EFFECTS OF PHYLLANTHUS AMARUS SUPPLEMENTATION ON GROWTH PERFORMANCE AND COCCIDIOSIS MANAGEMENT IN BROILER CHICKENS

(A CASE STUDY OF AGRICULTURAL GARDEN IN KWARA STATE POLYTECHNIC, ILORIN)

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CERTIFICATION

This is to certify that this project was carried out by ADEOYE TAIWO RASHEED, OGUNTAYO HABEEB OLADIMEJI, TAIWO TEMITOPE DANIEL AND ADEBAYO ABDULRASHEED OLAMILEKAN, Has been read and approved as meeting the requirements in partial fulfilment of the award of Higher National Diploma (HND) in statistics, institute of applied science, Kwara state polytechnic, Ilorin.

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DEDICATION

This project is dedicated to Almighty God for granting us the ability, wisdom, knowledge and understanding toward the successful completion of our Higher National Diploma (HND) and project, we also dedicate this project to our lovely parents MR. and MRS. ADEOYE, OGUNTOYE, TAIWO AND ADEBAYO, For their prayers, advices, financial support and encouragements.

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ABSTRACT

This study investigated the temporal effects and block variations associated with a treatment of coccidiosis using phyllantus Amarus administered at two volume levels, 5ml (Trt_5ml) and 10ml (Trt_10ml), over a 13-day experimental period within a two-block design. The research aimed to assess and compare the effects of these treatment levels, accounting for the influence of days and experimental blocks. Data were collected daily, with five replicates per treatment level within each block. Descriptive statistics were used to summarize the data. Analysis of Variance (ANOVA) was employed to determine the statistical significance of the effects of Days, Block, and their interaction on the measured sample values for each treatment level. Estimated Marginal Means were calculated to provide adjusted average responses. The results indicated that experimental blocks did not significantly influence the outcome for either treatment. For the 5ml treatment, the effects of Days, Block, and their interaction were not statistically significant, although a marginally non-significant trend was observed for the effect of Days (p=0.053). In contrast, the 10ml treatment showed a statistically significant effect of Days (p=0.029), indicating that the treatment's effect changed significantly over the 13-day period. Block and the Days * Block interaction were not significant for the 10ml treatment. Estimated marginal means provided overall adjusted averages, with Trt_10ml showing a slightly higher mean than Trt_5ml. The study concludes that while experimental blocks were consistent, the duration of the experiment significantly impacted the outcome for the 10ml dose, a finding not statistically confirmed for the 5ml dose within this analysis. These findings are significant for optimizing dosing strategies, determining appropriate assessment time points, and informing future experimental designs for this specific treatment.

Keywords: Birds, Coccidiosis, Phyllanthus Amarus, ANOVA, Estimated Marginal Means.

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CHAPTER ONE

1.1 INTRODUCTION

Understanding the effects of interventions or treatments is a cornerstone of scientific research across various disciplines, including medicine, biology, agriculture, and environmental science. The efficacy and impact of a treatment are often dependent on multiple factors, including the administered dose, the duration of exposure, and potential variations in experimental conditions or inherent differences among the subjects or materials being treated. This study focuses on evaluating the effects of two specific treatment levels over a defined period, taking into account the influence of experimental blocking, to gain a comprehensive understanding of their performance.

Coccidiosis is one of the most economically significant diseases in poultry production, affecting broiler chickens worldwide. It is caused by protozoan parasites of the Eimeria species, which invade the intestinal lining, leading to diarrhea, reduced feed efficiency, poor weight gain, and increased mortality rates. Conventional control measures involve the use of anticoccidial drugs and vaccines; however, challenges such as drug resistance, residue accumulation in meat products, and high costs have led to a growing interest in alternative treatments.

Phyllanthus amarus, a medicinal plant known for its antimicrobial and antiparasitic properties, has gained attention as a potential natural alternative for managing coccidiosis in broiler production. Studies have suggested that Phyllanthus amarus possesses bioactive compounds such as alkaloids, flavonoids, and tannins, which may enhance immunity, promote gut health, and reduce parasite load in infected birds. This study seeks to evaluate the efficacy of Phyllanthus amarus supplementation in mitigating the effects of coccidiosis in broiler chickens.

1.2 BACKGROUND OF THE STUDY

Experimental investigations into the effects of Eimara-oocyst frequently involve assessing responses across different dose levels and observing how these responses change over time. The concept of a dose-response relationship is fundamental, positing that the magnitude of an effect is related to the amount of Phyllanthus Amarus administered. Furthermore, the dynamic nature of biological and physical systems means that the timing of observation relative to Phyllanthus Amarus application can significantly influence the outcome, highlighting the importance of studying temporal effects.

In controlled experiments, it is also crucial to minimize the impact of extraneous variables that could obscure the true effects of the Eimara-oocyst. Experimental blocking is a widely used technique to manage variability arising from known or suspected sources of variation that are not the primary focus of the study. By grouping experimental units into homogeneous blocks, researchers can isolate the effects of the variables of interest from the variability between these blocks, thereby increasing the precision and reliability of the findings.

This study is situated within this context, specifically examining a Eimara-oocyst administered at two distinct volumes, 5ml and 10ml of Phyllanthus Amarus. The experiment was conducted over a period of 13 days, with observations recorded daily. To account for potential non-treatment related variations, the experiment was structured into two experimental blocks. While the specific nature of the treatment and the measured outcome variable are particular to this research, the principles of dose-response, temporal effects, and blocking are broadly applicable across scientific inquiry. Previous research (as reviewed in Chapter Two) has established the theoretical basis for investigating these factors, but there remains a need for specific empirical data on how this particular treatment, at these doses, behaves over this duration within a blocked design.

1.3 PROBLEM STATEMENT

Despite the general understanding of dose-response and temporal effects, the specific impact of administering the treatment at 5ml versus 10ml volumes of Phyllantus Amarus over a 13-day period, and how these effects might be influenced by or vary across different experimental blocks, is not fully characterized. Without a clear understanding of these dynamics, it is difficult to determine the most effective dose, the optimal timing for observing effects, or whether the experimental conditions (as represented by the blocks) introduce significant variability that needs to be considered when applying the treatment. Therefore, the problem this study addresses is the lack of specific empirical evidence detailing the temporal effects and block variations associated with the 5ml and 10ml treatment levels over a 13-day experimental period.

1.4 AIMS AND OBJECTIVES OF THE STUDY

This project aim to assess the effects of Phyllanthus Amarus over a 13-day period on the growth of poultry birds.

The main objective of this study is to assess and compare the effects of a 5ml and a 10ml treatment of Eimara-occyst over a 13-day period, while accounting for variations across two experimental blocks.

The specific objectives are:

a. To obtain the descriptive statistics.

b. To determine if there is a statistically significant effect of days on category of treatments of Phyllanthus Amarus on growth of the chicken.

c. To determine if there is a statistically significant difference on inclusion level of the treatment applied with respect to growth of the chicken.

d. To estimate the marginal means of the chicken growth based on the day and treatment inclusion level.

1.5 RESEARCH QUESTIONS

Based on the objectives, the study seeks to answer the following research questions:

a. What are the descriptive statistics (mean, standard deviation) of the daily sample values for the 5ml and 10ml treatments of coccidiosis across the two experimental blocks over the 13-day period?

b. Does the effect of the 5ml treatment on the observed sample values change significantly over the 13-day period?

c. Does the experimental Block significantly influence the Eimara-oocyst for the 5ml treatment of coccidiosis?

d. Is there a significant interaction effect between Days and Block on the observed sample values for the 5ml treatment of coccidiosis?

e. Does the effect of the 10ml treatment on the observed sample values change significantly over the 13-day period?

f. Does the experimental Block significantly influence the observed sample values for the 10ml treatment of coccidiosis?

g. Is there a significant interaction effect between Days and Block on the observed sample values for the 10ml treatment of coccidiosis?

h. What are the estimated marginal means of the observed sample values for the 5ml and 10ml treatments of coccidiosis, accounting for the effects of Days and Blocks?

