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EVALUATION OF THE SAFETY PROFILE OF BANANA PEEL EXTRACT IN RATS

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ABSTRACT

The current study assessed the effect of supercritical fluid extract of the banana peel (an agricultural waste) on some haematological and biochemical parameters in Sprague Dawley rats. Twenty (20) rats were assigned as 4 groups and each group had 5 rats. Group 1 was assigned as control. Groups 2, 3 and 4 were administered 400.00, 800.00 and 1200.00 mg/kg per body weight respectively of the banana peel extract for a period of 21 days. Blood samples were collected by cardiac puncture and analyzed. Hemoglobin concentration, PCV, WBC, Lymphocyte, Monocyte values and total RBC count showed significant difference between treatment groups. But these changes did not cause any toxicity in the rats as their variation was in range when compared with the control group. These changes were noted due to possible genetic variations in the rats. Total Platelet count, MCV, MCH and MCHC, Eosinophils, and Neutrophils did not show any significant differences between the treatment groups. No changes were observed in rats' weight and feed intake having banana peel extract in their diets. This confirms the neutral behavior of the extracts in the rats thus not causing any toxicity. The extract is saved to be used in preparation of any functional food in the future. Moreover, extract can be used as preservative in stabilization of the food products in the replacement of the synthetic preservatives. These supposed uses will be covered and discussed in upcoming research objectives.

Keywords: Banana peel extract; toxicity; hematology; biochemical parameters; physiological parameters,

1. Introduction

The fruits and vegetables processing industry generate a staggering amount (>25–40%) of residues e.g., peel, seed, press cake, pomaces, etc. that are frequently dumped in the environmental streams causing air pollution and their management is of serious concern and expensive. In recent years, special focus has been placed on the valorization of these residues in order to transform them into valuable ingredients and recover some essential components (i.e. phenolic, anthocyanin, flavonoids, vitamins, minerals, and antioxidants). These compounds have possessed antimicrobial, antioxidant, anti-diabetic, anti-aging, anti-cancer, anti-obesity functions (Islam *et al.*, 2023).

Bananas are a major crop in the globe, so plantations produce tons of residues during the processing stage to create banana pulps in each harvest season. Banana peels make up between 35% and 50% of the entire fruit mass, however there may also be deposits of leaves, pseudo stems, stalks, and inflorescence (Gomes *et al.,* 2020). Usually, banana peels are thrown into the environment untreated. Because banana peel has a high fiber content and minimal tannin level, it can occasionally be utilized as organic fertilizer and animal feed. Several tons of waste banana peels are produced daily in fruit markets and residential garbage disposal sites. Bananas are eaten raw, a large number of bananas are industrially processed to make chips, flour, and other processed foods, which leads to a huge amount of banana peel waste. Banana peels were previously disposed off by the food production sectors in landfills. The transformation of banana peel into a valued commodity would have a positive financial impact on the agriculture sector (Zaini *et al.,* 2022).

Peel has high levels of antioxidant, antibacterial, and antibiotic properties. It also contains phenolic compounds and dietary fiber. Because of this, it is a substance with a lot of potential, which encourages the pharmaceutical and nutraceutical businesses to use it (Pereira & Maraschin, 2015).

Antioxidants help prevent various diseases or work in conjunction with existing treatments. Dietary antioxidants have the potential to serve as a substitute for synthetic antioxidants, whose usage is closely restricted due to potential health hazards, as they can also prevent food from oxidizing (Agourram *et al.,* 2013). Due to their low cost and high production of plant biowastes, their application can be extended to the food business, where they can be utilized as antioxidants to create novel functional products. In comparison to other fruits, banana peels have a higher concentration of phenolics, which are significant secondary metabolites. Banana peels contain a variety of phenolic compounds, including epicatechin, gallic acid, tannins, and anthocyanins. Furthermore, banana peels have five times more gallocatechin than pulp, suggesting that they are rich in antioxidant compounds (Sidhu & Zafar, 2018).

There is insufficient information in the literature concerning the toxicity of the banana peel. Hence, this study was carried out to assess the effects of supercritical fluid extract of banana peel on some haematological and biochemical parameters in sprague dawley rats. It is expected that the outcome of this study will provide additional information on the safety of banana peel extract exposure to animals.

