

Determining the Role of *Morinda citrifolia* and *Stevia rebaudiana* as Nutritional Enhancers

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ABSTRACT

Morinda citrifolia and *Stevia rebaudiana* are the buzz words from plant kingdom for the diabetic community. As known to all, diabetic people are devoid of the privilege of consuming sweets or any food sweet in taste. Though, there are several special foods available for diabetics in market, the jams or spreads is most limited. Jam being most favoured spread for people of all ages, especially on the top of frequently consumed breads, it becomes obligatory to enhance its nutritional parameters. Hence, as a pilot initiative this study aims to develop value added jam consumable by diabetics. Jam was developed by incorporating noni fruit pulp (*Morinda citrifolia*) as a major ingredient and stevia (*Stevia rebaudiana*) leaves extract as a source of sweetness. The developed value added jam was subjected to physical, organoleptic and nutritional evaluation. The brix value of the value added jam was 68.50, pH 3.3 and moisture was 29.73%, which met the set standards. The organoleptic evaluation score high in all aspects like appearance, texture, flavour, mouthfeel and overall acceptability. The valued added jam, with noni fruit pulp and stevia powder incorporated was found low in calories and carbohydrates and rich in fibre, calcium, magnesium and potassium. It was observed that the resultant product was rich in micronutrients with enhanced taste and can be considered as an apt complimentary food for diabetics and persons with liver disorders.

KEY WORDS: DIABETES MELLITUS, JAM, MORINDA CITRIFOLIA, STEVIA REBAUDIANA, VALUE ADDITION.

INTRODUCTION

The main components of this study are *Morinda citrifolia* and *Stevia rebaudiana*. *Morinda citrifolia* commonly

known as Indian mulberry or noni fruit has been cultivated since 400 A.D. Therapeutically, noni is used as a medicine due to its antimicrobial and antioxidant properties (Duduku Krishnaiah et.al, 2015). Some of the medicinal and functional properties of noni includes wound healing, promotes a healthy inflammatory response, reinforces the body's ability to fight infection, helps maintain healthy blood sugar levels and strengthens cells at the micro level (Aline Carla Inada et.al, 2017). Noni juice has found to enhance neural-immune interactions and cell survival pathways while inhibiting inflammatory processes in age-associated diseases (Jahidul Islam, 2019). Although noni is power packed with phytonutrients or nutraceutical compounds like alizarin an anthroquinone, epigallocatechin gallate,

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limonene, terpenes like beta-carotene and fibre its use is scarce. However, it still requires more research aimed at standardization to raise the quality of products that are already in the market, such as Noni fruit juice, and to elucidate the real potential of this plant. (Edipo.S. Almedia et. al, 2019).

Stevia rebaudiana generally known as sweet tulsii, is composed of several natural, heat-stable steviol glycosides (Margaret Ashwell, 2015) with different intensities of sweetness and flavour profiles which differ from each other and vary according to concentration and environment of growth. Due to its low calorific value and intense sweetness stevia will prove as an effective alternate to table sugar. Unlikely, the artificial sweeteners like aspartame have gained popularity as a sugar substitute for diabetes mellitus than stevia. Stevia has proved to exhibit bactericidal activity, possess antioxidant properties, lowers blood sugar levels and controls blood pressure (Rojas E et. al, 2018). In addition to be used as intense sweetener, Stevia helps in preparation of functional and medicinal foods that augment health status of masses (Muhammad Farhan Jahangir Chughtai et. al, 2020).

Jam, a versatile food product used globally is high in calories. Jam includes fruits in its preparation and hence seems to be a healthier food product than jellies and preserves (Kevin Farrell, 2020). As the diabetic people are deprived of relishing the taste of jam, the development of value added jam by incorporating noni fruit pulp and stevia will benefit the needy diabetics.

MATERIAL AND METHODS

Procurement and Processing of Raw Material: Different ingredients for the development of jam like noni fruit, stevia powder and pectin powder were procured from the local departmental store in Salem district, Tamil Nadu. **Processing of Noni Fruit:** Noni fruits were purchased and checked for any infestation or damage. Noni fruits free from damage were then kept to ripen. The noni fruits were mashed and ground, after peeling skin and removing seeds, to make pulp.

Physical and Functional Characteristics of Noni Fruit: The physical characteristics of noni fruit such as mass, length, circumference, density, seed size and functional traits such as juice recovery and mass of the pulp were assessed.

Formulation of Noni Fruit Pulp and Stevia Powder Incorporated Value Added Jam: Pulp from the fruit were processed into fruit jam according to the FAO guidelines (Mircea Enachescu Dauthy, FAO, 1995). Pectin from different sources was tested for gelling capacity needed to produce acceptable jam. The sources of pectin were the natural pectin present in the fruit itself and commercial pectin powder.

