TIU Transactions on Human Sciences (TTHS)

TIU Transactions on Human sciences

Development of eggless cake with functional components through incorporation of blueberry-pulp

Dipanjan Ghosh[a], Subhrajit, Subhankar[b] , Dr. Jayati Chattopadhyay[c]

[a,b,c] *Techno Main Salt Lake, Sector-V, Salt Lake, Kolkata – 700 091, India*

Abstract

The market of bakery products in India has tremendous potential for growth. Market demand for these products are increasing at the rate of 10% per anum. These products enjoy a wide acceptability by people of all age group and include variety of products like bread, cake, cookies, biscuit etc. These products are found to be ideal vehicle for enhancement of nutritional quality and incorporation of functional components to achieve health benefits beyond nutrition. Novel fruit source, blue-berry, rich in dietary fibre and total phenolics were identified. Incorporation of blue-berry fruit-pulp in an egg-less cake-base were explored. Wheat flour, blended with 2.25% (w/w) whey-protein andsoy protein powder respectively, was chosen as base blend for incorporation. Through different trials, 15.0 % of blueberry pulp was selected for development of final product with comparable sensory attributes with the control cake. 14.18%(w/w) of crude fibre and 15.16% (w/w) of protein were found in functional cake. Total phenolics content were found to be 29.65 mg/100 g. cake compared to literature value of 0.43-0.79 mg./100 g. in control product.

1. Introduction

Wheat is consumed mostly as raw materials for baked products throughout the world. In India, demand of baked products is increasing day by day with an increase of 10% per anum (Singh, 2016).Baked products, originating from cereals, are major source of starch (%?) and so, hold a major market share as breakfast items and as snacks. In India, 25% of total wheat production is utilized for production of bakery products through organized and unorganized sector (Kamaljeet et al., 2010). Acceptability of bakery products like bread, biscuit, cakes and cookie is rapidly increasing due to many factors like changing lifestyle, convenience, affordability and availability of different varieties in Indian market. People of all age group consumed these products as per their requirement. These products are found to be ideal vehicle for enhancement of nutritional quality and incorporation of functional components to achieve health benefits beyond nutrition. Proximate composition of bakery products reveals that major nutrient present is starch, followed by protein and fat. Micronutrients such as vitamins and minerals are added externally to increase their content in bakery products. Baked products, produced from flour, are deficient in phytochemicals from fruits or vegetables and herbs or spices. These photochemical include polyphones, flavonoids, crude fibre, soluble fibre etc.

It has been observed that, with various epidemiological studies that high intake of dietary fiber has been found to be associated with reduced blood pressure, LDL cholesterol and associated cardiovascular diseases (Lupton and Turner, 2003).Poly phenols, flavonoids are known to have significant functional properties as antioxidants, anti-aging agents, anti-inflammatory substances etc.Being ranked as third in world in fruit production, fruit pulp can be considered as potential ingredient to increase functional value of bakery products. Ignat et al. (2011) showed importance of agricultural and industrial residues of fruit and vegetable processing as natural antioxidants Berries and other red fruits are characterized by the high amount of antioxidant molecules: phenolic acids, tannins, carotenoids, vitamin A, C, E, folic acid and minerals such as calcium, selenium and zinc. Canada and United states are the major hub of blueberries, indicating three-fourth production of commercial blueberries across world in 2014. According to Rejman and Pliszka (1991), proximate composition of fresh blueberry is known to be 83.4% moisture, 0.6% protein, 0.6% fat, 15% sugar and 0.3% ash on w/w basis. In addition to that, approx. 16 mg of vitamin content and approx. 30 mg. of mineral content are also contained by blueberry fruit matrix. Apart from being consumed as fresh fruit, these are also processed into various foods, such as fruit juice, jams, syrups and beverages (Olas, 2018).

