WNRF Technical Bulletin : 07

Development of Processed Products from Noni

(*Morinda citrifolia* L.)

Dr. (Mrs). Chandra Venkatasubramanian
Queen Mary's College (Autonomous), Chennai - 600 004

World Noni Research Foundation
12, Rajiv Gandhi Road, Perungudi, Chennai – 600 096, India
Phone : 91-44-4901 1111 – 04 Fax : 91-44-4901 1149
E mail : mail@worldnoni.net Visit : www.worldnoni.net

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Foreword

Morinda citrifolia L., popularly known as Indian Mulberry, is gaining popularity among farmers, users of natural products, medical practitioners and traders of natural products. Many house wives are keen to grow Noni on their backyards as a medicinal plant. When the trees start bearing, many of them are not able to utilize the fruits because of obvious reasons of unfamiliarity and bitterness. There are no protocols unfamiliarity and bitterness available to use the fruits for value added products. Hence, a project, "Development of Processed Products from Noni (*Morinda citrifolia* L.)" was sanctioned to Queen Mary's College, Chennai with the objective of developing recipes for house hold preparations of jam, jelly, squash *etc*., so that the fruits harvested from the back yards could be profitably utilized as value added products besides generating income to the housewives. Dr. Chandra Venkatasubramanian, the Principal Investigator has done an excellent job and has developed protocols for preparation of jam, jelly, squash, pickle and so on. The standardized products taste on par with any other branded items and even excel them in taste. I congratulate Dr. Chandra Venkatasubramanian and her team for the excellent output from the project and for preparing the Technical Bulletin of World Noni Research Foundation.

Chennai
September, 2011

(Kirti Singh)
Chairperson

About the Project

World Noni Research Foundation, Chennai provides funds to various Research, Educational and Development Institutions of the country either Governmental or Non-Governmental to take up projects on various aspects of Noni. The present Technical Bulletin on "Development of Processed Products from Noni (*Morinda citrifolia* L.)" is the 7th publication in the series from World Noni Research Foundation from the concluded projects sanctioned. Dr. Chandra Venkatasubramanian, Queen Mary's College, Chennai in short span of time has standardized recipes for making jam, jelly, pickle, squash and other products using Noni fruits. The quality of the products, so developed are on par with any other commercially available products. The technology developed will be of great help to house wives, small farmers who maintain Noni trees in their farm / back yards to produce value added products. I congratulate and compliment Dr. Chandra Venkatasubramanian for bringing out an excellent Technical Bulletin from the project.

(P. T. Peter)
Chairman

Chennai
September, 2011

Preface

Noni an underexploited fruit crop is becoming popular because of its health benefits experienced by many people in India and other countries. Noni is becoming a house hold plant and is being cultivated in backyards though it is now extensively cultivated in India through the technical support and contract farming facilities extended by Indian Noni Cultivation Council of World Noni Research Foundation. The fruits which are harvested in the backyards are not able to be properly processed and used as in the case of other fruit crops. Considering the importance, growing awareness on health benefits of Noni a project was conceived to develop jam, jelly, pickles, squash etc as a cottage product so that avocation of employment and self supporting business venture among rural and urban women could be created. The outcome of the project is a standardized techniques of preparing noni based bye products mentioned above..

I would like to place on record my sincere gratitude to Dr. Kirti Singh, Chairperson, WNRF, Prof. P.I. Peter, Chairman, Noni Biotech, Dr. K.V. Peter, Director, Dr. T. Marimuthu, Joint Director and all members of RAB for sanctioning the project entitled "Product development through standardization of recipes using Noni in the laboratory and acceptability of the same", providing the necessary financial support and for their continuous support and encouragement throughout the study. I acknowledge with gratitude the efforts taken by Dr. J. Subramani towards the successful completion of the project work. The help rendered by Dr. K. Ambujam, Principal-in-charge, Queen Mary's College (Autonomous), Chennai - 600 004 is worth mentioning, for providing the space, electricity, water and security. I wish to extend my gratitude to the staff of State Canning Center in Rajaji Bhavan who provided the basic training in product preparation. Last but not the least my sincere wishes are extended to the two project officers - Ms. T. Alwar and Ms. Deepa Aravind for their hard work and dedication. I wish to thank all the respondents who participated in the sensory evaluation - both from WNRF and Queen Mary's College.

Chennai
September, 2011

Chandra Venkatasubramaniam

1. Introduction

Morinda citrifolia L., commonly known as Noni, great morinda, Indian mulberry, Nunaakai (Tamil Nadu), beach mulberry, Tahitian noni, is an ever green small tree bearing flowers and fruits throughout the year and belongs to family Rubiaceae. It grows in tropical regions of the world, although it adapts better to coastal regions. (Singh *et al.,* 2005). Noni has been traditionally used by Polynesians for food and medicinal purposes for more than 2000 years (Wang *et al.,* 2002; Mathivanan *et al.,* 2005). Written documentation on the consumption of this fruit as a food source precedes the twentieth century. The roots, stems, bark, leaves, flowers and fruits of the Noni plant are all involved in various combinations in almost 40 known and recorded herbal remedies (Bruggnecate, 1992). Captain James Cook of the British Navy noted in late 1700' that the fruit was eaten in Tahiti (Cheeseman, 1903). An 1866 publication in London explained that *Morinda citrifolia* fruit was consumed as a food in the Fiji Islands (Seemann, 1866). Later publication describes the use of this fruit as a food throughout the Pacific Islands, Southeast Asia, Australia and India. Abbott also reported that Noni had been used as a food, drink, medicine, and colorful dye (Abbott, 1992) Noni has been the most preferred drug among ancient healers against every disease. Recently noni is being used worldwide and an extensive research is going on regarding the miraculous action of noni. It has been referred as the "greatest nutritional discovery of our times" by the discovery channel in its broad cast on 3rd February 2003.

Noni is reported to have antibacterial, antiviral, antifungal, anti tumor, antihelminthic, analgesic, hypotensive, anti-inflammatory and immune enhancing effects Lie *et al*, 2001, Wang and Su, 2001; Duke *et al*., 2002 McClatchey, 2002. It possesses a large number of bioactive compounds, which are phytochemicals, omega-3-fatty acids and plant sterols. The major functional micronutrients of noni are phenolic compounds (anthraquinones, aucubin, asperuloside, serotonins, scopoletin, damnacanthal), organic acids (caproic and caprylic acids) (Dittmer, 1993)and alkoloids (xeronine and proxeronine) (Heinicke, 1985). Joseph Betz, a research chemist in the FDA's Division of Natural Products, Center for Food Safety and Applied

Nutrition, stated that *Morinda citrifolia* has been tested for a number of biological activities in animal and anti-microbial studies." Noni is documented to contain a mixture of several vitamins (such as beta-carotene, niacin, riboflavin, thiamine), some minerals, iron and calcium. The potassium content of noni is similar to that in tomato juice and orange juice

2. State of Knowledge

The fruit juice is in high demand in alternative medicine for different kinds of illnesses such as arthritis, diabetes, high blood pressure, muscle aches and pains, menstrual difficulties, headaches, heart disease, AIDS, cancers, gastric ulcers, sprains, mental depression, senility, poor digestion, atherosclerosis, blood vessel problems and drug addiction. Noni is a powerful antioxidant. The immense free radical scavenging capacity of noni is due to its ability to act within the cell membrane and its capacity to simultaneously neutralize both water and fat soluble free radicals. Noni would be particularly useful for protection against peripheral disorders like phlebitis, varicose veins, high blood pressure, visual dysfunction, arthritis, atherosclerosis, cataracts, diabetes, heart disease and other degenerative conditions.

