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PURPLE SWEET POTATO EXTRACT ATTENUATES GENTAMICIN-INDUCED HEPATOTOXICITY IN WISTAR RATS

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ABSTRACT

Purple sweet potato extract (Ipomoea batatas L.) has hepatoprotective potential due to its antioxidant properties. This study evaluated the effect of purple sweet potato extract (PSPE) on gentamicin-induced hepatotoxicity in male Wistar rats. Thirty rats were divided into five groups: negative control, positive control, and PSPE-treated groups receiving 50, 100, and 200 mg/kg body weight (BW). Hepatotoxicity was induced using gentamicin for seven days, followed by extract administration for fourteen days. Caspase-3 expression was analyzed using immunohistochemistry, while fibrosis was assessed using Masson's Trichrome staining and METAVIR scoring. One-way ANOVA showed significant differences in Caspase-3 expression among groups (p ¡ 0.001). PSPE was associated with reduced Caspase-3 expression and attenuated hepatic fibrosis, with the strongest effect observed at 200 mg/kgBW. Histopathological evaluation showed predominantly METAVIR grade F0 fibrosis at doses of 100 and 200 mg/kgBW. These findings suggest potential hepatoprotective effects of PSPE in this preclinical model of gentamicin-induced hepatotoxicity.

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1. INTRODUCTION

The liver is a central organ in metabolic regulation, responsible for biotransformation, detoxification, and the clearance of endogenous and exogenous toxins. Although it possesses an extraordinary capacity for regeneration, sustained exposure to harmful agents can gradually impair hepatic structure and function [1]. Liver cell damage

can occur due to viral infections, consumption of certain drugs, or alcohol exposure, which may progress into severe hepatic disorders [2].

Cirrhosis is the advanced stage of chronic liver disease, characterized by the replacement of normal hepatic tissue with fibrotic scar tissue, leading to structural distortion and functional decline [3]. The condition may develop as a result of chronic hepatitis infection, metabolic disturbances, non-alcoholic fatty liver disease (NAFLD), or drug-induced liver injury. In Indonesia, cirrhosis remains a major health concern and continues to rank among the top five causes of mortality. Between 2007 and 2017, there was a 15% rise in mortality associated with liver cirrhosis and chronic liver disease globally. From 2000 to 2015, the incidence of liver cirrhosis also increased in the Asia-Pacific region, including Indonesia [4].

Drug-induced liver toxicity is one of the major contributors to cirrhosis. Gentamicin, an aminoglycoside antibiotic widely used in the treatment of Gram-negative bacterial infections, has been shown to induce hepatic damage, especially when administered at high doses or for extended periods [5]. Gentamicin-induced hepatotoxicity is closely associated with oxidative stress, mitochondrial dysfunction, and apoptosis pathways, which contribute to hepatic cellular injury and fibrosis [5, 6]. The hepatotoxic effects of gentamicin are closely linked to oxidative stress, which disrupts cellular homeostasis and activates intrinsic and extrinsic apoptotic pathways [6].

Increased oxidative stress may activate apoptotic signaling pathways involving Caspase-3, which belongs to the cysteine aspartate-specific protease enzyme family and acts as an executioner enzyme in apoptosis through intrinsic and extrinsic pathways. This enzyme is expressed in various body tissues, including the liver and kidneys. Increased Caspase-3 expression indicates enhanced apoptotic activity [7], [8].

The limitations of conventional therapy in terms of effectiveness and side effects have encouraged the exploration of safer, more affordable, and more efficient alternative treatments. One of the developing approaches involves the use of herbal plants as hepatoprotective agents [7], [8]. Herbal ingredients containing antioxidants are known to help protect the liver from damage, accelerate the healing process, and improve cellular defense mechanisms. Several plants that have shown hepatoprotective potential due to their antioxidant content include purple sweet potato extract [9], [10], purple cabbage [9], [10], and blueberry-bilberry [11].

