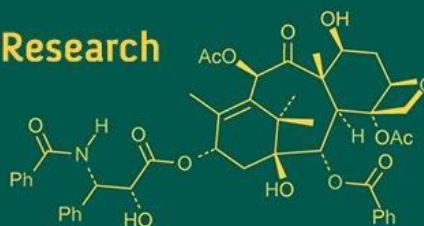


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Clinico-pathological studies and therapeutic effects of febuxostat on visceral gout in vanaraja chicken

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Abstract

The present study investigates the clinico-pathological effects and therapeutic potential of Febuxostat on aceclofenac-induced visceral gout in Vanaraja chickens. A total of 72 day-old Vanaraja chicks were randomly assigned to four experimental groups: Group I (Control), Group II (Aceclofenac + Bottle Gourd Juice), Group III (Aceclofenac + Febuxostat), and Group IV (Aceclofenac + Febuxostat Treatment). Birds in the aceclofenac-treated groups exhibited clinical signs of dehydration, lethargy, anorexia, emaciation, and greenish diarrhea, with a mortality rate of 22.77% in Groups II and IV. Hematological analysis revealed significant increases in packed cell volume (PCV), total erythrocyte count (TEC), and total leukocyte count (TLC) in aceclofenac-induced groups, while Group III (preventive treatment with Febuxostat) showed values comparable to the control. Serum biochemical analysis demonstrated elevated uric acid and creatinine levels in aceclofenac-treated groups, indicative of renal dysfunction. However, Febuxostat administration significantly reduced serum uric acid levels, mitigating renal damage and restoring hematological and biochemical parameters to near-normal levels. Bottle gourd juice also exhibited a protective role, reducing clinical signs and improving body weight. These findings suggest that Febuxostat effectively prevents and alleviates aceclofenac-induced visceral gout, with bottle gourd juice providing additional supportive benefits.

Keywords: Febuxostat, aceclofenac, visceral gout, vanaraja chickens, hematology, renal dysfunction

Introduction

India's poultry industry is one of the fastest-growing sectors within agriculture, significantly contributing to the national economy. Among various poultry breeds, Vanaraja is a dual-purpose bird, suitable for both egg and meat production, particularly under rural and backyard farming conditions. However, with advancements in genetic selection for higher productivity, poultry birds are increasingly prone to metabolic disorders, including visceral gout—a major cause of economic losses in the industry.

Visceral gout is a metabolic disorder characterized by urate deposits on visceral organs due to elevated blood uric acid levels. It is often linked to nutritional imbalances, management issues, nephrotoxic drugs, and infectious agents. Studies suggest that veterinary use of non-steroidal anti-inflammatory drugs (NSAIDs), particularly aceclofenac, may contribute to visceral gout, similar to diclofenac's known toxicity in vultures.

Febuxostat, a selective xanthine oxidase inhibitor, has shown promise in lowering serum uric acid levels by inhibiting its synthesis, offering a potential therapeutic approach for managing visceral gout in poultry. Additionally, natural remedies like bottle gourd (*Lagenaria siceraria*) possess medicinal properties that may support kidney function and metabolic health.

Despite the economic significance of visceral gout in poultry, limited research has been conducted on its prevalence and management in Vanaraja chickens, especially in Bihar. This study aims to investigate the role of aceclofenac in visceral gout, evaluate the therapeutic potential of Febuxostat and analyze the associated haemato-biochemical.

Materials and Methods

Experimental Design

The study on "Clinico-Pathological Studies and Therapeutic Effect of Febuxostat on Visceral Gout in Vanaraja Chickens" was conducted at ILFC, BVC, Patna, and the Department of

Veterinary Pathology, Bihar Veterinary College, Bihar Animal Sciences University, Patna. A total of 72 day-old Vanaraja chicks were procured and housed under standard management conditions.

