Research Article **ISSN: 2393 – 9540**

International Journal of Nutrition and Agriculture Research

Journal home page: www.ijnar.com

THE BEST USE OF KOKUM (*GARCINIA INDICA)* FRUIT AS RTS BEVERAGE AND FRUIT BAR

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ABSTRACT

Investigations were made on "The Best Use of Kokum (*GarciniaIndica*) Fruit as RTS Beverage and Fruit Bar". RTS (Ready-to Serve) Beverage and Fruit Bar were formulated, packed and quality parameters were assessed during different periods of storage up to 75 days. The storage stability of RTS beverage and fruit bar was good with respect to flavour and consistency. The percent reduction in Anthocyanin content was 19.66% in RTS beverage while 23.87% in fruit bar at the end of 75 days storage. The loss in Hydroxycitric acid (HCA) content was 18.85% in fruit bar and 21.43% in RTS beverage. No Significant change observed in TSS, pH and Ash value for RTS beverage during storage. There was gain in total sugar content of RTS beverage 3.32% and 0.78% in case of fruit bar. There was loss in calcium content of the fruit bar about 6%. The microbial load of RTS beverage and fruit bar were under the limit at the end of 75 days. Hence, the prepared preserved products were safe and fit for consumption. Product provides both nutritional, photochemical benefits to human population.

KEY WORDS

Kokum, Anthocyanin, HCA (Hydroxy citric acid) and RTS (Ready-to serve) beverage Fruit bar.

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INTRODUCTION[1]

The perishable fruits and vegetables are available as seasonal surpluses during certain parts of the year in different regions and are wasted in large quantities due absence of facilities and know-how for proper handling, distribution, marketing and storage. Quality of techniques fruits in pre and post harvest influences the consumer acceptance. The changes that occur in various physical and chemical characters determine the quality and in turn the

economic returns to the producers and processors[1]. Fruit plays an important role in the harvest losses, estimated to nearly 35%. Only 1% of the preparation of preserves, in cooking and in fermented total fruits and vegetables produced are processed in the beverage production[2]. In India, fruits and vegetables are wasted to the tune of rupees 30,000 million tonnes due to poor post harvest management.

Garciniaindica Choisy belonging to the family Guttiferae (in the mangosteen) is an indigenous tree of India. It was originally found only in the western peninsular coastal regions and the adjoining Western Ghats in the states of Maharashtra, Goa, Karnataka and Kerala, India as well as parts of Eastern India in the states of West Bengal, Assam and North Eastern Hill regions. Studies have shown that the rind contains moisture (80.0 g/100 g), protein (1%), tannin (1.7%), pectin (0.9%), Total sugars (4.1%) and fat (1.4%). The seed is very rich in stearic, oleic and stearic triglycerides Phytochemical studies have shown that when compared with any other natural sources, kokum rind contains the highest concentration of anthocyanins (2.4 g/100 g of kokum fruit)[3]. The anthocyanins cyanidin-3-glucoside and cyanidin-3-sambubioside are the major pigment present in kokum and is reported to occur in the ratio of 4:1. Studies have shown that (-)-hydroxycitric acid (HCA) is the major organic acid in kokum leaves and rinds.

In summer the ripe rinds are ground in a blender with sugar and cardamom and consumed as a cooling drink. Addition of kokum is supposed to enhance the taste of coconut-based curries and to remove the unpleasant smell of mackerel and sardines. They are also used in some vegetable dishes and to prepare chutneys and pickles. The Goans regularly prepare kokum kadi or birindasolkadhi. This curry is used with rice or like an after meal digestive drinks. Both birindisaar and kokum kadi are supposed to be digestive and to relieve gastric problems. As kokum is a highly under-utilized fruit, it can be preserved by making it as a processed food to use it during off-season[4].

Realizing the importance of fruits as a significant contributor to human well being, as a cheaper and better source of protective foods, their perishable nature and seasonality in production calls for preservation of them to be supplied throughout the year for human consumption. This study was planned keeping in view the nutritional importance of kokum, to utilize it by formulating RTS beverage and fruit bar.

MATERIALS AND METHODS

Selection of the Kokum Fruits

Ripe Kokum fruits ("*GarciniaIndica*") with hard shell, fairly large and globular shaped with soft, fleshy, yellowish edible pulp was selected for the study. They were purchased from the daily market as a bulk as they are highly seasonal and available only during the month of April. The procured kokum were stored at room temperature until they were used for the product development.