1.6 SIGNIFICANCE OF THE STUDY

The findings of this study are expected to contribute significantly to the understanding of the specific treatment of coccidiosis under investigation. By characterizing the temporal dynamics and block variations associated with the 5ml and 10ml doses, the study will provide valuable empirical data. This information can inform decisions regarding:

- **Optimal Dosing:** Understanding the dose-response relationship over time can help determine if one dose is consistently more effective or if their relative effectiveness changes over the experimental period.
- **Timing of Assessment:** Identifying if and how the treatment effects change over 13 days can guide future research and practical applications regarding the most appropriate time points for evaluating treatment outcomes.
- **Experimental Design:** The assessment of block effects will confirm whether blocking was an effective strategy for controlling variability in this specific experimental context and provide insights for the design of future studies.
- **Resource Allocation:** Knowing the temporal effects can help optimize the duration of future experiments, potentially reducing costs and resources if effects stabilize or diminish after a certain period.

1.7 SCOPE OF THE STUDY

This study is delimited to assessing the effects of the specific treatment at two volume levels (5ml and 10ml) of Eimara-oocyst. The investigation is confined to a 13-day experimental period, with data collected daily. The study utilizes a blocked experimental design involving two distinct blocks. The analysis focuses on the measured sample values as the sole dependent variable. The study does not explore other potential dose levels, longer or shorter durations, different blocking strategies, or other potential confounding factors beyond the two specified blocks. The findings and conclusions are therefore specific to the conditions and variables examined within this defined scope.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 OVERVIEW OF COCCIDIOSIS IN POULTRY

Coccidiosis is a common and economically significant disease in poultry, primarily caused by protozoan parasites of the genus Eimeria. These parasites infect the intestinal lining of birds, leading to severe damage in the digestive tract. The clinical manifestations of coccidiosis include diarrhea, weight loss, reduced feed efficiency, and, in severe cases, high mortality rates. The disease is highly contagious and spreads rapidly in poultry farms through the ingestion of contaminated feed, water, or litter containing Eimeria oocysts.

The economic impact of coccidiosis on poultry production is significant, as infected birds exhibit stunted growth, increased feed conversion ratios, and heightened susceptibility to secondary infections. This necessitates effective control measures to minimize losses and maintain productivity.

2.2 CONVENTIONAL CONTROL METHODS FOR COCCIDIOSIS

Traditionally, poultry farmers have relied on synthetic anticoccidial drugs and vaccines to manage coccidiosis. Common anticoccidial drugs, such as amprolium, sulfaquinoxaline, and toltrazuril, work by disrupting the life cycle of Eimeria. However, prolonged and indiscriminate use of these drugs has led to drug-resistant strains of Eimeria, reducing their effectiveness.Vaccination is another strategy used for controlling coccidiosis. Live or attenuated Eimeria vaccines stimulate immunity in birds, helping them develop resistance to future infections. Despite its effectiveness, vaccination is costly and may not be a viable option for small-scale poultry farmers. Furthermore, maintaining strict biosecurity measures, including proper sanitation and litter management, is crucial in preventing coccidiosis outbreaks.

2.3 MEDICINAL PLANTS IN POULTRY DISEASE MANAGEMENT

The use of medicinal plants in animal health management is gaining attention due to concerns about drug resistance and chemical residues in poultry products. Phytogenic feed additives derived from plants such as Azadirachta indica (Neem), Allium sativum (Garlic), Vernonia amygdalina (Bitter Leaf), and Phyllanthus amarus have been reported to possess antimicrobial, antiparasitic, and immunomodulatory properties.

Medicinal plants are rich in bioactive compounds, including alkaloids, flavonoids, saponins, and tannins, which contribute to their therapeutic effects. These compounds have been found to enhance immune response, improve gut health, and reduce the pathogenicity of various infectious agents, including Eimeria spp.

2.4 PHYLLANTHUS AMARUS: PROPERTIES AND USES

Phyllanthus amarus is a widely distributed medicinal plant known for its diverse pharmacological properties. It has been traditionally used in herbal medicine for its antiviral, antimicrobial, and hepatoprotective effects. The plant contains bioactive compounds such as lignans, flavonoids, tannins, and alkaloids, which contribute to its medicinal benefits.

Studies have shown that Phyllanthus amarus possesses significant antiparasitic activity, making it a promising candidate for managing coccidiosis in poultry. The plant is believed to enhance gut health by reducing the colonization of harmful pathogens and promoting beneficial gut microbiota. Its immunomodulatory effects further aid in improving the resistance of broiler chickens to infections.

2.5 EFFECTS OF PHYLLANTHUS AMARUS ON POULTRY HEALTH

Several experimental studies have demonstrated the beneficial effects of Phyllanthus amarus supplementation in poultry. Some of the observed effects include:

- *Improved Growth Performance:* Birds supplemented with Phyllanthus amarus show increased weight gain and improved feed conversion efficiency.
- *Reduced Fecal Oocyst Count:* The plant exhibits strong anticoccidial activity, leading to a significant reduction in fecal oocyst shedding.
- *Enhanced Immunity:* The immunostimulatory properties of Phyllanthus amarus help boost the immune response of birds, making them more resistant to infections.
- *Gut Health Promotion:* Phyllanthus amarus has been reported to improve gut morphology, increase villi height, and reduce intestinal lesions caused by Eimeria infection.

2.6 PREVIOUS STUDIES ON HERBAL ANTICOCCIDIALS

Various studies have evaluated the effectiveness of medicinal plants in controlling coccidiosis in poultry. Research findings indicate that plant-based anticoccidial agents, including Phyllanthus amarus, have comparable efficacy to synthetic drugs. For instance, a study by Adegbemi et al. (2020) reported that broiler chickens fed Phyllanthus amarus extract exhibited a significant reduction in oocyst count and improved overall performance. Similarly, Oyewole et al. (2021) found that incorporating herbal extracts in broiler diets led to enhanced immunity and reduced mortality rates.Despite these promising results, further research is needed to optimize dosage levels, standardize extraction methods, and evaluate the long-term effects of Phyllanthus amarus supplementation.

2.7 THEORETICAL FRAMEWORK

This study is anchored on the principles of phytotherapy and immune modulation in poultry disease management. Phytotherapy emphasizes the use of plant-derived compounds in disease prevention and treatment, while immune modulation focuses on enhancing the body's natural defense mechanisms against infections. By integrating these principles, the study seeks to evaluate how Phyllanthus amarus supplementation influences the health and performance of broiler chickens infected with coccidiosis.

2.8 SUMMARY OF LITERATURE REVIEW

The literature review highlights the growing interest in alternative coccidiosis control strategies due to the limitations of conventional drugs. Phyllanthus amarus has emerged as a promising herbal remedy with demonstrated anticoccidial and immunomodulatory effects. Previous studies support its potential benefits in poultry health, but further investigations are required to establish optimal application methods for large-scale adoption in the poultry industry.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter outlines the research methodology employed to investigate the effects of two treatment levels (5ml and 10ml) of Emiara-oocyst over a 13-day period, while accounting for variations across two experimental blocks. A robust methodology is crucial for ensuring the validity and reliability of the study's findings. This chapter details the research design, study participants or materials, data collection procedures, and the statistical methods used for data analysis.

3.2 RESEARCH DESIGN

The study utilized a controlled experimental design to assess the impact of the independent variables (Days and Block) on the dependent variable (body weight) under two distinct treatment conditions (5ml and 10ml) of Phyllanthus Amarus. Given the structure of the analysis presented in Chapter Four, the design essentially involved examining the effects of Days (13 levels) and Block (2 levels) within each treatment level (5ml and 10ml of Phyllanthus Amarus) through separate analyses or as factors in a broader model. This approach allowed for the assessment of temporal effects and block variations for each treatment independently. The use of blocks aimed to control for potential sources of extraneous variability not directly related to the treatments or days.

