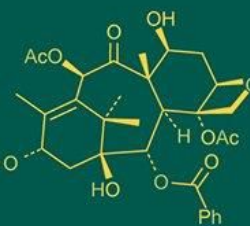
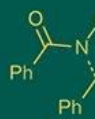
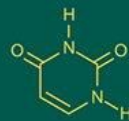
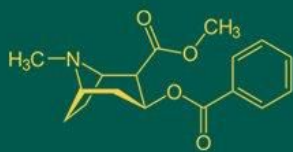


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Comparative efficacy of liver tonics (LIV100-Amorvet) on production performance of commercial broilers

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Abstract

The present study evaluated the efficacy of Amorvet-Liv 100 liver powder on the production performance of commercial broilers. A biological trial was conducted at Sree Sai Poultry Solutions research facility to compare two liver tonic sources in terms of broiler growth performance, feed utilization efficiency, immune response, and economic benefits. A total of 450 day-old Cobb-430 broiler chicks were randomly assigned to three dietary treatments: a control group (basal diet without liver tonic), a commercial liver tonic-supplemented group (1.0 kg/ton), and an Amorvet-Liv 100-supplemented group (1.0 kg/ton). Birds were raised under uniform management conditions for 42 days, with body weight, feed intake, feed conversion ratio (FCR), carcass traits, and blood biochemical profiles recorded.

Results indicated that liver tonic supplementation significantly improved feed intake, body weight gain, and FCR compared to the control group. The European Production Efficiency Factor (EPEF) was notably higher in supplemented groups, with Amorvet-Liv 100 demonstrating superior performance. Blood biochemical parameters, including serum protein, creatinine, uric acid, and liver enzymes, remained within normal ranges, indicating no adverse effects. Histological analysis of the duodenum revealed improved villus height, crypt depth, and goblet cell populations in supplemented groups, suggesting enhanced nutrient absorption and gut health.

This study highlights the benefits of liver tonic supplementation in optimizing broiler growth, feed efficiency, and economic returns. Amorvet-Liv 100 demonstrated efficacy comparable to, if not better than, the commercial liver tonic in enhancing broiler performance.

Keywords: Broiler performance, economic benefits, feed efficiency, growth promotion, gut health, liver tonic

Introduction

Liver health is pivotal to the overall performance and well-being of poultry. The liver plays a central role in metabolism, detoxification, bile secretion, and the regulation of vital nutrients such as proteins, lipids, and carbohydrates. In commercial broiler production systems, hepatic function is often challenged due to elevated metabolic demands, exposure to dietary toxins, and stressors including rapid growth and environmental variability. Consequently, dietary supplementation with liver tonics has emerged as a promising approach to enhance growth performance, feed conversion efficiency, and general health status in broilers. Traditional Ayurvedic medicine, a time-honored Indian system, offers a repertoire of herbal liver tonics and growth promoters with significant potential. These phytogetic formulations have demonstrated immunomodulatory effects, bolstering the immune response of birds against infectious agents and physiological stress. Such interventions contribute to improved toxin tolerance, decreased morbidity and mortality, enhanced adaptability, and ultimately, improved productivity in poultry farming.

Several investigations have assessed the efficacy of both herbal and synthetic liver tonics in poultry production. Herbal liver supplements, typically composed of hepatoprotective and antioxidant-rich phytoconstituents, have demonstrated positive effects on liver function,

nutrient assimilation, and immune modulation. In addition, emerging evidence indicates that these supplements contribute to improved gut health by enhancing intestinal morphology and enzymatic activity, thereby facilitating efficient digestion and feed utilization. However, disparities in formulation composition, biological efficacy, and economic viability among commercially available liver tonic preparations underscore the need for further systematic research. Such studies are essential to identify the most effective and practical liver tonic solutions for integration into commercial broiler nutrition programs.

The present study was conducted to evaluate the comparative efficacy of two liver tonic formulations—one commercially available product and a newly developed herbal liver powder (Amorvet-Liv 100)—on the production performance of commercial broilers. The objectives of the study were to:

1. Assess the impact of liver tonic supplementation on broiler growth performance and feed conversion efficiency.
2. Evaluate the effects of liver tonic on blood biochemical profiles as indicators of liver health.
3. Examine gut morphology to understand the role of liver tonic in nutrient absorption and digestive efficiency.
4. Determine the economic benefits of using liver tonics in commercial broiler production.

Treatment Groups	Dietary Supplementation
Control	Basal diet without liver tonic
T ₁	Basal diet + Commercial liver tonic @ 1.0 kg/ton
T ₂	Basal diet + Amorvet-Liv 100 powder @ 1.0 kg/ton

All diets were iso-caloric and iso-nitrogenous, formulated to meet commercial broiler nutrient requirements as per NRC (1994) guidelines.

Housing and Management

- Birds were raised under a deep litter system with uniform environmental conditions.
- Adequate floor space, ventilation, and drinking space were maintained across treatments.
- Standard brooding, temperature regulation, and lighting schedules were followed.
- Mortality was recorded daily, with feed conversion ratio (FCR) adjusted accordingly.

Diet and Feeding Management

- A mash diet was formulated for each phase, with no synthetic or herbal choline supplementation in the control diet.
- Treatments T₁ and T₂ received either a commercial liver tonic or Amorvet-Liv 100 at 1.0 kg/ton of feed.
- Feed intake and refusals were recorded weekly, with body weight measurements taken at specific intervals.

Vaccination and Medication

- Birds were vaccinated against Newcastle Disease (LaSota strain) and Infectious Bursal Disease (intermediate strain) at 7 and 14 days, with a booster for Newcastle Disease at 28 days.
- Multivitamin supplements were provided in drinking water post-vaccination to minimize stress.

By addressing these research questions, this study aims to provide insights into the role of liver tonics in optimizing broiler production and improving profitability for poultry farmers.

Materials & Methods

Study Area

The biological trial was conducted at Sree Sai Poultry Solutions, a recognized poultry research facility located in Nildoh (Pannase)-Mangrul Road, Tq. Hingna (District), Nagpur, India. The facility is situated 25 km from Nagpur Veterinary College, ensuring proximity to veterinary support and research expertise.

