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## Nutritive analysis of enzyme treated mosambi juice

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### Abstract

The present study is aimed at developing sparkling mosambi juice and with significant changes in physical parameters. Mosambi juice was subjected to centrifugal force for clarification and treated with pectinase enzyme with 10000ajdu acitivity with time and temperature combination as 100 minutes and 42 °C. The enzyme concentration of juice samples are S<sub>1</sub> (5% Enzyme), S<sub>2</sub> (7.5% Enzyme), S<sub>3</sub> (10% Enzyme), and S<sub>4</sub> (12.5% Enzyme). Proximate analysis of control juice, centrifuged juice and selected enzyme treated juices are done. Transmittance and Turbidity of the juices were also analysed to study the treatment effects. Results indicated that Mosambi juice treated with 7.5% pectinase concentration had 3568.9% transmittance and 125.6 NTU turbidity.

**Keywords:** Mosambi juice, pectinase, transmittance, turbidity

### 1. Introduction

In India, more than 20–25% of fruits and vegetables are spoiled before utilization as the post-harvest life of maximum fruits and vegetables is limited. Despite being the world's second-largest producer of fruits and vegetables, in India, only 1.5% of the total are being processed [1]. From many field observations and studies over the past 40 years, it has been reported that 40-50% of horticultural crops produced in developing countries are lost before they can be consumed, mainly because of high rates of water loss, bruising and decay during post-harvest handling [2].

The increase of citrus world production was relatively constant during the last decades of the twentieth century, and annual production has reached more than 105 million tons (2000–2004)<sup>3</sup>. Oranges constitute the major part of the citrus production (61%), followed by mandarins (20%), lemons and limes (14%), and grapefruits (5%). The production of citrus fruits is very widespread around the world, located approximately between 40°N and 40°S latitudes, with more than 140 producing countries. However, the major part of the production is concentrated in Brazil (20%), the Mediterranean countries (20%), China (16%), and the USA (11%). These areas account for about two-thirds of the total citrus production [4].

Citrus fruits are also important sources of folate, potassium, and carotenoids. Some of the carotenoid pigments are precursors of vitamin-A. Red pigment lycopene also has significant antioxidant activities. Other naturally occurring compounds with important physiological properties are polyphenols (phenols and hydroxycinnamic acid derivatives), flavonoids, coumarins, terpenes that, in general, protect against chronic diseases such as cancer and heart diseases and have anti-viral, anti-allergic, anti-inflammatory and anti-proliferative activities. Other health benefits of citrus compounds are related to the prevention of diseases such as liver problems, obesity, asthma, kidney stones, bone metabolism, osteoporosis, and other age-related diseases [7].

Mosambi is well cultivated in central and south Asia. It is the place where most of the production of the fruit comes from. Citrus species is known for its medicinal and nutritional properties. It is commonly known as the rich source of vitamin C. Nearly all parts of the plant as peel, flower, and fruit juice are used as traditional medicine. Some pharmacological activities are reported such as antibacterial and antifungal activity, antioxidant activity, anti-hyperglycemic-hyperglycemic activity, antitumor potential, Larvicidal property, and property

**Table 1:** All India Area, Production, the Productivity of Mosambi

Year	Area (000 Ha)	Production (000 MT)	Productivity (MT/Ha)
2000-01	80.6	1160.4	14.4
2001-02	126.4	1210.4	9.6
2002-03	146.1	785.3	5.4
2003-04	194.5	2019.1	10.4
2004-05	194.4	2078.7	10.7
2005-06	230.3	2138.6	9.3
2006-07	268.8	2909.4	10.8
2007-08	300.2	398.6	11.3
2008-09	317.8	3567.4	11.2
2009-10	346.3	3882.4	11.2
2010-11	157.0	1316.0	8.4
2011-12	161.7	1231.9	7.6
2012-13	323.2	3519.9	10.9
2013-14	334.9	3886.2	11.6
2014-15	274.7	4229.0	15.4
2015-16	243.8	3468.1	14.2
2016-17	209.19	3497.35	16.7