Purple sweet potato (Ipomoea batatas L.) is a plant rich in nutrients and bioactive compounds such as anthocyanins, phenolic compounds, vitamins, minerals, fiber, and carotenoids [12]. Anthocyanins are the primary pigments responsible for the purple color and possess antioxidant activity capable of scavenging free radicals [13]. Research on mice induced with carbon tetrachloride (CCl) showed that anthocyanins from purple sweet potato exert protective effects against acute liver fibrosis [9]. Other studies on purple corn cobs demonstrated that anthocyanin content may improve liver damage by regulating oxidative stress and apoptosis pathways, including reducing Caspase-3 protein expression [14].

Despite increasing evidence regarding the antioxidant and hepatoprotective properties of anthocyanin-rich plants, the clinical translation of herbal hepatoprotective agents remains challenging. Variability in bioavailability, metabolism, systemic absorption, and interactions among bioactive compounds may influence therapeutic efficacy in vivo. Therefore, animal models remain essential for evaluating the integrated biological effects of herbal extracts, including pharmacodynamic responses, tissue-level histopathological alterations, and systemic interactions that cannot be fully replicated in in vitro models.

The use of an in vivo gentamicin-induced hepatotoxicity model in the present study was intended to simulate complex physiological responses associated with oxidative stress, apoptosis, and fibrosis progression within the hepatic microenvironment. This approach enables comprehensive evaluation of the hepatoprotective potential of purple sweet potato extract under conditions that more closely resemble systemic pathological processes.

Although the hepatoprotective effects of anthocyanins have been widely investigated, studies specifically evaluating purple sweet potato extract (PSPE) on both Caspase-3 expression and hepatic fibrosis in gentamicin-induced Wistar rats remain limited. We hypothesized that purple sweet potato extract would dose-dependently reduce Caspase-3 expression and attenuate hepatic fibrosis in gentamicin-induced Wistar rats through its antioxidant and anti-apoptotic activities. This study aimed to assess the effectiveness of purple sweet potato (Ipomoea batatas L.) extract in reducing Caspase-3 expression and improving hepatic histopathology in male Wistar rats (Rattus norvegicus) exposed to gentamicin. The findings of this study are expected to provide additional evidence regarding the hepatoprotective potential of purple sweet potato extract against gentamicin-induced liver injury

2. RESEARCH METHOD

2.1 Research Design and Ethical Approval

This experimental laboratory study employed an in vivo post-test-only control group design to evaluate the hepatoprotective effect of purple sweet potato extract on hepatic Caspase-3 expression and histopathological changes in gentamicin-induced male Wistar rats. A post-test-only design was selected because histopathological and immunohistochemical evaluations required terminal tissue harvesting. Histopathological evaluation was conducted

independently by two blinded observers using the METAVIR scoring system. Interobserver agreement statistics were not formally evaluated; discrepancies between blinded observers were resolved by consensus review. The experimental endpoint on day 21 was selected to allow sufficient progression of gentamicin-induced hepatic injury and fibrosis, as reported in previous experimental studies. Representative normal liver tissue images were included as reference morphology only and were not included in statistical analysis.

The study was conducted at the Biotechnology Laboratory and Animal House, Faculty of Medicine, Universitas Sriwijaya. Ethical approval was obtained from the Health Research Ethics Committee of the Faculty of Medicine, Universitas Sriwijaya (Certificate No. 468-2025). Animals were monitored daily throughout the experimental period for general health condition, activity, food and water intake, body weight changes, and signs of distress following gentamicin administration. Humane endpoints included severe lethargy, inability to access food or water, marked weight loss, or signs of severe pain or distress. All efforts were made to minimize animal suffering during handling and experimental procedures. At the end of the study period, animals were deeply anesthetized with ketamine–xylazine prior to euthanasia and tissue collection.

2.2 Materials

Purple sweet potato (Ipomoea batatas L.) used in this study was obtained from Jarai District, Lahat Regency, South Sumatra, Indonesia. Plant identification was confirmed at Herbarium Bogoriense, National Research and Innovation Agency of Indonesia. Gentamicin sulfate was purchased from Indofarma. Caspase-3 expression was evaluated using Anti-Caspase-3 antibody [EPR18297] (Abcam Ltd., United Kingdom). Reagents for Masson's Trichrome staining were obtained from ScyTek Laboratories.

