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# Formulation and Sterilization of a Traditional Beverage from the Fruit of Borassus flabellifer

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***Abstract:*** ***In India, summers are very hot all over the country and causes the mercury levels raising every day. On the other hand, water and electrolyte levels in our bodies are falling every hour. It is very important to take proper diets in summers, to keep the body cool and to avoid diseases like dehydration, vomiting, diarrhea etc., Therefore the electrolytic balance of the body during summer season is necessary to avoid a lot of health problems and tiredness. The foods to be included in our daily diet to beat the summers are curd, watermelon, tender coconut water, plenty of water etc., Besides these foods, Pathaneer is consumed in Tamilnadu during the summer.***

***Pathaneer is a sweet beverage extracted from palm trees. It is non-alcoholic, translucent, white, watery liquid in pure form. But it is prone to fermentation quickly if proper preservation is not given. Fermentation occurs due to the airborne yeast or bacteria which induces alcohol production and convert it as alcohol toddy. Thus thermal processing of pathaneer can extend its shelf life to some extent.***

***The basic purpose for the thermal processing of foods is to reduce or destroy microbial activity, reduce or destroy enzyme activity and to produce physical or chemical changes to make the food meet a certain quality standard and prolong its shelf life. Pathaneer has a unique taste, which is predominantly sweet with a hint of astringent flavour. In order to suppress the astringent flavour, dextrose is added at different levels and best product is chosen through sensory evaluation.***

***The best product among them is subjected to retort processing at 121°C. The characteristics of Pathaneer is determined by the $F_0$ value and the changes during its storage.***

## I. INTRODUCTION

*Borassus flabellifer***,** commonly known as doub palm, palmyra palm, tala palm, toddy palm or wine palm, is native to the Indian subcontinent and Southeast Asia, including Nepal, India, Bangladesh, Sri Lanka, Cambodia, Laos, Burma, Thailand, Vietnam, Malaysia, Indonesia and the Philippines. The different parts of the palm tree, such as fruit, seed, sprout, sap, leaves, trunk, crown etc., are used for various purposes.

The palm fruit has a black husk, and is borne in clusters. The top portion of the fruit must be cut off to reveal the sweet jelly seed sockets, translucent pale-white, with a milder flavor and no pit. The sap is obtained traditionally by tapping the top shoots and collecting the dripping juice in hanging earthen pots.

The juice so collected before morning is refreshing and light drink called Pathaneer. Pathaneer has a unique taste, which is predominantly sweet and a translucent, white, watery liquid in pure form. After fermentation, the juice becomes sour and exhibits astringent flavor.

Fermentation also contributes to the increase in alcoholic content of the juice. Toddy is the fermented pathaneer with an alcohol content of 4 to 5 %. Pathaneer is rich in carbohydrate and moisture content. It is a good source of minerals and vitamins. It is prone to fermentation quickly and becomes an alcoholic beverage.

This project involves the thermal processing of pathaneer to enhance its shelf life by delaying the fermentation process.Dextrose is the natural form of glucose and is assimilated easily.

Thus dextrose is added to pathaneer at different levels (S1, S2, S3) to enhance its taste. The sensory evaluation is conducted with 10 panel members to choose the best product among them. Nowadays Basil seeds are incorporated in various fruit juices and drinks. This is due to the presence of essential oils in it (Putievsky, 1983).

In my project, I have added the basil seeds to the final product and is thermally processed. The processed glass containers with the beverage is cooled to room temperature and stored. Incorporation of basil seeds may increase its nutritional content and can also improve its market value.

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## II. REVIEW OF LITERATURE

### A. Pathaneer

Pathaneer is the product of palm nectar. It can be allowed to ferment to produce alcoholic beverage called toddy. It is obtained from *Borassus flabellifer*, a robust tree and can reach a height of 30 metres (98 ft). The trunk is grey, robust and ringed with leaf scars; old leaves remain attached to the trunk for several years before falling cleanly. After pollination, these blooms develop into fleshy fruits 15–25 cm wide, each containing 1-3 seeds. The fruits are black to brown with sweet, fibrous pulp and each seed is enclosed within a woody endocarp. Young palmyra seedlings grow slowly, producing only a few leaves each year (establishment phase), but undetermined time, they grow rapidly, producing a substantial stem (*Bayton, Ross P, 2007).* A sugary sap called Pathaneer, can be obtained from the young inflorescence, either male or female. After fermentation, it is called toddy.