Source [5]

**Table 2:** State-wise productivity (in 000 MT) of Mosambi

Sl.no	States	2014-15	2015-16	2016-17
1	Andhra Pradesh	16.71	16.23	25.00
2	Tamil Nadu	19.26	17.31	16.87
3	Madhya Pradesh	12.76	14.29	16.09
4	Karnataka	16.04	16.10	16.05
5	Assam	13.00	10.28	14.00
6	Telangana	19.29	14.90	13.73

Source [6]

to antagonize the hypertensive effect of angiotensin II. d-limonene, one of the most abundant terpenes found in the plant is reported to be very low toxic [8]

Fruit juice preparation is one of the easiest ways to preserve fruit. The production of fruit and vegetable juices is important both from human health and commercial standpoints. The availability of nutritious components from fruits and vegetables to a wide range of consumers is thus facilitated throughout the year by the marketing of their juices. The production process of fruit and vegetable juices includes steps like extraction, clarification, and stabilization [9].

The enzymatic process is claimed to offer several advantages over the mechanical-thermal comminution of several fruit pulps. In particular, the use of celluloses and pectinases has been an integral part of the modern fruit processing technology involving the treatment of fruit masses. The enzyme treatment not only facilitates easy pressing and

increase in juice recovery but also ensures the highest possible quality of the end products. These enzymes not only help in softening the plant tissue but also lead to the release of cell contents that may be recovered with high yield [10].

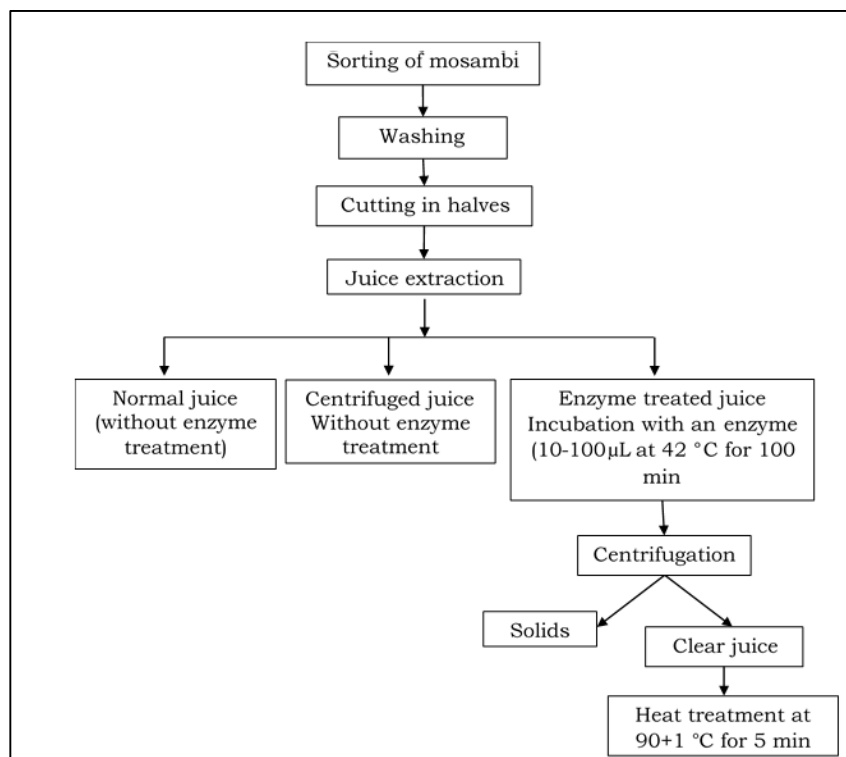
Pectin is a class of hetero-polysaccharide found primarily in the cell walls of the plants. The presence of negatively charged rhamnogalacturonans and neutral arabinogalactans imparts viscosity to the juices, but they also form a haze in a combination of different proteins. Pectin is a high molecular weight polysaccharide consisted of linear chains of  $\alpha$ -1,4-linked D-galacturonic acid residues present in the middle lamella of the plant cell wall. The presence of pectic substances is a major factor responsible for cloudiness in juices. The impact of the increase in viscosity due to these substances is in-efficiency of filtration during juice processing. Pectic enzymes are used to degrade such pectins. They have a considerable effect on increasing the juice yield and in the clarification of fruit juices. The hydrolyzation of pectins by pectinase results in a pectin-protein complex which further flocculates. Thus fruit juice of lower viscosity and turbidity is obtained [11].

