ANTHOCYANINS RICH PAPAYA CANDY (*TUTTI FRUITY*): AN INNOVATIVE FUSION PRODUCT WITH ENHANCED FUNCTIONALITY

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ABSTRACT

Acylated black carrot anthocyanins (BCA) known for remarkable heat stability and GRAS (Generally Recognized as Safe) status, can successfully replace synthetic pigments in tutti-fruity which is a common ingredients in other food formulation and thus consumed by all age of groups.Papaya's porous nature provides great opportunity in the form of ideal matrix to impregnate bioactive/functional/essential components like anthocyanins through osmosis. The targeted level of anthocyanins in present study was 100 mg/Kg of raw papaya flesh (50% of Maximum Permissible Limits).Papaya candy was prepared after boiling of raw papaya dices in sugar solution followed by drying for 2-3 days with the addition of anthocyanins during drying process. Blanching time, length of infusion time and concentration of anthocyanins in infusing medium ($p < 0.05$) was found to be the major factors influencing the infusion process. Prior blanching (85°C at 3 min), significantly reduced the infusion time by 1.8 to 2 folds.The findings of present study showed that the potential and possibility of infusing BCA into papaya matrix to transform hitherto unsafe image of papaya candy (tutti fruity) into a low fat functional product by developing an innovative fusion product.

Key words: *Anthocyanins, Infusion, Papaya,Tutti-Fruity.*

I. INTRODUCTION

Papaya candy (*tutti fruity*) enriching with bioactive anthocyanins pigments is an innovative and non-transgenic method for enhancing antioxidant activity of processed papaya productswhich could be used as an ingredient in variousfood formulations like cakes, biscuits, desserts etc. Acylated black carrot anthocyanins (BCA) known for remarkable heat stability and GRAS (Generally Recognized as Safe) status, can successfully replace synthetic pigments in *tutti-fruity*. Anthocyanins are water-soluble vacuolar pigments that may appear red, purple, or blue depending on the pH of the base matrix. Anthocyanins are well known for their pharmacological properties and when included in the human diet, they exhibit a wide range of antioxidant protection and therapeutic benefits [1-4].

India, with 5.639 million ton production (2013-14), is the largest producer of papaya in the worldwith 43.7% share in global production. Since papaya candy (*tutti fruity*) is one of the important ingredients of confectioneries and bakery products therefore consumed by all age of groups.Major concern associated with *tutti fruity* available in local market is;made of artificial and inferior quality of coloursin its manufacturing which are associated with severe health hazards [5]. Therefore, immediate attention is required to make them safe and natural withfood colours within the permissible levelso that the developed product would be safe and perfectly suitableto the consumers' expectations with enhanced functionality. Since*Tuttifruity* contained products are widely consumed by the children therefore to explore the potential of utilization ofanthocyanins as safe food colour is quite imperative.

Papaya's porous natureprovides great opportunity in the form of ideal matrix to impregnate bioactive/functional/essential components like anthocyanins through osmosis. Anthocyaninsare used to substitute synthetic pigments for their attractive colour and physiological functionality [6]. Use of natural food colorants in impregnation is expected to have dual value by providing exotic colour and enhancing nutritional status of foods, besides being more appealing and rewarding [7]. **Thus, the present study was designed to explore the potential of infusing BCA into papaya matrix to transform hitherto unsafe image of papaya candy(*tutti fruity*) into a low fat functional product by developing an innovative fusion product.**

1.1 TARGET TO BE ACHIEVED**:** Maximum Permitted Levels (MPLs) of anthocyanins (E 163) have been defined in commission regulation (EU) No. 1129/2011 as food additive. Currently, anthocyanins (E 163) prepared by physical means from fruits and vegetables are authorized food colouring substances in the EU with a MPLs of 200 mg/Kg of food in fruit flavoured breakfast cereal alone or in combination with E 120 and E 162. The targeted level of anthocyanins in present study was 100 mg/Kg of raw papaya flesh (50% of MPLs).

II. MATERIAL AND METHODS

2.1 Material

Papaya candy was made by raw papayaprocured from local market of Delhi (Fig 1 a). Black carrotscv. PusaAsitawere procured from Vegetable Science division of ICAR-IARI, Delhi (Fig 2 b).

Fig1a: Raw Papaya **Fig 1b: Black Carrot**

2.2 Methods

Papaya candy was prepared after boiling of raw papaya dices in sugar solution followed by drying for 2-3 days withthe addition of anthocyanins during drying process. Black carrot cv. PusaAsita juice extracted after various pre-treatments (Enzyme assistant, freshly crushed and vacuum dried) was used for infusion of anthocyanins at atmospheric pressure.

