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Preliminary Investigation of Dry Matter, Total Carbohydrates and Fatty Acid Compositions of Rose Apple (*Syzygium Samarangense*)

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ABSTRACT

This study investigates the dry matter content, total carbohydrates, and fatty acid composition of *Syzygium samarangense* (Rose apple), a tropical fruit commonly grown in Southeast Asia. Samples were collected from a garden in Dhaka, Bangladesh, and analyzed for moisture, ash, fat, and carbohydrate content, as well as fatty acid composition. The dry matter content was determined to be 7.28%, with a moisture content of 92.72%, and ash content at 4.35%. The average fat content across samples was 0.29%. Gas Chromatography-Flame Ionization Detection (GC-FID) revealed that the predominant fatty acids were eicosenoic acid (25.59%), behenic acid (21.93%), and arachidic acid (19.16%). The total carbohydrate content was found to be 65 $mgkg,^{-1}$ was confirmed through a modified Molisch test and calibration curve analysis. Glucose presence in the fruit was verified via thin-layer chromatography. These findings provide a comprehensive nutritional profile of Rose apple, contributing to its potential as a functional food with benefits in hydration, energy provision, and cardiovascular health. This research lays a foundation for future studies on the nutritional and health benefits of this underexplored tropical fruit.

Keywords: Rose apple, Dry matter, Fatty acid, Carbohydrate, Gas Chromatography-Flame Ionization Detection

INTRODUCTION

The Rose apple (*S.samarangense*), a tropical fruit belonging to the Myrtaceae family, is widely cultivated in various regions of Southeast Asia, particularly in Malaysia, Indonesia, Bangladesh and Thailand (Banadka et al., 2022). Known for its glossy appearance, sweet flavor, and delicate aroma, the fruit is popular in local diets and is often consumed fresh, as well as in processed forms such as jams, jellies, and beverages (Ilyas, 2024). Despite its widespread use, the nutritional profile of Rose apple has not been as extensively studied as other tropical fruits, making it a subject of growing interest in food science and nutrition research (Selvaraj et al., 2017).Rose apples are known for their low-calorie content and high-water composition, making them a healthy choice for hydration and weight management. However, beyond these basic attributes, the fruit also contains significant amounts of carbohydrates, dietary fiber, and bioactive compounds, including vitamins, minerals, and antioxidants (Uddin et al., 2022; Shah, 2023). These nutritional components contribute not only to the fruit's health benefits but also to its potential as a functional food that could help in preventing chronic diseases like diabetes, cardiovascular disease, and cancer (Tarigan et al., 2021).

The composition of total carbohydrates in fruits is of particular interest due to their role in energy provision and their impact on glycemic response (Bonsembiante et al., 2021). Carbohydrates in fruits like Rose apple are primarily composed of sugars, such as glucose and fructose, and dietary fiber (Banadka et al., 2022). Understanding the carbohydrate profile of Rose apple can provide insights into its potential health benefits, particularly in relation to blood sugar regulation and digestive health (Du et al., 2024).While fruits are generally not known for their fat content, certain tropical fruits, including Rose apple, contain small but nutritionally significant amounts of fatty acids (Arnold and Gramza-Michalowska, 2023). Fatty acids play crucial roles in cellular structure, energy storage, and the regulation of metabolic processes (Günenc et al., 2022). The composition of fatty acids, especially the balance between saturated and unsaturated fatty acids, is an important determinant of a food's health impact (De Carvalho and Caramujo, 2018). Unsaturated fatty acids, particularly polyunsaturated fatty acids (PUFAs), are known for their beneficial effects on heart health and inflammation (Shahidi and Ambigaipalan, 2018), making the study of fatty acid profiles in fruits like Rose apple relevant to both nutrition and public health.

Dry matter content is another key parameter in the nutritional analysis of fruits (Kurina et al., 2021). It represents the total solids present in the fruit after the removal of water, including carbohydrates, proteins, fats, fibers, and minerals (Clark et al., 2007; Osadolor, 2009). The dry matter content is not only indicative of the fruit's nutritional density but also its shelf life, texture, and suitability for processing (Anjali et al., 2024; Marc and Mureșan, 2024). Higher dry matter content often correlates with better taste and quality, making it an important factor in both consumer preference and industrial applications (Rahman et al., 2021).With the increasing demand for natural and functional foods, fruits like Rose apple could be positioned as valuable ingredients in health-focused food products (Guldiken et al., 2021). Additionally, the findings of this study could have implications for public health, particularly in regions where the fruit is commonly consumed. By providing a comprehensive nutritional profile, this research could support dietary recommendations and inform public health initiatives aimed at reducing the burden of diet-related diseases.