Selection of the Method of Preservation

Food Preservation has an important role in the conservation and better utilization of fruits and vegetables. In order to avoid glut and utilize the surplus during the season, it is necessary to employ methods to extend storage life, for better distribution, to preserve them for utilization in the off-season both in large scale and home scale[5].

Jam is more or less a concentrated fruit processing which has fairly thick consistency and body. It is also rich in flavour, because ripe fruits which have developed full flavour are used in its preparation. A great advantage in its preparation is that it can be prepared in a single operation.

Pre-Preparation of the Selected Kokum

Sorting and grading is essential to get suitable quality of fruit which was done by hand. The fruits were first washed to remove the dirt. Grading of fruit was done based on soundness, firmness, cleanliness, size, maturity, weight, color, shape and freedom from foreign matters, insect damage and mechanical injury. From the graded kokum the pulp was extracted manually. It was homogenized in a mixer to obtain fine pulp.

Extraction of Kokum Pulp

Purchased kokum rinds were washed in cold water three times for the removal of salt.100 g of the samples was used for each treatment. Equal amount (100ml) of water was added to the washed rinds. The washed rinds were soaked in water at 24.97°C temperature for 30.42 min of time. The kokum pulp was extracted by grinding into the mixer operated at 5000 rpm for 5 min at controlled room temperature (28-32°C). After extracted, the pulp was strained through 20 mesh stainless steel sieve to get the smooth pulp[6].

Preparation of RTS Beverage

RTS beverage was prepared by using the clear juice obtained from the kokum pulp with addition of sufficient quantity of sugar followed by pasteurization and cooling. Process of making kokum RTS is given in Figure No.1.

Preparation of Fruit bar

Fruit bar was prepared by drying the boiled kokum pulp with addition of sufficient quality of sugar and other ingredients. Process of making Fruit bar is given in Figure No.2.

Physico-Chemical Characteristics of RTS beverage and fruit bar

Knowledge of the physico-chemical properties of food is fundamental in analyzing the characteristics of food during its processing. The study of these food properties and their responses to process conditions are necessary because they influence the treatment received during the processing and also because they are good indicators of other properties and qualities of food[7]. In the present investigation certain physico-chemical properties of the developed kokum jam was analysed, to ensure the quality of the products. PFA specifies that jam is the product obtained by processing fresh fruits, canned, dried fruit pulp with water, sugar, dextrose, invert or liquid glucose either singly or in combination by boiling to a suitable consistency. The analysis of jam for the various properties was done using an aqueous solution of the sample. This was prepared by weighing about 25gm of the sample and dissolving it in 200ml of water. The aqueous solution was kept on a boiling water bath for 1 hour. The solution was cooled and diluted to 250ml with distilled water, filtered and used for analysis.

Titerable Acidity and pH Value

Acidity value is a measure of stability and shelf life of RTS beverage and fruit bar. It is due to the organic acids in fruits and those which are added while making the jam and fruit bar. The setting quality of jam is improved by adequate pH maintenance.

Reducing sugar

During fruit bar making, sucrose is added. During boiling, the sucrose partly gets converted into invert sugar which prevents crystallization.

Total Solids and Soluble Solids

For RTS beverage total solids and soluble solids are calculated. The figure for soluble solids helps in accessing the fruit content of jam which also helps to prevent the growth of mould and yeast.

Calcium Content

Calcium is determined as calcium pectate. Pectin extracted from plant material is saponified with alkali and precipitated as calcium pectate from an acid solution by addition of calcium chloride. The calcium pectate precipitate is washed until free from chloride, dried and weighed.

Nutrient Analysis of the RTS beverage and Fruit bar

Kokum is rich in acid and pigment. Storage conditions and length of storage period may alter the nutritive value of fruit. Hence RTS beverage and Fruit bar were subjected to analysis of the following nutrients at an interval of 15 days, for a period of 75 days.

Hydroxycitric acid

Fruits are important source of acid. The HCA content decreased during storage.

Anthocyanin

Kokum is rich in red pigment.