3.3 STUDY PARTICIPANTS OR MATERIALS

The study was conducted at a poultry farm in Kwara state polytechnic, ilorin, (Agricultural Garden) using poultry birds subjected to the specified treatments levels of Phyllanthus Amarus.The data structure indicates that multiple replicates were observed under each unique combination of Day, Block, and Treatment level. A total number of 20 poultry birds were observed and data on weight gained collected for each treatment level over the entire study period, with 5 replicates per day within each block. The selection or preparation of these units is assumed to have followed standard procedures relevant to the specific domain of this experiment to ensure comparability.

3.4 POPULATION OF THE STUDY

The population of this study consisted of broiler chicks raised in the selected farm. Specifically, the population included day-old broiler chicks raised under controlled conditions from day one to market weight (usually 6 to 8 weeks).

3.5 EXPERIMENTAL PROCEDURE

Both groups were housed in similar conditions with equal access to feed, space, and ventilation. A commercial broiler feed was used, and both groups were fed ad libitum. The only variable was the source of drinking water:

- Block 1 drank 5ml of Phyllanthus Amarus throughout the experiment.
- Block 2 drank 10ml of Phyllantus Amarus throughout the experiment.

The birds were monitored for six weeks, during which the following parameters were recorded weekly:

- Body weight gain
- Feed consumption
- Feed Conversion Ratio (FCR)
- Mortality rate
- Signs of disease or abnormal behavior.

3.5.1 VARIABLES

The study involved the following variables:

a. **Independent Variables:**

- **Days:** A categorical or time-series variable representing the day of observation, with 13 distinct levels (Day 1 through Day 13).
- **Block:** A categorical variable representing the experimental block, with two levels (Block 1 and Block 2).
- **Treatment Level:** A categorical variable representing the treatment applied, with two levels (5ml and 10ml). Although analyzed somewhat separately in Chapter 4's ANOVA tables, this factor defines the two main groups under investigation.

b. **Dependent Variable:**

The measured outcome variable, referred to as "Sample Values" or the "treatment effect" (Trt_5ml or Trt_10ml depending on the analysis). This is the variable hypothesized to be influenced by the independent variables.

3.6 DATA COLLECTION METHODS

Data on the dependent variable was collected daily for a continuous period of 13 days. The experimental units were assigned to one of the two blocks, and within each block, they received either the 5ml or 10ml treatment. Five replicate measurements of the dependent variable were taken for each treatment level within each block on each day. Quantitative data were collected weekly by weighing the birds and measuring feed and water consumption. Mortality was recorded daily. Observational notes were also taken to assess the birds’ behavior and general health.

Tools used for data collection included:

- Weighing scale
- Measuring cups and containers
- Record sheets

3.7 DATA ANALYSIS METHODS

The collected data were analyzed using a combination of descriptive and inferential statistical techniques with the aid of appropriate statistical software. The chosen methods align with the research objectives and the experimental design:

a. **Descriptive Statistics:** Mean, standard deviation, and sample size were computed for the dependent variable for each combination of Day, Block, and Treatment level, as well as for relevant totals. This provided a summary of the data distribution, central tendency, and variability within different subgroups and overall.

- **Mean(Average):** $\hat{X} = \frac{\sum x}{n}$
- **Standard Deviation (SD):** $\sqrt{\frac{\sum (X-\hat{X})^2}{n-1}}$

b. **Analysis of Variance (ANOVA):** Two separate Between-Subjects ANOVAs were conducted – one for Trt_5ml and one for Trt_10ml. Each ANOVA model included Days, Block, and the Days * Block interaction as factors to assess their influence on the respective treatment's observed values. ANOVA was chosen to determine if the observed differences in means across the levels of the independent variables were statistically significant, beyond what would be expected by random chance. The significance level for all statistical tests was set at $\alpha=0.05$.

STATISTICAL MODEL OF TWO-WAY ANOVA OF INTERACTIONS

A Two-way ANOVA with interaction is used to examine the effect of two independent categorical variables (factors) on a continuous dependent variables, including whether there is an interaction effect between the two factors.

Model specification

Let:

- Y_{ijk}: response (dependent) variable
- μ: overall mean
- α_i: effect of level i of factor A.
- β_j: effect of level j of factor B.
- $(\alpha\beta)_{ij}$: interaction effect between level of i of A and level j of B
- $\in_{ijk}$: random error term (assumed normally distributed with mean 0 and constant variance)

$$\boldsymbol{Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij}} + \in_{ijk}$$

Where:

- i = 1,2,……., a (levels of factor A)
- j = 1,2,……., a (levels of factor B)
- k = 1,2,……., a (replicate per cell)

TEST HYPOTHESIS

1. **Main effect of A**

$$H_0:\ \alpha_1 = \alpha_2 = \ldots\ldots = \alpha_0 = 0$$

2. **Main effect of B**

$$H_0: \beta_1 = \beta_2 = \ldots\ldots.. = \beta_j = 0$$

3. Interaction effect (A* B)

$$H_0: (\alpha\beta)_{ij} = 0 \text{ for all i, j}$$

Level of significance: α (0.05)

ANOVA Table

	Degrees of Freedom (df)	Sum of Squares (SS)	Mean of Squares (MS)	F-ratio
Factor A	df_A= a-1	SS_A	$MS_A = \frac{SS_A}{df_A}$	$F_A = \frac{MS_A}{MS_{error}}$
Factor B	df_B= b-1	SS_B	$MS_B = \frac{SS_B}{df_B}$	$F_B = \frac{MS_B}{MS_{error}}$
Interaction (AB)	df_{AB}= (a-1)(b-1)	SS_{AB}	$MS_{AB} = \frac{SS_{AB}}{df_{AB}}$	$F_{AB} = \frac{SS_{AB}}{MS_{error}}$
Error	df_{error}= ab(n-1)	SS_{error}	$MS_{error} = \frac{SS_{error}}{df_{error}}$	
Total	df_{total}= abn-1	SS_{total}		

FORMULA

Sum of Squares (SS):

SS_A = is the sum of squares due to Factor A.

SS_B = is the sum of squares due to Factor B.

SS_{AB} = is the sum of squares due to the interaction between Factor A and Factor B.

SS_{error} = is the sum of squares due to residual error.

SS_{total}= is the total sum of squares.

Mean Squares (MS):

MS_A = is the mean of squares due to Factor A.

MS_B = is the mean of squares due to Factor B.

MS_{AB} = is the mean of squares due to Factor AB.

ANOVA (F-test): $F = \frac{MS_{between}}{MS_{within}} \sim F(df_B, df_W)$

- $MS_{between}$ =Mean square between Groups (Variation due to treatment or factor)
- MS_{within}= Mean square within Groups (Variation due to error or residual)

Decision rule: reject the H_0 if the p-value < α (0.05) or accept the H_0 if otherwise.

c. **Estimated Marginal Means (EMMs):** Estimated Marginal Means were computed for the dependent variable for each treatment level. EMMs represent the adjusted average response for each treatment, taking into account the effects of other factors in the model (Days and Blocks). This provided a more refined estimate of the average treatment effect across the experiment.

The statistical analysis aimed to identify whether Days and/or Blocks had a significant impact on the 5ml and 10ml treatment outcomes and to understand the average effect of each treatment while controlling for the experimental design fact.

d. **POST HOC Test (LSD)**

In a scientific study, post hoc consists of statistical analyses that were not specified before the data was seen. Post Hoc typically create a multiple testing problem because each potential analysis is effectively a statistical test. Multiple comparisons are generally about determining which of the treatments is an experiment can be said to be responsible for significant differences in its data.

LSD Post Hoc Table and Formula:

Post hoc Table:

Comparison (Group I vs J)	Mean of Group I $(\hat{X}_i)$	Mean of Group j $(\widehat{X_j})$	Mean Difference $(\widehat{X_i} - \widehat{X_j})$	LSD value	significant
A vs B	$\widehat{X_A}$	$\widehat{X_B}$	**D=** $\widehat{X_A} - \widehat{X_B}$	**LSD**	**Yes/ No**
A vs C	$\widehat{X_A}$	$\widehat{X_C}$	**D=** $\widehat{X_A} - \widehat{X_C}$	**LSD**	**Yes/ No**
B vs C	$\widehat{X_B}$	$\widehat{X_C}$	**D=** $\widehat{X_B} - \widehat{X_C}$	**LSD**	**Yes/ No**

The formula for calculating the LSD between two group means is:

$$LSD = t_{\propto/2, df_{error}} \cdot \sqrt{2.\frac{MSE}{n}}$$

- $t_{\propto/2, df_{error}}$: t-value from the t-distribution with degrees of freedom for error (usually from the ANOVA output), at a chosen significance level (e.g., 0.05).
- MSE: Mean Square Error (from ANOVA).
- n:Number of observations per group (assumed equal).
- $\sqrt{2.\frac{MSE}{n}}$: Standard error of the difference between means.

