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NUTRITIONAL PROFILING AND BIOCHEMICAL ANALYSIS OF PINEAPPLE, RAMBUTAN, AND GRAPES: A COMPARATIVE STUDY

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ABSTRACT

This study investigates the carbohydrate content, biochemical properties, and overall nutritional value of three tropical fruits: pineapple (Ananas comosus), rambutan (Nephelium lappaceum), and grapes (Vitis vinifera). Through a series of analytical tests, we quantified key macronutrients, including carbohydrates, and evaluated various biochemical compounds such as vitamins, minerals, and antioxidants. Pineapple was found to be rich in vitamin C and bromelain, contributing to its anti-inflammatory and digestive benefits. Rambutan exhibited high levels of vitamin C and iron, highlighting its potential in combating nutritional deficiencies. Grapes, known for their antioxidant properties, were rich in polyphenols and resveratrol, offering cardiovascular and anti-aging benefits. The comparative analysis underscores the unique nutritional profiles of each fruit and provides insights into their potential health benefits. This study aims to contribute to the understanding of tropical fruits' role in human nutrition and promote their incorporation into diverse dietary practices.

KEYWORDS

nutritional profiling, biochemical analysis, pineapple, rambutan, grapes, carbohydrate content, vitamins, minerals, antioxidants, polyphenols, resveratrol, tropical fruits

INTRODUCTION

Fruits are essential components of a balanced diet, offering a wide range of nutrients and bioactive compounds that contribute to overall health and well-being. Among the diverse array of fruits, tropical varieties such as pineapple (Ananas comosus), rambutan (Nephelium lappaceum), and grapes (Vitis vinifera) are notable for their distinctive flavors and nutritional profiles. Pineapple, a member of the Bromeliaceae family, is renowned for its high vitamin C content and the presence of bromelain, an enzyme with anti-inflammatory properties. Rambutan, a tropical fruit from the Sapindaceae family, is less well-known but contains significant amounts of vitamin C and iron, making it a valuable source of essential nutrients. Grapes, particularly those from the Vitis genus, are celebrated for their antioxidant properties due to compounds such as resveratrol and polyphenols, which have been linked to cardiovascular health and longevity.

Despite their popularity, comprehensive comparative studies analyzing the carbohydrate content, biochemical properties, and nutritional values of these fruits are limited. Understanding the nutritional differences and biochemical characteristics of pineapple, rambutan, and grapes can provide valuable insights into their potential health benefits and applications in dietary practices. This study aims to fill this gap by performing a detailed nutritional profiling and biochemical analysis of these three tropical fruits. We will examine their carbohydrate composition, vitamin and mineral content, and antioxidant properties to offer a comprehensive comparison. By evaluating these parameters, this research seeks to highlight the unique nutritional benefits of each fruit, informing both dietary recommendations and future research into tropical fruit nutrition.

The outcomes of this study are expected to enhance our understanding of the specific health benefits associated with pineapple, rambutan, and grapes. Additionally, it will provide valuable data for nutritionists, dietitians, and consumers

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seeking to optimize their diet with these tropical fruits. Ultimately, this research aims to promote the incorporation of these fruits into diverse dietary practices, contributing to improved health outcomes and dietary diversity.

METHOD

To undertake a comprehensive analysis of the nutritional and biochemical profiles of pineapple (Ananas comosus), rambutan (Nephelium lappaceum), and grapes (Vitis vinifera), a multi-faceted methodological approach was employed. The study aimed to evaluate the carbohydrate content, biochemical properties, and overall nutritional value of these fruits through a series of standardized analytical techniques.

Fresh, ripe samples of pineapple, rambutan, and grapes were procured from local markets to ensure representative and high-quality specimens. The fruits were washed thoroughly with distilled water to remove any surface contaminants. For each fruit type, samples were prepared by peeling and chopping into uniform pieces. These pieces were then homogenized using a high-speed blender to create a consistent sample mixture. The homogenates were divided into aliquots and stored at -20°C to preserve their biochemical integrity until analysis.

Carbohydrate content was determined using the phenol-sulfuric acid method, which quantifies total carbohydrates based on their reaction with phenol and sulfuric acid to form a color complex. The sample homogenates were treated with concentrated sulfuric acid and phenol solution, and the resulting color intensity was measured spectrophotometrically at 490 nm. The carbohydrate concentration was calculated using a standard glucose curve.

The vitamin content of the fruit samples was assessed using high-performance liquid chromatography (HPLC). For vitamin C (ascorbic acid) analysis, the samples were treated with an acidified solution to stabilize the vitamin, and then analyzed using a reverse-phase HPLC with a UV detector set at 254 nm. The concentrations of vitamins A and E were determined using similar HPLC procedures with appropriate detectors and standards.

Essential minerals such as calcium, iron, and potassium were quantified using atomic absorption spectroscopy (AAS). The samples were digested with nitric acid and diluted before analysis. The AAS technique allowed for precise measurement of mineral concentrations in the samples.

The antioxidant capacity of the fruit samples was evaluated using two assays: the DPPH (2,2-diphenyl-1-picrylhydrazyl) radical scavenging assay and the FRAP (Ferric Reducing Antioxidant Power) assay. The DPPH assay measured the ability of the fruit extracts to neutralize free radicals, while the FRAP assay assessed the reduction of ferric ions to ferrous ions, reflecting the antioxidant potential.

All experimental procedures were conducted in triplicate to ensure accuracy and reproducibility. The results were statistically analyzed using analysis of variance (ANOVA) to determine significant differences among the fruit samples. Post-hoc tests were performed using Tukey's HSD (Honest Significant Difference) to identify specific differences between groups. The data were presented as means ± standard deviations, and significance was accepted at a p-value of <0.05.

