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PREFACE

Welcome to the 2nd International Science, Engineering and Technology Colloquium 2025 (ISETC 2025)!

It is with great pleasure that we present this year's colloquium, a distinguished gathering of scholars, researchers, and professionals dedicated to the advancement of applied sciences. Held virtually on 9th July 2025, ISETC 2025 serves as a platform to highlight cutting-edge research, foster meaningful networking, encourage collaborations, and explore innovative solutions to global challenges.

This year's theme, "The Power of Scientific Innovation: Intelligent Solutions for a Sustainable World" highlights our shared goal to solve global challenges through applied science. It celebrates innovation as a key to building a more sustainable and resilient future. We're proud to feature keynote speakers and presenters who bring fresh insights, bold ideas, and breakthroughs shaping tomorrow's world.

We would like to extend our heartfelt appreciation to the Faculty of Applied Sciences, Universiti Teknologi MARA, Perak Branch, Tapah Campus, for their outstanding support and assistance throughout the planning and execution of the event. Their dedication has been instrumental to the success of this colloquium. We would like to sincerely thank all participants and researchers for their valuable contributions. We also appreciate the reviewers for their careful evaluations and helpful feedback. Your hard work and support mean a lot to us.

As editors, we are proud to present this collection of proceedings. It is an honour to bring together the interesting and meaningful work of our speakers and authors. We hope the ideas shared will lead to new discoveries, encourage more research, and help solve global challenges through science and innovation.

Warm regards,

Dr. Emi Norzehan Mohamad Mahbob
Dr. Saiyidah Nafisah Hashim
Ms. Lili Widarti Zainuddin
Ms. Nurul Nazwa Mohammad
Ms. Rozaina Saleh

ISETC 2025 Proceedings Editors

THERAPEUTIC POTENTIAL OF KAFFIR LIME (*Citrus hystrix* DC) LEAF EXTRACTS IN COMBATING OBESITY AND DIABETES

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Abstract: Kaffir lime (*Citrus hystrix* DC) leaves, widely utilized in traditional medicine, are renowned for their therapeutic properties in managing ailments such as coughs, colds, and digestive disorders. Given the limitations of synthetic drugs including high costs and adverse effects, natural alternatives for obesity and diabetes management warrant further exploration. This study evaluates the anti-obesity and anti-diabetic potential of *C. hystrix* leaf extracts obtained through maceration using ethanol, ethyl acetate, and n-hexane, yielding crude extracts at 8.03%, 2.21%, and 1.24%, respectively. Anti-diabetic activity was assessed via α-amylase inhibition and reducing sugar content assays. The ethyl acetate extract demonstrated the strongest α-amylase inhibitory effect (IC_{50} = 0.16 mg/mL), while the ethanolic extract exhibited the highest reducing sugar content (142 ± 8.56 mg GE/g dry extract). Additionally, the ethanolic extract displayed notable anti-obesity activity, inhibiting pancreatic lipase with an IC_{50} of 0.09 mg/mL. These findings highlight the therapeutic potential of *C. hystrix* leaf extracts as a natural alternative for mitigating obesity and diabetes, supporting further investigation into their pharmacological applications.

***Keywords*:** *Anti-diabetic activity, anti-obesity, α-amylase inhibition, C. hystrix leaf*

INTRODUCTION

The global rise in obesity and diabetes has become a critical public health concern, with significant implications for morbidity and economic burden. Obesity, characterized by excessive body fat accumulation (World Health Organization, 2021), is a major risk factor for type 2 diabetes (T2DM), cardiovascular diseases, and certain cancers (Moores, 2023). In Malaysia, projections indicate that 41% of adults will be obese by 2035 (CodeBlue, 2023), exacerbating the demand for effective interventions. Similarly, diabetes mellitus, particularly T2DM, is linked to obesity and insulin resistance, with 70% of Malaysian COVID-19 fatalities occurring among diabetics (CodeBlue, 2020). Conventional treatments, such as liraglutide and semaglutide, often entail adverse effects like gastrointestinal distress and retinopathy (Seo, 2021; Singh et al., 2022), alongside high costs (Ott et al., 2020), underscoring the need for safer, affordable substitutes.

