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Research Article

# DEVELOPMENT OF NOVEL FUNCTIONAL CONFECTIONERY USING LOW REDUCED SUGAR

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**ABSTRACT**

Sugar is the new dietary concern, reducing the level of sugar is definitely the actual trend worldwide. Increase in non-communicable diseases such as Diabetics and Obesity has increased the demand for less sugar / sugar free products. The aim of this project is to reduce the sugar level in the jelly confectionery without affecting the sensory attributes and to increase the antioxidant property of the jelly. We have incorporated Fructose oligo saccharide (FOS) to replace the sugar and blue berry extract to increase the antioxidant property. Three different concentration of FOS was used at 6, 12, 18 % and blue berry extract at 5 and 10%. All the Jellies were evaluated for moisture, pH, total acidity, ash, total soluble solids and antioxidant capacity using DPPH method. Texture of reduced sugar jelly was similar to the standard sugar jelly. Sensory analysis was done using 9-point hedonic scale which resulted that jelly with 18% FOS and blue berry extract 10% most preferable. FOS level can be used to replace the sugar in jelly without affecting sensory properties.

**KEY WORDS**: Jelly confectionery, Fructose oligo saccharides, Blue berry pulp, antioxidant, DPPH.

## INTRODUCTION

Blueberry is rich in antioxidant activity which contains a group of phytochemicals including gallicacid p-hydroxybenzoic acid, chlorogenic, p-coumaric, caffeic, ferulic,ellagic acids, anthocyanins, catechin, and quercetin (Devareddy et al. 2008). Blueberries prevent several diseases in rat model according to previous studies. Blueberry supplementation may protect against neurodegeneration and cognitive impairment mediated by excitotoxicity and oxidative stress (Duffy et al. 2008). Blueberries can prevent bone loss caused by ovarian hormone deficiency (Devareddy et al. 2008). Also, consumption of blueberry polyphenols reduces exercise-induced oxidative stress compared to vitamin C and may be beneficial for athletes exercising in hot environments (McAnulty et al. 2004). Blueberries are fruits with one of the highest antioxidant capacities. The antioxidant activity of blueberry depends on their phytochemical complex, being mainly represented by anthocyanins, procyanidins, chlorogenic acid, and other flavonoid compounds (Giovanelli, 2013). It is supposed that the major contributors to their antioxidant activity are mainly anthocyanins, responsible for about 84% of TAC, and not ascorbic acid (Borges 2010). Ascorbic acid, which is present in blueberries in a significant amount, was found to contribute to antioxidant capacity only with a small portion up to 10% (Harasym 2014, Barberis 2015). Regarding cultivar variance, for rabbiteye blueberries it was hypothesized that they could have higher antioxidant activity than lowbush and

highbush varieties. This might be due to their thicker skin having higher concentrations of anthocyanins. The variances in total phenolic content between cultivars and maturity stages are relevant for the obtained changes of the antioxidant activity. The contribution of each individual phenolic compound to the total antioxidant capacity may vary (Pertuzatti 2014). Fructooligosaccharides (FOS) belong to the group of oligosaccharides and are isolated from plants. They consist of three to ten monosaccharide units joined by α-glycosidic bonds (1-2) between terminal fructose and glucose (Tamine, 1994). FOS are available in some foods such as bananas, garlic, onion, tomato, wheat, asparagus, artichoke, leek, honey, rye, brown sugar, barley, triticale, beer, lettuce, chicory, burdock, beetroot and apples.

FOS is commercial use emerged in the 1980s in response to consumer demand for healthier and calorie-reduced foods. FOS resists hydrolysis by salivary and intestinal digestive enzymes. In the colon, they are fermented by anaerobic bacteria. In other words, they have a lower caloric value, while contributing to the dietary fiber fraction of the diet. FOS is more soluble than inulins and is, therefore, sometimes used as an additive to yoghurt and other products (Gibson GR, 1997 and Roberfroid MB). FOS has been used especially in combination with high-intensity artificial sweeteners, to improve sweetness profile and aftertaste. FOS also acts as a prebiotic by stimulating the growth of „healthy" bacteria in the colon. FOS can be used for its nutritional advantages or technological properties, but it is often applied to offer a dual benefit: an improved organoleptic quality and a better-balanced nutritional composition. FOS has technical properties that are comparable to those of sugar and glucose syrups. It provides 30–50% sweetness compared with table sugar (Gibson and Roberfroid MB, 1997). These have been utilized in many food products.

