



Effect of Hydrocolloid Carboxymethyl Cellulose (CMC) on Clarification of Bottle Gourd Juice and Its Physicochemical Properties

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Authors' contributions

This work was carried out in collaboration among all authors. Author Anjum Ayoub designed the study, wrote the protocol, managed the literature searches and analyses of the study. Author Aafaq Ashraf wrote the first draft of the manuscript also analyses of the study. Author AD performed the statistical analysis. All authors read and approved the final manuscript.

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ABSTRACT

Effectiveness of the Hydrocolloid Carboxymethyl Cellulose (CMC) on Bottle Gourd Juice was investigated in this study. The influence of carboxymethyl cellulose (CMC) on the colloidal stability of cloudy Bottle Gourd juice has been studied. Concentrations of CMC from 0.1–0.4% completely inhibited juice clarification. Juices with CMC were more stable. Characterization of rheology is important for clarification of the product and storage. Use of hydrocolloid was only to enhance viscosity and creating gel structure of juice. Temperatures ranging from 5-35°C were used in carrying out the experiments. The purpose of this research was to study the clarification, quality improvement and shelf life of Bottle gourd juice.

Keywords: Carboxymethyl Cellulose (CMC); turbidity hydrocolloid; bottle gourd; clarity.

1. INTRODUCTION

Efficient sources of sugar, minerals and vitamins are known to be juices, all of which are beneficial ingredients for human health. Because of the ongoing lifestyle scenario in the country, people are drawn to healthy diets that make juices one of the better alternatives to the rest of the foods. The composition of the juices therefore depends exclusively on the growing conditions, the variety of fruits and the origin of the fruits and their quality parameters, including different storage and processing procedures [1]. To enhance the life style and health of humans vegetables and fruits paly a crucial role [2]. Preservation is intended to accomplish the self-life extension of foods. Current trends rely on the use of methods that from a microbiological point of view, ensure that goods are qualitatively less stored, non-additive, nutritionally useful, but also safe [3]. Significant risks to quality and food safety are posed by the demand for minimally produced, readily prepared and ready-to-eat fresh food products, worldwide food trade, and centralised production distribution. Various conventional approaches are those approaches that have different adverse effects on the entire environment and society, such as adding preservatives, cooling, etc. Cooling has adverse environmental consequences and the ozone layer and preservatives can impact the health of customers [4].

One of the essential vegetables belonging to the Cucurbitaceae family is the bottle gourd (*Lagenaria siceraria*). Bottle gourd originates and is grown globally in Africa and India. Because of its greater therapeutic importance, it is also used in many Ayurvedic medicines. Broadly speaking, antioxidants are compounds that significantly delay or prevent substrate oxidation when they are present in lower concentrations compared to oxidizable substrates. Oxidizable substrates [5]. There are everything present in living tissues and foods, including lipids, proteins, DNA and carbohydrates. The non-edible components of various fruits and vegetables (mainly seeds and peels) have been shown to be good antioxidant sources [6]. The cultivation of the bottle gourd plant in various seasons in different locations throughout the year. Therefore the supply in one particular location is not uniform throughout the year and appropriate steps must be taken or ensured in order to make it available during off-seasons throughout the year. This achievement can be accomplished by improving the fresh or

manufactured life span [7]. The current study relies on shelf stability of the juice by using Carboxymethyl cellulose hydrocolloid and its impact on clarification of the bottle gourd juice.

The other important thing about Bottle Gourd is that when extracted, its juice produces a sufficient amount of haze. Bottle Gourd haze is a very rich source of nutrition in terms of vitamins and minerals. We need several strategies and methods to maintain the haze present in juice that do not allow the haze to settle down and should not be completely visible in the juice that is processed.

2. MATERIALS AND METHODS

The following study was conducted at (GBU) Gautam Buddha University, Greater Noida UP in (SOVSAS) school of Vocational studies and applied sciences, Department of food processing and technology. Hydrocolloidal Clarification by CMC of Bottle gourd juice was carried out by using CMC hydrocolloid.

2.1 Raw Materials

2.1.1 Bottle Gourd (*Lagenaria siceraria*)

Bottle gourd raw material was purchased from nearby market Kasana in Greater Noida, Gautam Buddh Nagar.

2.1.2 Hydrocolloid

The hydrocolloids used in this study were Carboxymethyl Cellulose (CMC).