Pectinolytic enzymes or pectinases are a heterogeneous group of related enzymes that hydrolyze the pectic substances, present mostly in plants. Pectinolytic enzymes are widely distributed in higher plants and microorganisms. They are of prime importance for plants as they help in cell wall extension and softening of some plant tissues during maturation and storage. It has been reported that microbial pectinases account for 25% of the global food enzymes sales. Almost all the commercial preparations of pectinases are produced from fungal sources. *Aspergillus niger* is the most commonly used fungal species for the industrial production of pectinolytic enzymes. The pectinolytic enzymes may be divided into three broader groups as follows (I) Protopectinases: degrade the insoluble protopectin and give rise to highly polymerized soluble pectin. (II) Esterases: catalyze the de-esterification of pectin by the removal of methoxy esters. (III) Depolymerases: catalyze the hydrolytic cleavage of the  $\alpha$ -(1-4)-glycosidic bonds in the D-galacturonic acid moieties of the pectic substances [12].

## 2. Materials and Methods

### 2.1 Raw materials and chemicals

Raw material such as mosambi was purchased from a local market (Pulivendula, India). All chemicals used in the research were of analytical grade and purchased from HiMedia Laboratories Pvt. Ltd. (Mumbai, India). Pectinase from *Aspergillus niger* with activity 10000 ajdu was used for the enzymatic treatment of mosambi juice.



## 2.2 Enzymatic Treatment

For each experiment, 200 ml of juice was subjected to different enzyme concentrations as cited in the table. Enzyme treatment conditions are time 100 minutes and temperature 42 °C.

**Table 3:** Enzyme treatment for mosambi juice

S. No.	Sample (200ml)	Yield(ml)
1	Control	200
2	Centrifuged juice	180
3	Enzyme treated juice S <sub>1</sub> (5% Enzyme)	175
4	Enzyme treated juice S <sub>2</sub> (7.5% Enzyme)	175
5	Enzyme treated juice S <sub>3</sub> (10% Enzyme)	180
6	Enzyme treated juice S <sub>4</sub> (12.5% Enzyme)	185

## 3. Results and Discussion

### 3.1 Enzyme treatment for Mosambi juice

Fresh juices were treated with different enzyme concentrations and analysed so as to identify selected enzyme treated samples.

**Table 4:** Proximate analysis of fresh, centrifuged and selected enzyme treated juices

S. No.	Sample (200ml)	Yield (ml)	Turbidity (NTU)	Transmittance (%)
1	Control	200	145.3	30.3
2	Centrifuged juice	180	119.2	916.8
3	Enzyme treated juice S <sub>1</sub>	175	152.1	3233.6
4	Enzyme treated juice S <sub>2</sub>	175	124.6	3568.9
5	Enzyme treated juice S <sub>3</sub>	180	136.6	3407.7
6	Enzyme treated juice S <sub>4</sub>	185	147.9	3456.8

### 3.2 Fresh juice sample analysis

Juice was extracted from fresh mosambi fruits and proximate analysis was done to compare with enzyme treated mosambi juices.