1) *Composition and Nutritive value:* Bayton, Ross P. has given that Pathaneer are rich in carbohydrate and moisture content. They provide plenty of minerals such as calcium, phosphorous and iron, along with fibres and proteins to the body. The fruit contains Vitamins A, B and C in the form of ascorbic acid. It is perfect for the figure-conscious as it contains zero fat.
2) *Health Benefits:* Pathaneer has many health benefits. The pulp is highly nutritious and the fibrous outer layer mitigates body heat. Application of Pathaneer on the body cures boils, rashes and dermatitis. Pathaneer can cure all known diseases from hair fall to obesity. It is good at treating a major disease that affects almost everyone during summers, Thirst and dehydration. Headaches, fatigue, increased blood pressure, decreased electrolyte etc can be caused by excessive sweating. So Pathaneer is an easy way to replenish the water and essential electrolytes in our body (Heinrich Zimmer, 1946).
3) *By-Products of Pathaneer:* Pathaneer is obtained from palm nectar. It can be allowed to ferment to produce alcoholic beverage called toddy (*kallu* in Tamil). Fermented toddy can be distilled to produce arrack called as *panamcharayam* in Tamil. The nectar can be further boiled and processed to produce palmgur known as *karuppatti/panavellam*, palm sugar (panamsini) and palm candy (panamkalkkandu).

### B. Dextrose

Santos J *et al.*, 1996 has defined that Dextrose (or D-Glucose) is a simple hexose mono-saccharide sugar. It is so called because it turns the plane of polarization to the right. It is derived from corn and is free from all other sugars and starches, proteins, alcohols and heavy metals. It is the natural form of Glucose. Dextrose is offered at a very high grade of purity. Its empirical formula is $C_6H_{12}O_6$. Mono-saccharides are sweet, water soluble and crystalline in nature. It is small, white crystal, with molecular weight of 180.2 and specific rotation range is +52.6 - 53.2°C. Dextrose is used as a source of energy to cultivate microorganisms and for fermentation studies. This hexose sugar has a beneficial effect of easy assimilation. Sugars with less than 2% moisture as defined in the Standard for Sugars (CODEX STAN 212-1999): sucrose, dextrose anhydrous, glucose, fructose, may be added to all products. In my project, dextrose is added in the product to improve its taste.

### C. Basil Seeds

Sweet basil (*Ocimum basilicum L.*) produces a mucilaginous fruit. The outer pericarp (or outer epidermis) of basil seeds quickly swells into a gelatinous mass when soaked in water (Azoma and Sakamoto, 2003). In many Asian countries, the mucilage and seeds of sweet basil are bottled as a popular drink. The sweet basil seeds are also sold as a diet food to make drinks because the mucilage tends to fill the stomach easily reducing the craving for food. Therefore, basil seed mucilage is of interest not only for its effects on seed germination but also as a human food as well ( Monica Ponder *et al.*, September 2012). In my project, I have incorporated basil seeds in the final product.

### D. Thermal Processing

The two main temperature categories employed in thermal processing are Pasteurization and Sterilization. The basic purpose for the thermal processing of foods is to reduce or destroy microbial activity, enzyme activity and to produce physical or chemical changes to make the food meet a certain quality standard (Heyliger, 2012). Pasteurization is a relatively mild heat treatment in which food is heated to <100°C. It is widely used throughout the food industry and is frequently employed as a CCP in various HACCP plans. As a unit operation in food processing it can be used to destroy enzymes and relatively heat sensitive micro-organisms (e.g. non-spore forming bacteria, yeast and molds). In this regard is it used to extend shelf life by several days e.g. milk, bottled fruit drinks and juices etc.(Taylor and Francis, 2006). Sterilization is the process of heating the food product to a temperature >100°C. Commercial sterility of the food means by the condition achieved by the application of heat which renders such food free of viable forms of microorganisms having public health significance, as well as any microorganisms of non-health significance capable of reproducing

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in the food under normal non- refrigerated conditions of storage and distribution. The sterilization value is known as the $F_0$ value for the thermal process (M.R.Berry *et al.*,). In this project, the final product is subjected to sterilization at 121°C.

