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Fatty acids from waste rosehip seed: chemical characterization by GC-MS

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Abstract — Recently, the use of oils obtained from waste vegetable sources in the food, pharmaceutical, and cosmetic industries has been increasing. Rosehip fruit is a good source of waste, resulting in a large number of waste seeds after processing for various products in the food industry. Waste rosehip seed was obtained from the rosehip marmalade canning industry. The main aim of this study is to determine fatty acid contents of waste rosehip seed by Gas Chromatography coupled with Mass Spectrometry (GC-MS). Eighteen components comprising 100% of the total peak area were determined in the petroleum ether extract. Oleic acid methyl ester (9-Octadecenoic acid (Z)-, methyl ester) (36.42%) was determined to be the dominant fatty acid.

1. Introduction

Plant wastes are more than the parts of the plants that are consumed by eating or processing [1]. There are many plant-based organic waste materials (bark, leaves, bushes, fruit and vegetable waste, weeds, seed) in harvest, agriculture, and various industrial enterprises [2]. As the world population grows, converting all industrial and agricultural organic waste into reusable products is essential. Also, this has great benefits for environmental pollution. Most of these wastes are very rich in content, and some of them are disposed of directly as municipal solid waste or by mixing with soil in nature. Recently increasing attention is gained to the effective use of waste biomass as a recycle resource of valuable components with applications biodiesel productions, food, cosmetics, and pharmaceutical industries [3,4].

In a few studies, the researchers aimed to evaluate fatty acids from different seeds from agro-industrial waste to determine the presence of bioactive compounds. For this reason, the fatty acid profile was determined in date, cherry, pomegranate seeds [5-7].

The rosehip genus belonging to the *Rosaceae* family has more than 400 species, and it is rich in vitamin C, phenolics, unsaturated fatty acids, and carotenoids [8-10]. Plant materials are mostly consumed in herbal teas, marmalades, and fruit juices [11]. In some cultures such as Turkey, rosehip has medical

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applications for flu, inflammation, gastric disorder, rheumatoid arthritis, and pain [12,13]. Approximately 30% of rosehip weight is seeds, and these seeds are discarded as waste after the rosehip has been processed. The seed oil has nutritional value and biological properties like antioxidant, anticancer, anti-inflammatory, immune system enhancement, and carbohydrate metabolism [8].

Rosehip seed oil is rich in polyunsaturated fatty acids. The most abundant fatty acid is linoleic acid (41.1-51.0%), followed by α-linolenic (19.6-23.8%) and oleic (20.3-23.0%) acids [8,14,15]. the oil content in rosehip seeds is not much, but the oil is rich in bioactive lipids, including tools and sterols that contribute to healthy properties [16]. The oil also contains high levels of carotenoids [9]. The rosehip seed oil has been applied in dermatological and cosmetic applications to treat pigmentation, ulceration, and scarring problems. Due to its high bioactive contents, rosehip oil has antibacterial, antifungal, anticancer, and anti-inflammatory properties [17].

The growing interest in plant wastes as a source of bioactive contents has motivated consumers and researchers. There is limited published research on waste rosehip seed oil. Therefore, it was aimed to determine fatty acid constituents of rosehip waste seeds by GC-MS.

2. Materials Method

2.1. Chemicals

All chemicals and reagents were analytical grades. Deionized water was used from a Milli-Q water purification system (Millipore, USA).

2.2. Plant material

Waste rosehip seeds were supplied from a rose hip processing industry in Tokat (Turkey). The seeds were washed and cleaned to remove the adherent materials. After that, the cleaned seeds were dried at room temperature, stored at 4°C until further use.

2.3. GC-MS analysis of fatty acids

Gas chromatography coupled with mass spectrometry (GC-MS) was used to identify volatile constituents in fatty acids extracted from waste rosehip seed. The analysis was carried out in a Trace 1310 gas chromatograph equipped with an ISQ single quadrupole mass spectrometer (Thermo Fisher Scientific, Austin, TX). The procedure was set to an initial temperature of 70 °C for 6 min, then ramp at 3 °C/min to 235°C and finally 10 min 235 °C. The ion source and detector temperature were 250°C and 250°C, respectively. Before injection, the samples were filtered with a 0.22 μm syringe filter. The volume of injection was 1 μL. A Thermo TG-WAXMS GC column (60m×0.25mm×0.25μm) was used for identification. The carrier gas was helium with a flow rate of 1.2mL/min. Mass spectral scan range was set at the rate of 55-550 (amu). Peak identification was conducted by comparing the known compounds stored in the NIST Demo, Wiley7, Wiley9, red lip, main lip, WinRI. The retention indexes were determined by referring to the literature [18].