**Table 5:** Proximate analysis of fresh, centrifuged and selected enzyme treated juices

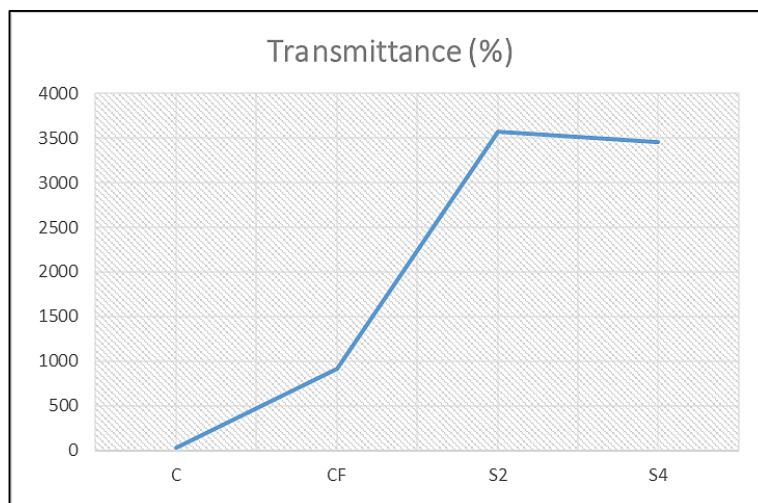
S. No.	Parameter	Value
1	Yield	200ml
2	Turbidity	145.3 (NTU)
3	PH	3.91
4	TSS	7.1 <sup>0</sup> brix
5	Reducing Sugars	3.50%
6	Vitamin C	75.14
7	Carbohydrates	0.703
8	Protein	2.36
9	Titrateable Acidity	2.36
10	Transmittance	30.3%

**Table 6:** Proximate analysis of fresh, centrifuged and selected enzyme treated juices

Parameter	Normal juice	Centrifuged juice	Enzyme treated juice(S <sub>2</sub> )	Enzyme treated juice (S <sub>4</sub> )
Transmittance (%)	30.3	916.8	3568.9	3456.8
Turbidity (NTU)	144.9	120.3	125.6	133.6
pH	3.91	4.05	3.85	3.80
Titrateable acidity	0.8	0.78	0.768	0.757
Reducing Sugars (%)	3.50	3.33	3.39	3.46
Carbohydrates(µg/100g)	0.703	0.557	0.545	0.532
Vitamin-C(mg/100 g)	75.14	73.73	73.13	73.03
Protein (µg/100 g)	2.36	0.65	0.85	0.97
TSS (° Brix)	7.1	7.2	7.35	7.5

### 3.3 Transmittance

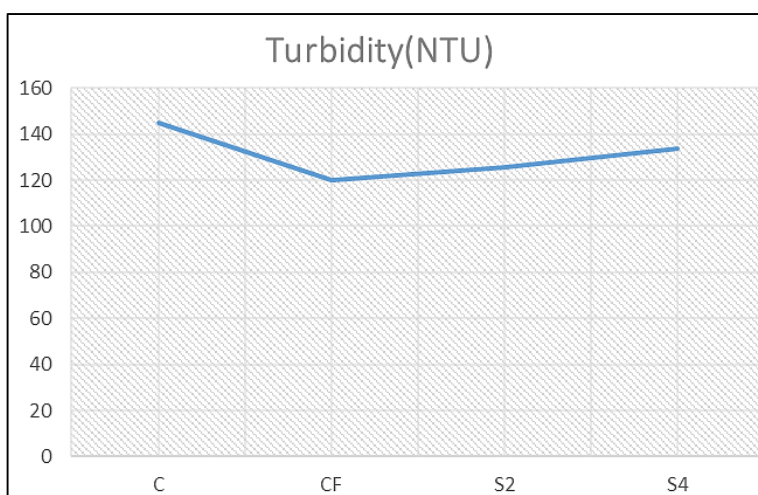
A significant increase in transmittance was observed in enzyme-treated samples when compared to untreated pectolytic enzymes breakdown the pectin molecules, which facilitate the formation of pectin- protein flocs leaving clear supernatant and significantly removing the colloid aspect of the juices.



**Fig 3.1:** Effect of enzymatic treatment on Transmittance

### 3.4 Turbidity

The mean values of the Turbidity for the Control sample, Centrifuged juice, and Enzyme treated juices S2 and S4 are 144.9, 120.3, 125.6, and 133.6 respectively.