Test Chemicals

- Febuxostat (Febustat 40, Abbott Healthcare Pvt. Ltd., 40 mg/kg) was used for therapeutic evaluation.
- Aceclofenac (Zerodol 100, IPCA Laboratories Ltd., 100 mg) was used to induce visceral gout.
- Bottle gourd juice was freshly extracted and administered as a potential treatment.

Experimental Groups

Chicks were randomly divided into four groups (n=18 per group):

- **Group I (Control):** Fed normal starter feed.
- **Group II (Producing):** Fed aceclofenac (20 mg/kg) for 28 days, treated with bottle gourd juice (20 ml).
- **Group III (Preventive):** Fed aceclofenac (20 mg/kg) + febuxostat (4 mg/kg) for 28 days.
- **Group IV (Treatment):** Fed aceclofenac (20 mg/kg) for 28 days, treated with febuxostat (4 mg/kg).

All birds were observed daily for clinical signs, mortality, and body weight changes for 42 days.

Sample Collection and Analysis

- Blood samples (2 ml) were collected from the wing vein on days 7, 14, 21, 28, and 42 for hematological and biochemical analysis.
- Hematological parameters included hemoglobin, TEC, TLC, PCV, and DLC.
- Biochemical parameters (measured using a semi-auto analyzer) included serum uric acid, total protein,

albumin, globulin, ALP, creatinine, SGPT, and SGOT.

Results and Discussion

In this study, aceclofenac-induced visceral gout in Vanaraja chickens was evaluated, along with the therapeutic effects of bottle gourd juice and febuxostat.

Clinical-Signs

Chickens in Group I (control) remained clinically healthy, while those in Group II and IV (aceclofenac-induced) exhibited signs of dehydration, lethargy, anorexia, emaciation, and greenish diarrhea, along with lesions of visceral gout. Birds in Group III (treated with febuxostat) and those in Group II treated with bottle gourd juice showed no clinical signs, suggesting a protective effect.

Mortality

No mortality was recorded in Group I and Group III. However, mortality rates of 22.77% were observed in Groups II and IV, starting from day 14 and continuing up to day 28. All deceased birds exhibited visceral gout lesions.

Body-Weight

A significant reduction in body weight was noted in Groups II and IV compared to Group I, indicating aceclofenac toxicity. However, birds treated with bottle gourd juice (Group II) and febuxostat (Group IV) showed slight improvements in body weight by day 42, suggesting a protective role of these treatments.

Packed Cell Volume (PCV)

Packed cell volume (PCV) is a critical hematological parameter used to assess dehydration (increased PCV), anemia (decreased PCV), polycythemia (increased PCV), and overall nutritional status. The mean PCV values of Vanaraja chicks across different experimental groups.

Mean $\pm$ S.E. values of Packed cell Volume (PCV) (%) of Vanaraja chickens in different groups at various time interval

Groups	7 day	14 day	21day	28 day	42day
Group I	22.50 $\pm$ 0.78 ^a	22.35 $\pm$ 4.63 ^a	25.96 $\pm$ 1.51 ^a	25.71 $\pm$ 1.33 ^a	24.87 $\pm$ 1.51 ^a
Group II	22.13 $\pm$ 0.84 ^a	37.26 $\pm$ 0.22 ^b	39.13 $\pm$ 0.25 ^b	41.79 $\pm$ 0.25 ^b	24.38 $\pm$ 0.60 ^a
Group III	22.90 $\pm$ 1.03 ^a	24.48 $\pm$ 1.05 ^a	24.90 $\pm$ 2.98 ^a	26.36 $\pm$ 2.11 ^a	25.15 $\pm$ 0.96 ^a
Group IV	22.15 $\pm$ 0.42 ^a	37.34 $\pm$ 0.55 ^b	39.04 $\pm$ 0.46 ^b	41.75 $\pm$ 4.21 ^b	25.81 $\pm$ 1.33 ^a

Superscript a, b, c, d in column indicates significant difference between the groups within days

