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Extraction of Apple Juice using Pectinase Enzyme

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Abstract

The aim of this study was to extract the apple juice from fresh apple using pectinase enzyme and distilled water at different temperatures and to check their sugar quantity.

Apples were chopped in small pieces. Eight beakers having 50g of chopped apples in each were taken. Pectinase enzyme solution was prepared with help of sorbitol. Added 10 ml of diluted enzyme solution in first 4 beakers and 10 ml of distilled water to another 4 beakers. After these preparations, beakers were kept at 4 degree, 30 degree, 40 degree and 50 degree, in the incubators. At each degree two beakers were kept i.e. one with water and apple, another containing diluted enzyme and apple. Samples were taken after 40 minutes.

It was observed that the beakers kept at 40 degree at pH – 5.0 having pectinase solution had highest quantity of apple juice and rich in sugar quantity as compare to other beakers. It was due to Pectinase Enzyme which catalyzed the breakdown of Pectin, a component of the cell wall of apple.

Keywords: Apple Juice, Pectinase Enzyme, Incubator, Temperature.

Introduction

Delicious and crunchy apple fruit is one of the most popular fruits, favorite of health conscious, fitness lovers who believe in the concept “health is wealth.” This wonderful fruit is packed with rich phyto-nutrients that in the true senses indispensable for optimal health. The antioxidants in apple have much health promoting and disease prevention properties; thus truly justifying the adage, “an apple a day keeps the doctor away. “Scientific name of apple: Malus domest.”

Apple fruit contains good quantities of vitamin-C and beta-carotene. Vitamin C is a powerful natural antioxidant. Consumption of foods rich in vitamin C helps the body to develop resistance against infectious agents and scavenges harmful, pro-inflammatory free radicals from the body. Apple also contains a small amount of minerals like potassium, phosphorus, and calcium. Potassium is an important component of cell and body fluids helps controlling heart rate and blood pressure; thus, counters the bad influences of sodium. Sliced apple turns brown (enzymatic brownish discoloration) on exposure to air due to conversion in iron form from i.e. ferrous oxide to ferric oxide. Cloudy as well as clear apple juice is a healthy alternative drink with dinner. Apple juice is a great thirst quencher! No matter where you are, what the occasion is or what time it is, apple juice is perfect for all times. Apple juice is a type of fruit juice, which is made by squashing and squeezing apples. Fresh apple juice is a very good source for vitamin A and C and other substances as well. Depending up on what you like, you can either make the apple juice at home or buy packaged juices from the market. Apple juice with high content of antioxidant looks turbid, so this is what you should look out for if you want to buy one with higher content of antioxidant. However, it is suggested that you buy the sparkling variety, which has 100% apple juice for best results. There are various properties of apple juice and some of them are given here:

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Sweet in taste, Health Vitalizer,Breaks down calculi, Improves intelligence, Cleans the digestive tract, Stops excessive bleeding, Regulates menstruation, Rich in Phosphates and vitamins, A rejuvenator and an aphrodisiac, Good for hair, skin, nails and eyes, Apple juice has anti-oxidant compounds, Apple fiber lowers blood cholesterol level and raises HDL

Apple juice is not only an excellent thirst reliever but also helps in overcoming many disturbances, which we may feel in our body. Other than being a great cleanser, taking apple juice regularly in diet helps in purifying blood, which in turn is helpful for the skin and the liver. After the apple juice is made, the liquid oxidizes very quickly, so it is recommended that you store it in the refrigerator for a short while. Apple juice can be taken individually or mixed with other juices to create a preferable flavor and taste. The vitamins which are found in apple juice include nicotinic acid, folic acid, riboflavin, vitamin C, vitamin A, carotene, B6, thiamine, biotin etc.

Enzymes are the workhorses of biochemistry. Enzymes are proteins that catalyze (speed up) specific chemical reactions—increasing reaction rates by factors of at least a million. Pectinase is an enzyme that catalyzes the breakdown of pectin, a component of the cell wall in fruits such as apples and oranges. Pectinase is also used in enzymatic hydrolysis of carrot for increased juice recovery (1). Enzymes can be purified from micro-organisms too (2). Pectinase is also used for clarifying the extracted juice.

Therefore pectinase enzymes are commonly used in processes involving the degradation of plant materials, such as speeding up the extraction of fruit juice from fruit, including apples and sapota. Some enzymes are multi-purpose biocatalysts (3). Some enzymes are used for enhancing oil extraction from seeds (4). One of the most studied and widely used commercial pectinase is polygalacturonase. It is useful because pectin is the jelly-like matrix which helps cement plant cells together and in which other cell wall components, such as cellulose fibrils are embedded. Pectinase has its applications in commercial sector (5).