Experimental Design

The study was designed to evaluate the efficacy of two liver tonic formulations on broiler performance. A total of 450-day-old Cobb-430 broiler chicks were used in the 42-day trial, divided into three growth phases:

- **Pre-starter phase:** 0-11 days
- **Starter phase:** 12-22 days
- **Finisher phase:** 23-42 days

Chicks were randomly distributed into three dietary treatment groups, each with five replicates of 30 birds per replicate:

Parameters Studied

1. **Growth Performance:** Body weight, feed intake, and FCR.
2. **Carcass Traits:** Live weight, dressed weight, and organ weight.
3. **Blood Biochemical Analysis:** Serum total protein, uric acid, creatinine, SGOT, and SGPT were analyzed on days 22 and 42.
4. **Gut Morphology:** Duodenal villi height, crypt depth, and goblet cell population.
5. **Economic Evaluation:** Cost of production and European Production Efficiency Factor (EPEF).

Laboratory Analysis

- Blood samples (three birds per replicate) were collected on days 22 and 42 and analyzed using an automated blood analyzer (Mindray BS-120, China).
- Histological examination of the duodenum was conducted using Hematoxylin and Eosin (H&E) staining.

Statistical Analysis

- Data were analyzed using SPSS (Version 2022) following a completely randomized design (CRD).
- One-way ANOVA determined significant differences among treatments, with mean comparisons using Duncan's Multiple Range Test at $P < 0.05$.

Results

Feed Intake

The feed intake of commercial broiler chickens across different dietary treatments is presented in Table 1. The

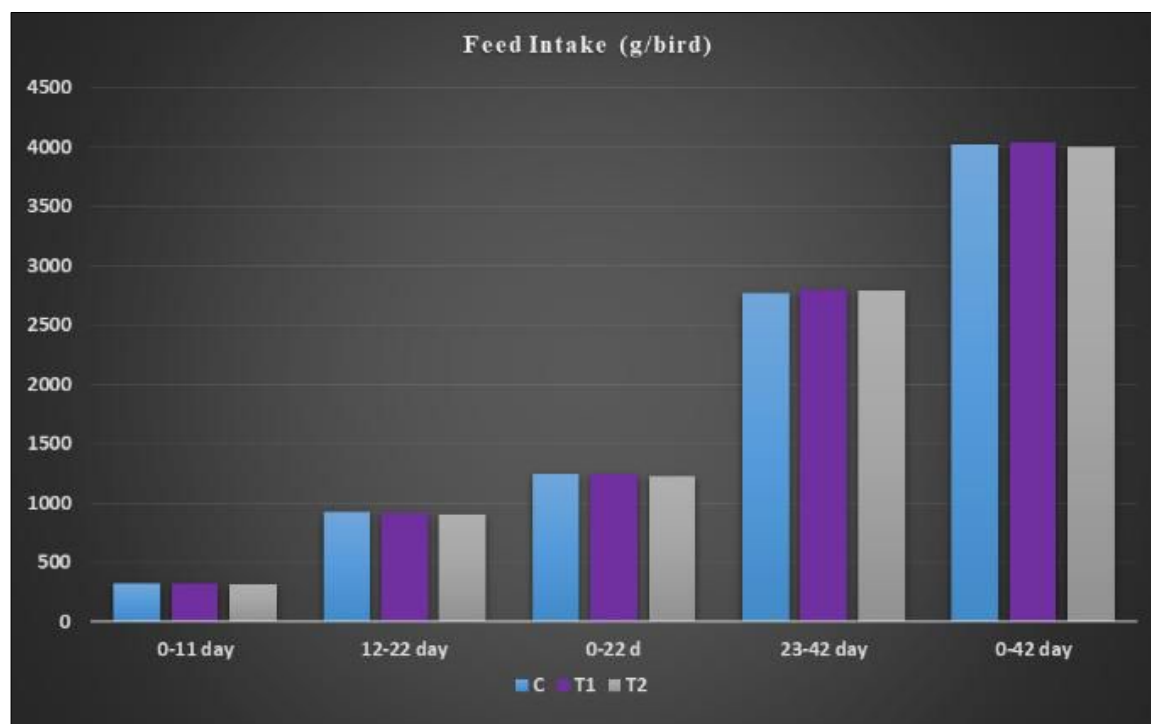
inclusion of liver tonic in the diet significantly improved feed intake during the 12-22 days, 0-22 days, and 0-42 days growth phases ($P < 0.05$). However, feed intake did not differ statistically during the pre-starter (0-11 days) and finisher

(23-42 days) phases. Birds in the control group exhibited lower feed intake in the finisher phase compared to liver tonic-supplemented groups.

Table 1: Feed intake (FI, g/bird) at different growth phases of commercial broiler chickens in different dietary treatments

Treatment	Feed Intake (g/bird)				
	0-11 day	12-22 day	0-22day	23-42 day	0-42 day
T1	321.89±1.62	923.66 ^a ±13.59	1245.55 ^b ±14.06	2364.09±21.01	3609.65 ^b ±14.28
T2	325.69±1.32	955.47 ^b ±04.97	1281.15 ^a ±5.31	2436.91±08.09	3718.07 ^a ±08.98
T3	326.63±2.48	953.27 ^b ±06.04	1279.90 ^a ±7.18	2435.32±37.66	3715.22 ^a ±35.73
SEM	1.14	6.20	6.77	16.30	18.18
Probability	NS	$P < 0.05$	$P < 0.05$	NS	$P < 0.01$

^{ab}Values in a column bearing different superscripts differ significantly ($P < 0.005$). NS: Non-significant ($P > 0.05$)



Body Weight and Weight Gain

The body weights recorded at different growth stages are shown in Table 2, while Table 3 presents weight gain at various phases. Initial body weights were similar across treatments. However, birds supplemented with liver tonic exhibited significantly higher ($P < 0.01$) body weights on

days 11, 23, and 42 compared to the control group. The liver tonic-supplemented groups did not show any significant differences in body weight between the two test diets.