2. Materials and Methods

2.1. Procurement of Raw material

Banana peels were purchased from a local Faisalabad market. Sigma Aldrich (Sigma Aldrich, Tokyo, Japan) and Merk (KGaA Merck Darmstadt, Germany) were used to purchase the chemicals and standards.

2.2. Preparation of peel powder

The peels were cleaned before being dried at 55 °C in a hot air oven. Using a small laboratory grinder, the dried material was ground into a fine powder. The powder was then refined further by passing through sieves with an 80-mesh mesh size. The powder was prepared and then put into airtight plastic jars for analysis at room temperature (Kumar *et al.,* 2020).

2.3. Preparation of Extract

Supercritical fluid extraction method was used for the purpose of extraction. With the supercritical extraction apparatus, banana peel extract was obtained. In a fixed bed at 55 °C and 30 MPa, 15 g of raw material was extracted using CO_2 at 8.33 g/min and 15% ethanol-water (50:50 v/v) at 1.25 g/min, respectively. Depressurization was used to remove CO_2, and a rotary evaporator and freeze-dryer were used to separate the co-solvent. There were two runs of the extraction. (Santos *et al.,* 2021).

2.4. Biosafety Assessment of Extracts

Table 1: Treatment Plan for safety assessment

Groups	Description
D_0	Diet with no preservative
D_1	Diet with natural preservative (banana peel extract) at 400mg/kg body weight
D_2	Diet with natural preservative (banana peel extract) at 800mg/kg body weight
D_3	Diet with natural preservative (banana peel extract) at 1200mg/kg body weight

*D=Diet, Treatments were assessed for toxicity at 400mg/kg, 800mg/kg and 1200mg/kg body weight.

2.5. Experimental Procedure

The banana peel extract was tested for toxicity at various levels using in-vivo toxicological experiments following the Puri *et al.* (2022). The acute toxicity of extract was determined as per organization for economic co-operative and development (OECD) guidelines No. 423. In acute toxicity study, determination of LD50 was carried out in healthy rat. The present study was approved by Institutional ethics committee of GCWUF, Pakistan. A full experimental schedule is presented in Table 1, which included a 21-day study of acute oral toxicity. Five rats were used in each treatment, and the initial dose for the rats was 400mg/kg per body weight for the rats. Both extracts were given as a single oral dosage of 400 mg/kg to two distinct groups: $Group_1$ (400 mg/kg banana peel extract) and $Group_2$ (800 mg/kg banana peel extract). There were three animals per group, and oral gavage feeding needles made of stainless steel were employed. When the dose was administered, no toxic effects or behavioral changes in the animals were seen after 24 hours. No substantial changes in behavior or mortality were seen, and no toxicity was generated. Consequently, we raised the concentration and administrated to $Group_3$ (1200 mg/kg banana peel extract). On the final day of the investigation, significant traits including hematological and biochemical parameters were determined. The cervixes of the rats were dislocated for the histological analysis of several organs before all living rats were put to death using a mild anesthesia. The animals were monitored daily for cage-side observations and at least twice a day for viability. Before the first therapy and every week after that until the study's conclusion, thorough clinical evaluations were carried out. During acclimation, the first day of therapy, and right before necropsy, body weight and feeding intake were noted.

2.6. Hematology and Biochemical Test Parameters

On the last day of the treatment, blood samples from the retroorbital plexus of rats in each group were taken and put in vials coated with EDTA for haematology analysis and biochemical evaluation. The Eurocount-TS Haematology Analyzer was used to measure the following parameters: mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration, mean corpuscular hemoglobin volume, white blood cell count, lymphocytes, neutrophils, eosinophils, monocytes, platelet count, and hemoglobin concentration. On the other hand, biochemical parameters such as blood urea nitrogen for renal function and blood glucose, total cholesterol, triglycerides (TG), serum alkaline phosphatase, serum aspartate aminotransferase, and serum alanine aminotransferase enzyme levels were evaluated for liver function (Heimbach *et al.,* 2013).

2.7. Statistical Analysis

With Statistix 8.1 software, the data was presented as the mean standard deviation of three replicates and analyzed.