2.3 Preparation of Purple Sweet Potato Extract

Purple sweet potato extract was prepared using the maceration method with 96% ethanol as solvent. The extraction process was carried out for three days at room temperature in a light-protected container. The filtrate was collected and remacerated repeatedly using fresh solvent to optimize extraction yield. Combined filtrates were concentrated using a rotary evaporator at 50°C to obtain a viscous extract, followed by oven drying at 40°C until a stable extract consistency was achieved. Total anthocyanin content of the extract was determined using a spectrophotometric method and measured at $282.86 mg/100 g$ extract.

2.4 Experimental Animals and Treatment

Thirty male Wistar rats aged 2–3 months and weighing 150–200 g were used in this study. Animals included in the study had comparable age and body weight ranges prior to randomization. Animals were maintained under controlled conditions at 22 ± 2°C, relative humidity of $55 \pm 10\%$, and a 12-hour light/dark cycle with free access to food and water. The sample size was determined using the Federer formula: $(n-1)(t-1) \geq 15$, where n represents the number of animals per group and t represents the number of treatment groups. Based on this calculation, a minimum of five rats per group was required. To anticipate potential dropouts during the experimental period, six rats were included in each group, resulting in a total of 30 rats. Animals were randomly allocated into five groups using a simple randomization method generated by random number allocation. The groups consisted of negative control (0.5% Na-CMC), positive control (10% anthocyanin concentrate), and purple sweet potato extract-treated groups at doses of 50, 100, and 200 mg/kgBW. The negative control group consisted of gentamicin-induced rats receiving 0.5% Na-CMC without active therapeutic intervention, whereas the positive control group consisted of gentamicin-induced rats treated with anthocyanin concentrate as a reference therapeutic comparator. Gentamicin was administered for seven consecutive days to induce hepatotoxicity, followed by oral administration of purple sweet potato extract or anthocyanin concentrate for fourteen consecutive days. Animals were sacrificed on day 21 for tissue collection and histopathological evaluation. Representative normal liver tissue images were included in the histopathological figures as reference morphology only and were not included as experimental or statistical comparison groups.

The doses of purple sweet potato extract (50, 100, and 200 mg/kgBW) were selected based on a previous study evaluating the hepatoprotective effects of anthocyanin-rich extracts in experimental liver injury models [15]. The positive control group received Navitas Acai Powder as an anthocyanin concentrate at a dose of 12.5 mg/day for 14 consecutive days following gentamicin induction. Navitas Acai Powder was selected as the positive control because it is a commercially available anthocyanin-rich preparation with documented antioxidant activity and was used as a reference comparator for anthocyanin-associated hepatoprotective effects. Purple sweet potato extract and anthocyanin concentrate were administered orally once daily for 14 consecutive days after gentamicin induction. Histopathological and immunohistochemical assessments were performed by two blinded observers. Tissue slides were coded prior to evaluation, and code identification was revealed only after completion of data collection and scoring to minimize assessment bias.

2.5 Tissue Collection and Histopathological Examination

At the end of the treatment period, animals were euthanized and liver tissues were collected and fixed in 10% neutral-buffered formalin for immunohistochemical and histopathological analysis. Liver tissues were dehydrated, cleared in xylene, embedded in paraffin, and sectioned at 3–5 µm thickness.

Caspase-3 expression was evaluated immunohistochemically using Anti-Caspase-3 primary antibody. Antigen retrieval was performed by heat-induced epitope retrieval, followed by incubation with primary antibody, secondary antibody, horseradish peroxidase, and diaminobenzidine chromogen. Slides were counterstained with hematoxylin and observed under a light microscope. Caspase-3 expression was evaluated from five non-overlapping microscopic fields per slide at 400× magnification. Representative fields with adequate staining quality were selected for analysis. Quantification was performed using ImageJ software based on positive brown immunostaining.

Histopathological assessment of liver fibrosis was performed using Masson's Trichrome staining. Collagen deposition and fibrosis severity were evaluated microscopically using the METAVIR scoring system. Fibrosis scoring was independently performed by two blinded observers based on predominant histopathological findings observed across representative microscopic fields.

