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Studies on formulation of noni (*Morinda citrifolia* L.) based syrup

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Morinda citrifolia L., commonly known as 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). Recently, the fruit juice is in high demand as food supplement or alternative herbal medicine for different kind of illnesses. The fruits are edible, but don't have a nice taste or smell. Hence, noni juice was blended with some other juices and noni based syrup was prepared. In which aloe vera juice and aonla juice were blended with noni juice to overcome the strong flavour of noni juice and also to improve nutraceutical value of beverage. Aonla juice and aloe vera juice were used as noni juice replacer at different concentrations. Ginger juice was added to improve taste of final product. Accordingly eleven samples (A to K) of noni syrup were formulated. The formulated noni based syrup samples were organoleptically analyzed for quality attributes like colour and appearance, flavour, mouth feel, taste and overall acceptability. The organoleptic evaluation of beverages indicated that sample H having 50 per cent noni juice, 10 per cent aloe vera juice and 40 per cent aonla juice scored highest rank on 9 point hedonic scale. Further, the physico-chemical properties of noni juice, aonla juice, aloe vera juice, ginger juice and sample H of syrup were investigated. The physico-chemical analysis of sample H showed that syrup had total soluble solids 66.60bx, acidity 1.23 per cent, brix:acid ratio 54.14, pH 4.05, ascorbic acid content 75.23mg/100ml, total sugar content 76.33 per cent, reducing sugar content 32.45 per cent and ash content 0.30 per cent. Moreover, the prepared noni based nutraceutical beverages were qualitatively assessed for their shelf- life by storing at refrigerated (5°C) and ambient conditions (35-40°C).

Key Words : Noni, Aloe vera, Aonla, Ginger, Syrup, Juice, Physico-chemical properties

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INTRODUCTION

Today busy families have less free time to prepare nutritious, home-cooked meals. In this context, various beverages such as fruit juice syrups, squashes or ready to serve juices represent an alternative way of consuming fresh fruit and vegetables. Furthermore, these products meet the needs of modern consumers, who increasingly buy ready to eat foods to save time, without giving up the pleasure and nutritional intake linked to healthy diet (Endrizzi *et al.*, 2009). Also with the exhaurbitant cost of synthetic soft drinks, there are promising lines for replacing the synthetic products by any other suitable alternative such as natural fruit juice beverages which are nutritionally many times superior. The fruit juices can be concentrated for reduction in volume (eg.: Syrups)

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and thereby reducing packaging and transportation cost with an added advantage of prolonged shelf-life. Fruit syrup is a type of fruit beverage contains at least 25 per cent fruit juice or pulp and 65 per cent total soluble solids. It also contains 1.3-1.5 per cent acid and is diluted before serving (Srivastava and Kumar, 2004).

Morinda citrifolia L., commonly known as noni, has been used in folk medicine for over 2000 years, it's every part *i.e.* roots, stem, bark, leaves, flowers and fruit is utilized in various combinations for herbal remedies (Tabrah and Eveleth, 1966). It have a broad range of therapeutic effects, its juice is equally effective for diabetics and hypertension (Yanine *et al.*, 2006). Satwadhar *et al*. (2011) identified the bioactive components *viz*., Anthraquinones, saponins and scopoletin by TLC techniques. The fruits are edible, but don't have an acceptable 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 more popularized in the form of RTS, beverages, squash, concentrated liquid, flavoured beverages, fortified beverages, mixed or blended juice, wine etc. With the increasing demand, both the supply and price of products is increasing. Therefore, it seems feasible to utilize noni fruit for the preparation of different value added products such as syrups, squashes and ready to serve beverages by blending with different fruit juices 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.

According to Food Safety and Standards Act-2006, syrup should contain at least 25 per cent fruit juice and 65^{0}Brix total soluble solids. But due to the strong, unacceptable flavour of noni juice it is not possible to use noni fruit juice alone upto 25 per cent in syrup. Hence, in order to satisfy the technical requirement of a drink to be called as syrup, noni juice was blended with some other juices. Accordingly aloe vera (*Aloe barbadensis* Miller) juice and aonla or Indian gooseberry (*Emblica officinalis*) juice were blended with noni juice to mask the strong flavour of noni juice and develop nutraceutical rich noni based syrup. Ginger (*Zingiber officinale*) juice extract was added to improve the taste and overall acceptability of beverage.