Despite the known benefits of Rose apple, there is limited information available on its complete nutritional profile, particularly regarding its dry matter content, total carbohydrate composition, and fatty acid profile. This study aims to fill this gap by conducting a detailed investigation of the dry matter content, total carbohydrates, and fatty acid composition of Rose apple. The objective is to provide a thorough understanding of the fruit's nutritional profile, which could have implications for its use in health promotion and disease prevention. Additionally, this study will contribute to the broader knowledge of tropical fruits and their potential as functional foods in the global market.

MATERIALS AND METHOD

Sampling and sample preparation: Rose apple samples were collected at three different dates from the garden of Professor Dr. Nilufar Nahar in Uttara, Sector-11, Dhaka, Bangladesh. Each sample was pretreated and stored at suitable environment in the laboratory indicating date of collection with signature.

Determination of dry matter: The washed fruits were finely chopped, and precise amounts were placed into pre-dried porcelain crucibles. Then the crucibles were heated at 105 °C in muffle furnace (CARBOLITE–GSM 11/8). The residues obtained were cooled, weighed, and the moisture percentage was calculated. The mean moisture content was then determined using equation (1). The same crucibles were subsequently heated for an additional 4 hours at 700 °C to determine ash content, which was calculated using equation (2) (Park, 1996).

$$\text{Moisture (\%)} = \frac{\text{Loss of weight}}{\text{Weight of the sample}} \times 100 \text{ ----------(1)} \quad \text{Ash (\%)} = \frac{\text{Weight of the residue}}{\text{Weight of the sample}} \times 100 \text{ ----------(2)}$$

Analysis of fatty acid composition: The Rose apple samples were ground into crumbs by a kitchen blender and made homogenized mash. About 5g of powdered Rose apple sample was transferred into a teflon tube (500 mL). Then 15 mL n-hexane solvent added into it and vortex for one minute. The n-hexane extract was centrifuged for 5 minutes with 4000 rpm and collected by decantation. The n-hexane extracts were concentrated by the rotary evaporator into dry mass. The evaporation was carried out at bath temperature not exceeding 40 °C. The weight of the lipid was taken and labeled with sample ID and kept in the refrigerator at -18 °C.

Saponification of Lipid: The sample's lipid obtained from n-hexane extract was taken in a pear-shaped flask and 2mL 0.5M methanolic sodium hydroxide was added to it. Then the mixture was ultrasonicated for one minute and heated in a boiling water bath at about 90 °C for an hour. The mixture was cooled at room temperature and dried soap was formed after evaporation of the solvent.

Preparation of methyl ester of fatty acid: The fatty acid was then converted to their corresponding methyl ester by adding 1.5mL borontrifluride-methanol complex (BF_3-MeOH). The solution was refluxed on a boiling water tub for an about half an hour and cooled at normal condition. The content was concentrated with a rotavapor. Approximately 2 mL n-hexane solvent added to the solution and filtered through cotton filter with anhydrous Na_2SO_4. The filtrate was collected in a GC-vial, concentrated and analyzed by GC-FID for fatty acids composition of rose apple samples.

GC analysis condition: A GC-2025 SHIMADZU Gas Chromatography equipped with Flame Ionization Detector (FID) was used for identification and composition of fatty acids. FID was very sensitive and detection limit was 1 ngL^{-1} level. Separations were performed on a capillary WCOT quartz column. The column thickness was 0.25µm. N_2 was used as a carrier gas.Hydrogen gas and air were used for flame. Column flow rate was 2 $mLmin^{-1}$ and the split ratio was 1:9. Injected volume was 1.0 µL. Column, injector and detector temperature was set at 270 °C, 280 °C and 290 °C, respectively. The column oven temperature program was set as follows: Initially, the temperature was held at 120°C for 1 minute. Then, the temperature was increased at a rate of 7°C per minute until it reached 270°C, where it was held for 5 minutes. Afterward, the temperature was reduced back to 0°C with no hold time. The total program time was 30.0 minutes.

