OPTIMIZATION OF MICROWAVE-ASSISTED EXTRACTION OF BIOACTIVE COMPOUNDS FROM MALE FLOWERS (CARICA PAPAYA L.) USING RESPONSE SURFACE METHODOLOGY

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ABSTRACT

The study was conducted with the aim of optimizing the extraction conditions for alkaloids and bioactive compounds from male papaya flowers (Carica papaya L.) using microwave-assisted extraction, to produce male papaya flower honey extract. The microwave power (119W – 700W) and time (60 – 120 seconds) were examined by using the experimental design employed the Response Surface Methodology (RSM) with a Central Composite Face-centered (CCF) model. The results demonstrated that the optimal extraction conditions were achieved at a microwave power of 385W and a microwave time of 80 seconds. In these conditions, alkaloid content, polyphenol content, flavonoid content, and antioxidant activity reached 0.033 ± 0.001 mg BER-H/g, 9.15 ± 0.14 mg GAE/g, 3.39 ± 0.13 mg rutin/g, 12.93 ± 0.17 mg vitamin C/g, respectively.

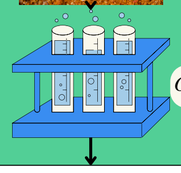
INTRODUCTION

Figure 1: Male Papaya flowers (Carica papaya L.)

MATERIALS AND METHODS

55 - 60°C

LESS THAN 10%



Optimization experiment using a central composite face design (CCF)

Runs	Variables	
	X1 (%)	X2 (seconds)
1	231	60
2	539	60
3	231	100
4	539	100
5	231	80
6	539	80
7	385	60
8	385	100
9	385	80
10	385	80
11	385	80

Table 1: Optimization treatments

Alkaloid Content (TAC)

Total Flavonoid Content (TFC)

Antioxidant capacity (AC)

Total phenolic content (TPC)

Diagram Experimental design

RESULTS AND DISCUSSION

Table 2: Results of optimization treatments affecting the extraction process

Runs	X1 (%)	X2 (seconds)	TAC (mg BER – H/g)	TPC (mg GAE/g)	TFC (mg rutin/g)	AC (mg vitamin C/g)
1	231	60	0.021	8.31	2.419	10.86
2	539	60	0.023	8.496	2.999	11.161
3	231	100	0.023	8.522	2.567	11.63
4	539	100	0.026	8.675	3.118	11.635
5	231	80	0.026	8.702	2.744	11.68
6	539	80	0.028	8.871	3.31	11.992
7	385	60	0.027	8.764	3.041	11.992
8	385	100	0.029	8.96	3.175	12.475
9	385	80	0.032	9.07	3.314	12.825
10	385	80	0.034	9.315	3.544	12.829
11	385	80	0.034	9.076	3.318	13.129

Based on the ANOVA results, the p-values for both the first-order and second-order regression coefficients were > 0.05, indicating that the regression equation is statistically significant. Microwave power (X1) and microwave time (X2) have a substantial impact on the bioactive compounds in this study, particularly alkaloids.

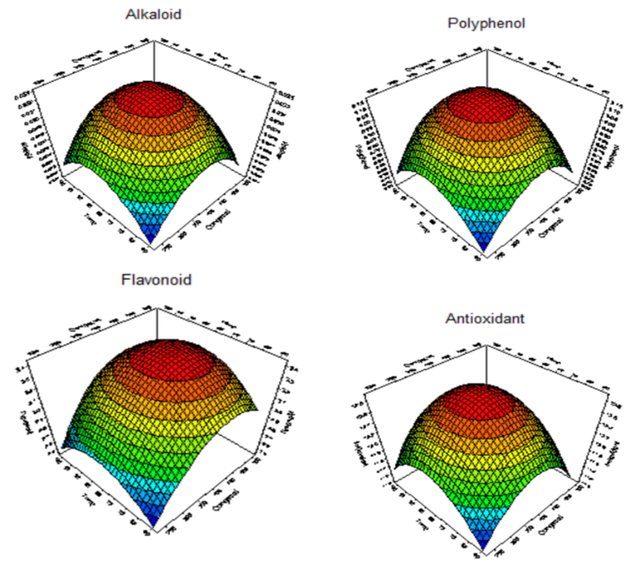


Figure 2: Response surface model illustrating the effect of microwave power and microwave time on alkaloid content, polyphenol content, flavonoid content, antioxidant activity

Table 3: Optimal parameters adjusted

Parameters	Content
TAC (mg BER -H /g)	0.033 ± 0.001
TPC (mg GAE/g)	9.15 ± 0.14
TFC (mg rutin/g)	3.39 ± 0.13
AC (mg Vitamin C/g)	12.93 ± 0.17

CONCLUSION

The extraction process of male papaya flowers (Carica papaya L.) using the microwave-assisted extraction method described in this study. The highest extraction efficiency was obtained at a microwave power of 385W and a microwave time of 80 seconds. The alkaloid content reached 0.033 ± 0.001 mg/g, the total polyphenol content reached 9.15 ± 0.14 mg/g, the flavonoid content reached 3.39 ± 0.13 mg/g, and the antioxidant activity reached 12.93 ± 0.17 mg/. These results provide a basis not only for further research but also for potential industrial applications to maximize the biological activities of male papaya flowers.

REFERENCES

[1] Chew, S. K., Teoh, W. H., Hong, S. L., & Yusoff, R. (2022). Extraction of rutin from the leaf of male Carica papaya Linn. using microwave-assisted and ultrasound-assisted extractive methods. ASEAN Journal of Chemical Engineering, 22(2), 1–9. https://doi.org/10.22146/ajche.77375

[2] Dwivedi, M. K., Sonter, S., Mishra, S., Patel, D. K., & Singh, P. K. (2020). Antioxidant, antibacterial activity, and phytochemical characterization of Carica papaya flowers. Beni-Suef University Journal of Basic and Applied Sciences, 9(1), 23. https://doi.org/10.1186/s43088-020-00048-w

[3] Rumpf, J., R. Burger, and M.J.I.J.o.B.M. Schulze. (2023). Statistical evaluation of DPPH, ABTS, FRAP, and Folin-Ciocalteu assays to assess the antioxidant capacity of lignins. 233: p. 123470