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ENGINEERING AND TECHNOLOGY
COLLOQUIUM



THE POWER OF SCIENTIFIC INNOVATION

INTELLIGENT SOLUTIONS FOR A
SUSTAINABLE WORLD

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PREFACE

Welcome to the 2nd International Science, Engineering and Technology Colloquium 2025 (ISETC 2025)!

It is with great pleasure that we present this year's colloquium, a distinguished gathering of scholars, researchers, and professionals dedicated to the advancement of applied sciences. Held virtually on 9th July 2025, ISETC 2025 serves as a platform to highlight cutting-edge research, foster meaningful networking, encourage collaborations, and explore innovative solutions to global challenges.

This year's theme, "The Power of Scientific Innovation: Intelligent Solutions for a Sustainable World" highlights our shared goal to solve global challenges through applied science. It celebrates innovation as a key to building a more sustainable and resilient future. We're proud to feature keynote speakers and presenters who bring fresh insights, bold ideas, and breakthroughs shaping tomorrow's world.

We would like to extend our heartfelt appreciation to the Faculty of Applied Sciences, Universiti Teknologi MARA, Perak Branch, Tapah Campus, for their outstanding support and assistance throughout the planning and execution of the event. Their dedication has been instrumental to the success of this colloquium. We would like to sincerely thank all participants and researchers for their valuable contributions. We also appreciate the reviewers for their careful evaluations and helpful feedback. Your hard work and support mean a lot to us.

As editors, we are proud to present this collection of proceedings. It is an honour to bring together the interesting and meaningful work of our speakers and authors. We hope the ideas shared will lead to new discoveries, encourage more research, and help solve global challenges through science and innovation.

Warm regards,

Dr. Emi Norzehan Mohamad Mahbob

Dr. Saiyidah Nafisah Hashim

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ISETC 2025 Proceedings Editors

A STUDY ON CHEMICAL AND PHYSICAL PROPERTIES, AND MOISTURE CONTENT OF ROSELLE (*Hibiscus sabdariffa* L.) POWDER AS A NATURAL EXFOLIATING SCRUB

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Abstract: Roselle or also commonly known by its scientific name (*Hibiscus sabdariffa* L.), it is locally known as asam susur or Ribena Malaysia. This Roselle calyces extract is rich in antioxidant compounds that will bring numerous health advantages, such as in food, medicine, and skin care, industry. This study investigates the potential of Roselle powder (*Hibiscus sabdariffa* L.) as an organic exfoliating and moisturising scrub. There were two variations of scrubs prepared by adding ingredients such as brown sugar, shea butter, sweet almond oil and roselle extract in powder form with different proportions, while castor oil and essential oil were kept constant. The formulation differed in purpose to compare their texture and moisturizing effects. Furthermore, the research continues to identify and analyse the chemical and physical properties of the roselle extract powder, which was carried out by the Fourier Transform Infrared Spectroscopy (FTIR) method to determine the functional groups contained in the spectrum analysis. The bonding appears to be hydroxyl groups, carbonyl, and aromatic rings, which indicate the presence of active compounds such as anthocyanins, flavonoids, and organic acids. Besides that, physical changes of the scrub was observed over a week. This study has also led to examining the moisturising effect and the level of moisture content of the scrub, which is analyzed by using a digital skin meter to obtain the level of skin moisture before and after application of the scrub. To indicate the moisture level, 25 respondents of different genders have been chosen. The result concluded that the moisture level obtained is affected by a few factors such as the differences in gender, the production of sebum level, the body part tested, and skin thickness. Further research is needed to explore the potential of the roselle to create an effective and hydrating scrub. Future recommendations include enhancing the scrub's scent by incorporating natural, foam-producing ingredients such as aloe vera. For a smoother exfoliation experience, brown sugar could be replaced with rice powder. Additionally, yogurt may help improve skin moisture, while honey offers both moisturizing and healing properties. The inclusion of lemon juice could also provide benefits due to its vitamin C content, which is known to help brighten the skin and cucumber juice provides cooling properties to keep skin hydrated.

