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STUDIES ON READY TO SERVE (RTS) BLEND BEVERAGE FROM AONLA (*EMBLICA OFFICINALIS* GAERTN.), BOTTLE GOURD (LAGENARIA *SICERARIA* STANDLEY), GINGER (ZINGIBER *OFFICINALE* ROSCOE) AND CARDAMOM (*ELETTARIA CARDAMOMUM* MATON)

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KEYWORDS
RTS, Aonla, Bottle gourd, Ginger and Cardamom, Blend beverage, Ambient temperature storage, organoleptic quality.

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ABSTRACT

The present investigation was carried out at Post Graduate Laboratory, Department of Post Harvest Management College of Horticulture & Forestry, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya-224229, U.P. India during 2024 2025. Aonla (*Emblica officinalis* Gaertn.), Bottle gourd (*Lagenaria siceraria* Standley), Ginger (*Zingiber officinale* Roscoe) & Cardamom (*Elettaria cardamomum* Maton)" which have nutritional, medicinal and therapeutic values were blended in different ratios viz., 86:5:5:4(T_1), 72:10:10:8 (T_2), 58:15:15:12(T_3), 44:20:20:16 (T_4), 30:25:25:20 (T_5) to get the best blend combination for the preparation of RTS. The blend comparising 30% aonla juice, 25% bottle gourd, and 25% ginger juice and 20 % cardamom powder was found to be best over other treatments for the preparation of palatable quality of RTS. The 10% of best blend with 13% Total Soluble Solids, 0.30% acidity and incorporated with 70 ppm SO_2 was used to prepare RTS for storage study. During the storage TSS, acidity, reducing sugars, total sugars and browning increased, whereas ascorbic acid (Vitamin C), non-reducing sugar and organoleptic quality decreased with the advancement of storage period. The RTS was organoleptically acceptable upto 3 months of storage in case of ambient temperature.

INTRODUCTION

Fruit beverages are widely consumed globally and are prepared by blending fruit juice or pulp with ingredients such as sugar, acids and preservatives. These beverages are categorized into various types, including natural fruit juices, sweetened juices, ready-to-serve (RTS) drinks, nectars, cordials, squashes, crushes, syrups and juice concentrates.

Aonla (*Emblica officinalis* Gaertn.) or Indian gooseberry, is a hardy and commercially important minor fruit in India, cultivated widely across several states with an annual production of 13.78 lakh Metric Ton (NHB, 2023-24). Belonging to the Euphorbiaceae family, Aonla is widely recognized for its remarkably high vitamin C content ranging from 1100 to 1700 mg per 100 grams of edible portion (Ting, 1986) after Barbados Cherry. Nutritionally, aonla is rich in dietary fiber, Total Soluble Solids, pectin and phenolic compounds.

Bottle gourd (*Lagenaria siceraria* Standley) commonly known in India as lauki, dudhi or ghiya, is a nutrient-rich vegetable from the Cucurbitaceae family. Bottle gourd contains approximately 94.5% moisture, 1.2% protein, 0.2% fat, 3.75% carbohydrates, 0.7% dietary fiber and 0.5% ash, providing an energy value of approximately 15 kcal per 100 grams of edible portion (Bhat *et al.*, 2017).

Ginger (*Zingiber officinale* Roscoe) is a perennial herb from Southeast Asia, belonging to the Zingiberaceae family. It is rich in nutrients such as carbohydrates, proteins, amino acids, vitamins, minerals, fatty acids, lipids and bioactive compounds like phenolics and essential oils. It exhibits anti-inflammatory (Aryaeian *et al.*, 2019), antioxidant (Seif *et al.*, 2021) and antibacterial (Abdullahi *et al.*, 2020) activities.

Cardamom (*Elettaria cardamomum* Maton) is an aromatic, evergreen perennial herb from the ginger family, native to tropical regions of Sri Lanka, India and Burma, especially the Western Ghats of South West India. It's essential oil primarily contains 1,8-cineole (20-60%) and α-terpinyl acetate (20-55%).