Onces the LSD is computed, two group means are significantly different if:

$$\left|\widehat{X_i} - \widehat{X_j}\right| > \textbf{LSD}$$

CHAPTER FOUR

4.0 DATA ANALYSIS AND INTERPRETATION

4.1 INTRODUCTION

This project aims to assess the effects of a 5ml and 10ml treatment (Trt_5ml and Trt_10ml) of Phyllanthus Amarus over a 13-day period while accounting for variations across two experimental blocks. Using descriptive and inferential statistical techniques, we explore the central tendencies, variability, and significance of observed differences across time and treatment conditions. Key analyses include Descriptive Statistics, Estimated Marginal Means, and Tests of Between-Subjects Effects (ANOVA).

4.2 DATA PRESENTATION

Table 4.2: Daily 5 ml and 10 ml Sample Values

Days	**Blocks**	**Treatment 5ml**	**Treatment 10ml**
1	1	600	500
1	1	500	300
1	1	500	450
1	1	450	500
1	1	300	450
1	2	300	450
1	2	300	300
1	2	500	500
1	2	500	450
1	2	300	450
2	1	350	400
2	1	400	350
2	1	500	450
2	1	500	250
2	1	600	500
2	2	400	300
2	2	550	400
2	2	300	550

2	2	550	350
2	2	350	400
3	1	650	350
3	1	500	500
3	1	450	350
3	1	350	500
3	1	550	500
3	2	400	400
3	2	300	450
3	2	350	350
3	2	350	550
3	2	350	500
4	1	600	450
4	1	500	500
4	1	450	350
4	1	350	500
4	1	350	400
4	2	400	450
4	2	350	400
4	2	350	450
4	2	300	500
4	2	400	500
5	1	350	350
5	1	500	250
5	1	450	650
5	1	500	450
5	1	550	450
5	2	550	550
5	2	450	450
5	2	550	500
5	2	550	500
5	2	550	250
6	1	600	450
6	1	600	500
6	1	350	550
6	1	400	600
6	1	500	600
6	2	450	450
6	2	500	500

6	2	550	550
6	2	600	450
6	2	600	500
7	1	200	400
7	1	400	550
7	1	350	600
7	1	300	500
7	1	0	0
7	2	300	300
7	2	300	450
7	2	450	300
7	2	250	300
7	2	400	250
8	1	400	350
8	1	250	350
8	1	250	300
8	1	300	450
8	1	0	0
8	2	250	350
8	2	450	350
8	2	300	250
8	2	300	400
8	2	0	350
9	1	400	400
9	1	500	550
9	1	450	550
9	1	550	600
9	1	0	0
9	2	500	400
9	2	550	600
9	2	400	350
9	2	450	450
9	2	0	500
10	1	650	650
10	1	400	500
10	1	500	550
10	1	550	600
10	1	0	0
10	2	450	450

10	2	500	500
10	2	600	550
10	2	550	600
10	2	0	650
11	1	550	650
11	1	600	400
11	1	400	550
11	1	500	500
11	1	0	0
11	2	550	450
11	2	400	400
11	2	600	650
11	2	500	400
11	2	0	500
12	1	650	650
12	1	600	600
12	1	550	550
12	1	450	500
12	1	0	0
12	2	500	500
12	2	600	550
12	2	400	450
12	2	550	600
12	2	0	500
13	1	700	600
13	1	650	700
13	1	600	550
13	1	600	600
13	1	0	0
13	2	650	700
13	2	600	600
13	2	500	650
13	2	550	650
13	2	0	650

Source: Agricultural Garden in Kwara state polytechnic.

4.3 DESCRIPTIVE STATISTICS

4.3.1 Descriptive Statistics of Treatment (5ml) Across Days and Blocks

Descriptive statistics provide a snapshot of how the treatment (Trt_5ml) performed across different days and blocks. Each group combination (e.g., Day 1 Block 1) includes the mean treatment effect, standard deviation, and number of observations.

Table 4.3.1 summarizes the descriptive statistics for treatment 5ml.

Descriptive Statistics

Dependent Variable: Trt_5ml

Days	Block	Mean	Std. Deviation	N
1	1	470.00	109.545	5
	2	380.00	109.545	5
	Total	425.00	113.652	10
2	1	470.00	97.468	5
	2	430.00	115.109	5
	Total	450.00	102.740	10
3	1	500.00	111.803	5
	2	350.00	35.355	5
	Total	425.00	111.181	10
4	1	450.00	106.066	5
	2	360.00	41.833	5
	Total	405.00	89.598	10
5	1	470.00	75.829	5
	2	530.00	44.721	5
	Total	500.00	66.667	10
6	1	490.00	114.018	5
	2	540.00	65.192	5
	Total	515.00	91.439	10
7	1	250.00	158.114	5
	2	340.00	82.158	5
	Total	295.00	127.911	10
8	1	240.00	147.479	5
	2	260.00	163.554	5
	Total	250.00	147.196	10
9	1	380.00	219.659	5

	2	380.00	219.659	5
	Total	380.00	207.096	10
	1	420.00	251.496	5
10	2	420.00	241.350	5
	Total	420.00	232.379	10
	1	410.00	240.832	5
11	2	410.00	240.832	5
	Total	410.00	227.058	10
	1	450.00	262.202	5
12	2	410.00	240.832	5
	Total	430.00	238.281	10
	1	510.00	288.097	5
13	2	460.00	263.154	5
	Total	485.00	261.460	10
	1	423.85	184.795	65
Total	2	405.38	167.034	65
	Total	414.62	175.699	130

4.3.2 DESCRIPTIVE STATISTICS OF TREATMENT (10ML) ACROSS DAYS AND BLOCKS

Descriptive statistics provide a snapshot of how the treatment (Trt_10ml) performed across different days and blocks. Each group combination (e.g., Day 1 Block 1) includes the mean treatment effect, standard deviation, and number of observations.

Descriptive Statistics

Dependent Variable: Trt_10ml

Days	Block	Mean	Std. Deviation	N
	1	440.00	82.158	5
1	2	430.00	75.829	5
	Total	435.00	74.722	10
	1	390.00	96.177	5
2	2	400.00	93.541	5
	Total	395.00	89.598	10
3	1	440.00	82.158	5

	2	450.00	79.057	5
	Total	445.00	76.194	10
	1	440.00	65.192	5
4	2	460.00	41.833	5
	Total	450.00	52.705	10
	1	430.00	148.324	5
5	2	450.00	117.260	5
	Total	440.00	126.491	10
	1	540.00	65.192	5
6	2	490.00	41.833	5
	Total	515.00	57.975	10
	1	410.00	240.832	5
7	2	320.00	75.829	5
	Total	365.00	174.881	10
	1	290.00	171.026	5
8	2	340.00	54.772	5
	Total	315.00	122.588	10
	1	420.00	246.475	5
9	2	460.00	96.177	5
	Total	440.00	177.639	10
	1	460.00	263.154	5
10	2	550.00	79.057	5
	Total	505.00	189.224	10
	1	420.00	251.496	5
11	2	480.00	103.682	5
	Total	450.00	184.089	10
	1	460.00	263.154	5
12	2	520.00	57.009	5
	Total	490.00	182.270	10
	1	490.00	279.285	5
13	2	650.00	35.355	5
	Total	570.00	205.751	10
	1	433.08	182.062	65
Total	2	461.54	108.170	65
	Total	447.31	149.846	130

4.4 TESTS OF BETWEEN-SUBJECTS EFFECTS (ANOVA TABLE)

The table presents the output of an ANOVA (Analysis of Variance) examining the effects of various factors (Days, Block, and their interaction) on the dependent variable Trt_5ml and Trt_10ml.

