic acid solution 0.1%, 6 – ethanol solution 50%, 7 – ethanol solution 20%, 8 –citric acid 0.5% and ascorbic acid 0.1% solution, 9 –citric acid 0.2% and ascorbic acid 0.1% solution, 10 – ethanol 20% and citric acid 1% solution and 11 –ethanol 20% and citric acid 0.5% solution. Batch extraction were carried out at 25 oC, liquid solid / ratio of 5 : 1, extraction time 3 minutes.

About 200 g of red beet was mixed in blender with 1 litre of ethanol (acidified with 2% citric acid) for 15 min at room temperature and left for 24 hours. The extract were filtered and concentrated under vacuum by a rotary vacuum evaporator at 40 0 C. as reported by [4]

3. EXTRACT PURIFICATION

A solid-phase extraction (SPE) with a vacuum manifold processor with CHROMABOND C18 column was used for extract purification in order to remove the organic acids, residual sugars, amino acids and proteins *JelenaVulić (2012)*



4. CHARACTERISATION OF THE NATURAL PIGMENT

Preliminary study was conducted to test the stability of betalains pigments derived from red beet in different pH media. The results obtained in Table (1) show that there are relationship between colour changes and pH variation.Most striking was the effect of on betalains content which was about 93.0 to 100.0 % at pH varied from 2.0 to 7.0, while the degradation of colour reached to 21.87 and 50.0 % at pH 8.0 and pH 10.0 respectively.

Moreover, the degradation of colour does not exceed 7 % in the range of pH values 3.0 to 7.0. For instance, the highest stability remained at pH 3.0 to pH 7.0 since less betalain degradation were extracted from red beet these results are similar with that of [2]. Below pH 3.0, the absorption maximum shifts toward lower wavelengths, and above pH 7.0 the change is toward upper ones, out of the pH range 3.0–7.0 the intensity of the visible spectra decreases.

Table 1: Retention% of betalain pigments extracted from red beet as a function of pH values. (ATTIA et al., 2013)

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

5. PACKAGING REQUIREMENTS FOR BETALAIN PIGMENTS

Modified atmospheric packaging is the replacement of air in a pack with a single gas or mixture of gases, either naturally or artificially. The proportion of each component is fixed when the mixture is introduced to the package. No further control is exerted over the initial composition, and the gas composition is likely to change with time owing to the diffusion of gases into and out of the product, the permeation of gases into and out of the pack, and the effects of product and microbial metabolism.

The major factors to be taken into account while selecting the packaging materials are:

(1) The type of package (i.e. flexible pouch or rigid or semi-rigid lidded tray)
(2) The barrier properties needed (i.e. permeabilities of individual gases and gas ratios when more than one gas is used)
(3) The physical properties of machinability, strength, clarity and durability
(4) Integrity of closure (heat sealing), fogging of the film as a result of product respiration.
(5) Sealing reliability
(6) Water vapour transmission rate
(7) Resistance to chemical degradation
(8) Nontoxic and chemically inert
(9) Printability
(10) Commercial suitability with economic feasibility

The success of modified atmosphere packaging (MAP) greatly depends on the accuracy of the predictive respiration rate models. Due to the complexity of the respiration process, only empirical models have been developed. The particular variables that influence the O2 uptake and CO2 production rate should be identified and quantified for each fruit or vegetable product.

Considerably more research is needed in this area. Fresh-cut products bring more variables that may influence respiration rate, such as preparation method, cutting size and time after cutting.

6. ACKNOWLEDGEMENT

The authors wish to thank Alam SK, RupamKarmakar, Murad Hossain, Debleena Das, Meghali Borah, NadiraSayedafor help with the experimental portions of this paper.

REFERENCE

[1] Church N (1994) Development in modified-atmospherepackaging and related technologies. Trends Food SciTechnol 5: pp 345–352

[2] Church IJ, Parsons AL (1995) Modified atmosphere packaging technology: a review. J Sci Food Agric 67: pp 143–152

[3] EL – Massry, Fatma, H. M.1, H. S. Hamed and F. A. EL – Ashwah, “RED CARROT ROOTS PROCESSED WASTES AS A SOURCE OF NATURAL RED PIGMENTS”, Egypt. J. Agric. Res., 91 (3), 2013, pp 1083-1093

[4] Attia,Gamila Y., M. E. M. Moussa and E.R.Sheashea, “CHARACTERIZATION OF RED PIGMENTS EXTRACTED FROM RED BEET (BETA VULGARIS, L.) AND ITS POTENTIAL USES AS ANTIOXIDANT AND NATURAL FOOD COLORANTS”, Egypt. J. Agric. Res., 91(3), 2013, pp 1095-1109

[5] Aura Sturzoiu, Marta Stroescu, AnicuţaStoica, TănaseDobre, “BETANINE EXTRACTION FROM BETA VULGARIS– EXPERIMENTAL RESEARCH AND STATISTICAL MODELING” U.P.B. Sci. Bull., Series B, Vol. 73, Iss. 1, 2011, pp 145-156