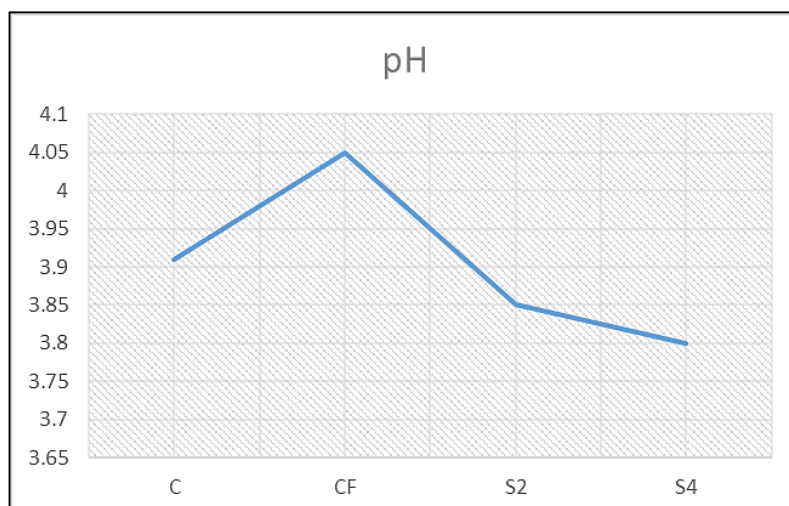


**Fig 3.2:** Effect of enzymatic treatment on Turbidity

### 3.5 pH

The pH values of the juices produced without enzyme treatment are significantly higher as compared to the juices with enzyme treatment. The enzyme-treated juice is more

acidic, which might be due to the formation of the galacturonic acid by the enzymatic breakdown of pectin. The increase in the pH value of centrifuged juice might be due to the increase in speed and time of the centrifugation.



**Fig 3.3:** Effect of enzymatic treatment on pH

### 3.6 Titratable acidity

The appreciable decrease in Titratable acidity in enzyme-treated samples compared to untreated samples was observed.

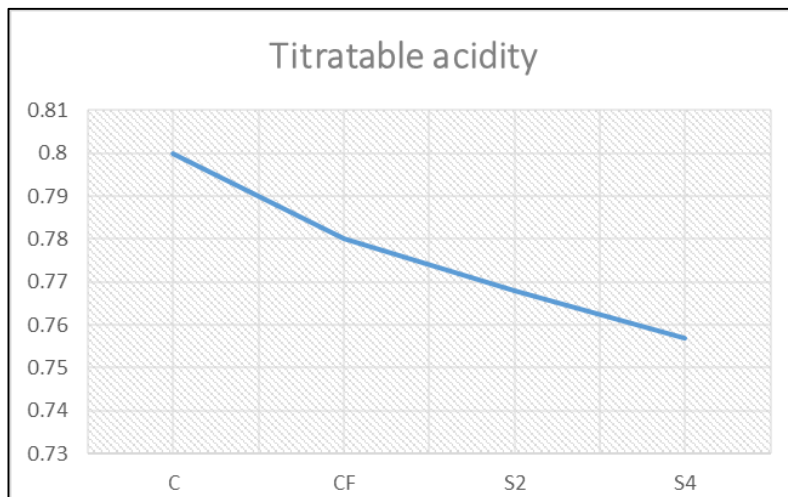


Fig 3.4: Effect of enzymatic treatment on Titratable acidity

### 3.7 Reducing sugars

A significant increase in reducing sugars in enzyme-treated samples was observed than untreated samples. This is due to

the enzyme-treated sample to increase the natural sugars in the juices by partly degrading the existing sucrose.