Antioxidant effect of noni was analyzed by Tetrozolium nitro blue (TNB) assay and Leucomethylene blue (LMB) assay methods (Su *et al*., 2005) and it was based on protection from free radicals and consequent lipid peroxidation on liver from oxidant damage. A one month double blind, randomized, placebo controlled clinical trial was conducted among smokers (Wang *et al*., 2002). The results showed that noni produced 23% reduction in Superoxide Anion Radicals (SAR) level and 27% reduction in LPO level. This proves that noni protects the body from oxidative damage caused by cigarette smoking.

Noni fruit extract showed cytotoxic effect in breast carcinoma cell line and Colon carcinoma cell line studies (Mc Clatchey, 2002). Study on cultured leukemia cell line showed that noni induced apoptosis at lower doses and cancer cell necrosis at higher doses. Cancer preventive effect of noni was demonstrated in mammary breast carcinogenensis induced by DMBA(7,12 -

dimethyl benzanthracene) in rats (Akihisa et al., 2007). DMBA treated rats showed lesions like epithelial hyperplasia, benign tumours and *in situ* carcinomas. Noni administered rats showed hyperplasia thus proving that noni prevents mammary breast cancer. Hirazumi and Furusawa (1999) described the activity of a polysaccharide-rich substance from the fruit juice of noni, noni-ppt. In studies, noni-ppt demonstrated immunomodulatory and antitumor activity. The authors suggested that noni-ppt may be a valuable supplementary agent in cancer treatment. Okadaic acid in noni fruit was determined by Asahina and co workers (Asahina *et al.,* 1995) to increase the synthesis of tumor necrosis factor. A research (Hiramatsu *et al.,* 1994) revealed that noni juice acted indirectly by enhancing host immume system involving macrophages and/or lymphocytes in mice.

The fruit extract of noni is reported to have potent antimicrobial activity. Noni supports the immune system, which strengthens the body's natural ability to fight disease and infection. It acts as a health enhancer. French scientists tested the analgesic and sedative effects of extracts from the *Morinda citrifolia* plant. The extract was shown to be non-toxic and did "show a significant, dose-related, central analgesic activity in the treated mice." This study included various experiments on the treated mice to determine the analgesic effect, if any, from the plant extracts of *Morinda citrifolia* (Noni). The conclusion of these researchers was that the extract did in fact demonstrate analgesic effects consistently in each experiment. The conclusion of this study included a simple statement from the authors: "These findings validate the traditional analgesic properties of this plant." Anti inflammatory activity of noni was evaluated by Carrageenan induced rat paw oedema method and acute injury induced by CCl4. Potent anti-inflammatory activity was observed in both methods.

The primary ingredient in noni is proxeronine which is converted to xeronine in our body. This xeronine is a pain reliever and an anesthetic. It acts with endorphins in the body to numb pain and produce feelings of euphoria. Endorphins are hormones which are responsible for producing good feelings in body. Noni acts as a cell rejuvenator, healthy immune system promoter and has a very low glyceamic index and hence reduces the risk of complications of Diabetes mellitus (Wang et al., 2002). Xeronine, the alkaloid

of noni in the presence of insulin activated the peripheral cell membrane insulin receptors and helped in the normal absorption of glucose (Murdiati, 2000). Non insulin dependent diabetic subjects who took noni supplements for a period of 60 days showed marked decrease in blood sugar level, BMI and lipid profile when compared to the control group of the same age and condition of NIDDM who were not given the noni juice (Chandra and Priya, 2008). Thus it was inferred that noni juice could be a good hypoglycaemic and hypo cholesteroleamic agent.

A basic requirement of good health is our body's ability to supply adequate anti oxidants to meet our requirements. Noni is commonly consumed in the form of juices, extracts and concentrates which are either to be diluted with water or with other fruit juices. Hence an effort is made to develop food products like jams, jellies, pickles, sauce and squash using noni alone and in combination with various concentrations of other fruits.

3. Objectives

1. To develop food products like jam, jelly, ketchup, pickle and squash using noni fruit.
2. To assess the acceptability of these products through sensory evaluation using a panel of judges.
3. To conduct trials in order to modify the products based on consumer acceptance along with the FPO standards.
4. To standardize the most accepted and preferred products.
5. To analyze the keeping quality of the products.

4. Experimental details

The project focused on the development of food products like jam, jelly, sauce, pickle and squash using noni fruit. The acceptability of the products was also assessed to find out the consumer preference of noni products over other commercially available products. In order to identify the most popular commercially available jam, jelly, sauce, pickle and juice, a survey

was conducted among women in the age group of 18 - 40 years. The sample size was 60 which included 20 college girls aged 17 - 21 years of age, 40 adult women, of which half of them belonged to higher income group and (lecturers) and the remaining belong to lower middle income group (office staff). From the survey, it was found that the most popular commercially available jam was Kissan mixed fruit jam. The use of jelly was very limited among the samples and college girls preferred the jelly priced Rs 2/-, which had no brand name. Kissan tomato sauce, Ruchi mango pickle (thokku) and Nimboos were the other preferred commercial products among sauce, pickle and juice. Thus the prepared noni products were organoleptically evaluated for acceptability as against the commercially popular products (Kissan mixed fruit jam, Locally available jelly, Kissan tomato sauce, Ruchi mango pickle, Nimboos).

Totally five trials were conducted and after each trial the prepared products were organoleptically evaluated. In the first two trials, noni products were compared against commercial products available in the market. The third trial focused to provide variety in noni products ie., noni mixed fruit jam was organoleptically evaluated against noni pineapple jam, similarly noni jelly against noni guava jelly, noni pickle against noni ginger garlic pickle, noni squash against noni ginger lime squash. In noni tomato ketchup one set was prepared by incorporating 10 percent noni which was organoleptically evaluated against noni tomato ketchup in which 20 percent noni was incorporated.

Based on the sensory evaluation of trial III, the most preferred noni product was chosen and that was again prepared in small quantities as trial IV. Trial V was a repeat of trial IV so that a standardized recipe is obtained.

5. Experimental Findings

The experimental findings are discussed below.

a. Sensory evaluation of jam

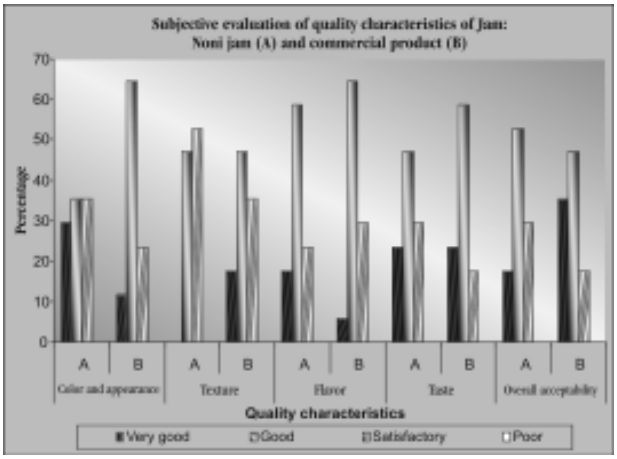

Figure 1

From figure 1 it can be summarized that 30% of the respondents have scored 'very good' for noni jam against 11.8% for the commercial product in regard to color and appearance. Eighteen Percent of the respondents rated 'very good' on flavor characteristic of noni jam while 6% rated 'very good' for commercial product. Both the jams were rated equally for taste.

