FORMULATION AND CHARACTERIZATION
OF NUTRACEUTICAL BEVERAGE
USING GUAVA LEAVES EXTRACT

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ABSTRACT

The main objective of this study is to formulate and characterize a nutraceutical beverage based on *Psidium guajava* leaves and to evaluate its stability and consumer acceptance. Nutraceuticals are known to have numerous health benefits. Therefore, been used for the treatment and prevention of health problems, such as cancer, inflammatory diseases, hypertension, autoimmune diseases, cardiovascular diseases, atherosclerosis, diabetes, and others. The global spread of nutraceutical products has dramatically increased recently, especially during and after the Covid 19 pandemic (Helal, N. A., et al, 2019). *Psidium guajava* leaves have traditionally been used to manage several diseases. The pharmacological research in vitro as well as in vivo has been widely used to demonstrate the potential of the extracts from the leaves for the co-treatment of different ailments with high prevalence worldwide, upholding the traditional medicine in cases such as diabetes mellitus, cardiovascular diseases, cancer, and parasitic infections (Jassal, et al, 2019). Hence, the aqueous extract of *Psidium guajava* leaves is highly potential to be formulated as a nutraceutical beverage. In this study, the extracts of three types of *Psidium guajava* leaves (Kampuchea, Lao Han, and Seedless) found in Malaysia were investigated for their total phenolic content, total flavonoid content and antioxidant activity to obtain a good formulation. The results showed Kampuchea with the highest polyphenol content and highest antioxidant activity. Kampuchea aqueous extract was used to formulate a nutraceutical beverage by incorporating lemon juice, stevia, and gum Arabic to enhance its texture, flavor, aroma and appearance, and health benefit. A sensory test was done and showed the final product to be palatable and acceptable to consumers.

ABSTRAK

Tujuan utama kajian ini adalah untuk mengformulasi dan mencirikan minuman nutraseutikal berdasarkan daun *Psidium guajava* dan menilai kestabilan formulasi serta penerimaan pengguna. Nutraseutikal diketahui mempunyai banyak kelebihan kesihatan. Maka, nutraseutikal telah digunakan untuk di dalam rawatan dan pencegahan masalah kesihatan seperti kanser, penyakit keradangan, tekanan darah tinggi, penyakit autoimmune, penyakit kardiovaskular, artherosclerosis, diabetes dan lain-lain. Penyebaran produk nutraseutikal global telah meningkat secara dramatic, terutamanya ketika dan selepas pandemik Covid19 (Helal, N. A., et al, 2019). Daun *Psidium guajava* telah digunakan secara traditional dalam beberapa jenis penyakit. Kajian farmakologi in vitro dan in vivo yang meluas telah menunjukkan potensi extract daun tersebut sebagai rawatan komplimentari untuk pelbagai masalah kesihatan yang mempunyai prevalan yang tinggi seluruh dunia, memartabatkan perubatan tradisional dalam kes seperti kencing manis, penyakit kardiovaskular, kanser, dan jangkitan parasit (Jassal, et al, 2019). Oleh itu, ekstrak akueous daun *Psidium guajava* berpotensi tinggi diformulasi sebagai minuman nutraseutikal. Dalam kajian ini, ekstrak daun tiga jenis *Psidium guajava* (Kampuchea, Lao Han, and Seedless) yang ditemui di Malaysia dikaji dari segi kandungan 'total phenolic' dan 'total flavonoid' serta aktiviti antioksidan untuk memperolehi formulasi yang baik. Keputusannya menunjukkan Kampuchea mengandungi kandungan 'polyphenol' tertinggi dan mempunyai aktiviti antioksidan yang paling tinggi. Ekstrak akueous daun Kampuchea telah digunakan untuk menghasilkan minuman nutraseutikal dengan gabungan jus lemon, stevia, dan gum Arabic untuk mempertingkatkan tekstur, rasa, aroma, rupa dan manfaat kesihatan. Ujian sensori telah dijalankan dan menunjukkan produk akhir sedap dan boleh diterima oleh pengguna.

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LIST OF ABBREVIATIONS

PGL   -   *Psidium Guajava* Leaves

EFSA   -   European Food Safety Authority

NDDS   -   Novel Drug Delivery Systems

AGI   -   Alpha Glucosidase Inhibitors

NDDS   -   Novel Drug Delivery System

FDI   -   Food Drug Interphase

NPRA   -   National Pharmaceutical Regulatory Division

FSQD   -   Food Safety and Quality Division

CAM   -   Complementary and Alternative Medicine

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CHAPTER 1

INTRODUCTION

1.1   Research Background

Nutraceutical products largely are not being strictly controlled by regulations compared to pharmaceutical products, hence are seen to dramatically increase spread globally (Nounou, M. I., et al, 2018). Another factor contributing to the rapid growth of nutraceuticals market is the advertisement claims on its safety, efficacy and as drug substitute. Consumers are also reluctant to use pharmaceutical products because of their high price and several side effects (Nounou, M. I., et al, 2018). Therefore, the market share of nutraceuticals has been expanding tremendously. The preference of global population towards nutraceuticals and dietary supplements are approximately 80% making nutraceutical products the fastest growing market with an estimated worth of USD 117 billion globally in 2017 (Helal, N. A., et al, 2019).