METHODOLOGY

The research was conducted in the Department of Food Trade and Business Management, in collaboration with Department of Food Science and Technology, Department of Food Chemistry and Nutrition, Department Food and Industrial Microbiology and Department of Food Engineering, College of Food Technology, Vasantrao Naik Marathwada Krishi Vidhyapeeth, Parbhani during the year 2014-2015. Well matured noni fruits (*Morinda citrifolia*) with white-yellowish tint and fresh, matured and undamaged aloe vera leaves of indigenous edible variety (*Aloe barbadensis* Miller) were obtained from university orchard, Vasantrao Naik Marathwada Krishi Vidhyapeeth, Parbhani. Other ingredients like aonla, ginger, sugar, citric acid, etc. were purchased from local market of Parbhani.

Extraction of juices:

Well matured Noni fruits with white-yellowish tint colour were manually harvested and kept for aging for 2-3 weeks period. The juice gets extracted due to natural dripping under anaerobic condition at ambient temperature (Joshi *et al.*, 2012).

Fresh, fully ripe, sound aonla and ginger were used for extraction of juice (Ramachandra and Srinivasa, 2008). Each fruit was cleaned, thoroughly washed, blanched and blended in a laboratory blender to a pulp and the juice was extracted by filtering through muslin cloth and stored at refrigerated temperature separately.

Aloe vera gel was extracted by using hot extraction method and processed into juice as per the method reported by Ramachandra and Srinivasa (2008).

Preparation of syrup:

Extracted juices of noni, aloe vera, aonla and ginger extract were strained through muslin cloth and mixed with strained sugar syrup (sugar + water + citric acid; heated just to dissolve). The syrup was then poured in sterilized glass bottles and sealed (Fig. A).

Standardization of recipe for noni based syrup:

As the main aim of the present investigation was to exploit the nutritional or health benefits of noni, so concentration of noni juice in blend was kept higher than other. Also from informal trials the ginger juice level was decided in order to increase taste, flavour and overall acceptability of beverages and it was observed that 5ml ginger extract in syrup increased the taste, flavour and overall acceptability of the beverage (100 ml). The data

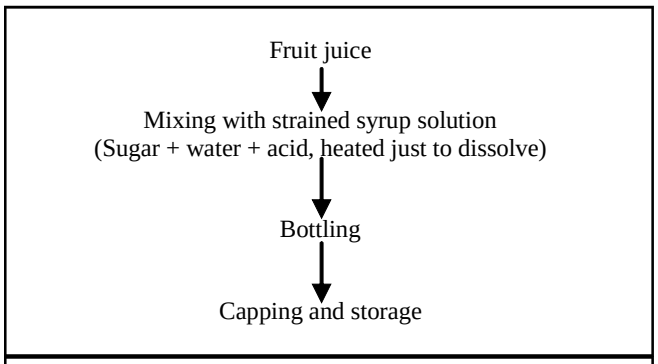

Fig. A : Flow-sheet for syrup processing (Srivastava and Kumar, 2004)

on ingredients in specific quantities for standardization of recipe for noni based syrup are given in Table A.

Table A : Standardization of recipe for noni based syrup

Ingredients	Quantity for 100ml syrup
Blended fruit juice	50 ml
Ginger juice	5 ml
Sugar	75 g
Citric acid	1.3 g
Water	9 ml

Formulation of noni based syrup:

In the present study 11 different samples of syrup were made by altering juice concentrations of noni : Aloe vera : Aonla as shown in Table B.

The sensory evaluation of noni based syrup was carried out by 10 semi-trained panel members comprised of postgraduate students and academic staff members of the faculty who had some previous experience in sensory evaluation. Judgment were made through rating products on a 9 points Hedonic Scale with corresponding descriptive terms ranging from 9 'like extremely' to 1 'dislike extremely' with respect to different quality attributes such as colour, flavour, taste, aroma, mouthfeel and overall acceptability, as per the method recommended by Ranganna (1986).

OBSERVATIONS AND ASSESSMENT

The results obtained during present investigation are presented and discussed with respect to experimental data under following suitable headings.