*E. Total Soluble Solids*

The composition of the sugars in food products can be successfully analyzed only if a sensitive, reliable, and rapid analytical method is available (Shanmugavelan *et al.*,2013). The refractometer, which optically measures the refractive index of juice, is the standard method used to measure SSC or TSS of fruit and vegetables. TSS or Brix represents the percentage by mass of total soluble solids of a pure aqueous sucrose solution (Pereira *et al.*, 2013). Several refractometers are available, some of which are based on either refraction or critical reflection of light (Meeten and North, 1995; Dongare *et al.*,2014). A digital refractometer is used to determine the TSS of the samples S1, S2, S3.

*F. Sensory Evaluation*

O'Mahony,1991 has explained that Sensory evaluation is traditionally used to determine the taste of fruit and vegetables. In sensory analysis, trained and consumer panels are used to evaluate taste because given by far most realistic technique to obtain information on human taste and aroma perception (Beullens *et al.*, 2006). Different scoring scales are used in sensory evaluation to rank the samples in order of preference. These scales include hedonic scale where panelist rate products from 1(extreme dislike) to 9(extreme like) given by Baldwin *et al.*, 1998. I have used 9-point hedonic scale with 10 panel members to determine the best product.

## III. MATERIALS AND METHODS

*A. Thermal Processing of Pathaneer*

The Pathaneer is sweet beverage obtained from palm nectar, and is prone to fermentation quickly. Therefore, thermal processing of it may extend its shelf life. In this project, Pathaneer is thermally processed in a retort processing unit at 121.1°C for 3 minutes. The steps involved in the thermal processing of the Pathaneer are given below.

1) *Collection of Pathaneer:* The sugary sap called pathaneer is obtained from the young inflorescence either male or female. The traditional method involves tapping the top shoots and collecting the dripping juice in hanging earthen pots. The juice is collected early morning by the palm tree climbers. This Juice is very light, refreshing, extremely cool in sensation and has a sugary sweet taste. The pathaneer is collected and filtered using a sieve to remove foreign particles.
2) *Addition of Dextrose:* Dextrose is added to the sample to enhance the taste and to prolong the product's shelf life. It is the natural form of glucose and is easily soluble. Dextrose is added to the 200 ml of sample(S1) to achieve a TSS of 21°brix, another 200 ml of sample(S2) till 25°brix and the third sample S3 with 30°brix. Initial TSS of the sample is obtained as 16°brix. The TSS of the samples are determined using the digital refractometer.
3) *Processing Flowchart*

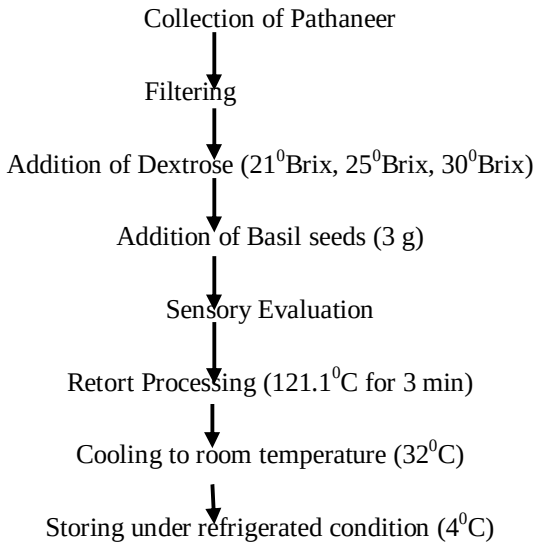



Fig no. 3.1 Flowchart for the Thermal Processing of Pathaneer

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Plate 3.1 Collected Pathaneer

