Antibacterial and antioxidant activities of *Cleistocalyx nervosum* var. *paniala* and *Carissa carandas* L. extracts against skin pathogenic bacteria



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Abstract

Human skin infection by pathogenic bacteria can cause symptoms such as abscesses, rashes, swelling, and inflammation. In severe cases, these bacteria are resistant to commonly used antibiotics. Consequently, natural extracts have gained increasing attention as alternative treatment. This study aimed to investigate the antibacterial and antioxidant activity of *Cleistocalyx nervosum* var. *paniala* (*C. nervosum*) and *Carissa carandas* L. (*C. carandas*) extracts. The physical properties showed that color of extracts was varied from purple to dark brown. The highest extraction yield was obtained from *C. carandas* extracted with 70% ethanol. Moreover, 95% and 70% ethanolic extracts of *C. nervosum* showed the highest antioxidant activity of 14.813 ± 0.912 mg TE/g extract and 44.33 ± 4.37 mg GAE/g extract using the DPPH assay and ABTS assay. Moreover, the 70% ethanolic extract of *C. carandas* exhibited the highest total phenolic content of 44.33 ± 4.37 mg GAE/g extract. In contrast, the 95% ethanolic extract of *C. nervosum* demonstrated the highest total anthocyanin content of 37.18 ± 0.98 mg C3G/g extract. Then, the antibacterial activity of the extracts was tested against six skin pathogenic bacteria by the agar well diffusion method. The results showed that all ethanolic extracts could inhibit skin pathogenic bacteria. Furthermore, the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) were determined. The ethanolic extracts of *C. nervosum* and *C. carandas* exhibited the strongest antibacterial activity. Therefore, this study revealed extracts of *C. nervosum* and *C. carandas* indicated potential as a promising antibacterial agent against skin pathogenic bacteria.

Introduction

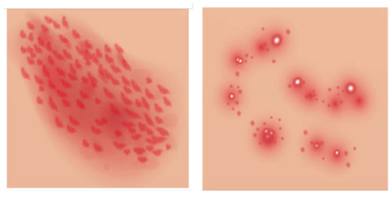


Figure 1 Symptoms of rashes and inflammation

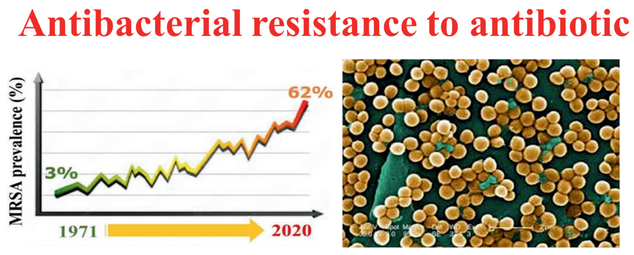


Figure 2 MRSA prevalence (%)



Figure 3 Plant extract

Objectives

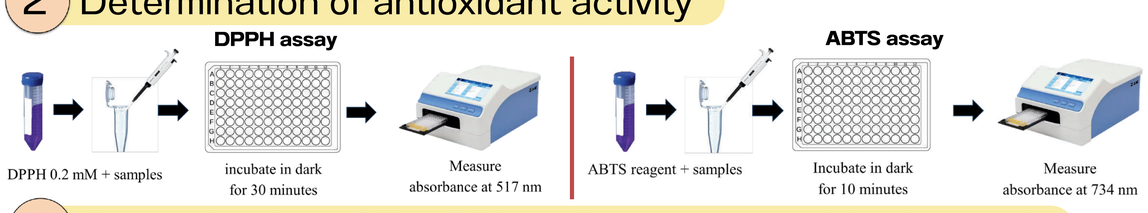
- To investigate the antioxidant activity of plant extracts derived from *cleistocalyx nervosum* var. *paniala* and *Carissa carandas* L.
- To assess the antibacterial potential against pathogenic bacteria associated with skin infections