2. Materials and Methods

2.1 Raw materials used for beverages preparation:

For the preparation of blend RTS from aonla, bottle gourd, ginger and cardamom were the raw materials that bought from different places. Aonla (var. NA-7) from Horticultural Main Experiment Station, Department of fruit science, Bottle gourd(var. Narendra madhuri)from Horticulture Main Experiment Station, Department of vegetable science, Acharya Narendra Deva University of Agriculture & Technology, Narendra Nagar,

Kumarganj,Ayodhya(UP)India, while ginger and cardamom (Local variety) purchased from local market Kumarganj, Ayodhya(UP) India.

2.2 Extraction of aonla juice, bottle gourd juice, ginger juice and cardamom powder

The processes employed for extracting juice from aonla, bottle gourd, ginger and powder from cardamom are showing in Fig.-1, Fig.-2, Fig.-3, and Fig.-4, respectively.

2.3 Standardization of blends for RTS

The RTS containing 10 % blends, 13 % TSS, 0.30 % acidity and 70 ppm SO_2 were prepared from each combination of aonla juice, bottle gourd juice, ginger juice and cardamom powder to obtain best combination for quality RTS beverages through 9-point Hedonic Scale.

T1 10% B.C. No.1 containing 86% aonla juice + 5% bottle gourd juice + 5% ginger juice +4% cardamom powder + 13% Sugar+ 0.3%acidity+ 70ppm SO_2

T2 10% B.C. No.2 containing 72% aonla juice + 10% bottle gourd juice + 10% ginger juice +8% cardamom powder + 13% Sugar+ 0.3%acidity+ 70ppm SO_2

T3 10% B.C. No.3 containing 58% aonla juice + 15% bottle gourd juice + 15% ginger juice +12% cardamom powder + 13% Sugar+ 0.3%acidity+ 70ppm SO_2

T4 10% B.C. No.4 containing 44% aonla juice + 20% bottle gourd juice + 20% ginger juice +16% cardamom powder + 13% Sugar+ 0.3%acidity+ 70ppm SO_2

T5 10% B.C. No.5 containing 30% aonla juice + 25% bottle gourd juice + 25% ginger juice +20% cardamom powder + 13% Sugar+ 0.3%acidity+ 70ppm SO_2

Preparation of RTS

500ml RTS from each blend combination, with 10% blend, 13% TSS, 0.30% acidity, and 70 ppm SO_2, were developed, and a panel of nine semi-trained judges assessed these beverages organoleptically to determine the ideal combination of aonla juice, bottle gourd juice, ginger juice and cardamom powder. Then, 4 liters of RTS were made using the best blend combination and filled into 250 ml glass bottles, leaving 2-centimetre headspace, crown corked, and pasteurized before being put for storage investigation at room temperature. Fig. 5 displays the flow chart used in the RTS preparation process.

2.4 Storage studies

Prepared Ready-to-Serve (RTS) beverage samples were stored under ambient temperature conditions for shelf-life evaluation. During the storage period, changes in various physicochemical and sensory parameters including Total Soluble Solids (TSS), titratable acidity, ascorbic acid (vitamin C), reducing sugars, non-reducing sugar, total sugars, non-enzymatic browning and organoleptic attributes were monitored at monthly intervals.TSS content was measured using a hand refractometer (Erma Inc., Tokyo, Japan) with scale ranges of 0–32%, 28–62% and 58–92%. The readings were corrected to a standard reference temperature of 20°C using tabulated correction values and the final results were expressed as a percentage (% TSS) following the method outlined by Ranganna (2010). Titratable acidity was determined by titrating a known aliquot of the sample against standard N/10 sodium hydroxide (NaOH) using phenolphthalein as an indicator. Results were expressed as a percentage of anhydrous citric acid. Ascorbic acid content was estimated by extracting the sample in 3% metaphosphoric acid (HPO_3) and titrating it against 2,6-dichlorophenol-indophenol dye solution until a persistent light pink endpoint was observed, as per Ranganna (2010). Reducing sugars, non-reducing sugar and total sugars were quantified by the Lane and Eynon method using Fehling's solutions A and B, with methylene blue serving as the internal indicator during the boiling stage. Non-enzymatic browning was assessed by mixing 20 ml of the RTS sample with30 ml of 60% ethanol, followed by centrifugation at 1500 rpm for 15 minutes. The resulting supernatant was filtered and analyzed for absorbance at 420 nm using a UV-Visible double beam spectrophotometer, with 60% ethanol serving as the blank. An increase in absorbance at 420 nm was indicative of browning intensity. Sensory evaluation was conducted by a panel of semi-trained judges who assessed the color, flavor and texture of RTS formulation using a 9-point Hedonic Rating Scale, as described by Amerine *et al*. (1965).