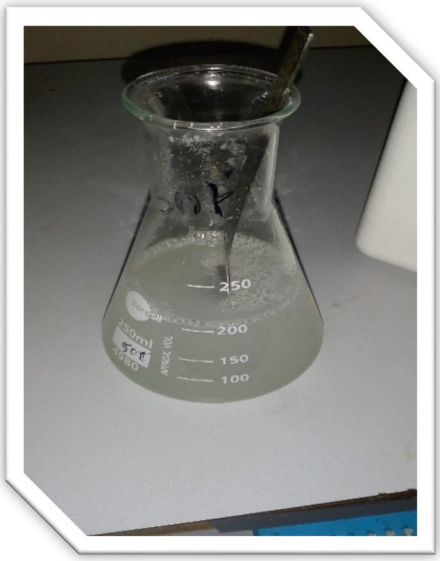



Plate 3.2 Filtered 200 ml Pathaneer Sample



Plate 3.3 Addition of Dextrose



Plate 3.4 TSS Determination using Refractometer

*4) Sensory Evaluation:* Sensory evaluation is conducted for a panel members of 10, using a 9-point hedonic scale. The sample that got the highest score is subjected to the thermal processing.

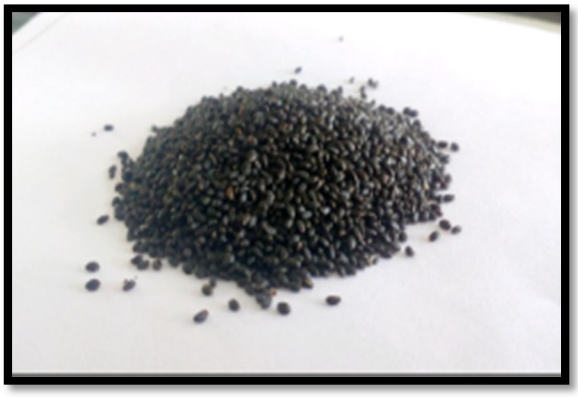


Plate 3.5 Basil Seeds



Plate 3.6 Filling the sample in glass container

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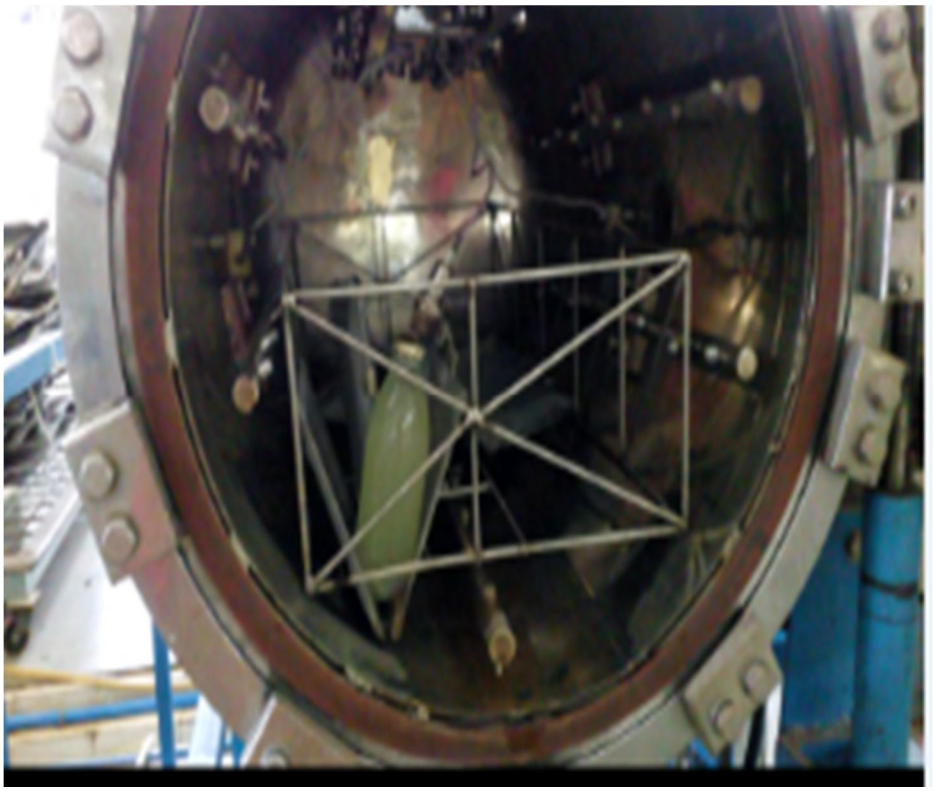