3. Results and Discussion

3.1. Hematological Parameters

The effect of supercritical fluid extract of banana peel on haematological parameters in sprague dawley rats is shown in Table 3. Hemoglobin concentration, PCV, WBC, Lymphocyte, Monocyte values and total RBC count showed significant differences between treatment groups. But these changes did not cause any toxicity in the rats as their variation was in range when compared with the

control group. These changes were noted due to possible genetic variations in the rats. The observed mean values for Hb were 12.16±0.24, 11.73±0.31, 11.56±0.04, 12.22±0.12, for PCV 34.26±0.27, 33.53±0.22, 33.36±0.03, 34.42±0.21, for WBC 71.39, 72.41±0.42, 72.21±0.25, 71.53±0.20, for Lymphocytes 67.24±0.06, 67.64±0.21, 67.61±0.13, 67.48±0.07, and for Monocytes 0.87±0.01, 0.85±0.02, 0.83±0.02, 0.88±0.02, for D_0 (Control), D_1 (400mg/kg BPE), D_2 (800mg/kg BPE), and D_3 (1200 mg/kg BPE) respectively as shown in Table 2. Total Platelet count, MCV, MCH, MCHC, Eosinophils, and Neutrophils did not show any significant differences between the treatment groups. The mean value for total platelet count was 31.74±0.07, 31.72±0.05, 31.40±0.06, 31.54±0.15, for MCV 83.76±0.13, 83.64±0.20, 83.54±0.02, 83.63±0.05, for MCH 21.62±0.03, 21.52±0.03, 21.68±0.03, 21.49±0.02 and for MCHC 21.62±0.03, 21.52±0.03, 21.68±0.03, 21.49±0.02, for Eosinophils 3.04±0.02, 3.01±0.01, 2.99±0.02, 3.01±0.02, for Neutrophils 25.81±0.06, 25.87±0.03, 26.15±0.05, 26.26±0.03, for D_0 (Control), D_1 (400mg/kg BPE), D_2 (800mg/kg BPE), and D_3 (1200 mg/kg BPE) respectively as shown in Table 2. Mean square values for hematological parameters are in Table 3. Comparison of hematological parameters of sprague dawley rats treated with supercritical fluid banana peel extract with reference values are depicted in figure 1. When determining a test substance's potential for hemotoxicity, the evaluation of haematological parameters is helpful. The current investigation has shown that extracts variate WBC count in a dose-dependent manner. One could consider the observed variation in this parameter to be a typical immunological reaction to a foreign invasion. This suggests that the extract might variate hematopoietic activity. Bioactive components in plant extracts have been linked to their hematopoietic potential.

These results are in line with research conducted by Halim *et al.*, 2011 who administrated Carica papaya leaf extract to Sprague Dawley rats at a dose of 2000 mg/kg for 14 days. When compared to rats given a normal diet, no discernible difference was seen in the hematology values of treated rats, including lymphocyte percentage (Halim *et al.,* 2011).

These findings are also consistent with those of Ojuade et al. (2021), who conducted toxicity research on albino rats to determine whether or not Allium cepa peels are safe for human consumption. Aqueous peel extract was administered at three levels (125, 250, and 500 mg per kg) for 28 days in order to conduct a subacute toxicity study. Hematological characteristics, such as RBC, MCV, MCH, LYM, HCT, MCHC, HGB, and PCV, did not show any discernible variations.

Citrus macroptera fruit extract's toxicity was assessed in efficacy research using a number of hematological and biochemical markers in Sprague Dawley rats. Rats were administered 250, 500, and 1000 mg of this fruit's methanol extract per kilogram of body weight. The findings showed that hematological parameters were not significantly impacted by the administration of extract at several doses. The fruit extract's non-toxic nature was suggested. After three weeks of treatment, methanol extract at a dose of 1000 mg/kg did not cause any physical abnormalities or death (Nizam Uddin et al. 2014).

For ninety days, rats were given three different doses of rosemary supercritical CO_2 extract: 300, 600, and 2400 mg/kg. No clinical symptoms or fatalities were reported because of administering the extract (Phipps *et al.,* 2021).

