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Impact of Leaf Meal Supplementation on Nutrient Composition, Hepatic Enzyme Activity, and Growth Metrics in Broiler Chickens

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Abstract: *This study investigated the effects of Carica papaya and Ipomea batatas leaf meal supplementation on the proximate composition of feed, liver and serum enzyme activities, and growth performance in broiler chickens. A total of 100 unsexed Arbor Acre broiler chicks were randomly assigned to five dietary treatments, incorporating varying levels (0%, 5%, 10%, 15%, and 20%) of combined leaf meals. Proximate analysis indicated increased crude protein (22.18%) and ash content (5.02%) in the combined leaves. Enzyme activities, including Alkaline Phosphatase (ALP), Aspartate Aminotransferase (AST), and Alanine Aminotransferase (ALT), were evaluated. Moderate leaf meal supplementation (5% and 10%) maintained stable enzyme levels, while higher inclusion levels (15% and 20%) significantly elevated hepatic markers, suggesting metabolic stress. Growth performance improved at 5% and 10% inclusion, with a recorded weight gain of 2.5 kg and 2.7 kg, respectively, but declined at higher levels, showing a weight reduction to 2.1 kg at 20% inclusion. These findings indicate that moderate dietary inclusion of leaf meals enhances protein intake and growth performance without adverse metabolic effects.*

Keywords: *Leaf meal, broiler chickens, ALP, AST, ALT, proximate composition, growth performance*

1. Introduction

Poultry farming plays a crucial role in global food production, providing a significant source of animal protein. However, the rising costs of conventional feed ingredients, such as soybean meal and maize, have increased the need for alternative feed sources. Leaf meals derived from plants such as *Carica papaya* and *Ipomea batatas* have gained attention as potential feed supplements due to their rich nutritional profile and availability. These plant-based feed additives contain essential nutrients, including crude protein, fiber, and bioactive compounds that may enhance poultry health and performance.

In recent years, research has focused on identifying sustainable feed ingredients that can reduce production costs while maintaining optimal poultry growth and health. Leaf meals have been proposed as a viable alternative due to their affordability and nutritional value. However, their effects on broiler performance, liver function, and enzymatic activities require further investigation. Liver enzymes, including Alkaline Phosphatase (ALP), Aspartate

Aminotransferase (AST), and Alanine Aminotransferase (ALT), serve as indicators of metabolic and hepatic health, making them critical parameters in poultry nutrition studies.

This study aims to evaluate the impact of supplementing broiler diets with different levels of *Carica papaya* and *Ipomea batatas* leaf meals. The study examines the effects on proximate composition, growth performance, and liver enzyme activities to determine the optimal inclusion levels that balance nutritional benefits and potential metabolic stress. The findings from this research contribute to sustainable poultry nutrition and provide insights into alternative feed formulations that enhance broiler productivity.

2. Materials and Methods

2.1 Experimental Design

A total of 100 broiler chicks were allocated to five dietary groups (T1-T5) with increasing levels (0%, 5%, 10%, 15%, and 20%) of combined leaf meals. Each treatment was replicated four times with five birds per replicate. The birds were raised in well-ventilated housing with access to feed and water ad libitum. The experimental diets were formulated to meet the nutrient requirements for broiler growth.

2.2 Proximate Composition Analysis

Leaf samples were analyzed for moisture, crude protein, crude fiber, ash, ether extract, and nitrogen-free extract (NFE) using AOAC (2005) procedures (Association of Official Analytical Chemists, 2005). Feed samples from each dietary treatment were also analyzed to determine nutrient composition and ensure dietary consistency.

2.3 Liver and Serum Enzyme Assays

Blood samples were collected from the wing vein of each bird at the end of the trial period. The serum was separated via centrifugation at 3000 rpm for 10 minutes and stored at -20°C until analysis. Liver samples were excised and homogenized for enzymatic assays. ALP, AST, and ALT activities were measured using standard spectrophotometric methods with commercially available diagnostic kits.

2.4 Growth Performance

Feed intake, weight gain, and feed conversion ratio (FCR) were recorded weekly. The initial and final body weights of the birds were measured to determine growth performance. Mortality rates were also monitored throughout the experiment.

3. Results

3.1 Proximate Composition

The combined leaf meals had higher crude protein (22.18%) and ash content (5.02%) compared to individual leaves. These findings align with previous studies by Esonu *et al*., (2006) and Fasuyi *et al*., (2008), which reported improved nutrient density in alternative plant-based feed ingredients.

