# Phytochemical content, antioxidant activity and in-vitro digestive enzymes inhibition properties of Vietnamese coriander (*Persicaria odorata*)

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**ABSTRACT** Obesity, a prevalent global health issue, is closely associated with oxidative stress and impaired lipid metabolism. Inhibition of digestive enzymes such as amylase and pancreatic lipase slows starch digestion and reduce fat absorption, respectively, thus may be beneficial in obesity management. This study explores the potential of Vietnamese coriander (*Persicaria odorata*) as a natural source of antioxidants and enzyme inhibitors. Dried leaf samples were extracted with 80% ethanol and water using ultrasound-assisted extraction. Phytochemical content was analyzed through total phenolic and flavonoid colorimetric assays, while antioxidant activity and digestive enzymes (pancreatic lipase and alpha amylase) inhibition were assessed spectrophotometrically. The 80% ethanol extract exhibited significantly higher yield (25.59 ± 2.24%), TPC (106.85 ± 2.14 mg GAE/g), and TFC (101.09 ± 0.06 mg QE/g) compared to the water extract. Antioxidant activity was greater in the 80% ethanol extract (63.22 ±3.04%). Additionally, ethanolic extract showed higher inhibition of pancreatic lipase and alpha-amylase (58.05 ± 2.87% and 39.07 ± 1.71%), respectively. Strong positive correlations were found between phenolic content, antioxidant capacity, and alpha-amylase inhibition. These findings suggest that 80% ethanol is a more effective solvent for extracting bioactive compounds from Vietnamese coriander and highlight the herb's potential in managing oxidative stress and obesity-related enzyme activity.

**KEYWORDS:** Antioxidant activity; Enzyme inhibition; Phenolic compounds; Ultrasound-assisted extraction; Vietnamese coriander
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TRANSACTIONS ON SCIENCE AND TECHNOLOGY

## INTRODUCTION

Obesity has become a global health concern, defined as a chronic and progressive illness linked to increased morbidity and mortality (Schetz *et al*., 2019). According to the World Health Organization (WHO), the prevalence of obesity is rising at an alarming rate (WHO, 2024). In Malaysia, the prevalence of abdominal obesity among Malaysian adults has risen steadily, reaching 54.5% in 2023 (Institute for Public Health, 2023). Natural products and traditional medicinal plants are being explored as potential alternatives for obesity management (Shaik Mohamed Sayed *et al*., 2023). In line with this, plant-derived antioxidants such as lipoic acid, procyanidins, catechins and cinnamon extracts have gained considerable attention in managing obesity for their ability in modulating oxidative stress and attenuation of weight gain (Gjermeni *et al*., 2021).

In addition to evaluating bioactivity, the efficiency of extraction process is crucial as the method employed strongly influences the yield, stability, and biological potential of the extracts. In this study, ultrasound-assisted extraction (UAE) was utilized due to its advantages over conventional extraction techniques. Previous research has demonstrated that UAE is particularly effective for extracting polyphenols, flavonoids, and other bioactive components associated with potential health benefits (Mokaizh *et al*., 2024). Therefore, this study was conducted to evaluate the potential of Vietnamese coriander, *Persicaria odorata* extracts following UAE extraction, specifically related to its inhibitory effects on pancreatic lipase and alpha amylase. The findings may serve as a preliminary

basis to support the development of functional foods or interventions to combat obesity and promote overall metabolic health.

## METHODOLOGY

### Materials

Dried Vietnamese coriander powder was used for extraction. All reagents and solvents, including ethanol, methanol, gallic acid, quercetin, DPPH, p-nitrophenyl butyrate (PNPB), porcine pancreatic lipase, $\alpha$-amylase, DNSA, and buffer components, were of analytical grade.