2.5 Statistical analysis

The experiments were conducted in 3 replications and the statistical analysis of the data was done by OPSTAT as the method developed by Prof. O.P. sheoran (2010) for CRD experiment.

Result and Discussion

3.1 Chemical attributes of Aonla, Bottle gourd, Ginger and Cardamom powder

The data noted for the chemical attributes of aonla juice, bottle gourd juice, ginger juice and Cardamom powder is listed in table 1. TSS, acidity, vitamin C, reducing sugars, non reducing sugar and total sugars of aonla juice were reported 8.20%, 2.10%, 459 mg/100g, 1.50%, 4.46% and 5.96%, respectively. Similar in current study Beck *et al*. (2022) observed in aonla juice TSS 9° brix, vitamin C 445.83 mg/ 100 ml, acidity 2.12 %, total sugars 6.5%, reducing sugars 1.30 % and non reducing sugar 4.40%, Hedge *et al*. (2018) reaveled that aonla juice contained TSS 5.80°brix, acidity 1.56 %, pH 3.11, ascorbic acid 448.70 mg/100 ml, reducing sugars 4.59 % and total sugars 9.50%. Bottle gourd juice contained TSS, acidity, vitamin C, reducing sugars, non reducing sugar and total sugars 4.50%, 0.09%, 15 mg/100g, 1.40%, 3.10% and 4.50%, respectively. Agarwal &Kumar (2017) noted TSS of bottle gourd 7.8 to 8.4° brix and acidity 1.8 to 2.7 %, while Gajera *et al*. (2015) observed that in bottle gourd TSS ranged 5.17 to 5.23°brix, pH in range of 3.47 to 3.52 and vitamin C in range of 30.51 to 38.12mg/100ml, acidity 0.84 to 0.89%, reducing sugars 2.59 to2.72%, non reducing sugar 0.44 to 0.66% and total sugars 3.12 to 3.15%. Ginger juice contained TSS, acidity, vitamin C, reducing sugars, non reducing sugar and total sugars 2.30%, 0.29%, 1.98 mg/100g, 0.70%,1.14% and 1.84%, respectively. Hedge *et al*. (2018) noted that ginger juice contain TSS 1.50°brix, acidity 0.24%, pH 5.20%, ascorbic acid 2.70 mg/100ml, reducing sugars 0.64% and total sugars 1.60%. Cardamom powder contained TSS, acidity, vitamin C, reducing sugars, non reducing sugar and total sugars 1.76%, 0.24%, 2.00mg/100gm, 0.50%, 1.23% and 1.73%, respectively. Similarly, Souza *et al*.(2020) observed that 5.1% TSS and 1.5% acidity.

3.2 Organoleptic quality of RTS prepared from different blends aonla juice, bottle gourd juice, ginger juice and cardamom powder

The data on organoleptic quality of RTS prepared using various combinations of aonla juice, bottle gourd juice, ginger juice, cardamom powder and sugar are represented in table-2. Results shows that the blend combination no. 5 was liked the most over all other blend combinations. Therefore, the best quality RTS beverages can be prepared using 10 % blend combination comprising of 30 % aonla juice, 25% bottle gourd juice, 25% ginger juice and 20 % cardamom powder with 13 % total Soluble Solids, 0.30 % acidity and 70 ppm SO_2. Similerly, Verma and Deen (2024) deveolped blended beverages RTS from Guava (*Psidium gujava* L.), wood apple (*Feronia limonia* L.) and ginger (*Zingiber officinale* Rosc.) and Panday *et al*. (2022) developed RTS from blends of bottle gourd, aloe vera and ginger juice of the highest organoleptic score. these finding supported to results that beverages can be prepared from different combination of fruit, vegetables and spices.