Methodology

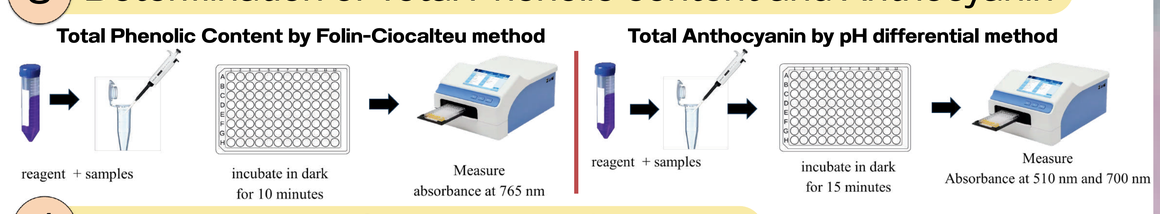
1 Plant extraction



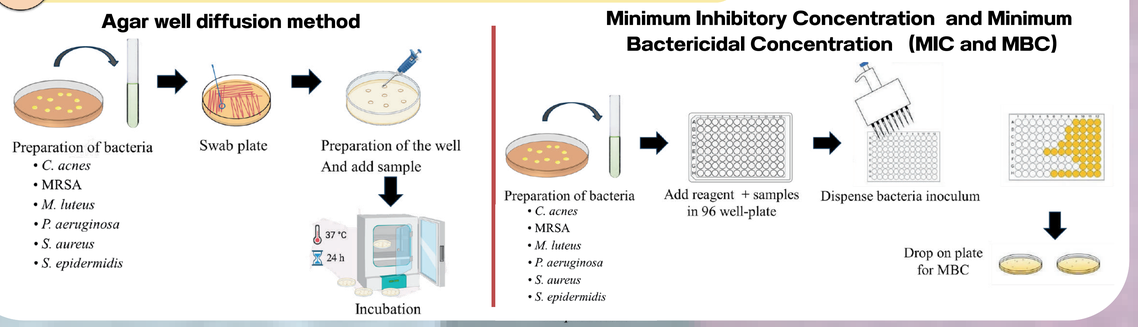
2 Determination of antioxidant activity



3 Determination of Total Phenolic content and Anthocyanin



4 Determination of Antibacterial activity



Result

1 Plant extraction

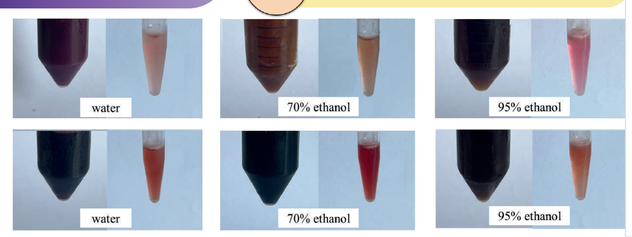


Figure 4 Color of the extracts

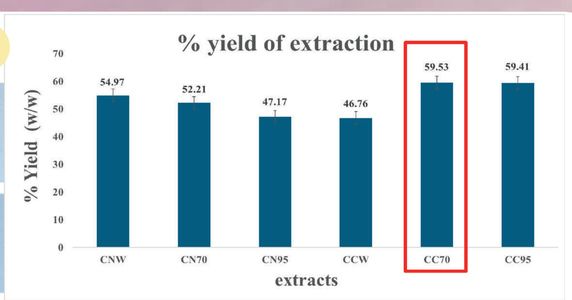


Figure 5 % yield of extraction

2 Determination of antioxidant activity

Table 1 Antioxidant activity of extracts determine using DPPH and ABTS assay

extracts	solvents	DPPH assay IC50 (mg/mL)	DPPH assay Antioxidant activity (mg TE/g extract)	ABTS assay IC50 (mg/mL)	ABTS assay Antioxidant activity (mg TE/g extract)
C. nervosum	DI water	1.82 ± 0.06 ^{c}	8.23 ± 0.29 ^{b}	3.19 ± 0.10 ^{b}	48.66 ± 1.25 ^{b}
	70% ethanol	1.07 ± 0.03 ^{d}	13.97 ± 0.45 ^{a}	3.14 ± 0.03 ^{c}	60.75 ± 0.59 ^{a}
	95% ethanol	1.01 ± 0.06 ^{d}	14.81 ± 0.91 ^{a}	3.49 ± 0.02 ^{bc}	54.51 ± 0.37 ^{ab}
C. carandas	DI water	3.04 ± 0.02 ^{a}	4.93 ± 0.03 ^{c}	3.97 ± 0.11 ^{b}	48.00 ± 7.42 ^{b}
	70% ethanol	1.09± 0.03 ^{d}	13.75 ± 0.39 ^{a}	3.30 ± 0.07 ^{bc}	57.76 ± 1.31 ^{a}
	95% ethanol	2.80 ± 0.09 ^{b}	5.34 ± 0.18 ^{c}	6.39 ± 0.23 ^{a}	29.81 ± 1.09 ^{c}