### Preparation of Extracts by Ultrasound-Assisted Extraction (UAE)

Fresh Vietnamese coriander leaves were purchased from local market and dried in a chamber at 50 °C until the moisture content reached 10%. The dried leaves were stored in sealed containers in a cool, dry place, then ground, homogenized, and stored in the dark. The plant powder was mixed with 80% ethanol or distilled water at a 1:10 (w/v) ratio and subjected to ultrasound treatment (35 kHz, 100 W) at room temperature in two 15-min cycles, with vortexing after each cycle, followed by vacuum filtration. The filtrates were dried in a universal oven at 50°C overnight and stored at 4°C. The extraction yield was calculated based on dry weight (Hajji Nabih *et al*., 2023).

### Determination of Total Phenolic Content (TPC) and Total Flavonoid Content (TFC)

Total phenolic and flavonoid content were assayed according to the methods by Phuyal *et al*. (2020) and Rao *et al*. (2016), respectively. Briefly, extracts (1 mg/mL) were reacted with Folin–Ciocalteu reagent and sodium carbonate, incubated at room temperature in the dark for 30 min and absorbance was read at 760 nm. Meanwhile, TFC was assessed using a colorimetric assay with quercetin as the standard. The extract (1 mg/mL) was mixed with aluminum chloride, potassium acetate, ethanol, and distilled water, incubated in the dark for 30 minutes, and measured at 415 nm. Results of TPC and TFC were expressed as mg gallic acid equivalents (GAE)/g extract and mg quercetin equivalents (QE)/g extract, respectively.

### Antioxidant Assay

Extracts (1 mg/mL) were reacted with DPPH solution (0.004% in ethanol), incubated at 37°C in the dark for 30 min, and read at 517 nm. Ascorbic acid was used as a positive control. Scavenging activity was calculated as a percentage relative to the negative control (Truong *et al*., 2019).

### Pancreatic Lipase Inhibition Assay

Extracts (1 mg/mL) were prepared in phosphate buffer (100 mM, pH 7.2) containing 0.5% Triton X-100. A series of working concentrations of the extracts was prepared to obtain final assay concentrations of 0.125, 0.25, and 0.50 mg/mL (final concentration in the reaction mixture). Reaction mixtures consisting of extract, porcine pancreatic lipase (0.6 mg/mL), phosphate buffer, and PNPB substrate were incubated at 37°C in 96-well microplates. The release of p-nitrophenol was measured at 405 nm. Orlistat, used as a positive control was tested at concentrations ranging from 0.125 – 0.50 mg/mL to confirm assay validity (Estribillo *et al*., 2022).

**α-Amylase Inhibition Assay**

Extracts (1 mg/mL) were mixed with α-amylase solution (1 mg/mL) and incubated at 37°C, followed by addition of 1% potato starch. The reaction stopped with DNS reagent and heated in a boiling water bath. After cooling and dilution, absorbance was read at 540 nm. Acarbose served as a positive control. Inhibition percentage was calculated based on blank and control absorbance values (Oluwagunwa *et al*., 2021).

**Statistical Analysis**

All measurements were conducted in triplicates. Data were expressed as mean ± standard deviation (SD). An independent sample *t*-test was used to compare TPC and TFC between extracts. One-way ANOVA was conducted for antioxidant and enzyme inhibition assays, with Tukey HSD as post hoc test ($p < 0.05$). Pearson's Correlation Analysis was also done between extracts, TPC, TFC, antioxidant activity and enzyme inhibitory properties. Statistical analysis was performed using SPSS version 29.

## RESULTS AND DISCUSSION

**Yield of Extraction, Total Phenolic Content (TPC) and Total Flavonoid Content (TFC) of Vietnamese coriander**

Table 1 shows the effect of extraction solvents on the yield, total phenolic and flavonoid contents of Vietnamese coriander extracts. Using 80% ethanol resulted in a significantly higher percentage yield compared to water extraction. This study shows that 80% ethanol is more effective than water in extracting bioactive compounds from plants, supporting findings by Atu *et al.* (2022) and Majhi *et al.* (2023). Its mixed polarity allows better solubility of both polar and non-polar compounds, resulting in higher yield. Hydroalcoholic solvents like ethanol–water mixtures are ideal for extracting diverse secondary metabolites efficiently.