4.4.1 ANOVA RESULT FOR TREATMENT 5ML

ANOVA was used to test for the subject effect of a dependent variable. The results are summarized in Table 4.4.1.

Test Hypothesis

$\boldsymbol{H_0}$: there is no significance between the days and blocks of treatment 5ml.

$\boldsymbol{H_1}$: there is a significance between the days and blocks of treatment 5ml.

Level of significance: α (0.05)

Decision rule: reject the H_0 if the p-value < α (0.05) or accept the H_0 if otherwise.

Table 4.4.1 ANOVA Results

Tests of Between-Subjects Effects

Dependent Variable: Trt_5ml

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	815230.769a	25	32609.231	1.071	.389
Intercept	22347769.231	1	22347769.231	733.871	.000
Days	667730.769	12	55644.231	1.827	.053

Block	11076.923	1	11076.923	.364	.548
Days * Block	136423.077	12	11368.590	.373	.970
Error	3167000.000	104	30451.923		
Total	26330000.000	130			
Corrected Total	3982230.769	129			

a. R Squared = .205 (Adjusted R Squared = .014)

Observations:

- **Corrected Model:** The overall model has an F-value of 1.071 with a significance (p-value) of 0.389, indicating that the model is not statistically significant at the 0.05 level. This suggests that the predictors included in the model do not explain a significant amount of variation in the dependent variable.
- **Days:** Has an F-value of 1.827 and a p-value of 0.053, which is marginally non-significant (just above the 0.05 threshold). This implies a possible influence of days on the treatment response, which might reach significance with a larger sample size.
- **Block and Days*Block interaction:** Both have high p-values (0.548 and 0.970, respectively), indicating that they are not significant contributors to the variation in Trt_5ml.
- **R Squared** is 0.205, meaning that only 20.5% of the variance in the treatment effect is explained by the model. The Adjusted R Squared is much lower (0.014), further suggesting limited explanatory power when adjusting for the number of predictors.

Conclusion:

The analysis reveals that the experimental model, including factors such as Days, Block, and their interaction, does not significantly predict the dependent variable Trt_5ml. While the effect of Days shows a near-significant trend, it is not conclusive.

4.4.2 ANOVA RESULT FOR TREATMENT 10ML

ANOVA was used to test for the subject effect of a dependent variable. The results are summarized in Table 4.4.2.

Test Hypothesis

$\boldsymbol{H_0}$: there is no significance between the days and blocks of treatment 10ml.

$\boldsymbol{H_1}$: there is a significance between the days and blocks of treatment 10ml.

Level of significance: α (0.05)

Decision rule: reject the H_0 if the p-value < α (0.05) or accept the H_0 if otherwise.

Table 4.4.2: ANOVA Results

Tests of Between-Subjects Effects

Dependent Variable: Trt_10ml

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	662557.692a	25	26502.308	1.234	.229
Intercept	26010942.308	1	26010942.308	1210.894	.000
Days	520807.692	12	43400.641	2.020	.029
Block	26326.923	1	26326.923	1.226	.271
Days * Block	115423.077	12	9618.590	.448	.940
Error	2234000.000	104	21480.769		

Total	28907500.000	130				
Corrected Total	2896557.692	129				

a. R Squared = .229 (Adjusted R Squared = .043)

Observations:

- **Corrected Model:** The overall model has an F-value of 1.234 with a significance (p-value) of 0.229, indicating that the model is not statistically significant at the 0.05 level. This suggests that the predictors included in the model do not explain a significant amount of variation in the dependent variable.
- **Days:** Has an F-value of 2.020 and a p-value of 0.029, which is marginally non-significant (just above the 0.05 threshold). This implies a possible influence of days on the treatment response, which might reach significance with a larger sample size.
- **Block and Days*Block interaction:** Both have high p-values (0.448 and 0.940, respectively), indicating that they are not significant contributors to the variation in Trt_10ml.
- **R Squared** is 0.229, meaning that only 22.9% of the variance in the treatment effect is explained by the model. The Adjusted R Squared is much lower (0.043), further suggesting limited explanatory power when adjusting for the number of predictors.

Conclusion:

The analysis reveals that the experimental model, including factors such as Days, Block, and their interaction, does not significantly predict the dependent variable Trt_10ml. While the effect of Days shows a near-significant trend, it is not conclusive.

4.5 POST HOC TEST

In a scientific study, post hoc consists of statistical analyses that were not specified before the data was seen. Post Hoc typically create a multiple testing problem because each potential analysis is effectively a statistical test. Multiple comparisons are generally about determining which of the treatments is an experiment can be said to be responsible for significant differences in its data.

4.5.1 MULTIPLE COMPARISON (POST-HOC TEST)

To identify where the significant differences lie between days, a post-hoc LSD (Least Significant Difference) test was conducted.

LSD FOR 5ML

The table shows multiple comparisons using LSD (Least Significant Difference) to examine how the means of the variable T4_5ml differ across various Days (treatments). This is typically done after a one-way ANOVA shows a significant difference, to identify which specific groups (days) differ.

Multiple Comparisons
Dependent Variable: Trt_5ml
LSD

(I) Days	(J) Days	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-25.00	78.041	.749	-179.76	129.76
	3	.00	78.041	1.000	-154.76	154.76
	4	20.00	78.041	.798	-134.76	174.76
	5	-75.00	78.041	.339	-229.76	79.76
	6	-90.00	78.041	.251	-244.76	64.76
	7	130.00	78.041	.099	-24.76	284.76
	8	175.00*	78.041	.027	20.24	329.76
	9	45.00	78.041	.565	-109.76	199.76
	10	5.00	78.041	.949	-149.76	159.76
	11	15.00	78.041	.848	-139.76	169.76
	12	-5.00	78.041	.949	-159.76	149.76
	13	-60.00	78.041	.444	-214.76	94.76
2	1	25.00	78.041	.749	-129.76	179.76

	3	25.00	78.041	.749	-129.76	179.76
	4	45.00	78.041	.565	-109.76	199.76
	5	-50.00	78.041	.523	-204.76	104.76
	6	-65.00	78.041	.407	-219.76	89.76
	7	155.00*	78.041	.050	.24	309.76
	8	200.00*	78.041	.012	45.24	354.76
	9	70.00	78.041	.372	-84.76	224.76
	10	30.00	78.041	.701	-124.76	184.76
	11	40.00	78.041	.609	-114.76	194.76
	12	20.00	78.041	.798	-134.76	174.76
	13	-35.00	78.041	.655	-189.76	119.76
	1	.00	78.041	1.000	-154.76	154.76
	2	-25.00	78.041	.749	-179.76	129.76
	4	20.00	78.041	.798	-134.76	174.76
	5	-75.00	78.041	.339	-229.76	79.76
	6	-90.00	78.041	.251	-244.76	64.76
	7	130.00	78.041	.099	-24.76	284.76
3	8	175.00*	78.041	.027	20.24	329.76
	9	45.00	78.041	.565	-109.76	199.76
	10	5.00	78.041	.949	-149.76	159.76
	11	15.00	78.041	.848	-139.76	169.76
	12	-5.00	78.041	.949	-159.76	149.76
	13	-60.00	78.041	.444	-214.76	94.76
	1	-20.00	78.041	.798	-174.76	134.76
	2	-45.00	78.041	.565	-199.76	109.76
	3	-20.00	78.041	.798	-174.76	134.76
	5	-95.00	78.041	.226	-249.76	59.76
	6	-110.00	78.041	.162	-264.76	44.76
	7	110.00	78.041	.162	-44.76	264.76
4	8	155.00*	78.041	.050	.24	309.76
	9	25.00	78.041	.749	-129.76	179.76
	10	-15.00	78.041	.848	-169.76	139.76
	11	-5.00	78.041	.949	-159.76	149.76
	12	-25.00	78.041	.749	-179.76	129.76
	13	-80.00	78.041	.308	-234.76	74.76
	1	75.00	78.041	.339	-79.76	229.76
	2	50.00	78.041	.523	-104.76	204.76
5	3	75.00	78.041	.339	-79.76	229.76
	4	95.00	78.041	.226	-59.76	249.76
	6	-15.00	78.041	.848	-169.76	139.76

