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Evaluation Of Different Varieties Mixture Of Fruit Peel For Its Potential As A Functional Food.

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ABSTRACT

Introduction: Functional foods not only provide essential nutrition but also offer additional health benefits that enhance overall well-being and reduce illness risk. This research explores the potential of utilizing a blend of fruit peels from durian (the king of fruits), mata kuching (cats eye fruit), dragon fruit (pitaya), mangosteen (the queen of fruits), and rambutan as natural food ingredients. These peels are rich in flavonoids, phenols, alkaloids, sugars, and phytosterols, which exhibit antioxidant, antihistamine, antidepressant, and antimicrobial properties. Additionally, using fruit peels contributes to reducing food waste. Such beneficial and budget-friendly foods can be easily integrated into diets without the need for supplements or medications.

Method: Peels from each fruit were collected, washed, dried, and ground into a fine powder. The powders were blended in equal ratios to create a fruit peel mixture (FPM). Bioactive compounds were extracted using a 70:30 ethanol -water solvent, and phytochemical analyses were conducted to evaluate anti-ulcer, antihistamine, antidepressant, and antioxidant activities through DPPH assays. Nutritional composition, including fiber, fat, protein, and carbohydrates, was determined using standard methods.

Results: The combined peel mixture of Durio zibethinus (durian), Nephelium lappaceum L. (Rambutan), Selenicereus undatus (dragon fruit), Euphoria malaiense (Mata Kuching), and Garcinia mangostana L. (mangosteen) were examined for its physicochemical properties and functional food potential. No toxicity was observed in acute tests at 72 mg extract or even at higher doses (500 mg/kg and 1000 mg/kg) during sub-acute evaluations compared to control animals. The extract demonstrated significant bioactive activity, particularly in anti-ulcer, antihistamine, antidepressant, and antioxidant properties, indicating its potential as a safe and effective functional food component beneficial for health promotion and the prevention of oxidative stress-related diseases.

Conclusion: The combined peels of rambutan, Mata Kuching, durian, mangosteen, and dragon fruit suggest promising potential as a functional food. The sample proved to be non-toxic in both chronic and sub-chronic tests. The notable antioxidant, anti-ulcer, antihistamine, and antidepressant effects highlight its therapeutic relevance. Future studies should focus on investigating the mechanisms of action and determining appropriate dosages for food applications and pharmaceutical use...

Keywords: *Functional food, Phytochemicals, DPPH assay, Fruits peels..*

INTRODUCTION

The substantial amount of waste generated by the fruit industry has come to light as environmental sustainability has gained more attention. Millions of tons of fruit trash, mostly peels, are discarded annually despite the fruit's high nutritional content and useful qualities (Zahid, et al., 2019). Frequently, these peels are treated as only decorative items. They do, however, present a number of chances for innovative methods of producing food in a sustainable manner. The peel is not only a waste but also a potential treasure trove for creating rich foods because it is full of bioactive substances such dietary fiber, carotenoids, polyphenols, and enzymes (Bhardwaj, et al., 2022). However, there is a distinct lack of research on the potential uses of fruit peels, especially in tropical fruits such as Durio zibethinus (durian), Nephelium lappaceum L. (Rambutan), Selenicereus undatus (dragon fruit), Euphoria malaiense (Mata Kuching), and Garcinia mangostana L. (mangosteen).

Although recent studies have shown that these beans are rich in dietary fiber and have many health benefits such as antioxidant, anti-diabetic and anti-hypercholesterolemic, their activities and bioavailability still need to be further investigated (Muhtadi, et al., 2016. Kumoro, et al., 2020). Available data suggest that the peel may surpass other parts of the fruit in terms of biological and chemical properties (Hussain, et al., 2022), however, significant obstacles remain regarding their integration into mainstream food production and the possible antinutritional factors involved.