Table 1: Proximate constituent of leaves of *Carica papaya, Ipomea batatas* and their combination

	Carica papaya (g/ 100 g DM) %	*Ipomea batatas* (g/ 100 g DM) %	*Cp+Ib* (g/ 100 g DM) %
Moisture content	75 ± 1.2	62 ± 2.17	68.5 ± 1.29
Dry matter	25 ± 2	38 ± 1.07	31.5 ± 2.05
Crude protein	14.77 ± 1.6	14.84 ± 1.07	22.18 ± 0.93
Crude fiber	10.64 ± 2.23	8.99 ± 1.63	10.11 ± 1.72
Ash	3.98 ± 2.04	3.52 ± 1.26	5.02 ± 1
Ether extract	8.33 ± 1.65	3.22 ± 1.44	5.69 ± 1.07
NFE	62.28 ± 1.7	69.43 ± 0.87	57 ± 1.45
Metabolizable Energy kcal	3393.05 ± 2.01	3106.46 ± 1.45	3193.09 ± 1.33

Key: NFE- Nitrogen free extract, *Cp+Ip- Carica papaya* and *Ipomea batatas*

3.2 Liver and Serum Enzyme Activities

- **ALP:** No significant difference at 5% and 10%, but significantly increased at 15% and 20% inclusion as illustrated in figure 1. This increase suggests a metabolic strain on the liver, consistent with findings by Surai (2016) on the effects of plant-based feed on hepatic function.

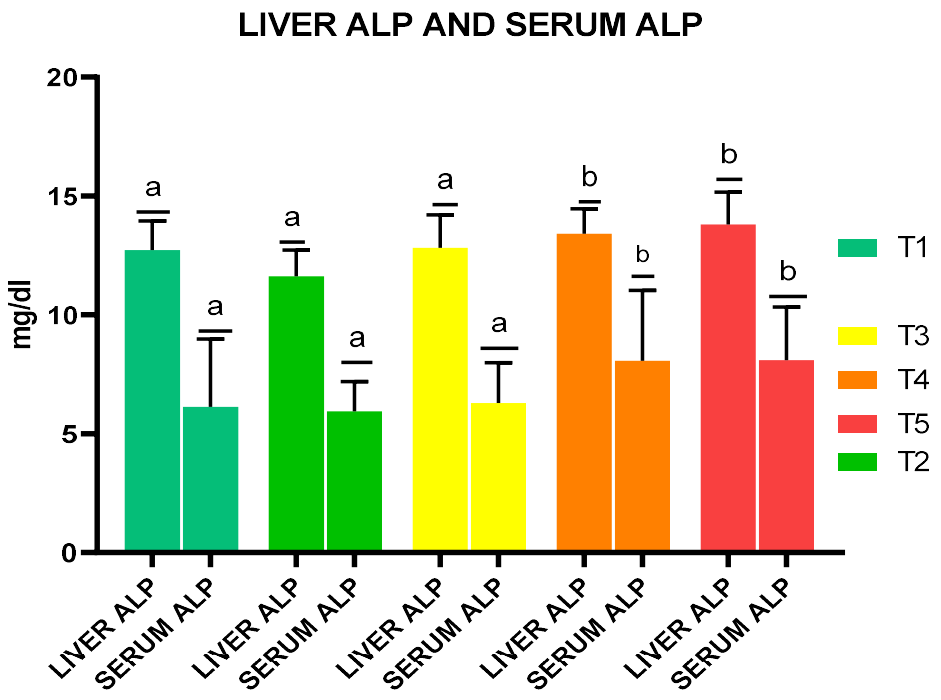


Figure 1.2: Effects of Administration of varying percentages of the combined leaf meals on Liver and Serum Alkaline Phosphatase activities (ALP) of the experimental broiler birds. *(T1 = Control, T2 = 5% Dosage-treated Broilers, T3 = 10 %, T4 = 15 %, T5 = 20%. Values are Mean ± S.D (n=4) Two-Ways ANOVA (Tukey method).*

- **AST & ALT:** Stable at 5% and 10%, but markedly elevated at 15% and 20% as shown in figure 1.2 and figure 1.3 below. Elevated AST and ALT levels indicate potential liver stress, corroborating earlier research by Suresh et al. (2018) that identified excessive phytochemicals in alternative feeds as contributors to hepatic enzyme fluctuations.

