

# Chemical Profile of Red Dragon Fruit Peel (*Hylocereus polyrhizus*) by Gas Chromatography - Mass Spectrometry

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**ABSTRACT:** Red dragon fruit (*Hylocereus polyrhizus*), a tropical species native to Asia, has gained attention for its potential as a source of bioactive compounds. This study aimed to characterize the chemical constituents present in the peel of *H. polyrhizus* using gas chromatography–mass spectrometry (GC–MS). The extraction process was performed through maceration with 96% ethanol for four days, followed by filtration and concentration using a rotary vacuum evaporator. The resulting ethanolic extract was analyzed using GC–MS under the following parameters: injector temperature of 250 °C and a programmed column temperature ranging from 70 °C (held for 2 min) to 200 °C at a heating rate of 100 °C/min. The chromatographic analysis identified a total of 82 distinct compounds, indicating the chemical diversity of the extract. Among these, the most abundant peak was detected at a retention time (RT) of 22.806 min, corresponding to pentadecanoic acid (C<sub>15</sub>H<sub>30</sub>O<sub>2</sub>). The presence of fatty acids, esters, and phenolic derivatives suggests that *H. polyrhizus* peel may serve as a valuable natural source of antioxidants and other pharmacologically active constituents. Overall, the findings provide fundamental insights into the phytochemical composition of red dragon fruit peel, supporting its potential application in pharmaceutical and nutraceutical formulations.

**KEYWORDS:** Tropical; extraction; phytochemical; spectrophotometry; food.

## 1. INTRODUCTION

Red dragon fruit (*Hylocereus polyrhizus*) peel is a rich source of various bioactive compounds, including vitamins E and A, alkaloids, terpenoids, flavonoids, thiamine, niacin, pyridoxine, cobalamin, phenolics, carotene, phytoalbumin, steroids, saponins, and tannins (Naga & Nizori, 2020). In addition, the peel contains  $\beta$ -sitosterol, pectin, galacturonic acid, mannose, galactose, and xylose (Ramdhan et al., 2022). These phytochemicals contribute to the diverse pharmacological properties of the plant. The peel of red dragon fruit is particularly rich in polyphenols and exhibits potent antioxidant activity, which has been reported to surpass that of the fruit pulp. This highlights its potential as a promising source of natural antioxidants (Naga & Nizori, 2020).

Previous studies have demonstrated that the peel of the red dragon fruit possesses significant wound-healing properties, which are primarily attributed to its rich content of tannins and flavonoids. These bioactive compounds play crucial roles in the modulation of inflammatory responses, enhancement of collagen synthesis, and acceleration of tissue regeneration during the healing process. In addition to these effects, the red dragon fruit peel also exhibits broad-spectrum antibacterial activity, which helps prevent secondary infections in wounds, and hypocholesterolemic effects, contributing to improved lipid metabolism and cardiovascular health.

The phytochemical richness of this plant part is further enhanced by the presence of terpenoid compounds, notably lupeol, which has been reported to possess potent antioxidant, anti-inflammatory, and anticancer activities (Ramdhan et al., 2022). Lupeol acts as a free radical scavenger, protecting cells from oxidative stress and lipid peroxidation, which are key mechanisms underlying degenerative and inflammatory diseases.

Characterization of the ethanol extract of red dragon fruit peel using Fourier-transform infrared (FTIR) spectroscopy has confirmed the presence of several major secondary metabolites, including alkaloids, phenolics, flavonoids, terpenoids, steroids, saponins, and tannins (Watuguly et al., 2019). These phytoconstituents are known to contribute to a variety of pharmacological activities such as anticancer, antidiabetic, anti-inflammatory, detoxifying, and cholesterol-lowering effects, highlighting the therapeutic potential of this natural resource.