Kaffir lime (*Citrus hystrix* DC), a tropical plant rich in bioactive compounds like flavonoids and alkaloids, has shown promise in traditional medicine for its therapeutic properties (Anuchapreeda et al., 2020). Studies highlight its antioxidant, antimicrobial, and anticancer potential (Purwanto et al., 2019), yet research on its anti-obesity and anti-diabetic effects remains limited. Preliminary findings suggest that *C. hystrix* leaf extracts exhibit α-amylase inhibitory activity, a key mechanism in managing postprandial hyperglycemia (Irawaty & Ayucitra, 2018), and may inhibit pancreatic lipase, reducing fat absorption (Kato et al., 2021). However, comprehensive *in vitro* studies validating these effects are scarce (Bumrungpert et al., 2018; Jantan et al., 2021), leaving gaps in understanding its efficacy and mechanisms.

This study investigates the anti-obesity and anti-diabetic potential of *C. hystrix* leaf extracts through *in vitro* assays. The leaves will be extracted using solvents of varying polarities, and the extracts will be evaluated for anti-diabetic activity via enzyme inhibition assays targeting carbohydrate metabolism. Anti-obesity effects will be examined by assessing the extracts' ability to suppress fat-digesting enzymes. By leveraging *C. hystrix*'s bioactive properties, this research aims to provide safer, cost-effective alternatives to synthetic drugs for metabolic disorders.

MATERIALS AND METHODS

Preparation of Plant Extracts

Fresh *C. hystrix* leaves were obtained from a local market in Arau, Perlis. The leaves were washed, air-dried at 37°C, and ground into a fine powder. Crude extracts of varying polarities were prepared following Luetragoon et al. (2023) with minor modifications. Briefly, 50 g of powdered leaves were macerated in 100 mL each of n-hexane, ethyl acetate, and 95% ethanol for 72 hours at room temperature. The extracts were filtered and concentrated under reduced pressure at 35°C using a rotary evaporator.

Determination of Pancreatic Lipase Activity

Porcine pancreatic lipase (PPL) inhibition was assessed using olive oil as a substrate (Mhatre et al., 2019). A mixture of phosphate buffer (pH 7.2), crude extract, and lipase solution was incubated at 37°C for 10 min, followed by olive oil addition and further incubation (1 h). The reaction was terminated by boiling, centrifuged, and titrated with NaOH using phenolphthalein as an indicator.

Determination of α-Amylase Activity

The α-amylase inhibitory assay was performed using the DNS method as described by Magwaza et al. (2024) with slight modifications. Starch (1%) in phosphate buffer (pH 6.9) was incubated with α-amylase and extracts (0.05–0.25 mg/mL) at 37°C for 10 min. DNS reagent was added, heated to 60°C, and absorbance was measured at 540 nm. Inhibition (%) was calculated as:

$$\text{Inhibition (\%)} = \frac{\left(A_{\text{control}} - A_{\text{sample}}\right)}{A_{\text{control}}} \times 100$$

Determination of Reducing Sugar Content (RSC)

RSC was quantified via the DNSA method. Extracts (1 mg/mL) were mixed with DNSA reagent, heated to 95°C for 5 min, diluted, and absorbance was measured at 540 nm. Glucose equivalents were calculated from a standard curve (Khatri & Chhetri, 2020).

Statistical Analysis

All experiments were performed in triplicates and data obtained were analyzed by using standard deviation and mean wherever applicable.

RESULTS AND DISCUSSION

The extraction of *C. hystrix* leaves using solvents of varying polarities yielded distinct bioactive profiles, with ethanol producing the highest extract yield (8.03%), followed by ethyl acetate (2.21%) and n-hexane (1.24%). This aligns with previous findings as reported by Anuchapreeda et al. (2020), confirming ethanol's efficacy in solubilizing polar phytoconstituents.

