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YST027 - SO-LEANYUM: FUNCTIONAL SAUCE FROM TERUNG ASAM (*Solanum lasiocarpum* Dunal) WITH ENHANCED ANTIOXIDANT PROPERTIES AND ANTI-OBESITY POTENTIAL

Muhammad Naufal Qaweim Rushdy¹, Aniza Saini¹, Muhammad Daniel Eazzat Mohd Rosdan¹, Mohammad Amil Zulhilmi Benjamin¹, Hasdian Mudin¹, and Mohd Azrie Awang^{1,2*}

¹ Faculty of Food Science and Nutrition, Universiti Malaysia Sabah, Jalan UMS, 88400, Kota Kinabalu, Sabah, Malaysia

² Food Security Research Laboratory, Faculty of Food Science and Nutrition, Universiti Malaysia Sabah, Jalan UMS, 88400, Kota Kinabalu, Sabah, Malaysia

*Corresponding author: ma.awang@ums.edu.my

ABSTRACT

The growing demand for functional foods offers an opportunity to create products that support healthier lifestyles and address public health challenges such as obesity. *Solanum lasiocarpum* Dunal, locally known as '*terung asam*', is a native Bornean fruit valued in Sarawak for its culinary and medicinal uses. Rich in chlorogenic acid, it possesses strong antioxidant activity and potential anti-obesity benefits. While *terung asam* has been incorporated into product such as sauces, research on optimising these formulations remains limited. *So-LeanYum* is a novel functional sauce developed using D-optimal mixture design to maximise nutritional value while maintaining appealing sensory and storage qualities. The formulation, consisting of *terung asam* purée (98.46%), virgin coconut oil (0.73%), and garlic powder (0.81%), was optimised for total phenolic content (TPC), total flavonoid content (TFC), antioxidant capacity (DPPH assay), chlorogenic acid content, and storage stability. Its anti-obesity potential was evaluated through both in-silico and in-vitro approaches, while consumer acceptance was assessed via sensory testing against commercially available sauces. *So-LeanYum* demonstrated high chlorogenic acid content, retained strong antioxidant activity over 28 days, and exhibited promising anti-obesity effects. Sensory evaluation indicated excellent consumer acceptance. More than a flavourful condiment, *So-LeanYum* is a shelf-stable, health-promoting product that uses local ingredients, aligns with the rising demand for natural functional foods, and offers strong potential for commercialisation in both domestic and international markets.

Keywords – functional food, *Solanum lasiocarpum*, antioxidant activity, anti-obesity, D-optimal mixture design

INTRODUCTION

The rise in obesity cases in Malaysia has emphasised the need for dietary interventions that are both effective and appealing to consumers. According to the World Obesity Federation, in 2025, 59% of Malaysian adults are having a high body mass index (BMI).

This number is predicted to increase by 2030, whereby it is predicted that around 17.55 million adults are expected to have a high BMI reading (World Obesity Federation, 2025). Functional foods are foods that offer health benefits besides giving basic nutritional needs for human. *Solanum lasiocarpum* Dunal, commonly known as '*terung asam*', is a native plant of Borneo Island that is widely utilised in Sarawak, Malaysia, for its culinary and medicinal applications and is rich in chlorogenic acid that is known to have antioxidant and anti-obesity properties (Ibrahim et al., 2022; Ting & Ding, 2021). *So-LeanYum* is developed as a novel functional sauce, developed using D-optimal mixture design, a technique within response surface methodology that allows the optimisation of nutritional content while maintaining the favourable sensory attributes and storage stability.

OBJECTIVE

The objectives of the development of this product include:

- i. To optimise the formulation of *terung asam* sauce based on the total phenolic content (TPC), total flavonoid content (TFC) and antioxidant capacity via 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay by using D-optimal mixture design.
- ii. To determine the chlorogenic acid (CGA) content in the optimised sauce formulation (*So-LeanYum*) using high performance liquid chromatography (HPLC).
- iii. To analyse the effect of storage time on total phenolic content (TPC), total flavonoid content (TFC) and antioxidant activity of the best formulation (*So-LeanYum*).
- iv. To evaluate the anti-obesity potential of the optimised sauce formulation (*So-LeanYum*) through in-silico and in-vitro analyses.
- v. To study the consumer acceptance of the optimum sauce formulation (*So-LeanYum*) through sensory analysis in comparison with commercially available sauces in the market.

DESCRIPTION OF THE PROJECT

So-LeanYum is an innovative functional sauce developed from *Solanum lasiocarpum* Dunal, locally known as '*terung asam*', a unique fruit native to Borneo and traditionally used in Sarawak's cuisine and herbal remedies. Recognised for its high chlorogenic acid content with antioxidant and potential anti-obesity benefits, *terung asam* was transformed into a health-promoting condiment through a scientific optimisation process that supports Sustainable Development Goals SDG 2 (Zero Hunger) by promoting value-added utilisation of local crops, enhancing food diversity, and strengthening community-based agriculture. Figure 1 shows the overall process flow of the project.