## MATERIAL AND METHODS

Blueberry (*vaccinium corymbosum*) pulp was purchased from local market at Chennai, Tamil nadu. Pulp was stored in a freezer until processing. Other jelly preparation additives such as citric acid, sodium benzoate, tri sodium citrate was purchased from sigma Aldrich. Sugar and liquid glucose were purchased from local market, pectin was purchased from CPKELCO, Fructose oligo saccharide (FOS) and blueberry flavour were procured from KP MANISH Global Ingredients Pvt Ltd, Chennai.

**Preparation of Premix**

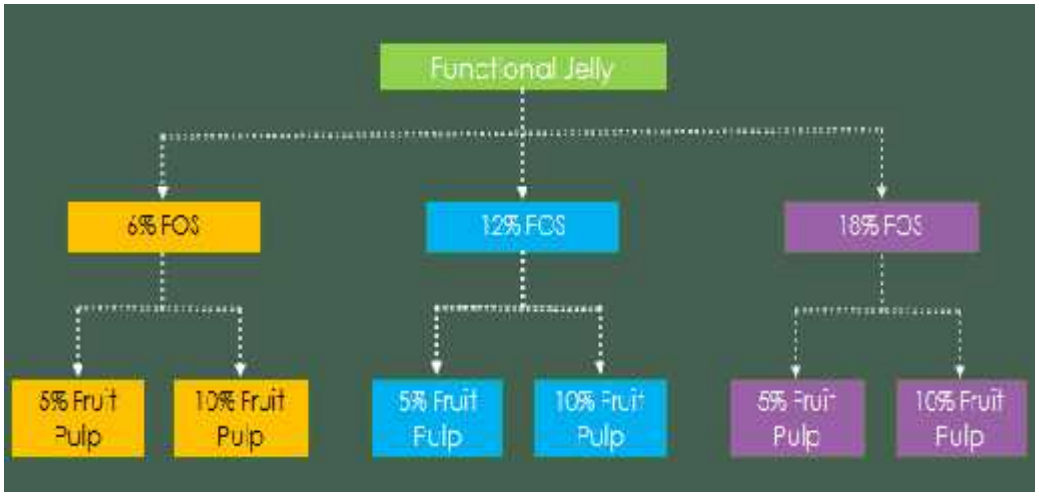
Ingredients for the premix is listed in the above table. For the preparation of jelly products, the pectin is mixed with powdered recipe components. Usually a part of the sugar required in the formulation is used for this purpose. If buffered pectins are used, it will not be necessary to add retarding agents. With non-buffered pectins the buffer component should be added to the pectin-sugar mix. It is important that the pectin is distributed homogeneously in the sugar in order to prevent lumping when it is added to the product mix.

**A.** Mix pectin and sodium citrate with sucrose (taken from the total amount). **B.** Stir mixture **A** into the hot water until the pectin is completely dissolved.

Preparation of base ingredients

Base ingredients for any confectionery article is Sugar, liquid glucose and water. The ultimate of this project is to reduce the sugar content without affecting the texture of the jelly. FOS was used for sugar replacement in jelly at 6, 12, 18 %. And blueberry pulp was added at 5 and 10% (Fig 1).

**Fig 1** Composition of the functional jelly




**Cooking process**

The recipe ingredients water, fruit pulp are poured into the pan and the premixture was then added while the mixture was being stirred. The mixture is heated to boiling point and kept boiling until the pectin was completely dissolved. Then the remaining pectin – sugar mix was added. The preparation is boiled until the desired soluble solids content, which is usually 78%, is reached. The mixture was cooled to approx. 90°C, and the colourants, flavours and acid were added. Then the preparation was deposited quickly. Following the addition of acid, after a certain time a dissociation equilibrium is established between the added buffer salts and the edible acid. This causes a slow decrease of the pH-value. Depending on the retarding agents used, the pH-value required for the pectin gelation will be reached after different times Once the edible acid is added, the gelling process starts irreversibly. The mixture should now be quickly deposited into the desired mould to give sufficient time for proper setting. If the depositing temperature drops too low or if the delay between the addition of acid and depositing the product is too long, pregelation may occur, considerably affecting the quality of the final product. After 15-20min jellies were taken from mold and dried at 40°C for 36 hours and packed. The product was studied for chemical, microbial and sensory evaluation on day 15, 30 of storage period.

## RESULTS AND DISCUSSION

In this project different batches of reduced sugar jelly was prepared successfully with incorporating different levels of Blue berry pulp to increase the antioxidant property of the jelly. Sugar free or reduced sugar confectionery article is a challenging task to perform, here sugar reduction in jelly confectionery was done using Fructose Oligo Saccharide (FOS).

