Formulation of low calorie therapeutic RTS Drink; Blend of Cabbage, Lime, Amla and Ginger

M.B.F. JEMZIYA[*,1] and T. MAHENDRAN[2]

[*,1]Department of Biosystems Technology, Faculty of Technology, South Eastern University of Sri Lanka

[2]Department of chemistry, Faculty of agriculture, Eastern University, Sri Lanka

[*]Corresponding author: fathimajemziya@yahoo.com

ABSTRACT

In present investigation the efforts have been made to prepare a therapeutic ready-to-serve (RTS) made from blend of cabbage, lime, amla and ginger juice extracts. Considering the results of preliminary studies four formulation of the low calorie functional RTS beverage were prepared by blending different ratio of cabbage, lime juice, amla and ginger (60:20:15:5, 50:30:15:5, 40:40:15:5 and 30:50:15:5). The prepared formulations were subjected to nutritional and sensory assessment after the formulation. Microbial studies and nutritional parameters; titrable acidity, pH, vitamin C content, total sugar and total soluble solids were analysed for the cabbage based RTS beverage. Sensory attributes of colour, aroma, taste, appearance and overall acceptability were evaluated by 30 semi-trained panellists using a seven point hedonic scale. The nutritional analysis of the fresh low calorie RTS beverage shown increasing trend in titrable acidity (from 1.86% to 3.32% as citric acid), vitamin C content (from 156.33mg/100g to 159.8mg/100g), total sugar (from 3.26% to 2.49%), and total soluble solids (from 5.06 ° Brix to 5.54 ° Brix) with the increase of lime juice from 20% to 50%. The pH was reduced when the lime juice concentration increased. The sensory assessment of low calorie therapeutic RTS beverage revealed that there were significant ($p>0.05$) differences among the sensory attributes according to Friedman Test. The highest overall acceptability was observed in formulation with 50% cabbage extract, 30% lime juice, 15% amla juice and 5% ginger extract with ideal functional qualities.

Keywords: cabbage extract, low calorie therapeutic beverage, microbiological analysis, physico chemical analysis, sensory attributes

INTRODUCTION

Consumer demands for healthy and nutritious food products with a fresh-like appearance have undergone a continuous rise during recent years. Fruits and vegetables have always had an elite status among the health foods (Jairajpuria and Qadrib, 2015). The demand for ready to serve almost always has an increasing trend and there is a great scope for development of natural nutrient rich beverages owing to negligible synthetic chemical content and also has immense health benefits of these beverages. Healthy beverages, particularly those that offer functional ingredients such as botanicals, minerals, and antioxidants, are increasing in demand (Sanguansri and Augustin, 2009; Ramachandran, 2014). Moreover, they are an excellent delivering means for nutrients and bioactive compounds ω-3 fatty acids, plant extracts, fiber, prebiotics and probiotics (Sanguansri and Augustin, 2009).

Cabbage (Brassica oleracea L. var. capitata) is one of the most popular cultivar of the family Brassicaceae or Cruciferae grown around the world. Cabbage nutrient rich, economically important vegetable crop with higher amount of vitamins C, K, A and folic acid, fiber, flavonoids, proteins, minerals and connected with secondary metabolites called glucosinolates contributed to anti-carcinogenic properties (Sarikamis et al., 2009). Fresh cabbage juice, prepared either separately or mixed with other vegetables such as carrot and celery, is often included in many commercial weight-loss diets (Samec et al., 2011). Lime (Citrus aurantifolia) is a fruit crop belongs to the family Rutaceae which are an excellent source of vitamin C, and are often used to accent the flavors of foods and beverages. Citrus is likely the most widely established fruit for direct human consumption in the world for with pleasant flavor, sour taste and attractive color. Lime juice contains compounds active

phytochemical saponins, alkaloids, tannins, phenolics, flavonoids and terpenoids (Robinson, 2006).

