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Studies on standardization of blended RTS based on apple and orange juice

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Abstract

The present investigation was carried out to prepare and standardize the recipe of blended RTS based on fresh apple and orange juice. The chemical analysis results obtained for apple and orange juice indicated that the total soluble solids is 11.50°Bx, pH 3.60, acidity is 0.46 percent, total sugars is 10.26 percent, ascorbic acid is 10.20mg/100ml. Whereas for orange juice the total soluble solids is 9.00°Bx, pH 3.80, acidity 0.42 percent, total sugars 8.38 percent and ascorbic acid 48.60mg/100ml. The ascorbic acid content of orange juice is 48.60 mg/100ml much higher than that of apple juice having 10.20 mg/100ml ascorbic acid. Finally, it can be concluded from the obtained results that fresh juices are rich in antioxidants like ascorbic acid that makes them potential source of various bioactive compounds which can be utilised for value addition in food commercialization. Hence, the present investigation focused on the formulation and standardization of the recipe of blended RTS based on apple and orange juice with the incorporation of spice extract.

Keywords: Apple, orange, chemical composition, antioxidant, value addition, standardization

Introduction

Fruit beverages such as ready-to-serve (RTS) are becoming increasingly popular in comparison to synthetic drinks, evidently because of their taste, flavor and nutritive value. They are in great demand in various public eating places like school canteens, cafeterias, snack bars as well as homes. Many of the beverages that are available in the market attract the consumers mainly because of their color and taste without providing nutrients apart from the empty calories in the form of sugar.

However, the beverages based on fruit juice or pulp are easily digestible, appetizing, thirst quenching, highly refreshing and are nutritionally superior to many aerated and synthetic beverages. Since, these beverages are meant for direct consumption without further dilution thus provides the advantage of convenience of consumption. These beverages also serve as healthy alternative for the children and elderly people who have difficulties in handling the whole fruits.

Nowadays, customers demand products which are free from any chemical additives like color or flavors and are natural with assured safety and better shelf life. Thus, beverages based on fruit juices can be used to replace the artificial or synthetic beverages that are available in the market having no nutritional value.

The shelf life of fruits and vegetables is very limited because of their perishable nature. In India over and above 20-25 percent of fruits and vegetables are spoiled before utilization. Despite being the world's second largest producer of fruits and vegetables, in India only 1.5 percent of the total fruits and vegetables produced are processed. Maximum amount of fruit and vegetable juices get bitter after extraction as a result of conversion of chemical compounds. Despite being under utilized, the utilization of highly nutritive fruits and vegetables is very minimal due to high acidity, astringency, bitterness, and some other aspects. While enhancing flavor, palatability, and nutritive and therapeutic value of various fruit juices such as apple, aonla, ber, papaya, pineapple, citrus, mango, pear, watermelon and vegetables including beet root, bottle gourd, bitter gourd, carrot, medicinal plants like aloe vera and spices can also be used for juice blending. All these natural products are appreciated very highly for their refreshing juice, nutritional value, delectable flavor, and therapeutic properties. Fruits and vegetables are also an excellent source of sugars, vitamins, and minerals. However, some fruits and vegetables have an off flavor and bitterness although they are an excellent source of vitamins, enzymes and minerals. For this reason, blending of two or more fruits and vegetable juices along with spice extract for the preparation of nourishing ready-to-serve (RTS)

beverages is thought to be a convenient and economic substitute for utilization concerning these fruits and vegetables.

Apples and oranges are the most popular fruits available throughout the world. Both fruits are not only popular due to their taste profile but also for their various nutritional and medicinal properties. Various parts of these fruits are utilized for making delicacies as well as traditional medicines. The major medicinal properties of these fruits include antibacterial, antidiabetic, anticancer, anti-inflammatory, antihypertensive, cardio protective etc.