**Table 1** The sugar replacement which means FOS percentage and incorporation level of the Blueberry pulp in confectionery jelly

| Batch No. of the jelly | FOS % | Blueberry pulp % |
|---|---|---|
| KRDPRK605 | 6 | 5 |
| KRDPRK610 | 6 | 10 |
| KRDPRK1205 | 12 | 5 |
| KRDPRK1210 | 12 | 10 |
| KRDPRK1805 | 18 | 5 |

| | | |
|---|---|---|
| KRDPRK1810 | 18 | 10 |
| KRDPRKSD05 | 0 | 5 |
| KRDPRKSD10 | 0 | 10 |

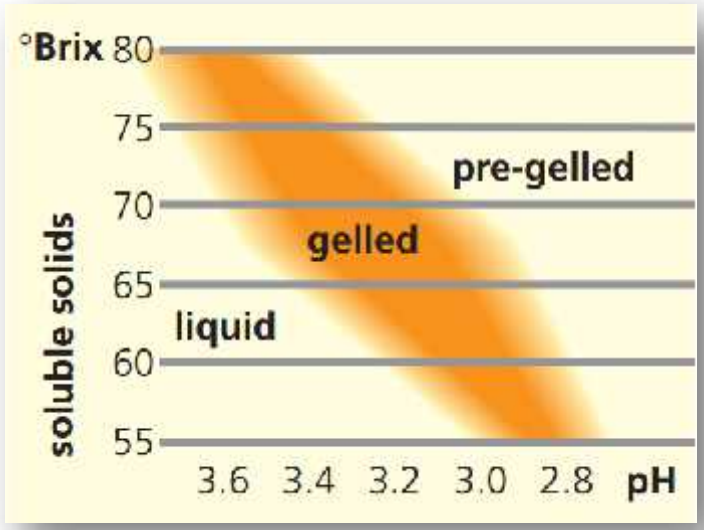
**Physico-chemical analysis of the functional blueberry jelly**

pH of the jelly was measured for batch following batch (table 2) Product KRDPRK605 contains maximum pH value of 3.64±0.02 and KRDPRK 1810 contains the minimum pH value of 3.29±0.03. It was observed that the pH value for Blueberry jelly is in accordance with recommendations for an adequate gel formation, as shown in the pH vs brix (Fig 2). The gel formation occurs only at certain pH values, and the optimal conditions for its formation are close to 3.2 to 3.6 at 78°Bx.

**Table 2** Physico-chemical analysis of the functional blueberry jelly

| Product | pH | Moisture content | Titratable acidity | °Brix | Total Ash (%) |
|---|---|---|---|---|---|
| KRDPRK605 | 3.64±0.02 | 15.62±0.11 | 0.582±0.01 | 78.4±0.02 | 0.4234±0.21 |
| KRDPRK610 | 3.59±0.01 | 17.08±0.09 | 0.624±0.21 | 78±0.06 | 0.592±0.24 |
| KRDPRK1205 | 3.48±0.05 | 18.14±0.10 | 0.524±0.05 | 78.2±0.00 | 0.4452±0.26 |
| KRDPRK1210 | 3.56±0.01 | 16.53±0.00 | 0.498±0.04 | 78±0.05 | 0.4921±0.21 |
| KRDPRK1805 | 3.34±0.02 | 15.65±0.02 | 0.487±0.06 | 78.5±0.04 | 0.4872±0.25 |
| KRDPRK1810 | 3.29±0.03 | 17.73±0.06 | 0.527±0.00 | 78.1±0.03 | 0.5451±0.21 |
| KRDPRKSD05 | 3.61±0.04 | 15.02±0.05 | 0.502±0.04 | 77.9±0.01 | 0.4128±0.22 |
| KRDPRKSD10 | 3.52±0.11 | 16.54±0.04 | 0.542±0.05 | 78.4±0.06 | 0.468±0.20 |

**Fig 2** Blueberry jelly is in accordance with recommendations for an adequate gel formation, as shown in the pH vs brix




It is noteworthy that at lower values, the gel resistance decreases (Gava et al., 2008), occurring syneresis. Thus, the pH value found in Blueberry jelly is consistent with recommended, causing no damage to the gel formation and presenting intermediate acidity without affecting the jelly elasticity. Several researchers have reported different pH values for optimum jelling. Desrosier and Desrosier (1978) found that gel formation occurs only within a narrow range of pH values. Optimum pH conditions are found near 3.2 for gel formation. Values below this point find gel

strength decreasing slowly; values above 3.5 do not permit gel formation at usual soluble solids range. Most jams have pH values between 2.9 and 3.4 as suggested by Egan et al. (1981). Falco et. al. (1983) tested Sodium Benzoate and Potassium Sorbate for their ability to preserve 3 months concentrated jam (pH-3.7, water activity 0.87) stored in non-hermetic containers. The results indicated that pH-3.2 to pH-3.6 gives the proper ranges of jellification which is similar to Egan et al. 1981