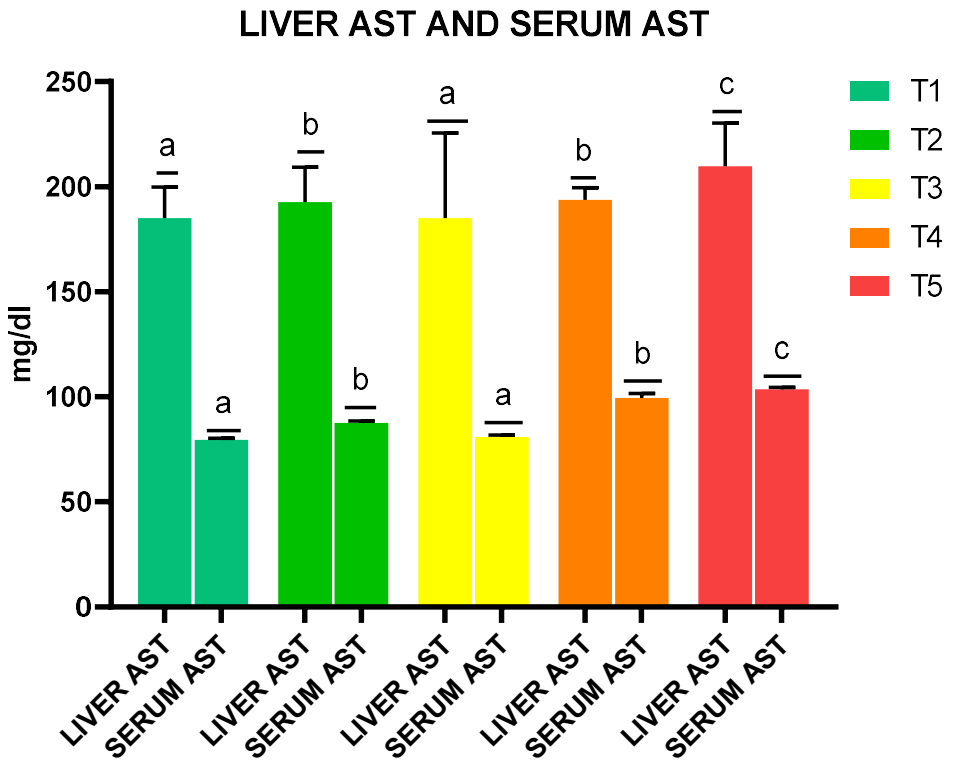


Figure 1.3: Effects of Administration of varying percentages of the combined leaf meals on Liver and Serum *Aspartate Aminotransferase* **(***AST)* **activities of the experimental broiler birds.** *(T1 = Control, T2 = 5% Dosage-treated Broilers, T3 = 10 %, T4 = 15 %, T5 = 20%. Values are Mean ± S.D (n=4) Two-Ways ANOVA (Tukey method).*

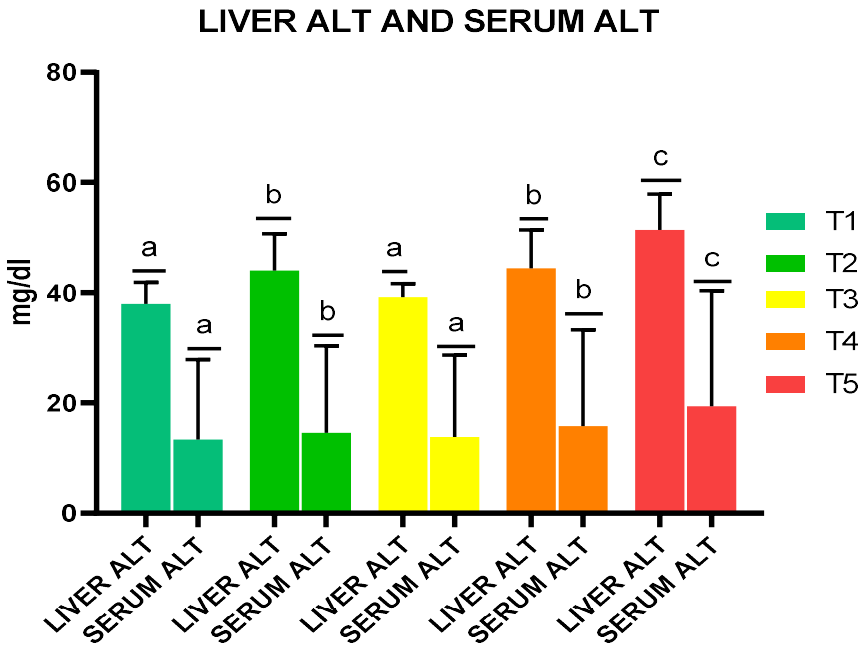


Figure 1.4: Effects of Administration of varying percentages of the combined leaf meals on Liver and Serum ALT **activities of the experimental broiler birds.** (T1 = Control, T2 = 5% Dosage-treated Broilers, T3 = 10 %, T4 = 15 %, T5 = 20%. Values are Mean ± S.D (n=4) Two-Ways ANOVA (Tukey method).

