



Nutritional and sensory evaluation of value-added juice drink from star fruit (Carambola)

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Abstract

Tropically grown star fruit (*Averrhoa carambola* L.) commonly known as Carambola belongs to the family Oxalidaceae and it is generally being used as a medicinal fruit. Due to its star shape appearance it is also used as a decorative fruit. It is rich in vitamin B and C, potassium, iron and calcium however presence of high oxalate and caramboxin content hinders its widely use. Star fruit is also rich source of natural antioxidants and has great antimicrobial activity. The aim of this study was to mix the various amount of juice of carambola with different Indian spices and study the physicochemical parameters such as pH, acidity, ash and moisture content, vitamin C, sugar, fat and total soluble solid (TSS). The best combination of juice drink possesses pH=2.42, ash content=1.2286% TSS =18.1°Brix, moisture content= 24.179%, acidity= 0.48%, sugar content = 7.78%, fat= 2.52% and vitamin C = 6.25%. We have also studied the contamination in the different mixtures by total CFU counts on solid culture medium plate. The sensory evaluation suggested that the appearance of juice, taste, aroma, color of all four treatments are acceptable but among them T1 treatment was best in all the sensory evaluations. The combination of Indian spices and carambola juice drink in T1 may be used as a low sugar and high nutritional value drink.

Keywords: Carambola; Star fruit; Caramboxin; antimicrobial; Sensory evaluation.

1. Introduction

Vegetables and fruits are very essential part of our food. Fruits usually provide us ample of nutrients such as minerals, vitamins and energy. Most of the fruits and vegetables are perishable and seasonal in nature. Their shelf life can be increased by proper storage and processing. Recently, food processing industries have been grown enormously due to dependency of consumers on packaged food. Regulatory authorities have made various rules and regulations for the processing and packaging of food to assure the quality, safety and nutrition of food items. (Avinash et al., 2010). Fruits are also processed to preserve its nutritional content for longer time and help in the distribution and diversification of economy. It also generates revenues and employment in agricultural sector. India has variety of tropical as well as subtropical fruits and vegetables grown in many regions of the country. Star fruit (*Averrhoa carambola* L.) is a species native to Southeast Asia and consumed in parts of south pacific, southeast Asia and part of east Asia. In India, it is found in the north east region (Julia and Morton, 1987). Carambola is cultivated in India whole year, but its flowering occurs during September through October and January through February. In spite of its high availability, it is an underutilized fruit in the Indian market. The star fruit carambola requires warm to hot temperature in the range of 68 °F to 95 °F. It requires plenty of soil moisture and wind protection. The carambola tree when grown in soil with pH above 7 develops manganese and iron deficiencies. Star fruit is low in calorie, fat and high in fiber and water content therefore good for calorie conscious peoples. It is rich in vitamin B, B-complex and C (Luan et al., 2021), sodium, potassium, iron and several anti-oxidants, polyphenols and flavonoids. Star fruit has immense antimicrobial and antioxidant activity (Nirali et al., 2017, USDA Nutritional Data Base, 1997, 2014; Ramadan et al., 2020). It also improves the immunity

which help in removal of toxic chemicals and fight against common infections. The insoluble dietary fibers present in the star fruit lowers the cholesterol which support healthy heart. It also supports the digestion and prevent the colon cancer. Previous studies on *Averrhoa carambola* plant suggested that it has many medicinal properties such as analgesic, anti-inflammatory and antimicrobial properties (Silva et al., 2021). The star fruit has anti-ulcer and hepato-protective role therefore used as a medicine (Dasgupta et al., 2013), roots extract of star fruits used in diabetes treatment (Qin et al., 2019). The star fruits have high nutritional value however its sour taste makes it less popular among other fruits. The advance fruit processing and preservation techniques make it available throughout the year. The mixing of variety of spices in the fruit juice makes it tastier and healthier. The present study aims to develop a carambola summer drink using carambola and various Indian spices. We will study the nutritional properties of value-added juice drink mix.

In this study, a carambola juice drink was formulated by using natural ingredients such as jaggery, fennel powder, cumin powder, mint leaves, lemon juice, red chili powder, black salt powder. The product undergoes various analysis such as physico-chemical analysis and sensory evolution. Total colony forming units (CFU) were detected to determine the spoilage of the product.

2. Materials and methods

Carambola fruit: Ripe or unripe fruit that is not soft, mouldy or discoloured and free from bruises was purchased from the local market in Sultanpur, U.P., India. Lemon and mint leaves were purchased from the local market of Sultanpur (U.P). The other ingredients used for the product development are: jaggery, black pepper, cumin powder, fennel powder, red chili powder, black

salt were purchased from a local store in Lucknow. Culture media were purchased from Hi media, India (M091A-500G), Eosin methylene blue agar (Himedia M317-500G).