The list of ingredients and their level of incorporation for preparing the product are given in Table 1. 100gms

of noni fruit pulp and 10gms stevia powder was placed in a stainless steel kettle and heated to about 110°C under constant stirring and was turned low. 0.2 gms of pectin powder was mixed with another 5gms of stevia powder, and then added into the fruit pulp and stirred constantly to prevent the pectin from coagulating. When the pectin dissolved completely, the remaining 5gms of stevia powder was added and dissolved completely in the mixture. The heat was then increased and the jam mixture was stirred constantly, until vigorous boiling started. Near the finishing point approximately 221°C, lemon juice was used to justify the customary acidity. For the control jam strawberry fruit pulp was used as, strawberry fruit jam was considered as most favourite through survey. Same methodology with 100 gms of strawberry fruit pulp and 20gms of sugar was followed for the preparation of control jam.

Table 1. Ingredients in the Preparation of Control Jam and Value Added Jam

Ingredients	Level of Incorporation	
	Control Jam	Noni Fruit Pulp and Stevia Incorporated Value Added Jam
Noni fruit pulp (gms)	-	100
Strawberry fruit pulp	100	-
Stevia powder (gms)	-	20
Sugar (gms)	20	-
Pectin powder (gms)	0.2	0.2
Lemon juice (ml)	10	10

RESULTS AND DISCUSSION

The findings of the study are presented below.

Physical and Functional Characteristics of Noni Fruit and Pulp:

Fruits in different maturation stages may be found in the same shrub to tree (Carrillo-Lopez and Yahia, 2011). The fruits can be harvested at different stages of maturation, which will continue to ripen naturally. The ripening process of the fruit comprises five phases that correspond to the tonality and hardness of the fruit (Chan-Blanco et al. 2006). Noni fruit has a shelf-life of 5 to 7 days at an ambient temperature between 25 and 30°C and relative humidity between 70 and 75% (Singh DR et al. 2007). The noni fruit has brown colored seeds (3 to 9 mm long), housed in groups of four inside numerous reddish-brown, triangular-shaped grooves (Dittmar, 1993). When dried in the air noni seed is lightweight, weighing about a quarter of gram, and its coating is made up of extremely resistant layers of cellulose fibers. Its interior is composed of bulbous ovoid chamber where the embryo is housed. The embryo is quite small (few millimetres), flat and oily (Nelson, 2005). It is evident from table 2 that the physical and functional traits of

noni fruit and pulp used for the study complied with the values reported by various researchers.

Functional Properties of the Control Jam and Developed Value Added Jam:

The Physical and functional properties of noni fruit pulp and stevia powder incorporated value added jam was evaluated. The parameter such as brix, pH and moisture were studied and the results are presented in the table 3.

Brix scale is commonly used for total sugar content measurement for any substance. The range from 40 to 70o brix is required for fruit jam to be acceptable (Azam ali, 2007). Up to 70o brix, jam doesn't require

pasteurization, a process that inhibits microbial growth, and extends the shelf life of the product. Table 3 shows that the developed value added jam with noni fruit pulp and stevia showed a brix value of 68.50. The pH was recorded as 3.3, which reflects that the developed product was acidic in nature. Studies show that the property of forming a viscous semi-solid gel is achieved at a pH of 3.2 to 3.4. Moisture content was 29.73%. The physical and functional characteristics of the developed value added jam met the same standards as that of the control jam (Hui. H.Y. 2006, T. M. Rababah et al, 2014). All these factors had been favourable for the development of a high quality jam.

Table 2. Physical and Functional Characteristics of Noni Fruit and Pulp

Physical and Functional Parameters	Measured Values of Noni Fruit and Pulp Used for the Study	Nelson (2003-2005)	Singh et al. (2007)	Carrilo-Lopez and Yahia (2011)
Mass (g)	151.20	-	147.9	50 to 300
Average length (cm)	8.6	14	9.8	4 to 10
Circumference (cm)	4.8	8	5.26	3 to 4
Density (g/cm ³)	-	-	1.13	-
Juice recovery (%)	46.90	≅50	38.95 to 48.50	-
Relative mass of pulp (%)	45.71	-	44.76 to 46.72	-
Seed size (mm)	3.3	4 to 9	3 to 5	4 to 6

Organoleptic Evaluation of the Control Jam and Value Added Jam:

9 point hedonic rating scale method was adopted to estimate the organoleptic acceptance of the developed product. Totally 50 semi trained people were used for organoleptic analysis. The sensory parameters like appearance, texture, flavour, mouthfeel, taste and overall acceptability of the value added jam developed by incorporating noni fruit pulp and stevia and control strawberry jam were assessed. Figure 1 depicts the comparative results of sensory parameters between the value added jam and control jam. Except the taste all the other sensory parameters were high in the developed value added jam. The overall acceptability was also high for the developed value added jam. After organoleptic evaluation the products were further subjected to nutritional evaluation.

jam that can be consumed by the diabetic population as well to enhance the nutritional value of the jam. As a means of value addition the noni fruit and stevia powder, a rarely used plant species have been utilised for the development of jam. Since it has passed the organoleptic evaluation, nutritional analysis was carried out. The nutrient content of the control jam as well as the value added jam is projected in Table 4.