2.6 Statistical Analysis

Data on Caspase-3 expression were analyzed using SPSS version 26.0. Normality and homogeneity tests were conducted using Shapiro–Wilk and Levene's tests, respectively. Differences among groups were primarily analyzed using one-way ANOVA followed by Games–Howell post hoc analysis for multiple comparisons. Statistical analysis was performed at a 95% confidence level. METAVIR fibrosis scores were analyzed using the Kruskal–Wallis test as a non-parametric approach for ordinal data.

3. RESULT AND ANALYSIS

3.1 Result

Baseline body weight characteristics of the experimental animals are presented in Table 1. One-way ANOVA demonstrated no significant differences in baseline body weight among experimental groups prior to intervention, $F(4, 25) = 1.883, p = 0.145$.

Table 1: Baseline Body Weight Characteristics of Experimental Wistar Rats

Experimental Groups	**Body Weight (g) Mean ± SD**	**Minimum**	**Maximum**
Negative control	197.67 ± 5.785	191	207
Positive control	196.17 ± 7.782	190	209
PSPE 50 mg/kgBW	203.50 ± 5.010	195	209
PSPE 100 mg/kgBW	205.17 ± 8.733	190	216
PSPE 200 mg/kgBW	202.17 ± 6.369	191	209

Note: Levene's test: $p = 0.784$; One-way ANOVA: $p = 0.145$. No significant differences in baseline body weight were observed among groups prior to treatment allocation.

3.1.1 Caspase-3 Expression

Immunohistochemical staining demonstrated differences in hepatic Caspase-3 expression among treatment groups, as shown in Figure 1. The negative control group exhibited more intense brown staining compared with the extract-treated groups, indicating increased apoptotic activity following gentamicin induction. Lower Caspase-3 expression was observed after administration of purple sweet potato extract, particularly at the dose of 200 mg/kgBW. Quantitative analysis of Caspase-3 expression using ImageJ is presented in Figure 2 and Table 2.

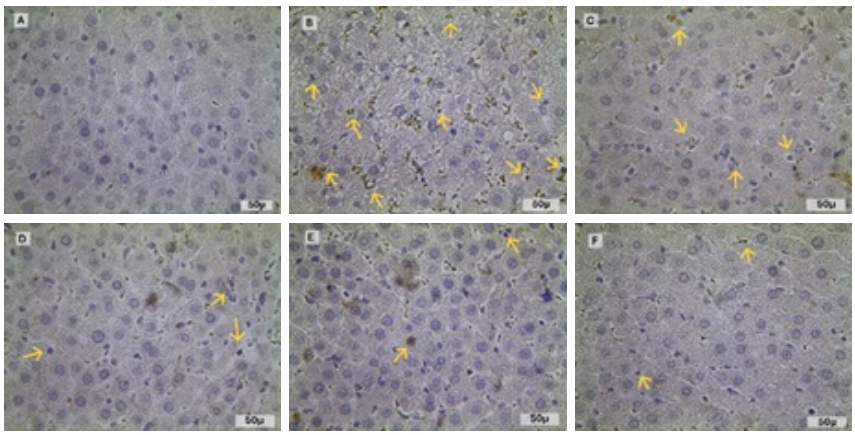

Figure 1. Caspase-3 Expression in Liver Tissue with Immunohistochemical Staining. Magnification 400×; scale bar = 50 μm. (A) Representative normal hepatic tissue, (B) negative control group, (C) positive control group, (D) PSPE 50 mg/kgBW group, (E) PSPE 100 mg/kgBW group, and (F) PSPE 200 mg/kgBW group. Brown staining indicates positive Caspase-3 immunoreactivity.

One-way ANOVA demonstrated a significant difference in Caspase-3 expression among the experimental groups, $F(4, 25) = 111.317, p < 0.001$. Subsequent Games–Howell post hoc analysis showed significant differences between the negative control group and all treatment groups. The negative control group showed the highest mean Caspase-3 expression (64.94 ± 2.33), whereas the PSPE 200 mg/kgBW group demonstrated the lowest expression (28.33 ± 4.13).