- Physical properties of noni fruit, aloe vera leaves, aonla fruit and ginger rhizome
- Physico-chemical properties of noni, aloe vera, aonla juice and ginger extract
- Development of noni based blended syrup
- Organoleptic evaluation of syrup formulated by different proportions of noni juice, aloe vera juice and aonla juice
- Physico-chemical properties of noni based nutraceutical beverage: syrup
- Effect on physico-chemical properties of syrup during storage at room temperature and refrigerated temperature (4-5^{0}C)

Physical properties of noni fruit, aloe vera leaves, aonla fruit and ginger rhizome :

The knowledge of physical properties helps in the development of processing technology. Ripe noni fruit, aonla fruits, fresh aloe vera leaves and partially dried ginger rhizomes were collected and studied for different physical parameters such as colour, average length, breadth, thickness and average weight fruits and leaf, edible index and juice yield. The corresponding data is

Table B : Formulation of noni based syrup (100ml)

Sr. No.	Sample code	Juice(50 ml) Noni : Aloe vera : Aonla	Ginger juice (ml)	Sugar (g)	Citric acid (g)	Water (ml)
1.	A	50 : 0 : 0	5	75	1.3	9
2.	B	40 : 5 : 5	5	75	1.3	9
3.	C	35 : 10 : 5	5	75	1.3	9
4.	D	35 : 5 : 10	5	75	1.3	9
5.	E	30 : 15 : 5	5	75	1.3	9
6.	F	30 : 5 : 15	5	75	1.3	9
7.	G	30 : 10 : 10	5	75	1.3	9
8.	H	25 : 5 : 20	5	75	1.3	9
9.	I	25 : 20 : 5	5	75	1.3	9
10.	J	25 : 10 : 15	5	75	1.3	9
11.	K	25 : 15 : 10	5	75	1.3	9

represented in Table 1.

Physico-chemical properties of noni, aloe vera, aonla juice and ginger extract :

The extracted juices of noni, aloe vera, aonla and ginger were analyzed for their physico-chemical properties such as total soluble solids, per cent acidity, brix : acid ratio, pH, total sugar, reducing sugar, ascorbic acid content and per cent ash.

Organoleptic evaluation of syrup formulated by different proportions of noni juice, aloe vera juice and aonla juice :

The data pertaining to organoleptic evaluation of blended noni based syrup beverages are presented in Table 3. The prepared syrup beverages were analyzed organoleptically after four times diluted with chilled potable drinking water. Table 3 shows the scores obtained for different formulations made to prepare noni based syrup with varying proportions of noni juice, aloe vera juice and aonla juice. It is observed from Table 3 that sample H having 25:5:20 ml proportions of noni : Aloe vera : Aonla got the highest overall acceptability. The mean score for colour and appearance and mouth feel was 6.95 and 7.01. Sample H scored highest among others (Fig. 1).

Physico-chemical properties of noni based syrup :

The organoleptically accepted noni based syrup sample *i.e.* sample-H was analyzed for its physico-chemical properties such as total soluble solids, per cent acidity, brix:acid ratio, pH, total sugar, reducing sugar, ascorbic acid content and per cent ash. The data pertaining to the physico-chemical properties of noni based blended syrup is presented in Table 4.

Table 4 shows that syrup had total soluble solids 66.6^{0}bx. The acidity of syrup was 1.23 per cent. The brix:acid ratio for syrup was 54.14. The pH of syrup was 4.05.

It can be seen from results expressed in following table that syrup was rich in ascorbic acid content. This is mainly due to the aonla juice and noni juice. Though aonla has great level of ascorbic acid content upto 900mg/100g (Ghorai and Sethi, 1996) but it was reduced in the drink mainly due to heat processing. Syrup had 75.23mg/100ml ascorbic acid content. The Noni based blended syrup was made with total sugar content of 76.33 per cent and reducing sugar content (32.45 %). The ash content of syrup was found to be 0.30 per cent.

Table 1 : Physical properties of noni fruit, aloe vera leaves, aonla fruit and ginger rhizome

Parameters	Noni fruit	Aloe vera leaf	Aonla fruit	Ginger rhizome
Colour	Yellowish white	Greenish	Light green with yellowish	Light brown
Average length (cm)	7.2	31.50	3.1	4.8
Average breadth (cm)	3.8	3.50	2.7	2.6
Average thickness (cm)	4.6	1.97	3.3	1.5
Average weight (gm)	35.36	227	17	37.5
Edible index (%)	50.85	70.79	77	84
Juice yield (%)	43	35.5	51	42

* Each value represents the average of three determinations

Table 2 : Physico-chemical properties of noni, aloe vera, aonla juice and ginger extract

Parameters	Noni juice	Aloe vera juice	Aonla juice	Ginger extract
Total soluble solids (^{0}bx)	9	4	5	3.1
Acidity (%)	1.21	1.22	2.1	0.6
Brix : acid ratio	7.43	3.3	2.63	5.16
pH	4.1	4.4	2.8	4.0
Total sugar (%)	3.84	1.12	1.52	0.2
Reducing sugar (%)	3.26	-	0.31	-
Ascorbic acid (mg/100ml)	35.32	4	340.0	2
Ash (%)	0.41	0.01	0.23	0.005