2.1.3 Chemicals and reagents

The chemicals used in this study were purchased from CDH chemicals and Hi- Media Chemicals. Nutrient agar, nutrient Broth, magnesium sulphate, Potassium phosphate buffer.

2.2 Estimation of Physico-Chemical Properties of Raw Bottle Gourd Juice

Bottle Gourd was peeled cut into pieces and 100 gm bottle gourd was weighed. 5% distilled water was added to it and it was steam blanched at 1.054kg/cm² for two minutes. It was blended into pulp and 100gm was weighed. This raw juice sample was used for analysis and kept as control.

2.3 Estimation of TSS (Total Soluble Solids) [8]

Using a hand refractometer, the TSS was measured. Sugars, sucrose, fructose and glucose are mainly these soluble solids. It is expressed in "Brix" and is percentage-equivalent. A juice of 3^o Brix, for example, has 3% total soluble solids. One or two drops of the juice sample were kept on the prism and the glass plate was closed over the sample, then its reading was noted by looking through the piece of the eye. Sample is placed in between the refractometer's measurement prism and the cover layer. Light passing through the sample is often internally transmitted through the sample. The shadow line created between the dark area and illuminated area is the net result [9].

2.4 Estimation of pH [10]

Measurement of the pH was done with the help of the digital pH meter. Calibration of the pH meter was done using buffer solution of pH 7 and pH 4. After rinsing the probe, it was submerged into the sample to be studied to be tested. Enough time was allowed for the meter reading to stabilize the final stable shown on meter was noted. The aliquot extract of juice that was drawn out. Measuring of the value of pH of juice was done by using digital pH meter [11].

2.5 Estimation of Clarity

[12] and [13] methods were used to measure the juice clarity. Determination of the clarity of the raw juice were determined by measuring the absorbance at 450 nm against distilled water using UV- VIS Spectrophotometer. 10 ml of juice was taken and used for determination of clarity against distilled water at 450 nm. The percentage transmittance accounts for the clarity of Bottle Gourd juice.

2.6 Estimation of Turbidity

Turbidity is a fluid's cloudiness or haziness which is caused by particles or solids which are suspended which are not visible to the naked eye. Turbidity calculation is an important test when trying to assess juice content. The Nephelometric Turbidity Units (NTU) is the most common measurement for turbidity. It is an aggregate optical property of the juice and does not distinguish individual substances.

A light beam centred on them will disperse the particles suspended in the water. From the incident light path, the scattered light is then measured at different angles. This is now accepted as a more reliable turbidity test. Using a nephelometer, such as the LaMotte 2020we, to measure turbidity this way. The scattered light is measured at 90 ° by most nephelometers. If more light is able to reach the detector, it means that the source beam is scattered by many small particles, diminished light reaching the detector means fewer particles. The measurement units are the Nephelometric Turbidity Units (NTU).

2.7 Sedimentation

The tendency of the suspended particle to settle out of the liquid or fluid in which they are entrapped or entrained which comes to the rest against a barrier. This is due to the movement through the fluid in against the response to the forces that act on them: centrifugal acceleration, gravity, or electromagnetism may be responsible for these forces.

$$\frac{\text{Sedimentation Level}}{\text{Vol.of juice}} \times 100\%$$

2.8 Bottle Gourd Juice Extraction

Fresh Bottle gourd was borrowed from nearby Kasma Market Greater Noida. Thorough washing of the fresh bottle gourds were done and cutting off from the top and peeled. Extraction of the juice were done with the help of the juice extractor (Kalsi: 9001-2008). Followed by the pasteurization of the juice at 80-83°C for 3 min. [14].

2.9 Hydrocolloid Treatment on Bottle Gourd Juice

Bottle Gourd juice was treated with CMC hydrocolloid. The Conditions for the treatment were optimized.

2.10 Preparation of Hydrocolloid Solutions CMC

The hydrocolloid were dispersed in a small quantity of deionized water with a magnetic stirrer and heated for 2 hr in a 70° C water bath. The concentration of each hydrocolloid in solution was maintained at desired percentages (w/v).

2.11 Sensory Analysis of Bottle Gourd Juice Treated with Hydrocolloid

A experienced panel consisting of ten judges were selected from students of food processing technology department SOVSAS GBU. They evaluated the product fortnightly with the help of the Hedonic scale method for color, Aroma, Texture, Taste and overall acceptability. The Hedonic method using a scale from 1 to 9, where 1 = (Extremely dislike), 2 = (Strong dislike), 3 =

(Moderate dislike), 4 = (Slight dislike) 5 = (Neutral), 6 = (Slight Like), 7 = (Moderate like), 8 = (Strong like), 9 = (Extremely like) [15].