Figure 1: Comparison of Mean Organoleptic Scores of Value Added Jam with Control Jam

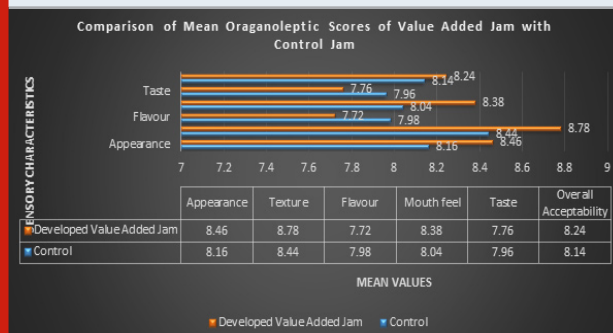


Table 3. Functional Characteristics of Value Added Jam

S.No	Functional characteristics	Control Strawberry Jam	Developed Value Added Jam
1.	Brix	680	68.50
2.	pH	3.4	3.3
3.	Moisture	22.3%	29.73%

Nutritional Value of the Control Jam and the Value Added Jam:

The purpose of this study is to develop a

The noni fruit pulp and stevia powder incorporated value added jam provided 118.05 Kcal of energy, 29.2g of carbohydrate, 0.2g and 0.05 g of protein respectively. 16.65 gms of fibre was present. It is also understood that the value added jam contained 1.1mg of Vitamin C. Calcium, sodium, potassium and magnesium were

present at a level of 23.4mg, 14.6mg, 110mg and 10.2mg respectively for 100gms of accepted variation of value added jam. The commercialisation of what once was a homemade jar of goodness is now termed unhealthy because it contains more sugar and less fruit. Sometimes it is only the essence of the fruit or fruit juice and a whole lot of additives and preservatives, while our value added jam prepared with noni pulp and stevia proves vice versa (Shanthini Rajkumar, 2020).

Table 4. Comparison of Nutrient Composition of the Value Added Jam with Control Jam

Nutritional Parameters	Control Jam	Value Added Jam
Ash (%)	0.25	3.3
Energy (kcal)	280	118.05
Carbohydrate (g)	68.85	29.2
Protein (g)	0.35	0.2
Fat (g)	0.05	0.05
Fibre (g)	1	16.65
Vitamin C (mg)	6	1.1
Calcium (mg)	20	23.4
Sodium (mg)	30	14.6
Potassium (mg)	75	110
Magnesium (mg)	0.04	10.2

On comparison with the strawberry control jam, the valued added jam, with noni fruit pulp and stevia powder incorporated was found low in calories and carbohydrates. Vitamin C and sodium was more in the control jam which may be attributed to the use of strawberry pulp rich in these nutrients. Fibre, Calcium, Magnesium and Potassium were found in higher proportion in value added jam compared to the control. The presence of noni fruit in the jam would also help to alleviate stress and oxidative inflammation (Xiaobing Yang et. al, 2020). Apart from prescribing for diabetics, this jam can also be recommended for persons with liver injury as noni fruit showed higher antioxidant capacities against acute alcoholic-induced liver injury (Min Guo et. al, 2020).

CONCLUSION

It can be concluded the nutritional parameters of jam prepared using noni fruit pulp and stevia powder is superior compared to control jam. The value added jam prepared will prove effective and valuable for diabetic patients as it is low in carbohydrates and calories. Noni has a favourable effect on liver disorders. Noni is rarely used as a whole fruit or processed because of its unpleasant taste. Noni juice is the product commonly available, hence the food industries can be encouraged to use noni fruit in various recipes or menus, as a means of value addition. Although stevia has been substantiated as a substitute for sugars or commercial artificial sweeteners, the promotion on the usage of stevia

is insufficient. It is endorsed that further cognizance is vital, regarding the ubiquity and prominence of noni as an anti-diabetic fruit and stevia as an alternate sweetener. As noni is high in potassium, people with renal diseases should avoid. Research studies with human clinical trials is recommended to promote the potentiality of noni fruit for non-communicable diseases.

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