Keywords: *Hibiscus sabdariffa* L., natural scrub, FTIR analysis, moisture content, antioxidant

INTRODUCTION

Many plants and fruits have numerous benefits in terms of assisting us in producing goods that are safe for human consumption, whether in the form of food, medication, or skin care. Roselle, commonly known by its scientific name (*Hibiscus sabdariffa* L.), is a blooming plant that was first planted in Sudan, Africa, approximately 6000 years ago (Mohd-Nasir et al., 2021). Furthermore, Roselle (*Hibiscus sabdariffa* L.) is a great organic product with numerous applications and benefits. Roselle calyces contain a variety of antioxidants such as anthocyanins, flavonoids, and ascorbic acid. In the beauty industry, roselle can be used as an exfoliant, anti-inflammatory, and also helpful in moisturizing (Hashim & Ghazali, 2024). An increase in antioxidant levels will help regulate skin hydration and reduce redness. In addition, ascorbic acid in roselle can aid in skin exfoliation, giving a more radiant effect and balanced complexion. It also claimed that it is able to reduce fine lines and wrinkles. Roselle is an ideal candidate for research since it is a highly economical crop that is also abundant in strong bioactive chemicals that serve numerous functions in promoting human health and well-being.

The main objective of this research is to formulate roselle powder into a natural exfoliating scrub. Besides, it is to determine its functional group and physical properties by Fourier Transform Infrared Spectroscopy (FTIR) of the roselle extract powder. The research also aims to examine the moisturising effect on the skin and the level of moisture content of the scrub.

Having personal care and beauty items is not exclusive to any one gender, as it's a great routine to take care of yourself (Alnuqaydan, 2024). Regrettably, most of the popular commercial exfoliating scrubs that are often available in the drugstore usually contain unsafe chemicals, such as parabens and phthalates. A long-term contact with these hazardous substances may cause a variety of health and skin problems, from skin sensitivity and allergies. Roselle extract is an organic product and chemical-free, which can offer an alternative as a natural exfoliant and does not harm the environment. This study is significant as Roselle contains organic compounds beneficial for the skin. It provides both physical and chemical exfoliation advantages to the skin. This scrub is primarily intended to assist everyone in protecting and maintaining the health of their skin. This study is also valuable since it may help more people understand the benefits of using organic substances in their everyday products.

The method that has been used for this research is, firstly the scrub is formulated by using only natural ingredients such as brown sugar, shea butter, sweet almond oil, castor oil, roselle extract powder, and English pear essential oil. Next, FTIR spectroscopy is used to analyze the functional properties of the roselle extract. Lastly, the moisture content of the scrub was tested by applying the scrub onto skin, and measurements of the skin hydration before and after were taken by a skin moisture meter. The participants' feedback for the scrub was also taken by a short survey.

The findings of this research were able to determine the functional group that appeared in roselle extract, which is the peak of FTIR obtained corresponding with the functional group of O-H, C=C and C-O, indicating the presence of active compounds such as anthocyanin, flavonoids, and organic acids (Sapian et al., 2023). The moisture content of the skin was then evaluated before and after the scrub was applied; there were also differences in moisture level between genders. where the male respondent had a lower difference in moisture level compared to the female respondent, which may be affected by a few factors such as sex differences, production of sebum level, body part tested and skin thickness.

Body scrubs are a cream-based preparation containing abrasives which help to remove dead skin cells while also exfoliating and nourishing the skin (Rakhmawati et al., 2021). In scrub preparation, it requires a cream base component consisting of an oil and water phase containing an emulsifier or and an abrasive. In addition, the tests that need to be conducted include spreadability and adhesion tests. It was stated that the spreadability test would be able to determine the softness of the body scrub mass. Also, the adhesive test will result in the ability of the scrub to stick to the surface of the skin when applied. The longer it sticks, the higher the absorption of scrub into the skin. The texture of this scrub altered and solidified at times owing to freezing temperatures, and the aromas would progressively fade over time.

MATERIALS AND METHODS

List of Instruments

Fourier Transform Infrared Spectroscopy (FTIR), weighing balance, beaker, glass rod, measuring cylinder, containers and spatula.

List of Chemicals

Roselle powder, brown sugar, shea butter, castor oil, sweet almond oil and essential oil (English Pear).

Fourier Transform Infrared Spectroscopy (FTIR)

A tiny amount of roselle powder is applied to the ATR crystal. The autosampler's pressure is then reduced until the tip makes contact with the powder. The sample is run, and the peak components in it are recorded.

Preparation for Scrub

Scrub A :

According to Harshitha et al. (2024), approximately 60 g of brown sugar was weighed and placed in a beaker, followed by 5 ml of castor oil and 20 ml of sweet almond oil. Both oils were measured with a measuring cylinder. All of those components were combined to preference with a stirring rod. Following that, 20 g of shea butter was weighed and placed in a beaker with 4 g of roselle powder. The entire mixture was then stirred well. Finally, 5 drops of essential oil were added, giving the scrub a lovely smell. The mixture was then stored in a container and placed at room temperature. The observations were then recorded.