To gain deeper insight into the chemical constituents responsible for these biological properties, Gas Chromatography–Mass Spectrometry (GC–MS) was employed in the present study. GC–MS is a highly sensitive and specific analytical method widely used for the identification of volatile and semi-volatile organic compounds in complex plant extracts. In this technique, gas chromatography (GC) functions to separate individual components of a mixture based on their volatility and thermal stability under low-pressure, high-temperature conditions, while mass spectrometry (MS) provides molecular weight and structural information by analyzing the ionized fragments of these compounds (Hotmian et al., 2021).

The GC–MS approach offers several advantages, including high resolution, reproducibility, and the ability to detect compounds even at trace levels, making it an indispensable tool in phytochemical profiling (Gandjar & Rohman,



2013; Warisno, 2018). Therefore, the present study aimed to characterize the chemical profile of the ethanol extract of *H. polyrhizus* peel using GC–MS, thereby providing a comprehensive understanding of its phytochemical composition and supporting its potential pharmacological applications in the development of natural therapeutic agents.

## 2. EXPERIMENTAL SECTION

### 2.1. Materials and instrumentation

The materials used in this study were red dragon fruit peel extract (*Hylocereus polyrhizus*), 96% ethanol, filter paper, SH-Rxi-5Sil MS column, and aluminum foil. The tools used in this research are a set of maceration tools (clear glass jar), a set of glassware (pyrex), blender (Philips), analytical balance (Ohaus), water (prio DWB), rotary evaporator (IKA®RV 10 basic), a set of *Gas Chromatography - Mass Spectrometry* Ultra QP 2010 Shimadzu (GC-MS), Eppendorf tube, SH-Rxi-5Sil MS column.

### 2.2. Sample preparation

The research sample used was red dragon fruit skin (*Hylocereus polyrhizus*) obtained in Makassar, South Sulawesi. Red dragon fruit was taken in good condition and fresh, after which washing was carried out to remove dirt from the outer skin of the red dragon fruit and from other impurities that were still attached to the skin. Then the fruit skin is separated from the dragon fruit flesh and then cut into small pieces and then dried in the sun without direct sunlight until dry. The dried samples were then pulverized until smooth using a blender and then the extraction process was carried out using the maceration method.

### 2.3. Extraction procedure

The dry powder of *simplisia* was extracted using the maceration method with 96% ethanol as the solvent. One part of the *simplisia* powder was placed into a macerator and mixed with ten parts of solvent. The mixture was soaked for the first six hours with occasional stirring, then allowed to stand for an additional eighteen hours. The macerate was separated by filtration, and the extraction process was repeated at least once using the same solvent, with the solvent volume reduced to half of that used in the initial extraction. All macerates were combined and concentrated using a vacuum evaporator or low-pressure evaporator, such as a rotary evaporator (“rotavapor”), until a thick extract was obtained (Fawwaz *et al.*, 2017; Silverman *et al.*, 2023).

### 2.4. GC-MS analysis

A total of 0.5 mL of sample was pipetted into a test tube and 5 mL of methanol was added. The mixture was homogenized using a vortex for 1 minute, put into a vial, and then a chromatography test using GC-MS Ultra QP 2010 Shimadzu instrument. Instrument conditions were operated at an injector temperature of 250° C with splitless mode, the pressure of 76.9 kPa and a flow rate of 1.4 mL/min, and a ratio of 1:10. Ion source and interface temperatures of 200° C and 280° C, *solvent cut* time 3 min, 400-700 m/z. Column type SH-Rxi-5Sil MS column length 30 m with an inner diameter of 0.25 mm. The initial column temperature was 700° C with a holding time of 2 minutes and the temperature was increased to 200° C at a rate of 100° C/min and a final temperature of 280° C with a holding time of 9 minutes at a rate of 50° C/min so that the total analysis time was 30 minutes. The chromatogram data obtained was interpreted using the NIST 20 *library* in the instrument application (Fawwaz *et al.*, 2025).