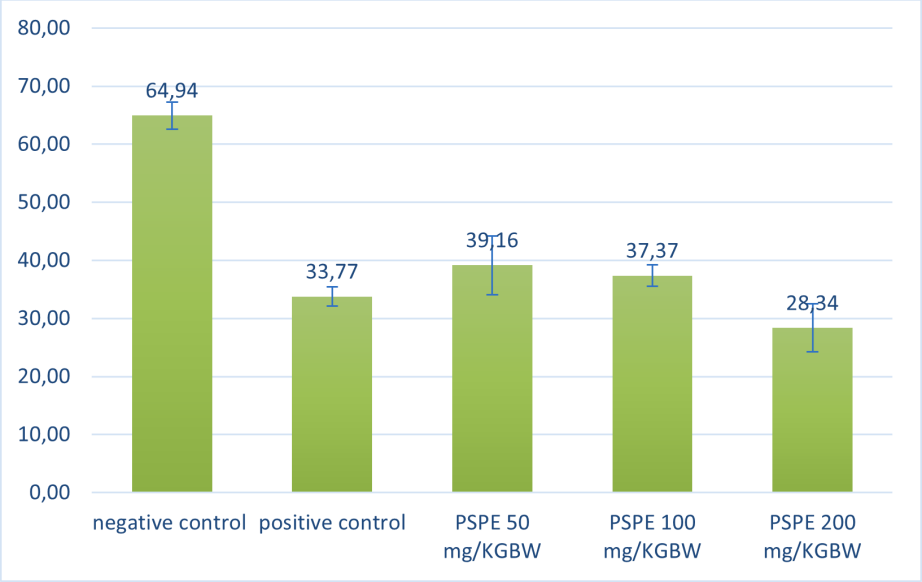

Figure 2. Mean levels of Caspase-3 expression in gentamicin-induced Wistar rats treated with purple sweet potato extract

Figure 2 illustrates the reduction of Caspase-3 expression following PSPE administration, with the lowest expression observed in the PSPE 200 mg/kgBW group. Games–Howell analysis demonstrated significant differences between the positive control group and all PSPE-treated groups (p ¡ 0.05), with smaller differences observed in the PSPE 50 mg/kgBW and PSPE 200 mg/kgBW groups.

Table 2: Games–Howell Post Hoc Analysis of Caspase-3 Expression Among Experimental Groups

Comparison Groups	Mean ± SD	p value
Negative control vs Positive control	64.94 ± 2.33 vs 33.77 ± 1.62	0.000
Negative control vs PSPE 50 mg/kgBW	64.94 ± 2.33 vs 39.15 ± 5.04	0.000
Negative control vs PSPE 100 mg/kgBW	64.94 ± 2.33 vs 37.36 ± 1.84	0.000
Negative control vs PSPE 200 mg/kgBW	64.94 ± 2.33 vs 28.33 ± 4.13	0.000
Positive control vs PSPE 50 mg/kgBW	33.77 ± 1.62 vs 39.15 ± 5.04	0.047
Positive control vs PSPE 100 mg/kgBW	33.77 ± 1.62 vs 37.36 ± 1.84	0.005
Positive control vs PSPE 200 mg/kgBW	33.77 ± 1.62 vs 28.33 ± 4.13	0.013
PSPE 50 mg/kgBW vs PSPE 100 mg/kgBW	39.15 ± 5.04 vs 37.36 ± 1.84	0.444
PSPE 50 mg/kgBW vs PSPE 200 mg/kgBW	39.15 ± 5.04 vs 28.33 ± 4.13	0.002
PSPE 100 mg/kgBW vs PSPE 200 mg/kgBW	37.36 ± 1.84 vs 28.33 ± 4.13	0.001

Note: Games–Howell post hoc test. Differences were considered statistically significant at p ¡ 0.05.

The Games–Howell analysis presented in Table 2 demonstrated significant differences among several treatment groups. Lower Caspase-3 expression was observed in the PSPE-treated groups compared with the negative control group, indicating reduced apoptotic activity following administration of purple sweet potato extract.