Amla (Emblica officinalis) is a minor subtropical deciduous tree indigenous to Indian subcontinent. It is also known as Indian Gooseberry and has both nutritive and medicinal properties. It is very rich in Vitamin C (Chauhan et al., 2005). It has also been found to be rich in phenols and tannins such as elegiac acid and gallic acid that prevent the oxidation of vitamin C. The medicinal properties of amla against several ailments like tuberculosis, asthma, bronchitis, scurvy, diabetes, anemia, weakness of memory, cancer and influenza are well known. However, its juice is acidic and astringent in nature which has negative impact on its palatability if consumed fresh (Goyal et al., 2008). Ginger (Zingiber officinale) is valued as a spice for ages and is also known for its medicinal properties such as to treat rheumatoid arthritis, ulcer, preventing heart attack and stroke. Ginger is an aromatic tuber crop having volatile oils that account for the aroma of the tubers (Kikuzaki et al., 1991). Not only this, the use of ginger as antiviral, anti-cancer and anti-ulcerogenic drug has been widely accepted (Katiyar et al., 1996; Yamahara et al., 1988). A combination of above botanicals could lead to the production of delightful and delicious beverages with improve organoleptic quality and high nutritive value.

The development of novel RTS blends is required for meeting the demands of the consumers and also for growth of the food processing industry. A beverage prepared by blending of fruits, vegetables and products from medicinal plants is an emerging sector in food industry. Optimization of diet by including fruits and vegetables with promising quantities of phytochemicals of nutraceutical importance would be a very cost-effective method of disease prevention, since diet-induced health improvements would not carry any added costs for the health sector. With the above facts in view, in the present study, a low calorie therapeutic blend RTS functional beverage was developed using cabbage, lime extract, amla and ginger

and its physicochemical characteristics, microbial quality and sensory acceptability were evaluated.

MATERIALS AND METHODOLOGY

Procurement of raw materials

Healthy fresh and firm white cabbages heads dense with shiny, crisp and brighten leaves, free of cracks, bruises and blemishes were obtained. Outer covers were removed and remained cabbage head were washed under running distilled water. The thick fibrous outer leaves were collected, sliced into pieces with 2cm thick. Then the cabbage slices were steam blanched at 80±2 °C for 2-3 minutes (Burtness, 2014). The 200g of cabbage and 200ml of distilled water were blended with a blender (Model Smeeth) and filtered using a cheese cloth to obtain the juice. The juice was kept in a refrigerator at 4 °C. Key limes were washed and cleaned thoroughly. Then the fruits were washed again with distilled water. The limes were cut and squeezed to extract the juice. A cheese cloth was used to filter the juice from the pulp. Juice was then kept in a refrigerator at a temperature of 4 °C.

Other ingredients like ginger, amla, sweetener (aspartame), KMS and permitted color (E142) were purchased from local market and their respective juices were extracted with the help of a laboratory blender followed by filtering through muslin cloth and stored separately under refrigerated conditions for future use.

