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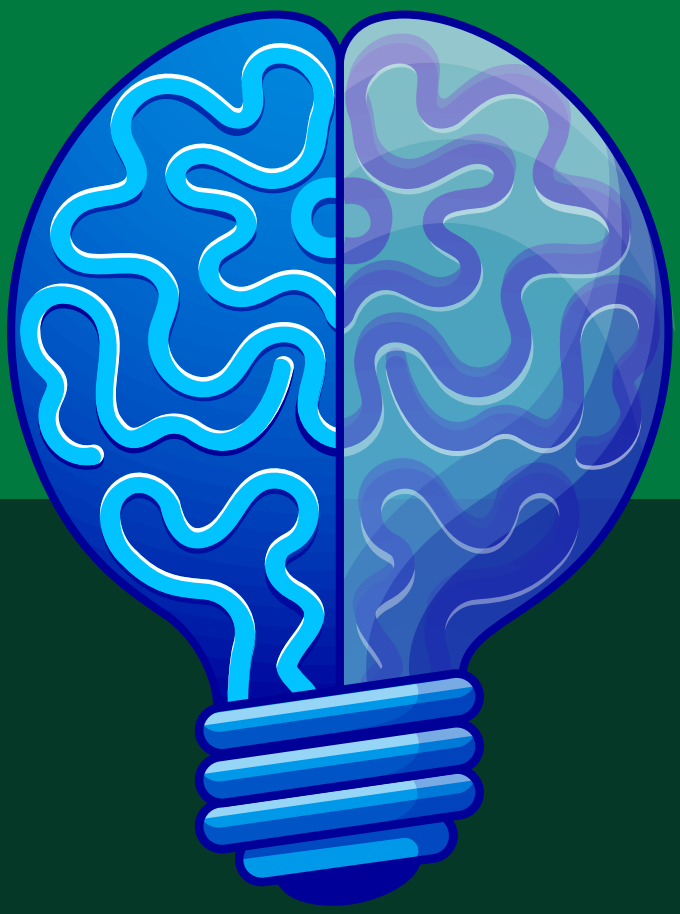

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Preface

The Scientific Project Colloquium offers a platform for publishing Diploma Science final year projects (FYP). The objective is to effectively distribute research findings throughout all scientific disciplines. The primary objective of including final year projects into the course curriculum is to encourage students to put their theoretical knowledge into practical applications.

We would like to express our gratitude to our primary establishment, the Faculty of Applied Sciences and Universiti Teknologi MARA, Perak Branch, for their invaluable assistance.

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ANTI-DIABETIC POTENTIAL OF *Stenochlaena palustris* AND *Diplazium esculentum*

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Abstract: The increasing global prevalence of diabetes mellitus highlights the urgent need for alternative therapeutic strategies that are affordable, effective and associated with minimal side effects. This study aimed to comparatively assess the anti-diabetic potential of *Stenochlaena palustris* and *Diplazium esculentum* ethanolic extracts through phytochemical screening and in-vitro bio-assay. The crude ethanolic extracts of both ferns were subjected to standard qualitative phytochemical analysis and anti-diabetic activity was evaluated using α-glucosidase inhibition assay. Both *S. palustris* and *D. esculentum* extracts demonstrated the presence of bioactive phytochemicals, with flavonoids, phenolics, saponins and tannins compounds being dominant. Comparative enzyme inhibition assay revealed that *S. palustris* and *D. esculentum* demonstrate moderate and comparable α-glucosidase inhibitory activity. It can be concluded that *S. palustris* and *D. esculentum* possess promising anti-diabetic potential. Further in-vivo and animal trials are warranted to validate their efficacy and safety as phytopharmaceutical candidates.

Keywords: *Phytochemicals, Ferns, Hyperglycemic, Diabetes mellitus, Metabolic disorder*

INTRODUCTION

Diabetes mellitus is a complex, chronic metabolic disorder characterized by persistent hyperglycaemia resulting from defects in insulin secretion, insulin action, or both. It has emerged as one of the most pressing global health challenges of the 21st century, affecting an estimated 783 million adults worldwide by 2045 (Hossain et al., 2024). The condition is broadly classified into type 1 diabetes mellitus (T1DM) and type 2 diabetes mellitus (T2DM). T1DM is an auto immune mediated destruction of pancreatic β-cells leading to absolute insulin deficiency (Aamodt and Powers, 2025). T2DM, which accounts for more than 90% of cases and is primarily associated with insulin resistance, progressive β-cell dysfunction and lifestyle factors (Gieroba et al., 2025). Gestational diabetes mellitus and other specific forms, including monogenic and secondary diabetes, further contribute to its heterogeneity. Consequently, diabetes mellitus is a leading cause of cardiovascular disease, chronic kidney disease, blindness and lower limb amputations, imposing substantial health and economic burdens globally (Alijanzadeh et al., 2024).