Apple is the second most consumed fruit in the world (Drogoudi and Pantelidis, 2011) ^[9] that contains many phenolic compounds beneficial to human health (Wolfe *et al.*, 2003) ^[32]. It is stated that because of their high antioxidant capacity, phenolics offer protection from cancer, cardiovascular conditions and some age-related diseases (Knekt *et al.*, 1997; Kris-Etherton *et al.*, 2002; Ju *et al.*, 2012) ^[17, 18]. In India, Kashmir is the leading producer of apples. The intrinsic factor which influences temperate fruit bearing trees is soil, climate and environment which are remarkably favorable and unmatched in the province of Kashmir. According to numbers from the National Horticulture Board in the years 2017-18, the state produced 77.7% of apples in India and considering that, India is the fifth largest producer of apples in the world, coming after Russia and above Brazil. Despite the fact that apple can be grown in all temperate regions including both the northern and the southern hemisphere it is not possible in the tropical climate of South Asia. Fruits and vegetables are rich in many antioxidant compounds including phenolic compounds, carotenoids, anthocyanins and tocopherols (Naczka and Shahidi, 2006) ^[23]. Apple is a crucial source of bioavailable polyphenols such as flavonols, monomeric and oligomeric flavonols, dihydrochalcones, anthocyanidins, as well as others (Escarpa and Gonzalez, 1998) ^[10]. The foremost abundant polyphenols present in apples are chlorogenic acid, phloretin glucosides and quercetin glucosides (Wijngaard *et al.*, 2009) ^[31]. Other polyphenolic compounds such as catechins and procyanidins have also been identified but are present in relatively small amounts (Foo and Lu, 1999) ^[11].

In general, apples have shown to guard against human chronic diseases due to their fibre content and phenolic compounds. These bioactive compounds have low availability and potentially reach to colon, modulate the balance of bacterial populations within the gut and influence the host physiology (Delzenne *et al.*, 2011; Moco *et al.*, 2012) ^[5]. The apple health benefits are, to a certain extent, because of the interaction of fibre and phenolics with gut microbiota. It leads to changes in the activity and production of short chain fatty acids (SCFAs) after fibre fermentation and phenolic bioavailability. Dietary fibre in apples consists of mainly cellulose, hemicellulose, lignin and pectin (Yan and Kerr, 2012) ^[33].

Orange specially, the sweet orange (*Citrus sinensis* L.) is an evergreen tree that belongs to family Rutaceae. It is the most commonly grown fruit in the world. It is an evergreen flowering tree generally growing to 9-10 m height. Orange trees are widely grown in tropical and sub-tropical climates for the delicious sweet fruit which is peeled or cut (to avoid the bitter rind) and eaten whole, or processed to extract fruit juice, ready-to-serve (RTS) beverages, cordial, nectar etc.

In India orange has been cultivated in 2,85,000 ha area with an annual production of 29 lakh tonnes (Anonymous, 2015) ^[2]. Major Orange cultivating states are Maharashtra, Madhya

Pradesh, Rajasthan, Tamil Nadu, Assam and Tripura. In some parts of Madhya Pradesh, particularly in Mandsaur, Neemuch, Chhindwada, Betul, Ujjain and Shajapur districts, orange is grown on large scale. Maharashtra is the leading producer of oranges with

8.27 lakh tonnes production. The area under orange in Madhya Pradesh is 38,300 ha and production is 6,78,000 MT with productivity of 17.7 MT/ha (Anonymous, 2015) ^[2].

Orange is sort of popular because it features a greater kind of beverage. It is also used for industrial and medicinal functions owing to its attractive color, distinguishing flavor and being rich source of vitamin "C", vitamin "B", β -carotene, calcium and phosphorus. Orange juice turns bitter after extraction as a result of the conversion of a compound limonite-a-ring lactone (non-bitter) to limonin (bitter compound) during storage (Premi *et al.*, 1994) and thus makes its processing limited. For this reason, blending of two or more fruit juices along with spice extract for preparation of nourishing RTS beverages is thought to be a valuable and economic alternative for utilization of these fruits. Among the new exotic citrus cultivars grown in India, orange is undoubtedly the most priced one.

Ginger (*Zingiber officinale* Roscoe), is a rhizomatous plant that belongs to the family Zingiberaceae. Nativity of ginger is said to be in South East Asia. Ginger, a source of beneficial phytonutrients is identified by an aromatic odor and a pungent taste. The section of the ginger plant that is used is the root, which is the rhizome in terms of botanics. Ginger contains essential oils like "gingerol" and "zingiberene" which are delightful and spicy in nature. It also contains pungent elements such as "zingerone" and "shogaol". In India, ginger is cultivated in an area of 1.3 M ha with a production of 6.5 MT, (NHB, 2015) ^[24]. Nevertheless ginger is grown in almost all states in India. The leading ginger producing states are Meghalaya, Kerala, Arunachal Pradesh and Orissa. Fresh ginger rhizome has 80.9% moisture, 2.3% protein, 0.9% fat, 1.2% mineral, 2.4% fibre and 12.3% carbohydrate (Zadeh and Kor 2014) ^[34]. The minerals present in ginger are calcium, iron and phosphorus. It also contains vitamins like 'B1' (Thiamine), 'B3' (Riboflavin), 'B3' (Niacin) and 'C' (Ascorbic acid).