3.1.2 Histopathological Findings

Histopathological examination using Masson's Trichrome staining demonstrated variations in fibrosis severity among treatment groups, as presented in Figure 3 and Table 3. The negative control group predominantly exhibited METAVIR grade F3 with marked collagen deposition surrounding hepatic tissue. Lower fibrosis grades were observed in the extract-treated groups, particularly at higher extract doses.

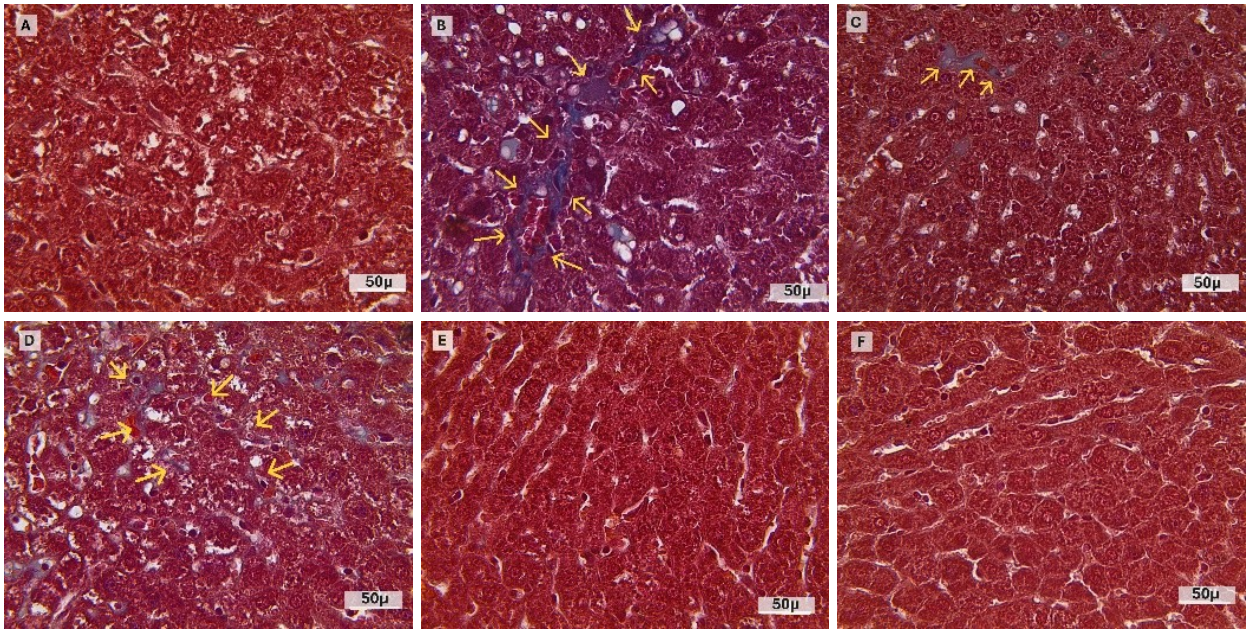

Figure 3. Histology of Liver Tissue with Masson's Trichrome Staining. Magnification 400×; scale bar = 50 µm. (A) Representative normal hepatic tissue (B) negative control group with grade F3, (C) positive control group with grade F1, (D) PSPE 50 mg/kgBW group with grade F1, (E) PSPE 100 mg/kgBW group with grade F0, and (F) PSPE 200 mg/kgBW group with grade F0. Blue-stained areas indicate collagen deposition

Kruskal–Wallis analysis demonstrated a significant difference in METAVIR fibrosis scores among experimental groups, $X^2(4) = 21.840, p < 0.001$. Lower fibrosis grades were observed in the PSPE-treated groups, particularly at doses of 100 and 200 mg/kgBW, compared with the negative control group. The PSPE 100 mg/kgBW and PSPE 200 mg/kgBW groups predominantly demonstrated METAVIR grade F0, indicating minimal collagen accumulation.