Total monomeric anthocyanins were calculated as cyanidin-3-glucoside by pH differential method using 80% methanol as solvent [8].

The effect of degree of blanching; anthocyanins concentration and infusion period on the anthocyanins content in processed papaya candy was determined using a three-level three-factor Box–Behnken design.

III. RESULTS

In the first phase of study, methodology for anthocyaninsquantification was standardized. pH differential method and colorimetric method as reported by Ranganna[9]using 80% methanol and Ethanol-HCl (80:20 ratio) as solvent system were tried for this purpose. Since pH differential method using 80% methanol was found the best for anthocyaninsquantificationtherefore was used during whole investigation. Enzyme assisted BCA concentrate had the highest anthocyanins content (2548mg/100g) followed by freshly crushed (876mg/100g) and then vacuum dried (354mg/100g). However, microwaved blanching was required to inhibit Polyphenol Oxidase (PPO) activity of BCA substrate followed by immediate and direct cooling.

In second phase of investigation,anthocyanins infusion study was conducted in blanched papaya dices rather than rawpapaya dices because blanching enhanced the porosity of tissues [10]which further facilitates infusion of bioactive components apart from inherent porous nature of papaya.

3.1 Infusion Of Anthocyanins

Blanching time, length of infusion time and concentration of anthocyanins in infusing medium ($p< 0.05$) was found to be the major factors influencing the infusion process. Prior blanching (85°C at 3 min), significantly reduced the infusion time by 1.8 to 2 folds. Results suggest that it is feasible to infuse anthocyanins content ranging from 200- 400 mg/Kg of papaya candy, depending upon the functionality required in the end product. Colour attributes in terms of (RGB) 136, 26, 99 further confirms, strong purple colorof the developed product (Fig 2 a) which retained during storage under refrigerated storage conditions(Fig 2 b).

Fig 2: (a) Developed Papaya Candy (b) Packed Papaya Candy

Infusion of anthocyanins and phenolics, increased antioxidant activity in papaya candy and imparted attractive purple colour seems an innovative way of transforming, unhealthy image of papayacandy into a safe functional product.Except colour, all other sensory scores were unaffected. The developed technology is a

successfulinitiative to providecolour and functionality without using any artificial colours and transgenic approachesto papaya candy which can easily be adopted by the small and large scale industry with very nominal capital investment.

IV. FUTURE LINE OF WORK

Having high α-glucosidase inhibitory activity (GIA), the BCA will not only impart an attractive purple colour to papaya candy but can also help in managing Type-2 diabetes provided the candies should be developed by using sugar replacer which will be perfectly suitable to diabetic people also.

REFERENCE

[1] C Kaur, HC Kapoor, Antioxidants in fruits and vegetables - the millennium′s health. International Journalof Food Science &Techology.36, 2001, 703–25.

[2] J Sun, YF Chu, X Wu, RH Liu, Antioxidant and antiproliferative activities of fruits. Journal of Agricultural and FoodChemistry 50, 2002, 7449–54.

[3] PL Prior, Absorption and metabolism of anthocyanins: Potential health effects. In: Meskin MS, Bidlack WR, Davies AJ, Levis DS, Randolph RK, editors. Phytochemicals: Mechanisms of action. CRC Press Inc: CRCPress, 2003.

[4] S Zafra-Stone, T Yasmin, MBagchi, A Chatterjee, JAVinson, D Bagchi, Berry anthocyanins as novel antioxidants in human health and disease prevention. Molecular Nutrition & Food Research.51, 2007, 675–83.

[5] http://articles.mercola.com. Are You or Your Family Eating Toxic Food Dyes?, 2011, Assessed on 06 May, 2016.

[6] G Fan,Y Han, Z Gu, D Chen, Optimizing conditions for anthocyanins extraction from purple sweet papaya using response surface methodology (RSM). LWT-Food Science& Technology, 41, 2008,155-160.

[7] ANBellary, NK Rastogi, Effect of Selected Pretreatments on Impregnation of curcuminoids and their influence on Physico-chemical Properties of raw banana slices. Food Bioprocess Technol, 7 (10) 2014, 2803-2812.

[8] S Sethi, S Singh ,SG Rudra, CKaur,. Protocols for analysis of antioxidants and functional quality in foods (Part 1). IARI, Pusa, New Delhi. 38-41 pp.

[9] SRanganna, Handbook of analysis and quality control for fruit and vegetable products. IInd ed. Tata McGraw Hill, New Delhi (India), 2007.

[10] SM Alzamora, D Salvatori, MS Tapia, ALópez-Malo, JWelti-Chanes, P Fito, Novel functional foods from vegetable matrices impregnated with biologically active compounds. Journal of FoodEngineering, 67, 2005, 205–214.