Weight gain followed a similar trend, with liver tonic-fed birds achieving significantly higher gains ($P < 0.001$) across all growth phases.

Table 2: Live weight (g/bird) of birds at different stages of growth phases of commercial broiler chickens

Treatment	Body weight			
	0 th day	11 th day	22 nd day	42 nd day
Control	47.53±0.12	314.59 ^b ±1.31	0952.07 ^b ±05.81	2190.00 ^b ±06.81
T1	47.59±0.24	322.00 ^a ±0.66	1004.53 ^a ±11.58	2350.51 ^a ±17.35
T2	47.52±0.17	324.60 ^a ±0.73	1008.69 ^a ±03.76	2364.37 ^a ±08.11
SEM	0.10	1.24	8.05	22.06
Probability	NS	$P < 0.001$	$P < 0.01$	$P < 0.001$

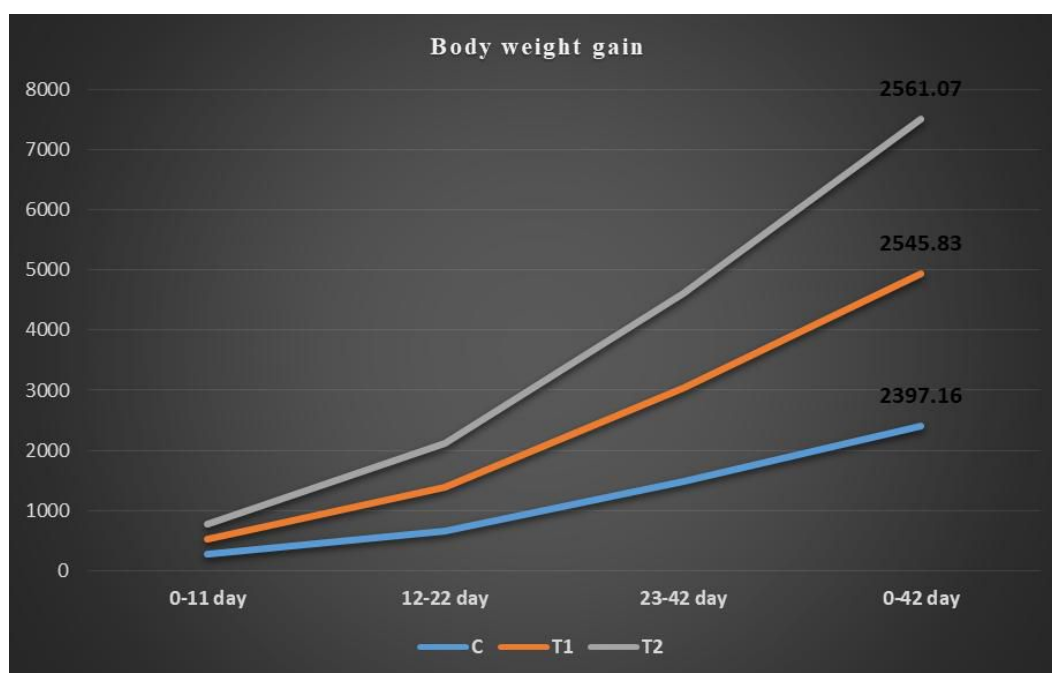
^{ab}Values in a column bearing different superscripts differ significantly ($P < 0.005$). NS: Non-significant ($P > 0.05$)



Table 3: Live weight gain (g/bird) of birds at different stages of growth phases of commercial broiler chickens

Body weight Gain				
Treatment	0-11 day	12-22 day	23-42 day	0-42 day
Control	267.06 ^b ±1.20	637.48 ^b ±04.81	1237.93 ^b ±09.12	2142.48 ^b ±06.80
T1	274.41 ^a ±0.54	682.53 ^a ±11.84	1345.98 ^a ±19.48	2302.92 ^a ±17.16
T2	277.08 ^a ±0.85	684.09 ^a ±03.53	1355.67 ^a ±10.84	2316.85 ^a ±08.09
SEM	1.23	7.08	16.08	22.04
Probability	$P<0.001$	$P<0.001$	$P<0.001$	$P<0.001$

^{ab}Values in a column bearing different superscripts differ significantly ($P<0.05$).



Feed Conversion Ratio (FCR)

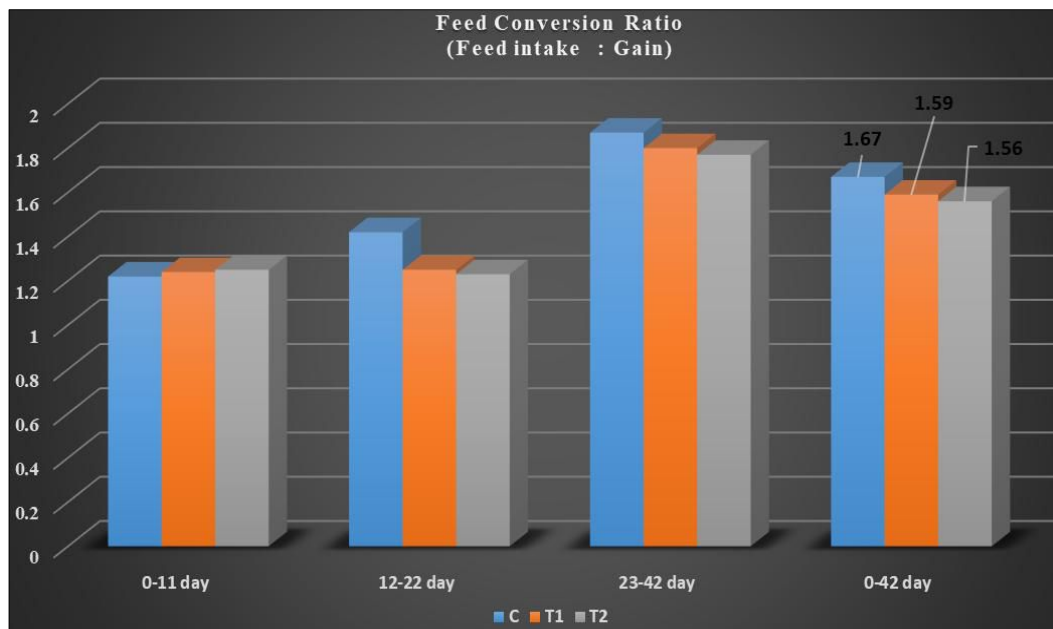
The FCR, calculated based on body weight gain and total body weight, is presented in Tables 4 and 5. The FCR (feed intake per unit of body weight gain) differed significantly during the 0-11 days, 23-42 days, and overall 0-42 days ($P<0.05$), while no significant differences were observed during

12-22 days. Similarly, FCR based on total body weight showed significant differences ($P<0.05$) in all phases. Birds receiving liver tonic demonstrated improved FCR, indicating better feed utilization efficiency compared to the control group.

