

Studies on Physico-Chemical Properties of Noni Fruit (*Morinda Citrifolia*) and Preparation of Noni Beverages

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Abstract

Noni (*Morinda citrifolia* linn) fruits are edible but they don't have nice taste and flavor. In present investigation attempts have been made to standardize the recipes for preparation of noni beverages i.e. RTS, Squash and Syrup and to study the physicochemical characteristics of noni fruit and techno economic feasibility of prepared beverages. The recipe for preparation of Noni RTS beverage was standardized by varying the levels of juice, TSS. Study revealed that the final beverage i.e. RTS having 10% juice, 140 bx T.S.S. and 2% ginger extract was found to be more acceptable. The effect of level of dilution on sensory quality of squash and syrup revealed that Squash and Syrup with 1: 3 and 1: 4 dilutions respectively were found to be more acceptable. The cost of noni RTS beverage, squash and syrup per litre was Rs.21.84, 53.84 and 59.94 respectively, shows that prepared noni beverages were cheap and cost effective.

Key Words: Noni, Morinda, Nutraceutical, Beverages, Functional Food

Practical Applications

Noni juice can be more popularized in the form of RTS, beverages, squash, concentrated liquid, flavoured beverages, fortified beverages, mixed or blended juice, wine etc. Pulp can be successfully exploited in preparation of fruit leather bar, pulp concentrate, herbal prash, puree, jam, spread, mixed fruit pulp, mix-fruit prash, powder, sauce, chutney, toffee etc. The fruit powder can be reconstituted with water and later concentrated or used as base for RTS, squash, flavoured beverages, fruit drink etc. It may contain added flavouring substances, honey or sugar for taste modification. The powder can be encapsulated or used for tablet making. It has a broad range of therapeutic effects, its juice is equally effective for diabetics and hypertension (Yanine et al., 2006). Recently, the fruit juice is in high demand as food supplement or alternative herbal medicine for different kind of illnesses.

INTRODUCTION

Noni (*Morinda citrifolia* linn) also called Indian Mulberry was used for the study. *Morinda citrifolia* linn, Indian mulberry is the plant that can be used as a raw material for nutraceutical and functional food products. Nutraceutical and functional food (NNF) products are increasingly becoming health products of choice. Nutraceutical offers medical or health benefits to the consumer by providing means for the maintenance of health and well being and protection from disease, on the other hand a functional food provides the body with the required amounts of vitamins, fats, protein, carbohydrates and many other compounds that are needed for its survival (Defelice, 2002; Karla, 2003). There are more than 120 nutraceutical compounds identified in noni (Solomon, 1999). Recently noni juice extract has been commercially processed and distributed internationally as a dietary supplement.

Herbal and natural products of folk medicine have been used for centuries in every culture throughout the world (Acharya and Shrivastava, 2008). "Let food be your medicine and let medicine be your food" is world famous advice of father of medicine "Hippocrates" (Katarzyna et al., 2010). Over the past few years as natural products have become increasingly popular, the field of natural herbal remedies has flourished. One such upcoming natural plant having medicinal properties is *Morinda citrifolia* L, commonly known as Noni (Mathivanan et al., 2005). Noni

has been used in folk medicine for over 2000 years, its every part i.e. roots, stem, bark, leaves, flowers and fruit is utilized in various combinations for herbal remedies (Tabrah and Eveleth, 1966). With the increasing demand, both the supply and price of products is increasing. The high cost makes it out of reach of common masses. Therefore, present investigations were undertaken to utilize Noni fruit for the preparation of different value added products which can be easily available at cheaper price so that all the masses can equally enjoy the medicinal benefit of this wonderful gift of nature.