2.1. Preparation of Carambola Juice drink mix

Carambola juice drink mix was formulated by slight modification method given by Piloo et al. 2019. Selected carambola fruits were washed and cut into small pieces after removing the edges and seeds. Blanched the slices and grind it and filter the carambola pulp by the sieve. Mixed the other ingredients into it such as jaggery, black pepper, cumin powder, fennel powder, red chili powder, black salt, lemon juice, mint leaves with varying carambola pulp amount (Kharsyntiew et al., 2019) (Table 1). Filled the prepared juice in the sterilized bottles and pasteurized the bottles in boiled water for 15 minutes and kept them at room temperature. Flow chart has been shown for the formation of carambola juice drink (Fig. 1).

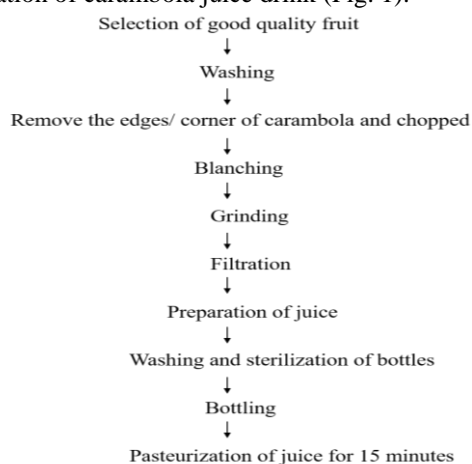


Fig. 1 Flow chart representing the various steps involve in the formation of Carambola juice drink mix

2.2. Physico-chemical analysis of Carambola juice drink mix

Physico-chemical analysis of a carambola drink was done by measuring the various parameters, such as moisture content was measured by crucible in a muffle furnace at 550°C for 12-18 hours and weigh the ash content in an electronic weighing balance. The analysis of ash content in food is simply burning away organic content, leaving inorganic materials measured. Total soluble solid (TSS) content of a juice was determined by the index of refraction. TSS is measured by using a refractometer and its unit is in degrees Brix. Basicity or acidity of the juice is measured by dipping the pH electrode in the drink mix sample. For liquid food products, the most commonly used method for determining total fat content is extraction using acid digestion by Soxhalte. The total acidity in fruit juices depends on the organic acids in the fruit, the acidity of juice measured by phenolphthalein as indicator with 0.1 NaOH titration method. Vitamin C is an important nutrient which helps in tissue repair mechanisms and enzyme production. Vitamin C content was measured by 3% of metaphosphoric acid method (Piloo et al., 2019). The sugar content in a juice sample is estimated by determining the volume of the unknown sugar solution required to completely reduce a measured volume of Fehling's solution (Dewi, 2010).

2.3. Microbiological analysis

Microbiological investigation was used for the estimation and enumeration of microbes. They can spoil food, introduce toxins, which cause diseases. The importance of microbiological testing is to quickly identify these contaminants by the method given by Maturin and Peeler (1998).

2.3.1. Total Plate Count (TPC) method

Total Plate Count (TPC) is a method of estimating the total number of microorganisms i.e. molds, yeasts, and bacteria present in the carambola juice drink mix. Plate Count Agar (PCA) media is used in this method to determine the total or viable bacterial growth of a sample by serial dilution method plated over fresh PCA plate and incubated at 37°C for 24 h (Gilbert et al., 2000, Carter et al., 2007, Bujna et al., 2018).

Escherichia coli determination in carambola juice

Escherichia coli (*E. coli*) is a pathogenic bacterium responsible for the spoilage of the food which may cause serious illness in humans like food poisoning. EMB (Eosin-methylene blue) agar is used for the determination of *E. coli* count in juice. 10⁻¹ and 10⁻² dilution of juice plated over EMB agar plate and incubated at 37°C for 24 h.

2.5. Sensory analysis

Sensory evaluation is the method used to identify the market susceptibility of food-based products. It is done by the procedure given by Setyaningsih et al. (2010). Sensory evaluation method is used to statistically analyze the human senses such as smell, taste, sight, touch and aroma by the experts. It requires the human experts which are trained to evaluate the consumer food items and give their feedback in a point of scale 0 to 9. The evaluation is conducted according to the 9-point sensory panel rated on the Hedonic rating test scale (hedonic point scale where 9 = like extremely and 1 = dislike extremely).