Table 4: Feed Conversion ratio (FI: b. wt. gain) of birds at different growth phases of commercial broiler chickens

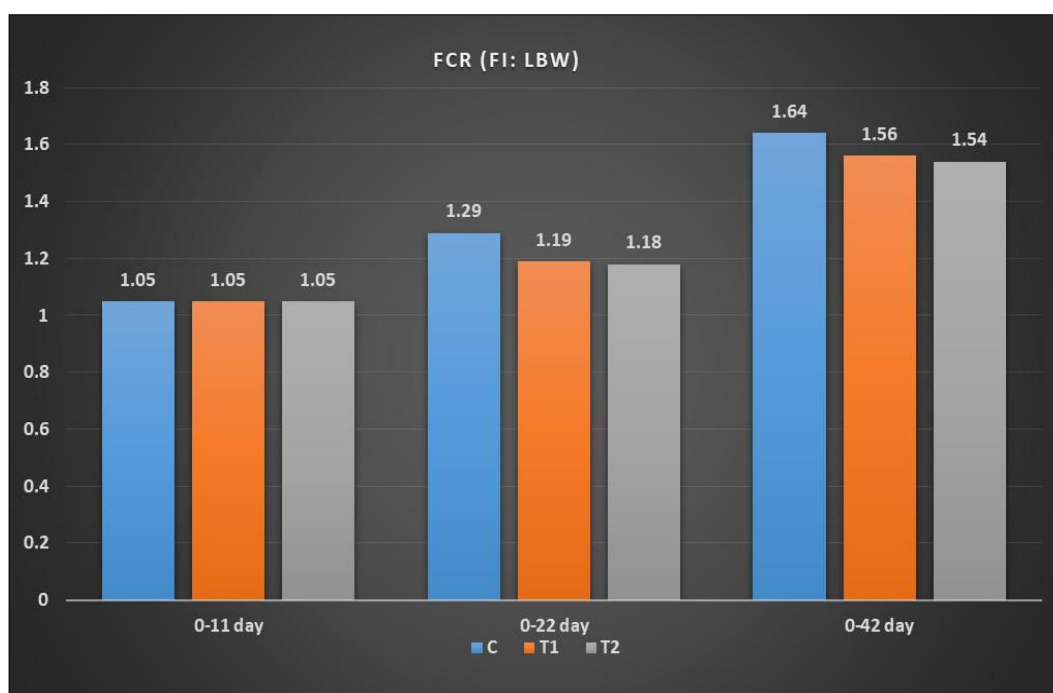
FCR (Feed Intake: gain)				
Treatment	0-11 day	12-22 day	23-42 day	0-42 day
Control	1.20 ^a ±0.00	1.45±0.02	1.91 ^a ±0.03	1.68 ^a ±0.01
T1	1.19 ^b ±0.00	1.40±0.03	1.81 ^b ±0.02	1.62 ^b ±0.01
T2	1.18 ^b ±0.01	1.39±0.01	1.80 ^b ±0.02	1.60 ^b ±0.01
SEM	0.00	0.01	0.02	0.01
Probability	<i>P</i> <0.05	NS	<i>P</i> <0.001	<i>P</i> <0.001

^{ab}Values in a column bearing different superscripts differ significantly (*P*<0.05). NS: Non-significant (*P*>0.05)

**Table 5:** Feed Conversion ratio (FI: B. wt) of birds at different growth phases of commercial broiler chickens

FCR (Feed Intake: body weight)			
Treatment	0-11 day	0-22 day	0-42 day
Control	1.02 ^a ±0.00	1.35 ^a ±0.02	1.65 ^a ±0.01
T1	1.01 ^a ±0.00	1.27 ^b ±0.02	1.58 ^b ±0.01
T2	1.00 ^b ±0.01	1.28 ^b ±0.01	1.57 ^b ±0.01
SEM	0.00	0.01	0.01
Probability	<i>P</i> <0.05	<i>P</i> <0.01	<i>P</i> <0.001

^{ab}Values in a column bearing different superscripts differ significantly (*P*<0.05)



Average Daily Gain, Survivability, and European Production Efficiency Factor (EPEF)

Average daily gain, survivability, and EPEF values for all treatment groups are summarized in Table 6. The daily weight gain was significantly higher ($P<0.001$) in birds receiving liver tonic, with no statistical difference between the two supplemented groups. Survivability, although not