## 3. RESULTS AND DISCUSSION

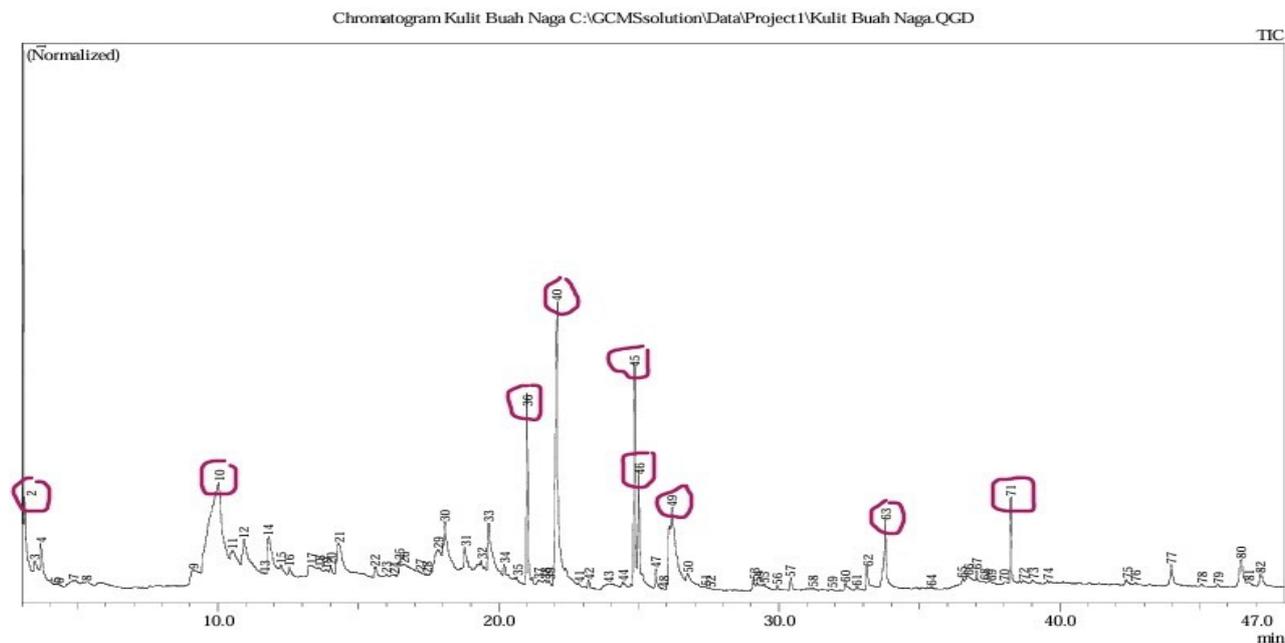
Red dragon fruit (*Hylocereus polyrhizus*) has been reported to possess several medicinal and pharmacological properties, including antioxidant and antibacterial activities. The ethanol extract of red dragon fruit peel contains various classes of secondary metabolites such as alkaloids, phenolics, flavonoids, terpenoids, steroids, saponins, and tannins (Sari Dian Novita, 2021). Furthermore, Luthfi and colleagues reported that *H. polyrhizus* peel contains bioactive compounds beneficial to human health, particularly those that help reduce total blood cholesterol levels, such as phenols, flavonoids, vitamin C, and betacyanins (Prakoso *et al.*, 2017). This study aims to determine the chemical profile of *H. polyrhizus* peel extract and identify the predominant phytochemical groups with the highest abundance, thereby revealing potential bioactive compounds with pharmacological value.

The red dragon fruit peel used in this study was collected from Makassar City, South Sulawesi, Indonesia. The fresh peel was dried to reduce its moisture content to less than 10%, preventing microbial activity and mold growth while preserving sample integrity for long-term storage. The dried *simplisia* was pulverized to reduce particle size and increase surface area, thereby enhancing solvent penetration during extraction.