* Each value represents the average of three determinations

Table 3 : Organoleptic evaluation of syrup formulated by different proportions of noni juice, aloe vera juice and aonla juice

Samples	Colour and appearance	Flavour	Taste	Mouth feel	Overall acceptability
A	6	5	5	6	5
B	6	5.5	5	7	5
C	7	5	5	7.3	5.5
D	7	6	5.5	7	6
E	7.3	5	5.5	7.3	5.5
F	7	6.5	6.8	7	6.5
G	7	6.2	6.3	7	6.3
H	7.5	7.2	7.5	7.4	7.5
I	7.5	6.5	6.5	7	6.5
J	7	7	6.9	7	7
K	7.2	6.5	6.3	6.9	6.5
Mean	6.95	6.03	6.02	7.01	6.11
S.E.±	1.7010	1.5328	1.4865	1.6300	1.5356
C.D. (P=0.05)	5.0541	4.5544	4.4168	4.8433	4.5629

* Each value represents the average of three determinations

where,

A: Noni:Aloevera:Aonla (50:0:0 ml)
B: Noni:Aloevera:Aonla (40:5:5 ml)
C: Noni:Aloevera:Aonla (35:10:5 ml)
D: Noni:Aloevera:Aonla (35:5:10 ml)
E: Noni:Aloevera:Aonla (30:15:5 ml)
F: Noni:Aloevera:Aonla (30:5:15 ml)
G: Noni:Aloevera:Aonla (30:10:10 ml)
H: Noni:Aloevera:Aonla (25:5:20 ml)
I: Noni:Aloevera:Aonla (25:20:5 ml)
J: Noni:Aloevera:Aonla (25:10:15 ml)
K: Noni:Aloevera:Aonla (25:15:10 ml)

Table 4 : Physico-chemical properties of noni based nutraceutical beverage: syrup

Sr. No.	Parameters	Syrup
1.	Total soluble solids (^{0}bx)	66.6
2.	Acidity (%)	1.23
3.	Brix : acid ratio	54.14
4.	pH	4.05
5.	Total sugar (%)	76.33
6.	Reducing sugar (%)	32.45
7.	Ascorbic acid (mg/100ml)	75.23
8.	Ash (%)	0.30

* Each value represents the average of three determinations

Storage study :

The data pertaining to changes in physico-chemical composition of prepared Noni based syrup beverage stored at ambient and refrigerated condition upto 2 months storage period is represented in Table 5 and 6, respectively.

The total soluble solid content in the beverage increased apparently during storage at room temperature, which might be due to hydrolysis of polysaccharides into monosaccharides and increase in concentration of beverage due to dehydration. Increase in TSS with increase in storage period was observed in the juice of mandarin, sweet orange and lemon by Mehta and Bajaj (1983). Similar results were also reported by Deka and Sethi (2001) in juice blends. One another possible justification for increase in TSS is the decrease in acidity at the same time. Acidity was lowered because some of the acid content might be converted into sugars which ultimately raised the TSS.

It is revealed that titrable acidity of noni based beverages significantly decreased with storage time. This can be attributed to the chemical interaction between the organic constituents of the juice induced by temperature and action of enzymes. The decrease in acidity during storage was also observed by Nagi and Manjrekar (1976).

The pH of noni based beverages increased during storage. The increase in pH can be attributed to the decrease in acidity during storage.

Table 5 : Effect on physico-chemical properties of syrup during storage at room temperature

Parameters	Days								
	0	10	20	30	40	50	60	S.E. ±	C.D. (P=0.05)
TSS (^{0}bx)	66.6	66.6	66.6	66.7	66.7	66.8	67.0	0.0482	0.1433
Acidity (%)	1.23	1.22	1.23	1.22	1.21	1.18	1.15	0.0044	0.0133
pH	3.20	3.20	3.20	3.22	3.23	3.25	3.27	0.0441	0.1311
Ascorbic acid (mg/100ml)	75.23	73.45	71.89	69.72	67.00	66.19	65.68	0.0387	0.1151

* Each value represents the average of three determinations

Table 6 : Effect on physico-chemical properties of syrup during storage at refrigerated temperature

Parameters	Days								
	0	10	20	30	40	50	60	S.E.±	C.D. (P=0.05)
TSS (^{0}bx)	66.6	66.6	66.6	66.6	66.6	66.6	66.6	0.1020	0.3033
Acidity (%)	1.23	1.23	1.23	1.23	1.22	1.21	1.20	0.0321	0.0955
pH	3.20	3.20	3.20	3.20	3.21	3.21	3.23	0.5833	0.1733
Ascorbic acid (mg/100ml)	75.23	75.10	74.10	73.64	72.00	71.09	70.12	0.0186	0.0552