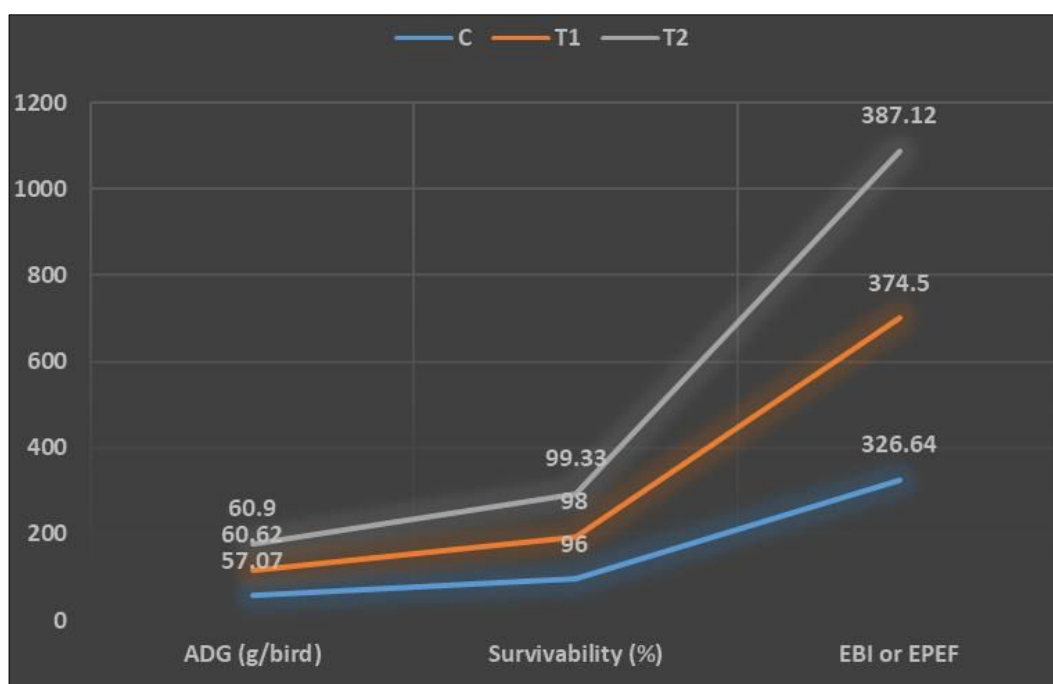
statistically different, was highest (99.33%) in the Amorvet-Liv 100 group, followed by the commercial liver tonic group (98.67%) and the control (97.33%).

The EPEF, a key indicator of production efficiency, was significantly improved ($P<0.001$) in liver tonic-fed birds. The Amorvet-Liv 100 group exhibited the highest EPEF, followed by the commercial liver tonic group, while the control group had the lowest value.

Table 6: Average daily gain, survivability and EPEF of birds of commercial broiler chickens

Treatment	ADG	Survivability	EBI
Control	51.01 ^b ±0.16	97.33±1.25	294.64 ^b ±2.60
T1	54.83 ^a ±0.41	98.67±0.82	335.25 ^a ±6.75
T2	55.16 ^a ±0.19	99.33±0.67	341.18 ^a ±3.80
SEM	0.52	0.55	6.13
Probability	$P<0.001$	NS	$P<0.001$

^{a,b}Values in a column bearing different superscripts differ significantly ($P<0.05$). NS: Non-significant ($P>0.05$)



Blood Biochemical Parameters

The blood biochemical profiles measured on days 22 and 42 are presented in Tables 7 and 8. The values for serum protein, creatinine, uric acid, SGOT, and SGPT remained

within normal physiological ranges and did not show significant differences among treatments ($P>0.05$). These results indicated that liver tonic supplementation did not have any adverse effects on liver or kidney function.

Table 7: Blood biochemical parameters of commercial broiler chickens on 22nd day of age

22 nd day of age					
Treatment	Protein	Creatinine	Uric acid	SGOT	SGPT
Control	2.83±0.03	0.43±0.03	3.03±0.33	126.00±08.02	4.13±0.47
T1	2.97±0.26	0.43±0.30	3.20±1.37	157.67±29.87	2.97±0.52
T2	2.70±0.15	0.40±0.06	2.90±0.97	204.33±27.42	4.10±0.64
SEM	0.11	0.02	0.33	11.68	0.27
Probability	NS	NS	NS	NS	NS

aNS: Non-significant ($P>0.05$)

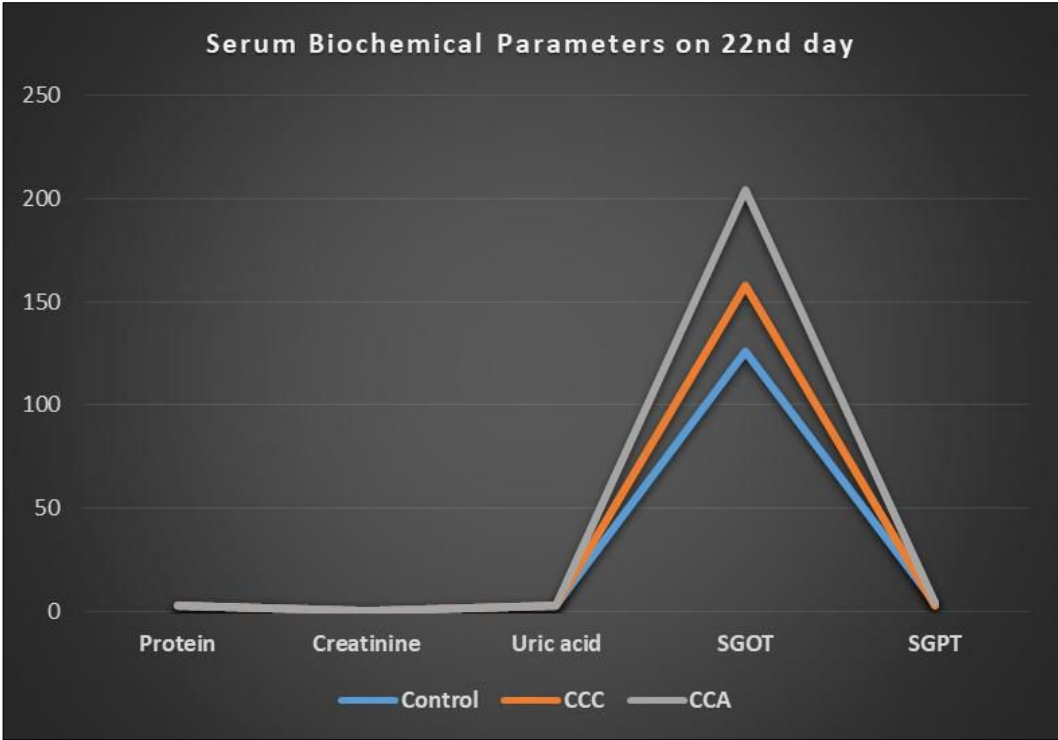
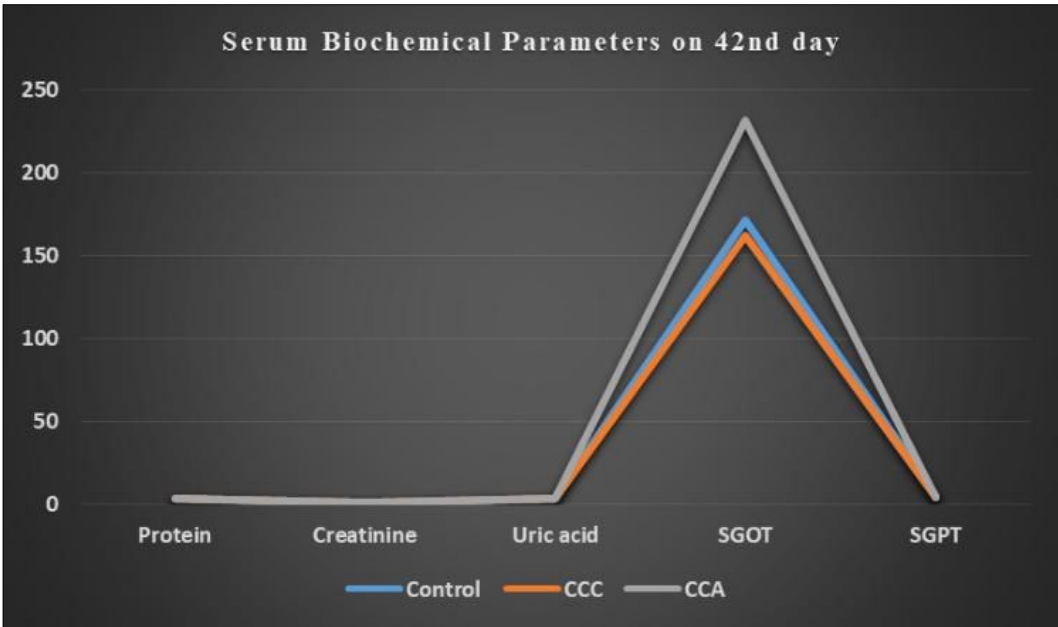