Almost 20% of initial fruit weight is produced as waste material, known as pomace or pressed cake, during processing of blueberry juice.This is found to be the richest sources of phenolic compounds (Ignat et al., 2011;Sˇ aric´ et al., 2016).70% of polyphenols, originally present in berries and significant amount of dietary fibre are the two essential functional components present in blueberry pulp (Hilz et al., 2005). Phenolic antioxidants interfere with the oxidation process as free radical terminators and sometimes also as metal chelators (Danev et al., 2013; Manganaris et al., 2013).Blueberry processing residue is found to be effectively utilized in development of different food products. Blueberry pomace powder was applied to develop muffins for sensory and physical properties, and also to develop cookies enriched in antioxidants and dietary fibre. Drying of pulp may reduce some functional value in pomace powder. This work, therefore, focuses on utilization of blueberry pulp, as is basis, to formulate and develop a functional cake.

2. Materials and methods

2.1. Materials

Blueberry puree concentrate was purchased from market to be used as blueberry pulp (28 degree, per 100 g.).Other ingredients, used for cake preparation are: wheat flour, sugar, butter, margarine, skim milk powder, soya protein isolate, whey protein, baking soda, baking powder, mono glyceride ,salt. Soy protein is used to improve nutritional characteristics and whey protein powder to comply with the requirements of egg protein. Soy Protein Isolate is a pure, dry extracted soy-protein which is not so good foaming agent in baking industry though it is a good nutrient and emulsifier which can be used in eggless bakery industry. Mono glyceride: It promotes homogeneous crumb texture and increases crumb volume of cake. Acts as an effective emulsifier to hold the final phase of batter, we use this DuPont product to obtain a smooth and consistent batter.

2.2. Methods

2.2.1. Development of cake

Blueberry pulp was allowed to concentrate by vacuum evaporation using rotary vacuum evaporator. Temperature of water-bath of evaporator was set at 70C.Pulp was blended with an aqueous suspension of emulsifier to get a homogeneous blend. Coarsely ground sugar was added to this suspension. Shortening mix was melted. Dry-mix was prepared using whey and soya protein and leavening agent. Gradual addition with mechanical beating process was carried out. Sequential addition of first two liquid phases and then with dry-mix and finally with the flour, was conducted. A bar shaped mold was taken and greased that mold with butter and butter paper was placed inside the mold and then the prepared batter was poured in the mold and left it in the baking oven for baking. Final product was allowed to pack in LDPE pouch and sealed and kept at ambient temperature (28-30℃) for monitoring shelf-life. Three trials were taken on the basis of percentage incorporation of blueberry pulp in cake formulations.

Fig.1. Image of cake with blueberry pulp

2.2.2. Analytical method

2.2.2.1. Proximate Composition

Moisture, ash and acid insoluble ash were determined as per AOAC methods, 984.13, 985.29, respectively (AOAC, 2012). Fat was estimated following the FSSAI 03.039:2022 procedure. Moisture content was determined by gravimetric method using hot air oven (Make – Instrumentation India) at 105 0C until constant weight. Total ash was determined using a muffle furnace (Make – Instrumentation India)and acid-insoluble fraction of total ash was determined after rejection of acid-soluble part.

2.2.2.2. Total Poly phenol content

Total phenolic compounds were extracted as suggested by Vitaliet al. (2009).A mixture of methanol/water (90:10 v/v) was used, as proposed by Gao et al. (2002). Briefly, 200 mg ofground sample was extracted in methanol-water for 6-8 h at room temperature on a shaker. The mixture was then centrifuged at for 20 min on a table centrifuge (Make - Remi). The supernatant was collected and used for the determination of total phenolic compounds. Total phenolic content (TPC) of extracts was determined using Folin– Ciocalteu method based on oxidation-reduction reaction (Waterhouse 2002). Preparation of standard calibration curve: Various concentrations of gallic acid solutions in methanol (100, 75, 50, 25 and 10 μg/ml) were