Table 3: Liver Histopathological Findings Based on Masson's Trichrome Staining

Group	n	METAVIR Score				
		F0	F1	F2	F3	F4
Negative control (CMC 0.5%)	6	0	1	2	3	0
Positive control (Anthocyanin concentrate 10%)	6	5	1	0	0	0
PSPE 50 mg/kgBW	6	4	2	0	0	0
PSPE 100 mg/kgBW	6	6	0	0	0	0
PSPE 200 mg/kgBW	6	6	0	0	0	0

Note: Histopathological assessment was performed using the METAVIR scoring system. F0 = no fibrosis; F1 = portal fibrosis without septa; F2 = portal fibrosis with few septa; F3 = numerous septa without cirrhosis; F4 = cirrhosis

3.2 Analysis

Gentamicin is widely used to treat Gram-negative bacterial infections; however, its therapeutic application is frequently limited by dose-dependent nephrotoxicity and hepatotoxicity. In this study, gentamicin induction at 80 mg/kgBW for seven days produced increased Caspase-3 expression and evidence of fibrosis in liver tissue. These findings align with previous studies showing that gentamicin disrupts hepatic cellular homeostasis through oxidative stress, mitochondrial impairment, and activation of apoptotic pathways [16]. Previous studies have also reported that gentamicin may induce reactive oxygen species (ROS) formation and mitochondrial dysfunction, which contribute to activation of intrinsic apoptotic pathways [15].

Caspase-3 serves as the final executioner caspase responsible for DNA fragmentation, chromatin condensation, and cleavage of structural proteins [17]. The increased Caspase-3 expression observed in the negative control group reflects active hepatocyte apoptosis following gentamicin exposure. Apoptotic hepatocytes may stimulate Kupffer cells and hepatic stellate cells (HSCs), thereby contributing to fibrogenic responses through secretion of TGF-β_1, PDGF, and pro-inflammatory cytokines [18]. Persistent activation of these pathways has been associated with progressive hepatic fibrosis and cirrhosis [19].

Administration of purple sweet potato extract (PSPE) attenuated both molecular and histopathological alterations, with the strongest effect observed at the dose of 200 mg/kgBW. Purple sweet potato contains anthocyanins, including cyanidin, peonidin, and pelargonidin, with reported antioxidant and anti-inflammatory activities [13], [20]. Anthocyanins previously identified in purple sweet potato have been reported to neutralize free radicals, reduce lipid peroxidation, and stabilize mitochondrial membranes [20]. Therefore, the reduced Caspase-3 expression observed in the present study may be associated with the antioxidant and anti-apoptotic properties of anthocyanin-containing compounds [9].

This mechanism is supported by the observation that PSPE 200 mg/kgBW produced the lowest Caspase-3 expression among all extract-treated groups. Anthocyanins have been reported to influence apoptotic signaling through modulation of Bcl-2, Bax, Caspase-9, and Caspase-3 expression in experimental liver injury models [14]. Comparison with the positive control group showed differences in Caspase-3 expression among several PSPE-treated groups, although Caspase-3 expression in the PSPE-treated groups remained lower than the negative control group and showed partial similarity to the anthocyanin-treated group [21].

The PSPE 100 mg/kgBW group exhibited higher Caspase-3 expression relative to the positive control group, although expression remained lower than that of the negative control group. This finding may indicate a dose-related but non-linear response associated with differences in bioavailability or absorption of bioactive compounds at intermediate doses [14].

Histopathological analysis further supported the immunohistochemical findings. The negative control group predominantly exhibited METAVIR F3 fibrosis, confirming that gentamicin induced marked collagen deposition within hepatic tissue. In contrast, the positive control group and higher extract doses (100 and 200 mg/kgBW) predominantly demonstrated METAVIR F0 grading, indicating minimal collagen accumulation. Anthocyanins have been associated with modulation of HSC activation and fibrogenic mediators such as α-SMA, TGF-β_1, TNF-α, and NF-B [22], [23]. PSPE may be associated with attenuation of fibrogenic pathways involved in hepatic fibrosis progression, as previously reported for anthocyanin-rich compounds [9]. The reduced fibrosis observed following PSPE administration in the present study may be consistent with these previously reported mechanisms; however, direct evaluation of fibrogenic signaling pathways was not performed.