Table 8: Blood biochemical parameters of commercial broiler chickens on the 42nd day of age

42 nd day of age					
Treatment	Protein	Creatinine	Uric acid	SGOT	SGPT
Control	3.4±0.12	0.43±0.09	3.03±0.33	171.33±22.26	4.57±0.35
T1	3.37±0.39	0.53±0.20	3.20±1.37	162.33±26.61	4.03±0.18
T2	3.27±0.09	0.50±0.15	2.90±0.97	231.33±6.49	4.27±0.29
SEM	0.13	0.06	0.33	10.80	0.32
Probability	NS	NS	NS	NS	NS

NS: Non-significant (*P*>0.05)

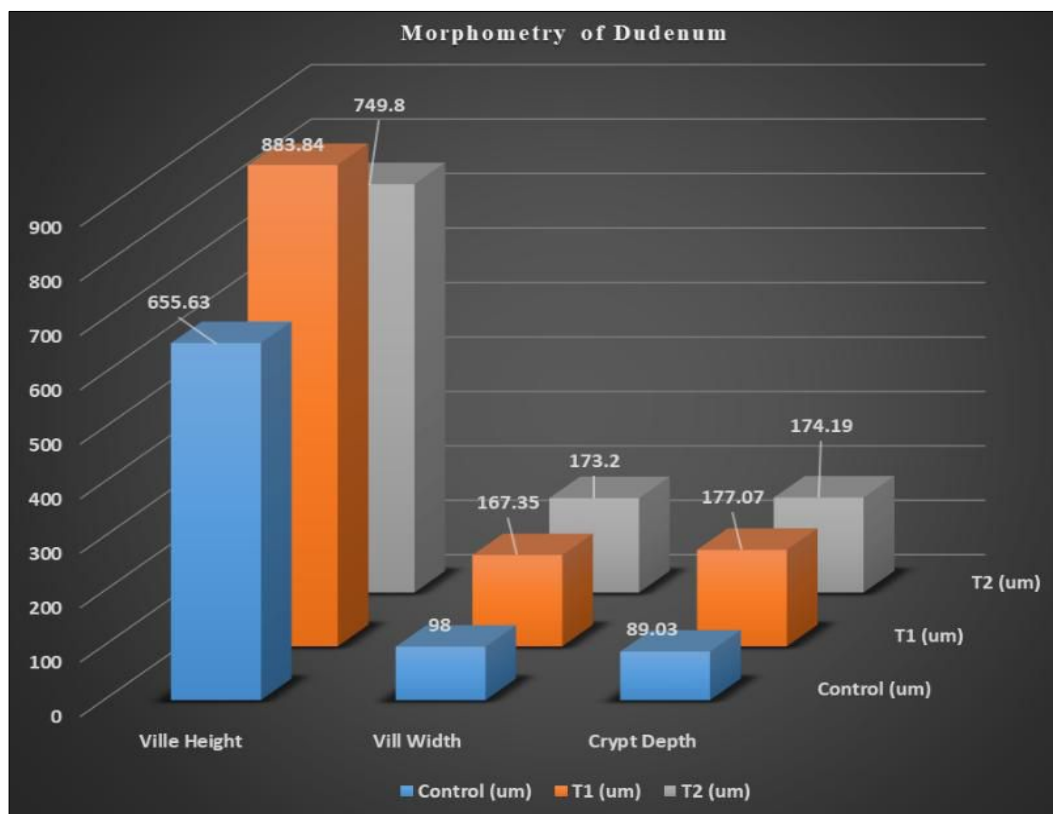


Gut Morphology: Morphological observations of the duodenum on day 42 are shown in Table 9 and Figures 1-3. Birds in the control group exhibited reduced villus height, villus width, and crypt depth, along with a lower goblet cell population. In contrast, liver tonic-supplemented groups demonstrated improved gut morphology, with significantly

(*P*<0.05) higher villus height and crypt depth. The histological improvements in the supplemented groups contributed to enhanced digestion and nutrient absorption. The Amorvet-Liv 100 group showed slightly better villus width than the commercial liver tonic group, although the difference was not statistically significant.