Despite advances in therapeutic strategies, including insulin formulations, oral hypoglycaemic agents and novel classes such as GLP-1 receptor agonists and SGLT2 inhibitors, the prevention and management of diabetes remain major challenges (Kang et al., 2025). Current research emphasizes not only pharmacological interventions but also lifestyle modifications and public health strategies aimed at reducing risk factors and delaying disease progression. Understanding the epidemiology, underlying mechanisms, diagnostic and therapeutic approaches to address this growing global health concern (Caturano et al., 2024). Beside significant advancements in synthetic anti-diabetic therapies, challenges persist in terms of cost, accessibility, adverse side effects and patient compliance. These limitations have fuelled a growing interest in alternative and complementary strategies, particularly plant-derived therapeutics.

In recent years, extensive pharmacological and clinical studies have provided scientific validation of numerous plants with anti-diabetic potential, such as *Momordica charantia* (bitter melon), *Trigonella foenumgraecum* (fenugreek), *Zingiber officinale* (ginger) and *Curcuma longa* (turmeric) (Sayem et al., 2025). The increasing body of evidence supports their role not only on glycaemic control but also in ameliorating diabetic complications, including dyslipidaemia, nephropathy and cardiovascular dysfunction. Given the escalating global diabetes mellitus burden and the limitations of existing therapeutic options, plant-based anti-diabetic treatments represent a promising avenue for drug discovery, integrative medicine and sustainable healthcare strategies (Ahmad et al., 2025). Therefore, this study was carried out to explore the potential of two ferns, native to Malaysia, namely *Stenochlaena palustris* (‘paku miding’, ‘paku naga’ or ‘pakis merah’ in Malay and climbing swamp fern in English) and *Diplazium esculentum* (‘pucuk paku’, ‘paku tanjung’ or ‘paku besar’ in Malay and vegetable fern in English).

METHODOLOGY

Plant materials and ethanolic extraction

Aerial parts of *Stenochlaena palustris* and *Diplazium esculentum* were collected from their natural environments in Behrang, Perak and authenticated by a plant taxonomist at Center of Biodiversity and Conservation, Universiti Pendidikan Sultan Idris. The plant materials were thoroughly washed, shade dried at room temperature and pulverized into coarse powder using an electrical blender. Approximately 100 g of the powdered plant material was macerated in 1 L of 80% ethanol (1:10 w/v) for 72 h at room temperature with occasional agitation. The mixture was filtered through Whatman No. 1 filter paper, and the residue was re-extracted twice under the same conditions to ensure maximum yield. All filtrates were pooled and concentrated under reduced pressure using a rotary evaporator at 40 ^{0}C to remove the solvent. The concentrated crude extract was then dried to constant weight in the oven at 40 ^{0}C and stored in airtight container at 4 ^{0}C until further analysis.

Phytochemical screening

Qualitative phytochemical screening of the extracts was performed using standard procedures as described by Salunke et al. (2025). The presence of major secondary metabolites including phenols, flavonoids, saponins, tannins, alkaloids, terpenoids, triterpenes glycosides and steroids were assessed through characteristic colorimetric changes and precipitation reactions. All procedures were carried out in triplicate to confirm the reproducibility of results, and observations were recorded based on the intensity of the colour change or precipitate formation.

α-glucosidase inhibition assay

The α-glucosidase inhibitory activity of the extracts was evaluated using a method of Rosa et al. (2025) with some modifications. Briefly, 50 µl of sample solution at various concentrations was pre-incubated with 100 µl of 5 mM p-nitrophenyl-α-D-glucopyranoside (pNPG) prepared in phosphate buffer (pH 6.8) at 37 ^{0}C for 5 min. The reaction was initiated by adding 50 µl of α-glucosidase enzyme solution (0.5 U/ml in phosphate buffer, pH 6.8). After incubation at 37 ^{0}C for 20 min, the reaction was terminated by adding 100 µl of 0.1 M sodium carbonate. The absorbance of the resulting ρ-nitrophenol was measured at 405 nm using a microplate reader. Acarbose was used as the positive control, while buffer served as the blank. The percentage of inhibition was calculated as:

$$\text{Inhibition (\%)} = [\ (A_c - A_s) / A_c] \times 100$$

Where A_c is the absorbance of the control and A_s is the absorbance of the sample.

Statistical analysis

All data are subjected to one-way ANOVA and values of $p<0.05$ were considered statistically significant.