Organoleptic Evaluation of RTS beverage and Fruit bar

Sensory evaluation offers the opportunity to obtain a complete analysis of the various properties of food as perceived by human sense. Sensory evaluation is an important and best method for evaluating new products developed which provide quality measure and production control. The Sensory evaluation was

done using a score card developed. A panel of 35 semi trained members evaluated the products at an interval of 15 days for a period of 75 days for RTS beverage and fruit bar.

Determination of Microbial Load

Contamination of food by moulds and bacteria is common. Hence their presence in the finished products is considered unfit for consumption[8]. In order to find the presence of bacterial load, standard pour plate method in nutrient agar was carried out. The results were analysed and interpreted.

RESULTS AND DISCUSSION

Periodical Organoleptic Evaluation of the prepared Jam

The developed RTS beverage was stored in PET bottles at Refrigerated Temperature (4°C). The developed fruit bar was packed in LDPE aluminium covers and stored at cool and dry place at room temperature.

Once in 15 days all the analysis Nutritional, Phytochemical, Microbial was carried out for the period of 75 days. The samples were evaluated organoleptically once in 15 days. The samples were graded by numerical scoring, on a nine point hedonic scale. The organoleptic evaluation shows, gradual reduction in the mean score for over all acceptability after 75 days of storage (Table No.1 and 2).

Quality Parameters of the Prepared RTS beverage and Fruit bar

Acidity

Acidity is the measure of shelf-life of the product. Titerable acidity studied to ensure physico-chemical changes during preparation[9] and during storage[10]. In beverage, acid content decreased to 8.06% at 30days and 17.96% and 21.43% at 60 and 75 days of storage respectively. In fruit bar, acid content decreased to 8.20% at 30days and 15.57% and 18.85% at 60 and 75 days of storage respectively. A similar observation was seen by[11] where there was a negligible change in titerable acidity and the acidity was maintained, during storage of tomato juice for a period of 60 days.

Brix Value

There is no significant change observed in TSS during the storage period. TSS of the products was the index of sweetness. It is correlated in most of the fruits with maturity and ripeness[12].

pH Value

Fruit products are being effectively preserved at low pH[11]. pH estimation was done in order to find out whether a low pH was maintained throughout the study which could be an effective preservation. There was increase in pH during the entire storage in case of RTS beverage. Significant pH changes were noticed during storage of papaya fruit bar by[13].

Total Sugar

The increase in TSS and sugars would be attributed to the conversion of starch and other insoluble carbohydrates into sugars. In RTS beverage, there was gradual increase (1.57%, 2.86% and 3.32%) on 30^{th}, 60^{th} and 75^{th}day. In case of fruit bar, there was gradual increase (0.21%, 0.52% and 0.78%) on 30^{th}, 60^{th} and 75^{th}day.

Reducing Sugars

Sugars with reducing property are called reducing sugars. Estimation of reducing sugar is done to find out the starch material content. Gradual increase of about 1.14%, 1.93% and 2.56% during 30th, 60th and 75th day of storage in RTS beverage was observed. Gradual increase of about 0.17%, 0.64% and 0.83% during 30^{th}, 60^{th} and 75^{th}day of storage in fruit bar was observed Changes in the values of reducing sugars were more due to the ambient temperature. This was mainly due to the hydrolysis of non-reducing sugars, resulting into their increase[14].

Hydroxycitric acid

Fruits and vegetables are important sources of acid. The HCA content decreased during storage due to oxidation. Hence estimation was carried out during the storage period. Temperature has a major effect on the rate of loss of ascorbic acid. Losses of ascorbic acid were increased with the increase in temperature[15].

Anthocyanin

Anthocyanin estimation was done as there is a significant amount of anthocyanin present in kokum. More amount of anthocyanin content decreased in case of fruit bar (23.87%) than RTS beverage (19.66%) at the end of the storage period.

Microbial Load of the Prepared RTS Beverage and Fruit bar

By using pour plate technique yeast and total plate count for RTS beverage; bacteria and fungi count for fruit bar were observed on the interval of 15 days with total storage period of 75 days for both RTS beverage and fruit bar.