Juice blend formulations

F1– Treatment 1: Cabbage: Lime: Amla: Ginger = 60:20:15:5

F2– Treatment 2: Cabbage: Lime: Amla: Ginger = 50:30:15:5

F3– Treatment 3: Cabbage: Lime: Amla: Ginger = 40:40:15:5

F4– Treatment 4: Cabbage: Lime: Amla: Ginger = 30:50:15:5

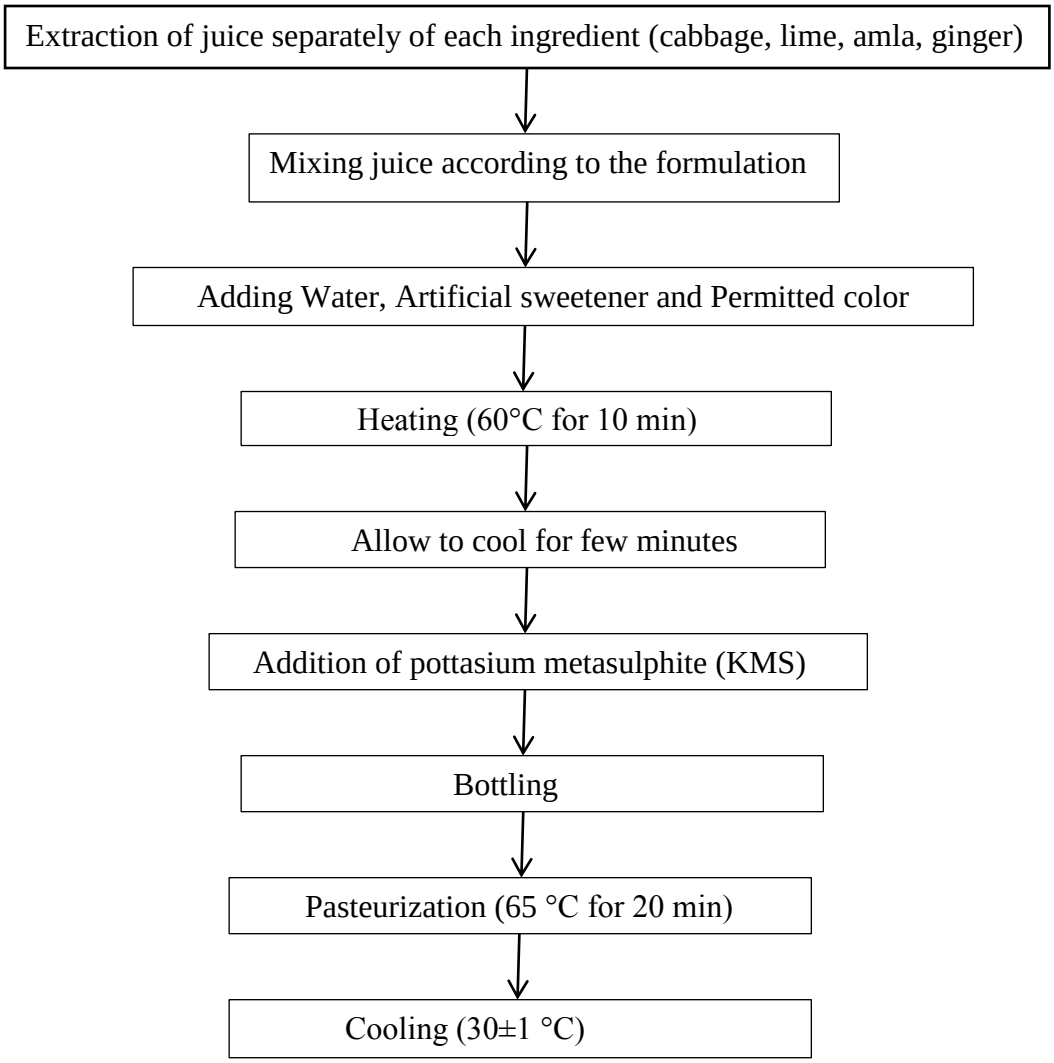


Figure 1: Preparation of Juice Blend

Preparation of RTS juice blend

The cabbage based RTS blended with lime juice, amla and ginger extract were prepared as per the flow chart given in Figure. 1. The RTS was prepared in four different variations coded as F1, F2, F3 and F4. The calculated amount of aspartame (0.032g) and 3 drops of permitted color (E142) were added equally to all the treatment and was heated at 60 °C for 10 minutes. Then it was allowed to cool for few minutes. After that KMS was added at the rate of 70ppm to the formulation.

Microbial, physico-chemical and sensory evaluation

After the preparation, microbial analysis, sensory evaluation and physico-chemical analysis were completed. The total microbial load was calculated by standard plate count (SPC) method. The SPC was done according to the method (APHA, 1967). The fresh beverage samples prepared with varying levels of cabbage, lime, ginger and amla were served chilled for sensory evaluation which was carried out by semi-trained panel with 7.0 point Hedonic scale (Amerine et al.,1965). Physico-chemical properties were analyzed using standard AOAC (1995) officials to all the formulation to determine the quality of RTS beverages.