There are various reasons why this study is significant. Firstly, it tackles the twin problems of cutting down on food waste and enjoying the health advantages of peels. We can create solutions that will raise food industry manufacturing standards and support public health initiatives to prevent chronic diseases by researching the nutritional qualities and uses of these peels. Furthermore, this research is based on the global sustainability goal of improving resources and reducing environmental impact. This study will use a multidisciplinary approach combining phytochemical analyses, bioactivity analyses, and standard methods to evaluate extracts from selected fruits. In particular, we will examine the antioxidant capacity, antidiabetic drugs and total bioactivity of the peels to allow their potential as ingredients to be assessed. How can the bioactive properties of fruit peels be used to create food ingredients that improve nutrition and health? Finally, this research aims to better understand the economic and environmental benefits of using peels, facilitating their transformation from waste to fresh food, thus contributing to greater health

METHOD AND MATERIALS

Materials

Fruit peels from various species collected in Malaysia include Durio zibethinus (durian), Nephelium lappaceum L. (rambutan), Selenicereus undatus (dragon fruit), Euphoria malaiense (mata kuching), and Garcinia mangostana L. (mangosteen). Common solvents used for the extraction process include ethanol and methanol. A-grade materials utilized in the extraction include 1,1-diphenyl-2-picryl hydrazyl (DPPH) and various acids such as hydrochloric acid, acetic acid, and sulfuric acid, along with reagents like Mayer's reagent and ferric chloride (FeCl3). Distilled water is employed for aqueous extractions. Equipment used in the process consists of heating apparatus like water baths and hot plate stirrers, as well as Soxhlet extraction systems. Filtration equipment includes filter paper and Buchner funnels. Additionally, analytical tools and a pH meter are also used.

Methods

Acute toxicity test

In acute toxicity tests, a total of 12 mice was randomly allocated into 2 groups consisting of 6 mice per group. That is, Group I (Control), Group II (mixture of extracts). Each group of mice was administered with a single fixed dose of the respective fruit peels extracts tested in a stepwise procedure (2000 mg/kg body weight). Group I mice received distilled water (vehicle) until the end of the experiment. Any indications of clinical toxicity were closely monitored within 4 hours of treatment period up to 24 hours (OECD, O. 2001).

Sub-acute toxicity test

As recommended by OECD (2001), the selection of the starting dose of the sub-acute toxicity test was based on a dose, which is not expected to produce mortality or severe acute toxicity. The 1000 mg/kg body weight of the extracted material was the highest dose. The experimental study of sub-acute toxicity was parallel design, in which each group given unique extracts. A total of 18 mice were randomly divided into 3 groups consisting of 6 mice per group with matching body weights. That is, Group I (Control), Group II (500mg/kg mixture of extract), Group III (1000mg/kg mixture of extract) were given a single dose mg/kg body weight once daily for 28 days, consecutively. The dosing volume was 2 mL/100 g of body weight. The control group received distilled water once daily throughout the experiment. Thereafter, observations for toxic manifestations (rising fur, draping, tremors, excitability, twitching, salivation and mortality) were made until the end of the 28-day period. After 28 days, they were humanly sacrificed (OECD, O. 2001).

Phytochemical test

Test for Alkaloids

The plant extract was dissolved in 1 mL of water, filtered, and cooked in steam with 2 mL of the filtrate and three drops of 1% HCl. Then, 1 mL of the heated mixture was combined with 2 mL of the Mayer-Wagner reagent. The appearance of a cream or brown-red colored precipitate indicated the presence of alkaloids (Lawal, et al., 2019).

Test for Flavonoids

1 mg of the plant extract was mixed with 10 mL of ethanol and filtrated. Two mL of the filtrate, concentrated NaOH, and magnesium ribbon were mixed. The formation of a pink or red color indicated the presence of flavonoids (Solanki, et al., 2019).

Test for Phenols

About 1 mL of the extract was combined with four drops of FeCl3, and 1 mL of K2Fe (CN6). The formation of greenish-blue forms confirmed the presence of phenols (Ben, et al., 2013).

Test for reducing sugar (Fehling test)

1ml of each of Fehling A and Fehling B reagents were mixed together and the mixture was then added to the Mixture of fruits peel extract and get thesolution boiled. The formation of brick red color precipitates in the bottom of the vessel shows the availability of reducing sugars in the sample (Sadasivam, et al., 2008).

Phytosterols

Libermann-Burchard's test

1mi of the extract was added with chloroform. After filtration, it is treated with a few drops of acetic anhydride, boiled, and cooled. Then conc. sulphuric acid is added. Formation of brown ring at the junction indicated the presence of phytosterols (Bandiola, et al., 2017).