The fruits are edible, but don't have a nice taste or smell. So that the variety of Noni fruit products are processed and prepared by variety of methods with addition of sugar, acids, spices and condiments, who helps to reduce the bad smell of Noni-fruit pulp. Noni juice can be blended with other herbal extracts to increase its medicinal value such as ginger extract. Noni juice is having somewhat pungent flavor and astringent taste so in preparation of beverages from noni we can improve its taste and flavor using ginger extract, cumin seed extract to increase not only its nutritional value but also consumer acceptability. The present experiment was conducted to standardize the recipes for preparation of noni beverages i.e. RTS, Squash and Syrup and to study the physico-chemical characteristics of noni fruit and techno-economic feasibility of prepared beverages.

MATERIALS AND METHODS

The fresh green colored noni fruits were obtained from Amravati city. While selecting the fruits; fresh, fully matured, dark green colored fruits were selected. These fruits are then allowed to ripen till green color changes to dark brown or amber color, and then the juice from ripe noni fruits is extracted. The various physical characteristics like average weight, Edible index and juice yield of ripe noni fruits were studied. The various chemical characteristics like total moisture, ash, TSS and titratable acidity of ripe noni fruits were studied. There are two types of noni juice on the basis of method of extraction i.e. Traditional and Nontraditional noni juice

- Analysis of Noni juice: Prepared noni juice was analyzed for its pH, total soluble solids, brix to acid ration, acidity, reducing sugar, tannin, pectin, total phenol and ascorbic acid by standard methods (AOAC, 1990). The color of noni juice was measured by using Lovibond tintometer.