Table 2: Effect of supercritical extract of banana peel on hematological parameters in sprague dawley rats

Hematological parameters	D_0 (Control)	D_1 (400mg/kg BPE)	D_2 (800mg/kg BPE)	D_3 (1200 mg/kg BPE)
Hb (g/dL)	12.16±0.24^{a}	11.73±0.31^{ab}	11.56±0.04^{b}	12.22±0.12^{a}
RBC (× 10^5 /µL)	44.4±0.50^{a}	43.60±0.45^{a}	43.76±1.25^{ab}	41.53±0.90^{b}
WBC (10^{12}/L)	71.39±0.14^{b}	72.41±0.42^{a}	72.21±0.25^{ab}	71.53±0.20^{b}
Lymphocytes (%)	67.24±0.06^{a}	67.64±0.21^{ab}	67.61±0.13^{ab}	67.48±0.07^{b}
Neutrophils (%)	25.81±0.06^{a}	25.87±0.03^{a}	26.15±0.05^{a}	26.26±0.03^{a}
Eosinophils (%)	3.04±0.02^{a}	3.01±0.01^{a}	2.99±0.02^{a}	3.01±0.02^{a}
Monocytes (%)	0.87±0.01^{a}	0.85±0.02^{ab}	0.83±0.02^{b}	0.88±0.02^{ab}
PLT (× 10^4 /µL)	31.74±0.07^{a}	31.72±0.05^{a}	31.40±0.06^{a}	31.54±0.15^{a}
PCV(%)	34.26±0.27^{a}	33.53±0.22^{ab}	33.36±0.03^{b}	34.42±0.21^{a}
MCH (pg)	21.62±0.03^{a}	21.52±0.03^{a}	21.68±0.03^{a}	21.49±0.02^{a}
MCHC (g/dL)	62.26±0.02^{a}	62.45±0.05^{a}	62.16±0.03^{a}	62.45±0.03^{a}
MCV (fl)	83.76±0.13^{a}	83.64±0.20^{a}	83.54±0.02^{a}	83.63±0.05^{a}

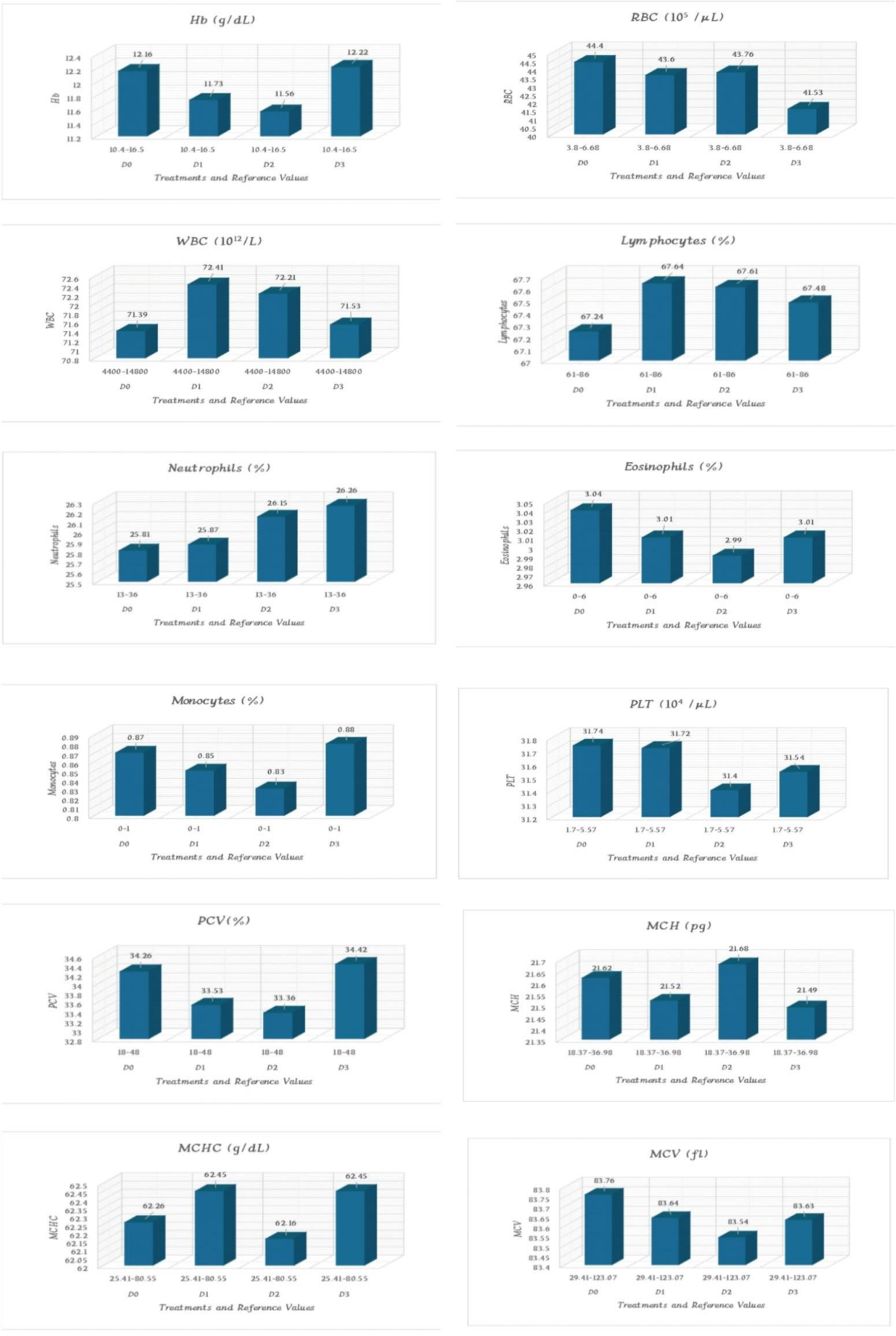
Hb (Hemoglobin concentration), RBC (Red Blood Cells), WBC (White Blood Cells) PLT (Total Platelet Count), PCV (Packed Cell Volume), MCH (Mean Corpuscular Hemoglobin), MCHC (Mean Corpuscular Hemoglobin Concentration), MCV (Mean Corpuscular Volume)
Means ± Standard Deviation of Hematological parameters