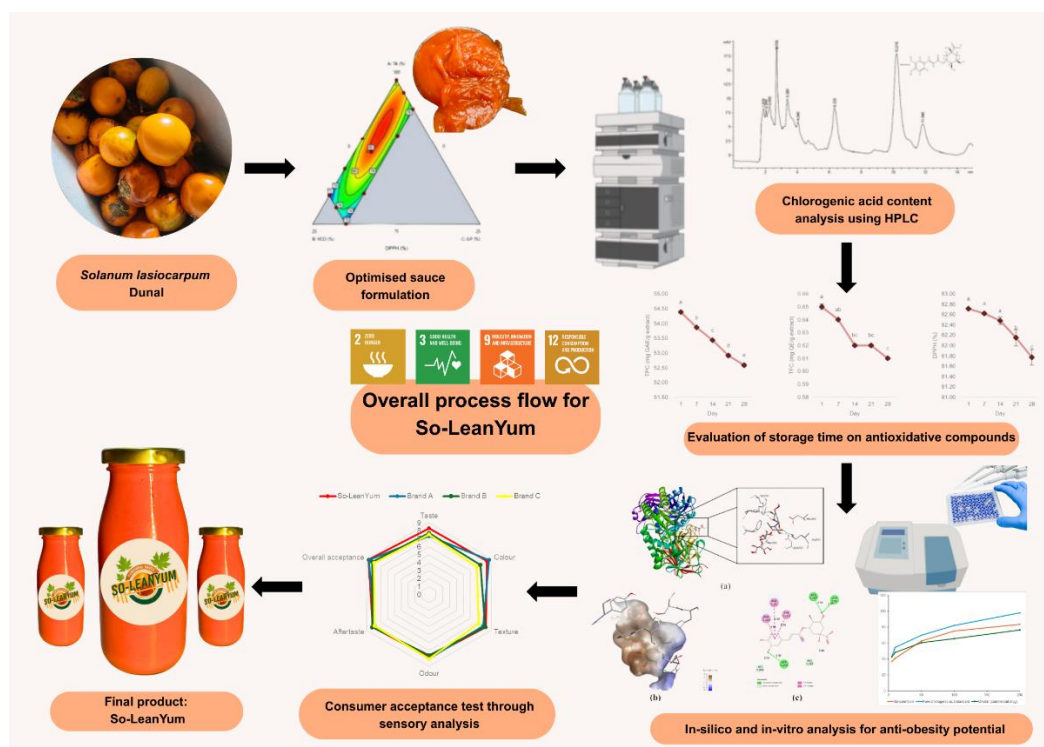


Figure 1: Overall process flow of the project

Using D-optimal mixture design, the formulation of *So-LeanYum* was optimised to maximise total phenolic content (TPC), total flavonoid content (TFC), and antioxidant capacity while preserving desirable taste, colour, and texture. The optimised formulation consists of *terung asam* purée (98.46%), virgin coconut oil (0.73%), and garlic powder (0.81%) (Rushdy et al., 2025). The sauce was further analysed for chlorogenic acid content using HPLC and monitored for the stability of its antioxidant compounds over 28 days of storage. Its anti-obesity potential was evaluated through both in-silico and in-vitro analyses, revealing promising activity (Saini et al., 2025) contributing to SDG 3 (Good Health and Well-Being). Sensory evaluation indicated that *So-LeanYum* was well-received by consumers, often outperforming selected commercial sauces in flavour and overall acceptability. Designed to be shelf-stable, naturally rich in antioxidants, and made from locally sourced ingredients, the product also supports SDG 9 (Industry, Innovation, and Infrastructure) by applying advanced food formulation techniques to a traditional ingredient, and SDG 12 (Responsible Consumption and Production) by promoting sustainable food processing practices. Beyond its unique tangy flavour, it supports healthier eating habits and offers strong potential for commercialisation in both domestic and international functional food markets.

NOVELTY

So-LeanYum stands out as the first *terung asam*-based functional sauce scientifically optimised for its bioactive properties and proven anti-obesity potential. Unlike conventional sauces, its formulation was developed using D-optimal mixture design to precisely balance nutritional value, sensory appeal, and storage stability. It is uniquely rich in chlorogenic acid, quantified using HPLC, and retains high antioxidant activity even after extended storage. The product's health benefits are supported by both in-silico and in-vitro evaluations, providing evidence-based functionality rarely seen in condiment products.

Additionally, its sensory acceptance was benchmarked against commercial sauces, ensuring market readiness. By combining advanced formulation science with a native Bornean ingredient, *So-LeanYum* introduces a new category of locally sourced, shelf-stable condiments that merge flavour, health benefits, and commercial potential.

CONCLUSION

The development of *So-LeanYum* successfully transformed *terung asam* into a scientifically optimised, health-promoting sauce with strong antioxidant properties and promising anti-obesity potential. The product demonstrated stable quality over storage, measurable chlorogenic acid content, and high consumer acceptance compared to commercial sauces. By combining advanced formulation methods with a native Bornean ingredient, *So-LeanYum* offers a unique, shelf-stable condiment that aligns with current trends in functional foods. This innovation not only promotes healthier eating habits but also creates opportunities for value-added use of local resources, supporting both community livelihoods and market expansion in domestic and international sectors.

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