Comparison of Phytochemical Contents, Antioxidant and Antibacterial Activities of Various Solvent Extracts Obtained from 'Maluma' Avocado Pulp Powder

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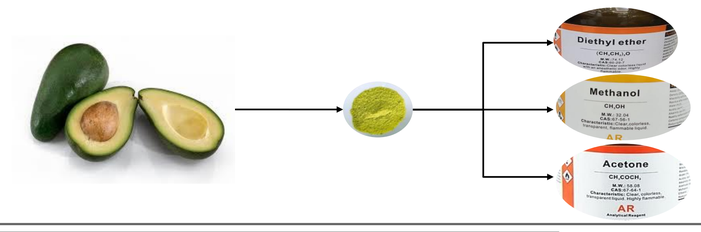
ABSTRACT

Although avocado is a superfood rich in phytochemicals with high antioxidant activities, studies on the antibacterial properties of its pulp are limited, except for seed and peel portions. In this study, three types of solvent (acetone, methanol, and diethyl ether) were used to obtain the extracts from "Maluma" avocado pulp powder prepared by infrared drying. The extracts were analyzed for total polyphenols, phytopigments (total chlorophylls and carotenoids), antioxidant activities (ferric-reducing antioxidant power (FRAP), 2,2-Diphenyl-1-picrylhydrazyl (DPPH), and 2,2-azinobis(3-ethylbenzothiazoline-6-sulfonic acid (ABTS) assays), and antibacterial activities against seven pathogens (*Shigella sonnei* ATCC 9290, *Escherichia coli* ATCC 8739, *Salmonella typhi* ATCC 6539, *Vibrio parahaemolyticus* ATCC 17802, *Proteus mirabilis* ATCC 25933, *Staphylococcus aureus* ATCC 6538, and *Bacillus cereus* ATCC 11778). The results showed that the acetone solvent could extract the highest polyphenols and chlorophylls with the highest antioxidant activity in terms of ABTS and DPPH assays. In contrast, diethyl ether exhibited the most significant content of carotenoids and FRAP values. However, the methanol extract was the best solvent, exerting the strongest antibacterial and meaningful antioxidant activities. For the bacterial activities, Gram-positive pathogens (*Bacillus cereus* and *Staphylococcus aureus*) were inhibited more efficiently by avocado extracts than Gram-negative bacteria. Therefore, the extracts from avocado powder showed great potential for applications in food processing and preservation, pharmaceuticals, and cosmetics. [5]