Above tables (Table No.3) showed that yeast count (cfu/ml) was found to be 4 on the end of storage period of 75 days. According to PFA standards it should be less than 2 (cfu/ml). Total plate count was found to be 17 (cfu/ml); According to PFA standards it should be less than 50 (cfu/ml). Above tables (Table No.4) showed that the bacteria count (cfu/ml) was found to be 25 in the fruit bar on the end of storage period of 75 days. According to PFA standards it should be less than 50 X 10^{-5}. 7 X10^{-5} (cfu/ml) for fungi were observed. As per PFA standards the count was less than 10 X10^{-5}. It means that both RTS beverage and fruit bar were safe and fit for consumption up to 75 days with respect to microbial count.

Sensory Analysis and Shelf Life Estimation

The mean scores are reported in Table No.5 for RTS beverage and Table No.6 for fruit bar. The Organoleptic evaluation shows, gradual reduction in the mean score for over all acceptability after 75 days of storage. Consistency remains same and the taste declined. Flavour change was observed, which showed a reduction in taste of RTS. Though there was reduction in the mean scores, statistical tests obtaining T-value proved that the calculated t-value in all the above parameters with varying nos. of days was lower than tabulated value of t of 2.26 with 9 degrees of freedom for 5% level hence null hypothesis hold good for the prepared beverage over the entire period. Hence maximum storage period of 75 at refrigerator temperature may give a better acceptability.

The Organoleptic evaluation shows, gradual reduction in the mean score for over all acceptability after 75 days of storage. Texture remains same and the taste declined. Flavour change was observed, which showed a reduction in taste of fruit bar. Though there was reduction in the mean scores, statistical tests obtaining T-value proved that the calculated t-value in all the above parameters with varying nos. of days was lower than tabulated value of t of 2.26 with 9 degrees of freedom for 5% level hence null hypothesis hold good for the prepared fruit bar over the entire period. Hence maximum storage period of 75 at room temperature may give a better acceptability.

DISSCUSSION

Organoleptic evaluation, nutrient analysis and microbial analysis were noted in both products during 30^{th}, $60^{th}$and 75^{th}day of storage. In Organoleptic evaluation, the overall acceptability of RTS beverage was decreased less than that of fruit bar on 75th day storage. The analyzed nutrient content showed that the percent reduction in HCA content was 18.85 percent and 21.43 percent in RTS beverage and fruit bar respectively. During the storage of up to 75th day the percent loss in Anthocyanin was 19.66 percent and 23.87 percent in RTS beverage and fruit bar respectively. As the period of storage increased the percentage loss of titerable acidity was also increased in both products. The percentage gain in reducing sugar content and total sugar content was observed in both the products. With regards to microbial load content of RTS Beverage and Fruit bar, only acceptable amount was observed during 75 day of storage. Hence the prepared kokum value added products were safe and fit for consumption.

Table No.1: Nutritional changes of stored RTS Beverage

S.No	Parameter	0^{th} day	15^{th} day	30^{th} day	45^{th} day	60^{th} day	75^{th} day
1	Total Carbohydrate (g/100ml)	20.34	20.43	20.58	20.67	20.78	20.90
2	Protein (µg /100ml)	0.96	0.94	0.92	0.90	0.88	0.86
3	Total Sugar (g/100ml)	16.32	16.47	16.58	16.70	16.80	16.88
4	Reducing sugar (g/100ml)	12.18	12.25	12.32	12.38	12.42	12.5
6	Acidity (HCA)g/100ml	0.980	0.945	0.901	0.855	0.804	0.770
7	Anthocyanin (mg/100ml)	110.16	106.45	101.30	96.42	93.35	90.5
8	Vit. C (mg/100ml)	20.15	18.54	17.35	16.28	15.63	15.03
9	pH	3.8	4.0	4.2	4.4	4.5	4.7
10	TSS or brix	17	18	18	18	18	18

Table No.2: Nutritional changes of stored Fruit bar

S.No	Parameter	0^{th} day	15^{th} day	30^{th} day	45^{th} day	60^{th} day	75^{th} day
1	Total Carbohydrate (g/100g)	80.72	80.78	80.82	80.87	80.92	80.95
2	Crude fat (g/100g)	2.15	2.11	2.09	2.08	2.08	2.06
3	Protein (µg /100g)	1.05	1.03	0.96	0.90	0.87	0.85
4	Total Sugar (g/100g)	70.13	70.20	70.28	70.38	70.50	70.68
5	Reducing sugar (g/100g)	62.43	62.48	62.54	62.74	62.83	62.95
6	HCA (g/100g)	12.2	11.7	11.2	10.8	10.3	9.90
7	Anthocyanin (g/100g)	1.55	1.47	1.35	1.25	1.21	1.18
8	Ca (mg/100g)	92	90	88	86	86	86
9	Vit. C (mg/100g)	20.82	18.45	16.30	14.28	13.04	12.0