3.3 Biochemical changes during storage of prepared RTS

Data noted on physico-chemical changes of RTS during storages represented in table 3, which observes that TSS of RTS increased under ambient temperature from13.00 % to 13.38% during 3 months of ambient storage. Increased in TSS might be due to the hydrolysis of polysaccharides into monosaccarides. This process of conversion seemed to take place at a faster under the ambient conditions possibly due to temperature influences. Similar pattern were recognized by Assumi *et al*. (2023) in RTS beverage made from pineapple, passion fruit and ginger, Beck *et al*.(2022) noticed similar trends in RTS beverages made from bitter gourd and aonla, Harendra and Deen (2021) in RTS beverages, containing ginger, mango, kagzi lime and aloe vera. The acidity level of RTS increased during storage at ambient temperature from 0.30 % to 0.45%. A rise in acidity levels may appear from the breakdown of pectic substances and the production of organic acids (Conn and Stum, 1976). Beck *et al*.(

2022) noticed similar trends in acidity of RTS beverages made from bitter gourd and aonla. Vitamin C of RTS prepared from aonla, bottle gourd juice, ginger juice and cardamom powder decreased from 12.72 mg/100ml to 12.61mg/100ml during storage. The reduction in ascorbic acid (Vitamin C) content may be attributed to its oxidation into dehydroascorbic acid, a process accelerated by the presence of oxygen within the container and the intercellular spaces of the product. Mahnoori *et al*. (2020) noted that ascorbic acid decrease during storgae of litchi beetroot blend RTS, Agarwal and Kumar (2017) observed decreasing trend of ascorbic acid in RTS beverage of bottle gourd juice blends with mint and lemon, Devra *et al*. (2017) found declining trend of ascorbic acid content in aonla based blended RTS beverages, Balaji and Prasad (2014) noted decrease ascorbic acid in aonla and kinnow mix beverage with three levels of cardamom and ginger as herbal ingredients and Deen and Kumar (2014) also observed in RTS beverage prepared from mango and ginger blend at ambient temperature. Reducing sugars content of RTS increased continuously up to the termination of storage period under ambient temperatures and it was increased from 3.38 to 3.98 %. The increase in reducing sugars of products might be due to conversion of non-reducing sugar into reducing sugars. Similar finding were also reported by the earlier researcher like Verma and Deen (2024) in ready-to-serve (RTS) blend beverage made from guava, wood apple and ginger, Assumi *et al*.(2023) in RTS beverage prepared from pineapple, passion fruit and ginger, Awasthi *et al*.(2022) in wood apple and aonla based blend RTS beverage, Beck e*t al*.(2022) in RTS beverage made from bitter gourd along with aonla, Surya *et al*.(2019) in RTS beverage made from aonla with dietary fiber and Hegde *et al*.(2018) in kokum blended RTS beverage using aonla and ginger. These findings support the results of present investigation. The non-reducing sugar content of RTS showed gradual decreasing trend when stored under ambient temperature. Verma and Deen (2024) in RTS beverages, Beck *et al*.(2022) in bitter gourd and aonla based blend beverage, Harendra and Deen (2021) in RTS beverage of ginger, mango, kagzi lime and aloe vera. The total sugars content of RTS increased gradually from 12.30 to 12.52% when stored under ambient temperatures. A rise in total sugars of product might be due to inversion of non-reducing sugar into reducing sugars. The present results on increase of total sugars content in RTS is also similar to findings of Beck *et al*.(2022). The browning in RTS increased continuously up to the termination of storage under ambient temperature. It was increased from 0.22(O.D.) to 0.34(O.D.). An increase in browning of RTS could be mainly due to the non- enzymatic reaction (Millard reaction) in which organic acids react with sugars and amino acids and lead to the formation of brown pigments. The present findings are also in agreement with the findings of previous research workers like Verma and Deen (2024) in guava, wood apple and ginger blended RTS, Awasthi *et al*. (2022) in wood apple and aonla RTS beverage. The organoleptic quality of RTS reduced continuously with the storage period and it was acceptable up to three months of ambient storage. The quality score were reduced from 8.44 to 7.06 under ambient temperature. It might be due to temperature, because temperature plays an important role in biochemical changes that leads to development of off flavour as well as discolouration in the beverages. Similarly, Verma and Deen (2024) and Angami *et al*. (2023) noticed decrease in quality scores of different blend beverages which supports the results of present investigation.