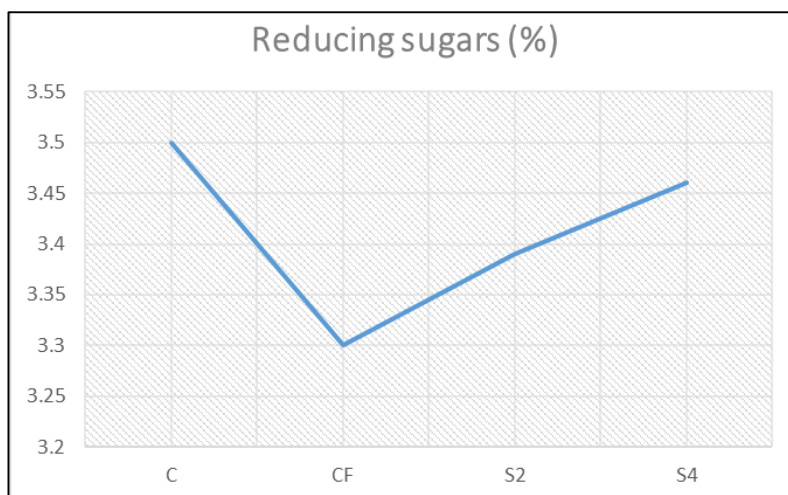


Fig 3.5: Effect of enzymatic treatment on Reducing sugars

### 3.8 Total Carbohydrates

The insignificant decrease in total carbohydrates in enzyme-treated samples was observed when compared to untreated samples.

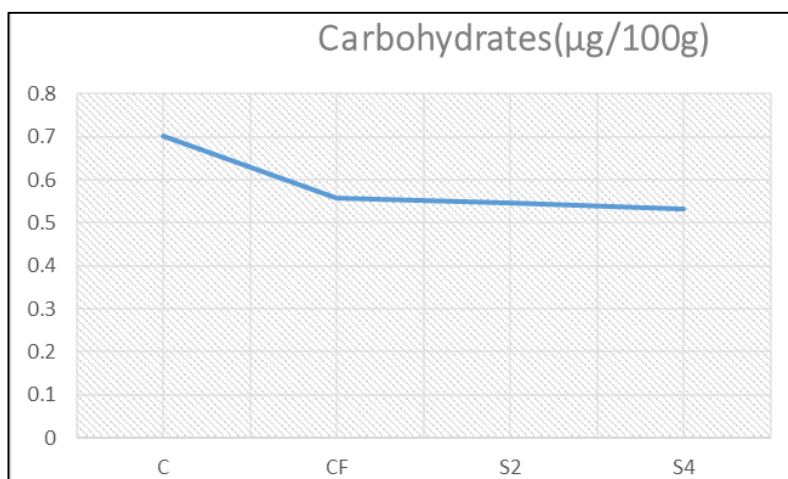
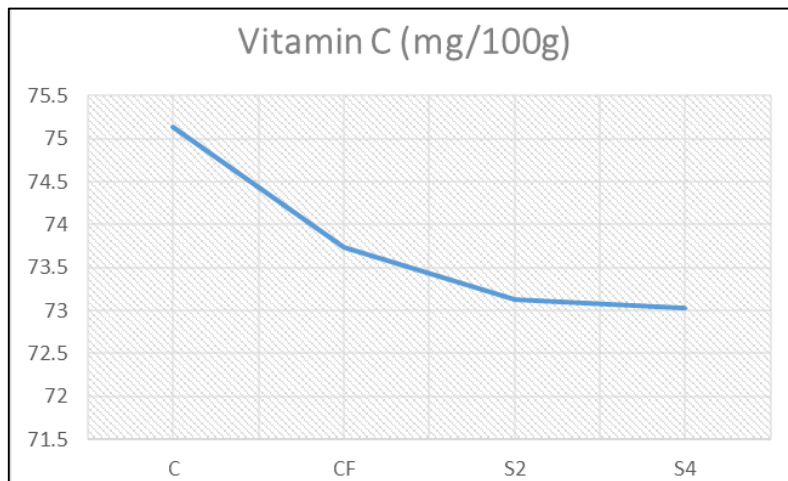


Fig 3.6: Effect of enzymatic treatment on Total carbohydrates

### 3.9 Vitamin-C

A significant decrease in Vitamin-C content was observed in enzyme-treated samples than untreated samples. The amount

of ascorbic acid decreases in enzyme-treated juice is due to heat treatment in processing steps.