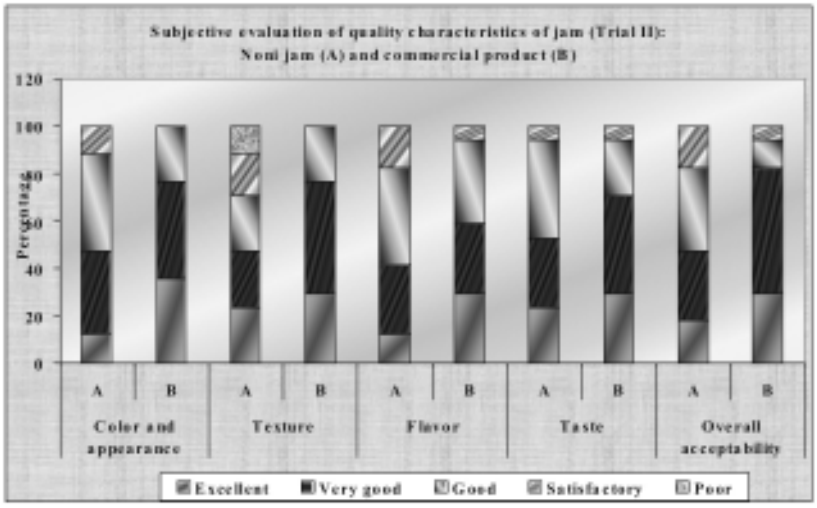

Figure 2

From figure 2 it can be observed that the commercial product has been rated high on all quality characteristics when compared with noni mixed fruit jam though there was no significant difference between the quality characteristics of noni jam with the commercial jam.

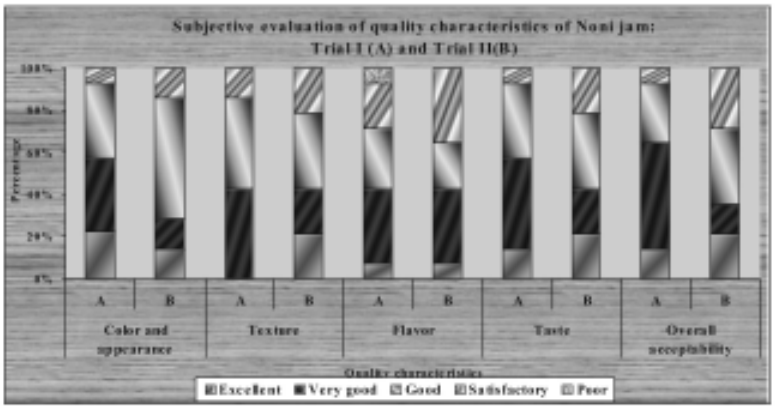

Figure 3

From figure 3, it can be observed that the texture, taste and overall acceptability of noni mixed fruit jam prepared in trial II was rated better than trial I, while the color and appearance of trial I jam were rated better than trial II. The respondents rated the flavor of trial I and trial II more or less similar.

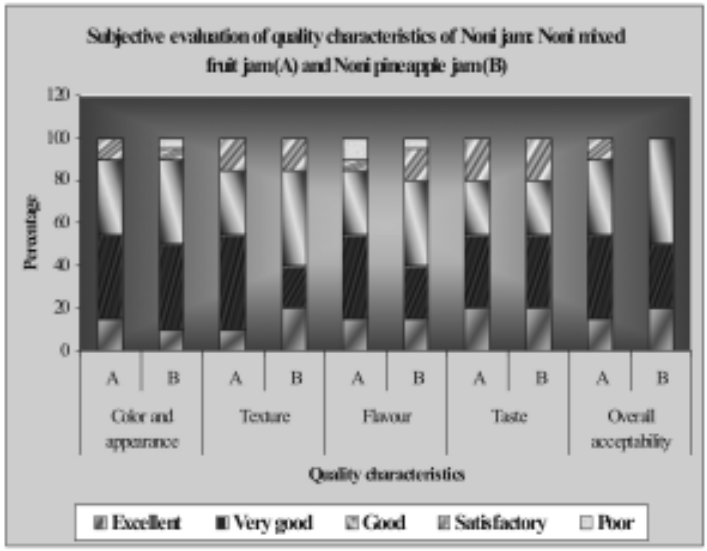

Figure 4

From figure 4, it was observed that noni mixed fruit jam was more preferred by the respondents than noni pineapple. It can also be observed that noni mixed fruit jam was rated "very good" and "good" by most of the respondents.

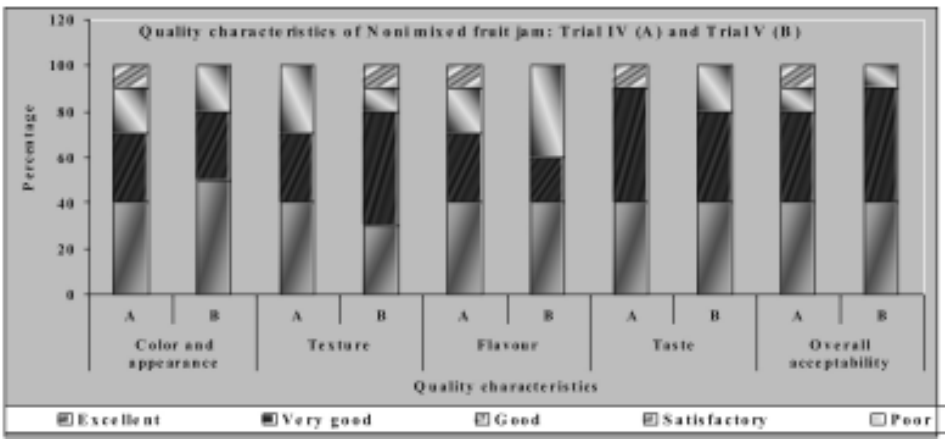

Figure 5

The flavor, taste and overall acceptability of jam A and jam B were almost the same and were rated as "excellent" by most of the respondents which can be observed from figure 5. There was no significant difference between the jams prepared in trial IV and trial V.

b. Sensory evaluation of Jelly

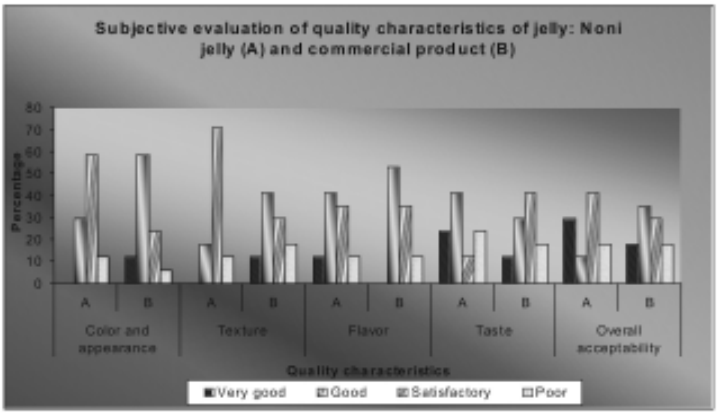

Figure 6

From figure 6 it can be observed that 12, 24 and 29% of the respondents rated 'very good' for noni jelly for quality characteristics of flavor, taste and overall acceptability respectively. Synthetic color, pectin and flavors were added in the commercial jelly whereas no such agents were added in noni jelly.