Pectinases have also been used in wine production since the 1960s. The function of Pectinase in brewing is twofold, first it helps breakdown the plant (typically fruit) material, secondly the presence of pectin in wine causes a haze or slight cloudiness, Pectinase is used to break this down and so clear the wine. The kiwi fruit has also been given enzymatic treatment for high juice yield and clarity (6). Apple kiwi concentrate can be prepared by following set protocol (7).

If pectinase is boiled it is denatured (unfolded) making it harder to connect with the pectin at the active site.

In this project, we wanted to see the effect of pectinase on the extraction of apple juice.

Materials and Methods

Source of Material:-

1. Apple (fresh apples from the market)

2. Pectinase Enzyme (commercially available) (Hi-media)

Other materials: Sharp Knife, Weighing Balance, Sorbitol, Paper Filter, Water Bath, Disposable Plastic Spoons, 8 Funnels, 8 Beakers, 8 Measuring Cylinders, Distilled Water

Procedure

- The apples were chopped into cubes of 5mm sizes. The pieces were kept very small because surface area helps the enzyme to break down the pectin, releasing more juice.

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- Weighed equal amounts of chopped apples (about 25g) into each beaker. Using balance (Figure-1).
- Prepared the pectinase enzyme using sorbitol, took 0.5g of pectinase powder in a beaker, added 10ml of sorbitol in it and heated the solution. Adjusted the pH (5) by adding dilute Nacl.
- Added 4ml each of diluted enzyme to first four beakers and added 4ml each of distilled water to the other four beakers, all the beakers were having 25g of chopped apples. Labeled the beakers.

Figure-1

Stirred the chopped apple pieces in each beaker with a plastic spoon. Covered the beakers with plastic wrap.

- Both the beakers were kept (one with enzyme and other one with distilled water) at 4 °C water bath for 45 minutes.
- Repeated the above steps by keeping other beakers at different temperatures i.e. 30 °C, 40°C, 50 °C respectively (Figure-2).
- Removed the beakers from the water bath and used a plastic spoon to squeeze the apple pieces in each beaker.
- Filtered the apple juice into fresh beakers. Measured the juice quantity of each beaker in a graduate cylinder and prepared a table.
- Checked the sugar level of each beaker containing apple juice and recorded the data into table.

Figure-2

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Results

S.No.	Temperatures (°C)	Amount Of Juice (ml) (With Pectinase)	Amount Of Juice (ml) (With Distilled Water)
1	20	19	16
2	30	30	19
3	40	32	29
4	50	16	20

Table-1: Samples at pH 4

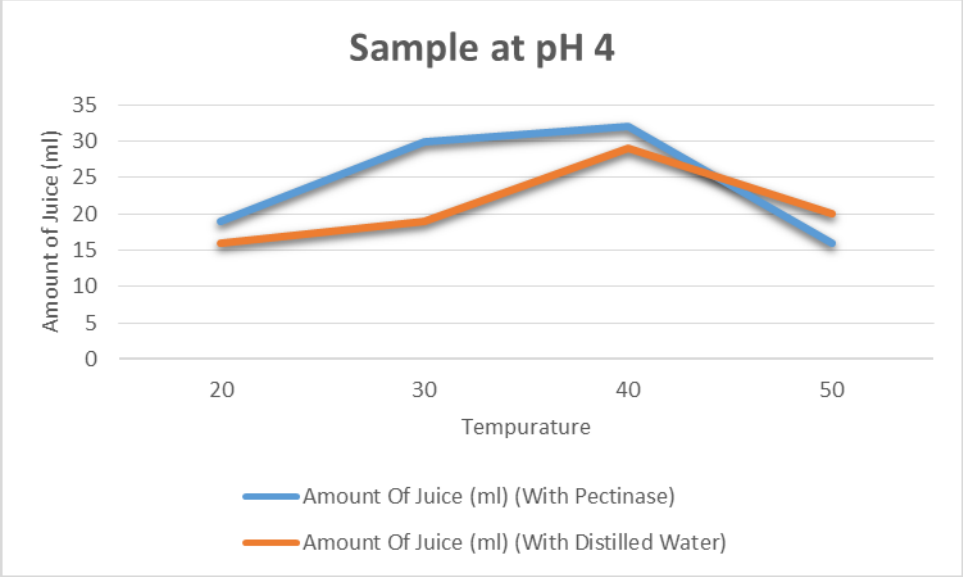

Figure-3: Comparision of amount of apple juice with Pectinase Enzyme and Distilled water at pH 4.