	7	205.00*	78.041	.010	50.24	359.76
	8	250.00*	78.041	.002	95.24	404.76
	9	120.00	78.041	.127	-34.76	274.76
	10	80.00	78.041	.308	-74.76	234.76
	11	90.00	78.041	.251	-64.76	244.76
	12	70.00	78.041	.372	-84.76	224.76
	13	15.00	78.041	.848	-139.76	169.76
6	1	90.00	78.041	.251	-64.76	244.76
	2	65.00	78.041	.407	-89.76	219.76
	3	90.00	78.041	.251	-64.76	244.76
	4	110.00	78.041	.162	-44.76	264.76
	5	15.00	78.041	.848	-139.76	169.76
	7	220.00*	78.041	.006	65.24	374.76
	8	265.00*	78.041	.001	110.24	419.76
	9	135.00	78.041	.087	-19.76	289.76
	10	95.00	78.041	.226	-59.76	249.76
	11	105.00	78.041	.181	-49.76	259.76
	12	85.00	78.041	.279	-69.76	239.76
	13	30.00	78.041	.701	-124.76	184.76
7	1	-130.00	78.041	.099	-284.76	24.76
	2	-155.00*	78.041	.050	-309.76	-.24
	3	-130.00	78.041	.099	-284.76	24.76
	4	-110.00	78.041	.162	-264.76	44.76
	5	-205.00*	78.041	.010	-359.76	-50.24
	6	-220.00*	78.041	.006	-374.76	-65.24
	8	45.00	78.041	.565	-109.76	199.76
	9	-85.00	78.041	.279	-239.76	69.76
	10	-125.00	78.041	.112	-279.76	29.76
	11	-115.00	78.041	.144	-269.76	39.76
	12	-135.00	78.041	.087	-289.76	19.76
	13	-190.00*	78.041	.017	-344.76	-35.24
8	1	-175.00*	78.041	.027	-329.76	-20.24
	2	-200.00*	78.041	.012	-354.76	-45.24
	3	-175.00*	78.041	.027	-329.76	-20.24
	4	-155.00*	78.041	.050	-309.76	-.24
	5	-250.00*	78.041	.002	-404.76	-95.24
	6	-265.00*	78.041	.001	-419.76	-110.24
	7	-45.00	78.041	.565	-199.76	109.76
	9	-130.00	78.041	.099	-284.76	24.76
	10	-170.00*	78.041	.032	-324.76	-15.24

	11	-160.00*	78.041	.043	-314.76	-5.24
	12	-180.00*	78.041	.023	-334.76	-25.24
	13	-235.00*	78.041	.003	-389.76	-80.24
9	1	-45.00	78.041	.565	-199.76	109.76
	2	-70.00	78.041	.372	-224.76	84.76
	3	-45.00	78.041	.565	-199.76	109.76
	4	-25.00	78.041	.749	-179.76	129.76
	5	-120.00	78.041	.127	-274.76	34.76
	6	-135.00	78.041	.087	-289.76	19.76
	7	85.00	78.041	.279	-69.76	239.76
	8	130.00	78.041	.099	-24.76	284.76
	10	-40.00	78.041	.609	-194.76	114.76
	11	-30.00	78.041	.701	-184.76	124.76
	12	-50.00	78.041	.523	-204.76	104.76
	13	-105.00	78.041	.181	-259.76	49.76
10	1	-5.00	78.041	.949	-159.76	149.76
	2	-30.00	78.041	.701	-184.76	124.76
	3	-5.00	78.041	.949	-159.76	149.76
	4	15.00	78.041	.848	-139.76	169.76
	5	-80.00	78.041	.308	-234.76	74.76
	6	-95.00	78.041	.226	-249.76	59.76
	7	125.00	78.041	.112	-29.76	279.76
	8	170.00*	78.041	.032	15.24	324.76
	9	40.00	78.041	.609	-114.76	194.76
	11	10.00	78.041	.898	-144.76	164.76
	12	-10.00	78.041	.898	-164.76	144.76
	13	-65.00	78.041	.407	-219.76	89.76
11	1	-15.00	78.041	.848	-169.76	139.76
	2	-40.00	78.041	.609	-194.76	114.76
	3	-15.00	78.041	.848	-169.76	139.76
	4	5.00	78.041	.949	-149.76	159.76
	5	-90.00	78.041	.251	-244.76	64.76
	6	-105.00	78.041	.181	-259.76	49.76
	7	115.00	78.041	.144	-39.76	269.76
	8	160.00*	78.041	.043	5.24	314.76
	9	30.00	78.041	.701	-124.76	184.76
	10	-10.00	78.041	.898	-164.76	144.76
	12	-20.00	78.041	.798	-174.76	134.76
	13	-75.00	78.041	.339	-229.76	79.76
12	1	5.00	78.041	.949	-149.76	159.76

	2	-20.00	78.041	.798	-174.76	134.76
	3	5.00	78.041	.949	-149.76	159.76
	4	25.00	78.041	.749	-129.76	179.76
	5	-70.00	78.041	.372	-224.76	84.76
	6	-85.00	78.041	.279	-239.76	69.76
	7	135.00	78.041	.087	-19.76	289.76
	8	180.00*	78.041	.023	25.24	334.76
	9	50.00	78.041	.523	-104.76	204.76
	10	10.00	78.041	.898	-144.76	164.76
	11	20.00	78.041	.798	-134.76	174.76
	13	-55.00	78.041	.483	-209.76	99.76
13	1	60.00	78.041	.444	-94.76	214.76
	2	35.00	78.041	.655	-119.76	189.76
	3	60.00	78.041	.444	-94.76	214.76
	4	80.00	78.041	.308	-74.76	234.76
	5	-15.00	78.041	.848	-169.76	139.76
	6	-30.00	78.041	.701	-184.76	124.76
	7	190.00*	78.041	.017	35.24	344.76
	8	235.00*	78.041	.003	80.24	389.76
	9	105.00	78.041	.181	-49.76	259.76
	10	65.00	78.041	.407	-89.76	219.76
	11	75.00	78.041	.339	-79.76	229.76
	12	55.00	78.041	.483	-99.76	209.76

Based on observed means.

The error term is Mean Square(Error) = 30451.923.

*. The mean difference is significant at the .05 level.

Interpretation of the Table:

Significance Column (Sig.):

- Shows the p-value of the test.
- If Sig. < 0.05, the difference is statistically significant.

Significant Comparisons:

- Day 1 vs Day 8: Mean Diff = 175, Sig. = 0.027 → Significant.
- Day 2 vs Day 7: Mean Diff = 155, Sig. = 0.050 → Significant.

- Day 3 vs Day 8: Mean Diff = 175, Sig. = 0.027 → Significant.
- Day 4 vs Day 8: Mean Diff = 155, Sig. = 0.050 → Significant.
- Day 5 vs Day 7: Mean Diff = 205 , Sig. = 0.010 → Significant
- Day 6 vs Day 7: Mean Diff = 220, Sig. = 0.006 → Significant.
- Day 7 vs Day 13: Mean Diff = 190 , Sig. = 0.017 → Significant
- Day 8 vs Day 6: Mean Diff = 265 , Sig. = 0.001 → Significant

Conclusion:

The LSD post hoc test reveals statistically significant differences in Trt_5ml levels across days, especially between some days. There is a clear, statistically significant difference in performance across some various days.

LSD FOR 10ML

The table shows multiple comparisons using LSD (Least Significant Difference) to examine how the means of the variable T4_10ml differ across various Days (treatments). This is typically done after a one-way ANOVA shows a significant difference, to identify which specific groups (days) differ.