Plate 3.7 Thermally Processed sample

*B. Addition of Basil Seeds*

Basil seeds are added to the sample to improve its appearance and the market value. Basil seeds are incorporating in the fruit juices and drinks because of the essential oils present in it. 3 g of sweet basil seeds are added to the sample.

*C. Bottling*

The sample is filled in the glass bottles of 12.5 cm height, leaving a headspace of 2 cm. With the help of a hand operated cap sealing machine, it is cap sealed

*D. Retort Processing*

Retort processing is done in a forced steam/ air type retort. It is one of the type of "overpressure" retort. Sterilization in this type of retort is accomplished by using a steam and air mixture which is circulated within the retort by means of a turbine type fan. The homogeneous mixture of steam and air is drawn to the rear of the retort by the fan and then back to the front in a channel between the retort shell and baskets. As in the spray retort, pressure control is accomplished by air and achieved through a completely independent control loop. Consideration must be given to the desired pressure control set point since the ratio of steam and air in the vessel can affect heat transfer. When large amounts of air are mixed with steam to provide overriding pressure, the surface heat transfer coefficients are reduced. Unlike steam retorts, steam/air retorts require only a minimal vent phase. Steam/Air retorts are typically pressure rated to at least 50psi or higher. This style of retort is available in both rotary and non-rotary models. Both rotational and non-rotational models are available. Rotational models are typically not recommended due to the non-buoyant environment. The glass container with the sample is placed in the retort processing unit and the temperature is set for 121.1°C for 3 min. The temperature of the sample and retort temperature versus time is plotted in the graph with the help of the sensor connected to it.

*E. Storage*

The processed sample is cooled to room temperature and stored under refrigerated condition(4°C). Normal shelf life of pathaneer is 12-24 hours. The thermal processing of the can extent its shelf life.

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## IV. RESULTS & DISCUSSION

### A. *Sensory Evaluation*

Sensory evaluation gives the final best product among the 3 samples. A panelist of 10 members including teaching staffs, PG & UG students helped me to find the best sample. The scores given by them are plotted in the following graphs.