Anti-obesity Activity via Pancreatic Lipase Inhibition

The ethanolic extract of *C. hystrix* leaves showed potent, dose-dependent porcine pancreatic lipase (PPL) inhibition, with activity ranging from 32.24% to 94.74% across tested concentrations (0.05-0.25 mg/mL). The calculated IC_{50} value of 0.09 mg/mL (Figure 1(a)) demonstrates efficacy comparable to other natural inhibitors reported in the literature (Liu et al., 2023; Ngoh et al., 2017). This strong inhibitory activity, likely mediated by flavonoid compounds such as β-sitosterol (Siti et al., 2022), suggests the extract's potential to reduce dietary fat absorption by interfering with the enzyme-substrate complex. Although this study did not isolate specific bioactive constituents, the observed

effects position *C. hystrix* as a promising natural alternative for obesity management through its ability to decrease caloric uptake from fats.

Anti-diabetic Potential of *C. hystrix* Leaf Extracts

Our study revealed that *C. hystrix* leaf extracts exhibited significant α-amylase inhibitory activity, with the ethyl acetate fraction showing the strongest inhibition (IC_{50} = 0.16 mg/mL), followed by ethanol (IC_{50} = 0.17 mg/mL) and n-hexane (IC_{50} = 0.23 mg/mL) (Figure 1(b)). This activity profile suggests that medium-polarity solvents like ethyl acetate are particularly effective at extracting bioactive compounds capable of inhibiting this key carbohydrate-digesting enzyme. The observed activity approaches that of the standard drug acarbose (IC_{50} = 0.07 mg/mL), indicating the potential of *C. hystrix* as a natural alternative for managing postprandial hyperglycemia. The superior performance of ethyl acetate aligns with prior studies on *C. hystrix* peels, where ethyl acetate fractions also showed the strongest inhibition (IC_{50} = 0.09 mg/mL) (Irawaty & Ayucitra, 2018). This consistency across plant parts underscores the role of medium-polarity solvents in extracting inhibitory alkaloids or flavonoids, which may bind to α-amylase's catalytic residues or allosteric sites, impeding starch hydrolysis (Yadav et al., 2023).

Complementing these findings, the ethanol extract demonstrated the highest reducing sugar content (RSC) (142 ± 9.56 mg GE/g), significantly surpassing the ethyl acetate (94.80 ± 6.82 mg GE/g) and n-hexane (44.27 ± 6.54 mg GE/g) extracts. The standard D-glucose calibration curve is depicted in Figure 2. This polarity-dependent trend suggests ethanol's efficacy in solubilizing carbohydrate-derived metabolites, such as glycosides or oligosaccharides, which may contribute to postprandial glucose regulation (Nurcahyani et al., 2022). The correlation between high RSC and anti-diabetic activity hints at a dual mechanism: delayed carbohydrate digestion (via α-amylase inhibition) and enhanced glucose metabolism (via soluble sugar modulation). Such multifaceted action positions *C. hystrix* as a promising alternative to single-target synthetic drugs like acarbose, which often cause gastrointestinal side effects (Kaur et al., 2021).

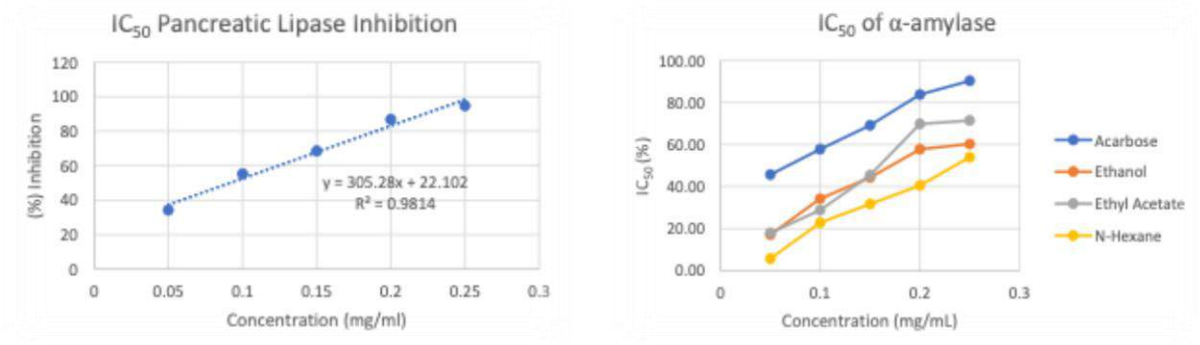


Figure 1. (a) Inhibitory Effects of Ethanolic *C. hystrix* Leaf Extracts against Porcine Pancreatic Lipase (PPL); (b) Inhibitory Effects of *C. hystrix* Leaf Extracts against α-Amylase