Determination of total carbohydrate: The total carbohydrate content of the Rose apple samples was determined using a modified Molisch test, a widely recognized method for assessing carbohydrates in food products. This procedure involved the use of 80% aqueous phenol and concentrated sulfuric acid (98%). A Shimadzu UV-1800 ultraviolet-visible spectrophotometer was utilized to measure the absorption maxima of various fractions. Different concentrations of the samples were placed in a quartz cell (1 cm x 1 cm), and the absorbance was recorded accordingly.

Preparation of standard solution: 20 mg of D-(+)-glucose was weighed and taken in a test tube with the addition of 50 µL 80% aqueous phenol. Then 3 mL of concentrated sulfuric acid (98%) was added and vortexed for 1 min. In this reaction, the glucose is converted into furfural complex which formed reddish-brown color. After that, the solution was taken in 100 mL volumetric flask and it was up diluted to the mark by concentrated sulfuric acid (98%). After the standard solution was prepared, several dilutions were made by pipetting a measured volume of the standard solution and adjusting the volume with concentrated sulfuric acid (98%). The concentrations prepared for the study were 3.4, 6.7, 13.4, 26.7, and 53.4 mgL^{-1}. The absorbance of these solutions was measured within the range of 400 nm to 600 nm to determine the λ_{max}, which was found to be 490 nm, as shown in Figure 1(a). Based on this data, a standard calibration curve was constructed, as displayed in Figure 1(b).

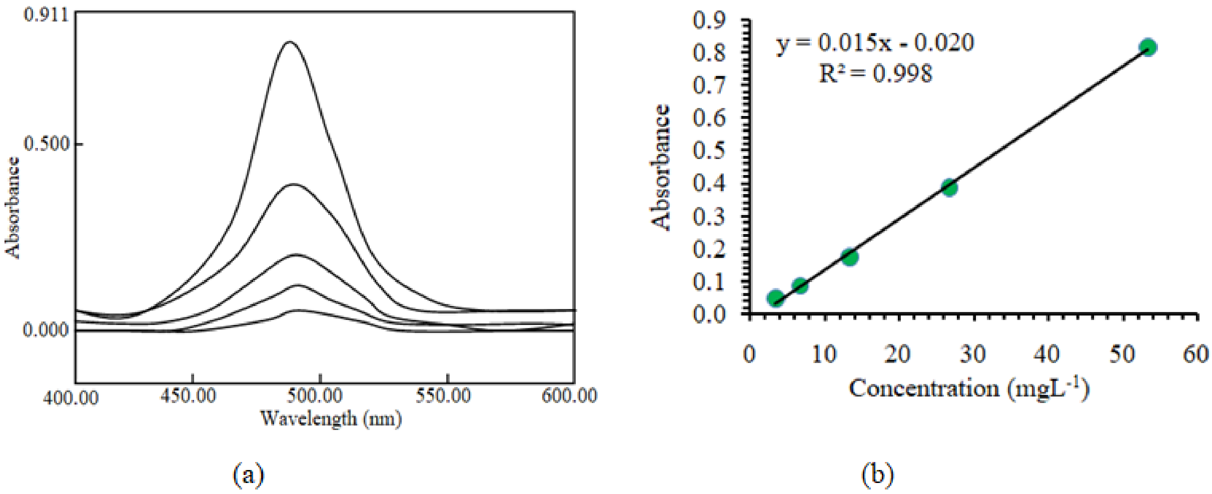

Figure 1: Overlain UV-Spectrum of five standard D-(+)-glucose solutions (a) and calibration curve (b)

Sample preparation for carbohydrate: About 0.5 mL of the sample was placed in a test tube, followed by the addition of 50 µL of 80% aqueous phenol. The mixture was thoroughly mixed using a vortex for 30 seconds. Next, 1.5 mL of concentrated sulfuric acid (98%) was added, and the solution was further mixed with a vortex for 1 minute. After 30 minutes, a reddish-brown color developed, and the solution was transferred to a 25 mL volumetric flask. The volume was then adjusted using concentrated sulfuric acid (98%), and the absorbance of the solution was measured at the predetermined λ_{max} of 490 nm.