Antioxidant assays

DPPH assay

DPPH 11-diphenyl-2-picrylhydrazyl the ability to neutralize free radicals was evaluated employing the technique explained by (Ebrahimzadeh, et al., 2008) to prepare the samples for analysis each peel the extract was thinned out by mixing 001 g of the extract from Durio zibethinus, Nephelium lappaceum L., Seleniferous undatus, Euphoria malaiense, and Garcinia mangostana L. with 100 ml of extraction solvent from this solution 2 ml 4 ml 6 ml and 8 ml aliquots were taken into separate measuring flasks a DPPH reagent was then prepared by dissolving 0004 g of solid DPPH in 100 ml of ethanol freshly prepared DPPH reagent was added to each aliquot the samples were kept in the dark at room temperature for 15 minutes after this period the absorbance of each sample the absorbance was recorded at 517 nm with a uv-vis spectrophotometer a control sample which contained the same amount of DPPH reagent and solvent but excluded the extract was also measured at the same wavelength the ability of each to scavenge DPPH citrus peel The extract is represented as a percentage reduction of DPPH radicals (Ashraf, et al., 2024).

Reduction in Absorbance (%)= $\frac{A+B}{A} \times 100$

A is absorbance of control and B is absorbance of tested sample.

Acute ulcer study

Naproxen-induced ulcer model

This experiment was conducted following the procedure described by (Ashraf, et al., 2024) in summary mice of 120 and 150 g the animals were chosen weighed and labeled for identification and all of them underwent a fasting period 24 h prophylactic treatment of a mixture of fruits peel extract 500 and 1000 mg kg po was given to three experimental groups with each using distilled water 1 ml and omeprazole 30 mg/kg po naproxen was given to both the control and standard groups 30 mg/kg was administered po after 1 h of mixture of fruits peel the animals used for pretreatment were euthanized after a duration of 6 hours after administering naproxen treatment the stomachs of all the treated animals were carefully isolated and opened along the greater curvature to reveal the inner surface the surfaces were thoroughly washed with normal saline before being examined for analysis and the ulcer index was subsequently calculated using the following formula:

Ulcer index (UI) = Total area of ulcer (mm^2) /Total area of stomach (mm^2)

test group, respectively, after 24 h, and treatment was continued daily for next 8 weeks. Stomach was isolated from the animals at the end of the experiment and analyzed (Satoh, et al., 1982).

Anti-depression activity

Forced swimming test

In this approach, mice were made to swim until they reached exhaustion 34 a cylindrical container measuring 25 cm in height and 18 cm in diameter was filled with water at a 15cm depth at a temperature maintained at 25c. The mice during the last 4 min of 6 the minimum duration of stress-induced immobility was observed with a reduction in immobility time noted during the forced swimming test (FST) which was used as an indicator of antistress activity over the 24 h the urinary concentrations of vanillylmandelic acid (VMA) and ascorbic acid were measured for both the normal and stress-induced animals (Arun, et al., 2014).

Treatment protocol

Group I: Positive control (received 1% CMC in normal saline (1 mL) P.O saline water once daily for 7 days) with stress

Group II: Standard (received diazepam 5 mg/kg (Standard drug) once daily for 7 days) with stress

Group III: Received 500 mg/kg extract (test sample) once daily for 7 days with stress

Group IV: Received 1000 mg/kg extract (test sample) once daily for 7 days with stress.

RESULTS AND DISCUSSION

Acute toxicity and sub chronic toxicity

Body weight measurement

The body weight of mice was measured weekly until the end of acute and sub chronic toxicity studies. There were no significant ($p > 0.05$) differences in the body weight changes between the control and peel mixture of Durio zibethinus, Nephelium lappaceum L., Seleniferous undatus, Euphoria malaiense, and Garcinia mangostana L. ethanol extract treated mice as shown in Figure.1