Multiple Comparisons
Dependent Variable: Trt_10ml
LSD

(I) Days	(J) Days	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	40.00	65.545	.543	-89.98	169.98
	3	-10.00	65.545	.879	-139.98	119.98
	4	-15.00	65.545	.819	-144.98	114.98
	5	-5.00	65.545	.939	-134.98	124.98
	6	-80.00	65.545	.225	-209.98	49.98
	7	70.00	65.545	.288	-59.98	199.98
	8	120.00	65.545	.070	-9.98	249.98

	9	-5.00	65.545	.939	-134.98	124.98
	10	-70.00	65.545	.288	-199.98	59.98
	11	-15.00	65.545	.819	-144.98	114.98
	12	-55.00	65.545	.403	-184.98	74.98
	13	-135.00*	65.545	.042	-264.98	-5.02
2	1	-40.00	65.545	.543	-169.98	89.98
	3	-50.00	65.545	.447	-179.98	79.98
	4	-55.00	65.545	.403	-184.98	74.98
	5	-45.00	65.545	.494	-174.98	84.98
	6	-120.00	65.545	.070	-249.98	9.98
	7	30.00	65.545	.648	-99.98	159.98
	8	80.00	65.545	.225	-49.98	209.98
	9	-45.00	65.545	.494	-174.98	84.98
	10	-110.00	65.545	.096	-239.98	19.98
	11	-55.00	65.545	.403	-184.98	74.98
	12	-95.00	65.545	.150	-224.98	34.98
	13	-175.00*	65.545	.009	-304.98	-45.02
3	1	10.00	65.545	.879	-119.98	139.98
	2	50.00	65.545	.447	-79.98	179.98
	4	-5.00	65.545	.939	-134.98	124.98
	5	5.00	65.545	.939	-124.98	134.98
	6	-70.00	65.545	.288	-199.98	59.98
	7	80.00	65.545	.225	-49.98	209.98
	8	130.00*	65.545	.050	.02	259.98
	9	5.00	65.545	.939	-124.98	134.98
	10	-60.00	65.545	.362	-189.98	69.98
	11	-5.00	65.545	.939	-134.98	124.98
	12	-45.00	65.545	.494	-174.98	84.98
	13	-125.00	65.545	.059	-254.98	4.98
4	1	15.00	65.545	.819	-114.98	144.98
	2	55.00	65.545	.403	-74.98	184.98
	3	5.00	65.545	.939	-124.98	134.98
	5	10.00	65.545	.879	-119.98	139.98
	6	-65.00	65.545	.324	-194.98	64.98
	7	85.00	65.545	.198	-44.98	214.98
	8	135.00*	65.545	.042	5.02	264.98
	9	10.00	65.545	.879	-119.98	139.98
	10	-55.00	65.545	.403	-184.98	74.98
	11	.00	65.545	1.000	-129.98	129.98

	12	-40.00	65.545	.543	-169.98	89.98
	13	-120.00	65.545	.070	-249.98	9.98
5	1	5.00	65.545	.939	-124.98	134.98
	2	45.00	65.545	.494	-84.98	174.98
	3	-5.00	65.545	.939	-134.98	124.98
	4	-10.00	65.545	.879	-139.98	119.98
	6	-75.00	65.545	.255	-204.98	54.98
	7	75.00	65.545	.255	-54.98	204.98
	8	125.00	65.545	.059	-4.98	254.98
	9	.00	65.545	1.000	-129.98	129.98
	10	-65.00	65.545	.324	-194.98	64.98
	11	-10.00	65.545	.879	-139.98	119.98
	12	-50.00	65.545	.447	-179.98	79.98
	13	-130.00*	65.545	.050	-259.98	-.02
6	1	80.00	65.545	.225	-49.98	209.98
	2	120.00	65.545	.070	-9.98	249.98
	3	70.00	65.545	.288	-59.98	199.98
	4	65.00	65.545	.324	-64.98	194.98
	5	75.00	65.545	.255	-54.98	204.98
	7	150.00*	65.545	.024	20.02	279.98
	8	200.00*	65.545	.003	70.02	329.98
	9	75.00	65.545	.255	-54.98	204.98
	10	10.00	65.545	.879	-119.98	139.98
	11	65.00	65.545	.324	-64.98	194.98
	12	25.00	65.545	.704	-104.98	154.98
	13	-55.00	65.545	.403	-184.98	74.98
7	1	-70.00	65.545	.288	-199.98	59.98
	2	-30.00	65.545	.648	-159.98	99.98
	3	-80.00	65.545	.225	-209.98	49.98
	4	-85.00	65.545	.198	-214.98	44.98
	5	-75.00	65.545	.255	-204.98	54.98
	6	-150.00*	65.545	.024	-279.98	-20.02
	8	50.00	65.545	.447	-79.98	179.98
	9	-75.00	65.545	.255	-204.98	54.98
	10	-140.00*	65.545	.035	-269.98	-10.02
	11	-85.00	65.545	.198	-214.98	44.98
	12	-125.00	65.545	.059	-254.98	4.98
	13	-205.00*	65.545	.002	-334.98	-75.02
8	1	-120.00	65.545	.070	-249.98	9.98
	2	-80.00	65.545	.225	-209.98	49.98

	3	-130.00*	65.545	.050	-259.98	-.02
	4	-135.00*	65.545	.042	-264.98	-5.02
	5	-125.00	65.545	.059	-254.98	4.98
	6	-200.00*	65.545	.003	-329.98	-70.02
	7	-50.00	65.545	.447	-179.98	79.98
	9	-125.00	65.545	.059	-254.98	4.98
	10	-190.00*	65.545	.005	-319.98	-60.02
	11	-135.00*	65.545	.042	-264.98	-5.02
	12	-175.00*	65.545	.009	-304.98	-45.02
	13	-255.00*	65.545	.000	-384.98	-125.02
9	1	5.00	65.545	.939	-124.98	134.98
	2	45.00	65.545	.494	-84.98	174.98
	3	-5.00	65.545	.939	-134.98	124.98
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	4	55.00	65.545	.403	-74.98	184.98
	5	65.00	65.545	.324	-64.98	194.98
	6	-10.00	65.545	.879	-139.98	119.98
	7	140.00*	65.545	.035	10.02	269.98
	8	190.00*	65.545	.005	60.02	319.98
	9	65.00	65.545	.324	-64.98	194.98
	11	55.00	65.545	.403	-74.98	184.98
	12	15.00	65.545	.819	-114.98	144.98
	13	-65.00	65.545	.324	-194.98	64.98
11	1	15.00	65.545	.819	-114.98	144.98
	2	55.00	65.545	.403	-74.98	184.98
	3	5.00	65.545	.939	-124.98	134.98
	4	.00	65.545	1.000	-129.98	129.98
	5	10.00	65.545	.879	-119.98	139.98
	6	-65.00	65.545	.324	-194.98	64.98

	7	85.00	65.545	.198	-44.98	214.98
	8	135.00*	65.545	.042	5.02	264.98
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	13	-120.00	65.545	.070	-249.98	9.98
12	1	55.00	65.545	.403	-74.98	184.98
	2	95.00	65.545	.150	-34.98	224.98
	3	45.00	65.545	.494	-84.98	174.98
	4	40.00	65.545	.543	-89.98	169.98
	5	50.00	65.545	.447	-79.98	179.98
	6	-25.00	65.545	.704	-154.98	104.98
	7	125.00	65.545	.059	-4.98	254.98
	8	175.00*	65.545	.009	45.02	304.98
	9	50.00	65.545	.447	-79.98	179.98
	10	-15.00	65.545	.819	-144.98	114.98
	11	40.00	65.545	.543	-89.98	169.98
	13	-80.00	65.545	.225	-209.98	49.98
13	1	135.00*	65.545	.042	5.02	264.98
	2	175.00*	65.545	.009	45.02	304.98
	3	125.00	65.545	.059	-4.98	254.98
	4	120.00	65.545	.070	-9.98	249.98
	5	130.00*	65.545	.050	.02	259.98
	6	55.00	65.545	.403	-74.98	184.98
	7	205.00*	65.545	.002	75.02	334.98
	8	255.00*	65.545	.000	125.02	384.98
	9	130.00*	65.545	.050	.02	259.98
	10	65.00	65.545	.324	-64.98	194.98
	11	120.00	65.545	.070	-9.98	249.98
	12	80.00	65.545	.225	-49.98	209.98

Based on observed means.
The error term is Mean Square(Error) = 21480.769.
*. The mean difference is significant at the .05 level.