CONCLUSION

It may be inferred from above finding that 10% of the blend containing 30 % aonla juice, 25% bottle gourd juice, 25% ginger juice and 20 % cardamom powder was found best on hedonic Scale for the preparation of palatable quality RTS adjusted to 13% total soluble solids, 0.30 percent acidity with 70 ppm SO_2. The TSS, acidity, reducing sugars, total sugars and browning were increased, whereas vitamin-C, non reducing sugar and organoleptic quality were declined during storage under ambient temperature. The prepared RTS can be stored with acceptable quality up to 3 month under ambient temperature.

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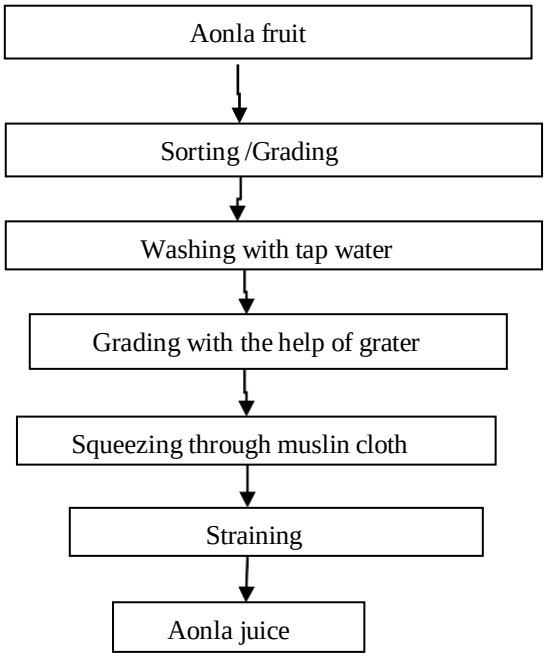
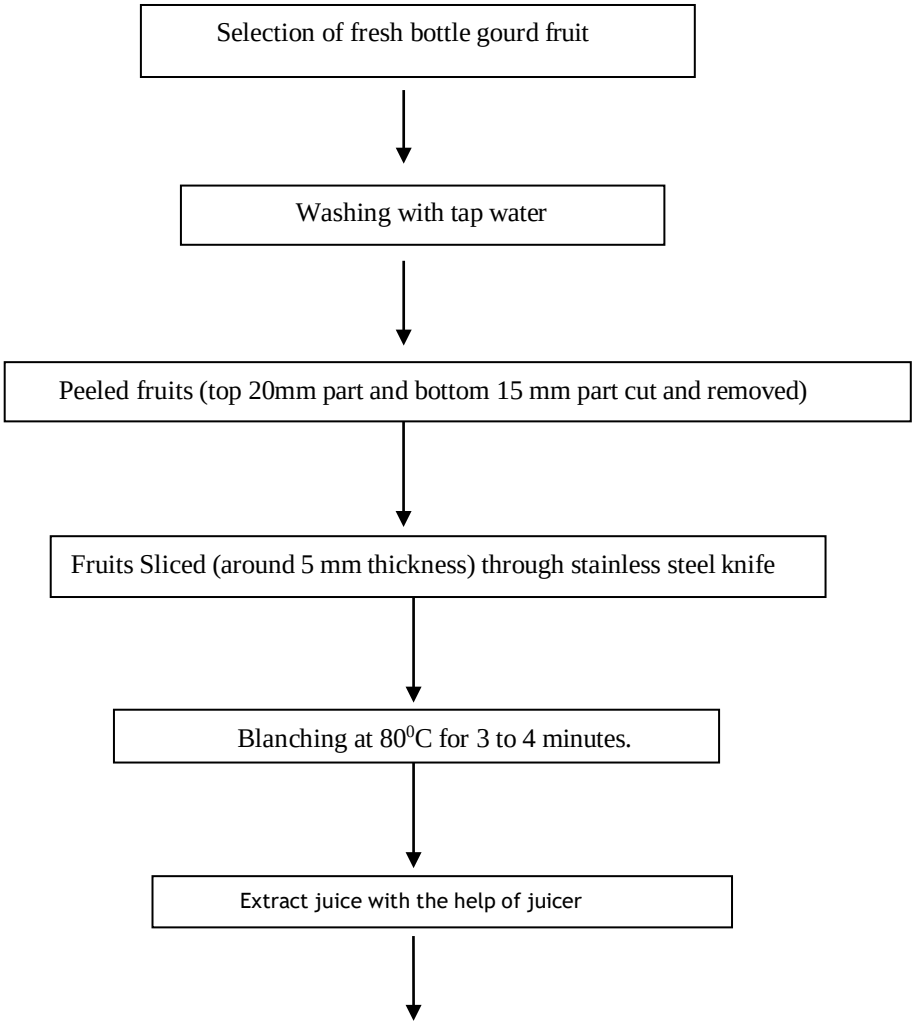