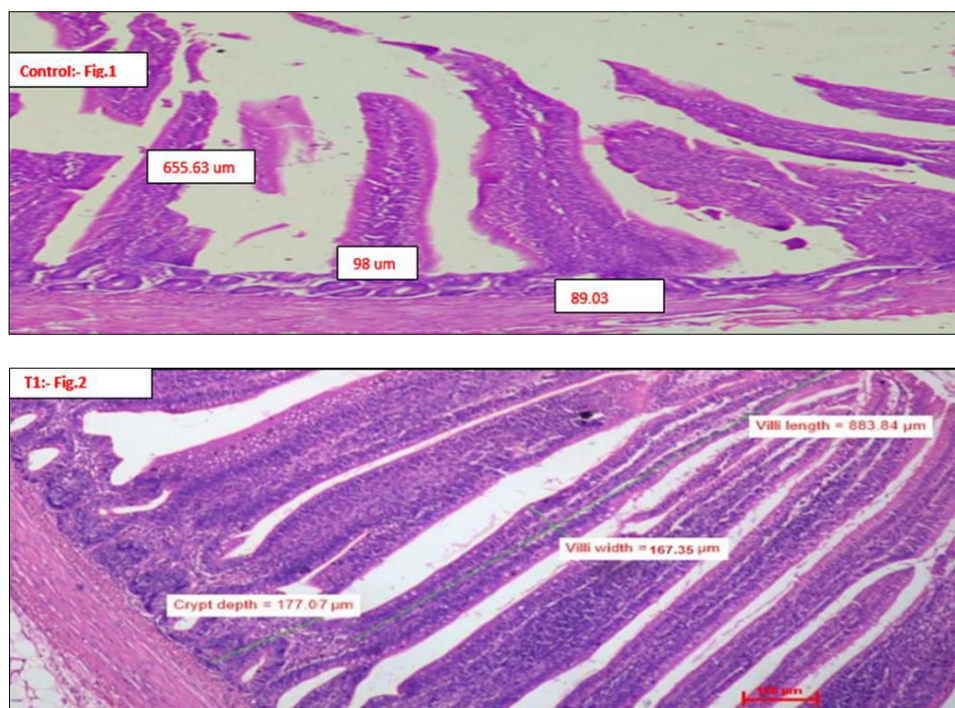
Table. 9: Morphometry of the duodenum at 42 days of age, broilers fed liver tonic

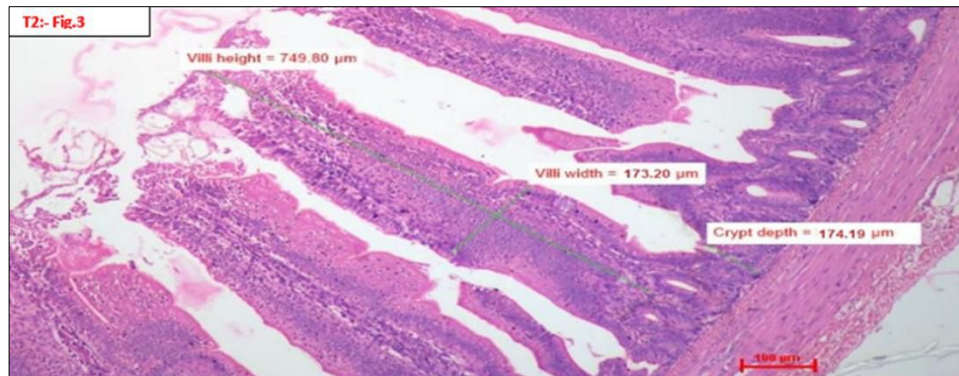
	Villi Height	Villi Width	Crypt Depth
Control (um)	655.63	98.00	89.03
T1 (um)	883.84	167.35	177.07
T2 (um)	749.80	173.20	174.19



Economic Analysis: The cost of chicks, labor, medications, and other management expenses remained similar across treatments. However, variations in feed cost, intake, and weight gain influenced the overall feed cost per kilogram of

live weight. Birds supplemented with Amorvet-Liv 100 exhibited the lowest feed cost per kilogram of live weight, followed by the commercial liver tonic group, while the control group had the highest cost.

Fig 1: Morphometry of Duodenal Villi at 42 Days of Age



Discussion

The present study demonstrated the beneficial effects of liver tonic supplementation on broiler chickens' growth performance, feed efficiency, and gut health. The significant improvements in feed intake and weight gain observed in the liver tonic-supplemented groups are consistent with previous findings, which suggest that hepatoprotective agents can enhance metabolic activity, support detoxification processes, and improve nutrient absorption. These effects collectively contribute to improved overall performance in broilers.

The results of the present study agree with those reported by Babu *et al.* (1992) [2], Narahari (1992) [13], Prajapati (1997) [16], Samarsinghe (2002), Kalorey *et al.* (2005) [10], Singh *et al.* (2009) [21], Went and Natsir (2013) [14], Surai (2015) [24], and Sharma *et al.* (2017) [19], who all observed significant improvements in body weight following supplementation with various herbal liver tonics. Sonkusle *et al.* (2011) investigated the hepatoprotective effects of Superliv liquid at a dosage of 10 mL/100 chicks/day and reported a significant ($P < 0.01$) increase in broiler body weight. Similarly, Bhattacharya *et al.* (2015) and Debnath *et al.* (2015) found that supplementation with Superliv liquid at 20 mL/100 chicks/day significantly ($P < 0.05$) improved body weight and weight gain in broilers between 3 and 6 weeks of age. Siddiqui *et al.* (2017) [20] reported that body weight increased significantly ($P < 0.01$) in liver tonic-supplemented groups compared to the control. Similarly, Somvanshi *et al.* (2020) [22] found that the growth rate was significantly higher ($P < 0.01$) in groups supplemented with an herbal liver stimulant at doses of 6, 9, and 12 mL/25 chicks/day. El-Damrawy *et al.* (2023) [8] observed that the adverse effects of aflatoxin B1 on body weight gain were mitigated by supplementing broiler diets with silymarin and choline chloride. Supporting these findings, Tedesco *et al.* (2004) [25] reported improvements in blood biochemistry parameters in broilers fed exclusively on milk thistle-based diets.