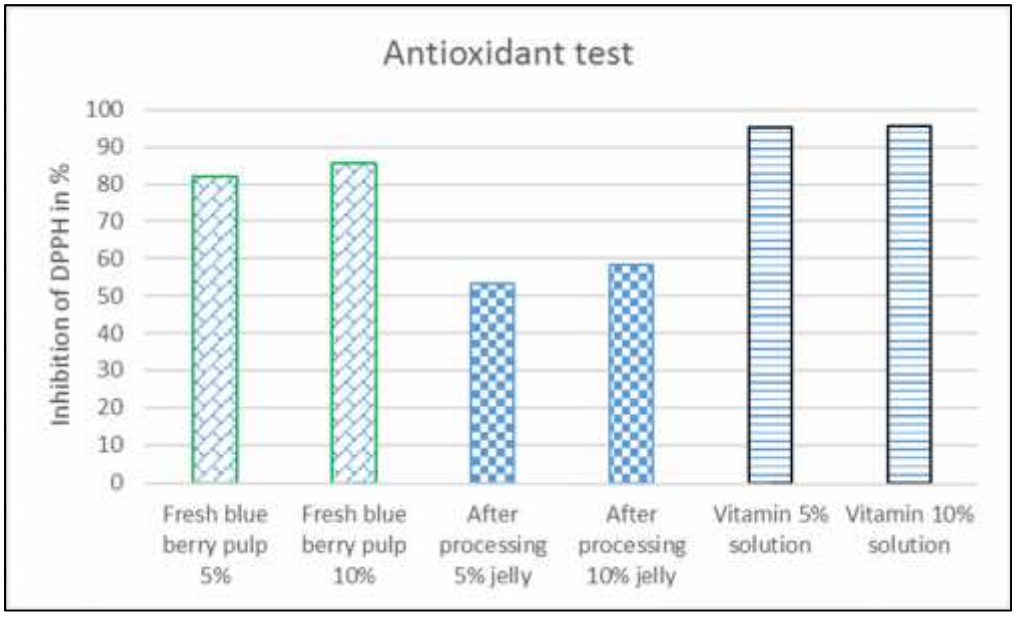
**Moisture content**

Blue berry jelly brix is 78º Bx hence the moisture of the product got reduced which is similar to the work done by Gava et al. 2008. Several workers have reported a range of acidity with proper gelation properties. Desrosier and Desrosier (1978) argued that added acid should be adjusted to maintain proper pH range necessary for gel formation. Egan et al. (1981) suggested a minimum of 0.65% acidity in table jelly crystals. Commercial producers of jam use the specification of 0.6%±0.05 of acidity (as citric acid) for mix fruit jams. Hyvonen and Torma reported that although pH-3.2 could not be achieved in all the jams when the maximum amount of 0.5% citric acid permitted by Finish food legislation was added, only this quantity was used at 40% sweeteners level. Torezan (2002) observed the acidity values of 0.9% in jam prepared by continuous process and 0.6% for jam prepared by conventional method. The increase in acidity is obviously due to breakdown of sugars and increase in total soluble solids.

**Antioxidant test**

There are many methods available to analyse the antioxidant property of the food material. One of the method is DPPH free radical scavenging method of analysing antioxidant property. The antioxidant capacity of standard solution vitamin c and 5% and 10% blueberry jelly and fresh blueberry pulp was determined.