At the end of 7 days, the mean $\pm$ S.E. values of PCV for Groups I, II, III, and IV were 22.50 $\pm$ 0.78, 22.13 $\pm$ 0.84, 22.90 $\pm$ 1.03, and 22.15 $\pm$ 0.42, respectively, with no significant differences among the groups. However, at 14 days, the PCV values showed an increase in aceclofenac-induced Groups II and IV (37.26 $\pm$ 0.22 and 37.34 $\pm$ 0.55) compared to Groups I and III (22.35 $\pm$ 4.63 and 24.48 $\pm$ 1.05). Similar trends were observed at 21, 28, and 42 days, where aceclofenac-induced groups consistently exhibited higher PCV levels than control and preventive groups.

The observed increase in PCV in aceclofenac-induced groups can be attributed to reduced water intake and subsequent hemoconcentration. Conversely, Group III (preventive group with aceclofenac + febuxostat) did not show significant changes compared to the control, suggesting a potential protective role of febuxostat in mitigating hemoconcentration effects.

Total Erythrocyte Count (TEC)

Total erythrocyte count (TEC) is an important diagnostic marker for anemia, polycythemia, and hemoconcentration. The mean TEC values across different experimental groups are detailed in Table 5 and Chart 5.

At the end of 7 days, the mean $\pm$ S.E. values of TEC for Groups I, II, III, and IV were 3.27 $\pm$ 0.07, 3.53 $\pm$ 0.16, 3.33 $\pm$ 0.19, and 3.89 $\pm$ 0.37, respectively, with no significant differences. However, at 14, 21, and 28 days, the aceclofenac-induced Groups II and IV showed significantly higher TEC values compared to Groups I and III. At 42 days, there was no significant difference among groups, indicating a potential recovery trend.

The increase in TEC in aceclofenac-induced groups may be linked to dehydration, hemoconcentration, and stress-induced erythropoiesis. The absence of significant TEC changes in Group III suggests a protective effect of febuxostat against aceclofenac-induced hematological alterations.

Total Leukocyte Count (TLC)

Total leukocyte count (TLC) is a key indicator of inflammatory responses, infections, and leukocytosis. The mean TLC values for different groups are presented in Table 6 and Chart 6.

At 7 days, TLC values did not show significant differences among groups. However, by 14, 21, and 28 days, aceclofenac-induced Groups II and IV exhibited significantly higher TLC values compared to Groups I and III. By 42 days, no significant differences were observed among the groups.

The increase in TLC in aceclofenac-induced groups may be due to metabolic acidosis leading to uremia, which could stimulate bone marrow activity, resulting in leukocytosis. The protective group (Group III) did not show significant changes, suggesting febuxostat's role in stabilizing immune responses.

Hematological-Parameters

Hemoglobin levels remained unchanged across groups at day 7. By day 14, Groups II and IV showed significantly elevated Hb levels compared to the control ($p < 0.05$), indicating dehydration and impaired kidney function. However, Groups I and III maintained stable Hb values throughout the experiment, suggesting that febuxostat prevented significant hematological alterations.

The study confirms that aceclofenac toxicity induces visceral gout, weight loss, and hematological alterations in Vanaraja chickens. Both bottle gourd juice and febuxostat exhibited protective effects by reducing clinical signs, improving weight gain, and stabilizing hemoglobin levels. These findings highlight their potential role in mitigating aceclofenac-induced toxicity in poultry.

Differential Leukocyte Count (DLC)

Lymphocytes

The Mean $\pm$ S.E values of lymphocytes in Vanaraja chicks of Group I, II, III, and IV were recorded at different time intervals. No significant alterations were observed in all groups at the end of 7 days. However, at the end of 14, 21, and 28 days, the aceclofenac-induced Groups II and IV exhibited comparatively higher lymphocyte counts than Groups I and III. The lymphocyte count in Group III (aceclofenac + febuxostat) did not show any significant difference when compared to the control Group I.