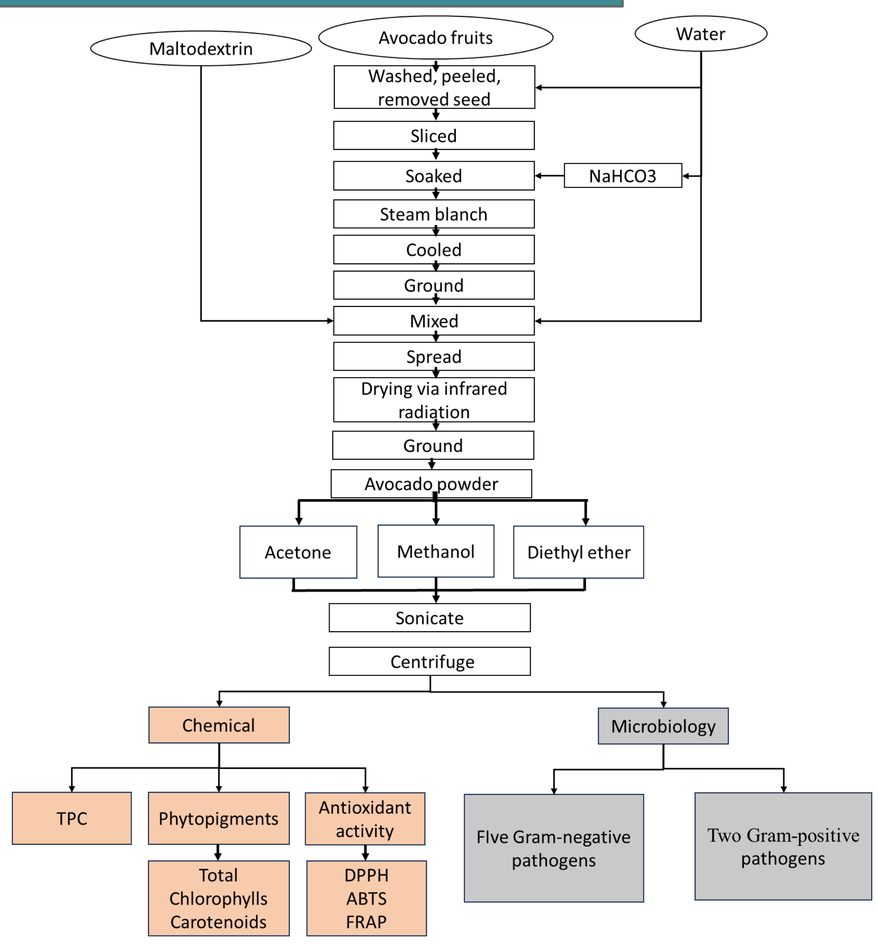
INTRODUCTION

Avocado [1]
- Superfoods" with a high commercial value
- High nutritious content
- Bioactive compounds related to health benefits

Extraction solvent [2]
- Influence the extraction yield
- Efficacy
- Solvent polarity



METHODS AND MATERIALS



CONCLUSIONS

This study characterized the antioxidant and antibacterial activities of different extracts (acetone, methanol, and diethyl ether) from avocado pulp powder. The results showed these activities were solvent-dependent, in which methanol and acetone were effective in extracting phenolic components and chlorophylls. Still, the extracts with diethyl ether obtained the highest content of carotenoids. The results found that the TPC and phytopigments in the investigated extracts showed different antioxidant mechanisms. Thus, these compounds played an important role in the antioxidant activity of extracts. Except for the diethyl ether extract, the methanol and acetone extracts inhibited all seven pathogens tested. The methanol extract had the most excellent antibacterial activity with exceptional inhibition zones (diameter ranging from 10 to 28 mm). In addition, Grampositive pathogens (Bacillus cereus and Staphylococcus aureus) were more sensitive to extracts from avocado powder than Gram-negative pathogens. Finally, it was indicated that the methanol extract was the best solvent, since it possessed the highest antibacterial and significant antioxidant activities. For further study, after the optimal extraction conditions were determined, the extracts with considerable antioxidant and antibacterial activities may have a wide range of applications in various fields, such as food processing and preservation, pharmaceuticals, and cosmetics. [5]

RESULTS AND DISCUSSION

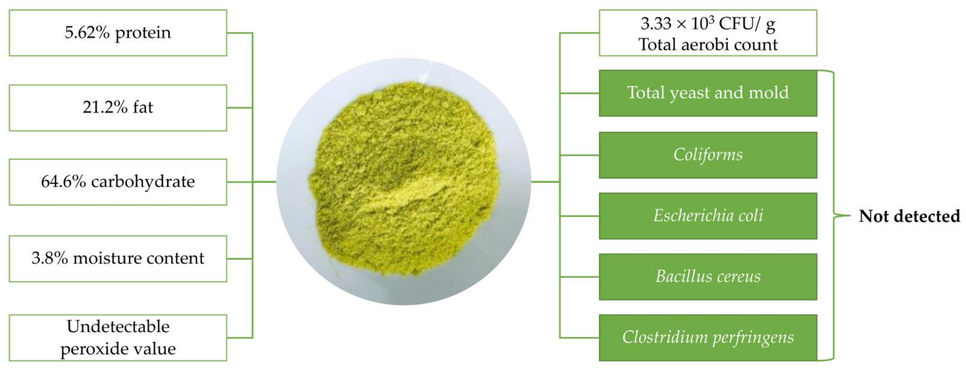


Figure 1. Physicochemical and microbiological properties of avocado powder prepared from avocado flesh (*Persea Americana* Mill. cv. "Maluma"). [5]

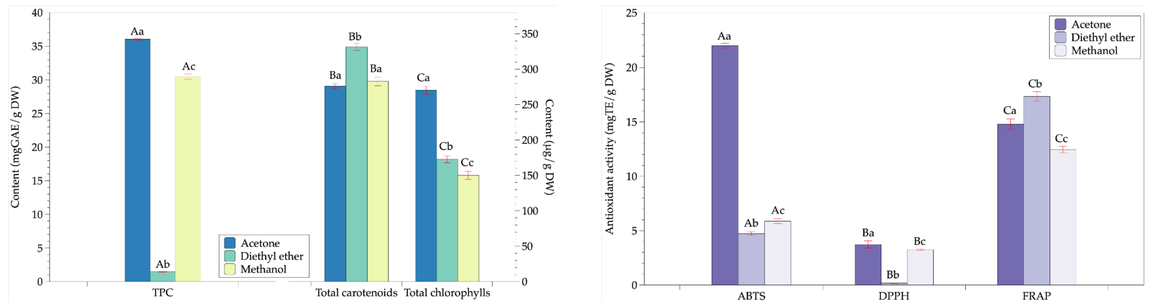


Figure 2. (A) Effects of solvents on the total phenolics content (TPC) and the content of phytopigments (B) the antioxidant activity of avocado extracts. Note: capital letters represent the same group of responding variables, and values within a group with the same lowercase letters are not significantly different ($p > 0.05$). [5]