**Fig 2** Antioxidant analysis of the functional jelly

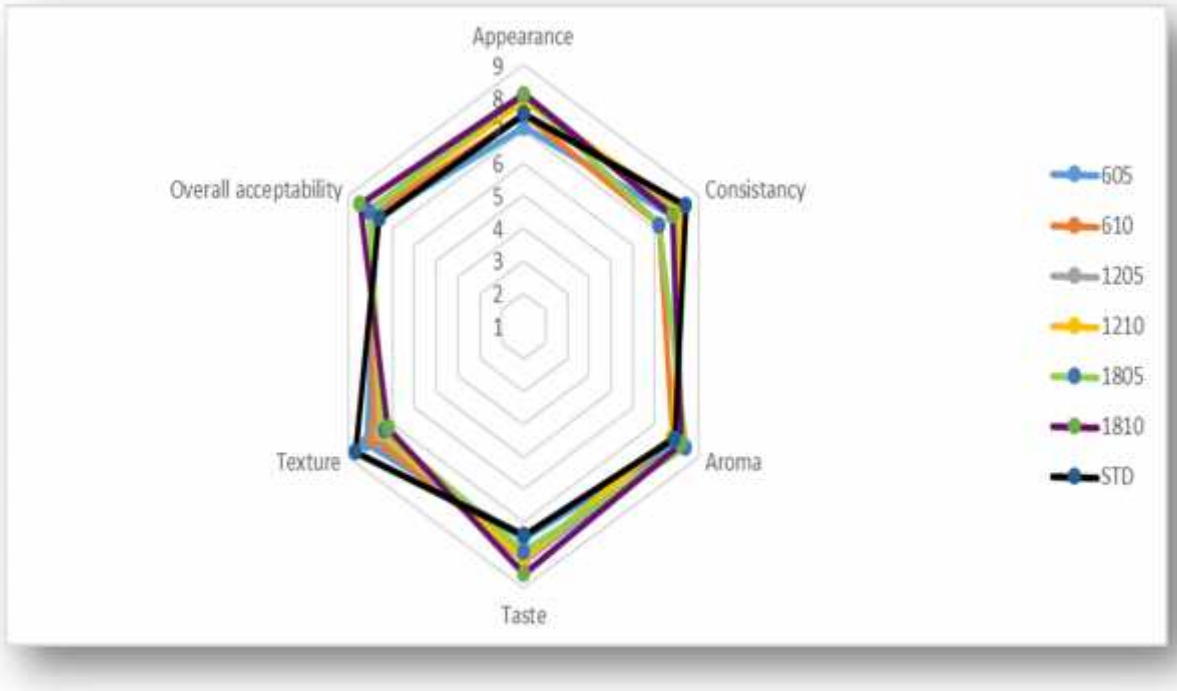



In this study, the antioxidant capacity was determined by the reduction of optical absorption at 517 nm due to the scavenging of the stable free radical by the DPPH radical. (Brand-williams, 1995) The results of DPPH tests indicated that even after cooking, the Blueberry jelly still had more than half of the antioxidant property. After performing the method in the fresh fruit, a reduction of 40% of the antioxidant capacity of the fresh fruit pulp was observed, showing 53% of total discoloration of the DPPH radical (Fig 2). A reduced antioxidant capacity was also observed by Kim and Padilla-Zakour

(2004) comparing the antioxidant capacity of fruits before and after processing into jellies. This decrease can be attributed to the destruction of active antioxidant compounds such as vitamin C by the heating process during processing. Vitamin C is very unstable to heat and decreases significantly during the preparation of orange juice (Piga et al., 2003). The reduced antioxidant capacity of orange juice, based on the elimination of free radicals, was attributed to the degradation of ascorbic acid due to heating (Loscalzo et al., 2004). Thus, it was observed that the Blueberry pulp jelly has reduced antioxidant capacity compared to fresh fruit due to thermal processing. However, it is interesting to observe that there is 60 percentage of discoloration of the DPPH radical, indicating that the jelly has the capacity of scavenging free radicals. These radicals react with biological substrates and may cause damage to biomolecules and thus affect human health. Thus, the consumption of products like this type of jelly with antioxidant properties is essential to control the action of these agents and reduce oxidative stress.

**Sensory evaluation**

**Fig 3**: Sensory analysis of the functional jelly using 9 point hedonic scale




Sensory analysis was done for jellies using 9 point hedonic scale at KP Manish R&D centre with trained panel members (Fig 3). Jelly contains 18% FOS and 10% blueberry pulp was most preferred by the panel members. All jellies were good in taste wise when compared to the standard jelly. FOS in jelly provides good taste when the concentration was increased.

## CONCLUSION

The present work showed that jelly production using different percentage of FOS and Blueberry pulp seems to be a good option for industrials to claim reduced sugar products and antioxidant rich product. After performing the physico-chemical characterization of the jellies significant differences were found in pH, ash content, titratable acidity. Even though processing may cause the loss of some antioxidant activity, our results showed that jellies still have antioxidant potential even after processing. There were no significant difference among the jellies with 18% FOS and 10% Blueberry

pulp In this work 40% of the sugar was replaced with FOS. Blueberry retained its antioxidant activity about 62% after processing. In future FOS percentage can be increased without affecting the sensory attributes.

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