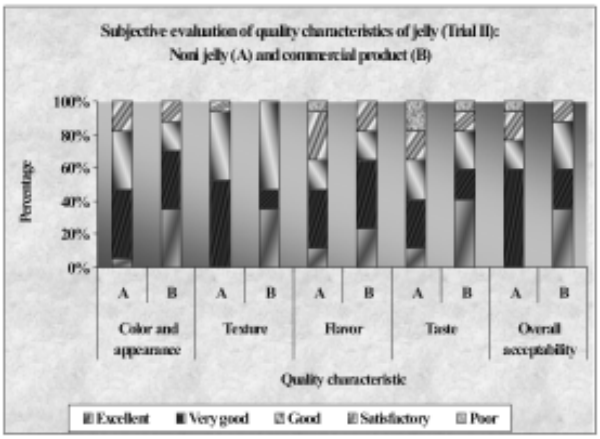

Figure 7

Figure 7 shows that the commercial product has been rated high on all quality characteristics when compared with noni jelly. The commercial product had added artificial food coloring and flavoring agents while noni jelly was prepared without any additives. There was no significant difference between the quality characteristics of noni jelly with the commercial jelly.

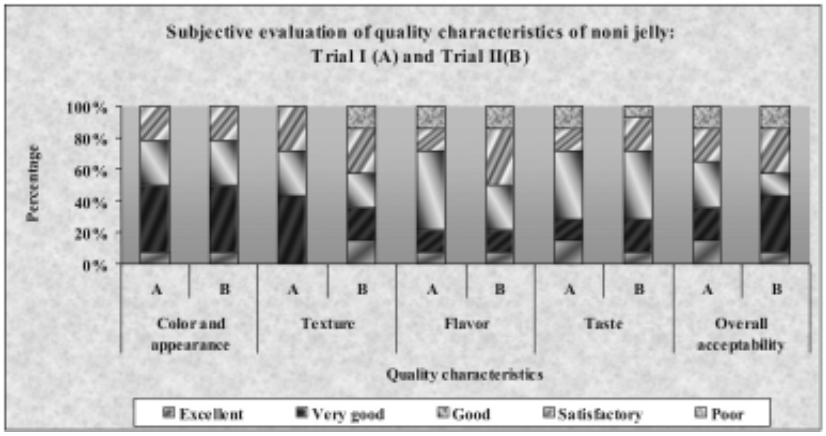

Figure 8

Figure 8 shows that the texture of trial II jelly was rated 'excellent' by 15% of the respondents. The color and flavor of trial I and trial II jelly were rated equally while the taste and overall acceptability of trial I were more preferred by the respondents when compared to that of trial II.

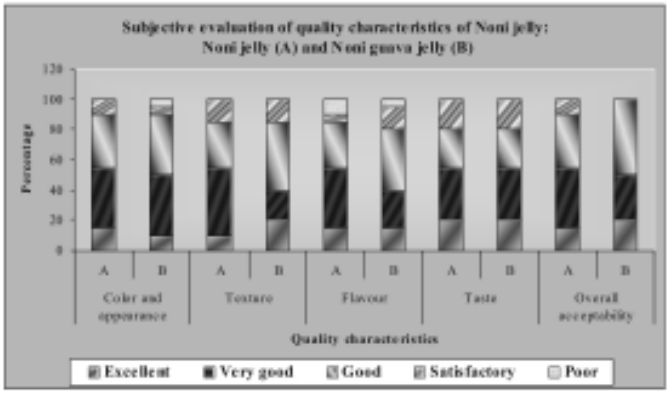

Figure 9

From figure 9, it can be inferred that noni guava jelly was preferred by the respondents rather than noni jelly. But noni guava jelly was rated only as "satisfactory" by majority of the respondents

c. Sensory evaluation of ketchup

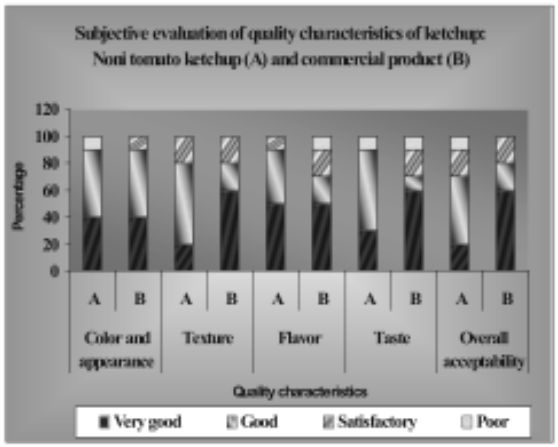

Figure 10

From figure 10 it can be observed that the commercial ketchup was rated high on all quality characteristics when compared with noni tomato ketchup. Though there existed no significant difference among noni tomato ketchup and the commercially available ketchup, improvisations on color, consistency, flavor and taste were performed in further trials.

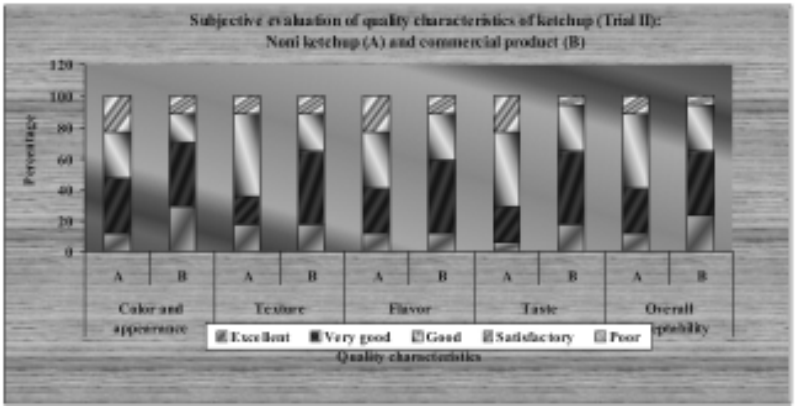

Figure 11

Figure 11. reveals that eighteen percent of the respondents rated 'excellent' for consistency and 12% of them rated 'excellent' flavor for both noni sauce and the commercial sauce. None of the respondent rated 'poor' for both the sauces.