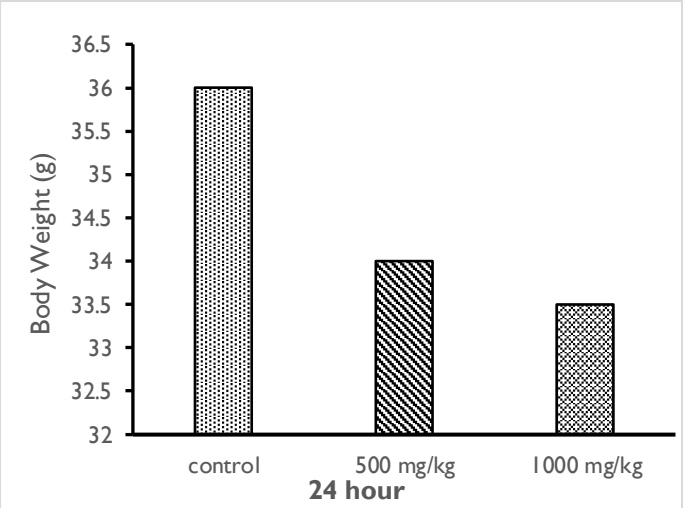

Figure. 1: Body weight of control and Mixture of fruits peel extract treated mice's in the acute toxicity (for 24 hours).

No death was recorded in the 24 hours of observation period in the animals given up to 1000 mg/kg P.O. of the given ethanol extract. The animals did not show any changes in the general appearance during observation period, except at a dose of 1000mg/kg showed increased motor activity.

Control		Treatment	
Parameters Observed	1% CMC	500mg/kg	1000mg/kg
Diarrhea	-	-	-
Muscle Relaxation	-	-	-
Sedation	-	-	-
Tremors	-	-	-
Muscle Spasm	-	-	-
Motor activity	-	+	+

Table 1: Parameters observed during acute toxicity study for 24 hours

		Weight of organs after treating with Epipremnum aureum ethanol extract mg/kg	
Parameters Observed	Control	500 mg/kg	1000 mg/kg
liver	6.39±0.25	6.80±0.14	6.59±0.23
kidney	1.38±0.11	1.30±0.17	1.36±0.16
heart	0.62±0.02	0.51±0.03	0.55±0.01
Pancreas	0.91±0.11	0.79±0.13	0.84±0.21
Adrenals	0.03±0.08	0.03±0.03	0.03±0.02
lungs	1.26±0.16	1.26±0.33	1.30±0.15

Table 2: Organ weight of control and treated mice at doses 500and 1000mg/kg b.wt. in the sub-chronic toxicity study for 28 days.

The weight of individual organs reveals that Mixture of fruits peel ethanol extract has no effect on the weight of heart, liver, kidney adrenals, lungs and pancreas when compared to control group.

Anti-oxidant activity

DPPH assay

DPPH scavenging capacity assay is generally utilized for the estimation of antioxidant activity. The DPPH is a stable and intense colored oxidizing radical that forms yellow colored hydrazine associated with abstraction of free hydrogen atoms from phenolic antioxidants. Pooled means regarding DPPH (Table 2) illuminated highest value for ethanolic extract 55.7± 2.5% followed by water extracts 43.4 ± 1.76%. Among various Mixture of fruits peel extracts, antioxidant power of ethanolic peel extract was maximum 61.54 ± 2.4% at 60 min but minimum at 30 min 54.8 ± 2.2%.

The present finding regarding DPPH of Mixture of fruits peel (Durio zibethinus, Nephelium lappaceum L., Seleniferous undatus, Euphoria malaiense, and Garcinia mangostana L.) are in collaboration with study of Khan (Khan, et al., 2012) who studied peels antioxidant potency of mixture of fruits by DPPH radical-scavenging activity using maceration and Soxhlet extraction modes. Accordingly, the percentage scavenging activity of Mixture of fruits peel against free radicals varied from 11.85% to 78.6%. The logic behind this alteration is more the phenolics present in peels extract, the lower will be optical density (OD) recorded owing to number of DPPH free radicals scavenged by the phytonutrients isolated from the peels of mixture of fruits.

(Ascorbic Acid) and a standard (Citrus peel extract).