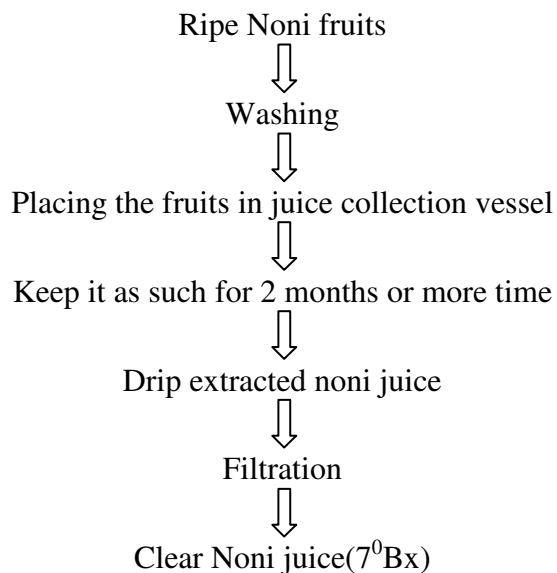


Figure 1: Flowsheet for production of traditional Noni Juice

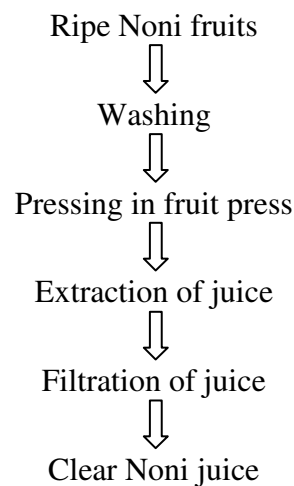


Figure 2: Flowsheet for production of Nontraditional Noni juice

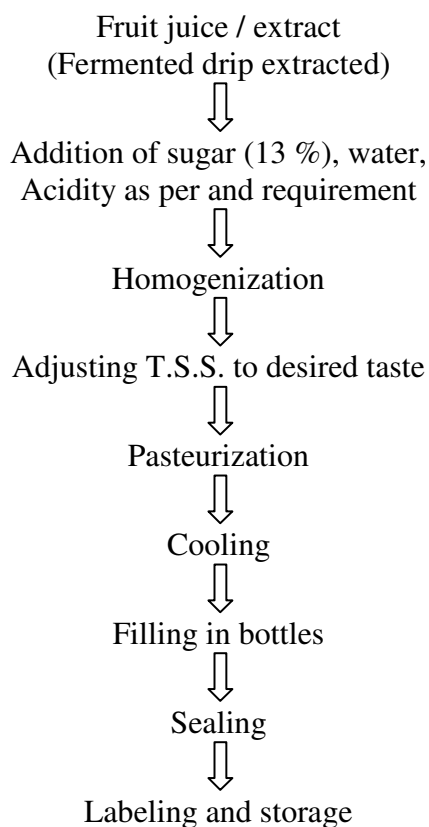


Figure 3: Flowsheet for Preparation of Noni

- Sensorial Analysis: Sensory analysis of prepared product was performed by using standard method (Amerine et al., 1987).
- Statistical analysis: The analysis of variance of the data obtained was done by using Completely Randomized Design (CRD) for different treatments as per the methods given by Panse and Sukhatme (1967). The analysis of variance revealed at significance of $P < 0.05$ level, S.E. and C.D. at 5 % level is mentioned wherever required.

Noni Beverages

The ready to serve beverage was formulated and standardized by varying juice levels i.e. 10, 13, 14 and 15 per cent and keeping the sugar and acidity constant i.e. 13 and 0.3 per cent for respectively. RTS prepared with FPO specifications having 10 per cent juice, 100Bx and 0.3 per cent acidity was used as experimental control. The RTS beverage was also analyzed for different levels i.e. 1%, 2%, 3%, of ginger extract. The Noni squash and Syrup were prepared as per FPO specifications and were analyzed for different levels of dilution. The process for preparation of Noni RTS beverage, squash and syrup are outlined in flow sheets.

Ingredients	Noni beverages		
	RTS	SQUASH	SYRUP
Juice (ml)	100	250	250
Sugar (g)	130	1500	680
Citric acid (g)	-	7	10
Water (ml)	770	486	310
Ginger Extract	20	-	-

Table 1: Recipe for Noni beverages

Sr.No.	Parameter	Observation
1	Color of the fruit	Brown/amber
2	Average wt of individual fruit (gm)	25.4
3	Average wt of waste from individual fruit (gm)	4.45
4	Edible index (%)	51.6
5	Waste index (%)	38.9
6	Juice yield (%)	51
7	T.S.S. of fresh juice (Bx)	7

Table 2: Physical Characteristics of ripe noni fruit

RESULTS AND DISCUSSIONS

Physical characteristics of noni fruits

The color of ripe noni fruit is dark brown or amber colour. The weight of individual noni fruit ranges from 11.5 to 32.5g. According to Heinicke (1985); the average yield of juice obtained from ripe noni fruit was 40-50% and it is found that the juice yield by fermented drip method is satisfactory i.e. 51%. Also the T.S.S. of the juice extracted from noni fruits was found to be 70bx and it is in the range of T.S.S. found by different scientists i.e. 7-80bx (www.nonijuice.org.com). The amount of seeds found in each noni fruit ranges from 28-32 in numbers. These seeds are found to be edible when roasted (www.healingnoni.com).

Proximate chemical composition of noni fruit

The acidity of noni juice extracted was 1.6% i.e. it is found to be less as compared to acidity of juice given in literature; i.e. The fruits obtained were less acidic. Also the protein found in noni fruits was less i.e. 0.24% (<http://www.healingnoni.com>) but the protein

Sr.No.	Parameter (Content)	Observations
1	Moisture (%)	89.6
2	Acidity (%)	1.6
3	Reducing Sugar (%)	3.26
4	Total carbohydrate (g)	3.4
5	Ash	0.43
6	Protein (g / 100 g)	0.43
7	T.S.S. of fresh juice (Bx)	7

Table 3: Proximate chemical compositions

content estimated in noni fruits was 0.43% i.e. found to be more. The ash content estimated i.e. 0.43% that is also less as compared to given in literature i.e. 0.54% (<http://www.healingnoni.com>). Also the carbohydrate estimated from noni fruits were found to be in the same range i.e. 3.08-3.46% (<http://www.healingnoni.com>). The moisture estimated from noni fruits (Ripe) was 89.6%; and it is less as compared to general moisture content of noni fruits i.e. 95.67% (<http://www.healingnoni.com>).