Statistical Analysis

Each formulation was triplicated and they were designed in Complete Randomized Design (CRD). Data for each sensory attribute was analyzed using Friedman's test. Physico-chemical properties were performed using ANOVA (a=0.05). Duncan's Multiple Range Test (DMRT) was used to determine the significance of the differences between the means of the measured parameters.

RESULTS AND DISCUSSION

Table 1: Analysis of raw ingredients used in low calorie therapeutic RTS formulations

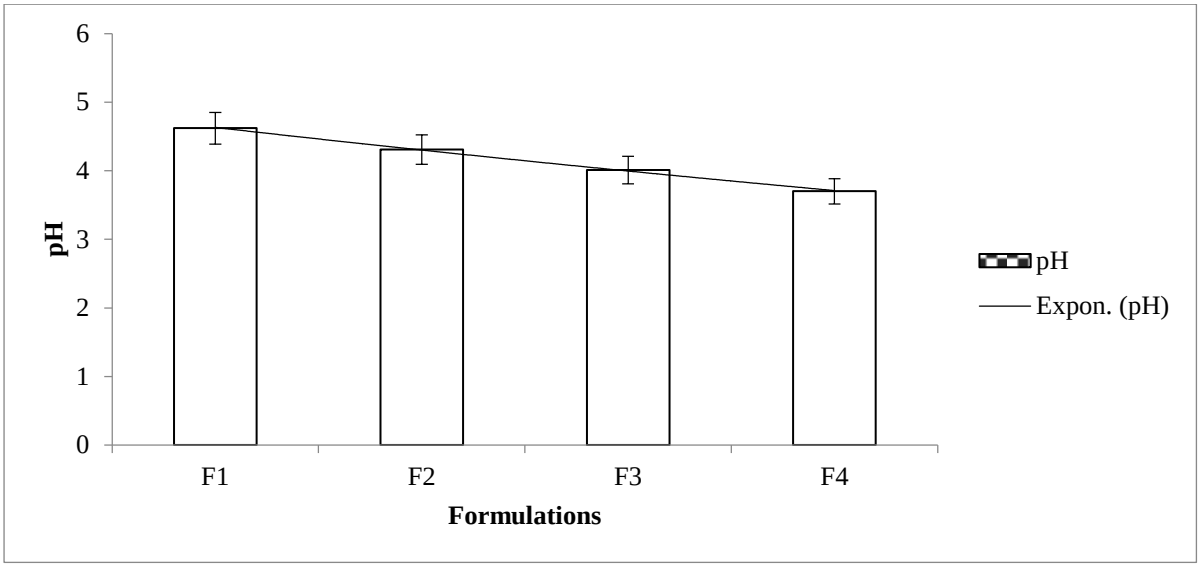
Physico chemical properties	**Cabbage juice**	**Lime juice**	**Amla juice**	**Ginger juice**
Total Soluble solids (TSS)	5.2	6.8	2.9	2.8
pH	5.7	2.7	2.9	4.2
Titratable Acidity (as % of citric acid)	0.61	5.48	2.4	0.8
Vitamin C (mg/100g)	26.26	37.82	885.6	3.4
Total sugar (%)	4.1	1.56	3.23	Not detected

The raw ingredients used for the preparation of the cabbage based RTS formulations were analyzed for important physico-chemical characteristics (Table 1). It is apparent that amla juice had the highest vitamin C content (885.6mg/100g), the total soluble solids expressed as

^{0}Brix was the highest in the lime juice (6.8), while the pH was recorded highest in the cabbage juice (5.7). The total sugar content was the highest in cabbage juice (4.1%) also whereas other ingredients were low in the total sugar content. Highest acidity was recorded in lime juice (5.48%) but was lowest in cabbage juice.

Table 2: Physico chemical properties of low calorie therapeutic blend RTS functional beverage

The data obtained (Figure 2) clearly indicate that the pH of the cabbage blend formulations significantly decreased. The presence of free hydrogen ions and buffering capacity of the juices influence the pH value of the beverage (Shubhangi, 2002). There was a significant ($p>0.05$) when increasing the concentration of lime juice. This might be due to increase in titrable acidity, as acidity and pH are inversely proportional to each other (Bhardwaj et al., 2005). The minimum pH was observed in the F4 formulation (3.7) and maximum pH was observed in the F1 formulation (4.6).