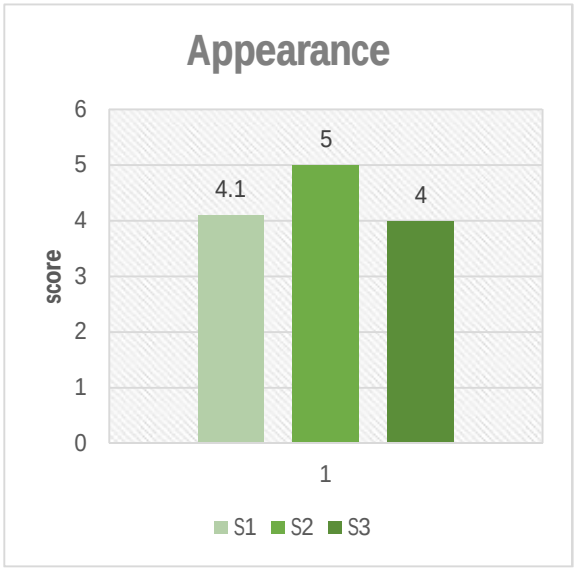



Fig no : 4.1 Score for the appearance




Fig no: 4.2 Score for the taste

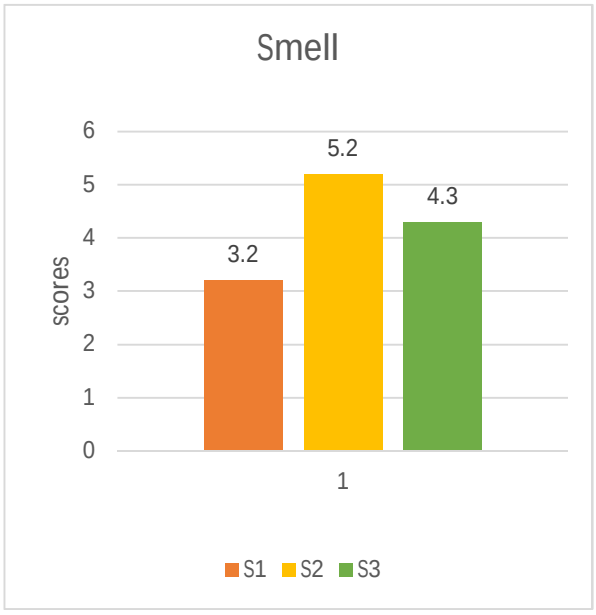



Fig no : 4.3 Score for the smell

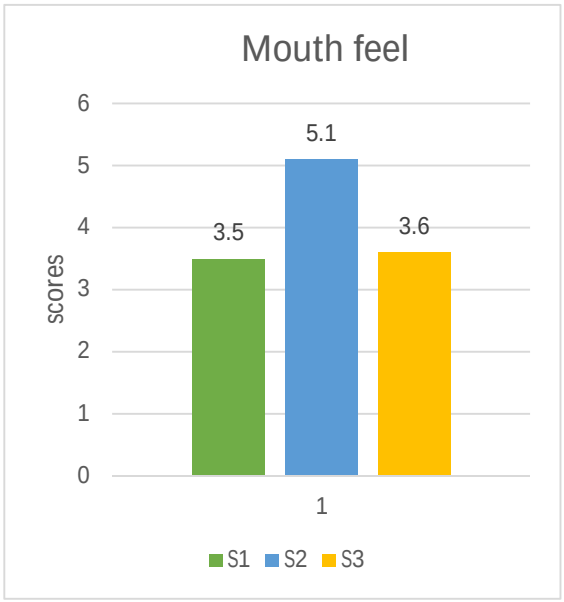



Fig no : 4.4 Score for the mouthfeel

The mouth feel of the sample is given in the fig 4.4. 1-5 is the score given for $S_1$ sample, 1-5 is for $S_2$ and 4-8 for the sample $S_3$. The overall acceptability is shown in fig 4.5. The sample $S_3$ is the best among the three samples.

$S_1$ – $21^0$Brix

$S_2$ - $25^0$Brix

$S_3$ - $30^0$Brix

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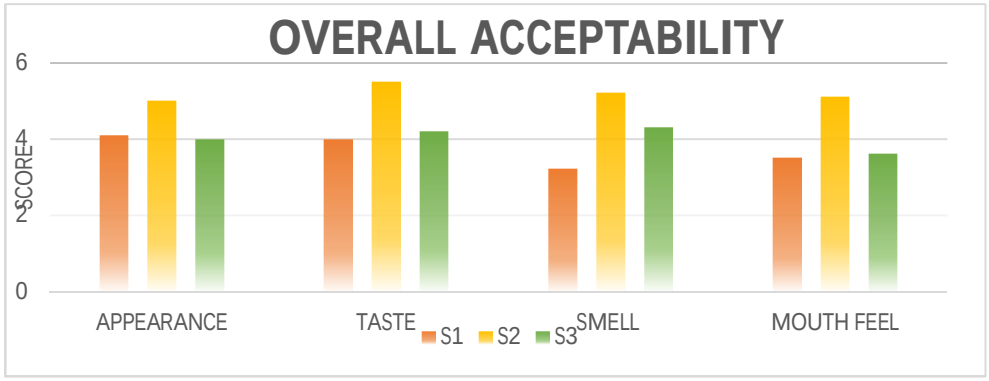



