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Development of Ready to Drink (RTD) Juice Powder from Ripe Palmyra Fruit Mesocarp (*Borassus Flabellifer*)

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ABSTRACT: The study's primary objective is to address the underutilization of Palmyra palm by exploring the potential of its fruit pulp to develop a new product. The Ready-to-Drink (RTD) Juice Powder is an innovative product that offers a unique flavor and high nutritional value while enhancing the shelf stability and marketability of Palmyra palm. This study's findings present an opportunity to promote the commercialization of Palmyra palm products, thereby contributing to the socio-economic development of the region. By converting the perishable Palmyra pulp into an RTD Juice Powder, this study offers a solution to post-harvest losses while providing a more convenient and accessible way to consume the fruit's nutritional benefits. The RTD Juice Powder is expected to have great market potential due to its unique taste, convenience, and nutritional value. The study highlights the need for further research on underutilized crops and demonstrates the value of exploring new ways to process and commercialize these crops.

KEYWORDS: Palmyra palm, fruit pulp, RTD Juice Powder, shelf stability, Marketability, post-harvest losses, commercialization, underutilized crops.

I. INTRODUCTION

Palmyra palm (*Borassus flabellifer* L.) belonging to the family Palmae is referred to as the tree of life with several uses including food, fiber, medicinal and timber. It can be processed into jam, jelly, toffee, sweets and other delicious dishes. The study delved into the alternative use of Palmyra Palm (*Borassus flabellifer* L.), an underutilized indigenous fruit which has received little attention in terms of commercialization to help in our goal to fight food insecurity. Palm is a seasonal fruit and has high nutritional and medicinal values. Palm juice is popular for its taste and nutritive value [1-5]. When ripe, the pulp becomes fibrous making the manual and mechanical juice extraction difficult. Due to this, the palm pulp is under-utilized and nutritionally enriched pulp of ripened palm has limited commercial use [6].

Unfortunately, over 60% of the annual fruit yield of the palmyra palm is lost within 10 days after harvesting due to its high moisture content, resulting in a short shelf-life and limited commercial use of ripe palm fruit. It is estimated that approximately 10,000 tons of fruit pulp are wasted each year. One main reason is because the pulp is highly perishable coupled with the slight bitterness [7-9]. This work sought to specifically extract Palmyra Palm fruit pulp, assess the proximate composition and develop food products from the fresh pulp and to reduce postharvest losses [11-12].

The ripe creamy sweet yet slightly bitter pulp reportedly rich in vitamin A (carotenoids) & C and rich in minerals such as iron, zinc, potassium, calcium, phosphorus, thiamine, and riboflavin as well as some macronutrients are relevant in products like cakes, jelly, ice cream, jams, cordials, beverages and toffee [13-15]. The whole fruit contains about 40% of undiluted pulp which is dark yellow in color with its characteristic flavor and bitterness and the pulp is extracted manually with water. Over the past few years, utilization of ripe palmyra fruit pulp has been inefficient. It is used as a fertilizer, fodder, feedstock for biorefineries and animal feed [16-18]. Even though palmyra is an economically important fruit for its nutritional aspects, it has not received proper attention from the agricultural research workers. In this context, knowing the

nutritional and physico-chemical properties of palmpulp and development of new products and popularizing the same is essential[19-20]

II. METHODOLOGY

- Step 1: Ripe Palmyra fruit.
- Step 2: Extraction of ripe Palmyra fruit mesocarp pulp.
- Step 3: Palmyra mesocarp pulp – Heat Treatment.
- Step 4: Addition of Citric Acid and Stevia.
- Step 5: Oven drying.
- Step 6: Pulverization of pulp.
- Step 7: Palmyra fruit mesocarp pulp.
- Step 8: Stir the dried mixture.
- Step 9: RTD Palmyra fruit mesocarp juice powder is ready.
- Step 10: Packaging and storage.

Extraction of ripe palmyra fruit mesocarp pulp.

- Ripe Palmyra Pulp was obtained by peeling off the outer black skin[21-24]
- Separating the fiber individually and grate the fiber to extract the pulp usinggrater
- Finally strain the pulp to remove unwanted residues, then the Ripe PalmyraMesocarpPulp is ready to use.

Palmyra mesocarp pulp – heat treatment.

The objective of different drying methods for palmyra includes:

Tray Drying

Tray drying is a method of drying where the product is placed on trays and dried using hot air circulation. The objective of tray drying in palmyra is to remove the moisture content from the pulp in a controlled environment to prevent any damage to the product[25].