Fig. 1 Flow chart for extraction of Aonla juice



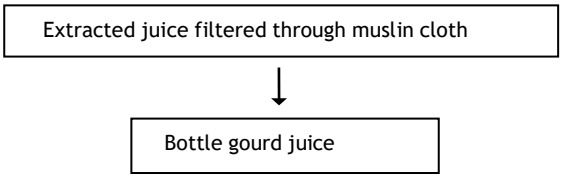


Fig. 2 Flow chart for extraction of bottle gourd juice

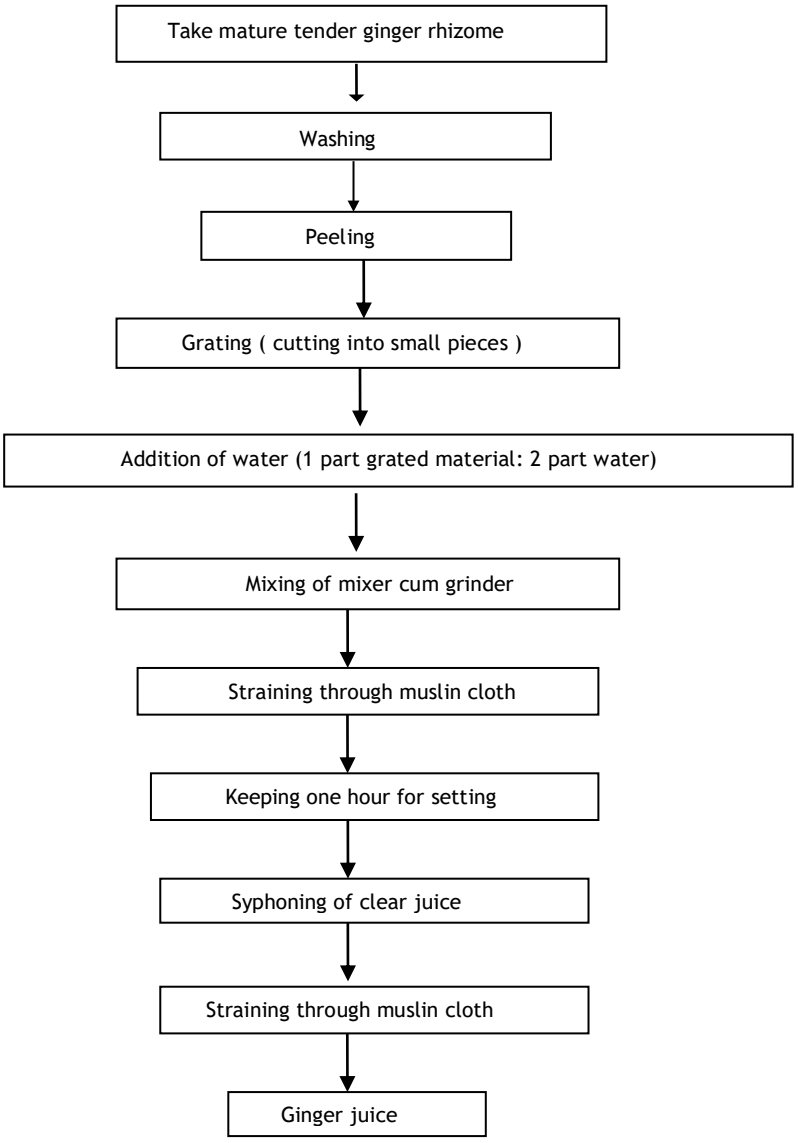


Fig. 3 Flow chart for extraction of ginger juice

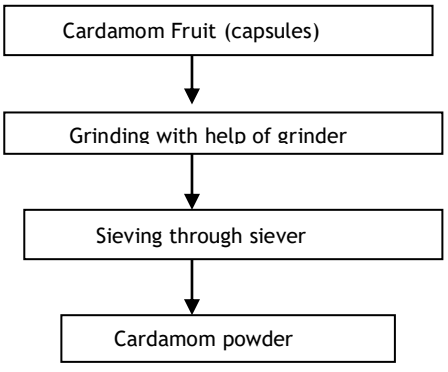


Fig. 4 Flow chart for preparation of cardamom powder

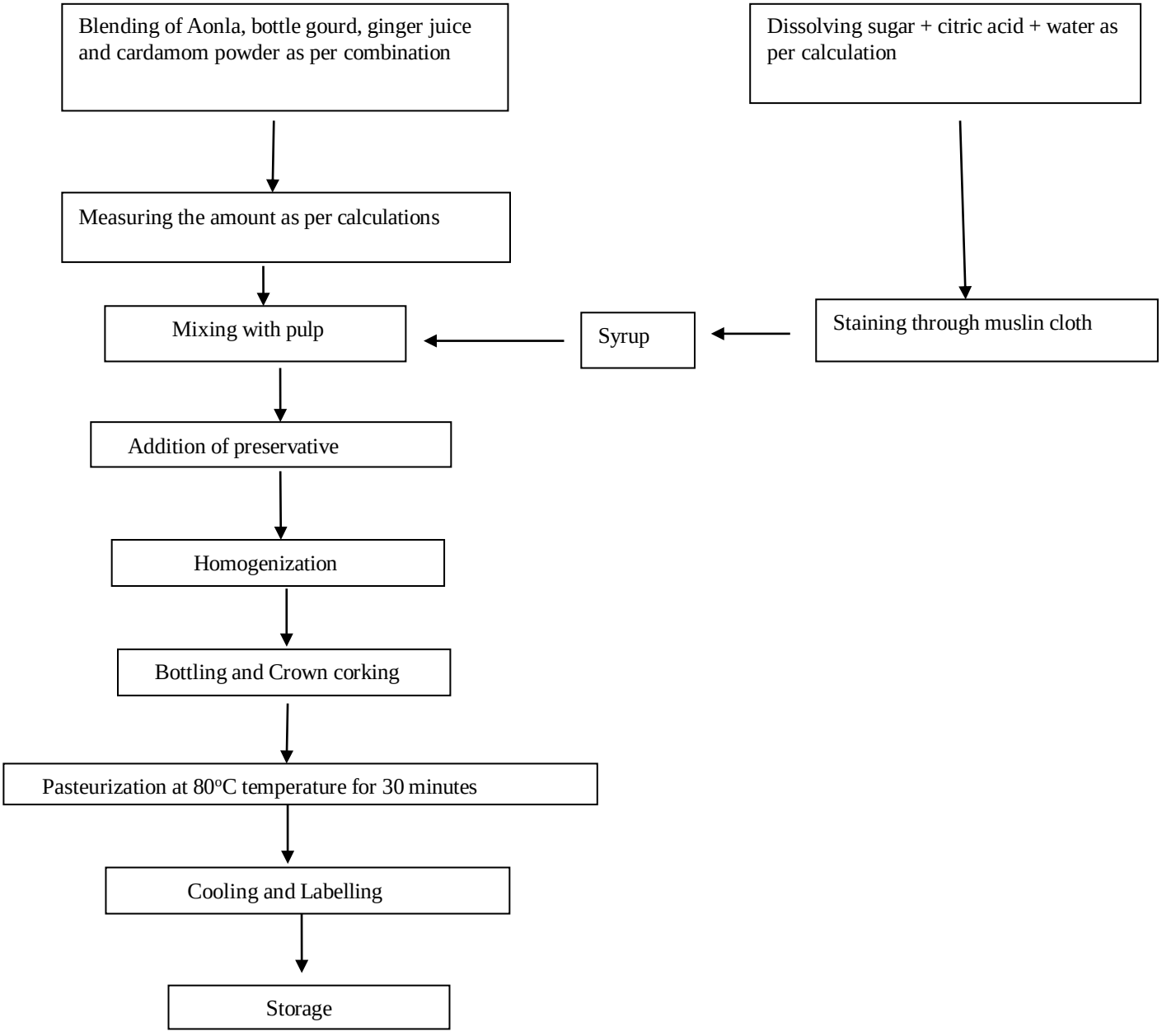


Fig. 5 Flow chart for preparation of blended RTS from aonla, bottle gourd, ginger and cardamom

Table -1 Chemical attributes of aonla juice, bottle gourd juice, ginger juice and cardamom powder

Raw Materials	Chemical Attributes					
	Mean Values					
	TSS (%)	Acidity (%)	Ascorbic Acid (mg/100gm)	Reducing Sugar (%)	Non reducing Sugar (%)	Total Sugar (%)