Effect of variation of juice levels on sensory quality of RTS

Sr.No.	Name of material	Rate (RS)	Quantity of material	Cost (Rs)
1	Fresh noni Juice(ml)	40/lit	100ml	4
2	Sugar (g)	22/kg	130	3
3	Ginger(ml)	30/kg	20	0.50
Total Raw Material Cost				7.50

RTS beverage prepared with different juice levels i.e. 10,11,12, 13 and 14 % juice analyzed for sensory evaluation and It was observed that sensory score for overall acceptability was maximum in RTS having 10% juice.

Effect of TSS levels on sensory quality of RTS

RTS beverage prepared with different TSS levels i.e. 10, 12 and 140Bx TSS analyzed for sensory evaluation and It was observed that sensory score for overall acceptability was maximum in RTS having 140Bx TSS. So that the RTS beverage containing 10% juice and 140Bx TSS was finalized for obtaining effect of ginger extract level on sensory quality of RTS.

Sr.no.	Name of material	Rate	Quantity of material	Cost RS
1	Fresh noni juice(ml)	40/lit	125ml	5
2	Sugar(g)	22/kg	750	16.5
3	Acid(g)	--	7	2
Total raw material cost				23.50

Effect of ginger extract level on sensory quality of RTS

It is evident from the values (Table-5) that sample S2 was found organoleptically superior for attributes like colour, flavor, taste and consistency as compared to other samples. Moreover, sample S2 has got highest score for overall acceptability indicating very much liked by the panel members.

Effect of dilution on sensory quality of Noni squash

The noni squash is diluted with water at the rate of 1:0.5, 1:1, 1:2 and 1:3 concentrations and converted

Sr.no.	Name of material	Rate(Rs)	Quantity of material	Cost(Rs)
1	Fresh noni juice(ml)	40/lit	250	10
2	Sugar(g)	22/kg	680	14.96
3	Acid(g)	--	10	3
Total raw material cost				27.96

into RTS containing 220 bx, 160 bx, 140 bx, and 100 bx T.S.S. and evaluated for overall quality, it was observed that the squash-diluted in 1:3 proportion tastes better and having good flavor with consumer acceptance.

Effect of dilution on sensory quality of noni syrup

The values revealed that the sample S3 was found organoleptically better as compared to other samples and rated highest for overall acceptability by panel members, indicating much liking by all the members.

Techno-economic feasibility of prepared Noni Beverages

Cost of noni fruits = RS20/kg and the juice content extracted from noni fruits is 50% of original weight of noni fruits. So the amount of juice extracted from 1kg of noni fruits is 500ml approximately, costing about RS40/ltr.

- **Noni RTS:**
Total raw material cost RS 7.50/-
Processing cost RS 5.00/-

Sample Code	Colour	Appearance	Taste	Flavour	mouthfeel	Over all acceptance
S0	7.6	7.8	8.0	7.6	7.4	7.8
S1	7.6	7.6	7.6	7.6	7.8	7.7
S2	7.4	7.2	7.6	7.4	7.2	7.2
S3	7.2	7.4	7.6	7.4	7.0	7.0
S4	6.8	7.0	7.4	6.6	6.8	6.6
SE ±	0.23	0.20	0.22	0.24	0.24	0.23
CD at 5%	0.67	0.59	0.65	0.72	0.70	0.70

Where, S0 - 10% Juice, S1 - 11% Juice, S2 - 12% Juice, S3 - 13% Juice, S4 - 14% Juice

Table 4: Effect of juice levels on sensory Quality of RTS

Sample Code	Colour	Appearance	Taste	Flavour	mouthfeel	Over all acceptance
S0	7.1	7.5	6.9	7	7.1	7.1
S1	7	7.7	7.9	7.8	7.3	7
S2	7.3	8.1	8.3	8.1	7.5	7.3
SE ±	0.187	0.140	0.149	0.140	0.147	0.187
CD at 5%	0.578	0.431	0.459	0.431	0.452	0.578