Psidium guajava leaves (PGL) are found to contain several bioactive compounds namely essential oils, saponins, and polyphenols (rich in phenolic and flavonoid contents) (Jassal, et al, 2019). The bioactive compounds that attract the attention of the pharmaceutical industry for generating novel phytotherapeutic drugs are the phenolic compounds. These compounds present several medicinal properties like antioxidants, anti-histamines, anti-inflammatory, antibacterial, and anti-thrombotic, and can also be used as adjuvants in the treatment of T2D (Nasser, et al, 2018). The action potential of phenolic compounds in the treatment and prevention of T2D is caused by digestive enzymes inhibition, namely α-glycosidase. Another interesting fact about PGL extract is the low toxicity level and high safety profile, being an excellent nutraceutical candidate. In this research, I focus on the formulation and characterization of functional beverage using the aqueous extract of PGL. Thus, the aim of this study is to formulate and characterize a functional beverage containing aqueous extract of PGL.

1.2   Problem Statement

The increase in the prevalence of T2D is a major health problem in Malaysia as this disease is highly associated with rising microvascular and macrovascular complications. It is also greatly associated with morbidity and mortality due to cardiovascular and cerebrovascular complications (Feisul, M., 2012). Dietary management and healthy lifestyle is the mainstay of management of the disease. However, the patient compliance level is very low, which is less than 20%. Hence, pharmacological treatment is focused on reducing blood glucose levels (Tan, S. L., et al, 2011).

Among the pharmacological groups of antidiabetic drugs, alpha glucosidase inhibitors (AGIs) have increasing interest in the formulation of natural and herbal based safer antidiabetic preparations. However, the commercial drug based AGIs have undesirable side effects. (Sugihara, H., et al, 2014) In addition, herbal based potent AGIs with comparable efficacy and less side effects have been under deep research recently. The high demand for herbal based treatments of chronic non communicable diseases has encouraged the research and development of such standardised herbal products.

Guava leaves extract has been shown in vivo as well in vitro through clinical trials to have significant antidiabetic effect mainly affecting metabolism of carbohydrates in the body. One proven mechanism of action for its effect as potent antidiabetic remedy is alpha glucosidase inhibition effect. As far as we know, no previous study has been done for formulation of a palatable and consumer acceptable functional beverage with antidiabetic activity using guava leaves extract. Therefore, this study looks forward to produce a formulation of antidiabetic functional food which with excellent consumer acceptance using guava leaves extract.

1.3 Research Objectives

The aim of this study is to formulate and characterize a nutraceutical beverage based on PGL and its potential as a palatable functional drink. To obtain this aim, our specific objectives are:

a) To extract (aqueous extract) leaves of three PGL variety namely Kampuchea, Lao Han and Seedless and to compare their phytochemical and biological properties.

b) To formulate a functional beverage containing aqueous extract of PGL which is palatable and accepted by consumers.

c) To evaluate the formulated product stability and consumer acceptance.

1.4 Research Scope

The scopes of this research are:

(a) Aqueous extraction of three PGL varieties namely Kampuchea, Lao Han, and Seedless using the decoction method and comparing their phytochemical (TPC and TFC) properties and antioxidant activities.

(b) Formulating functional beverage using aqueous guava leaves extract into three formulations with the percentage of lemon juice (5 – 15%) as the independent variable and the other contents (guava leaf extract at 2%, gum Arabic at 5%, and stevia at 10%) as controlled variables.

(c) Testing the formulated functional beverage for stability (centrifugation and microbiology, which are Total Plate Count and Total Mold and Yeast Count) and antioxidant activity (DPPH and ABTS).

(d) Testing the 3 formulated functional beverages for sensory evaluation with the method described by Watts (1989) using the Hedonic Scale.

1.5   Significance of Research

This study is expected to produce a formulation of functional beverage with antidiabetic property using guava leaves extract as its active ingredient. This study is also expected to provide details on the phytochemical and biological analysis of the aqueous extract of PGL for formulation of the nutraceutical beverage. This study is also significant as it fills the research gap where there is no previous study that looked at aqueous extract of different varieties of PGL. I hope to produce a formulation which has good or even better, excellent consumer acceptance and palatable. I also hope that the findings of this research will provide a healthy herbal beverage choice with to consumers especially those who metabolic diseases with beneficial effect on their disease management. It is also hoped that the findings of this study will help to provide a healthy herbal beverage choice to consumers with morbidities related to high carbohydrates intake and insulin resistance such as obesity, hypertension, dyslipidaemia, and cardiovascular diseases.

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