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Effect Of Ultrasound-Assisted Extraction On Efficiency, Antioxidant Activity, And Tocopherol Content Of Passiflora Edulis Seed Oil

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ABSTRACT

Introduction: Context: *Passiflora edulis* is tropical fruits that contain 70% of seeds. The juice industry categorizes the seed as a waste. Even though the seeds contain oil which has great potential in the pharmaceutical industry.

Objectives: to optimize the efficiency of Ultrasonic Assisted Extraction (UAE) thought antioxidant activity and tocopherol contents.

Methods: : The extraction of Ultrasonic-Assisted Extraction with various parameters in temperatures (50ºC and 60ºC) and time (5, 10, 15, 20, 30 minutes). Antioxidant assay was *used 1,1 Diphenyl 2-picrylhydrazyl* radical scavenging and tocopherol content with TLC-Densitometry.

Results: The results of the study showed that extraction with UAE at temperatures of 50ºC and 60ºC for 30 minutes showed very good results with higher oil yields and antioxidant potential IC_{50} of 14.996 and 14.865 ug/mL, while tocopherol levels were 32.302 and 33.097 ug/mL, respectively.

Conclusions: The results of the study showed that extraction with UAE at temperatures of 50ºC and 60ºC for 30 minutes showed very good results with higher oil yields and antioxidant potential by reducing DPPH IC_{50} of 14.996 and 14.865 ug/mL, antioxidant with FRAP method IC_{50} 50.592 and 47.076ug/mL, while tocopherol levels were 32.302 and 33.097 ug/mL, respectively

INTRODUCTION

Passiflora edulis Sims belong to the family Passifloraceae, is widely cultivated in tropical and subtropical regions of the world. *Passiflora edulis* is characterized by unique fragrance, moderate sweetness and tartness, and rich in active substances, such as pectin, anthocyanins, carotenoids, tocopherol and phenolics [Huo, et al., 2023; Kawasoe et al., 2021]. *Passiflora edulis* is extensively used to make juice, or used as a flavouring agent in beverages or desserts [Zhou et al., 2022; de Oleiveira, et al., 2016; Sanwal, et al., 2022]. Other research has been reported that *Passiflora edulis* seed oil more suitable for UAE extraction with hexane solution compared with conventional maceration method.

In green extraction method and modern extraction, ultrasound-assisted extraction (UAE) is a recent development. When the pressure created by the compression and expansion of mechanical sound waves from ultrasonography

exceeds the tensile strength of the liquid, vapor bubbles are created. When these bubbles subside, biological material's microporous particles get perturbed, which leads to high-velocity interparticle collisions and macro turbulence. As a result, the microjets' incursion causes matrices to break down and erode. Because of the internal diffusion mechanism and the increase in mass transfer via eddy, this permits intensification of extraction from a biological mass [Shisath, et al., 2012; Chemat & Khan., 2011; Dzah et al., 2020]. When UAE is used instead of traditional extraction methods, the oil yield is higher, the bioactive is better retained in the bio-matrices, and the extraction time is shortened while using a lower. UAE has been recognized as an appropriate method for low-cost extraction due to its ability to produce higher oil yield with better retention of bioactive in bio-matrices, shorter extraction times, and a lower volume of solvent to feed ratio when applied in comparison to conventional extraction techniques [Lukic et al., 2019; Roskiana, 2023; Roskiana 2023]. The effects of UAE factors, however, on antioxidant activity, tocopherol content, and moreover, stability while improving the extraction efficiency have not yet been studied and reported. Therefore, in order to achieve the desired physicochemical and functional properties of Passiflora seed oil, it becomes important to optimize the UAE process factors.

Objectives

The purpose of this study is to optimize the ideal UAE conditions to achieve improved oil quality and stability. It also aims to investigate the effects of ultrasound time and temperature on extraction yield, antioxidant activity, total tocopherol content of *Passiflora edulis* seed oil.

Methods

Preparing the Passiflora edulis seed

The seeds were collected from the syrup company at Makassar Indonesia. Then, drying and grinding to prepare extraction.

Extraction

Extraction was done by following the Ultrasonic-Assisted Extraction Method on various parameter of optimization including time and temperature. The UAE was following the concept (Tabel 1), each condition was using 100 mg of grounded seed and 300 mL hexanes as solvent.

Antioxidants assay

Antioxidants activity was measuring by scavenging of radical DPPH. About 1 mL of each sample added 3 mL DPPH solution, then incubated at dark room for 30 minutes. Then, the solutions were measured the absorbance by spectrophotometer at 517 nm. Tocopherol was used as standard for this experiment.

Tocopherol content

Tocopherol content was calculated by using TLC-Densitometer. Tocopherol was used a standard on vary concentration 10; 20; 30; 40; 50 ug/mL. The Passiflora seed oil was diluted on hexane pro-analyst. All the standard and samples were eluted with toluene; ethyl acetate (93:7). Then, calculated the Area Under Curve (AU) by TLC-Densitometer.