prepared. In a 20 ml test tube, 1 ml gallic acidof each concentration was added and to that 5 mlFolin-Ciocalteu reagent (10%) and 4 ml 7% Na2CO3were added to get a total volume of 10 ml. The blue coloured mixture was shaken well and incubated for30 minutes at 40 0C in a water bath. Absorbance was measured at 760 nm against blank. Preparation of sample: An aliquot of the extract (0.2 mL)was added to 1.5mL of freshly diluted (1:10) Folin–Ciocalteu reagent. The mixture was allowed to sit for5 min. After, 1.5mL of sodium carbonate solution(60 g/L) was added. The mixture was incubated for90 min and the absorbance read at 725nm in a Shimadzu 1800 UV-Visible spectrophotometer. Methanol-water was used as a blank and gallic acid as standard. The results were expressed in milligramsof gallic acid per gram of sample.

Moisture, fat and protein percentage were determined with an interval of five days for three times and with an interval of fifteen days for two times. Tests were conducted as per FSSAI guideline to monitor any kind of degradation in texture, probability of microbial attack or change in nutritional value.

3. Results and Discussion

3.1. General observations

Cakes with incorporation of 10% and 22% blueberry pulp were found not to comply with the sensory characteristics. With 10% pulp, taste of pulp was not being perceived during sensory evaluation and with 22% pulp, limitation was found during baking. Cake, developed with selected formulation, was evaluated for proximate composition. Proximate composition: Proximate composition of any food product determines category of that food in our diet e.g. protein-

Table 1: Formulation trial details: (Basis: 100g. flour)

Ingredients	Trial 1	Trial 2	Trial 3
Wheat flour	100 g.	100 g.	100 g.
Soy protein	2.20 g.	2.20 g.	2.20 g.
Whey protein isolate	2.20 g.	2.20 g.	2.20 g.
Sugar	100 g.	100 g.	100 g.
Skim milk powder	21.8 g.	21.8 g.	21.8 g.
Sweetened condensed milk	21.8 g.	21.8 g.	21.8 g.
Baking soda	1.25 g.	1.25 g.	1.25 g.
Baking powder	1.87 g.	1.87 g.	1.87 g.
Butter	25 g.	25 g.	25 g.
Margarine	25 g.	25 g.	25 g.
Blueberry pulp	10 g.	15 g.	22 g.
Monoglyceride	4.68 g.	4.68 g.	4.68 g.
Salt	1.56 g.	1.56 g.	1.56 g.

Total phenolic content of the extracts was expressed as mggallic acid equivalents (GAE) per gram of sample (mg/g). Total phenolic content in all samples were calculated using the formula: C = cV/m where, C = total phenolic content mg GAE/g sample, c = concentration of gallic acid obtained fromcalibration curve in mg/ml, V = volume of extract in ml,m = mass of extract in gram.

2.2.2.3. Chemical parameters during shelf-life of cake

based or carbohydrate based.Composition of developed cake was shown in the tableResults showed that, values of crude fibre content and ash content were found to be much high. Literature study revealed that cookies,produced by substituting 56% of wheatflour with blueberry pomace, were found to have a fiber content of 14.64 ± 4.40 g/100 g of cookies dwb.High-fibre blueberry cultivars are reported to have crude fibre content in the range of 0.78-1.41%(*Skupień*, **2006).** High amount of fibre in blueberry pulp may be the probable source of high fibre in cake.Thus, developed cake with blueberry may be termed as “high-fibre cake”, as per EU and

FSSAI guideline (at least 6 g of dietary fiber per 100 g).