2.4. Extraction

The waste seeds of rosehip (50 g) were immersed in petroleum ether (200 mL) overnight at room temperature. The supernatant was filtered through a Whatman No. 1 filter paper and then was concentrated under vacuum. After esterification sample was ready for GC-MS analysis.

2.5. Esterification

For the analysis, petroleum extract of the seeds (15 mg) was mixed 3 mL of 1 M KOH in methanol and vortexed for a couple of minutes. The esterified phase was obtained and filtered with a 0.22 μm filter, put in a vial for GC-MS [18].

3. Result and Discussion

While the human body can produce many fatty acids, it cannot synthesize linoleic acid, an omega-6 fatty acid, and linolenic acid, an omega-3 fatty acid, so they must be taken from the diet [19]. They are significant for health, brain development, growth and reproduction [20]. The necessity of taking these fatty acids necessary for the human body has increased the number of such studies [21].

The findings of earlier studies reported that rosehip seed has higher fatty acids [20]. This amount varies according to the extraction method and environmental conditions [22,23].

The fatty acid constituents of the petroleum ether extract were identified by GC-MS analysis (Figure 1.). The fatty acids of the waste material with individual percentages of each component are given in Table 1. The compounds were identified by comparing their mass spectra with specific features obtained with the 1-12 Wiley9, 13-14 main lib, 15-18 wiley9 library spectral data bank.

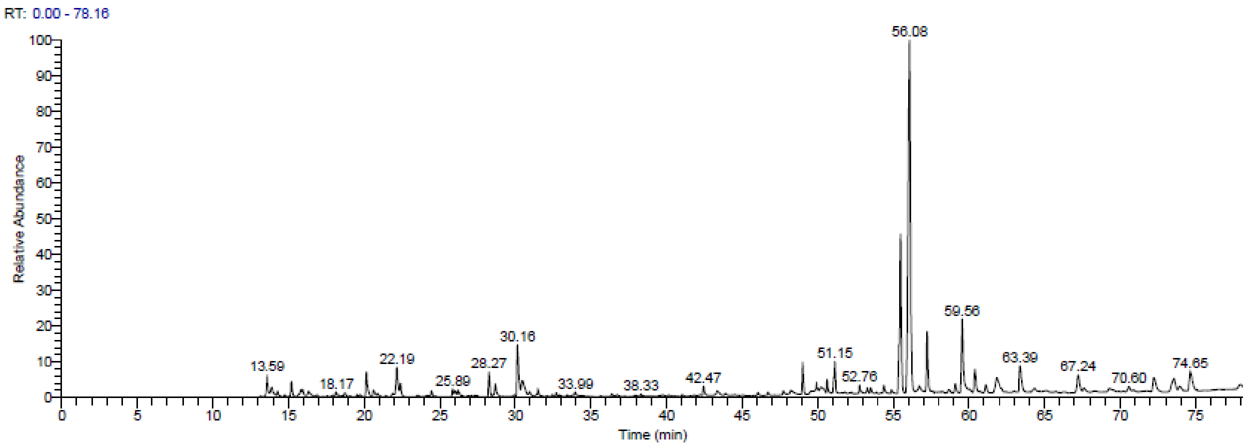

Figure 1. GC-MS chromatograms of fatty acids of waste rosehip seed.

For quantification, the normalized peak area was used without applying any correction factor. The petroleum ether extract was obtained from the seeds at room temperature. GC-MS analysis of waste rosehip seed essential oil led to identifying 18 constituents representing 100 % of the oil. It was found to be rich in unsaturated fatty acids.