Ginger is extensively used in ayurvedic medicines since long back, ginger has been used to cure dyspepsia, gastritis, blood circulation disturbance and inflammatory diseases. It displays potential antipyretic, antiallergenic, analgesic, antitussive (Gurdip *et al.*, 2008) ^[14] and chemopreventive activities (Sabulal *et al.*, 2007) ^[26]. Ginger is widely used in various forms such as raw ginger, dry ginger, sliced ginger, ginger candy, ginger oil, ginger oleoresin, ginger flake, ginger beer, ginger wine, ginger based blended RTS beverages. It has usage in various foods as preservatives, medicines and in perfumery industries.

Blended drinks are good substitute for development of new products to provide taste, nutritional as well as medicinal properties. In recent years blended and spiced beverages have become a subject of interest because of its beneficial effects on human health. Orange juice has bitter taste which can be unpleasant in raw state and its palatability could be enhanced with addition of ginger juice. Ginger is known to contain several antioxidant compounds like gingerol, gingediol and shogaol, which have antimicrobial activity (Singh *et al.*, 2008) against food spoilage causing organism and seems to improve shelf life.

Fruits and vegetables are a crucial part of our diet. They

provide not only the major dietary fibre component of food, but also a range of micronutrients, including minerals, vitamins and antioxidant compounds, such as carotenoids and polyphenols. Apples and oranges are the most popular fruits in the world; its bioactive constituents may be beneficial to a vast number of consumers. It is rich in pro-healthy antioxidants which are both of lipophilic (carotenoids) and hydrophilic (phenolic compounds) characters.

Sandhu and Sindhu (1992) [28], Saxena *et al.* (1996) [29], Attri *et al.* (1998) [4], Langthasa (1999) [19], Deka (2000) [6], Deka and Sethi (2001) [7] recorded that two or additional fruits juices or pulp can be blended in different proportions for the manufacturing of RTS beverages or nectar etc. The mixing of juices can also intensify the aroma, taste and nutrients of beverages.

Owing to high acidity, astrigency, blunt taste and such alternative factors in a number of the fruits like lime, aonla, black grape etc, the utilization of these fruits for preparation of various processed product become restricted, even with their high nutritional qualities. Therefore, mixing of two or additional fruit juices and their beverage with the addition of spice extracts/drops as health drinks are considered to be a convenient alternative for its utilization in order to have some value added fruit drinks which are of prime quality in respect of both sensory and nutritional aspects.

Of late, spiced beverages are gaining significance within the market in the form of fruit drinks/squashes/appetizers/health drinks etc. It is suggested that the organoleptic quality of RTS beverage prepared from juice like plum and watermelon could be increased by addition of spice extracts of ginger, mint, cardamom, black pepper and cumin etc. (Joshi *et al.*, 1993., and Gowda and Jalali, 1995) [15, 13]. The blending of juice and their spiced beverages can also improve taste, aroma, nutrition etc. finally, one might consider a new product development through blending in the form of natural health drinks. So far no work has been carried out on mixed fruit juice spiced beverage.

The present study is undertaken to develop value added blended RTS beverages of apple with orange and spice extract. The production of new product is necessary for the survival and growth of the processing industry, to meet new taste and demand in home as well as in export market. Hence, there is an urgent need to develop some suitable technologies for the preparation of apple and orange based blended RTS beverages which are economical and can be made available to a large population. In India soft drink have a good demand throughout the year traditionally, our country has been well known for offering syrup or sherbet.

Among these fruit juice and beverages have an important place as they are also liked and appreciated by the people of all ages and acceptable on all occasion beside, they are delectable and have a global appeal unlike other beverages. The nourishing value of fruit beverages is much more than the artificial products, which are available in the market throughout the country. If artificial drinks can be substituted with the fruit juice, it would be valuable to the consumers along with the fruit growers.