Table No.3: Microbial analysis result of RTS Beverage

S.No	Microbial Load	0^{th} day	15^{th} day	30^{th} day	45^{th} day	60^{th} day	75^{th} day
1	Yeast X 10^{-5} (cfu/ml)	0	1	2	2	3	4
2	Total plate count (cfu/ml)	12	15	17	17	17	17

Table No.4: Microbial analysis result of fruit bar

S.No	Microbial Load	0^{th} day	15^{th} day	30^{th} day	45^{th} day	60^{th} day	75^{th} day
1	Bacteria X 10^{-5}(cfu/ml)	12	15	17	23	23	25
2	Fungi X 10^{-5}(cfu/ml)	4	5	6	6	7	7

Table No.5: Sensory analysis result of RTS beverage

S.No	Parameter (Avg.Score)	0^{th} day	30^{th} day	T-value initial Vs 30^{th} day	60^{th} day	T-value initial Vs60^{th} day	75^{th} day	T-value initial Vs 75^{th} day
1	Colour	8.50	8.25	1.38 Ns	8.05	2.15 Ns	7.80	1.68 Ns
2	Appearance	8.33	8.15	1.22 Ns	7.95	1.47 Ns	7.63	1.95 Ns
3	Texture	8.63	8.39	0.74 Ns	8.14	1.25 Ns	7.81	1.68 Ns
4	Flavour	8.37	8.17	1.85 Ns	7.98	1.89 Ns	7.68	2.13 Ns
5	Taste	8.66	8.45	1.63 Ns	8.10	1.24 Ns	7.84	1.57 Ns
6	Overall Acceptability	8.40	8.28	0.58 Ns	7.98	1.65 Ns	7.75	1.87 Ns

Ns: Not significant, S: Significant

Table No.6: Sensory analysis result of fruit bar

S.No	Parameter (Avg.Score)	0^{th} day	30^{th} day	T-value initial Vs 30^{th} day	60^{th} day	T-value initial Vs 60^{th} day	75^{th} day	T-value initial Vs 75^{th} day
1	Colour	8.55	8.37	1.32 Ns	8.14	2.12 Ns	7.80	1.66 Ns
2	Appearance	8.35	8.21	1.27 Ns	7.94	1.43 Ns	7.73	1.75 Ns
3	Texture	8.68	8.47	0.78 Ns	8.17	1.29 Ns	7.85	1.83 Ns
4	Flavour	8.39	8.28	1.87 Ns	7.95	1.81 Ns	7.74	2.08 Ns
5	Taste	8.72	8.51	1.69 Ns	8.24	1.27 Ns	7.87	1.75 Ns
6	Overall Acceptability	8.58	8.32	0.67 Ns	8.01	1.55 Ns	7.84	1.84 Ns