Oleic acid methyl ester (9-Octadecenoic acid (Z)-, methyl ester (36.42%)), methyl stearate (Octadecanoic acid, methyl ester (11.91)), stearyl alcohol (1-Octadecanol (6.62%) were determined to be dominant fatty acids, which were in agreement with results of the previous studies [8]. No report is available of waste rosehip seed petroleum ether extract. This study is the first report of analysis for fatty acid from waste rosehip seed. According to the previous reports about non-waste rosehip seed, the most abundant fatty acids are linoleic acid (35.94±54.75%) and linolenic acid (20.29± 26.48%) [24].

Table1. Chemical composition of fatty acids of waste rosehip seed

No	RT	Compound Name	Area %	Molecular formulae	Molecular Weight
1	13.59	2-Heptanone (CAS)	2.96	$C_7H_{14}O$	114
2	15.94	1-Heptyn-3-ol	1.93	$C_7H_{12}O$	112
3	20.16	1-Hexanol	1.82	$C_6H_{14}O$	102
4	22.19	Benzene, (methoxymethyl)-	3.68	$C_8H_{10}O$	122
5	28.27	Linalool L	2.61	$C_{10}H_{18}O$	154
6	30.16	1-Dodecanamine, N, N-dimethyl-	6.34	$C_{14}H_{31}N$	213
7	50.64	Ethanol,2-(9-octadecenyloxy),	5.28	$C_{20}H_{40}O_2$	312
8	55.49	Octadecanoic acid, methyl ester	**11.91***	$C_{19}H_{38}O_2$	298
9	56.08	9-Octadecenoic acid (Z)-, methyl ester	**36.42***	$C_{19}H_{36}O_2$	296
10	57.23	7,10-Octadecadienoic acid, methyl ester	3.78	$C_{19}H_{34}O_2$	294
11	59.56	1-Octadecanol	**6.62***	$C_{18}H_{38}O$	270
12	60.29	2-Hexadecen-1-ol3,7,11,15tetramethyl	2.01	$C_{20}H_{40}O$	296
13	61.83	7-Methyl-Z-tetradecen-1-ol acetate	2.57	$C_{17}H_{32}O_2$	268
14	63.39	Docosane	2.59	$C_{22}H_{46}$	310
15	67.24	1-Hexadecanol,2-methyl-	2.32	$C_{17}H_{36}O$	256
16	72.25	Octadecane, -3ethyl-5-(2-ethylbutyl)	1.94	$C_{26}H_{54}$	366
17	73.56	Methyl10-oxohexadecanoate	2.54	$C_{17}H_{32}O_3$	284
18	74.65	Nonacosanol	2.68	$C_{29}H_{60}O$	424

*Bold means dominant compounds.

Besides rosehip seed oils have fatty acids and essential oils, they are a good source of other bio-active compounds like carotenoids, tocopherols, phospholipids [15]. But there are only a few reports to identify the content of these biologically active compounds in waste rosehip seeds. By determining its ingredients, it made it an attractive raw material for cosmetics [20]. This oil is also excellent natural moisturizing oil regenerative, anti-inflammatory, and anti-ageing properties associated with high content of unsaturated fatty acids such as omega-6 and omega-3 essential fatty acids. Interest in obtaining bioactive compounds in s directly or from waste has increased in recent years [19]. While more attention was paid to oil yield in the past, several new reports emphasized the importance of compounds in the waste rosehip seed.

4. Conclusion

In this study, fatty acid constituents of waste rosehip seed were determined by Gas Chromatography coupled with Mass Spectrometry (GC-MS). Eighteen components comprising 100% of the total peak area were determined in the petroleum ether extract. Oleic acid methyl ester (9-Octadecenoic acid (Z), methyl ester) (36.42%) was determined to be the dominant fatty acid. Although rosehip seed is a processed waste, it can be seen as a recycling material since it still contains fatty acids. Moreover, the use of new alternative fatty acid sources is also very important economically. This was the first report on the study of fatty acid compounds from waste rosehip seed. This waste material can be suggested as a source of bioactive compounds for the food and pharmaceutical industries.

Author Contributions

The author read and approved the last version of the manuscript.

Conflicts of Interest

The author declared no conflicts of interest concerning the research and publication of this article.

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