Looking at the demand of natural beverages, there is great opportunity for the preparation of juices and other fruit based beverages. RTS is a type of fruit beverage having at least fruit juice (10%), total soluble solids (10%) and acidity (0.3%) (FSSAI, 2006) [12]. RTS can be prepared from the clarified juice of orange.

However, the problem encountered during processing is development of bitterness. The juice of two or additional fruit juices helps in utilization of astringent and too acidic fruits like lime, sour palm, sour cherry, etc. These fruits and spices or their extracts are also famous for excellent quality with pleasant flavor, rich in sugar, vitamin-C and minerals. Therefore, blending of two or more fruit juices for the preparation of RTS beverages appears to be a convenient and economic alternative for utilization of orange.

Materials and Methods

The fresh apples and oranges were purchased from local village market, Parbhani. The proposed research was carried out in Department of Food Engineering, College of Food Technology, VNMKV, Parbhani.

Proximate composition of fresh apple and orange juice

The apple and orange juices were analyzed for TSS, pH, total acidity, total sugars, reducing sugars and ascorbic acid according to their respective standard methods.

Total Soluble Solids

TSS was determined in 0 Brix using a refractometer and it indicates the percentage of water-soluble solids in fruit juice.

pH

The pH of the juices was measured using an electronic digital pH meter.

Titrateable acidity

5mL of sample was taken and the final volume was made to 20ml and titrated against 1.1 Normal NaOH using phenolphthalein as indicator to a light pink color. It was expressed as per cent acidity.

$$\% \text{ Acidity} = \frac{\text{Titre} \times \text{Normality of NaOH} \times 0.090}{\text{Volume of sample}} \times 100$$

Total Sugars

Total sugars were determined by using Phenol Sulphuric Acid Method.

Reducing Sugars

Reducing sugars was estimated using Nelson Somogyi Method (1952).

Non Reducing Sugars

The value of non-reducing sugars was obtained by subtracting the reducing sugars from total sugars.

Ascorbic Acid

Estimation of Vitamin C was performed by Titrametric Method.

Result and Discussion

Physico-Chemical properties of fresh Apple and Orange

Apple juice is highly appreciated and consumed because of its flavor and nutritional properties. The physico-chemical properties of fruits are measured for a number of reasons including nutritional factors, economic importance, food quality after processing and storage stability considerations.

Table 1: Physico-chemical properties of apple fruit

Properties	Values
Fruit weight (g)	146.00
Peel (%)	29.60
Juice content (%)	58
TSS (0Brix)	11.50
pH	3.60
Acidity (%)	0.46
Total sugars (%)	10.26
Reducing sugars (%)	9.96
Non reducing sugar (%)	0.30
Ascorbic acid (mg/100ml)	10.20

*Each value represents the average of three determinations

The data recorded are tabulated in Table 1. The physical properties of apple fruit revealed that the fruit weight, peel and juice were recorded to 146 g, peel (29.60%) and juice content (58%). The chemical properties of apple were found to contain, TSS (11.500Bx), pH (3.6), acidity (0.46%), total sugars (10.26%), reducing sugars (9.96%), non-reducing sugars (0.30%) and ascorbic acid (10.2mg/mL).

These values recorded in the present study are similar to the values reported earlier by Azoubel *et al.*, (2005). The data obtained are also in good accordance with the data reported by Kanwar and Keshani (2016)^[16].

Physico-chemical properties of orange fruit (Kinnow)

Citrus fruits are the main source of important phytochemical nutrients and for long have been valued for their wholesome nutritious and antioxidant properties. It is scientifically proven that oranges being rich in vitamins and minerals have many health benefits. Moreover, it is now appreciated that other biologically active, non-nutrient compounds found in citrus fruits such as phytochemical antioxidants, soluble and insoluble dietary fibres are known to be helpful in reducing the risk for cancers, many chronic diseases like arthritis, obesity and coronary heart diseases.