Where, S0 - 100 Brix, S1 - 120 Brix, S2 - 140 Brix,

Table 5: Effect of TSS levels on sensory Quality of RTS

Sample Code	Organoleptic Characteristics					
	Appearance	Color	Flavor	Taste	Mouthfeel	Overall acceptability
S0	4.2	4.3	3.9	4.0	4.6	4.5
S1	6.0	6.3	5.9	6.4	6.1	6.0
S2	7.0	7.4	7.2	7.8	7.7	7.8
S3	7.1	7.0	7.2	7.5	7.3	7.5
SE±	0.07	0.14	0.13	0.15	0.14	0.13
CD at 5%	0.25	0.41	0.38	0.43	0.37	0.37

Where, S0 - control (14%TSS, 10% Juice), S1- 1% Ginger Extract, S2- 2% Ginger Extract
S3 - 3% Ginger Extract

Table 6: Effect of ginger extract level on sensory quality of RTS

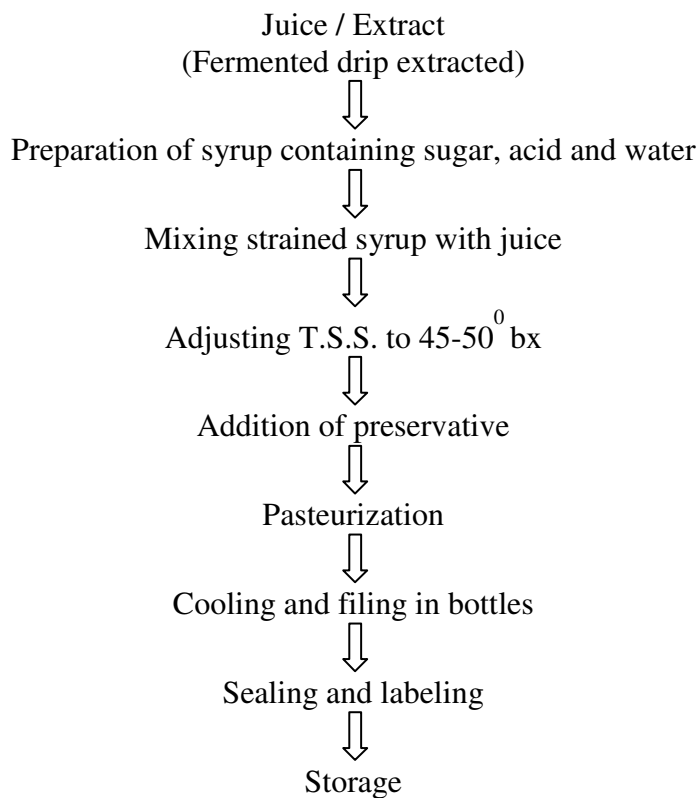


Figure 4: flow sheet for Preparation of noni squash

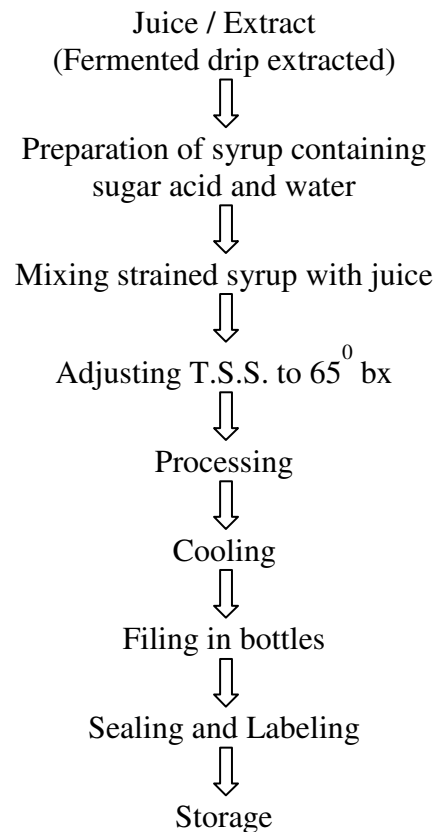


Figure 5: flow sheet for Preparation of Noni syrup

Sample Code	Organoleptic Characteristics					
	Appearance	Color	Flavor	Taste	Mouthfeel	Overall acceptability
S0	4.7	4.4	4.0	4.0	4.5	4.6
S1	6.7	5.9	5.8	6.0	6.2	5.8
S2	7.0	6.8	6.7	6.9	7.1	7.2
S3	8.0	8.0	7.8	8.0	8.0	8.0
SE ±	0.08	0.12	0.14	0.13	0.09	0.10
CD at 5%	0.25	0.33	0.40	0.30	0.27	0.31

Where, S₀ - 1:0.5 dilution with water (220 bx), S₁-1:1 dilution with water (160 bx)
 S₂- 1:2 dilutions with water (140bx), S₃- 1:3 dilutions with water (100bxT.S.S.)

Table 7: Effect of dilution on sensory quality of squash

Sample Code	Organoleptic Characteristics					
	Appearance	Color	Flavor	Taste	Mouthfeel	Overall acceptability
S0	4.7	4.4	4.0	4.0	4.5	4.6
S1	6.3	5.8	5.6	5.7	5.7	5.9
S2	6.9	6.9	6.5	6.4	6.9	7.0
S3	7.9	7.8	7.5	7.8	7.8	8.0
SE ±	0.14	0.13	0.16	0.13	0.15	0.12
CD at 5%	0.41	0.37	0.45	0.36	0.42	0.33

Where, S0 - 1:1 dilution with water, S1 - 1:2 dilutions with water, S2 - 1:3 dilutions with water, S3- 1:4 dilutions with water

Table 8: Effect of dilution on sensory quality of noni syrup

Production cost (raw material + processing cost)

RS12.50/-

Profit at 25% of production cost

RS 3.17/-