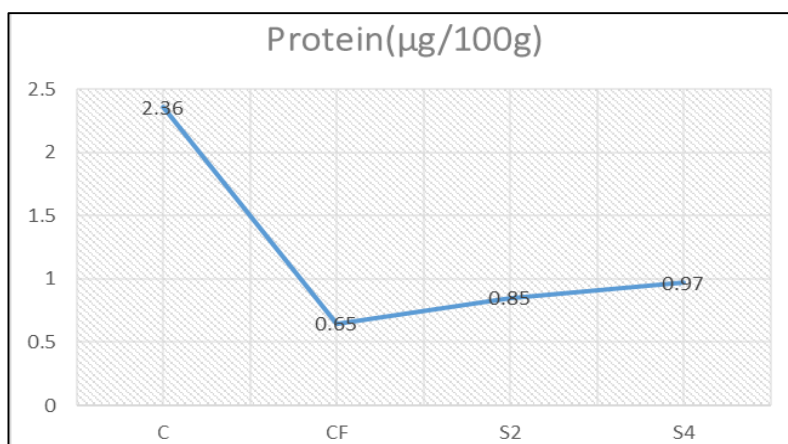


**Fig 3.7:** Effect of enzymatic treatment on Vitamin-C

### 3.10 Protein

A significant decrease in protein content was observed in enzyme-treated samples. Upon enzyme treatment pectolytic

enzyme breakdown the pectin molecules, which facilitate the formation of pectin-protein flocs.

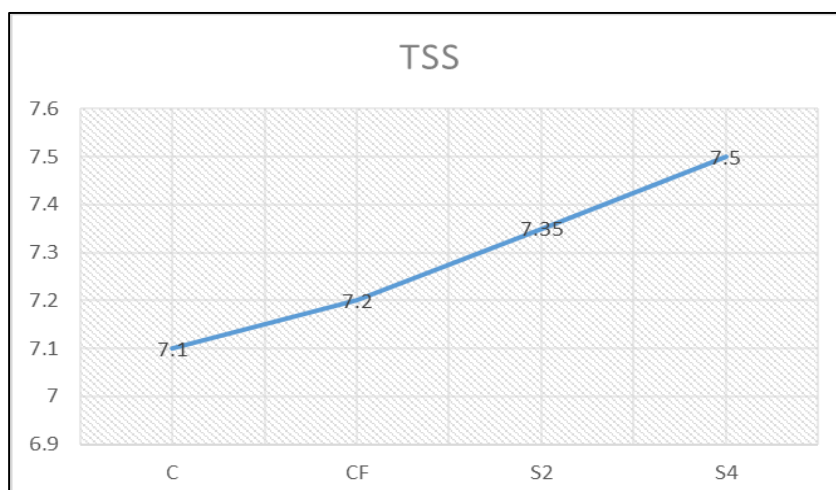


**Fig 3.8:** Effect of enzymatic treatment on Protein

### 3.11 Total Soluble Solids

A significant increase in TSS content was observed in enzyme-treated samples than untreated samples. This

significant rise in TSS content is due to the conversion of insoluble pectin by pectinolytic enzymes in enzyme-treated juice.



**Fig 3.9:** Effect of enzymatic treatment on TSS

#### 4. Conclusion

The effect of different enzyme treatments on Mosambi juice gave significant changes on physical parameters. The results showed that there is a significant reduction in Vitamin-C, Protein, and Carbohydrate in enzyme treated juice as compared to untreated juice. The enzyme treatment also significantly reduced the turbidity and sugar content. Mosambi juice treated with 7.5% pectinase concentration had 3568.9% transmittance and 125.6 NTU turbidity, this treatment can be used for mosambi juice production which will have sparkling nature.

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