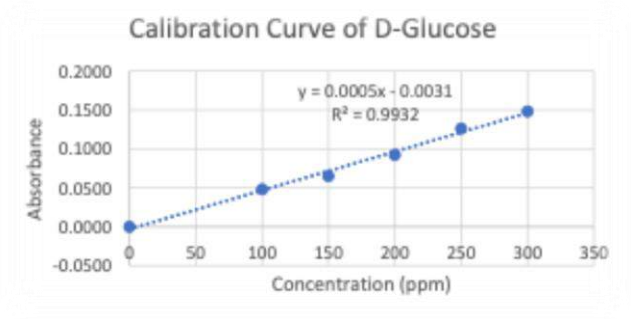


Figure 2. Calibration Curve of Standard D-glucose vs Absorbance for Reducing Sugar Content (RSC) Analysis

CONCLUSIONS

The *C. hystrix* leaf extracts, particularly the ethanol and ethyl acetate fractions, demonstrate significant anti-obesity and anti-diabetic potential through complementary mechanisms. The ethanol fraction shows notable lipase suppression activity along with sugar modulation capacity, while the ethyl acetate fraction exhibits strong α-amylase inhibition, together positioning this plant as a versatile natural therapeutic. Future research directions should include identification of the specific bioactive alkaloids and flavonoids responsible for these effects, investigation of potential synergistic interactions with standard pharmaceutical treatments, and comprehensive *in vivo* validation studies to assess efficacy and safety in animal models of obesity and diabetes, which would further establish its therapeutic potential for metabolic disorders.

REFERENCES

Anuchapreeda, S., Chueahongthong, F., Viriyaadhammaa, N., Panyajai, P., Anzawa, R., Tima, S., Ampasavate, C., Saiai, A., Rungrojsakul, M., Usuki, T., & Okonogi, S. (2020). Antileukemic cell proliferation of active compounds from Kaffir lime (*Citrus hystrix*) leaves. *Molecules*, *25*(6), 1300.

Bumrungpert, A., Leelarungrayub, D., Matsumoto, K., & Yamborisut, U. (2018). Kaffir lime leaves extract inhibits adipogenesis in 3T3-L1 adipocytes. *Journal of the Medical Association of Thailand*, *101*(7), S39-S44.

CodeBlue. (2020, October 13). NIH: 70% of Malaysia's coronavirus fatalities had diabetes. CodeBlue. https://codeblue.galencentre.org/2020/10/13/nih-70-of-malaysias-coronavirus-fatalities-had-diabetes/

CodeBlue. (2023, March 6). Report: 41% of Malaysia's adults will be obese by 2035. CodeBlue. https://codeblue.galencentre.org/2023/03/03/report-41-of-malaysias-adults-will-be-obeseby2035/#:~:text=Malaysia's%20 current%20obesity%20rate%20among,double%20in%20about%2012%20years

Irawaty, W., & Ayucitra, A. (2018). Assessment on antioxidant and in vitro antidiabetes activities of different fractions of *Citrus hystrix* peel. *International Food Research Journal*, *25*, 2467– 2477.

Jantan, I., Yasin, Y. H. M., Moharam, B. A., & Santhanam, J. (2021). Constituents of the essential oil from the leaves of Kaffir lime (*Citrus hystrix* DC.) and their antihyperglycemic and antioxidant activities. *Molecules*, *26*(1), 120.

Kato, E., Tsuruma, A., Amishima, A., & Satoh, H. (2021). Proteinous pancreatic lipase inhibitor is responsible for the antiobesity effect of young barley (*Hordeum vulgare* L.) leaf extract. *Bioscience, Biotechnology, and Biochemistry*, *85*(8), 1885–1889.