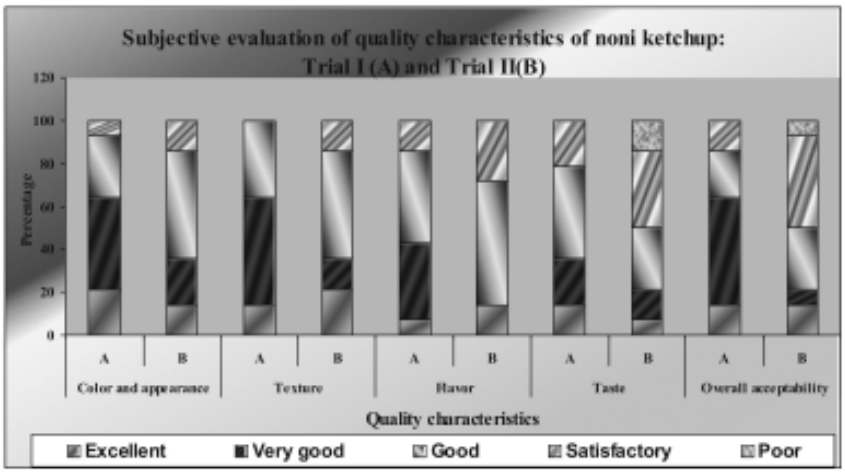

Figure 12

From figure 12 it can be observed that 22% of the respondents rated the color of noni ketchup as 'excellent' as against 14% for the commercially available ketchup. It can also be seen that the quality characteristics like texture, flavor and taste in the commercial ketchup were rated high. But when considering the overall acceptability, noni ketchup was much preferred. Fourteen Percent of the respondents have rated 'excellent' for both the ketchups while 50% of the respondents had rated noni ketchup as 'very good' as against 7% for the commercial ketchup.

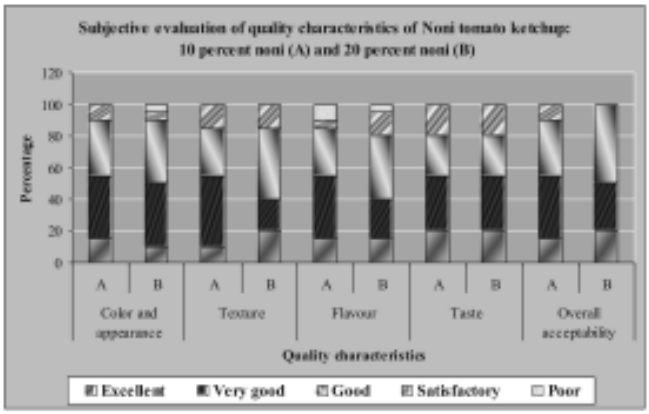

Figure 13

Figure 13 represents the sensory evaluation of noni tomato ketchup prepared using varying concentrations of noni fruit. Ketchup A was prepared using 10% concentration of noni while ketchup B was prepared using 20% noni concentration. Noni tomato ketchup at 20% concentration was considered better than 10% concentration on all qualities during sensory evaluation. Ketchup A was rated "very good" and "good" by 50 and 30% of the respondents on the quality characteristics of overall acceptability while 20 and 40% of the respondents rated ketchup B as "excellent" and "very good" respectively for the same characteristic.

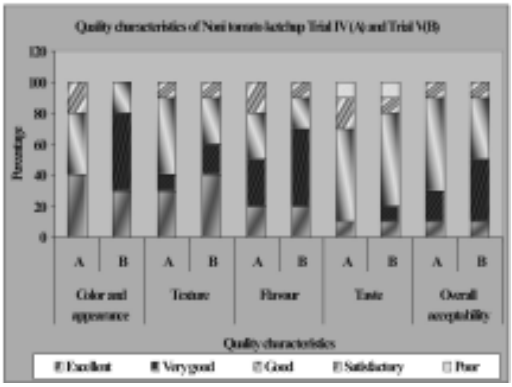

Figure 14

From figure 14 it can be stated that 10% of the respondents rated the overall acceptability of both the ketchup as "excellent". Twenty and 60% have rated ketchup A as "very good" and "good" for the quality characteristic of overall acceptability while 40% of the respondents have rated ketchup B as "very good" and "good" on the same characteristic. Though the texture of ketchup A and B were rated "excellent" by 30 and 40% of the respondents respectively, the quantity of the output was varying and the expected output was not obtained as the initial pulp content of both noni and tomato were different in both the trials.

d. Sensory evaluation of pickle

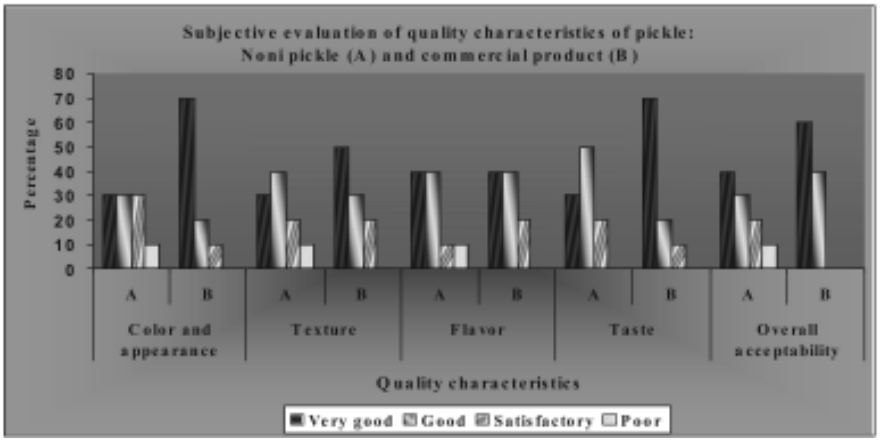

Figure 15

Figure 15 shows that 50% of the respondent rated 'very good' for flavor of noni pickle as against 30% of commercial pickle. Forty and 50% of the respondents have rated 'very good' for taste characteristics of noni pickle and commercial pickle respectively. A more or less similar figure is obtained on the overall acceptability of the two pickles.

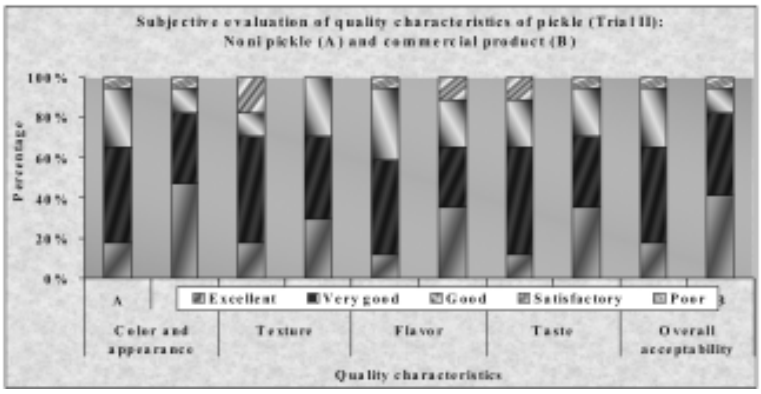

Figure 16

From figure 16 it can be observed that the commercial pickle has been rated high on all quality characteristics when compared with noni pickle. But there was no significant difference between the quality characteristics of noni pickle with the commercial pickle.

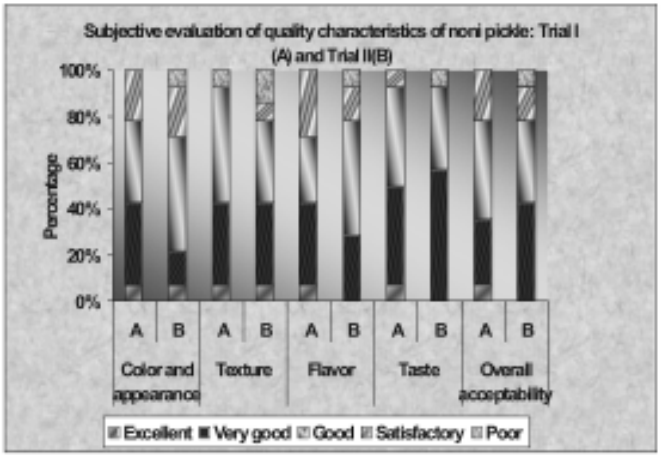

Figure 17

From figure 17, it can be observed that 7% of the respondents have rated 'excellent' for both the noni pickles (trial I and trial II) on quality characteristics of color and appearance and texture. On quality characteristics like texture, flavor, and taste both the products were more or less equally rated. The overall acceptability of trial II pickle was rated 'very good' by 42% of the respondents and 28% of the respondents rated trial I pickle as 'very good' for overall acceptability.