Table 3: Mean squares of hematological parameters in sprague dawley rats

SOV	DF	**Mean squares**					
		Hb	**RBC**	**WBC**	**Lymphocyte**	**Neutrophil**	**Eosinophil**
Treatments	3	0.25286*	4.52617*	0.53770*	0.1450*	0.01421^{NS}	0.00121^{NS}
Error	8	0.5456	0.71815	0.06147	0.0255	0.00356	0.00028
Total	11						
SOV	DF	**Mean squares**					
		Monocytes	**PCV%**	**PLT (× 10^4 /µL)**	**MCH (pg)**	**MCHC (g/dL)**	**MCV (fl)**
Treatments	3	0.00080*	0.33457*	0.02378^{NS}	0.00134^{NS}	0.0001^{NS}	0.02766^{NS}
Error	8	0.00023	0.04351	0.01450	0.00311	0.0003	0.01103
Total	11						

Hb (Hemoglobin concentration), RBC (Red Blood Cells), WBC (White Blood Cells) PLT (Total Platelet Count), PCV (Packed Cell Volume), MCH (Mean Corpuscular Hemoglobin), MCHC (Mean Corpuscular Hemoglobin Concentration), MCV (Mean Corpuscular Volume)

Figure 1: Comparison of hematological parameters of sprague dawley rats treated with supercritical fluid banana peel extract with reference values



3.2. Biochemical Parameters

Total glycerides, blood urea nitrogen, blood creatinine level, serum aspartate aminotransferase, and serum alanine aminotransferase effect were noted as non-significant at the 21st day as shown in Table 5. The noted values for total glycerides were 44.3±0.5, 43.5±0.65, 43.44±1.35, 41.32±0.90, for blood urea nitrogen 31.43±0.21, 32.4±0.1, 32.27±0.14, 32.2±0.11, for blood creatinine level 1.14±0.01, 0.92±0.02, 0.88±0.03, 1.05±0.03, for serum aspartate aminotransferase 415.16±0.35, 414.73±0.30, 414.56±0.03, 415.22±0.21 and for serum alanine aminotransferase 115.26±0.40, 114.80±0.32, 114.61±0.05, 115.28±0.21 for D_0 (Control), D_1 (400mg/kg BPE), D_2 (800mg/kg BPE), and D_3 (1200 mg/kg BPE) respectively as shown in Table 4. The banana peel extract has significant effect on blood glucose level, total cholesterol, serum alkaline phosphate as shown in Table 6. At 21st day the means values noted for blood glucose level were 132.4±0.24, 133.5±0.19, 134.3±0.32 and 135.6±0.30, for total cholesterol were 41.39±0.25, 42.41±0.15, 42.21±0.23, and 41.53±0.25. The observed values for serum alkaline phosphate were 514.14±0.30, 513.83±1.15, 513.56±1.00, and 511.73±0.70 for D_0 (Control), D_1 (400mg/kg BPE), D_2 (800mg/kg BPE), and D_3 (1200 mg/kg BPE) respectively as shown in Table 4. Comparison of biochemical profile of sprague dawley rats treated with supercritical fluid banana peel extract with reference values is depicted in Figure 2. A few biochemical values showed significant variations. Biological variation is most likely the cause of the variations. But all the variations shown were noted to be within the normal range. These results are well supported with the literature.