Results

Table 1. The data of UAE optimization

No.	Temperature (°C)	Time (Min)	Sample code	Total oil (mL)
1	50	5	A1	7,66
2		10	A2	11,26
3		15	A3	8,21
4		20	A4	12,92

5		30	A5	14,13
6	60	5	B1	6,78
7		10	B2	8,13
8		15	B3	11,48
9		20	B4	11,21
10		30	B5	11,74

Table 2. The data of Antioxidant assay of *Passiflora edulis* seed oil by DPPH method

NO	Temperature (°C)	Time (Min)	Sample code	IC_{50} (ug/mL) DPPH
1	50	5	A1	48.228
2		10	A2	46.311
3		15	A3	37.107
4		20	A4	36.013
5		30	A5	14.996
6	60	5	B1	46.602
7		10	B2	41.599
8		15	B3	39.148
9		20	B4	38.139
10		30	B5	14.865
11	Maceration		AB	41.744
12	Tocopherol			7.054

Table 3. The data of Antioxidant assay of *Passiflora edulis* seed oil by FRAP method

NO	Temperature (°C)	Time (Min)	Code Sample	IC_{50} (ug/mL) FRAP
1	50	5	A1	70.173
2		10	A2	87.370
3		15	A3	73.802
4		20	A4	55.901
5		30	A5	50.592
6	60	5	B1	71.396
7		10	B2	46.776
8		15	B3	87.136
9		20	B4	51.518
10		30	B5	47.076

Table 4. The data of tocopherol content of *Passiflora edulis* seed oil

NO	Temperature (°C)	Time (Min)	Sample code	Tocopherol contents (ug/mL)
1	50	5	A1	28.287

2		10	A2	28.792
3		15	A3	30.269
4		20	A4	31.582
5		30	A5	32.301
6		5	B1	28.579
7		10	B2	29.874
8	60	15	B3	32.028
9		20	B4	32.647
10		30	B5	33.097
11	Maceration		AB	25.893

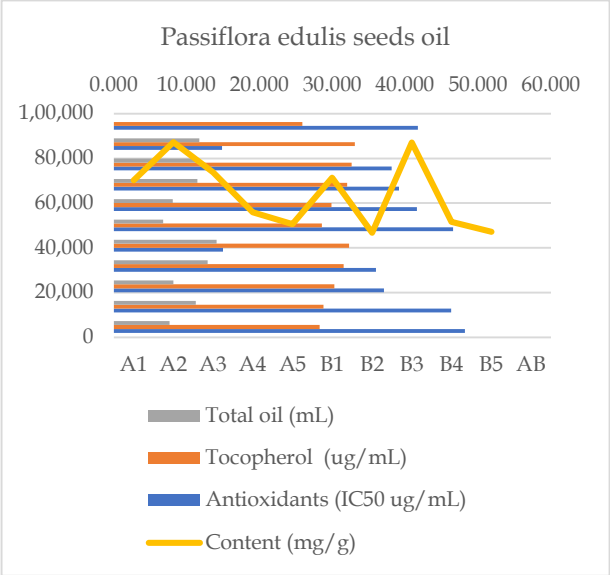

Figure 1. The effect of UAE on total oil, antioxidants and tocopherol contents

Discussion

Regarding the experiment, the data of the optimization UAE was collected, then presented in the Table 2.

The data shows that at temperatures of 50 and 60ºC there is an increase in the volume of extraction results per minute, so the significantly more oil was collected at an extraction time of 30 minutes compared to 5 minutes. This is probably needing more time to carry out of the oil from seed cells. Even though the data did not show a significant difference between 50 and 60ºC, however the 50 ºC (14,13 mL) little bit higher than 60ºC (11,74 mL).

The data in Table 3 and 4 shows that the treatment of increasing time in the UAE process shows increasingly potential results in antioxidant activity by reducing DPPH radical as shown in sample A5 IC_{50} 14,996 ug/mL and sample B5 14,865 ug/mL. In relation with the FRAB method, the potential antioxidant activity IC_{50} 50.592 and 47.076ug/mL. However, there is no significant difference for the temperature difference of 50 and 60. The data above is also compared with the results of conventional maceration extraction which shows that UAE results have much better antioxidant activity.

The tocopherol content test also showed data that correlated with the increase time of UAE on tocopherol levels. The longer the UAE time adequate to the higher the tocopherol levels. The results also did not show any significant differences between temperatures of 50 and 60ºC. This test was compared with oil from maceration extraction which showed lower tocopherol levels compared to the UAE.

The results above show that extraction with the UAE method is more efficient in producing *Passiflora edulis* seed oil.

In addition, antioxidant data also show that the extraction results with UAE are more potential as antioxidants. This data correlate with tocopherol level which show oil from the UAE method contains higher tocopherol levels than maceration.

CONCLUSION

The results of the study showed that extraction with UAE at temperatures of 50°C and 60°C for 30 minutes showed very good results with higher oil yields and antioxidant potential by reducing DPPH IC_{50} of 14.996 and 14.865 ug/mL, antioxidant with FRAP method IC_{50} 50.592 and 47.076ug/mL, while tocopherol levels were 32.302 and 33.097 ug/mL, respectively.

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