2.12 Statistical Analysis

The data collected from all the experimental observations were analyzed statistically using SPSS (Version 13) software and independent t sample test at level of significance $p < 0.05$ using Turkey's test and LSD.

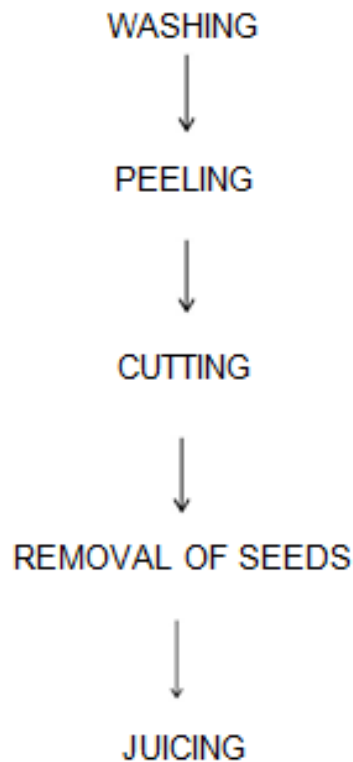


Chart 1. Flow Chart of Bottle gourd juicing Process: (Flow Chart)



Fig. 1. Samples of CMC Hydrocolloid treated and Untreated Bottle Gourd Juice

3. RESULTS AND DISCUSSION

3.1 Control Sample (Raw Bottle Gourd Juice)

3.1.1 Estimation of Physico-chemical properties of raw Bottle Gourd juice

The raw bottle Gourd juice was analyzed for its Physico- chemical properties. The TSS of raw bottle Gourd juice was found to be 3° Brix and pH was 5.86 and the turbidity was 28.0 NTU and clarity 0.05%.

3.2 Bottle Gourd Juice Treated with Hydrocolloid Carboxymethyl Cellulose (CMC)

3.2.1 Effect of CMC Treatment on TSS at various concentrations

The raw Bottle Gourd Juice TSS is 2.5° Brix, and as the amount of soluble solids decreased after CMC hydrocolloid treatment, the TSS decreased. A comparative analysis of the effects of Bottle Gourd Juice on TSS after CMC hydrocolloid treatment is shown in Table 1. According to [16] & [17], after the rise in CMC concentration, the total soluble solids began to decrease. They indicated that the change in total soluble solids is

due to the presence, as a result of sugar fermentation, of microorganisms that cause the fruit juice to deteriorate.

3.2.2 Effect of CMC on pH of Bottle Gourd Juice

The pH of the raw juice was 6.10 and the pH of the CMC treated juice was found to be reduced at different concentrations. A comparative analysis of the effects of Bottle Gourd Juice's TSS before and after hydrocolloid treatment is shown in Table 2. The increase in pH and decrease in TA suggest that with maturity, acid concentrations in the fruit are decreasing. The findings are in agreement with the findings of Srivastava and Tyagi [18].

3.2.3 Effect of CMC on Turbidity

28NTU was reported for the turbidity of the raw bottle of Gourd juice and the turbidity of hydrocolloid CMC treated juice was found to be decreased. The decrease in turbidity implies that suspended particles are stabilised. This is due to the hydrocolloids' gel formation, which connects all the haze particles suspended within the juice. The findings are consistent with the results Srivastava and Tyagi [18] and Lau et al. [19].

Table 1. Effect of Carboxymethyl Cellulose (CMC) on TSS of Bottle Gourd Juice

Raw Juice TSS° Brix	CMC concentration 0.1%	CMC concentration 0.2%	CMC concentration 0.3%	CMC concentration 0.4%
2.5	2.3	2	2	1.5