Nizam Uddin *et al.* (2014) carried out toxicity study on methanol extract of Citrus macroptera in Sprague Dawley rats. Rats were given the methanol extract of this fruit at three different doses i.e., 250, 500 and 1000 mg per kg. At these doses no significant changes were observed in ALT and AST activity indicating that extract didn't cause any change in liver. At 500 mg/kg extract decreased ALP level demonstrating protective impact on liver abnormalities. Non-significant variations in globulin, albumin provided evidence of non-toxicity of this fruit on liver. Administration of extract at 1000 mg/kg resulted in an increase in HDL level and decrease in total cholesterol and triglyceride. Antioxidant activity of pumpkin and ginger seeds extract alone and in combination was investigated through rat modeling. Hepatotoxicity was induced in rats by giving them cyclophosphamide for 2 weeks. To counter side effects of cyclophosphamide pumpkin and ginger seed extracts and combination of pumpkin, ginger seed extracts was fed to rats. Liver enzymes MDA, AST and ALT were measured after two weeks. Rats treated with cyclophosphamide exhibited a significant increase in liver enzymes. While, rats fed on pumpkin, ginger seeds extract and their combination demonstrated a significant decrease in levels of liver enzymes. This protective effect of ginger and pumpkin could be attributed to presence of phenolic compounds (Haddad Kashani *et al.*, 2024).

White blood cells (WBC) along with its differentials defend body against foreign substances. Besides lymphocytes, basophils, monocytes and eosinophils were insignificantly affected in Solanum macrocarpon fed rats as compared to control rats. MCHC and MCH levels are parameters that predict body' future regarding blood related diseases. Both of these parameters were not significantly affected in test rats. This insignificant effect declares that consumption of S. macrocarpon fruit is not linked with blood related disorders. Level of liver enzymes ALT, AST, and ALP were also insignificantly affected in fruit fed rats as compared to control. This implied that the fruit didn't result in hepatocellular injury in rats. The findings of this study demonstrated a non-toxic effect on hepatic and hematology parameters of test rats. These results declared it safe for human consumption (Majesty *et al.*, 2013).

Table 4: Effect of supercritical fluid extract of banana peel on biochemical parameters in sprague dawley rats

Biochemical Parameters	D_0 (Control)	D_1 (400mg/kg BPE)	D_2 (800mg/kg BPE)	D_3 (1200 mg/kg BPE)
Glucose (mg/dL)	132.4 ± 0.24^{d}	133.5 ± 0.19^{c}	134.3 ± 0.32^{b}	135.6 ± 0.30^{a}
Total cholesterol (mg/dL)	41.39 ± 0.25^{b}	42.41 ± 0.15^{a}	42.21 ± 0.23^{ab}	41.53 ± 0.25^{b}
TG	44.3 ± 0.5^{a}	43.5 ± 0.65^{a}	43.44 ± 1.35^{a}	41.32 ± 0.90^{a}
SALP (U/L)	514.14 ± 0.30^{a}	513.83 ± 1.15^{a}	513.56 ± 1.00^{ab}	511.73 ± 0.70^{b}
SAST (U/L)	415.16 ± 0.35^{a}	414.73 ± 0.30^{a}	414.56 ± 0.03^{a}	415.22 ± 0.21^{a}
SALT (U/L)	115.26 ± 0.40^{a}	114.80 ± 0.32^{a}	114.61 ± 0.05^{a}	115.28 ± 0.21^{a}
BUN (mg/dL)	31.43 ± 0.21^{a}	32.4 ± 0.1^{a}	32.27 ± 0.14^{a}	32.2 ± 0.11^{a}
BCL (mg/dL)	1.14 ± 0.01^{a}	0.92 ± 0.02^{a}	0.88 ± 0.03^{a}	1.05 ± 0.03^{a}