Scrub B :

A beaker was filled with roughly 45 g of brown sugar. The amount of castor oil used in the initial scrub remained unchanged at 5 ml, while the amount of sweet almond oil increased to 23 ml. Both oils were placed in a beaker with brown sugar. All components were thoroughly mixed. Shea butter was then put in an extra 30 g, along with 3 g of roselle powder. These components were mixed with a stirring rod until they formed a scrub. Finally, 5 drops of essential oil were added to enhance the aroma of the scrub. All of the ingredients were stored in a container and kept at room temperature. The observations were then recorded.

Moisture Measuring

A moisture level meter is used to measure the moisture on the forearm. The prepared scrub is applied to the back of the individual's hand. This is because the back of each human hand has a thinner layer that is easily visible. The forearm is as sensitive as the skin on our face. Half a scoop of scrub is applied to the skin and evenly rubbed for 2 minutes. The scrub is left on for two minutes to ensure that all of the components are absorbed by the skin. Following that, the scrub is cleaned with clean water. The washed area is gently wiped with a tissue. The moisture meter was scanned on the surface of the skin, and then the level of moisture was recorded. All scrubs were tested on 25 respondents, 20 of whom were female and 5 of whom were male.

RESULTS

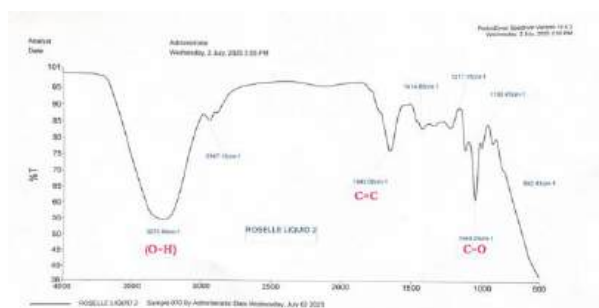
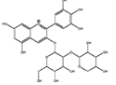
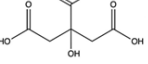
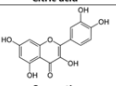


Figure 1. FTIR Spectrum of Roselle Extract Powder

Table 1. List of Bonding Present in Roselle Extract Powder

Organic compounds	Class	Functional group & wavenumber (cm ⁻¹)
	Anthocyanin	C-O: 1040.29 O-H: 3273.80 C=C: 1643.08
	Organic acid	O-H: 3273.80 C-O: 1040.29
	Flavonoids	O-H: 3273.80 C-O: 1040.29 C=C: 1643.08

The functional group appears corresponding to the peaks obtained from the FTIR analysis, which are a broad OH band with wavenumbers of 3273.80 cm⁻¹, C=C at 1643.08 cm⁻¹ and C-O at 1040.29 cm⁻¹. All these peaks indicate the presence of bioactive compounds contained in roselle extract, for example, delphinidin-3-sambubioside, a type of anthocyanin. Then, citric acid, which is an organic acid, was also found. Lastly, Quercetin, a class of flavonoid was also obtained.

Next is the physical observation of the scrub throughout seven days. From the first day, both scrubs had a soft and smooth texture, but scrub B was more oily. The scent was stronger, and the sugar did not dissolve. Then on the second and third day, both scrubs felt firmer but still oily and soft. After that, from day four to six, scrub A started to harden, felt drier with a slightly rough texture, and the colour also appeared uneven. Meanwhile, scrub B is less dry compared to scrub A. Both of the scrubs started to lose their scents. Lastly, on day seven, both scrubs had turned hard and dry in texture, then the shea butter and oil started to separate and hardened. This is probably due to the cooler temperature from rainy weather

Furthermore, a test was conducted on 25 respondents, consisting of 20 females and 5 males, to study the moisture level of the respondents before and after the application of scrub A and B. Based on table 2.0, this data was sorted from the highest to the lowest difference in moisture level. On the left shows data for scrub A, the highest difference recorded is 29% and the lowest is 2%. The majority of female respondents experienced higher changes in moisture level compared to male respondents. Meanwhile, on the right shows data for scrub B, where the highest level of moisture changes recorded was 25% and the lowest was 1%. To conclude, the hydration level of male respondents significantly increases after application of scrub B compared to scrub A.