S.No.	Temperatures (°C)	Amount Of Juice (ml) (With Pectinase)	Amount Of Juice (ml) (With Distilled Water)
1	20	32	16
2	30	36	25
3	40	56	36
4	50	36	18

Table-2: Samples at pH 5

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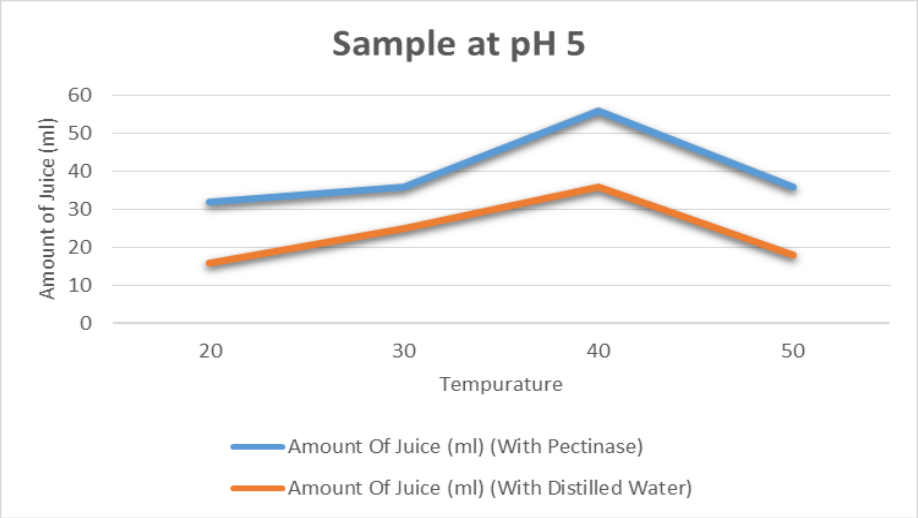

Figure-4: Comparision of amount of apple juice with Pectinase Enzyme and Distilled water at pH 5.

S.No.	Temperatures (^{o}C)	Amount Of Juice (ml) (With Pectinase)	Amount Of Juice (ml) (With Distilled Water)
1	20	18	12
2	30	26	20
3	40	29	25
4	50	16	16

Table-3: Samples at pH 6

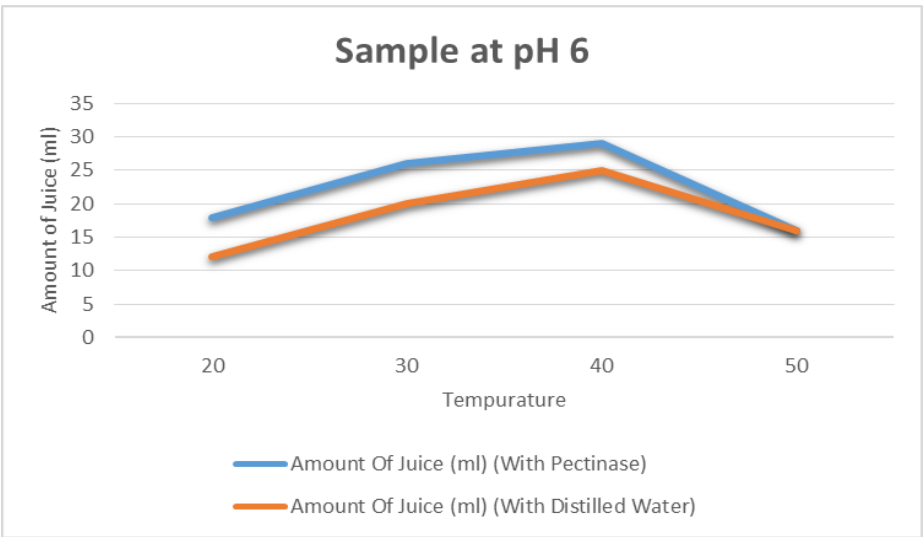

Figure-5: Comparision of amount of apple juice with Pectinase Enzyme and Distilled water at pH 6.

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Discussion

Pectinase is an enzyme that catalyzes the breakdown of pectin, a component of the cell wall in fruits such as apples and oranges. When the samples were kept at temperature 20, 30, 40, 50°C, at pH 4 as shown in Table-1 and Figure-3 the extraction of apple juice was more in the samples with Pectinase as compared to the samples with the distilled water. Same pattern was seen at pH 5, as shown in Table-2 and Figure-4 as well as at pH 6, as shown in Table-3 and Figure-5. Although, the maximum amount of apple juice was extracted at 40°C, pH 5. It was much more as compared to the samples with distilled water.

Conclusion

In the present study, the beaker containing chopped apple with pectinase solution at 40 °C showed the maximum formation of apple juice as compare to other beakers. This was due to pectinase enzyme that catalyzed the breakdown of pectin, a component of the cell wall of fruit like apple. By enzymatic ally breakdown of the cell wall pectinase releases the juice. The optimum temperature and pH at which they were most active were at 40 °C and pH 5.0.

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