FINDINGS

The qualitative phytochemical screening of the aerial parts of *Stenochlaena palustris* and *Diplazium esculentum* ethanolic extracts revealed the presence of several bioactive compounds (Table 1). Phenols, flavonoids, saponins, tannins and triterpenes glycosides compounds were detected in varying intensities, indicating the rich secondary metabolite content of *S. palustris* and *D. esculentum* ethanolic extracts. Terpenoids and steroids were not detected in both extracts. Alkaloids were detected in *S. palustris* ethanolic extract but not detected in *D. esculentum* ethanolic extract. The abundance of phenols and flavonoids constituents suggests strong antioxidant potential, whereas the presence of saponins, tannins, triterpenes glycosides and alkaloids may contribute to diverse pharmacological activities (Belew and Gebre, 2025). These findings highlight the therapeutic relevance of the extract and provide a foundation for further quantitative and bioactivity-guided studies.

Table 1 Phytochemical constituents of *S. palustis* and *D. esculentum* aerial parts ethanolic extracts.

Phytochemical	*Stenochlaena palustris*	*Diplazium esculentum*
Phenols	++	++
Flavonoids	++	+
Saponins	+	++
Tannins	++	++
Alkaloids	++	n/d
Terpenoids	n/d	n/d
Triterpenes glycosides	+	++
Steroids	n/d	n/d

Indicator: (++) high intensity detected, (+) low intensity detected, (n/d) not-detected

The ethanolic extracts of *Stenochlaena palustris* and *Diplazium esculentum* were evaluated for their in-vitro anti-diabetic activity using the α-glucosidase inhibition assay. Both extracts exhibited dose-dependent inhibitory effects

(Figure 1), suggesting the presence of bioactive compounds capable of modulating carbohydrate metabolism or insulin secretion. However, statistical analysis revealed no significant differences ($p>0.05$) in the inhibitory potential between the two species, indicating that both ferns possess comparable anti-diabetic activity. Results and statistical analysis also revealed that anti-diabetic activity of *S. palustris* and *D. esculentum* significantly lower ($p<0.05$) compared to Acarbose, a synthetic anti-diabetic drug commonly used in the management of type 2 diabetes mellitus and belongs to the class of α-glucosidase inhibitors. Qualitative phytochemical screening supported *S. palustris* and *D. esculentum* anti-diabetic potential, as both extracts demonstrated the presence of phenols, flavonoids, saponins and tannins which are highly reported for their anti-diabetic properties (Velmurugan et al., 2025). Flavonoids and phenolics in particular, are known to exert inhibitory effects on carbohydrate-hydrolysing enzymes and enhance glucose uptake (Hatanaka et al., 2024). Meanwhile, saponins and tannins contribute synergistically to glycaemic regulation (Babar et al., 2025). The similarity in phytochemical constituents between *S. palustris* and *D. esculentum* ethanolic extracts may explain their equivalent inhibitory responses in-vitro. Overall, these findings support the traditional consumption of *S. palustris* and *D. esculentum* as functional vegetables with health benefits, particularly in glycaemic control. Future studies involving in-vivo models and compound isolation are warranted to further validate their efficacy and elucidate the specific metabolites responsible for the observed effects.

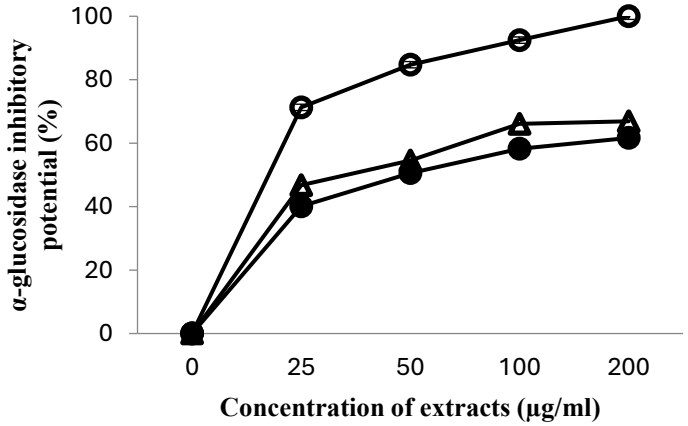

Figure 1 α-glucosidase inhibition activity of Acarbose (○) and ethanolic extract of *Stenochlaena palustris* (Δ) and *Diplazium esculentum* (●) aerial parts.

CONCLUSIONS

The comparative evaluation of the ethanolic extracts of *Stenochlaena palustris* and *Diplazium esculentum* demonstrated that both ferns possess comparable anti-diabetic potential, as evidenced by their similar α-glucosidase inhibitory activity. Phytochemical screening revealed overlapping profiles, with both extracts containing phenolics, flavonoids, saponins and tannins, which are likely contributors to the observed bioactivity. Although minor differences in phytochemical intensity and constituents were noted, these variations did not translate into significant differences in anti-diabetic efficacy. It can be concluded that both ferns are promising sources of natural α-glucosidase inhibitors. Further in-vivo studies and bioactive compound isolation are recommended to validate and expand upon these results.

COMPLIANCE OF ETHICAL STANDARDS

Not applicable.

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