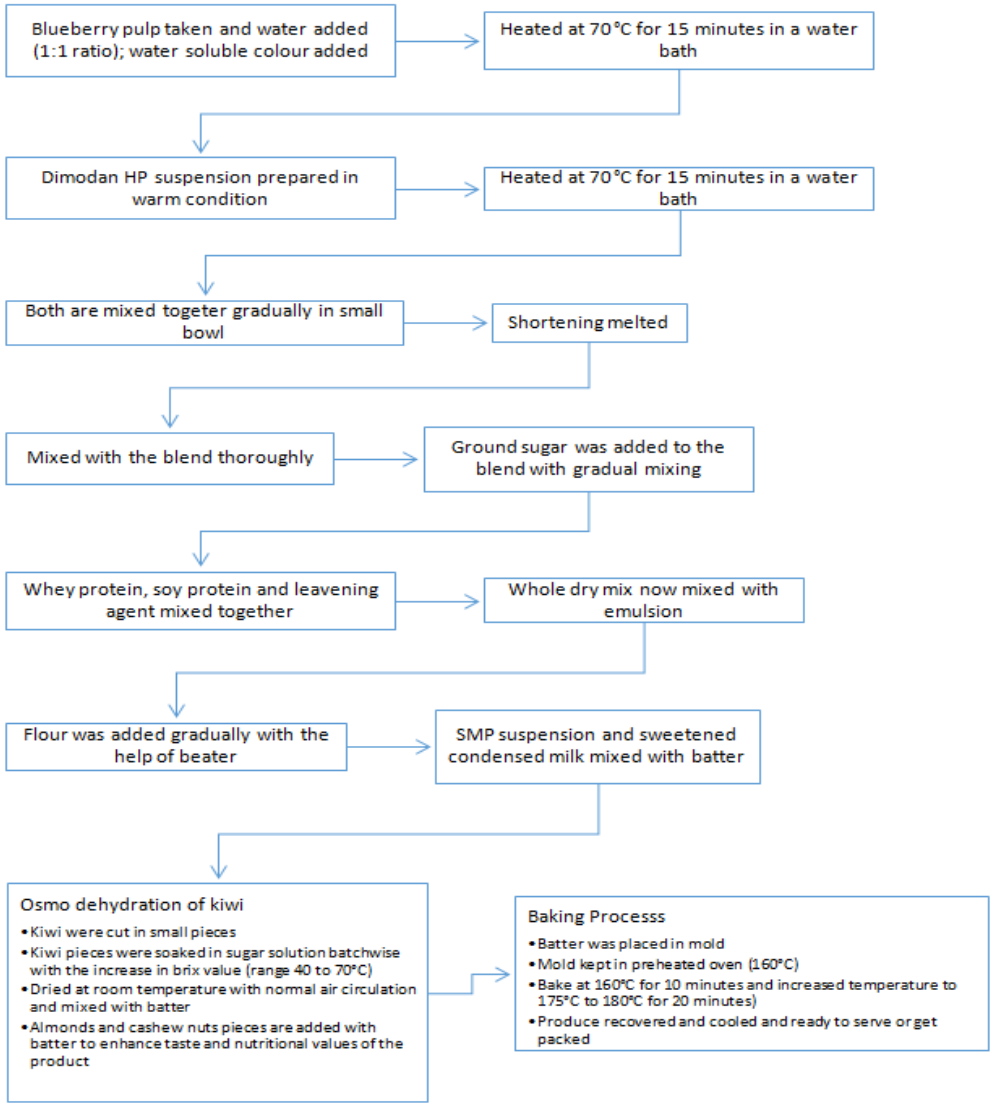

Fig. 2: Process flow-sheet of developed cake with blueberry pulp

3.2. Sensory analysis of cake

Scores on hedonic scale was represented in table (Table 2) for the cake, incorporated with 15% blueberry pulp.Munoz et al., 1992,considered an acceptability score of 6.0 in a nine-pointhedonic scale (the first score in the liking category) as acommercial or quality limit for baked products.Flavour, taste and overall acceptability were found to cross the acceptable score for the functional cake.