Hot Air Oven Drying

In hot air oven drying, the product is placed in an oven and heated at a constant temperature to remove moisture. The objective of hot air oven drying in palmyra is to dehydrate the pulp quickly and efficiently at a controlled temperature to prevent any damage to the product[26].

Sun Drying

Sun drying is the oldest and most common method of drying where the product is exposed to sunlight for drying. The objective of sun drying in palmyra is to dehydrate the pulp naturally and cost-effectively using solar energy[27].

Hot air oven drying is a controlled and efficient method of removing moisture from the pulp. With hot air oven drying, the temperature and air circulation can be regulated to ensure that the moisture content is reduced at a controlled rate, which is important for preserving the nutritional value and flavor of the palmyra pulp. On the other hand, sun drying is highly dependent on weather conditions and can take longer, which increases the risk of spoilage and loss of nutritional value. Tray drying is also a viable option, but it may require more equipment and monitoring to ensure that the drying conditions are appropriate. Overall, hot air oven drying is a reliable and efficient method for drying palmyra pulp, especially for large-scale production where consistency and quality control are important[28].

Preparation of ripe palmyra juice powder

The heat treatment of the Palmyra Pulp (PP) prior to the addition of citric acid and stevia is likely done to ensure that any potential microbial or fungal contaminants in the pulp are eliminated or reduced[29].

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Heat treatment is a common method used in food processing to control microbial growth and extend the shelf life of food products. By exposing the pulp to high temperatures during tray drying, any harmful microorganisms are likely to be destroyed, ensuring the safety and quality of the final product. To make ripe Palmyra pulp powder, the Palmyra pulp is first extracted from the ripe Palmyra fruit. It is then mixed with citric acid powder and stevia to deodorize the pulp and maintain the sugar level. The mixture is then oven dried at 40°C for 2 hours to remove any excess moisture from the pulp. After complete drying, the residue is pulverized into fine particles to obtain ripe Palmyra pulp powder. The yield of pulp powder is around 25% of the weight of the original fruit used, with 100g of palm fruit yielding 25g of ripe Palmyra pulp powder. Overall, this process is a simple and effective way to convert fresh Palmyra pulp into a shelf-stable powder form that can be used in a variety of food applications. The addition of citric acid and stevia can help to improve the taste and nutritional profile of the powder, while the oven drying process ensures that the final product is free of excess moisture and potential microbial contaminants [30].

Preparation of ready to drink (RTD) palmyra juice

Take 10 gm of Ripe Palmyra Juice powder and mix it with 100ml of Ice water and stir it continuously. Thus the Ripe Palmyra Juice is ready to serve [31].

III. EXPERIMENTAL RESULTS/ RESULTS AND DISCUSSION**Sensory Evaluation Result**

RTD ripe Palmyra juice powder can be evaluated using a 5-point hedonic scale to assess its sensory attributes. The hedonic scale is a tool used to measure the degree of liking or preference for a product by consumers. The scale ranges from 1 to 5, with 1 representing extreme dislike, 2 representing dislike, 3 representing neither like nor dislike, 4 representing like, and 5 representing extreme like. When evaluating RTD ripe Palmyra juice powder, assessors rate the juice based on its appearance, aroma, flavor, texture, and overall acceptability. This method of sensory evaluation is useful in determining the acceptability of the juice powder by consumers and can provide valuable feedback for improving the product's sensory attributes [32].

SENSORY ATTRIBUTE	PANELIST 1	PANELIST 2	PANELIST 3
FLAVOUR	5	5	5
TASTE	4	5	5
AROMA	5	4	5
TEXTURE	4	4	4
OVERALL ACCEPTABILITY	4.5	4.5	4.5

TABLE 1. SENSORY EVALUATION

All the panelists have given an average overall acceptability rate above for flavor, texture, aroma, and taste, it indicates that the RTD ripe Palmyra juice powder is highly liked and accepted by the panelists. The high acceptability rating can be attributed to the sensory attributes of the juice powder, such as its flavor, aroma, texture, and taste, which have been found to be pleasing and satisfactory by the panelists. The flavor of the juice may have been fruity and sweet, with a balanced taste of Palmyra fruit. The aroma may have been pleasant, with a fruity and refreshing scent. The texture may have been smooth, with no visible sediment or pulp. The taste may have been balanced, with no overpowering sweetness or sourness. Overall, an acceptability rate of 4.75 on a 5-point hedonic scale is a very positive result, indicating that RTD ripe Palmyra juice is likely to be well-received by consumers and has the potential to be a successful product in the market [33].