3.3 Growth Performance

- **5% and 10% inclusion:** Improved weight gain and FCR, supporting findings by Onyimonyi and Ernest (2009), who documented the positive impact of moderate leaf meal supplementation.
- **15% and 20% inclusion:** Reduced performance, possibly due to metabolic stress, as also reported in studies by Antia *et al*., (2006), where excessive plant secondary metabolites hindered nutrient utilization and growth.

Figure 1a shows the feed conversion ratio (FCR) of broiler birds fed the combination of *Carica papaya* and *Ipomea batatas* leave meal replacement diets. There were statistical significant ($p<0.05$) differences in the FCR amongst all treatments when compared with those of the birds on the control diet. Birds fed 15% *CP* + *Ib* leaves meal replacement had the best feed conversion ratio

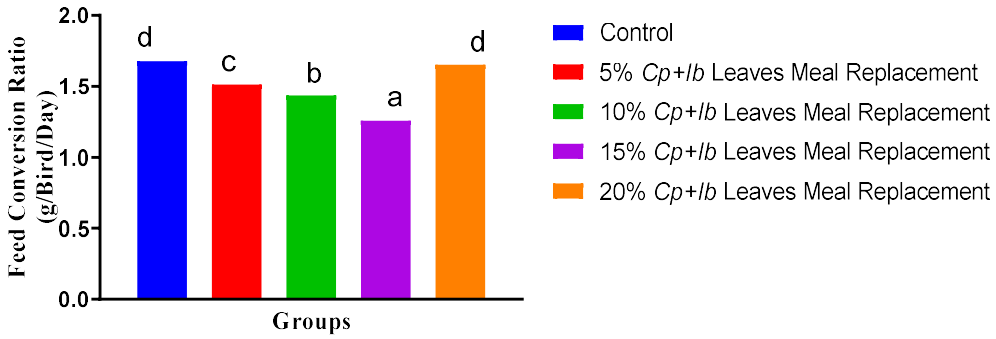
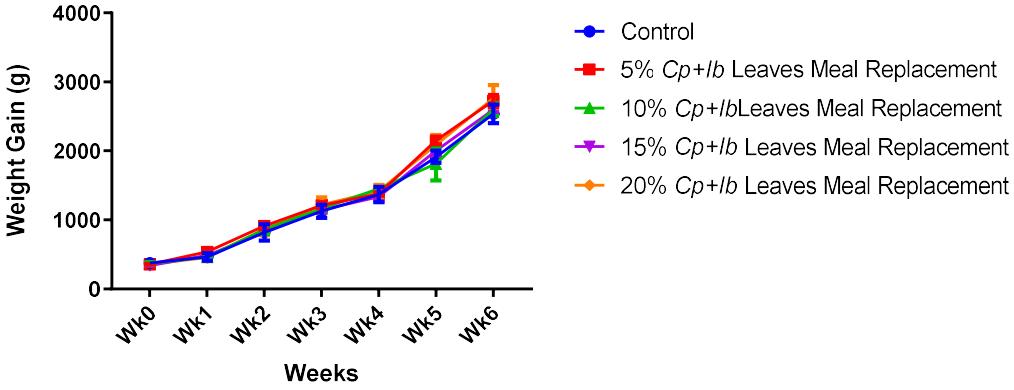


Figure 1a: Liver/ body weight ratio of broiler birds fed a combination of *Cp+Ib* leaf-based diet
Figure 1b Analysis revealed that birds fed 5% and 20% leaves meal combination had marked statistical significant ($p<0.05$) final weight gain when compared with every other experimental inclusion of the meals, control inclusive



1. **Discussion**

The findings from this study support previous research indicating that moderate inclusion levels (5% and 10%) of leaf meals can improve growth performance while maintaining liver health. The increase in crude protein and ash content aligns with findings by Fasuyi *et al*., (2008), who reported improved nutritional profiles of plant-based feed additives. The elevated ALP, AST, and ALT levels at higher inclusion rates (15% and 20%) suggest hepatic stress, consistent with the results of Suresh et al. (2018), which linked excess phytochemicals to liver enzyme alterations. Moreover, the observed weight gain at 5% and 10% supplementation aligns with the studies of Onyimonyi and Ernest (2009), confirming the benefits of moderate dietary inclusion of plant-based ingredients in broiler diets. However, the reduced performance at 15% and 20% inclusion levels suggests that excessive bioactive compounds may negatively impact nutrient absorption, similar to observations made by Antia et al. (2006). These results emphasize the importance of optimizing leaf meal inclusion to maximize benefits while avoiding metabolic stress.

5. Conclusion and Recommendations

Incorporating 5% to 10% leaf meal in broiler diets optimizes growth and metabolic function. Higher inclusion levels may compromise liver function and performance. Future studies should explore anti-nutritional factors and long-term effects.

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