The anti-fibrotic effects observed in the present study may be associated with the antioxidant activity of anthocyanins. ROS overproduction has been reported to contribute to hepatic fibrosis through activation of HSCs and stimulation of extracellular matrix deposition, including type I and III collagen formation [24]. Anthocyanins may be involved in attenuation of this process through reduction of ROS levels, malondialdehyde (MDA) concentration, and restoration of glutathione (GSH) reserves [25]. Additionally, anthocyanins have been reported to inhibit MAPK and JNK signaling pathways involved in oxidative stress-induced apoptosis and fibrosis [26], [27]. The combined reduction in Caspase-3 expression and fibrosis scores may reflect potential anti-apoptotic and anti-fibrotic effects of PSPE. These findings provide preliminary evidence suggesting potential hepatoprotective

effects of purple sweet potato extract in this experimental model of gentamicin-induced hepatotoxicity.

Although randomization and baseline body weight comparability were applied to reduce selection bias, the post-test-only design did not allow direct baseline assessment of hepatic Caspase-3 expression or histopathological status prior to intervention. Consequently, interpretation of treatment effects relied primarily on post-intervention comparisons between randomized groups. Despite the promising hepatoprotective effects observed in this study, translation of effective PSPE doses from animal models to humans remains challenging. Dose extrapolation from rats to humans requires allometric scaling approaches and pharmacokinetic evaluation to determine clinically relevant and safe therapeutic dosages [28], [29]. The therapeutic effectiveness of anthocyanins may also be influenced by their relatively low oral bioavailability, rapid metabolism, and compound instability during gastrointestinal absorption [30], [31]. In addition, differences in extraction methods may alter the concentration and profile of active anthocyanin compounds, potentially affecting reproducibility and translational applicability across studies [31], [32].

From a public health perspective, these findings may be particularly relevant for patients requiring prolonged gentamicin therapy, especially in settings with increased risk of drug-induced hepatotoxicity. Purple sweet potato extract may potentially serve as an adjunctive antioxidant supplementation strategy to reduce hepatic injury associated with long-term aminoglycoside exposure. Purple sweet potato is widely cultivated and relatively affordable in Indonesia and other low-resource settings, which may support its future development as an accessible plant-based hepatoprotective intervention.

Several limitations should be acknowledged in the present study. First, the post-test-only design did not permit direct baseline assessment of hepatic apoptosis or fibrosis severity prior to intervention. Second, although blinding was applied during histopathological and immunohistochemical assessment, potential observer-related bias cannot be fully excluded. Third, this study was conducted exclusively in male Wistar rats, thereby limiting generalizability to female animals and human populations. Fourth, standard serum biochemical markers of hepatic injury, including alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), and bilirubin, were not evaluated; therefore, hepatoprotective activity in the present study was primarily interpreted based on histopathological and immunohistochemical findings. Finally, differences in anthocyanin bioavailability, metabolism, and extraction standardization remain important barriers for clinical translation of PSPE-based hepatoprotective interventions.

These findings support further investigation of purple sweet potato extract as a potential adjunctive hepatoprotective intervention for prevention of gentamicin-induced hepatic injury, particularly in populations requiring prolonged aminoglycoside therapy.

4. CONCLUSION

Purple sweet potato extract demonstrated hepatoprotective activity in gentamicin-induced male Wistar rats through reduction of Caspase-3 expression and attenuation of hepatic fibrosis. Administration of the extract, particularly at the dose of 200 mg/kgBW, was associated with lower apoptotic activity and reduced collagen deposition compared with untreated rats. The PSPE 50 mg/kgBW and 200 mg/kgBW groups demonstrated reductions in Caspase-3 expression relative to the negative control group, although statistical differences among treatment groups were not uniformly equivalent to the positive control. These findings are consistent with modulation of apoptosis- and fibrosis-related pathways, although upstream molecular signaling pathways were not directly evaluated in the present study. Therefore, the observed findings should be interpreted as suggestive of potential anti-apoptotic and anti-fibrotic effects rather than direct mechanistic evidence. The present study provides preliminary evidence suggesting potential hepatoprotective effects of purple sweet potato extract in this preclinical model of gentamicin-induced hepatotoxicity. However, further studies involving biochemical and molecular analyses are needed to clarify the underlying mechanisms and evaluate its therapeutic potential in broader experimental models.

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