Table 2: Physico-chemical properties of orange fruit

Properties	Values
Fruit weight (g)	158.00
Peel (%)	26.00
Juice content (%)	50.30
TSS (0Bx)	9.00
pH	3.80
Acidity (%)	0.42
Total sugars (%)	8.38
Reducing sugars (%)	1.74
Non reducing sugars (%)	6.64
Ascorbic acid (mg/100ml)	48.60

*Each value is the average of three determinations

The physical properties of orange were found average fruit weight (158g), peel (26%) and juice content (50.3%). The chemical properties of orange were found to contain TSS (90Bx), pH (3.8), acidity (0.42%), total sugars (8.38%), reducing sugars (1.74%) and non-reducing sugars (6.64%). The highest amount of ascorbic acid content was found in orange (48.6%). This indicates the vitamin C content of fruit rich than other fruits.

These values recorded in the present study are similar to the values reported earlier by Diwan *et al.*, (2014)^[8]. The data obtained are also in good accordance with the data reported by Rai *et al.*, (2005)^[25] and Saifur Rehman *et al.*, (1983)^[27].

Effect of blanching treatment

Blanching is extremely important for further processing of apples and to improve the product quality and shelf life. The apple slices were pretreated with 2 % citric acid followed by blanching for 2 minutes. It showed a systematic trend of changes in the color of the apple juice with temperature of processing in blanching conditions.

Table 3: Effect of blanching treatments on color of apple juice

Blanching treatment (2 min)	Color
–	Brown
Steam Blanching	Pale Brown
Hot Water Blanching	Pale Yellow

The best blanching treatment for apples based on these process parameters was blanching for 2 min in hot water. At this time–temperature combination the desired anti browning effect was observed.

Methodology for preparation of blended apple and orange RTS beverage

Methodology used for preparation of apple and orange beverage is as follow.

Preparation of blended RTS

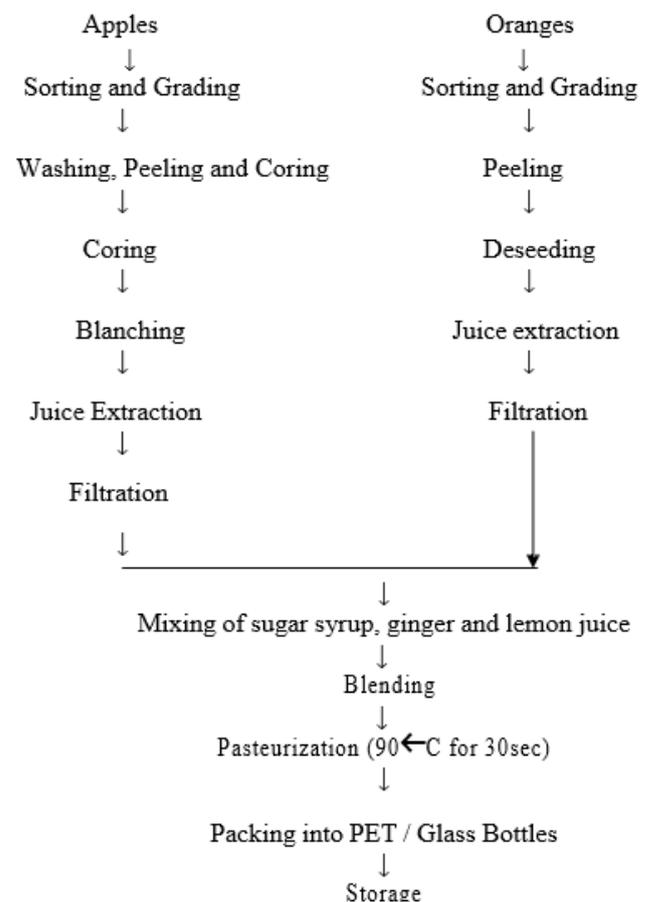


Fig 1: Process flowchart for preparation of blended RTS

Standardization of apple and orange juice proportion

Samples with variations in proportion of apple and orange juice were prepared and subjected to sensory analysis. Four samples were prepared with variations in proportion as shown in Table 4.

Table 4: Apple and orange juice with variations in proportion

Apple	Orange
100	00
50	50
60	40
70	30

Samples-Control - (100:0); A-(50:50); B-(60:40); C-(70:30)

Standardization of TSS content in blended apple and orange juice

The original TSS of the fruit juice was not so appealing organoleptically. Therefore, samples with variations in TSS were prepared and subjected to sensory analysis. Three samples were prepared with TSS variations ranging from 10 - 130Brix as shown in Table 5.