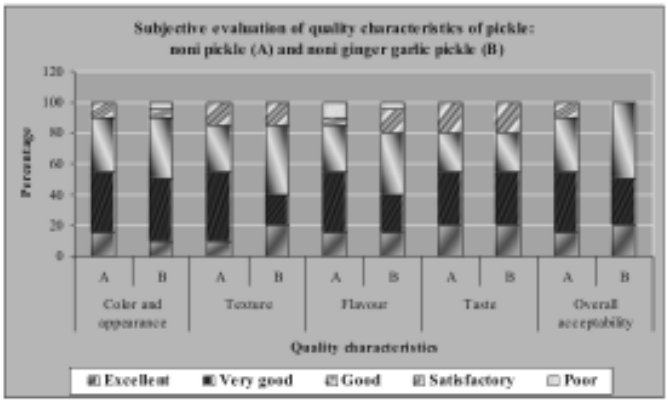

Figure 18

From figure 18 is can be observed that noni pickle and noni ginger garlic pickle were rated 'excellent' by 25 and 30% of the respondents respectively on the quality characteristic of overall acceptability. Both the pickles were rated equally on overall acceptability while the color, texture, flavor and taste of noni pickle were rated slightly higher than noni ginger garlic pickle.

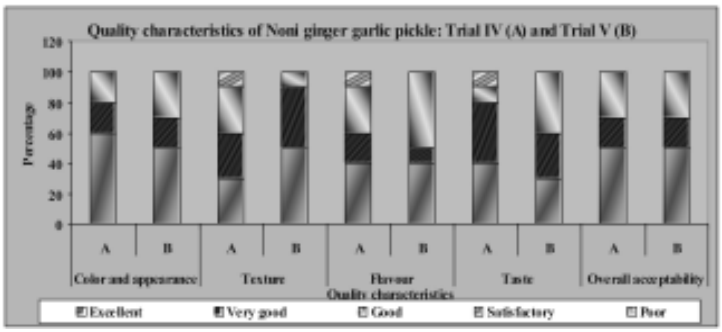

Figure 19

It can be observed from the above figure 19 that the overall acceptability of noni ginger garlic pickle prepared in trial IV and V were rated 'excellent', 'very good' and 'good' by 50, 20 and 30% of the respondents equally. Though the color, texture and taste of trial IV pickle were rated higher than trial V there was no significant difference between them

e. Sensory evaluation of cordial

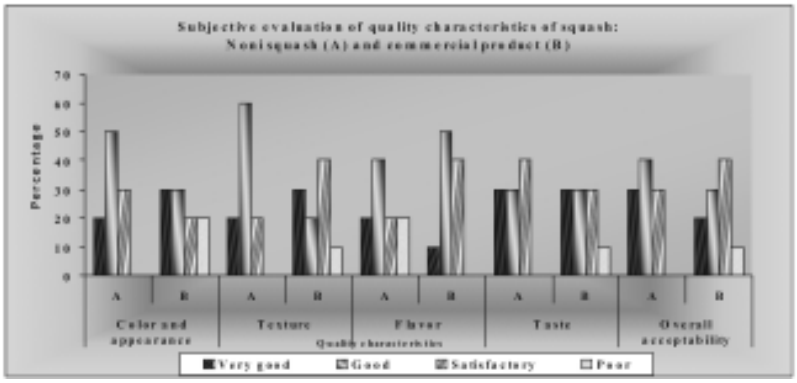

Figure 20

It can be observed from figure 20 that noni squash was rated 'very good' by 30% of the respondents with respect to taste in similar commercial product. The overall acceptability of noni squash was rated 'very good' by 30% of the respondents as against 20% for the commercial product.

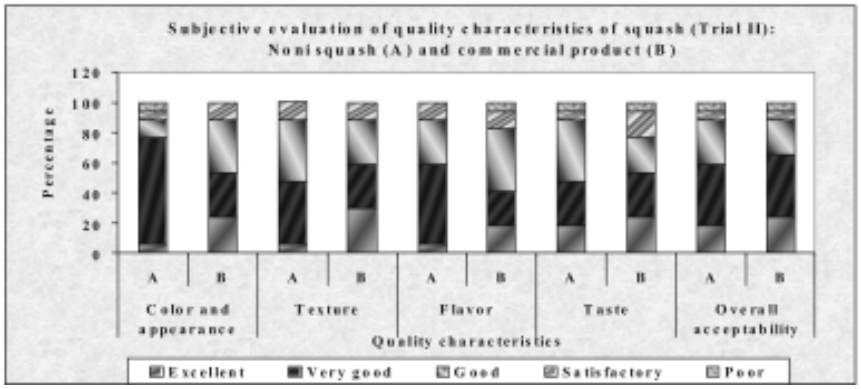

Figure 21

Figure 21 represents that the commercial product has been rated high on all the quality characteristics when compared with noni squash. On the contrary, no significant difference was observed between the quality characteristics of noni squash and the commercially available cordial.

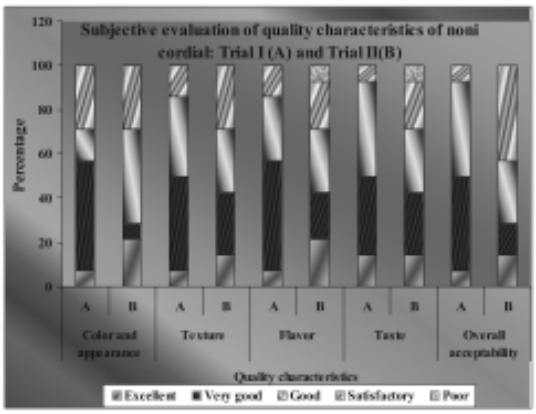

Figure 22

From figure 22, it was evident that trial I squash was more preferred when compared to trial II squash on quality characteristics like color and appearance, texture and flavor. The overall acceptability scores of both the squashes revealed that trial I squash was more preferred as 42% of the respondents have rated 'very good' and 'good' for trial I squash where as 14% and 28% have rated 'very good' and 'good' respectively for trial II squash.