Sample	***Total Phenolic Content (TPC) (mg GAE/g extract)***	***DPPH Radical Scavenging Activity (IC_{50}, µg/mL)***	***FRAP (mmol Fe^{2+}/g extract)***
Combined Plant Extract	**98.45 ± 2.34**	**20.67 ± 0.56**	**5.89 ± 0.22**
Citrus Peel Extract	**98.67 ± 1.89**	**18.45 ± 0.37**	**5.12 ± 0.18**
Control (Ascorbic Acid)	**N/A**	**4.87 ± 0.11**	**8.34 ± 0.30**

Antiulcer Activity

Naproxen-induced ulcers

The findings indicated the use of naproxen caused sores in all the animals that were addressed and the average number of ulcers observed was recorded area was 5.505 ± 01584 mm2 an ulcer index of 078 ± 0.03 was noted in the control group indicating the ulcer-causing effects of naproxen. Treatment mixture of fruit peel extract Durio zibethinus, Nephelium lappaceum L., Seleniferous undatus, Euphoria malaiense, and Garcinia mangostana L. demonstrated a notable reduction in

ulcer size with a ($p < 0.01$) especially at administration levels of 500 and 1000 mg/kg the increased dosage of the fruit peel extract mixture specifically 1000 mg/kg effectively protected against the ulcer-inducing effects of naproxen especially when compared to the control group treated with the 1000 mg/kg dose of the fruit peel extract this treatment resulted in an ulcer area of 3.422 ± 0363 mm2 and an ulcer index (UI) of 0.61 ± 0.01 additionally the use of omeprazole also resulted in a significant reduction of the ulcer area indicated the data in the table showed that the results were similar to those produced by the standard drug with values of 2.33 ± 0.01mm2 and an ulcer index of 0.32 ± 0.01. Notably, the mixture of fruit peel extract demonstrated effectiveness in inducing ulcer conditions.

Parameters	Control	Omeprazole 30 mg/ kg	Extract 500 mg/kg	Extract 1000 mg/kg
Area of ulcer (mm^2)	5.40 ± 0.16	2.33 ± 0.11	4.20 ± 0.10	3.52 ± 0.03
Ulcer index (UI)	0.70 ± 0.03	0.32 ± 0.01	0.50 ± 0.02	0.41 ± 0.01

Table 1 Effect of Mixture of fruits peel extract on area of ulcer and ulcer index in naproxen-induced acute ulcers.

Antidepressant Activity

The extract's total flavonoid content was measured at 275.5 mg equivalent to quercetin when ethanol was used as the extracting solvent in the FST model the swimming survival duration significantly increased in test group IV 200.67 ± 1.61 compared to the positive control group 122.67 ± 1.28 after a 7-day treatment with a mixture of fruit peels from ± 1.61) compared to the positive control group (122.67 ± 1.28) after a 7-day treatment with a mixture of fruit peels (from Durio zibethinus, Nephelium lappaceum L., Seleniferous undatus, Euphoria malaiense, and Garcinia mangostana L. as a result a higher dosage of the fruit peel mixture proved more effective than a lower dosage of the extract as indicated in table 1.

Group	Treatment	Swimming survival time (s)
Group I positive control	1% CMC in normal saline 1 mL P.O + stress	122.67±1.28
Group II standard	Diazepam 5 mg/kg P. O	239.65±1.17
Group III extract	Mixture of fruits peel extract 500 mg/kg P. O	135.19±1.64*
Group IV extract	Mixture of fruits peel extract 1000 mg/kg P. O	203.57±1.60**

CONCLUSION

By decreasing food waste, the investigation of fruit peel mixes presents a promising chance to create functional foods that improve nutritional value and support environmental sustainability. Fruit peels include bioactive substances such dietary fiber, carotenoids, and polyphenols that have several health advantages, such as anti-diabetic and antioxidant qualities. To optimize these advantages, possible negative consequences, such anti-nutritional factors, must be addressed. Future studies should concentrate on resolving these problems, comprehending the mechanisms of action, and determining the best dosages. In order to include fruit peels into regular food production, improve diets, and lessen the impact on the environment, it will also be crucial to investigate consumer acceptance and market possibilities

REFERENCES

[1] Zahid, H. F., Ranadheera, C. S., Fang, Z., & Ajlouni, S. (2019). Healthy and Functional Ingredients from Fruit Processing Byproducts: A Review Focusing on Fruit Peels. Int. J. Agric. Environ. Biores, 4, 336-360.