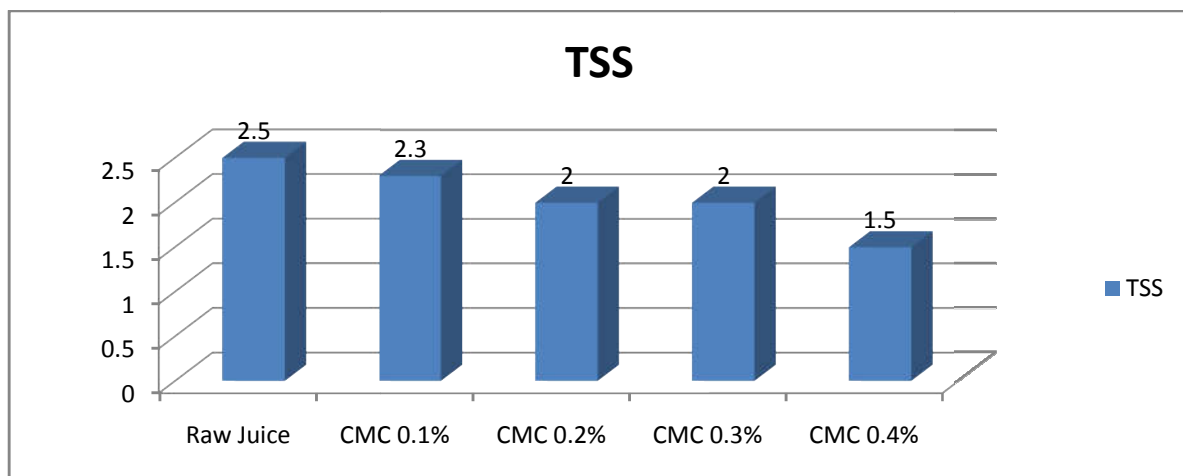


Fig. 2. Effect of CMC on TSS

Table 2. Effect of Carboxymethyl Cellulose (CMC) on pH of Bottle Gourd Juice

Raw Juice pH	CMC concentration 0.1%	CMC concentration 0.2%	CMC concentration 0.3%	CMC concentration 0.4%
6.10	6.15	6.20	6.24	6.29

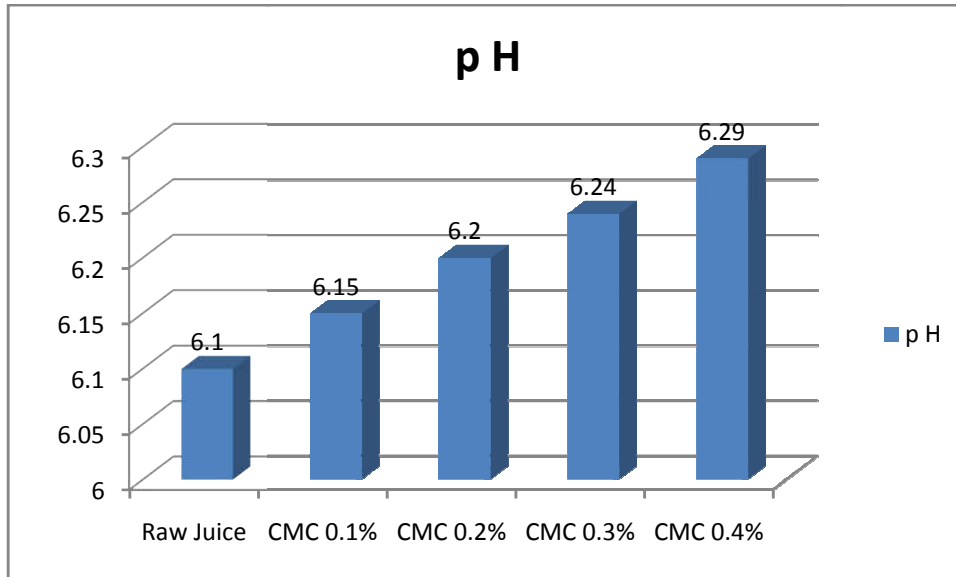


Fig. 3. Effect of CMC on pH

Table 3. Shows the comparative of Carboxymethyl Cellulose (CMC) on the turbidity of bottle gourd juice

Raw juiceturbidity	CMC concentration 0.1%	CMC concentration 0.2%	CMC concentration 0.3%	CMC concentration 0.4%
28	24	22	18	16

