

Effects of Temperature and Enzyme Concentration on Quality of Pineapple and Pawpaw Blended Juice

Ndidi F. Amulu, Calistus N. Ude, Patrick E. Amulu, Nneka N. Uchegbu

Abstract—The effects of temperature and enzyme concentration on the quality of mixed pineapple and pawpaw blended fruits juice were studied. Extracts of the two fruit juices were separately treated at 70°C for 15 min each so as to inactivate micro-organisms. They were analyzed and blended in different proportions of 70% pawpaw and 30% pineapple, 60% pawpaw and 40% pineapple, 50% pineapple and 50% pawpaw, 40% pawpaw and 60% pineapple. The characterization of the fresh pawpaw and pineapple juice before blending showed that the juices have good quality. The high water content of the product may have affected the viscosity, vitamin C content and total soluble solid of the blended juice to be low. The effects of the process parameters on the quality showed that better quality of the blended juice can be obtained within the optimum temperature range of (50-70 °C) and enzyme concentration range (0.12-0.18 w/v). The ratio of mix 60% pineapple juice: 40% pawpaw juice has better quality. This showed that pawpaw and pineapple juices can blend effectively to produce a quality juice.

Keywords—Clarification, pawpaw, pineapple, viscosity, vitamin C.

I. INTRODUCTION

FRUIT juices are naturally colloidal and with a varying degree of viscosity, especially due to the presence of polysaccharides (pectin, cellulose, hemicelluloses, lignin and starch), proteins, tannins and metals [1]. This is a determinant factor for consumers in quality assessment, and thus, the fruit juice industry is embarking on various methods with intention to optimize the appearance of juice. Pectin also impedes the use of filtration to remove suspended pulp particles as an alternative method [2].

The depectinization of fruit juices using pectinases and amylases has been presented as an efficient alternative to reduce turbidity, in many studies [1], [3]. Pectinases degrade pectin and thus reduce viscosity and cluster formation in juice, and hence, facilitates separation through centrifugation or filtration giving the product higher clarification value, concentrated flavour and colour [4], [5]. These pectinolytic enzymes act in different forms on their substrates

Pectinolytic enzymes, or pectinases, act in different forms

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on their substrate, the pectin. The commercial pectinase preparations normally are not customized to pectin but contain one or more types of microbial pectinolytic enzymes, as well as cellulases, hemicellulases, proteases and amylases [6], [7]. However, the successful use of pectinolytic enzymes in fruit juices clarification depends on the involved substrate, which may not only present different pectin concentrations, but also cellulose, hemicelluloses, lignin and other components [1], [8].

Mixed fruit juice, pineapple and pawpaw juices are enjoyed worldwide due to their pleasant unique aroma and flavour. Raw mixed fruit juice obtained after pressing the fruits is turbid, brown in colour and very viscous [8]. The resulting expelled juice may be further treated enzymatically and centrifuged to enhance clarification by removing the starch and pectin, which would hold fine particulate in suspension. Juice clarification prior to fermentation is an important aspect in producing high quality table juice, and as such, juice clarification helps to produce fruit and delicate juice, production of lesser higher alcohol with better varietal characteristics and produce juice with less harsh and rough characteristics, in addition it gives off less odour particularly hydrogen sulphide.

Pineapple or ananas season lasts for about four months in the tropics when fresh fruits are available in the markets at their best. Pineapples have exceptional juiciness and a vibrant tropical flavour that balances the tastes of sweet and tart. It ranks the third in the world as the most important fruit produce after bananas and mangoes [9].

Pawpaw (*Carica papaya*) is grown mostly for fresh consumption or for production of proteolytic enzyme papain from the fruit latex [10]. *C. papaya* plants contain mainly two natural compounds (annonaceous, acetogenins) in leaf bark and twig tissues that have both highly anti-hyperplastic and pesticidal properties [11], [12]. The fruit, as well as all other parts of the plant, contain a milky juice in which an active enzyme - papain is present which has ethnomedical value as a remedy in dyspepsia, and also an industrial value and has been utilized for the clarification of beer. The juice also has culinary value and is used on meat to make it tender, [13]. The unripe fruit is used as a remedy for ulcer and impotence. The objective of this study was to investigate the effects of temperature and enzyme concentration on the quality of pineapple and pawpaw blended fruits juice.