Extraction was performed using the maceration method with 96% ethanol as the solvent with the yield of extract 1.2%. Maceration was chosen as it is a cold extraction technique, avoiding heat exposure that could degrade thermolabile compounds. Ethanol (96%) was selected due to its polarity, ability to dissolve a wide range of bioactive compounds, relatively low boiling point (79°C), safety, affordability, and ease of availability (Amini *et al.*, 2019). The resulting extract was concentrated using a rotary evaporator (Rotavapor).

Gas Chromatography–Mass Spectrometry (GC–MS) was employed to analyze the chemical constituents of the extract. GC separates volatile compounds under low pressure and high vacuum conditions, while MS identifies

compounds based on molecular weight, molecular formula, and charge distribution (Nuriah et al., 2023). The identified chemical constituents of the *H. polyrhizus* peel extract are presented in **Figure 1** and **Table 1**.



**Figure 1.** Chemical profile of GC-MS results on red dragon fruit peel

**Table 1.** Chemical compound detected dominantly in the GC-MS analysis

No	Retention time	%Area	Molecular weight	Compound	Pharmacological effect
1	22.086	10,90	242	Pentadecanoic acid	The compound pentadecanoic acid, has neuroprotective, antioxidant, anti-inflammatory, and antibacterial activities (Tri Rumanti & Saragih, 2023).
2	24.847	4,60	294	9,12- <i>Octadecadienoic acid, methyl ester</i>	It has antioxidant, antibacterial, antiviral, and anti-inflammatory activities. The antioxidant activity of <i>Octadecadienoic acid</i> can be utilized for the treatment of cancer and/or diabetes triggered by oxygen free radicals (Tri Rumanti & Saragih, 2023).
3	21.021	3,63	270	<i>Pentadecanoic acid, methyl ester.</i>	The compound <i>pentadecanoic acid</i> and its <i>methyl ester</i> have neuroprotective, antioxidant, anti-inflammatory, and antibacterial activities (Tri Rumanti & Saragih, 2023).
4	24,996	3,34	348	8,11,14- <i>Docosatrienoic acid methyl ester.</i>	<i>Docosatrienoic acid</i> , and <i>methyl ester</i> Compounds are saturated fatty acids that reducing inflammation
5	38,259	1,59	342	2,6,10,14,18- <i>Pentamethyl-2,6,10,14,18-</i>	Eicosapentaenoic acid (EPA) has various pharmacological effects, especially in relation to its anti-inflammatory and neuroprotective properties (Tri Rumanti & Saragih, 2023).
6	26,189	7,10	266	<i>Z,Z-3,13- Octadecdien-1-ol Eicosapentaene</i>	It has antioxidant, antibacterial, antiviral, and anti-inflammatory activities. The antioxidant activity of <i>Octadecadienoic acid</i> can be utilized for the treatment of cancer and/or diabetes triggered by

					oxygen-free radicals (Tri Rumanti & Saragih, 2023).
7	33,782	2,38	390	<i>Diisocotyl phthalate</i>	Has neuroprotective, antioxidant, anti-inflammatory,- and antibacterial activities (Tri Rumanti & Saragih, 2023)

#### 4. CONCLUSION

Based on the results of this study, it can be concluded that the ethanol extract of red dragon fruit peel contains a total of 82 chemical compounds as identified by GC–MS analysis. Among these, nine compounds exhibited relatively high abundance, with peak area percentages ranging from 0.16% to 13.92%. The compound with the largest peak area was observed at a retention time (RT) of 22.806 minutes, corresponding to the 40th identified compound, *pentadecanoic acid*. This compound is known to possess diverse pharmacological activities, including neuroprotective, antioxidant, anti-inflammatory, anticancer, antidiabetic, and antibacterial properties. These findings suggest that *H. polyrhizus* peel represents a promising source of bioactive compounds with potential therapeutic applications.

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**Ethical Approval:** Not applicable

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