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RESULTS AND DISCUSSION

The moisture content of the Rose apple sample was obtained from the difference in weight and from that the percentage of moisture content was calculated. The results are presented in Figure 2. The mean percentage of the moisture content present in Rose apple samples was found to be 92.72% and the dry matter content of the Rose apple sample was found to be 7.28%. Ash content of the three Rose apple's sample was determined by subtracting the final weight of the crucible from the initial weight. The ash content was converted to 100g of the sample. The average ash content was found to be 4.35% for Rose apple. According to Biswas et al. the experimental fruit of *S. samarangense* had a moisture content of 92% and an ash content of 0.12% (Biswas et al., 2021). Rosnah et al. determined the moisture content of *S. samarangense* ranges from 90.66% to 92.41% and the ash content of *S. samarangense* ranges from 2.77 to 3.26% (Rosnah et al., 2012), which are consistent with the findings reported in the current research. Ash content in food indicates the mineral composition present (Liu, 2019). It plays a significant role in determining the nutritional value, quality and microbial stability of the food (Sonkamble and Pandhure, 2017).

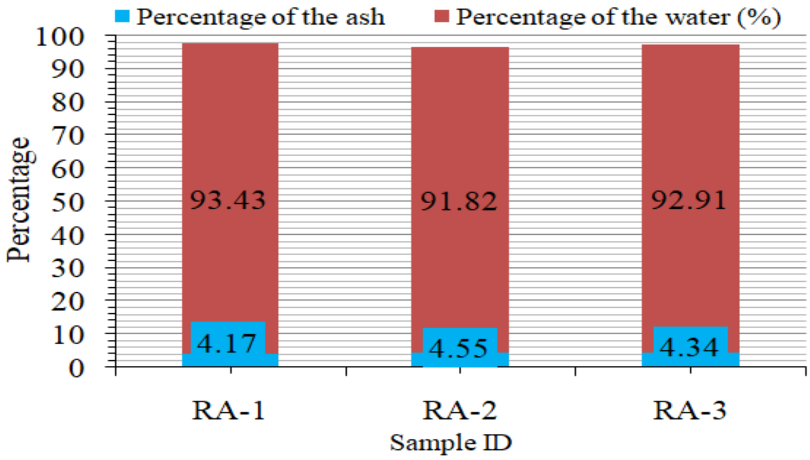


Figure 2: Percentage of moisture and ash content

Total fat content in the Rose apple samples were determined gravimetrically by extracting the sample (100 g) with n-hexane at room temperature. The mean fat content found in the Rose apple samples (RA) was calculated from three different samples. Sample RA-1 had a fat content of 0.28%, RA-2 had 0.31%, and RA-3 had 0.29%. The overall mean fat content was determined to be 0.29% with a standard deviation of ± 0.01%. In recent studies showed the fat content in the fruit samples is 0.17 g per 100 g of the samples which is somewhat lower than this study (Admin, 2024). Fatty acids were identified by comparing their retention time as shown in Figure 3(a) with standard fatty acids chromatogram. The relative percentage of individual fatty acid was calculated by the ratio of individual peak area of a particular fatty acid present in the sample and total peak area of all fatty acid present in the sample.

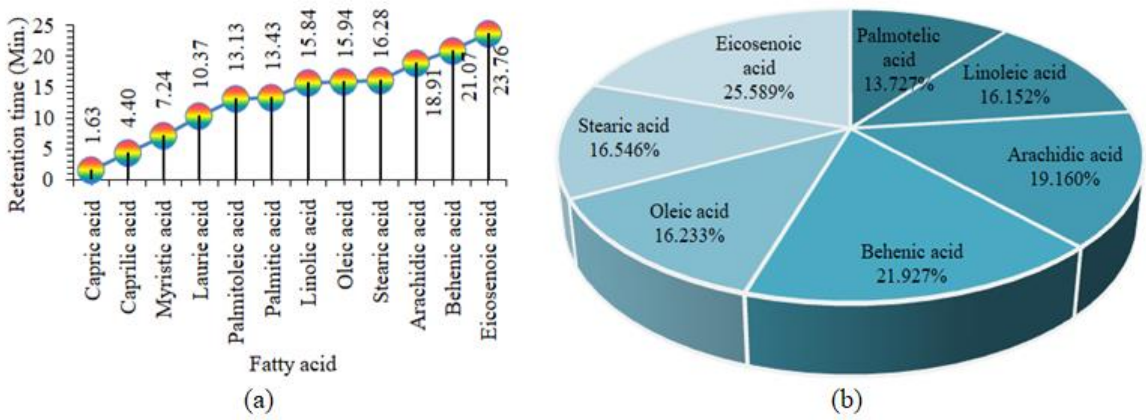
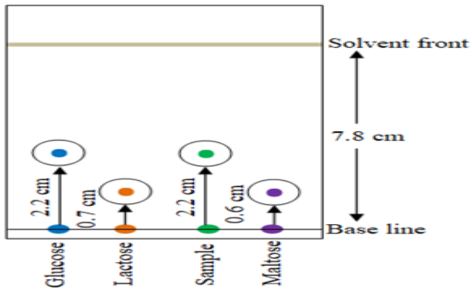