II. MATERIAL AND METHODS

A. Material

The fruits (pawpaw and pineapple) were purchased from

fresh fruits market at Ogbete Main Market, Enugu State, Nigeria. The commercial enzyme was obtained from Conraw Chemical Company in Enugu State, Nigeria. Other chemicals used were of analytical grade purchased from Home Science chemical Reagent CO LTD Ogui Road, Enugu State, Nigeria.

B. Methods

1) Juice Extraction

The pawpaw-pineapple juice was prepared according to the method of [14], with little modifications. The pawpaw were washed with tap water and then peeled to remove the skin. It was then cut into two halves and the seeds of the fruit removed. The fruit was reduced using a knife and then blended with a blender. After blending of the fruit it was then filtered with muslin cloth to get the fresh juice and citric acid was added. Then the pineapple was then washed with tap water, peeled and then cut into pieces; the juice was extracted using juice blender and then sieved with muslin cloth. The two fruits juices were pasteurized separately at 70 °C for 15 min so as to inactivate micro-organisms. It was then cooled in iced water to inactivate endogenous enzyme. At the end, they were blended with the addition of distilled water at 1:1 (v/w) and filtered on cheese cloth. Finally, the juice obtained was mixed at different proportions which include 70% pawpaw and 30% pineapple, 60% pawpaw and 40% pineapple, 50% pineapple and 50% pawpaw, 40% pawpaw and 60% pineapple. These proportions were used for analysis and then stored at -20°C before use.

2) Enzymatic Treatment

For each experiment, 100 ml of juice was subjected to enzyme treatment at the desired temperature of 50 °C at 120 min, 60 °C at 100 min, 70 °C at 80 min, 80 °C at 60 min and 90 °C at 40 min using a water bath. The pH of the juice was adjusted with a pH meter using citric acid. At the end of the enzymatic hydrolysis, the enzyme was inactivated by heating the suspension at 90 °C for 5 min in a water bath. The treated juice was centrifuged at 680xg, 30 min (GL – 20.B; ShangaiiAnke Co. Ltd) followed by the juice analysis.

3) Physicochemical Analysis

a) Determination of Clarity

The UV spectroscopy absorbance value (Abs) at 260 nm, of the juice using water as blank was assumed a measure of clarification value. The clarification value was thus expressed in absorbance value (Abs).

b) Determination of Viscosity

Relative viscosity was determined in a viscometer at 27 °C with distilled water as control. It was expressed in milipascal second (mpas).

c) Determination of Total Soluble Solid

The total soluble solid content was determined using a handheld refractometer with a scale of 0-450 Brix [15].

d) Determination of Ascorbic Content

The ascorbic content was determined by iodine titration

method AOAC, [16]. Ten millilitres of juice sample was taken in 250 ml conical flask and then 10 ml of distilled water and 0.5 ml of starch indicator was added. The sample was titrated with 0.1 mol iodine solution. The end point of titration was identified as the first permanent trace of a dark blue black colour due to starch-iodine complex. The amount of ascorbic acid was expressed in mg/100ml of juice.

e) pH Value

The pH values of pawpaw and pineapple samples were determined using pH meter. The pH meter was standardized using 4 and 5 buffer solution at ambient temperature.

III. RESULTS AND DISCUSSION

A. Characterization of the Fresh Pawpaw and Pineapple Juice before Blending

The summary of the characterization of the juice is shown in Table I, which shows that the pH value of the fresh juice before blending was within an acceptable range. The viscosity of the fresh fruit juice was low. The vitamin C content and total soluble solid of the juices were low and this may be attributed to the high water content of the pawpaw and pineapple.

TABLE I
SUMMARY OF CHARACTERIZATION OF THE FRESH FRUITS JUICE BEFORE BLENDING

Properties	Pawpaw	Pineapple
pH	6.20	5.60
Vitamin C content (mg/100ml)	0.690	0.89
Viscosity (mPas)	15.20	45.32
Total soluble solid (Abs)	14.30	15.33

B. Effects of Process Parameters on the Quality of Blended Pawpaw and Pineapple Fresh Juice

1) Effect of Temperature and Enzymes Concentration on Clarification of the Blended Fresh Juice