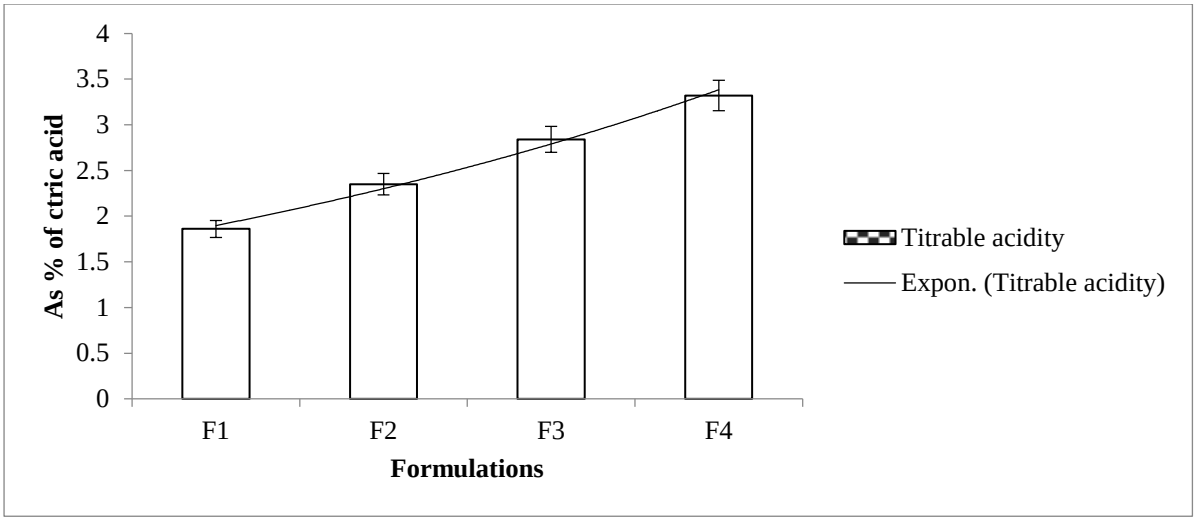


The values are means of triplicates

Vertical bars indicate the standard error

Figure 2: pH of cabbage based RTS beverage

Figure 3 shows the level of titrable acidity of cabbage based blend RTS functional beverage. Titrable acidity was increased by cumulating the volume of lime juice in the blend. There was significant increase in titrable acidity of all the formulations of the cabbage based RTS. It was measured with 1.86% up to 3.32%. A strong correlation between the increase in acidity and decrease in vitamin C content has been reported earlier (Simsek, 2011). The degradation of polyphenols in ginger and amla and rapid conversion of proteins to amino acids, are also the reasons for increase in the titrable acidity of the cabbage RTS blends. The findings are in accordance with the findings reported earlier (Yadav et al., 2013).



The values are means of triplicates

Vertical bars indicate the standard error

Figure 3: Titrable acidity of cabbage based RTS beverage

The total soluble solids in RTS formulations (Table 2) are expressed as ^{0}Brix. It is an indicator of sugar content in the RTS blends and it primarily results due to the sucrose, glucose and fructose components. According to the DMRT, the TSS increased significantly ($p>0.05$) when increasing the concentration of lime juice in RTS beverages. Similar increasing trend in total soluble solids (TSS) have been reported by Kausar et al. (2016) in ready to serve Aloe Vera-lemon functional drink. The ratio of the TSS and titrable acidity

contribute to the flavour and taste of the fruits and juices. The TSS is directly proportional to sweetness index (ratio of TSS and titrable acidity) (Sadler and Murphy, 2010).