Fig No: 4.5 Overall Acceptability of the Samples

*B. Thermal Processing & Determination of $F_0$ Value*

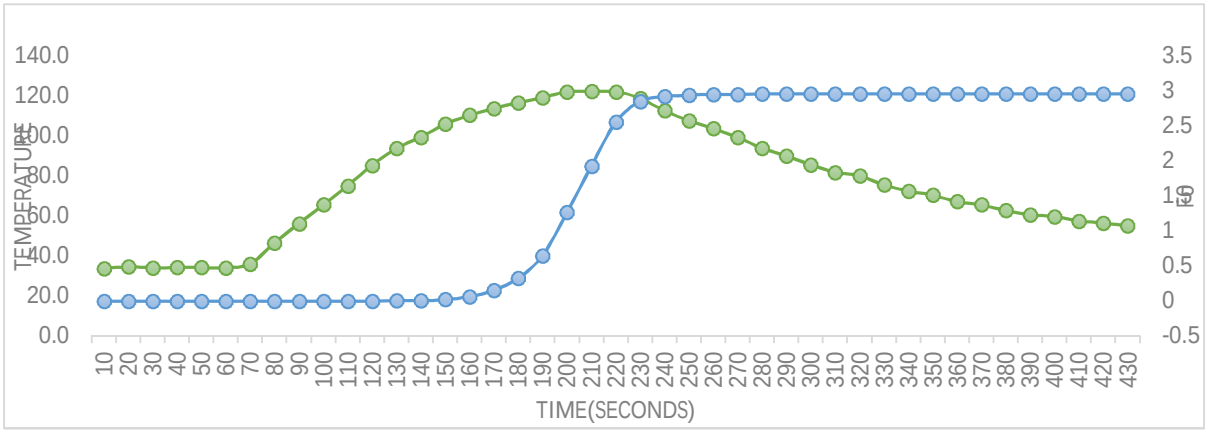



Fig No: 4.6 Graph for time versus $F_0$ and temperature

The final sample $S_2$ is subjected to sterilization in the retort processing unit. Sterilization is defined by $F_0$ (equivalent to heating for 3 minutes at 121 °C) to achieve twelve log reductions in the population of Clostridium Botulinum present in the food. Foods subjected to such treatment are stable at ambient temperatures and therefore considered commercially sterile. The figure 4.2 shows the temperature & $F_0$ value versus time. The $F_0$ value remains zero till $75^0$C and there is a drastic increase in the $F_0$ value. Sterilization temperature is $121.1^0$C.

The change in temperature and corresponding $F_0$ value are given in the table 4.2.

| TEMPERATURE ($^0$C) | $F_0$ |
|---|---|
| 33.7 | 0 |
| 85.1 | 0.00015 |
| 99.3 | 0.00435 |
| 110.3 | 0.06105 |
| 119.2 | 0.64824 |
| 121.1 | 1.9225 |

Table 4.1 Heating Temperature and the corresponding $F_0$ value

| TEMPERATURE ($^0$C) | $F_0$ |
|---|---|
| 121.0 | 2.5520 |
| 90.0 | 2.9528 |
| 85.6 | 2.9530 |
| 67.1 | 2.9532 |
| 59.7 | 2.9532 |
| 32 | 2.9532 |

Table 4.2 Cooling Temperature and the $F_0$ value

The $F_0$ value is 1.9225 at $121.1^0$C during the heating phase and the value increases to 2.9532 during cooling phase. The $F_0$ value remains constant at $72.04^0$C to $32^0$C.