Figure 3: Retention time of standard fatty acid methyl esters (a) and fatty acid compositions in Rose apple (b)

The relative compositions of the free fatty acid and bound fatty acids were calculated from the peak area and retention time and the results are given in Figure 3(b). The analysis of the Rose apple sample revealed that 0.5343 g of hexane extract contained 0.1476 g of total fatty acids. The fatty acid composition was determined as follows: palmitoleic acid constituted 13.727%, linoleic acid 16.152%, arachidic acid 19.160%, behenic acid 21.927%, oleic acid 16.233%, stearic acid 16.546%, and eicosenoic acid had the highest relative percentage at 25.589%. The values are expressed in grams per 100 grams of the extract sample. So, it is clear that the stem of *syzygium samarangense* contains both the saturated and unsaturated fatty acids.

The retardation factor (R_f) is frequently utilized in both paper chromatography and thin layer chromatography to analyze and compare various substances. According to $R_f$value, the fruit sample (0.27) and glucose (0.28) solution both are same that confirms presence that the Rose apple is a glucose containing fruit. The absorbance of the sample was taken at 490 nm. Using the calibration curve of the standard glucose solution the total carbohydrate was determined by using the equation y = 0.015x - 0.020. The total carbohydrate percentage was shown in the Figure. The total carbohydrate amount was determined from the calibration curve for three samples, identified as RA-1, RA-2, and RA-3. The amount of total carbohydrate for the samples were as follows: RA-1 had a concentration of 66.00 mgkg^{-1}, RA-2 had 64.00 mgkg^{-1}, and RA-3 had 65.00 mgkg^{-1}. The mean concentration of total carbohydrates across all samples was calculated to be 65 mgkg^{-1}.



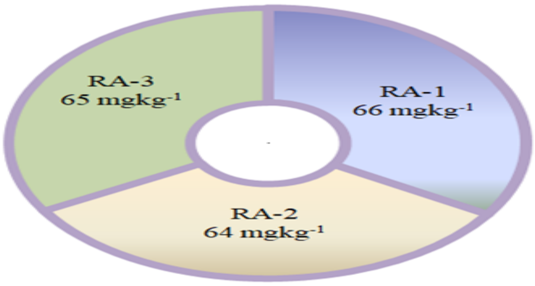


Figure 4: R_f values of fruit samples and glucose (a) and amount of total carbohydrates in Rose apple (b)

CONCLUSION

This study provides a comprehensive analysis of the nutritional composition of *Syzygium samarangense* (Rose apple), focusing on its dry matter content, total carbohydrates, and fatty acid profile. The findings demonstrate that Rose apple has high moisture content with a moderate amount of dry matter contributing to its hydrating and mineral-rich properties. The carbohydrate content confirmed its potential as a source of quick energy, with glucose being a significant component. Additionally, while the fruit has a low-fat content, its fatty acid profile shows a beneficial balance between saturated and unsaturated fatty acids, with eicosenoic, behenic, and arachidic acids being predominant. These results highlight Rose apple's potential as a functional food, especially in promoting cardiovascular health and offering a low-calorie option for hydration and weight management. Overall, the study advances understanding of the nutritional value of Rose apple, positioning it as a promising fruit for health-conscious consumers. Further research is recommended to explore its bioactive compounds and potential therapeutic applications, particularly in the prevention of chronic diseases such as diabetes and cardiovascular disorders.

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