Table 2: Total soluble solutes, vitamin C and total sugar content of cabbage based RTS beverage

Formulations	**TSS (^{0}Brix)**	**Vitamin C (mg/100ml)**	**Total sugar (%)**
F1	5.06±0.01	156.33±0.02	3.26±0.02
F2	5.22±0.03	157.49±0.03	3.00±0.01
F3	5.38±0.01	158.64±0.02	2.75±0.02
F4	5.54±0.05	159.8±0.04	2.49±0.03

The values are means of triplicates ± standard error

The vitamin C content was decreased clearly, shown in Table 2. The decrease in the vitamin C content can be attributed to the oxidation sensitive nature of the vitamin and its solubility in water. The maximum vitamin C content was observed in the formulation F4 and the minimum was observed in the F1 formulation. Similarly Afreen et al, (2016) reported increasing trend in vitamin C content when increasing the sour orange juice in RTS Beverage from carrot with sour-orange juices.

The minimum total sugar content (as sucrose) for RTS preparation is 5% (SLS 729:1985). The total sugar content decreased significantly ($p<0.05$) from 3.26% to 2.49% with an increase in the concentration of lime juice in cabbage based beverage formulations. The hydrolysis of the complex sugars into simple sugars due to higher acidity may be the cause of declining total sugar content in the present investigation. Findings reported by Verma and Gehlot in 2007 and Ramachadran and Nagarajan in 2014 are dissimilar to the results of this study.

Sensory attributes of the low calorie therapeutic cabbage based RTS formulations

Table 3: Sensory analysis of cabbage based blend RTS functional beverage during storage

Formulations	Colour	Taste	Aroma	Appearance	Overall acceptability
F1	5.6 ± 0.06^{ab}	4.4 ± 0.19^{b}	5.6 ± 0.11^{ab}	4.4 ± 0.02^{b}	5.3 ± 0.01^{ab}
F2	6.2 ± 0.01^{a}	6.1 ± 0.06^{a}	6.3 ± 0.16^{a}	6.1 ± 0.01^{a}	6.1 ± 0.01^{a}
F3	4.9 ± 0.18^{b}	5.6 ± 0.16^{a}	6.2 ± 0.03^{b}	5.9 ± 0.13^{a}	5.9 ± 0.05^{a}
F4	5.5 ± 0.18^{ab}	3.7 ± 0.02^{b}	5.5 ± 0.01^{ab}	3.7 ± 0.05^{b}	5.1 ± 0.03^{ab}

The values are means of 30 replicates ± standard error

The means with the same letters in same column are not significantly different from each other at 5% level based on Friedman's test

Sensory parameters were measured using seven point hedonic scale

The data (Table 3) clearly indicate that formulation F2 scored significantly higher scores with respect to all the sensory attributes like appearance, mouth feel, taste, flavor, color and overall acceptability also. The sensory evaluation of the cabbage based RTS functional beverage revealed that, there were significant differences between the formulations as the increase of lime juice content according to General linear model (GLM). The formulation F2 had the highest mean value score of 6.1. F4 had the higher score in color, aroma, taste, cloudiness and overall acceptability compared to other treatments.

Microbiological analysis

Initial quality of freshly made low calorie cabbage based blend RTS beverage formulations was microbiologically safe. This is because of the heat treatment (pasteurization) provided for the formulations and good hygienic practices. Carter et al, (2007) reported that many products that could safely be maintained sterile by pasteurization process alone could be

doubly preserved by the addition of pottsium metabisulphite. The sulphite inhibits yeasts, moulds and bacteria (Doughari and Elmahmood, 2007).

Conclusion

In present investigation, efforts were made to develop blended therapeutic RTS using cabbage, lime, amla and ginger juices. Cabbage extract has high potential to having functional properties such as antioxidant and anticancer agents while amla juice dominated in its vitamin C content; TSS, Acidity and pH are very similar characteristics. Sensory quality revealed that cabbage extract could be successfully incorporated with lime, amla and ginger juices in development of blended therapeutic RTS with improved sensorial quality profile up to the level of 50% while 30% lime juice, 5% amla juice and 15% of ginger juice extracts.

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