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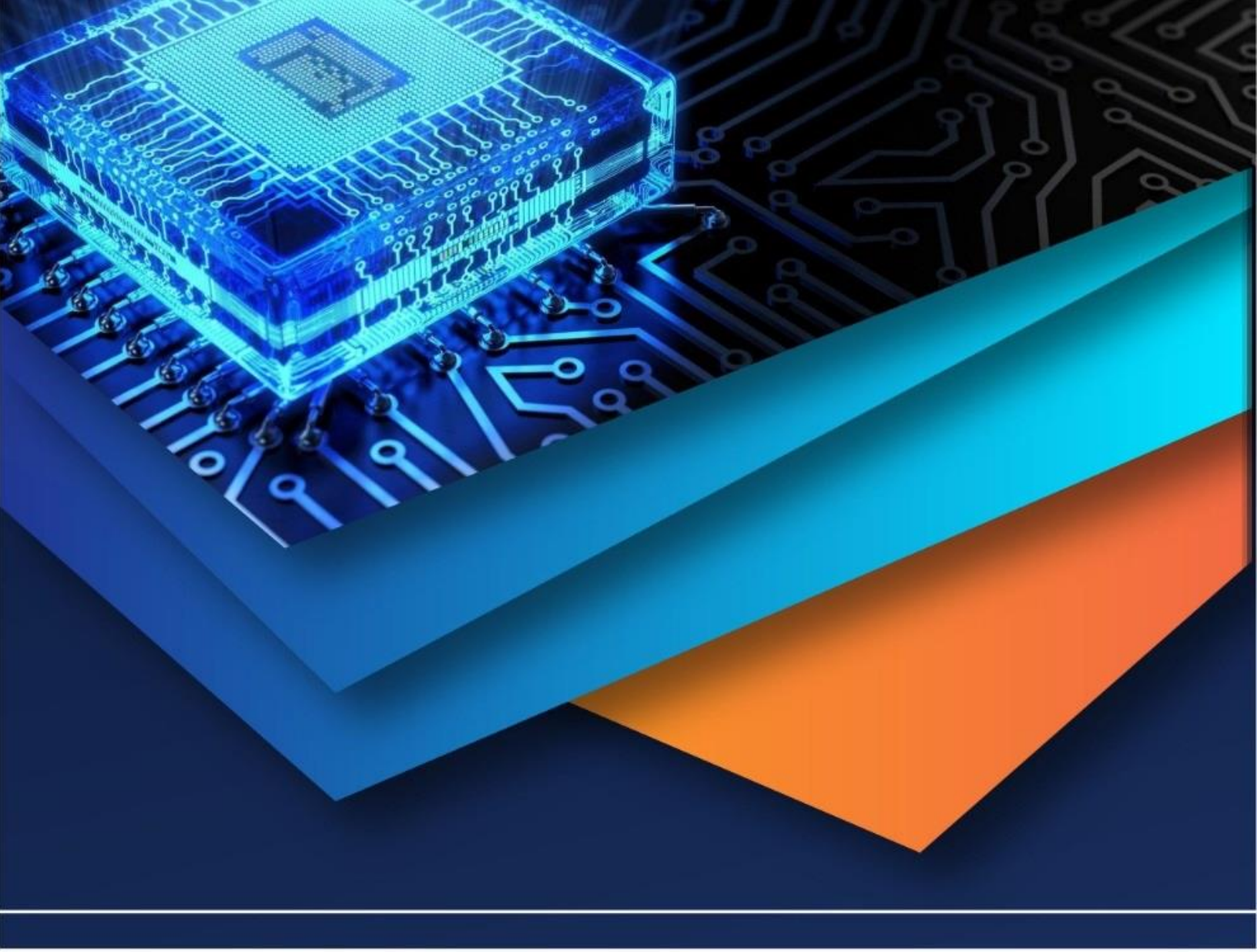
## V. SUMMARY & CONCLUSION

The Thermal Processing of the food product inhibits the enzyme activity and destroys the growth of microorganisms. The Pathaneer is a refreshing drink which is consumed by the people during summer. The simple sugars present in it, causes rapid fermentation and increases the alcohol content. Therefore processing of Pathaneer may delay the fermentation. In my project, I have done the thermal processing of Pathaneer. This process is carried out in a retort pouch processing unit. Sensory analysis is conducted for the samples $S_1$, $S_2$, $S_3$ at $21^0$Brix, $25^0$Brix, $30^0$Brix respectively. The $S_2$ sample is has given the highest score. Dextrose enhances the taste of the product. Besides this, Basil Seeds are also incorporated in the product to improve its nutritive and market value. The thermally processed Pathaneer can be stored at refrigerated temperature for 2-3 days. The $F_0$ value obtained at $121.1^0$C is 1.9225.

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