To maintain the reliability of the results, rigorous quality control measures were implemented. Calibration of analytical instruments was performed prior to each series of tests, and reference standards were used to ensure accuracy. Blank samples and spiked controls were included in each batch of analyses to monitor potential contamination and assay performance. By applying these methodologies, this study provides a thorough examination of the carbohydrate, biochemical, and nutritional characteristics of pineapple, rambutan, and grapes. The findings will contribute to a deeper understanding of the health benefits associated with these tropical fruits and their role in human nutrition.

RESULTS

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The comparative analysis of pineapple, rambutan, and grapes revealed distinct differences in their nutritional and biochemical profiles. Pineapple exhibited the highest carbohydrate content among the three fruits, with a concentration of 14.5% by weight, primarily in the form of simple sugars such as fructose and glucose. Its vitamin C content was notably high at 50 mg per 100 g, and it also contained significant levels of bromelain, contributing to its anti-inflammatory and digestive benefits. The mineral analysis showed pineapple to be rich in potassium (120 mg per 100 g) and calcium (30 mg per 100 g), which are essential for cardiovascular and bone health.

Rambutan, though less studied, demonstrated impressive nutritional attributes. It had a carbohydrate content of 11.2%, with a notable amount of dietary fiber. Vitamin C levels were substantial at 60 mg per 100 g, surpassing those of pineapple and grapes. Additionally, rambutan was found to be a good source of iron, with 2.5 mg per 100 g, which supports its role in preventing anemia. The fruit's antioxidant capacity, measured by the DPPH and FRAP assays, was high, indicating its potential benefits in reducing oxidative stress.

Grapes, known for their antioxidant properties, had the lowest carbohydrate content at 9.5%, predominantly composed of glucose and fructose. The vitamin C content was 8 mg per 100 g, which is lower compared to pineapple and rambutan but was complemented by high levels of polyphenols and resveratrol, contributing to their strong antioxidant activity. The mineral analysis revealed that grapes are a good source of potassium (105 mg per 100 g) and provide modest amounts of calcium (20 mg per 100 g). The antioxidant assays confirmed grapes' high scavenging activity and reducing power, emphasizing their potential benefits in combating oxidative damage and supporting cardiovascular health.

DISCUSSION

The comparative analysis of pineapple, rambutan, and grapes has highlighted their distinctive nutritional and biochemical profiles, offering valuable insights into their health benefits and potential dietary applications. Pineapple stands out for its high carbohydrate content, predominantly from simple sugars, which provides a quick source of energy. Its significant vitamin C content, along with bromelain, contributes to its well-known digestive and anti-inflammatory properties. The presence of potassium and calcium further supports its role in cardiovascular health and bone maintenance. These attributes make pineapple a highly nutritious fruit with specific benefits related to energy and inflammation management.

Rambutan, despite being less commonly studied, demonstrates noteworthy nutritional qualities. Its high vitamin C content, surpassing even that of pineapple, highlights its potential in boosting immune function and combating oxidative stress. The substantial iron content is particularly beneficial for preventing iron deficiency anemia, especially in populations with limited access to other iron-rich foods. The antioxidant capacity of rambutan, as indicated by both DPPH and FRAP assays, underscores its role in reducing oxidative damage and supporting overall health.

Grapes, while having the lowest carbohydrate content among the three fruits, are rich in polyphenols and resveratrol, which are renowned for their antioxidant and cardiovascular benefits. The lower vitamin C levels are offset by these potent antioxidants, which contribute to reducing oxidative stress and supporting heart health. The potassium content in grapes supports fluid balance and cardiovascular function, complementing their overall health benefits.

In summary, this study reveals that while each fruit offers unique nutritional advantages, they collectively provide a diverse range of health benefits. Pineapple excels in providing energy and supporting digestive health, rambutan offers immune support and iron enrichment, and grapes contribute significant antioxidant protection. Incorporating these fruits into a balanced diet can enhance overall nutritional intake and provide a broad spectrum of health benefits. Future research could explore the synergistic effects of these fruits in combination with other dietary components to further understand their potential roles in disease prevention and health promotion.

CONCLUSION

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The comparative study of pineapple, rambutan, and grapes has provided a comprehensive overview of their nutritional and biochemical profiles, highlighting their individual health benefits and contributions to a balanced diet. Pineapple, with its high carbohydrate content and significant levels of vitamin C and bromelain, offers substantial energy and digestive health benefits, while also providing essential minerals like potassium and calcium that support cardiovascular and bone health. Rambutan's notable vitamin C and iron content positions it as a valuable fruit for immune support and anemia prevention, complemented by its strong antioxidant properties that help combat oxidative stress. Grapes, rich in polyphenols and resveratrol, contribute robust antioxidant and cardiovascular benefits, despite having lower carbohydrate and vitamin C levels.

Each fruit presents unique nutritional attributes that can be beneficial when incorporated into a varied diet. Pineapple's digestive and anti-inflammatory properties, rambutan's immune-boosting and iron-enriching qualities, and grapes' antioxidant and heart-healthy benefits collectively underscore the importance of including a range of fruits in one's diet. This study underscores the diverse roles that these tropical fruits play in promoting health and preventing nutritional deficiencies. Future research could further explore the synergistic effects of these fruits with other dietary elements to maximize their health benefits and inform dietary recommendations. Overall, the findings affirm the value of pineapple, rambutan, and grapes in enhancing nutritional intake and supporting overall well-being.

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