3. Results and discussion

Generally, star fruits are regarded as an abundant source of various nutrients such as minerals, proteins, and vitamins, and also rich in natural phytochemicals such as flavonoids, polyphenols and B-complex vitamins.

3.1. Juice drink mix formulations

Star fruit is the storehouse of various minerals like proteins, minerals and proteins (Ramadan et al., 2020; Pal et al., 2021). All the used ingredients also have their own properties for the betterment of the health and are routinely used in Indian kitchens. Table 1 represents the various Indian spices mixed with varying amounts of carambola juice and denoted as treatment (T1), treatment (T2), treatment (T3) and treatment (T4).

3.2. Physico-chemical Analysis

The chemical composition of a typical Carambola juice has been reported as the moisture content of the fruit is 92.1%, TSS is 6° Brix, ascorbic acid: 16.8 mg/100g, reducing sugar: 5.68 %, non-reducing sugar: 2.04 % and total sugar: 7.72%. However, higher total sugar content (10.85%) was reported in ripen fruit (Neog and Mohan, 1991). Joseph and Mendonca (1989) noticed that sweet type fruits had higher sugar content with an average total sugar of 14g/100g as compared with 6.25g/100g for fruit of sour types. The physical appearance of the star fruit is green, yellowish green, unripe, semi-ripe, ripe which has sour and

fruity smell with perishable properties (Shirsat and Thakor, 2014). Physio-chemical analysis determine the nutrient contents present in carambola drink such as ash content, moisture content, total soluble solids (TSS), pH, fat content, acidity, vitamin C, and sugar (Pathak and Chakraborty, 2006). All these parameters were checked and given in Table 2.

Table 1 Different amounts of carambola juice were mixed with different ingredients for the formation of four types of juice drink mix in which T1 contains 40 g, T2 contains 60 g, T3 contains 45 g and T4 contains 20 g of carambola pulp

Ingredients	T1	T2	T3	T4
Carambola juice	40 g	60 g	45 g	20 g
Water	50 mL	30 mL	45 mL	70 mL
Jaggery	4 g	4 g	4 g	4 g
Cumin powder	1 g	1 g	1 g	1 g
Fennel powder	0.5 g	0.5 g	0.5 g	0.5 g
Black pepper	0.5 g	0.5 g	0.5g	0.5 g
Red-chili powder	0.5 g	0.5 g	0.5 g	0.5 g
Black salt	1 g	1 g	1 g	1 g
Lemon juice	2.5 mL	2.5 mL	2.5 mL	2.5 mL
Mint leaves	10-20	10-20	10-20	10-20

3.3. Microbiological analysis

Microbiological analysis methods are used for the detection and identification of microorganisms. Some microbes can cause serious illness. They can spoil food, introduce toxins, which cause diseases. The importance of microbiological testing is to quickly identify these contaminants. Many factors such as hygienic practices, pH, storage conditions and temperature affect the microorganism population in juice and its formulations (Tasnim et al., 2010).

Table 2 Physio-chemical parameters of carambola juice drink mix are given below

Ash content	1.2286%
Moisture content	24.179%
Total soluble solids (TSS)	18.1°B
pH	2.42
Fat content	2.52%
Acidity	0.48%
Vitamin C	6.25mg
Sugar	7.72%

The total number of microorganisms present in carambola juice drink mix was determined by the plate count method. PCA media is used to determine the viable microbial growth in juice. We didn't find any viable bacterial growth on the plate after 24 h of incubation at 37 °C. *E. coli* colonies were analyzed in EMB agar and after incubation we didn't find any bacterial colonies on the plate. It suggests that our preparation methodology and pasteurization method successfully kills all the microorganisms present in the carambola juice drink mix.

3.4. Sensory Evaluation

The sensory evaluation was conducted by a panel of trained judges and the scores were given according to the Hedonic Rating Test Scale. Where 9 = like extremely and 1 = dislike

extremely. The panel member evaluates the drink on the basis of its appearance, taste, flavor, aroma, color and overall acceptability. The drink obtains scores in sensory evaluation are 8 in appearance, 9 in aroma, 8 in taste, 8 in color, 8 in flavor and 8 in overall acceptance. This juice formulation has a better Hedonic Rating as compared to the previously reported juice formulation of star fruit, muskmelon and orange (Nirali, 2017). According to the score obtained by the sensory evaluation, formulation 1(T1) which contains 40gm carambola pulp and 50ml of water, shows the highest score of amongst all the other formulations. T1 has score 8 in appearance, 9 in aroma, 8 in taste, 8 in color, 8 in flavor, and 8 in overall acceptance (Fig. 2 and Table 3).