Table 5: Blended apple and orange juice with variations in TSS

Sample	TSS(°Bx)
A	10
B	12
C	13

Extraction of apple juice

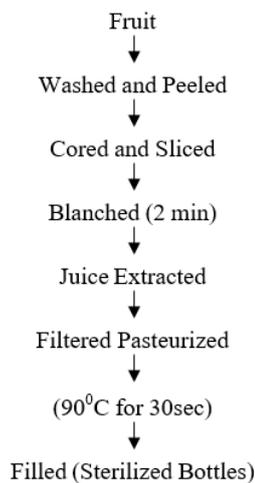


Fig 2: Extraction of apple juice

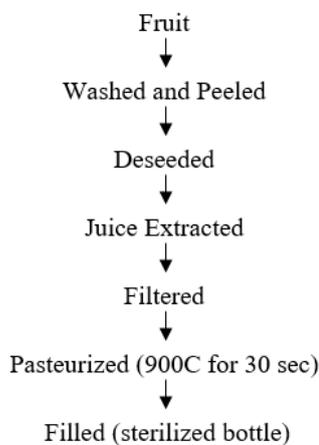


Fig 3: Extraction of orange juice

Standardization of blended RTS based on apple and orange juice

To standardize the preparation of blended RTS apple and orange juice samples were prepared in various ratios. Then

sugar (10%), ginger juice (3%) and lemon juice (1%) were added to the juice blends followed by filtration and pasteurization at 90°C for 30 sec.

Standardized parameter for the preparation of blended apple and orange juice

Table 6: Standardized parameter for the preparation of blended apple and orange juice

Parameter	Standardization
Apple juice	60 ml
Orange juice	40 ml
Ginger juice	3%
Lemon juice	1%
Pasteurization temperature	90°C
Pasteurization time	30 sec

Preparation of blended RTS based on apple and orange juice

After standardization of the recipe and method based on sensory analysis, the blending experiments were conducted in 200mL glass bottles each containing 100mL of pasteurized fruit juices. For the preparation of sample, the ginger and lemon juice is added 3% and 1% respectively to the juice blend having varying proportions of the respective apple and orange juice.

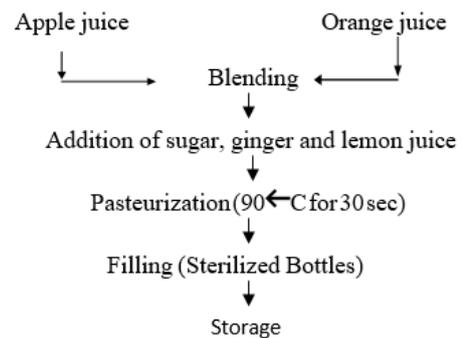


Fig 4: Standardized method for blended RTS based on apple and orange juice

Conclusion

The two fruits i.e apple and orange were blended together along with ginger extract to prepare the blended RTS. The physico-chemical properties of apple fruit such as fruit weight, peel per cent, juice content, TSS, pH, percent acidity, total sugars, reducing sugars, non- reducing sugars, ascorbic acid content were found to be 146g, 29.60%, 58%, 11.50Bx and 3.6, 0.46%, 10.26%, 9.96%, 0.30% and 10.2 mg/mL respectively.

The physico-chemical properties of orange fruit such as fruit weight, peel per cent, juice content, TSS, pH, percent acidity, total sugars, reducing sugars, non-reducing sugars, ascorbic acid content were found to be 158g, 26%, 50.3%, 90Bx, 3.8, 0.42%, 8.38%, 1.74%, 6.64% and 48.6mg/mL respectively. The blended RTS was prepared with 10% combined fruit juice in the ratio of (60:40) of apple and orange respectively followed by the addition of ginger and lemon juice. The RTS was then pasteurized at 90°C for 30 sec followed by filling in sterilized bottles and storage at refrigeration temperature (4°C) and room temperature (37°C). The physico-chemical analysis of the sample viz. TSS, pH, acidity and ascorbic acid content were found to be 12.60Bx, 5.10, 0.36% and 22.11mg/mL.

It may be concluded from the present investigation that the apple, orange and ginger can be well utilized in development of blended RTS beverage with its potential health benefits. Sensory evaluation with respects to storage shown that blended RTS beverage stored at refrigeration was found to be highly acceptable. Finally it could be suggested that the developed blended RTS beverage based on apple and orange juice can be explored for commercial utilization.

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