**Table 1.** Extraction yield, total phenolic content (TPC) and total flavonoid content (TFC) of Vietnamese coriander extracts.

| Extract solvent | Extraction Yield (%) | TPC (mg GAE/g) | TFC (mg QE/g) |
|---|---|---|---|
| 80% Ethanol | 25.59 ± 2.24[a] | 106.85 ± 2.14[a] | 101.09 ± 0.06[a] |
| Water | 4.58 ± 0.76[b] | 79.91 ± 1.52[b] | 34.52 ± 0.34[b] |

Different lowercase letters (a - b) indicate statistical differences according to one-way ANOVA ($p < 0.05$).

Additionally, the mean total phenolic content (TPC) and total flavonoid content (TFC) for the 80% ethanol extract (106.85 ± 2.14 mg GAE/g and 101.09mg QE/g, respectively) are significantly higher than that of the water extract (79.91 ± 1.52 mg GAE/g and 34.52 ± 0.34 QE/g, respectively). This study found that 80% ethanol extracts of Vietnamese coriander had significantly higher TPC and TFC than water extracts, supporting Mousavi *et al.* (2021). This supports previous findings that ethanol–water mixtures enhanced phenolic extraction by optimizing polarity and flavonoids dissolved better in moderately polar solvents, aligning with Zhang *et al.* (2022) and Zulkifli *et al.* (2020), who reported optimal TFC extraction at 70–80% ethanol. Ethanol's ability to disrupt plant matrices enhanced extraction efficiency, confirming 80% ethanol as an optimal solvent for flavonoid recovery.

**Antioxidant Activity**

Table 2 shows that the antioxidant activity differs significantly among the 80% ethanol extract, water extract, and positive control groups. The mean antioxidant activity for the 80% ethanol extract (63.22% inhibition) is considerably higher than that of the water extract (23.67% inhibition) and slightly lower than the positive control (74.78% inhibition).

This study found that the 80% ethanol extract of Vietnamese coriander showed higher antioxidant activity than the water extract. However, both were lower than the positive controls (ascorbic acid). These results align with previous studies, confirming that solvent type and polarity, especially hydroalcoholic mixtures, greatly influence antioxidant compound extraction and activity, supporting findings by Hosseinipour *et al.* (2022) and Ma *et al.* (2021).

**Table 2.** Antioxidant Activity of Vietnamese coriander extracts.

| Sample | Mean ± SD (Percentage Inhibition, %) |
|---|---|
| 80% Ethanol Extract | $63.22 \pm 3.04^{b}$ |
| Water | $23.67 \pm 6.03^{c}$ |
| Positive control (Ascorbic Acid) | $74.78 \pm 0.05^{a}$ |

Values are presented as means (mean ± SD) of three replicates. Different lowercase letters (a - c) indicate statistical differences according to one-way ANOVA ($p < 0.05$).

**Pancreatic Lipase Inhibition Activity Measurement**

Figure 1 shows the pancreatic lipase inhibition activity measurement of different extracts on different concentration.