* Each value represents the average of three determinations

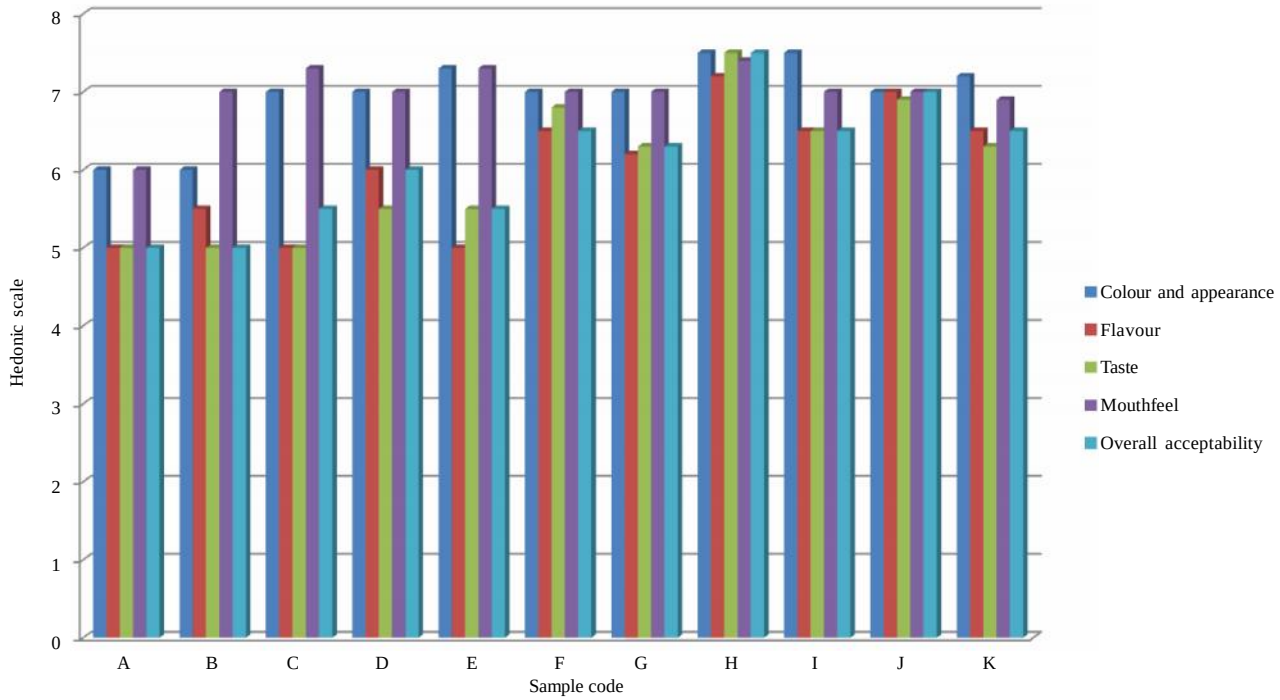

Fig. 1 : Organoleptic evaluation of syrup

The ascorbic acid content of syrup decreased from 75.23 to 65.68mg/100ml. This was probably due to the fact that ascorbic acid being sensitive to oxygen, light and heat was easily oxidized in presence of oxygen by both enzymatic and non-enzymatic catalyst (Mapson, 1970).

The results in Table 6 revealed that the TSS, acidity and pH of noni based syrup remained the same throughout the storage at refrigerated condition however, slight decrease in acidity after 40 days of storage with increase in pH was observed. However, ascorbic acid content had shown a decreasing pattern. The rate of decrease in ascorbic acid content was less as compared to the rate for sample stored at ambient or room temperature. Similar results were obtained by Bhardwaj and Mukherjee (2011) and Bhardwaj and Pandey (2011).

Conclusion :

It can be finally concluded that noni juice, aloe vera

juice and aonla juice can be successfully blended. Good quality of noni based nutraceutical beverage like syrup can be prepared with proportions of different juices noni : Aloe vera : Aonla as 25 : 5 : 20 ml. The prepared beverage was found to be nutritious, antioxidant rich and overall acceptable. Blending of aloe vera and aonla juice helps in improving physico-chemical, organoleptic quality of beverage. It is also concluded that the prepared noni based syrup beverage can be stored upto 2 months at refrigerated condition without any considerable change in quality attributes.

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