Table 1: Proximate composition of developed cake g/100g dwb

Component	Percentage in final product
Protein	15.06± 0.52
Lipid	18.89 ± 0.08
ash	2.56 ± 0.03
Crude fibre	14.85 ± 0.14
Carbohydrate	48.64[a]

Table 2: Sensory analysis of cake

Attribute	Score
Appearance	7.0
Colour	8.0
Aroma	6.5
Flavour	7.5
Mouthfeel	6.5
Taste	7.0
Overall acceptibility	8.0

3.3. Estimation of total polyphenol content:

Sample	Total poly-phenol content (%)
Cake with blueberry pulp	29.65 ± 1.27

Obtained data for total polyphenol content is conforming with that of blueberry cookies, studied by Arcia et al., 2017(Ref.).170-220 mg /100 g. of polyphenol in highbush cultivars of blueberry is found to enrich total polyphenol content and thus, functional value of the developed cake through blueberry pulp. Earlier study also showed high value of Malvidin, a type of anthocyanin, in cookie with grape pulp, as reported by Pasqualone et al. (2014).

4. Conclusion

Addition of blueberry pulp was proved to be successful in development of functional cake. An optimum level of 15% was found to be suitable for production of functional cake. Functional value of wheat-flour based cake was much improved by addition of blueberry pulp through an increase of crude fibre and total polyphenol content. Functional cake does contain 14.85% crude fibre and 29.65% total polyphenol content. This product comes under "High-fibre cake" as per EU and FSSAI guideline. Developed cake also showed 8.0 as overall acceptability score. The present study paves way to an innovative utilization of blueberry pulp and a sustainable solution for blueberry-processing industry.

References

[1] Singh, R. (2016). Development of fiber enriched bakery products by incorporating fruit pulp waste powder and their acceptability evaluation. *Int J Adv Res Biol Sci*, *3*, 222-6.

[2] Kamaljit, K., Baljeet, S., & Amarjeet, K. (2010). Preparation of bakery products by incorporating pea flour as a functional ingredient. *American Journal of Food Technology*, *5*(2), 130-135.

[3] Lupton, J. R., & Turner, N. D. (2003). Dietary fiber and coronary disease: does the evidence support an association?. *Current Atherosclerosis Reports*, *5*(6), 500-505.

[4] Ignat, I., Volf, I., & Popa, V. I. (2011). A critical review of methods for characterisation of polyphenolic compounds in fruits and vegetables. *Food chemistry*, *126*(4), 1821-1835.

[5] REJMAN A., PLISZKA K., 1991. Borówka wysoka. PWRiL, Warszawa: 112. [In Polish]

[6] Olas, B. (2018). Berry phenolic antioxidants–implications for human health?. *Frontiers in pharmacology*, *9*, 78.

[7] Hilz, H., Bakx, E. J., Schols, H. A., & Voragen, A. G. (2005). Cell wall polysaccharides in black currants and bilberries—characterisation in berries, juice, and press cake. *Carbohydrate Polymers*, *59*(4), 477-488.

[8] Denev, P., Lojek, A., Ciz, M., & Kratchanova, M. (2013). Antioxidant activity and polyphenol content of Bulgarian fruits. *Bulgarian Journal of Agricultural Science*, *19*(1), 22-27.

[9] AOAC. (2012). Official Methods of Analysis of AOAC International. 19th ed. Gaithersburg: AOAC International.

[10] Vitali, D., Dragojević, I. V., & Šebečić, B. (2009). Effects of incorporation of integral raw materials and dietary fibre on the selected nutritional and functional properties of biscuits. *Food chemistry*, *114*(4), 1462-1469.

[11] Determination of Total Phenolics - Waterhouse, Andrew in book"Current protocols in Food Analytical chemistry" 10.1002/0471142913fai0101s06

[12] Gao, L., Wang, S., Oomah, B. D., & Mazza, G. (2002). Wheat quality: Antioxidant activity of wheat millstreams. *Wheat quality elucidation*, *1*, 219-233.

[13] Skupień, K. (2006). Chemical composition of selected cultivars of highbush blueberry fruit (Vaccinium corymbosum L.). *Folia Horticulturae*, *18*(2), 47-56.

[14] Pasqualone, A., Bianco, A. M., Paradiso, V. M., Summo, C., Gambacorta, G., & Caponio, F. (2014). Physico-chemical, sensory and volatile profiles of biscuits enriched with grape marc extract. *Food Research International*, *65*, 385-393.