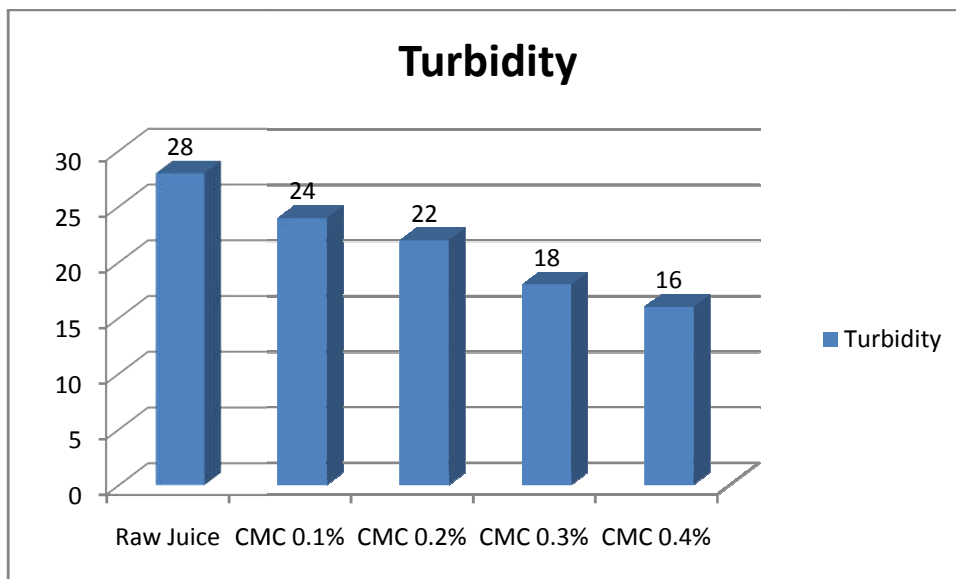


Fig. 4. Effect of CMC on Tubidity

3.2.4 Effect of CMC on Clarity of Bottle Gourd juice

The raw bottle Gourd juice clarity was 3.03 percent and at varying concentrations the CMC treated Bottle Gourd juice was reduced and shown in the table below. The decrease in clarity was due to the addition of hydrocolloids, which are very molecular weight macromolecular substances that, compared to raw bottle guard juice, contribute to an increase in absorption levels. I comply with the findings (Srivastava and Tyagi 2013) [18].

In order to maintain the stability of the particles in a solution, Sticking of the particles should be avoided as they collide in order to preserve the equilibrium of suspended particles in a solution. This implies that there should be the regulation of particle movement (free movement), this can be

done by raising the charge associated with the particle i.e. zeta potential and also by increasing the solution's viscosity of the bottle Gourd juice. In this analysis, different samples of bottle Gourd juice were treated with different concentrations of CMC hydrocolloid, then held for storage for up to 45 days and a large difference in haze settlement compared with the untreated or raw bottle Gourd juice Figure a of bottle Gourd juice treated at different concentrations with different hydrocolloids [17].

Sensory assessment of CMC hydrocolloid bottle Gourd juice revealed that the rise in CMC concentration had an adverse effect on the overall acceptability of the Gourd bottle juice. The colour and taste, however, remained high in all the CMC concentration categories. The moderate general acceptability showed just 0.45 percent concentration.

Table 4. Shows the comparative of CMC on the Clarity of bottle Gourd juice

Raw Juice Clarity(%T450)	CMCconcentration0.1%	CMC concentration 0.2%	CMC concentration 0.3%	CMC concentration 0.4%
3.03%	3.08%	4.01%	4.02%	4.04%