By the end of 42 days, no significant differences were observed among the groups, indicating a reversal of lymphocyte elevation. The increased lymphocyte count on days 14, 21, and 28 in aceclofenac-induced groups aligns with findings by Christopher (1978) [2], who also reported elevated lymphocyte counts in gout-affected birds. The observed increase might be due to metabolic acidosis leading to uremia, which could have stimulated the bone marrow to produce more lymphocytes as a compensatory mechanism.

Heterophils

The Mean $\pm$ S.E values of heterophils showed no significant alterations in any of the groups throughout the experimental period (7, 14, 21, 28, and 42 days). Normal heterophil counts indicate the absence of any significant infection in Vanaraja chickens. This observation is in agreement with studies conducted by Koutsos *et al.* (2020) [1] and Christopher (1978) [2], who also reported no significant

changes in heterophil counts.

Eosinophils

The eosinophil counts remained unchanged in all experimental groups at the end of 7, 14, 21, 28, and 42 days. This suggests that the birds did not have any parasitic infections, further supporting findings from Christopher (1978) [2] and Koutsos *et al.* (2020) [1], who observed no significant variations in eosinophil counts.

Monocytes

The Mean $\pm$ S.E values of monocytes in all experimental groups remained stable across all time points. The normal monocyte count indicates the absence of significant infections or inflammatory responses in the experimental birds. These findings align with the reports of Christopher (1978) [2], Koutsos *et al.* (2020) [1], and Singh *et al.* (2013) [3], who also noted no significant changes in monocyte counts.

Basophils

Similar to other leukocyte parameters, no significant alterations were observed in basophil counts across all experimental groups at different time intervals. The normal basophil counts indicate the absence of allergic reactions or infections in Vanaraja chickens, as also reported by Christopher (1978) [2], Koutsos *et al.* (2020) [1], and Singh *et al.* (2013) [3].

Serum Biochemical Parameters

Blood samples were collected from all experimental groups at the end of 7, 14, 21, 28, and 42 days. Serum was separated and analyzed for biochemical parameters.

Serum Uric Acid

The Mean $\pm$ S.E values of serum uric acid in different groups indicated significant changes in aceclofenac-induced groups. At the end of 7 days, no significant differences were observed among the groups. However, at the end of 14, 21, and 28 days, Groups II and IV (aceclofenac-induced) exhibited significantly higher serum uric acid levels compared to Groups I and III. Notably, Group III (aceclofenac + febuxostat) did not show any significant deviation from the control Group I.

The elevation of serum uric acid in Groups II and IV is indicative of impaired renal function due to aceclofenac administration, leading to hyperuricemia and visceral gout. These findings are in agreement with previous studies by Gajera (2006) [4], Shinde (2007) [5], Patel *et al.* (2007) [6], Sharma *et al.* (2012) [8], Ghodasara *et al.* (2014) [9], and Ramjan *et al.* (2015) [10], who reported increased uric acid levels in diclofenac-treated birds. Similar observations were made by Chandra *et al.* (1985) [11], Mert (1991) [12], Uma *et al.* (1997) [13], Oaks *et al.* (2004) [14], Irtaza *et al.* (2008) [15], Hedao *et al.* (2008) [16], and Sharma and Vegad (2010) [8].

The increased uric acid levels observed in gout-affected birds could be attributed to aceclofenac-induced renal damage, leading to inefficient uric acid excretion. The accumulation of uric acid resulted in supersaturation of blood and subsequent deposition in visceral organs, causing inflammatory changes and gout.

By the end of 42 days, Groups II and IV, which were treated with bottle gourd juice and febuxostat, respectively, exhibited significant reductions in serum uric acid levels.