Kaur, N., Kumar, V., Nayak, S. K., Wadhwa, P., Kaur, P., & Sahu, S. K. (2021). Alpha-amylase as molecular target for treatment of Diabetes mellitus: A comprehensive review. *Chemical Biology & Drug Design*, *98*(4), 539–560.

Khatri, D., & Chhetri, S. B. (2020). Reducing sugar, total phenolic content, and antioxidant potential of Nepalese plants. *BioMed Research International*, *2020*, 1–7.

Liu, X., Nie, Y., Chen, R., Zhang, X., Yue, L., & Chen, C. (2023). Inhibitory activities of extracts from Chinese medicinal herbs on α-amylase, α-glucosidase, and pancreatic lipase. *Pharmacognosy Magazine*, *19*(3), 530–538.

Luetragoon, T., Thongsri, Y., Daotak, K., Potup, P., & Usuwanthim, K. (2023). Anti- proliferative and immunomodulatory properties of Kaffir lime leaves and bioactive compounds on macrophages co-cultured with squamous cell carcinoma. *Plos One*, *18*(2), e0281378.

Magwaza, S. N., Erukainure, O. L., Olofinsan, K., Meriga, B. & Islam, M. S. (2024). Evaluation of the antidiabetic, antiobesity and antioxidant potential of *Anthophycus longifolius* ((Turner) Kützing). *Scientific African*, *23*(2024), e02051.

Mhatre, S. V., Bhagit, A. A., & Yadav, R. P. (2019). Proteinaceous pancreatic lipase inhibitor from the seed of *Litchi chinensis*. *Food Technology & Biotechnology*, *57*(1), 113-118.

Moores, D. (2023). Everything you need to know about obesity. Healthline. https://www.healthline.com/health/obesity

Ngoh, Y. Y., Choi, S. B. & Gan, C. Y. (2017). The potential roles of Pinto bean (*Phaseolus vulgaris* cv. Pinto) bioactive peptides in regulating physiological functions: Protease activating, lipase inhibiting and bile acid binding activities. *Journal of Functional Foods*, *33*, 67-75.

Nurcahyani, E., Sari, Y. P., Diana, E., Sumardi, Qudus, H. I., & Wahyuningsih, S. (2022). Analysis of reducing sugar levels of *Cattleya sp*. orchid plantlet after induction fusaric acid *in vitro*. World *Journal of Advanced Research and Reviews*, *14*(2), 095–099.

Ott, A., Liu, A., Ferrario, C. R., & Niswender, K. D. (2020). The role of orexin in reward seeking and addiction: A systematic review. *Frontiers in Behavioral Neuroscience*, *14*, 68.

Purwanto, R., Pabontong, J., Retnoningtyas, E. S., & Irawaty, W. (2019). Antimicrobial activity of Kaffir lime peel extract against *Streptococcus mutans*. *Reaktor*, *18*(04), 235–240. https://doi.org/10.14710/reaktor.18.04.235-240

Seo, J. H. (2021). Liraglutide for the treatment of type 2 diabetes: A review of clinical studies. *Diabetes & Metabolism Journal*, *45*(3), 337-348.

Singh, G., Krauthamer, M., & Bjalme-Evans, M. (2022). Wegovy (Semaglutide): A new weight loss drug for chronic weight management. *Journal of Investigative Medicine*, *70*(1), 5–13.

Siti, H. N., Mohamed, S., & Kamisah, Y. (2022). Potential therapeutic effects of *Citrus hystrix* DC and its bioactive compounds on metabolic disorders. *Pharmaceuticals*, *15*(2), 167.

World Health Organization. (2021). Obesity and overweight. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

Yadav, C. K., KC, S., Thapa, S., Kandel, K., Shrestha, L., Palikhey, A., & Lamsal, A. (2023). *In vitro* and *in silico* analysis of alpha-amylase inhibitory activity of ethanolic extract of *Adhatoda vasica* leaves. *Global Advances in Integrative Medicine and Health*, *13*, 1-12.

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Sekian, terima kasih.

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Setuju.

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PROF. MADYA DR. NUR HISHAM IBRAHIM
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