The feed conversion ratio (FCR) was significantly improved in the liver tonic-supplemented groups, indicating enhanced feed utilization. This finding is consistent with previous studies reporting that herbal liver tonics optimize hepatic function, thereby improving digestion and nutrient absorption efficiency. The results of the present study are in agreement with those reported by Ma *et al.* (2005) [12], Kumar *et al.* (2005) [11], Singh *et al.* (2009) [21], and Sharma *et al.* (2017) [19], who found that supplementation with polyherbal liver tonics improved broiler performance in terms of feed efficiency and livability. The improved European Production Efficiency Factor (EPEF) observed in our study further supports the economic viability of incorporating liver tonics into broiler diets. Notably, no

mortality was recorded in any of the treatment groups throughout the experimental period. These findings are consistent with the observations of Castro *et al.* (2011) [4], Reis *et al.* (2012) [17], and Sharma *et al.* (2017) [19]. Sonkusle *et al.* (2011) reported that supplementation with Superliv liquid at 10 mL/100 chicks/day significantly ($P < 0.01$) improved the feed conversion ratio (FCR) in broilers. Similarly, Bhattacharya *et al.* (2015) and Debnath *et al.* (2015) demonstrated that supplementation at 20 mL/100 chicks/day significantly ($P < 0.05$) enhanced FCR in broilers between 3 and 6 weeks of age. Somvanshi *et al.* (2020) [22] also observed significantly improved ($P < 0.01$) FCR in groups supplemented with an herbal liver stimulant at 6, 9, and 12 mL/25 chicks/day compared to the control. The improved feed utilization may be attributed to the active herbal constituents of Superliv liquid, including *Andrographis paniculata*, *Boerhaavia diffusa*, and *Picrorhiza kurroa*, which have been reported to enhance digestion and nutrient absorption (Yusuf *et al.*, 2014; Chithambaran & Devid, 2014; Alexander *et al.*, 2008) [26, 5, 1]. In layer birds, Lonkar *et al.* (2016) concluded that supplementation with the herbal liver tonic Superliv liquid at 10 mL/100 birds/day was beneficial in improving performance parameters, particularly feed efficiency. Similarly, El-Damrawy *et al.* (2023) [8] observed that the adverse effects of aflatoxin B1 on feed intake, feed efficiency, and mortality rate in broilers were mitigated by the inclusion of silymarin and choline chloride in aflatoxin B1-contaminated diets.

Blood biochemical parameters, including serum protein, creatinine, uric acid, SGOT, and SGPT, remained within normal physiological ranges and showed no significant differences among the treatment groups. These findings confirm that the tested liver tonics did not exert any adverse effects on liver or kidney function. Consistent with the present findings, El-Damrawy *et al.* (2023) [8] reported that supplementation of broiler diets with liver tonics such as silymarin and choline chloride significantly ($P < 0.05$) improved AST and ALT activity, while significantly reducing creatinine ($P < 0.05$) and uric acid levels ($P < 0.01$). Similar effects on blood biochemistry were observed by Tedesco *et al.* (2004) [25] in broilers fed exclusively on milk thistle-based diets. Sonkusle *et al.* (2011) demonstrated that Superliv liquid supplementation at 10 mL/100 chicks/day resulted in a significant ($P < 0.01$) reduction in serum SGPT, SGOT, and creatinine levels, along with a significant ($P < 0.01$) increase in serum protein levels. Similarly, Debnath *et al.* (2015) observed that plasma concentrations of total protein and the activities of AST and ALT were comparable across all treatment groups when broilers were supplemented with Superliv liquid at 20 mL/100 birds/day,

AV/SSL/12 at 10 mL/100 birds/day, AV/SSL/12 at 15 mL/100 birds/day, Xlivpro at 500 g/tonne of feed, or Superliv premix at 500 g/tonne of feed. Additionally, Hajare *et al.* (2020) ^[9] confirmed that the polyherbal liver tonic Superliv Gold liquid had no detrimental effects on serum ALT, ALP, AST, or creatinine levels, supporting its safety for use in broiler birds. Siddiqui *et al.* (2017) found that supplementation with Livavit® at 1 mL/L of drinking water significantly ($P < 0.01$) decreased serum aspartate transaminase (AST) and alanine transaminase (ALT) levels compared to the control. Similar results were also reported by Paul *et al.* (2010) and Debnath *et al.* (2014) ^[6].

Histological analysis revealed that liver tonic supplementation enhanced gut morphology, evidenced by increased villus height and crypt depth, features associated with improved nutrient absorption efficiency. These findings suggest that the performance benefits of liver tonics may be partly attributed to their positive impact on gut integrity. Furthermore, Sonkusle *et al.* (2011) investigated the hepatoprotective effects of Superliv liquid at a dosage of 10 mL/100 chicks/day and reported only mild congestion and negligible degenerative changes in the liver and kidneys of treated broilers, in contrast to more pronounced alterations observed in the control group.

Overall, the results indicate that both liver tonic formulations were effective in enhancing broiler performance. Among the two, the Amorvet-Liv 100-supplemented group demonstrated slightly superior outcomes compared to the group receiving the commercial liver tonic.

Conclusion

The study findings confirm that liver tonic supplementation significantly enhances growth performance, feed efficiency, and gut health in broiler chickens. Both commercial liver tonic and Amorvet-Liv 100 demonstrated comparable efficacy, with slight advantages observed in the Amorvet-Liv 100 group. The results suggest that liver tonics play a crucial role in optimizing poultry production, improving feed utilisation, and increasing economic returns. The inclusion of a liver tonic in commercial broiler diets is recommended for better growth performance, survivability, and production efficiency.

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