The effects of temperature and enzyme concentration on clarification of the blended fresh juice are shown in Fig. 1 and Fig. 2, respectively. It could be observed from the figures that the clarification rate fluctuates as the incubation temperature and enzymes concentration increases and later increased continuously at higher temperature and enzymes concentration. In this work the effect of temperature from (50-90 °C) and enzymes concentration (0.06 -0.3w/v) on the blended fresh juice clarity was investigated. It was found that the optimal incubation temperature and enzymes concentration were 60°C and 0.12w/v for different blending ratios and beyond it the clarity decreased (as shown in Figs. 1 and 2). Between the temperature and enzymes concentration ranges of (60-70 °C) and (0.12-0.18 w/v) the clarity decreased and increased beyond it. This may be attributed to the increase in the kinetic energies of the molecules which enhances the dissolution of the soluble solid thus increased the clarity. The inoculation of the blends with enzymes causes the decrease in clarity within the temperature of range of (60-70 °C) due to the mixing and dispersion of the enzymes and the coagulation of

the molecules due to the enzymes activities, which later dispersed as the temperature and enzymes concentration was further increased.

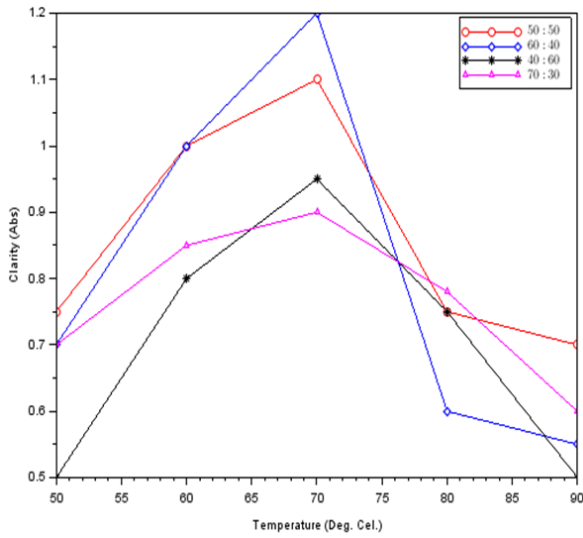


Fig. 1 Effect of temperature on clarity

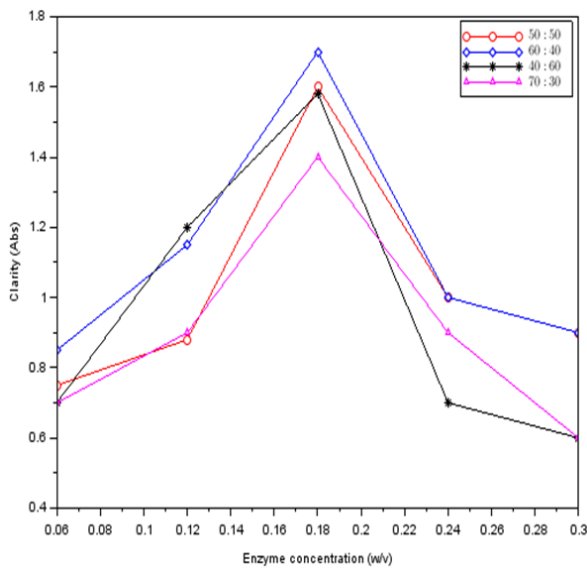


Fig. 2 Effect of enzymes concentration on clarity

2) Effect of Temperature and Enzymes Concentration on Viscosity of the Blended Fresh Juice

The effects of temperature and enzyme concentration on viscosity of the blended fresh juice are shown in Fig. 3 and Fig. 4, respectively. From the graphs it could be observed that the viscosity of the blended fresh fruit juice decreased rapidly as the incubation temperature and enzymes concentration increased to a certain range (50-70°C) and (0.12-0.18w/v). Beyond these ranges the viscosity of the blended fresh fruit juice increased as the temperature and enzymes concentration increased. This might be explained by the enzyme treatment of pectin leads to reduction in its water holding capacity and the

free water released to system has an effect on the viscosity. The increase in temperature during the enzyme treatment contributed to pectin cells destruction, and the enzyme activity was reduced when the incubation temperature was over 70 °C; therefore, the enzyme action on pectin cell was also reduced and this contributed to the increase in viscosity.