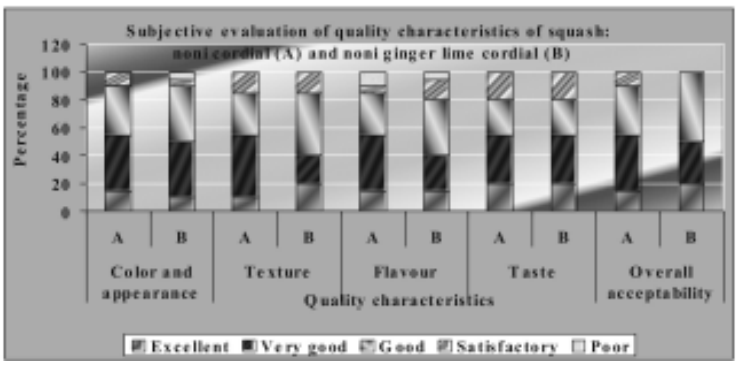

Figure 23

From above figure 23, it can be observed that the overall acceptability of the cordial prepared from noni ginger lime squash had better acceptability than cordial prepared using noni squash as none of the respondents have rated it 'poor', though it can be seen that there existed no significant difference between the two cordials.

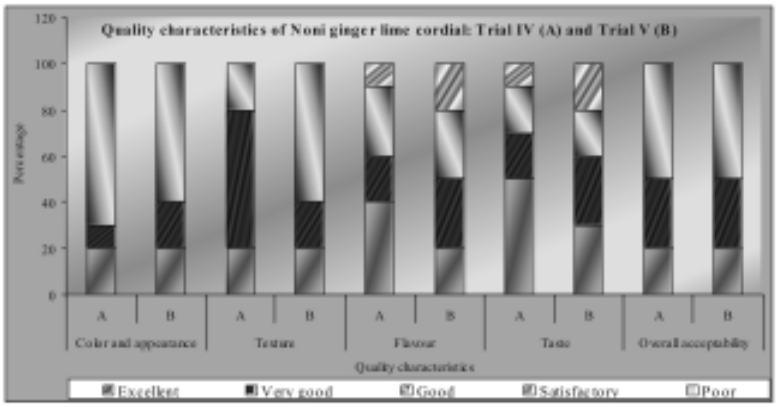

Figure 24

From the figure 24, it can be observed that about 20% of the respondents have rated 'excellent' for color and appearance, texture, and overall acceptability of both the cordials (cordial prepared using trial IV and trial V) yet there existed no significant difference between the two cordials

6. Summary and conclusion

The project was aimed to prepare food products like jam, jelly, ketchup, pickle and squash using noni fruit, assess the acceptability of these products through sensory evaluation using a panel of judges and to standardize the most accepted product. Five trials were conducted and the summary of the findings of each trial are given below.

- Trial I : Trial I depicted that a much more healthier version of commonly used products like jam, jelly, ketchup, pickle and squash using noni fruit can be prepared and the results of sensory evaluation of trial I indicated that the recipes should be improvised for consumer acceptance.

- Trial II: The sensory evaluation of trial II products revealed that majority of the people preferred and have rated noni products as 'good' and 'very good' in comparison with the commercial products. Specific jams like noni pineapple jam and noni strawberry jam could be prepared. The use of natural colors especially for jelly and squash by varying the ingredients will provide wider choices for health conscious people. Incorporation of spices like ginger and garlic in pickle will add variety to noni pickle, making it tastier and a healthier accompaniment.

- Trial III: In the third trial innovations like noni pineapple jam, noni guava jelly, noni tomato ketchup with increased concentration of noni than the previous trials, noni ginger garlic pickle and noni ginger lime squash were prepared. The sensory evaluation of trial III products revealed that noni mixed fruit jam, noni tomato ketchup (20% Noni concentration), noni ginger garlic pickle and noni ginger lime squash were the most preferred.

- Trial IV: In Trial IV, the products were prepared in smaller portions (10 samples). Every detail about the preparation (like taken for the whole preparation, ingredients utilized, output obtained etc) was noted down.

- Trial. V: Trial V was a repetition of trial IV so that a standard recipe could be developed. Noni mixed fruit jam, noni ginger garlic pickle and noni ginger lime squash were standardized but noni jelly and noni tomato ketchup couldn't be standardized. The pectin content of noni fruit varied from batch to batch and hence the pectin content had to be determined during every preparation so that jelly will be set properly. In the case of noni tomato ketchup, due to variation in the pulp content of both noni and tomatoes, the time duration for the preparation of noni tomato ketchup varied. The amount of ketchup obtained also reduced due to decreased pulp extraction. With the help of consistometer, the initial consistency of the fruit pulps could be assessed along with the end point.

- The recipes of the products are given below. Among them the recipes of noni mixed fruit jam, noni ginger garlic pickle and noni ginger lime squash are standardized recipes.

Recipes

a. Noni Mixed Fruit Jam

Ingredients required :

Noni fruit	185g
Fruit pulp	1.2kg (Apple, papaya, guava, banana - 300g each)
Parry's sugar	1.2kg
Sodium benzoate (SB)	2.5g
Red bust color	2.5g
Citric acid	7.5g
Tiger brand essence	3ml

Preparation method

Wash all the fruits and shred them except noni fruit. Cut noni fruit into small pieces and add 280 ml of water and allow it cook for 20 minutes. Extract the pulp of the noni fruit by passing it through the small pulper. Grind all the other fruits in the mixer grinder. Mix sugar and all fruit pulp together well and cook it over a medium flame till the end point is reached. The end point of the jam is the sheet formation on the ladle if held in a slanting position. Add the color, essence, citric acid and sodium benzoate (SB) and immediately remove it from the flame. Transfer the prepared jam immediately to sterilized bottles and fill it up to the top. After 5 minutes of cooling, close it well.

Pre preparation time	-	90 minutes
Cooking time	-	40 minutes
Serves	-	10 bottles of 200g each

b. Noni Jelly

Ingredients required

Noni Fruit (unripe)	1.66 kg
Clean sugar (Parry's)	1.5 kg
Water	4.74 l

Method of Preparation

Wash and cut noni into ½ inch thick pieces. All the said amount of water and heat it on a medium flame for about 40 minutes and filter it. To 3l of this filtrate, sugar was added and boiled till done (sheeting was visible). After a few minutes the jelly was removed from the fire and was poured into the mould and was allowed to cool.

Pre preparation time	- 40 minutes
Cooking time	- 60 minutes
Serves	- 10 bottles of 200g each

c. Noni Tomato ketchup

Ingredients required

Noni fruit	630 g
Tomato	3 kg
Onion	625 g
Sugar	320 g
Salt	100 g
Sakthi Garam masala	40 g
Sakthi Chilli powder	40 g
Everest Kashmiri lal powder	40 g
Garlic	30 g
Acetic acid	115 ml

Method of Preparation

Fresh ripened fruits were selected, washed and were cut into small pieces. To the cut fruits, chopped tomatoes, ground onion and garlic were added. The mixture was allowed to boil till the tomatoes became very tender. Then it was extracted. In the mean time, a spice bag was prepared. Chilli powder, *Kashmiri* lal chilli powder and garam masala were tied like a bag using muslin cloth. The spice bag was placed in the extract and it was allowed to boil for about twenty minutes on medium flame so that the essence of the spices was taken up by the extract. About one third of sugar and salt was added before the spice bag was lowered into the extract. After 20 minutes the spice bag was taken out and squeezed well. Then the remaining two third of the sugar was added and was cooked till the mixture thickened. Once removed from the flame, acetic acid was added and mixed well. The ketchup should be immediately transferred to sterilized glass bottles.