Table 1. Pearson correlation coefficients between the phytopigments, TPC, and antioxidant activity of avocado extracts. [5]

	TPC (mg Gallic Acid Equivalent/g of Sample Dry Weight (mg GAE/g DW))	Total Carotenoids (µg/g DW)	Total Chlorophylls (µg/g DW)
2,2-Diphenyl-1-picrylhydrazyl (DPPH; mg Trolox equivalent (TE)/g DW)	0.99308	−0.98586	0.44616
p-value (2-tailed)	0.00000	0.00000	0.22868
2,2-azino-bis(3-ethylbenzothiazoline-6sulfonic acid (ABTS; mg TE/g DW)	0.66928	−0.62861	0.96595
p-value (2-tailed)	0.04865	0.06979	0.00002
Ferric-reducing antioxidant power (FRAP; mg TE/g DW)	−0.77974	0.78034	0.14305
p-value (2-tailed)	0.01321	0.01309	0.71350

Note: correlations in bold are significant at the 5% level (2-tailed).

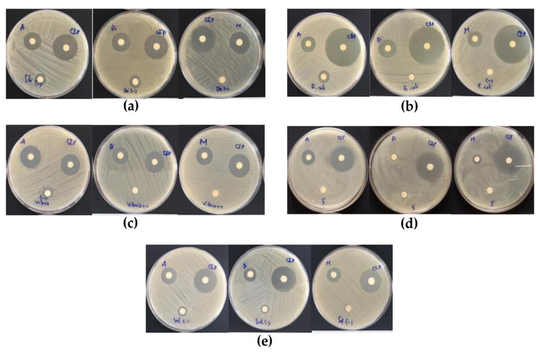


Figure 3. Visual observations of the inhibitory effects of avocado extracts against Gram-negative pathogens including *Shigella sonnei* ATCC 9290 (**a**), *Escherichia coli* ATCC 8739 (**b**), *Vibrio parahaemolyticus* ATCC 17802 (**c**), *Proteus mirabilis* ATCC 25933 (**d**), and *Salmonella typhi* ATCC 6539 (**e**). Note: A, Di, M, CIP, and (–) symbols on petri discs denote the acetone, diethyl ether, methanol extracts, ciprofloxacin (reference antibiotics), and negative control, respectively. [5]

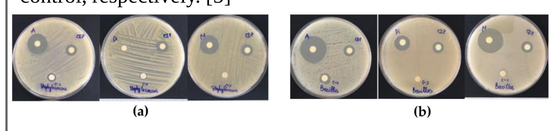


Figure4. Visual observations of the inhibitory effects of avocado extracts against Gram-positive pathogens including *Staphylococcus aureus* ATCC 6538 (a) and *Bacillus cereus* ATCC 11778 (b). Note: A, Di, M, CIP, and (–) symbols on petri discs denote the acetone, diethyl ether, methanol extracts, ciprofloxacin (reference antibiotics), and negative control, respectively. [5]

Table 2. Antibacterial activities of avocado extracts using different solvents against seven pathogens as presented in the diameters of inhibition zones using an agar well diffusion assay. [5]

NO	Pathogen	Sample	Inhibitory Diameter (mm) * Acetone	Diethyl Ether	Methanol
1	Shigella sonnei ATCC 9290	Ciprofloxacin	26	26	26
		Extracts	7	7	20
		Negative control	11	11	0
2	Escherichia coli ATCC 8739	Ciprofloxacin	32	31	33
		Extracts	6	12	16
		Negative control	11	8	0
3	Salmonella typhi ATCC 6539	Ciprofloxacin	25	25	23
		Extracts	5	3	15
		Negative control	12	9	0
4	Vibrio parahaemolyticus ATCC 17802	Ciprofloxacin	21	20	21
		Extracts	11	13	18
		Negative control	9	0	0
5	Proteus mirabilis ATCC 25933	Ciprofloxacin	26	27	26
		Extracts	14	0	10
		Negative control	0	0	0
6	Staphylococcus aureus ATCC 6538	Ciprofloxacin	10	10	10
		Extracts	11	0	20
		Negative control	10	7	0
7	Bacillus cereus ATCC 11778	Ciprofloxacin	11	10	11
		Extracts	17	15	28
		Negative control	11	0	0

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