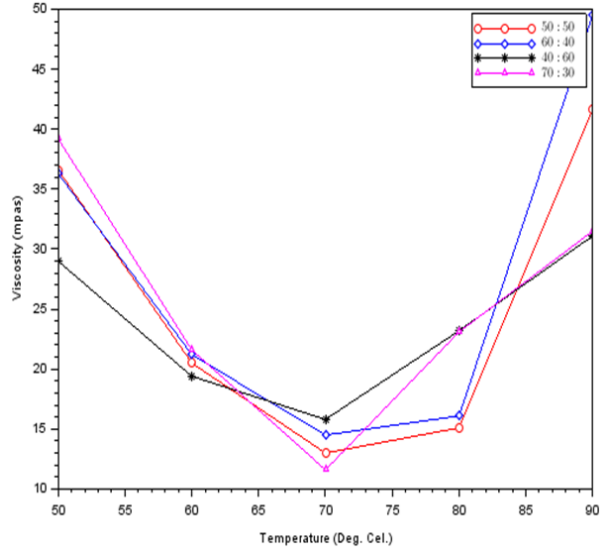


Fig. 3 Effect of temperature on viscosity

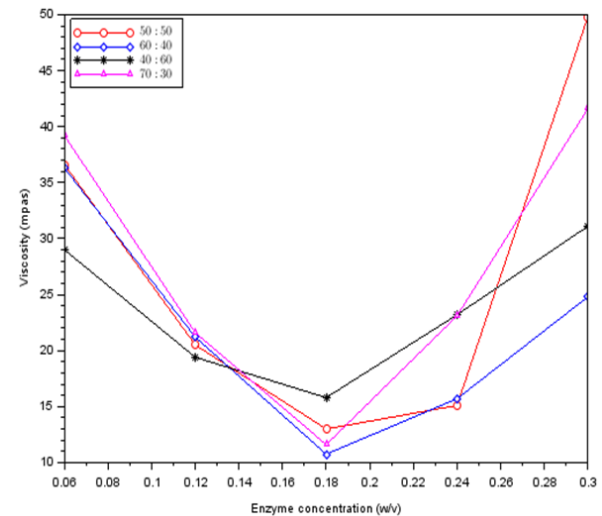


Fig. 4 Effect of enzymes concentration on viscosity

3) Effect of Temperature and Enzymes Concentration on Vitamin C Content of the Blended Fresh Juice

Figs. 5 and 6 depict the effects of temperature and enzyme concentration on the vitamin C content of the blended juice respectively. From the figures, it could be seen that the vitamin C content of the blended fresh fruits juice increased rapidly as the temperature and the enzymes concentration increased to 60 °C and 0.12 w/v, beyond this range the vitamin C content decreased rapidly. This may be attributed to the

pectinase hydrolysis on the pawpaw and pineapple pomace and vitamin C was released into the juice as related to the enzymes concentration, and beyond this optimal value of enzyme concentration (0.12 w/v), excess water will be introduced to the juice due to enzymes hydrolysis; thus, decreasing the vitamin C content of the fresh fruit juice. The effect of temperature may be attributed to the dehydration effect caused by increasing the temperature to a certain point 60°C, beyond which, the enzymes activities and the nutritional values of the blended juice were denatured, which enhanced the decrease in the vitamin C content of the juice.

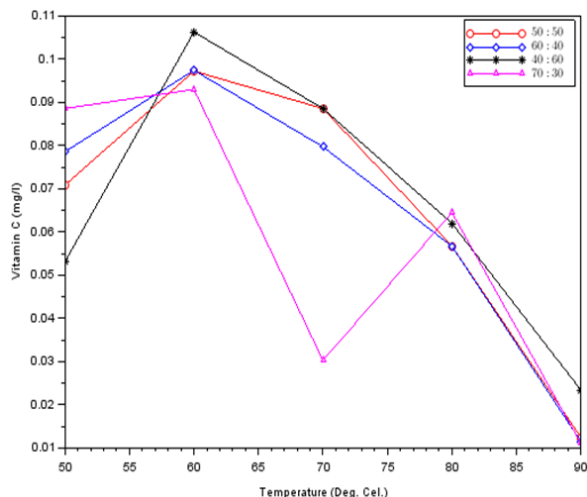


Fig. 5 Effect of temperature on vitamin C

temperature and enzymes concentration increased to the values of (0.18 w/v) for enzymes concentration and 60 °C for temperature. While, the total soluble solid decreased slowly when the incubation temperature was increased from 50-60 °C and a further increase in temperature over 60 °C showed a rapid increase of total soluble solid. It can be explained on the basis that the optimum temperature of the enzyme action favoured the enzyme activity resulting in low total soluble solid. Also, Fig. 8 showed that the total soluble solid decreased as the enzyme concentration increased. This suggested that the enzyme concentration was degrading the pectin content of juice; and thus, the juice total soluble solid was decreased.