Pre preparation time	-	60 minutes
Cooking time	-	40 minutes
Serves	-	10 bottles of 200ml each

d. Noni Ginger -Garlic Pickle

Ingredients required

Half ripen noni fruit	550 g
Idhyam gingerly oil	690 ml
Everest Kashmiri lal chilli powder	100 g
Sakhti chilli powder	50 g
Tamarind	80 g
Sakthi Turmeric powder	50 g
Garlic	30 g
Ginger	30 g
Salt	75 g
Mustard seeds	14 g

Roasted fenugreek powder	8 g
Roasted mustard powder	16 g
TTK asafoetida powder	3 g
Potassium meta bisulphite	2 pinch

Method of Preparation

Soak the tamarind in hot water for 20 minutes and remove the seeds. Then grind into a thick pulp. Wash the noni fruits well. Cut the fruits and immediately grind it into a fine paste. In order to prevent oxidation add turmeric powder, salt and tamarind paste little by little to the ground paste. Peel the skin of ginger and garlic and grind it into a fine paste. Heat the oil in a kadai. Once it is hot, add the mustard seeds and when it splutters add asafoetida powder and after a few seconds add the ground ginger garlic paste. Once it turns slight golden in color, add the ground noni fruit paste and cook it well. At first all the oil will be absorbed then after a while oil will spill out. Once the oil starts to come out, add mustard seed powder and fenugreek powder and mix it for a few minutes. Then remove from flame. After two minutes, add two pinches of potassium meta bi sulphite powder and mix it well. Transfer the pickle into sterilized bottles.

Pre preparation time	-	60 minutes
Cooking time	-	25 minutes
Serves	-	10 bottles of 200g each

e. Noni Ginger lime squash

Ingredients required

Noni fruit	2.8 kg
Ginger extract	180 ml
Lemon juice	1.170 l
Water	4.2 l
Potassium meta bi sulphite	2.5 g

For sugar syrup

Clean Sugar (Parrys)	4 kg
Water	2 l

Method of Preparation

In a big vessel add sugar and water and heat it. Once the sugar dissolves remove it from the flame and cool it thoroughly. Wash the noni fruits and cut them into small pieces. To this add 4.2 litres of water and allow it to cook well for 40 minutes. Immediately extract the pulp from the cooked fruit by passing it through the pulper. Now mix the pulp obtained into the sugar syrup. Add ginger extract, lime juice and potassium meta bi sulphite to the sugar syrup and mix well. Transfer the squash into sterilized bottles.

Pre preparation time	-	200 minutes
Cooking time	-	40 minutes
Serves	-	10 bottles of 700ml each

References

Abbott, I.A,. 1992. La'au Hawaii' traditional Hawaiian uses of plants. v 3. Honolulu, Hawaii: Bishop Museum Press, p 97- 100.

Akihisa, T., Matsumoto, K., Tokuda, H., Yasukawa, K., Seino, K., Nakamoto, K., Kuninaga, H., Suzuzki, T. and Kimura, Y. 2007. Anti-inflammatory and potential cancer chemopreventive constituents of the fruits of *Morinda citrifolia* (Noni). *J.Nat.Prod.,* 70:754-7.

Asahina, A.Y., Ebesu, J.S.M., Ichinotsubo, D., Tongson, J., Hokama, Y. 1995. Effect of okadaic acid (OA) and noni fruit extract in the synthesis of tumor necrosis factor -a (TNF-a) by peripheral Blood Mononuclear (PBM) cells in vitro. Department of Pathology, John A. Burns School of Medicine, University of Hawaii, Honolulu, HI.

Bruggnecate, J.T. 1992. Native plants can heal your wounds. Honolulu Star-Bulletin Local News, Feb 2.

Chandra, V. and Priya, K. 2008. Glycaemic and cholesterolaemic effect of nutritional supplement of Noni (*Morinda citrifolia*) on selected middle aged female Non Insulin Dependent Diabetic Mellitus (NIDDM) subjects. Noni search. Proceedings of the Third National Symposium Noni for Nutrition and Health, 18-19, Oct., 2008, New Delhi pp. 81-90.

Cheeseman, T.F. 1903The flora of raratonga, the chief island of the cook group. V6. London: Linnean Soc., pp 261-313.

Dittmar, A. 1993. Morinda citrifolia L.-Use in indigenous Samoan medicine. Journal of Herbs, *Spices and Medicinal Plants,* 1:77-92.

Duke, J., Bogenschutz, M. and Duke, P. 2002. Handbook of medicinal plants 2nd edition. Boca Raton, FL; CRC Press, p. 529

Heinicke, R.M, 1985. The pharmacologically active ingredient of Noni. Bulletin of National Tropical Botanical Garden, 15: 10-14.

Hiramatsu, T., Imoto, M., Koyano, T., and Umezawa, K. 1999. Cancer Letters 73 Induction of Normal Phenotypes in RAS-transformed cells by Damnacanthal from *Morinda citrifolia* pp. 161-166

Hirazumi, A., Furrasawa, E., Chou, S.C. and Hokama., Y. 1994. "Anti cancer activity of *Morinda citrifolia* on intraperitoneally implanted lewis lung carcinoma in syngenic mice. *Proc. West Pharmacol Soc.* 37: 145-146

Liu, G., Bode, A., Ma, W. Y., Sang, S., Ho, C.T., and Dong, Z. 2001. Two novel glycosides from the fruits of *Morinda citrifolia* (Noni) inhibit AP_1 transactivation and cell transformation in the mouse epidermal JB6 cell line, *Cancer Research*, 61(15): 5749-56.

Mathivanan, N., Surendiran, G., Srinivasan, K., Sagadeva, E., Malarvizhi, K. 2005. Review on the current scenario of noni research: Tamonomy, distribution, chemistry medicinal and therapeutic values of *Morinda critifolia*. *International Journal of Noni Research,* 1: 1-9

McClatchy, W. 2002. From Polynesian healers to health food stores:changing perspectives of Morinda citrifolia (Rubiaceae). *Integrative Cancer Therapies,* 1(2): 110 - 120.

Murdiati, M,M,S. 2000. To trace the active compound in Menkudu (*Morinda citrifolia*) with antihelmintic activity. *Journal ilmu termak das veteriner,* 5:(4), 255-259.

Seemann, B., Flora, V., 1866. A description of the plants of the Viti or Fiji islands with an account of their history, uses and Properties. London: L Reeve and Co., p 1865-1873.

Singh, D.R., Rai, R.B., and Singh, B. 2005. The Great Morinda - a potential underutilized fruit for Tsunami affected areas in Bay Islands. UTS's Voice, Port Blair, April 16-30, pp21.

Su, B.N., Pawlusm, A.D, Jung, H.A., Keller, W.J., McLaughlin, J.L. and Kinghorn, A.D. 2005. chemical constituents of th efruits of *Morinda citrifolia* (Noni) and their antioxidant activity. *J.Nat.Prod.,* 68:592-595.

Wang, M.Y, West, B.J, Jensen, C.J, Nowicki, D., Su, C., Palu, A.K and Anderson G. 2002. *Morinda citrifolia* (Noni): a literature review and recent advances in Noni research. *Acta Pharmacol. Sin.,* 23:1127-1141.

Wang, M.Y., and Su, C. 2001. Cancer preventive effects of *Morinda citrifolia* (Noni). *Annals of the New York Academy of Sciences*, 952:161-8.

Processing of Noni Fruit for Value Added Products

Baby Pulper

Products from Noni

Conditioning of Noni Fruit Juice