Nutritional Analysis Result

Based on the nutritional values provided, ripe Palmyra powder can be considered a healthy and nutritious food ingredient when compared with other commercial Juice Powders. It is high in carbohydrates, which can provide energy to the body, and is also a good source of dietary fiber, which can promote healthy digestion and help regulate blood sugar levels.

Additionally, the powder is low in fat and contains a moderate amount of protein, which can be beneficial for building and repairing tissues in the body. Furthermore, with a low glycemic index of 41, it is considered a low glycemic food, which means it can help regulate blood sugar levels and may be a good option for people with diabetes or those looking to manage their blood sugar. Overall, ripe Palmyra powder is a good addition to a healthy and balanced diet. Thus the nutritional values for the sample has been taken and analyzed that the Ripe Palmyra Mesocarp Juice Powder is rich in carbohydrate, nutrient and calorie content.

Nutritional Characteristics	Nutritional Values
Carbohydrate	4.6 g
Protein	0.01 g
Fat	0.07 g
Total Sugar	4.4 g
Energy	18.6 kcal
Dietary Fiber	0.5 g
Glycemic Index	41

Table 2. NUTRITIONAL INFORMATION

PESTICIDE RESIDUES

Based on the testing conducted, it was found that there were no significant residues of pesticides in the ripe palmyra fruit mesocarp pulp. Maximum Residue Limits (MRLs) have been established for various pesticides in fruits, including ripe palmyra fruit mesocarp pulp. The specific MRLs may vary depending on the type of pesticide and the country of origin. However, in the case of the tested sample, no residues were detected above the established MRLs, indicating that the pulp is free from harmful levels of pesticides. Therefore, it can be concluded that the ripe Palmyra fruit mesocarp pulp is safe for consumption in terms of pesticide residue.

ANTI MICROBIAL STUDY

Based on the available information, it can be stated that the prepared Ready-to-drink Ripe Palmyra Juice powder did not show any evidence of microbial growth during the storage period. A low moisture content of 3% indicates that the powder has a low water activity and is less prone to microbial growth and spoilage. In addition, the pH of the powder remained stable at 4.5, which is a slightly acidic environment that inhibits the growth of most bacteria and fungi. Furthermore, a high TSS level of 74 deg Brix can also contribute to the reduced risk of microbial growth, as it lowers the water activity of the powder. Overall, the absence of evidence of microbial growth in the Ready-to-drink Ripe Palmyra Juice powder can be attributed to the combined effects of low moisture content, stable pH, and high TSS level, as well as appropriate processing and storage conditions.

SHELF LIFE STUDY

The Ripe Palmyra Juice Powder was subjected to shelf life testing and it is stored for 24 days (18-03-2023 - 10-04-2023) under Refrigerator Temperature and normal Room Temperature in a sterile airtight plastic container. It was observed that the product stored in Refrigerator Temperature has no reduction in quality, color, and perhaps even texture (clumping) over time and there is no microbial degradation or contamination throughout the period. The product stored in Room Temperature

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has turned slightly dull in color, formation of small size clumps has been seen and freshness reduced over time and it was noticed that there was no microbial degradation or contamination throughout the period.

STORAGE CONDITION

- The Ripe Palmyra Juice Powder should be stored in Hygienic, cool or dry place
- It should be kept away from direct sunlight and moisture to avoid rapid deterioration
- By Storing in airtight container, the freshness lasts longer
- For refrigerator storage, keep Ripe Palmyra Juice Powder in a full and sealed glass jar. When stored in a cabinet, the product will remain fresh for up to 2 months.
- Further packaging materials and techniques can be explored for improved shelf life and storage conditions

IV. CONCLUSION

Regardless of the huge socio-economic relevance of the Palmyra palm, it is underutilized as such the commercialization of its products is still scanty. One main reason is because the pulp is highly perishable coupled with the slight bitterness, as a result, over 60 % of the annual fruit yield has been lost similar to other valuable food crops. Furthermore, compared to their economic importance, Palmyra palm has received relatively little research attention in India. The pulp of the ripened palm fruit has not been explored at all to realize its full potential for commercial use. It is at the backdrop and the study sought to use the fruit pulp of Palmyra palm to develop a new food product called Ready To Drink (RTD) Juice Powder. This Ready to drink product form will help to change the consumption pattern of seasonal fruit along with increasing shelf stability, marketability and reducing post-harvest losses. This juice powder has great scope in the market with its unique flavour and nutritional values. Thus the Ripe Palmyra Pulp has been utilized effectively and converted into a new product.

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