These findings indicate that both bottle gourd juice and febuxostat played a protective role in mitigating hyperuricemia. The effectiveness of febuxostat in reducing serum uric acid levels has been well-documented by Horiuchi *et al.* (1999) [17], Khosravan *et al.* (2006) [18], and Komoriya *et al.* (2004) [19], who reported a dose-dependent reduction in serum uric acid following febuxostat administration.

Additionally, bottle gourd juice demonstrated a significant reduction in serum uric acid levels, aligning with findings from Kausar and Waris (2016) [20], who reported that bottle

gourd effectively facilitated uric acid excretion in hyperuricemic rats. In the present study, a 20 ml dose of bottle gourd juice was found to effectively reduce serum uric acid levels in Vanaraja birds.

Serum Creatinine

Creatinine analysis is an important biochemical diagnostic tool to assess kidney function. It is primarily eliminated from the blood via glomerular filtration and proximal tubular secretion in the kidneys.

Mean $\pm$ S.E. values of creatinine of (mg/dl) of Vanaraja chickens in different groups at various time intervals

Groups	7day	14day	21days	28days	42days
Group I	0.51 $\pm$ 0.059 ^a	0.52 $\pm$ 0.076 ^a	0.51 $\pm$ 0.035 ^a	0.50 $\pm$ 0.027 ^a	0.54 $\pm$ 0.096 ^a
Group II	0.49 $\pm$ 0.083 ^a	1.52 $\pm$ 0.206 ^b	1.84 $\pm$ 0.32 ^b	1.98 $\pm$ 0.117 ^b	0.58 $\pm$ 0.088 ^a
Group III	0.50 $\pm$ 0.028 ^a	0.52 $\pm$ 0.115 ^a	0.54 $\pm$ 0.085 ^a	0.56 $\pm$ 0.179 ^a	0.50 $\pm$ 0.044 ^a
Group IV	0.50 $\pm$ 0.061 ^a	1.53 $\pm$ 0.196 ^b	1.80 $\pm$ 0.246 ^b	2.15 $\pm$ 0.162 ^b	0.53 $\pm$ 0.122 ^a

The Mean $\pm$ S.E values of serum creatinine in Vanaraja chicks of Groups I, II, III, and IV at different time intervals are as follows:

- **Day 7:** 0.51 $\pm$ 0.059, 0.49 $\pm$ 0.083, 0.50 $\pm$ 0.028, and 0.50 $\pm$ 0.061, respectively. No significant differences were observed among the groups.
- **Day 14:** 0.52 $\pm$ 0.076, 1.52 $\pm$ 0.206, 0.52 $\pm$ 0.115, and 1.53 $\pm$ 0.196, respectively. Aceclofenac-induced Groups II and IV exhibited significantly higher creatinine levels compared to Groups I and III.
- **Day 21:** 0.51 $\pm$ 0.035, 1.84 $\pm$ 0.32, 0.54 $\pm$ 0.085, and 1.80 $\pm$ 0.246, respectively. Groups II and IV showed significantly increased creatinine levels.
- **Day 28:** 0.50 $\pm$ 0.027, 1.98 $\pm$ 0.117, 0.56 $\pm$ 0.179, and 2.15 $\pm$ 0.162, respectively. The creatinine levels remained significantly elevated in Groups II and IV.
- **Day 42:** 0.54 $\pm$ 0.096, 0.58 $\pm$ 0.088, 0.50 $\pm$ 0.044, and 0.53 $\pm$ 0.122, respectively. No significant differences were observed among groups at this stage.

The elevated creatinine levels in Groups II and IV at Days 14, 21, and 28 indicate that aceclofenac induces kidney dysfunction. These findings align with previous studies by Feizi *et al.* (2012) [21], Irtaza *et al.* (2008) [15], Shinde (2007) [5], Hedao *et al.* (2008) [16], Jain *et al.* (2009) [22] and Undhad *et al.* (2012) [23].