3 Determination of Total Phenolic content and Anthocyanin

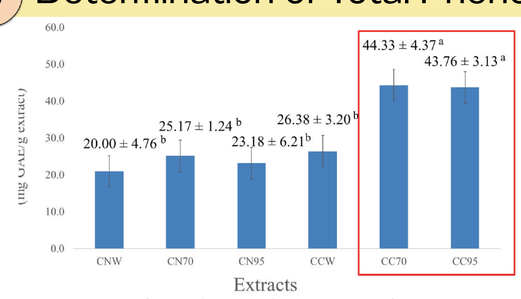


Figure 6 Total Phenolic content of extracts

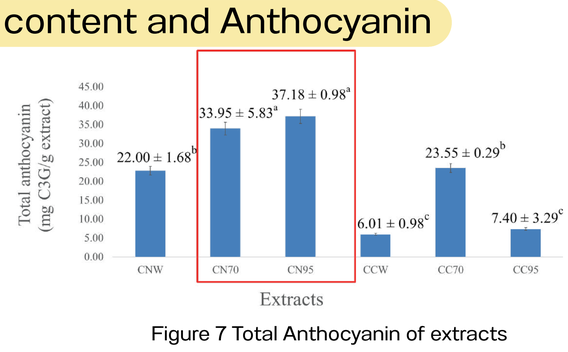


Figure 7 Total Anthocyanin of extracts

4 Determination of Antibacterial activity

Agar welldiffusion method

Table 2 Diameter of inhibition zones of extracts at concentration 500 mg/mL

extracts	solvents	Zone of inhibition (mm) *S. aureus*	*S. epidermidis*	*M. luteus*	MRSA	*C. acnes*	*P. aeruginosa*
C. nervosum	DI water	17.0 ± 0.6 ^{a}	18.0 ± 1.5 ^{c}	19.0 ± 0.6 ^{c}	17.0 ± 2.6 ^{ab}	0 ^{b}	0 ^{d}
	70% ethanol	17.0 ± 2.6 ^{a}	19.0 ± 0.6 ^{c}	27.0 ± 4.0 ^{b}	19.0 ± 2.0 ^{ab}	14.0 ± 1.0 ^{a}	13.0 ± 2.0 ^{b}
	95% ethanol	19.0 ± 1.7	20.0 ± 0.6 ^{b}	31.0 ± 1.4 ^{b}	20.0 ± 2.5 ^{ab}	14.0 ± 1.5 ^{a}	15.0 ± 1.2 ^{ab}
C. carandas	DI water	19.0 ± 1.5 ^{a}	24.0 ± 1.5 ^{a}	19.0 ± 0.6 ^{c}	19.0 ± 2.5 ^{b}	0 ^{b}	10.0 ± 0.6 ^{c}
	70% ethanol	21.0 ± 1.5 ^{a}	24.0 ^{a}	34.0 ± 1.5 ^{a}	24.0± 2.6 ^{a}	14.0 ± 1.2 ^{a}	17.0 ± 0.6 ^{a}
	95% ethanol	20.0 ± 1.5 ^{a}	21.0 ± 1.5 ^{ab}	32.0 ± 1.5 ^{b}	23.0 ± 1.5 ^{ab}	12.0 ± 1.5 ^{a}	16.0 ± 2.1 ^{a}
Antibiotic* (conc. 1 mg/mL)		30.7 ± 0.5	31.0 ± 0.6	43.8 ± 1.2	19.3 ± 1.2	13.4 ± 1.5	33.3 ± 0.8

MIC and MBC

Table 3 MIC and MBC values of extracts

extracts	solvents	MIC and MBC *S. aureus*	*S. epidermidis*	*M. luteus*	MRSA	*C. acnes*	*P. aeruginosa*
C. nervosum	DI water	250.00/250.00	125.00/125.00	31.25/31.25	250.00/250.00	250.00/250.00	125.00/125.00
	70% ethanol	31.25/31.25	125.00/125.00	15.63/15.63	62.50/62.50	31.25/31.25	62.50/62.50
	95% ethanol	31.25/31.25	31.25/31.25	15.63/15.63	31.25/31.25	15.63/15.63	62.50/62.50
C. carandas	DI water	62.50/62.50	125.00/125.00	125.00/125.00	62.50/62.50	125.00/125.00	31.25/31.25
	70% ethanol	31.25/31.25	62.50/62.50	31.25/31.25	62.50/62.50	62.50/62.50	31.25/31.25
	95% ethanol	62.50/62.50	62.50/62.50	62.50/62.50	31.25/31.25	62.50/62.50	31.25/31.25
Antibiotic* (conc. 1 mg/mL)		31.25/31.25	15.63/15.63	125.00/125.00	250.00/250.00	125.00/125.00	15.63/15.63

Discussion and Conclusions

- The solvents had a significant effect on the concentrations of the bioactive compounds and visual color. The 70% ethanolic extract of *C. carandas* showed the highest extraction yield.
- The ethanolic extracts exhibited significantly higher radical scavenging antioxidant activity than the aqueous extract.
- The ethanolic extracts of *C. carandas* showed the highest total phenolic content and the ethanolic extract of *C. nervosum* showed the highest total anthocyanin
- That ethanolic extracts of *C. nervosum* and *C. carandas* could inhibit skin pathogenic bacteria.
- The ethanolic extracts showed lower MIC and MBC values, indicating stronger antibacterial activity. Which, the ethanolic extracts of *C. nervosum* exhibited stronger antibacterial activity than *C. carandas.*

This study revealed extracts of *C. nervosum* and *C. caranda* indicated potential as promising antioxidants and antibacterial a gents against skin pathogenic bacteria.

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