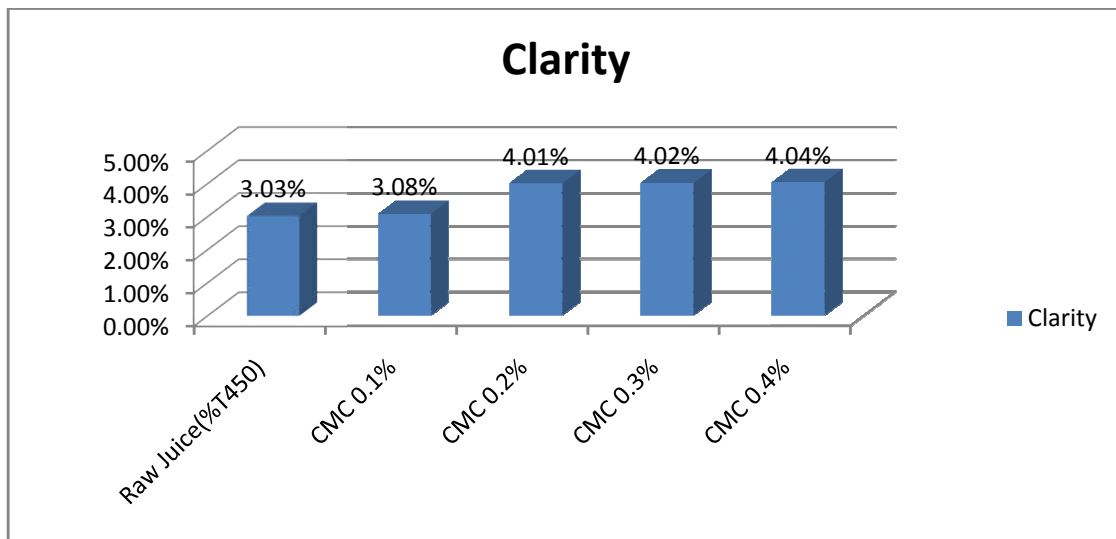


Fig. 5. Effect of CMC hydrocolloid on sedimentation and stability of haze present in bottle Gourd juice

Table 5. Sensory properties of Bottle Gourd Juice treated with Hydrocolloid CMC at different concentrations with 30 days of storage at below 5°C

S.NO.	CMC concentration	Color	Aroma	Taste	Overallacceptance
1	0.1%	9	8.5	8.5	8.7
2	0.2%	8.5	8.0	8.3	8.25
3	0.3%	8.3	7.8	7.9	8.0
4	0.4%	8.7	6.9	6.7	7.5

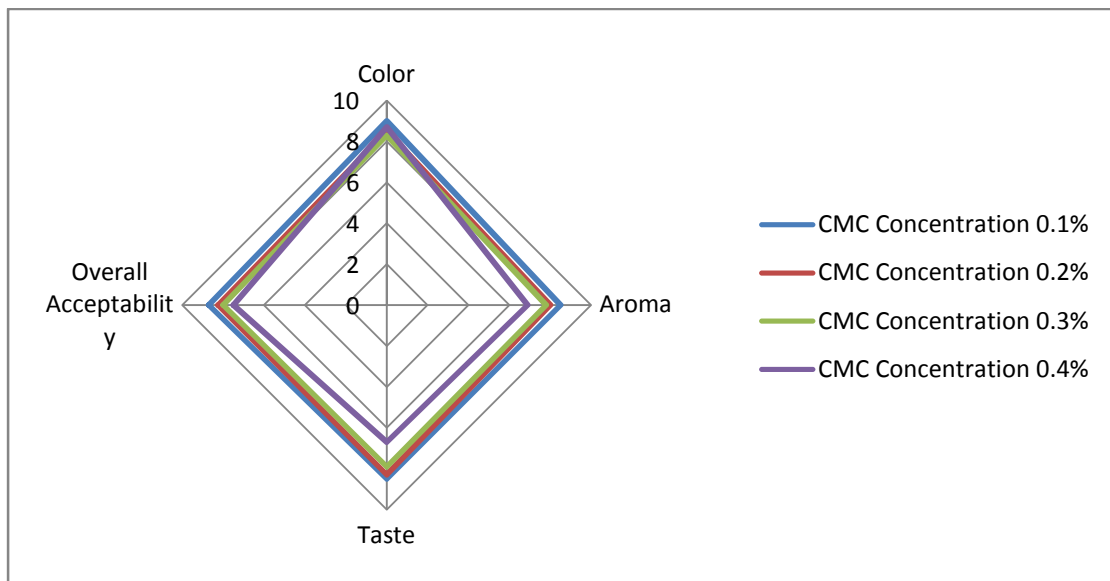


Fig. 6. Graphical presentation of overall acceptability of color and taste

4. CONCLUSION

In ambient and refrigerated conditions, the CMC hydrocolloid was stored and physico-chemical properties were also examined there. The following conclusions are drawn based on the findings. The pH values of the Gourd juice bottle treated with CMC hydrocolloid continued to decrease as the hydrocolloid concentration increased. Therefore the rise in the pH values was absolutely non-significant, showing that hydrocolloid has far less influence on the pH of bottle gourd juice. With all the increasing concentration of all the hydrocolloid, the total soluble solids (TSS) of the Gourd bottle increases. Here too, the improvement in TSS was just a non-significant change, so hydrocolloid does not have a major effect on TSS of bottle gourd juice. Bottle Gourd juice was found to increase turbidity as the concentration of hydrocolloid increased. In terms of NTU, there was a very large rise in turbidity levels. The improvement was due to hydrocolloid high macromolecular weight. The raw bottle Gourd juice clarity was 0.09 percent and the clarity decrease was due to hydrocolloid high aggregation and rise in TSS of bottle gourd juice.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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