Ns: Not significant, S: Significant

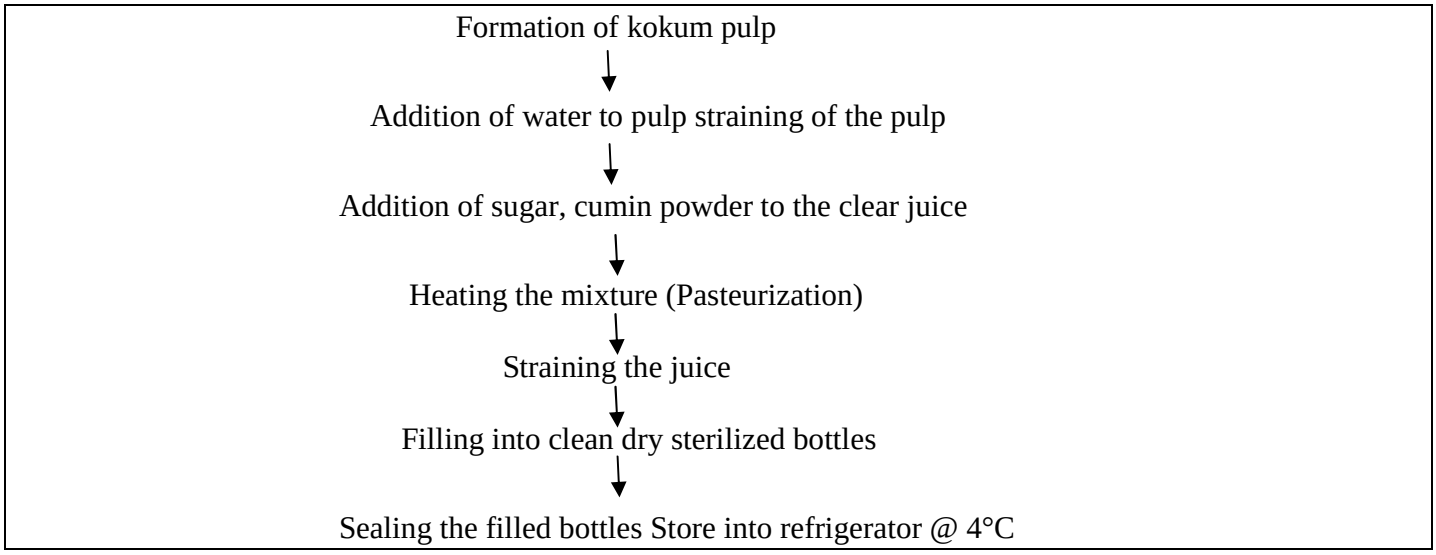

Figure No.1: Process of making Kokum RTS

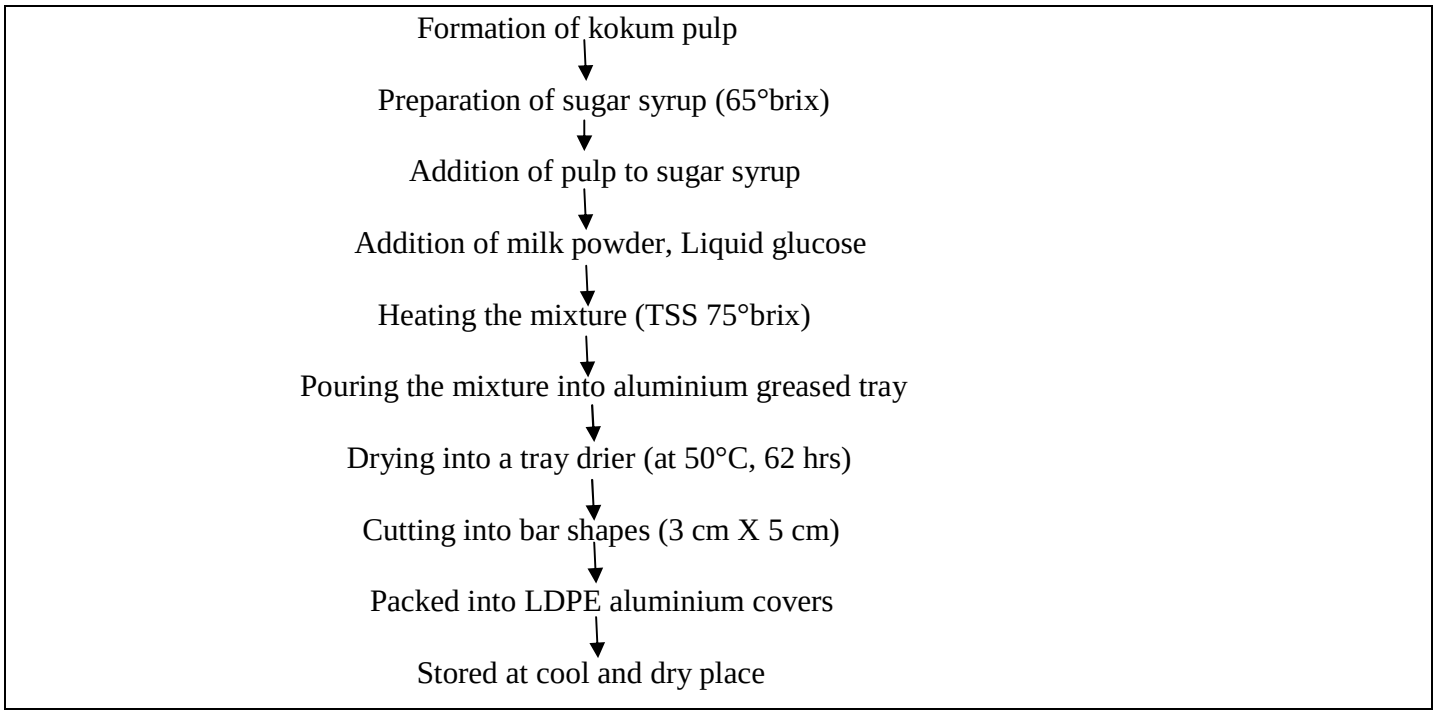

Figure No.2: Kokum bar preparation

CONCLUSION

The process had been developed for the preparation of value added products like RTS beverage, Fruit bar from kokum fruit. The RTS beverage and Fruit bar would have the shelf life of 75 days when stored at refrigerated storage (4°C) and at room temperature (28°C-35°C) respectively. These products provide nutritional as well as phytochemicals benefits to human population and the resulting observations should be implemented in industrial scale to cater to both national and international consumers of kokum.

ACKNOWLEDGEMENT

I would like to express my heartily gratitude to Mrs. N. Manimehalai, Asst. Professor (O.G.), Department of Food Process Engineering, for her guidance and encouragement throughout this research work.

BIBLIOGRAPHY

1. Agarwal G and Mangaraj S. Studies on physico-chemical changes in selected fruits during storage, *Beverage and Food World*, 32(11), 2005, 72-75.
2. Liangji. Use of ozone to improve the safety of fresh fruits and vegetables, *Food Science and Technology*, 53(10), 1999, 58-61.
3. Nayak C A, Rastogi N K and Raghavarao K S M S. Bioactive constituents present in Garciniaindica Choisy and its potential food applications: A review, *International Journal of Food Properties*, 13, 2010, 441-453.
4. Krishnamurthy N, Lewis Y S and Ravindranath B. Chemical constituents of Kokum fruit rind, *Journal of Food Science and Technology*, 19(3), 1982, 97-100.
5. Ashwah E I, Abd F A, Baki N M, Samahy S K, AbdE I and Fadeel M H. Effect of storage on the characteristics of the concentrated orange and lime juice, *Agricultural Research Review*, 38(3), 1982, 275-288.