Table 2. Moisture Level of Participant Before and After Application of Roselle Scrub A and B

Respondent	Moisture Before (%)	Moisture After (%)	Difference(%)
1	55	84	29
2	26	50	24
3	45	64	19
4	55	73	18
5	32	49	17
6	54	69	15
7	38	53	15
8	61	75	14
9	49	62	13
10	47	59	12
11	38	49	11
12	32	41	9
13	44	52	8
14	42	50	8
15	73	80	7
16	47	54	7
17	42	49	7
18	32	38	6
19	44	49	5
20	37	42	5
21	39	43	4
22	40	43	3
23	51	53	2
24	48	50	2
25	43	45	2

Respondent	Moisture Before (%)	Moisture After (%)	Difference(%)
1	45	70	25
2	58	79	21
3	35	54	19
4	52	69	17
5	39	56	17
6	34	50	16
7	40	55	15
8	31	46	15
9	52	66	14
10	41	55	14
11	40	54	14
12	35	49	14
13	33	47	14
14	51	64	13
15	36	48	12
16	68	79	11
17	39	49	10
18	61	70	9
19	50	58	8
20	34	42	8
21	53	59	6
22	42	47	5
23	41	45	4
24	54	57	3
25	49	50	1

DISCUSSION/ANALYSIS

Roselle powder contains natural compounds like anthocyanins, flavonoids, phenolic acids, and organic acids, which offer many skin benefits. These include moisturizing, exfoliating, and protecting the skin. To identify the functional groups in Roselle powder, FTIR spectroscopy was used. The FTIR results showed peaks related to hydroxyl, carbonyl, and aromatic groups, indicating the presence of bioactive compounds such as delphinidin-3-sambubioside, a type of anthocyanin. Then, citric acid, which is an organic acid, was also found. Lastly, Quercetin, a class of flavonoids, was also obtained.

Within a week, the scrub undergoes physical changes. Initially, both scrubs had a nice, moist texture. This showed that the scrub production was successful. By day 2 to 3, they started to harden, and oil separation became visible. Cold temperatures cause shea butter to harden. Scrub A appeared harder than Scrub B, likely due to using less shea butter. On day 7, oil was separated, and both scrubs lost their fragrance. Scrub A appeared oilier because the shea butter amount was higher than scrub B, causing it to produce more oil.

Lastly, a moisture meter tested how well the scrubs moisturized the skin. Out of 25 respondents (20 women, 5 men), both scrubs have improved in skin moisture for both genders. Producing more sebum, will help keep skin moisturized (Abdallah et al., 2017). Sex difference is also a significant factor affecting the amount of sebum production, which is significantly higher among males in comparison to females. The higher the sebum level leads to creating a natural oil

barrier on the skin which reduces the absorption of moisturizing ingredients. Women's skin thickness, on the forearm, skin collagen decreased with age and was less in female subjects of all ages compared to men that have a thicker skin which will absorb water more slowly. This results in female respondents experiencing greater improvement after applying the scrub and male respondents experience slower absorption of the scrub. However, there is a limitation to this result due uneven number of respondents from the male gender which may affect the accuracy of the data.

CONCLUSIONS

Eventually, a natural exfoliating scrub made from roselle powder was successfully produced. There are other helpful functional groups for the skin, such as anthocyanins, organic acids, and flavonoids. At last, the scrub hydrates the skin. The procedure for producing a natural exfoliating scrub from roselle powder can be quite beneficial to the skin. Every ingredient in roselle has a specific function, such as brightening, healing the skin, exfoliating, or preserving pH balance (Shruthi & Ramachandra, 2019). The scrub has a texture that is suitable for all users. Overall, the scrub's ingredients might be enhanced. Rice powder is a good choice for the exfoliator. Rice powder will function as an exfoliator, providing gentle exfoliation (Yang et al., 2025). Yogurt will also provide a light exfoliant and soften the skin. Next, for moisturizing, both oils used in the original scrub can be substituted with aloe vera and honey. Aloe vera may hydrate while also producing a tiny foam that is ideal for a scrub (Wulandini et al., 2019). Honey will moisturize and cure the skin (Ulfah et al., 2025). Finally, some additional benefits, such as cucumber juice, will provide a cooling impact and keep the scrub hydrated (Mansoor et al., 2023). Lemon juice is also a fantastic addition because it includes vitamin C, which brightens the skin (Leong et al., 2024). As previously stated, roselle powder and natural substances may be helpful in the production of healthy skin.

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Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan amanah,

Setuju.

27.1.2023

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