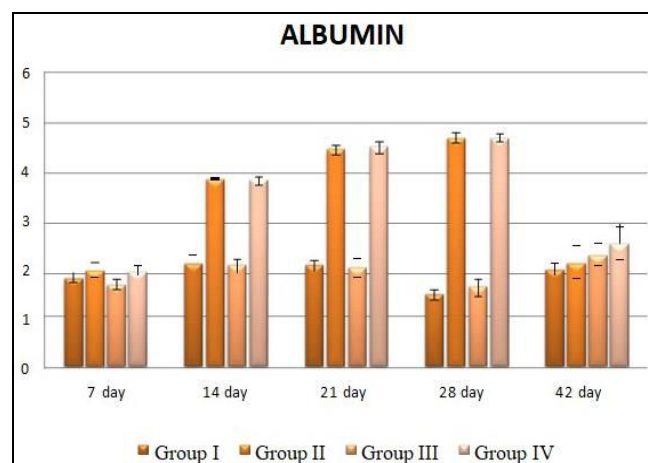
The administration of bottle gourd juice in Group II and febuxostat in Group IV demonstrated a protective effect against aceclofenac-induced nephrotoxicity. A significant reduction in serum creatinine levels was observed after 28 and 42 days. This suggests that both treatments effectively mitigate kidney damage, with bottle gourd juice playing a crucial role in renal protection by eliminating excess uric acid, as supported by Kausar and Waris (2016) [20].

Serum Total Protein (TSP)

The Mean $\pm$ S.E values of serum total protein in Vanaraja chicks of Groups I, II, III, and IV at different time intervals revealed no significant alterations at Days 7, 14, 21, 28, and 42. The normal TSP values indicate the absence of systemic infections in the birds. This finding is consistent with the studies of Singh *et al.* (2013) [3] and Chandra *et al.* (1985) [11], who reported no significant changes in serum total protein under similar conditions.

Serum Albumin

The Mean $\pm$ S.E values of serum albumin in Vanaraja chicks of Groups I, II, III, and IV at different time intervals are as follows:



- **Day 7:** 1.82 $\pm$ 0.10, 1.98 $\pm$ 0.16, 1.69 $\pm$ 0.11, and 1.96 $\pm$ 0.10, respectively. No significant differences were observed.
- **Day 14:** 2.08 $\pm$ 0.19, 3.83 $\pm$ 0.02, 2.07 $\pm$ 0.14, and 3.80 $\pm$ 0.09, respectively. Groups II and IV showed significantly increased serum albumin levels.
- **Day 21:** 2.06 $\pm$ 0.11, 4.43 $\pm$ 0.10, 2.01 $\pm$ 0.20, and 4.48 $\pm$ 0.13, respectively. A significant increase in albumin was observed in Groups II and IV.
- **Day 28:** 1.48 $\pm$ 0.11, 4.69 $\pm$ 0.11, 1.62 $\pm$ 0.18, and 4.69 $\pm$ 0.08, respectively. Groups II and IV continued to show significantly elevated serum albumin levels.

Mean $\pm$ S.E. values of albumin of (g/dl) of Vanaraja chickens in different groups at various time intervals

Groups	7 days	14 days	21 days	28 days	42 days
Group I	1.82 $\pm$ 0.10 ^a	2.08 $\pm$ 0.19 ^a	2.06 $\pm$ 0.11 ^a	1.48 $\pm$ 0.11 ^a	1.98 $\pm$ 0.13 ^a
Group II	1.98 $\pm$ 0.16 ^a	3.83 $\pm$ 0.02 ^b	4.43 $\pm$ 0.10 ^b	4.69 $\pm$ 0.11 ^b	2.13 $\pm$ 0.33 ^a
Group III	1.69 $\pm$ 0.11 ^a	2.07 $\pm$ 0.14 ^a	2.01 $\pm$ 0.20 ^a	1.62 $\pm$ 0.18 ^a	2.29 $\pm$ 0.22 ^a
Group IV	1.96 $\pm$ 0.10 ^a	3.80 $\pm$ 0.09 ^b	4.48 $\pm$ 0.13 ^b	4.69 $\pm$ 0.08 ^b	2.52 $\pm$ 0.33 ^a

- **Day 42:** 1.98 $\pm$ 0.13, 2.13 $\pm$ 0.33, 2.29 $\pm$ 0.22, and 2.52 $\pm$ 0.33, respectively. No significant differences were observed among the groups.