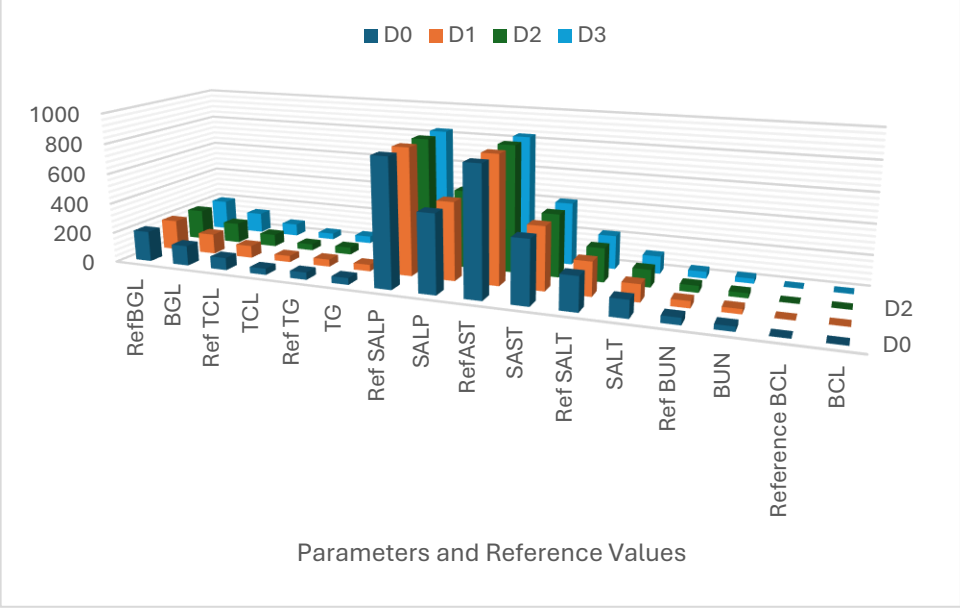
BGL (Blood Glucose Level), TCL (Total Cholesterol), SALP (Serum Alkaline Phosphate), TG (Total glycerides), BUN (Blood Urea Nitrogen), BCL (Blood creatinine level), SAST (Serum Aspartate Aminotransferase), SALT (Serum Alanine Aminotransferase).
Means ± Standard Deviation of Biochemical parameters

Table 5: Mean squares of biochemical parameters in sprague dawley rats

SOV	DF	Mean squares				
		BGL	TCL	TG	BUN	BCL (mg/dL)
Treatments	3	4.631*	0.4321*	4.5833^{NS}	0.3251^{NS}	0.00121^{NS}
Error	8	0.0716	0.0622	0.7180	0.0665	0.00032
Total	11					
SOV	**DF**	**Mean Squares**				
		SALP	**SAST**	**SALT**		
Treatments	3	3.2110*	0.3409^{NS}	0.4340^{NS}		
Error	8	0.7022	0.0445	0.0898		
Total	11					

BGL (Blood Glucose Level), TCL (Total Cholesterol), SALP (Serum Alkaline Phosphate), TG (Total glycerides), BUN (Blood Urea Nitrogen), BCL (Blood creatinine level), SAST (Serum Aspartate Aminotransferase), SALT (Serum Alanine Aminotransferase).

Figure 2: Comparison of biochemical profile of sprague dawley rats treated with supercritical fluid banana peel extract with reference values