Marketing cost at 25% of production cost

RS 3.17

Selling price (cost of production +

RS 18.84

a) For 1 liter RTS bulk packed (add r.s.3bottle)

RS 21.84/-

b) For 200 ml RTS packed in plastic bottles

(Add R.S. 2/ bottle) RS 5.76/-

• **Noni squash(1litre):**

Total raw material cost

RS 23.50

Processing cost

RS 10.00

Production cost

RS 33.50

(Total raw material cost + processing cost)

Profit at 25% of production cost

RS 8.37

Marketing cost at 25% of production cost

RS 8.37

Selling price (cost of production+ profit +marketing

cost) RS 50.24

For 200ml squash packed

RS 12.048

in plastic bottles (add RS 2/ bottle)

For 1 liter squash bulk packed (add RS 3/ bottle)

RS 53.24

• **Noni Syrup (1litre):**

Total raw material cost

RS 27.96

Processing cost

RS 10.00

Production cost (total raw material cost + processing

cost) RS 37.96

Profit at 25% of production cost

RS 9.49

Marketing cost at 25% of production cost

RS 9.49

Selling price (cost of production+ profit +marketing

cost) RS 56.94

For 200ml Syrup in plastic bottles (add RS 2/ bottle)

RS 13.38

For 1 liter Syrup bulk packed (add RS3/ bottle)

RS 59.94

CONCLUSION

From the study carried out on Standardization and techno economic feasibility evaluation of Noni (*Morinda citrifolia*) beverages, it can be concluded that RTS prepared from 10 % noni fruit juice, 14% T.S.S. 2% ginger extract was more acceptable with respect to organoleptic characteristics. Noni Squash and Syrup with 1: 2 and 1: 3 dilutions proportions were found to be more acceptable. The cost of prepared Noni Beverages was also less and affordable so the products are not only cost effective but also nutritive. The beverages prepared from *Morinda citrifolia* blended with ginger extract has wide range of nutritional as well as medicinal value and great consumer acceptability.

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