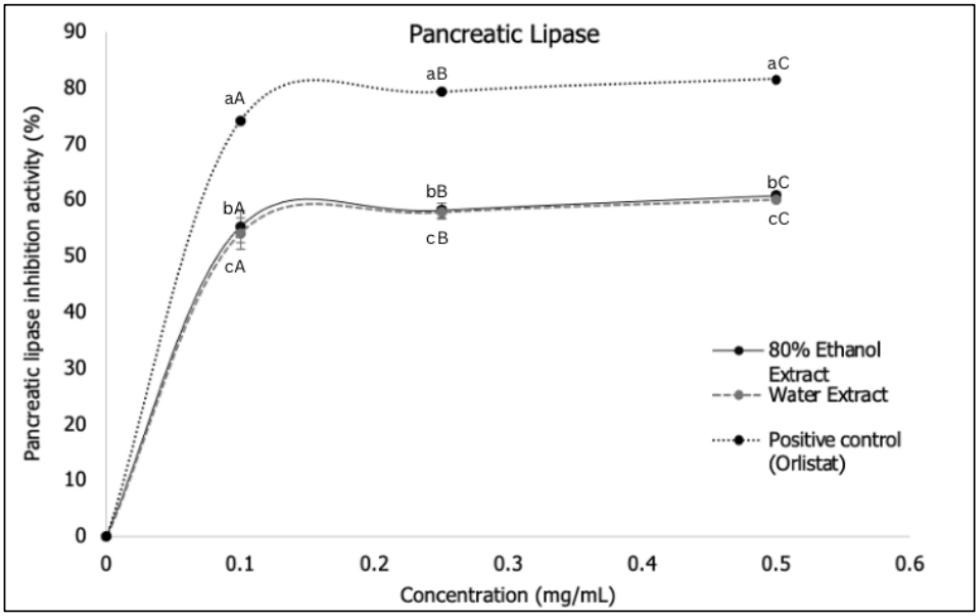


**Figure 1.** Pancreatic lipase inhibition activity of Vietnamese coriander extracts and Orlistat at 0.125, 0.25 and 0.5 mg/mL concentrations. Bars are presented as means (mean ± SD) of three replicates. Different lowercase letters (a - c) indicate statistical differences across different treatment groups according to one-way ANOVA ($p < 0.05$). Different uppercase letters (A-D) indicate statistical differences across different concentrations within the treatment group according to one-way ANOVA ($p < 0.05$).

This study found that 80% ethanol extract showed higher pancreatic lipase inhibition than the water extract, though not statistically significant. This aligns with findings by Limcharoen *et al.*

(2022) and Djiazet *et al*. (2021), who reported stronger lipase inhibition with ethanol-based extracts. Vangoori *et al.* (2019) also attributed this to the presence of phenolics and flavonoids in ethanolic extracts, emphasizing the importance of solvent polarity in enhancing extraction efficiency. Although the extracts demonstrated lower lipase inhibitory potency than orlistat, this is consistent with the use of crude plant extracts rather than purified pharmaceutical inhibitors, and such activity remains relevant for early-stage screening of natural anti-obesity candidates.

**α-Amylase Inhibition Activity Measurement**

Figure 2 presents the descriptive statistics of $\alpha$-amylase inhibitory activity (%), indicating the highest inhibition by acarbose (86.75 ± 1.59), followed by 80% ethanol (39.07 ± 1.71) and water extracts (28.56 ± 3.16). This study found that 80% ethanol extract showed significantly higher $\alpha$-amylase inhibition than water extract. These findings indicate that hydroalcoholic extraction is more effective than water alone in recovering bioactive compounds with $\alpha$-amylase inhibitory potential, supporting its relevance in screening for antidiabetic properties (Nisar *et al*., 2022; Choi *et al*., 2023).

Additionally, this study demonstrates strong positive correlations between TPC and TFC with antioxidant activity, with r values of 0.965 ($p < 0.01$) and 0.980 ($p < 0.01$), respectively. This suggests that the radical scavenging property of Vietnamese coriander extracts was likely contributed by the presence of the phenolics compound particularly flavonoids (Abdelouhab *et al*., 2023; Zhang *et al*., 2022). Subsequently, strong and significant correlations were also observed between TPC and $\alpha$-amylase inhibitory activity ($r = 0.919$, $p < 0.01$) as well as TFC and $\alpha$-amylase inhibitory activity ($r = 0.930$, $p < 0.01$), indicating that polyphenols may play a key role in modulating postprandial glycemia by slowing starch hydrolysis (Ayua *et al*., 2021).