3.3. Physiological Parameters

The effect of supercritical fluid extract of banana peel on physiological parameters in sprague dawley rats is shown in Table 6. The results for weight and feeding intake were not significant. No changes were observed in rats' weight and feed intake were observed in rats having banana peel extract in their diets. This confirms the neutral behavior of the extracts in the rats thus not causing any changes. The mean values observed for weight was 215.54±0.12, 215.52±0.15, 215.23±0.03, 215.49±0.45 at 0 day and 281.61±1.15, 281.60±0.3, 281.42±0.17, 281.32±0.3 at 21st day for D_0 (Control), D_1 (400mg/kg BPE), D_2 (800mg/kg BPE), and D_3 (1200 mg/kg BPE) respectively. The mean values for feed intake were 13.76±0.20, 13.64±0.17, 13.54±0.15, 13.53±0.05 at 0 day and 15.6±0.2, 15.42±0.05, 15.93±0.21, 15.50±0.20 at 21st day for D_0 (Control), D_1 (400mg/kg BPE), D_2 (800mg/kg BPE), and D_3 (1200 mg/kg BPE) respectively as shown in Table 6. The mean square values for feed intake and weight are shown in Table 7. These results are in line with a few studies of the past. The body weight and feed intake of Sprague Dawley rats were not significantly impacted by the administration of Citrus macroptera extract at doses of 250, 500, and 1000 mg/kg. Visible lesions, such as inflammation and necrosis, were not produced by extract administration at doses as high as 1000 mg/kg. Thus, it can be said that rats administered 250, 500, and 1000 mg/kg of methanol extract for three weeks did not experience any negative effects on their organs. Steroids, saponins, and terpenoids make up this fruit extract. Additionally, these phytochemicals have non-toxic effects and therapeutic potential (Nizam Uddin *et al.,* 2014).

Rat modeling was used to examine the toxicity of a supercritical CO_2 extract of rosemary. Rats were given varying doses of the extract, with the maximum being 2400 mg/kg. There were no clinical symptoms or fatalities after 90 days of extract treatment. When compared to control rats, extract-fed rats did not exhibit any appreciable changes in body weight or feed intake during the course of the trial. According to these findings, supercritical CO2 extract of rosemary is safe for ingestion by humans (Phipps *et al.,* 2021).

The high concentration of polyphenols in potato peel extract (PPE) gives it antioxidant properties. Rats were given 100 mg/kg body weight extract for seven days in order to test the extract's hepatoprotective effects. Additionally, the impact of extract administration on feed intake and body weight was assessed. Comparing extract-treated groups to control rats, the results showed non-significant changes in feed intake and body weight (Nandita Singh *et al.,* 2008).

Halim et al. (2011) conducted a study to determine the acute toxicity of papaya leaf extract from Carica. Over the course of 14 days, Sprague Dawley rats were given leaf extract at a dosage of 2000 mg/kg BW (body weight). There were five female rats in each of the treatment and control groups in this investigation. Mortality did not occur when leaf extract was administered at a dose of 2000 mg/kg. Throughout the trial, there was no discernible difference in the body weight or feed consumption of rats fed extract compared to control rats.

Table 6: Effect of supercritical fluid extract of banana peel on physiological parameters in sprague dawley rats

Physiological parameter	Day	D_0 (Control)	D_1 (400mg/kg BPE)	D_2 (800mg/kg BPE)	D_3 (1200 mg/kg BPE)
Weight (g)	**0**	215.54±0.12^a	215.52±0.15^a	215.23±0.03^a	215.49±0.45^a
	21st	281.61±1.15^a	281.60±0.3^a	281.42±0.17^a	281.32±0.3^a
Feed intake (g/day)	**0**	13.76±0.20^a	13.64±0.17^a	13.54±0.15^a	13.53±0.05^a
	21st	15.6±0.2^a	15.42±0.05^a	15.93±0.21^a	15.50±0.20^a

Means ± Standard Deviation of Biochemical parameters

Table 7: Mean squares of physiological parameters in sprague dawley rats

SOV	DF	Mean Squares			
		Weight (g)		Feed intake (g/day)	
		0 day	21st day	0 day	21st day
Treatments	3	0.25387^{NS}	0.08499^{NS}	0.02132^{NS}	0.01664^{NS}
Error	8	0.06345	0.04765	0.01547	0.01029
Total	11				

4. CONCLUSION

The banana peels are produced in large quantity. The use of these banana peels to get the extracts and its utilization in food products as natural preservative. It offers alternate to synthetic preservatives. For this purpose, a safety study was designed to evaluate the banana peel extract for its possible toxicity. The extract did not show any significant changes in most of the hematological and biochemical parameters. Moreover, no reasonable difference was observed in weight and feed intake of the rats hence proving banana pel extract as safe. The results confirmed that extract is causing neither any toxicity nor mortality in rat study. Hence it can be used in different food formulations in the future.

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