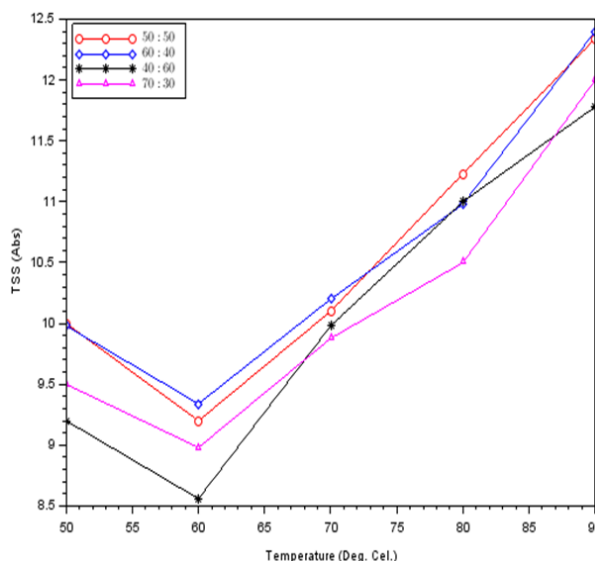


Fig. 7 Effect of temperature on TSS (Brix)

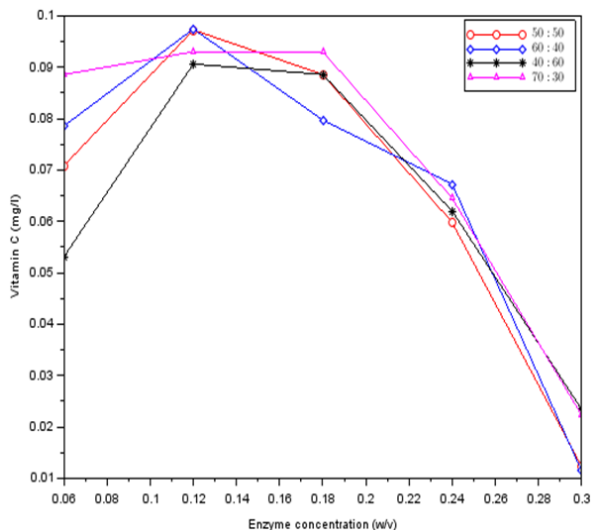


Fig. 6 Effect of enzymes concentration on vitamin C

4) Effect of Temperature and Enzymes Concentration on Total Soluble Solid of the Blended Fresh Fruit Juice

The effects of temperature and enzyme concentration on total soluble solid of the blended fresh fruit juice are shown in Figs. 7 and 8, respectively. The total soluble solid of the blended fresh fruit juice decreased gradually as the incubation

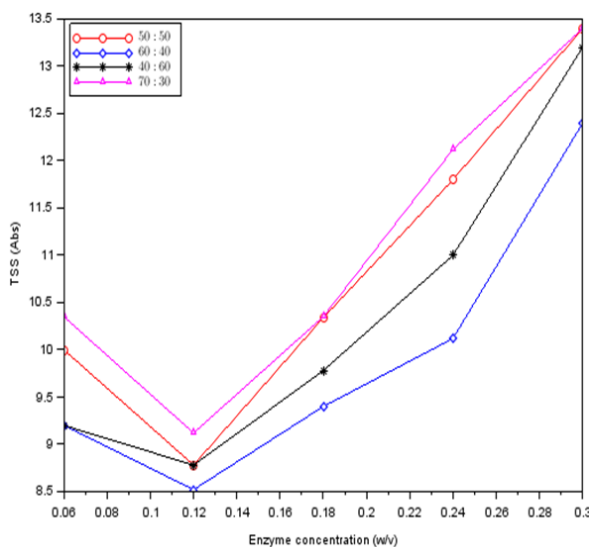


Fig. 8 Effect of enzyme concentration on TSS (Brix)

IV. CONCLUSION

The effect of temperature and enzyme concentration on the clarification, viscosity, vitamin C content and total soluble solid was studied. The characterization of the fresh pawpaw and pineapple juice before blending showed that the pH value of the individual fresh juice was within an acceptable range. The viscosity of the blended fresh fruit juice was low. The vitamin C content and total soluble solid of the blended juice were also low, which may be attributed to high water content of the pawpaw and pineapple. Thus, pawpaw and pineapple juices mix 60:40 ratio blended well to produce a quality juice with the optimum process parameters for the quality being within the temperature range of (50-70 °C) and enzyme concentration range (0.12-0.18w/v).

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