Table 3 Sensory evaluation of Carambola juice by different treatments, in which T1 contains 40 g, T2 contains 60 g, T3 contains 45 g and T4 contains 20 g of carambola pulp. Hedonic Rating Scale indicated as 9 =like extremely and 1= dislike extremely

Treatments	Appearance	Aroma	Taste	Color	Flavor	Overall acceptance
T1	8	9	8	8	8	8
T2	8	9	8	7	8	8
T3	7	7	6.1	6.8	6.8	7
T4	6.4	6.5	6	6	6	6.1

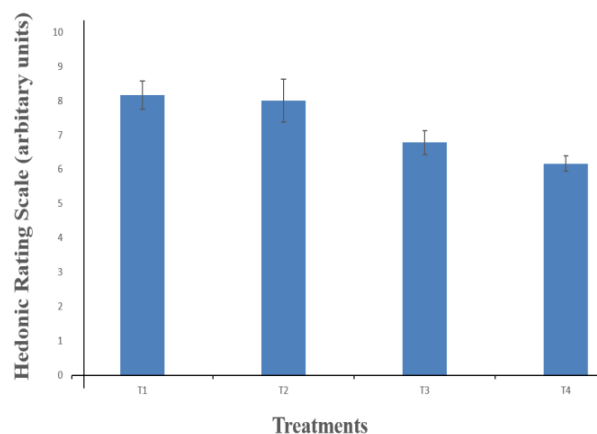


Fig. 2 Sensory evaluation of Carambola juice of different treatments in which T1 contains 40 g, T2 contains 60 g, T3 contains 45 g and T4 contains 20 g of carambola pulp. Graph bar indicates the average of five parameters used for sensory evaluation in Hedonic rating scale.

4. Conclusions

The carambola juice mix drink can be successfully stored for a greater period of time by blanching and pasteurization, which increases the shelf-life of carambola juice. The nutrient quality of carambola fruit was improved due to the mixing of Indian spices. The process was simple enough for small scale development and could be taken up for large scale production. Consumption of the carambola juice drink mix will increase its popularity and knowledge about the health benefits. Carambola juice formulation treatments as T1, T2, T3 and T4 among them

treatment T1 was best due to its variation in carambola pulp amount with other spices. Carambola drink mix was self-preserved due to its acidic and vitamin C contents, so no extra preservatives are required for its long shelf life. Carambola has a high water content which helps to hydrate the body in the summer so this drink is a good refreshment drink and also will increase its market value.

Author's contribution

Aishwarya Bhatnagar: performed the experiments, collected data, **Ruchi Sankhwar:** collected and analyzed the data, wrote the MS draft and **Ravi Kr. Gupta:** overall supervised the project, analyzed the data and finalized the MS.

Conflict of Interest

There is no conflict of interest for this study.