[2] Bhardwaj, K., Najda, A., Sharma, R., Nurzyńska-Wierdak, R., Dhanjal, D. S., Sharma, R., ... & Bhardwaj, P. (2022). Fruit and Vegetable Peel-Enriched Functional Foods: Potential Avenues and Health Perspectives. Evidence-based Complementary and Alternative Medicine, 2022(1), 8543881.

[3] Muhtadi, M., Haryoto, H., Sujono, T. A., & Suhendi, A. (2016). Antidiabetic and antihypercholesterolemia

activities of rambutan (Nephelium lappaceum L.) and durian (Durio zibethinus Murr.) fruit peel extracts. Journal of Applied Pharmaceutical Science, 6(4), 190-194.

[4] Kumoro, A. C., Alhanif, M., & Wardhani, D. H. (2020). A critical review on tropical fruits seeds as prospective sources of nutritional and bioactive compounds for functional foods development: a case of Indonesian exotic fruits. International journal of food science, 2020(1), 4051475.

[5] Hussain, H., Mamadalieva, N. Z., Hussain, A., Hassan, U., Rabnawaz, A., Ahmed, I., & Green, I. R. (2022). Fruit peels: Food waste as a valuable source of bioactive natural products for drug discovery. Current issues in molecular biology, 44(5), 1960-1994.

[6] OECD, O. (2001). Guidelines for the Testing of Chemicals. Acute Oral Toxicity—Acute Toxic Class Method: Test No-423 Organization for Economic Co-Operation and Development.

[7] Lawal, A. M., Abdullahi, R., Ibrahim, M. S., Kurfi, M. Y., Khalid, A., & Nuhu, M. (2019). Phytochemical analysis and thin layer chromatography profiling of crude extracts from Senna occidentalis (leaves). Journal of Biotechnology and Biomedical Science, 2(1), 12-21.

[8] Solanki, S. L., Modi, C. M., Patel, H. B., Patel, U. D., & Bhadarka, D. H. (2019). Phytochemical screening and thin-layer chromatography of six medicinal plants from the surroundings of Junagadh, Gujarat, India. Journal of Pharmacognosy and Phytochemistry, 8(4), 3122-3126.

[9] Ben, I. O., Woode, E., Abotsi, W. K. M., & Boakye-Gyasi, E. (2013). Preliminary phytochemical screening and in vitro antioxidant prop-erties of Trichilia monadelpha (Thonn.) JJ De Wilde (Meliaceae). Journal of Medical and Biomedical Sciences, 2(2), 6-15.

[10] Sadasivam, S., & Manickam, A. (2008). Biochemical Methods, 3rd. New Age International Publishers, New Delhi, India.

[11] Bandiola, T.M.B., Ignacio, G.B., Yunson, E.G.A., & Bandiola, P.D.B., 2017. International Journal of Applied Pharmaceutical and Biological Research, 2(6), 15-23.

[12] Ebrahimzadeh, M. A., Pourmorad, F., & Bekhradnia, A. R. (2008). Iron chelating activity, phenol and flavonoid content of some medicinal plants from Iran. African journal of Biotechnology, 7(18).

[13] Ashraf, H., Iahtisham-Ul-Haq, Butt, M. S., Nayik, G. A., Ramniwas, S., Damto, T., ... & Ansari, M. J. (2024). Phytochemical and antioxidant profile of citrus peel extracts in relation to different extraction parameters. International Journal of Food Properties, 27(1), 286-299.

[14] Satoh, H., Guth, P. H., & Grossman, M. I. (1982). Role of food in gastrointestinal ulceration produced by indomethacin in the rat. Gastroenterology, 83(1), 210-215.

[15] Arun, L. B., Arunachalam, A. M., Arunachalam, K. D., Annamalai, S. K., & Kumar, K. A. (2014). In vivo anti-ulcer, anti-stress, anti-allergic, and functional properties of gymnemic acid isolated from Gymnema sylvestre R Br. BMC complementary and alternative medicine, 14(1), 70.

[16] Khan, B. A., Akhtar, N., Rasul, A., Mahmood, T., Khan, H. M. S., Iqbal, M., & Murtaza, G. (2012). Investigation of the effects of extraction solvent/technique on the antioxidant activity of Cassia fistula L. Journal of Medicinal Plants Research, 6(3), 500-503.