Aonla juice	8.20	2.10	459	1.50	4.46	5.96
Bottle gourd juice	4.50	0.09	15.00	1.40	3.10	4.50
Ginger juice	2.30	0.29	1.98	0.70	1.14	1.84
Cardamom Powder	1.76	0.24	2.00	0.50	1.23	1.73

Table-2 Organoleptic quality of RTS prepared from different blend combinations of aonla juice, bottle gourd juice, ginger juice and cardamom powder

Blend Combinations (No.)	**Different combination of blends**					**Organoleptic quality**	
	Aonla juice (%)	Bottle gourd juice(%)	Ginger juice (%)	Cardamom Powder (%)	Sugar (%)	Score	Rating
1	86	5	5	4	13	7.20	LM
2	72	10	10	8	13	7.80	LM
3	58	15	15	12	13	7.90	LM
4	44	20	20	16	13	7.60	LM
5	30	25	25	20	13	8.44	LVM
SE.m±						0.06	
CD at 5%						0.20	

LM: Like moderately , LVM: Like very much

Table 3: Changes during storage in RTS under ambient temperature

Storage period (Month)	**TSS (%)**	**Acidity (%)**	**Vitamin-C(mg/100ml)**	**Reducing sugars(%)**	**Non-reducing sugar**	**Total sugars**	**Browning (O.D)**	**Organoleptic quality**	
								Score	**Rating**
0	13.00	0.30	12.72	3.38	8.92	12.30	0.22	8.44	LVM
1	13.29	0.35	12.69	3.65	8.74	12.39	0.25	7.23	LM
2	13.31	0.39	12.64	3.85	8.60	12.44	0.32	7.13	LM
3	13.38	0.45	12.61	3.98	8.51	12.52	0.34	7.06	LM
SE.m±	0.04	0.01	0.01	0.02	0.07	0.01	0.02	0.08	
CDat 5%	0.16	0.03	0.04	0.07	0.25	0.03	0.07	0.28	

LM: Like moderately , LVM: Like very much