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References

- Avinash, G.P., Darshana., A.P, Anita, V.P and Nresh, C., 2010. Physical and chemical characteristics of carambola (*Averrhoa carambola* L.) fruit at three stages of maturity. *Int. J. Appl. Biol. Pharm.* 1(2), 624 – 629.
- Bujna, E., Farkas, NA., Tran, M.A, Dam S.M, Nguyen, D.Q., 2018. Lactic acid fermentation of apricot juice by mono- and mixed cultures of probiotic *Lactobacillus* and *Bifidobacterium* strains. *Food. Sci. Biotechn.* 27,547– 54. doi: 10.1007/s10068-017-0269-x.
- Carter, H.W., Charley, V.L. S., Britolc., 2007. The Preservation of fruit juice products with special reference to nutritional value. *J. Camb.* 812–814.
- Dasgupta, P., Chakraborty, P., Bala, N.N., 2013. *Averrhoa Carambola*: An updated review. *Int. J. Pharm. Sci. Res. Rev.* 2, 54-63.
- Dewi, R.K., 2010. Stabilizer concentration and sucrose to the velva tomato fruit quality. *J. Tek. Kimia.* 4(2), 330-334.
- Gilbert, R.J., Louvois, J., Donovan, T., Little, C., Nye, K., Richards, C.D., Roberts, D., Botton, F.J., 2000. Guidelines for the microbiological quality of some ready-to-eat foods sampled at the point of sale. In: *J. Communicab. Dis. Public Health.* 3(3),163-167.
- Joseph, J., Mendonca, G., 1989. Chemical characteristics of *Averrhoa Carambola*. *Proceeding of Inter American Soc. J. Trop. Hortic.* 33, 111-116.
- Julia, F., Morton., 1987. "*Carambola (Averrhoa carambola)*; In: fruits of warm climates". New CROP, new crop resource online program, center for new crops & plant products, purdue university. pp. 125–128.
- Kharsyntiew, A., Broadway, A., Bharti, B.K., Hossain, S.A., Lal, N.K., 2019. Studies on the preparation of carambola juice. *J. Pharmacogn. Phytochem.* 8(6), 1664-1669
- Luan, F., Peng, L., Lei, Z., Jia, X., Zou, J., Yang, Y., He, X., Zeng, N., 2021. Traditional uses, phytochemical constituents and pharmacological properties of *Averrhoa carambola* L.: A Review. *Front. Pharmacol.* 12, 699899. <https://doi.org/10.3389/fphar.2021.699899>.
- Maturin, L.J., Peeler, J.T., 1998. Aerobic plate count. Chapter. 3. Food and drug administration bacteriological analytical manual, 8 thEdn. R. L. Merker (Ed.). AOAC International, U.S.A.
- Neog, M., Mohan, N.K., 1991. Growth and development of carambola (*Averrhoacarambola*) South Horticul. 39(4), 174-178.
- Nirali, C.S., Patil, D.S, Ahire, K.H., 2017. Formulation, sensory, chemical and nutritional attributes of star fruit, muskmelon and orange squash with basil seed. *Int. J. Sci. Res.* 6(9),1135-1142.
- Pal, H., Kaur, R., Kumar, P., Nehra, M., Rawat, K., Grover, N., Tokusoglu, O., Sarao, L.K Kaur, S., Malik, T., Singh, A., Swami, R., 2021. Process parameter optimization for development of beer: Star fruit fortified approach. Volume 46, Issue 10, e15838. <https://doi.org/10.1111/jfpp.15838>
- Pathak, P.K., Chakraborty, I., 2006. Studies on Physico-chemical characters of some potential underutilized tropical fruits. *Proceedings of the national symposium on production, utilization & export of underutilized fruits.* 4, 271-274
- Piloo, N.G., Singh, S.R., Surmina, Devi, N., Senjam, B.D., Messar, O., 2019. Studies on physico-chemical, sensory and microbiological evaluation of carambola (*Averrhoa carambola* L.) nectar under ambient condition. *Int. J. Chem. Studies.* 7(5), 498-501.
- Qin, L. H., X.C. Wu., Zhou, X., Wu, Y. N., Huang, R. B., and Zhang, S. J., 2019. Effects of benzoquinone of *Averrhoa carambola* L. root on glucose and lipid metabolism, oxidative stress and inflammatory injury in diabetic mice. *Chin. Pharmacol. Bull.* 35 (12), 1720–1725. doi:10.3969/j.issn.1001-1978.2019.12.019
- Ramadan, N.S., Wessjohann, L.A., Mocan, A., Vodnar, D.C., El-Sayed, N.H., El-Toumy, S.A., Mohamed, D.A., Aziz, Z.A., Ehrlich, A., Farag, M.A., 2020. Nutrient and sensory metabolites profiling of *Averrhoa Carambola* L. (Starfruit) in the Context of its origin and ripening stage by GC/MS and chemometric analysis. *Molecules* 22, 25(10), 2423. doi: 10.3390/molecules25102423. PMID: 32455938; PMCID: PMC7287910.
- Setyaningsih, D., Apriyantono, A., Sari, M.P. 2010. Analisis sensori untuk industri pangan Agro. Sardin. DS, editor. Bogor (ID): IPB Press.
- Shirsat, B.S., Thakor, N.J., 2014. Studies on physico-chemical characteristics of Carambola (*Averrhoa carambola* L.) fruit. *Bioved.* 25(2),121–125.
- Silva, K.B., Pinheiro, C.T.S., Soares, C.R.M., Souza, M.A., Matos-Rocha, T.J., Fonseca, S.A., Pavao, J.M.S.J., Costa, J.G., Pires, L.L.S., Santos, A.F., 2021. Phytochemical characterization, antioxidant potential and antimicrobial activity of *Averrhoa carambola* L. (Oxalidaceae) against multi-resistant pathogens. *Braz. J. Biol.* 81(3), 509-515. doi: 10.1590/1519-6984.220259. PMID: 32876163.
- Tasmin, F., Anwar Hossain, M., Nusrath, S., Kamal Hossain, M., Lopa, D., FormuzulHaque, K.M., 2010. Quality

Assessment of industrially processed fruit juices available in dhaka city, Bangladesh. Mal. J. Nutr. 16 (3), 431-438.

USDA Nutritional Data Base, 1997 & 2014. Preservation technologies for fresh fruits and vegetables.

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