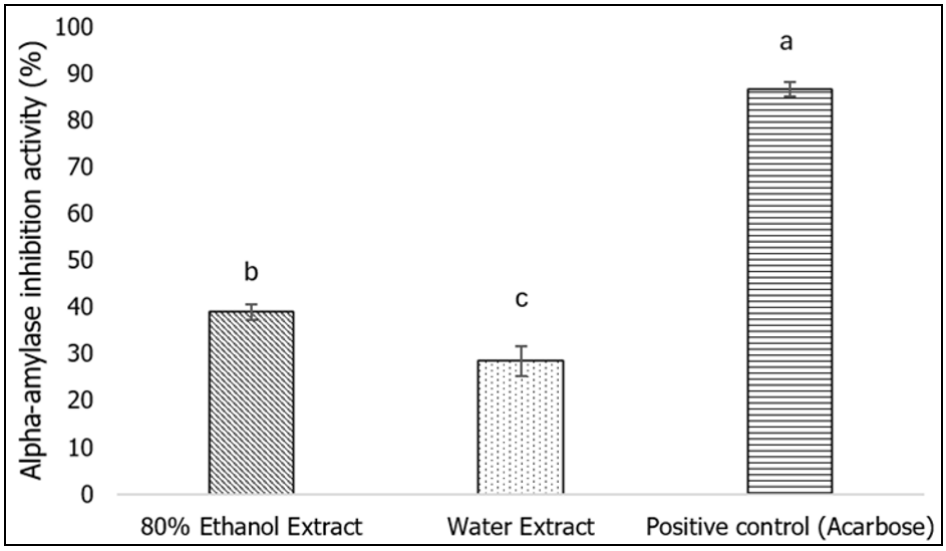


**Figure 2.** α-Amylase inhibition activity of Vietnamese coriander using different extracting solvents and acarbose (positive control) expressed in percentage (%). Different lowercase letters (a - c) indicate statistical differences according to one-way ANOVA ($p < 0.05$).

This mechanism is relevant to obesity management, as controlling postprandial hyperglycemia can improve insulin sensitivity, reduce adipogenesis, and ultimately contribute to body weight regulation [Tong *et al*., 2022]. In contrast, the correlations between TPC and TFC with pancreatic lipase inhibition are weak and not statistically significant ($p>0.05$), suggesting that possible presence of other compounds or synergistic interactions are contributing to the observed effects (Huei *et al*., 2020; Oluwagunwa *et al*., 2021). The present study has some limitations that should be considered when interpreting the findings. First, UAE was performed using only two solvent systems without optimisation of extraction parameters such as time or temperature. Although this approach is

appropriate for preliminary screening, optimization studies could further enhance extraction efficiency and bioactivity. Enzyme inhibitory activities were evaluated without determining the dose–response or $IC_{50}$ values. Therefore, future studies should therefore include concentration-dependent analyses and determination of $IC_{50}$ values to ascertain the strength and efficacy of enzyme inhibition. In addition, individual bioactive compounds were not identified, limiting mechanistic interpretation of the observed activities. Analytical techniques such as HPLC or LC–MS–based profiling, coupled with bioactivity-guided fractionation, would provide deeper mechanistic insight and enable identification of key active compounds in Vietnamese coriander.

## CONCLUSION

This study provides a comparative in vitro evaluation of Vietnamese coriander extracts obtained using different solvent systems under UAE. The 80% ethanol extract demonstrated higher phenolic and flavonoid contents than the aqueous extract and showed stronger antioxidant and $\alpha$-amylase inhibitory activities. These findings highlight the influence of solvent selection on bioactive recovery and enzyme inhibition profiles. In contrast, the weak and non-significant correlations observed between phenolic and flavonoid contents and pancreatic lipase inhibition suggest that other phytochemicals or synergistic interactions may contribute to this activity. Overall, the results offer preliminary insights into the bioactive properties of Vietnamese coriander and support further studies involving compound identification, dose–response analyses, and in vivo validation to clarify its relevance in metabolic health research.

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