The increased serum albumin levels in Groups II and IV from Days 14 to 28 suggest that aceclofenac toxicity contributes to elevated albumin levels, possibly due to dehydration. These findings align with the reports of Chandra *et al.* (1985)^[11] and Singh *et al.* (2013)^[3].

The administration of bottle gourd juice in Group II and febuxostat in Group IV resulted in a significant reduction in albumin levels by Days 28 and 42, demonstrating their protective effects against aceclofenac-induced visceral gout. The results indicate that both treatments helped restore albumin concentrations to near-normal levels, mitigating the impact of aceclofenac-induced nephrotoxicity.

Serum Globulin

The mean $\pm$ S.E. values of serum globulin in Vanaraja chicks across different experimental groups at various time points are presented in Table 1. At the end of 7 days, no significant differences were observed among Groups I, II, III, and IV. However, by the 14th day, aceclofenac-induced Groups II and IV showed significantly lower serum globulin values compared to the control (Group I) and the preventive group (Group III, aceclofenac + Febuxostat). A similar trend was observed at the 21st and 28th days, where Groups II and IV exhibited significantly decreased serum globulin levels as compared to Groups I and III. This reduction in serum globulin levels in aceclofenac-induced groups indicates its potential impact on protein metabolism and immune function. The observed findings align with previous studies by Chandra *et al.* (1985)^[11] and Singh *et al.* (2013)^[3], who attributed decreased globulin levels to emaciation and dehydration caused by drug-induced toxicity.

Interestingly, by the 42nd day, serum globulin levels in Group II (treated with bottle gourd juice) and Group IV (treated with febuxostat) showed a marked recovery, reaching levels comparable to the control group. This suggests a potential protective role of bottle gourd juice and febuxostat in mitigating the adverse effects of aceclofenac-induced visceral gout. The findings reinforce the hepatoprotective and nephroprotective properties of these treatments in restoring normal globulin concentrations.

Serum Glutamic Pyruvic Transaminase (SGPT)

Serum SGPT, also known as alanine transaminase (ALT), serves as an essential biomarker for liver function assessment. The mean $\pm$ S.E. values of serum SGPT at various time points are presented in Table 2. At the end of 7 days, no significant differences were observed among the groups. However, by the 14th day, aceclofenac-induced Groups II and IV exhibited significantly elevated SGPT levels compared to the control and preventive group. This trend persisted through 21 and 28 days, indicating aceclofenac's detrimental effect on liver function.

The increased SGPT levels in aceclofenac-induced groups suggest hepatocellular damage, likely due to inflammation or oxidative stress. These findings align with previous studies by Chandra *et al.* (1985)^[11], Garcia (1998)^[24], and Jain *et al.* (2009)^[22], who reported elevated ALT levels in cases of drug-induced hepatotoxicity. Darbar *et al.* (2010)^[25] and Kausar and Waris (2016)^[20] also observed increased ALT levels in experimental models of uric acid-induced gout.

By the end of 42 days, Groups II and IV, which were treated with bottle gourd juice and febuxostat, respectively, demonstrated a significant reduction in SGPT levels,

reaching values comparable to the control group. This suggests that both interventions effectively counteracted the hepatotoxic effects of aceclofenac. Patel (2017)^[5] similarly reported a significant decrease in serum ALT levels in animals treated with febuxostat, reinforcing its hepatoprotective potential. Additionally, bottle gourd juice demonstrated a notable effect in restoring liver function by significantly reducing SGPT levels after 28 and 42 days of treatment.

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