6. Pritam G. Bafna. Optimization of Process Parameters for Extraction of Kokum (*GarciniaIndica*) Fruit Pulp using Response Surface Methodology (RSM), *International Journal of Scientific and Engineering Research*, 3(8), 2012, 1-7.

7. Rao, Mir M A and Nirankar N. Storage changes in Fortified Mango Bars, *J. Food Science and Technology*, 30(4), 1993, 279-282.
8. Ranganna S. Sensory evaluation General Instruction for microbiological examination. Hand book of Analysis and the quality control for fruits and vegetable products, *Tata McGraw Hill Publishing Company Ltd., New Delhi*, 2nd edition, 1986, 670-686.
9. Sandhu K S, Bhatia K S and Shukla F G. Physico chemical changes during storage of kinnowmandarian, orange and pineapple juice concentrates, *Food Science and Technology*, 22, 1998, 343-345.
10. Kalra S K and Tandon D K. Physico-chemical changes in mango pulp during ambient storage in glass containers, *J. Food Science and Technology*, 22, 1985, 343-345.
11. Sindhu S, Bhumbla K and Joshi C. Preservation of Tomato juice under acid condition, *J. Food science and Agriculture*, 35, 1984, 345-352.
12. Jain M S and Agawal G. Studies on Physico-chemical changes in selected fruits during storage, *Beverage and Food World*, 32(11), 2005, 72-75.
13. Anonymous. Adapted from Herald of health, *Fruits - Natures Tonic, Nutrition,* 8, 1996, 56-57.
14. Sudheer K P and Dash S K. Osmo-solar dehydration of Fruits and Vegetables- An Overview, *Indian Food Packers*, 53(3), 1999, 28-35.
15. Johnson M and Hessel M. Stability of Ascorbic acid in ready to drink juices, *Varfoda*, 34(5), 1982, 267-279.