Interpretation of the Table:

Significance Column (Sig.):

- Shows the p-value of the test.
- If Sig. < 0.05, the difference is statistically significant.

Significant Comparisons:

Several days showed significant difference ($p<0.05$) in mean values.

- Day 1 vs 13: Mean Diff = 135, Sig. = 0.042 → Significant.
- Day 2 vs 13 : Mean Diff = 175, Sig. = 0.009 → Significant.
- Day 3 vs 8: Mean Diff = 130, Sig. = 0.050→ Significant.
- Day 4 vs 8: Mean Diff = 135, Sig. = 0.0422 → Significant.
- Day 7 and 10: Mean Diff = 140, Sig. = 0.035 → Significant.

Conclusion:

There is a clear, statistically significant difference in performance across some days. This confirms the presence of days specific treatment effects, especially under the 10ml treatment of Coccidiosis.

4.6 ESTIMATED MARGINAL MEANS

Estimated Marginal Means (EMMs) — also called Least Squares Means (LS Means) — are adjusted averages of the dependent variable for each level of a factor (Coccidiosis), after accounting for other variables in the model (like days, blocks, or interactions). In simple terms, EMMs represent the average outcome you'd expect for each group, assuming all other conditions are held constant.

4.6.1 ESTIMATED MARGINAL MEANS OF TREATMENT 5ML

The Estimated Marginal Mean represents the adjusted average response to the 5ml treatment of Coccidiosis, accounting for block and day effects.

Grand Mean

Dependent Variable: Trt_5ml

Mean	Std. Error	95% Confidence Interval

		Lower Bound	Upper Bound
414.615	15.305	384.265	444.966

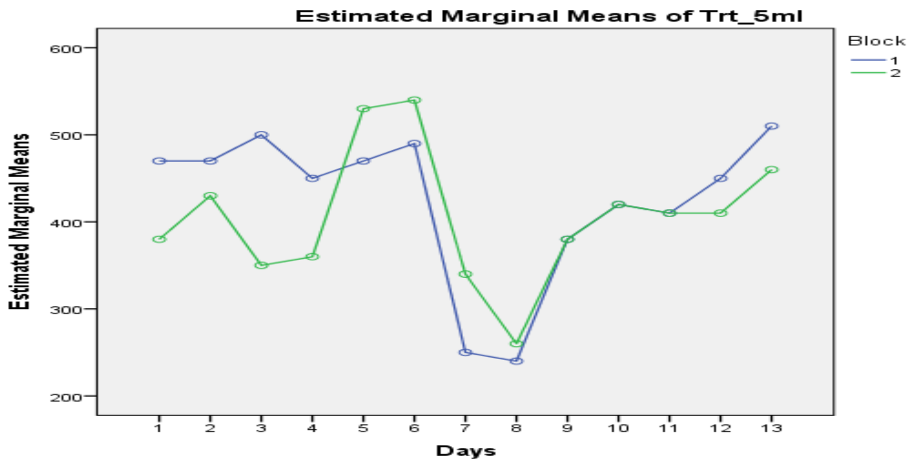
Interpretation:

a. The table above presents the Estimated Marginal Means for the dependent variable Trt_5ml, which likely represents a treatment dose or intervention effect. The analysis yields a grand mean of 414.615 with a standard error of 15.305. This implies that the average effect or measurement value from the treatment (5ml) of Coccidiosis is approximately 414.615 units.

b. The 95% Confidence Interval ranges from 384.265 to 444.966, indicating that we can be 95% confident that the true mean of the population lies within this interval. The relatively narrow confidence range reflects a moderate level of precision in the estimate.

Conclusion:

The treatment with 5ml of Phyllantus Amarus dosage produced a statistically reliable mean response of 414.615. Given the bounded confidence interval, it suggests a consistent and predictable effect of the treatment.



4.6.2 ESTIMATED MARGINAL MEANS OF TREATMENT 10ML

The Estimated Marginal Mean represents the adjusted average response to the 10ml treatment of Coccidiosis, accounting for block and day effects.

Grand Mean

Dependent Variable: Trt_10ml

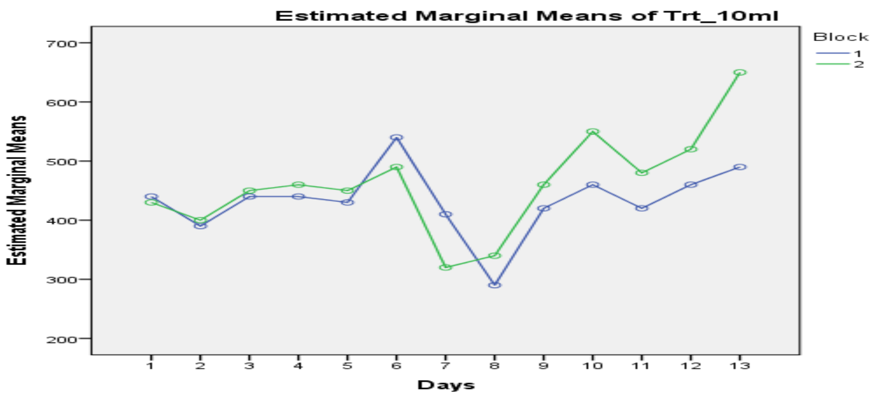
Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
447.308	12.854	421.817	472.799

Interpretation:

a. The table above presents the Estimated Marginal Means for the dependent variable Trt_10ml of Coccidiosis, which likely represents a treatment dose or intervention effect. The analysis yields a grand mean of 447.308 with a standard error of 12.854. This implies that the average effect or measurement value from the treatment (10ml) of Coccidiosis is approximately 447.308 units.
b. The 95% Confidence Interval ranges from 421.817 to 472.799, indicating that we can be 95% confident that the true mean of the population lies within this interval. The relatively narrow confidence range reflects a moderate level of precision in the estimate.

Conclusion:

The treatment with 5ml dosage of Phyllanthus Amarus produced a statistically reliable mean response of 447.308. Given the bounded confidence interval, it suggests a consistent and predictable effect of the treatment of Coccidiosis.



CHAPTER FIVE

5.0 DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 DISCUSSION OF FINDINGS

This study aimed to assess the effects of two treatment levels, 5ml (Trt_5ml) and 10ml (Trt_10ml), over a 13-day period, while accounting for potential variations introduced by experimental blocks. Chapter Four presented the detailed data analysis using descriptive statistics, estimated marginal means, and ANOVA. This chapter discusses the key findings in relation to the research aims and draws conclusions based on the statistical evidence.

The descriptive statistics in Chapter Four provided initial insights into the performance of each treatment. Overall, Trt_10ml exhibited a slightly higher grand mean (447.31) compared to Trt_5ml (414.62), suggesting a potentially greater average effect at the higher dose over the entire experimental period. However, these means encompass considerable variability, as indicated by the standard deviations, and do not account for the influence of time or block in a statistically rigorous manner.

The ANOVA results for Trt_5ml (Table 4.4.1) indicated that the experimental model, including the factors Days, Block, and their interaction, did not significantly predict the variation in the 5ml treatment response. While the effect of Days showed a marginally non-significant p-value (0.053), suggesting a possible time-dependent trend, it did not reach statistical significance at the 0.05 level. This implies that, based on this dataset and analysis, we cannot definitively conclude that the effect of the 5ml treatment changes significantly over the 13 days. The absence of significant Block and Days * Block interaction effects further suggests that the experimental blocks did not introduce significant variability, and the potential (though non-significant) effect of days on Trt_5ml was consistent across both blocks.

In contrast, the ANOVA results for Trt_10ml (Table 4.4.2) revealed a statistically significant effect of Days (p=0.029). This is a crucial finding, indicating that the mean response observed for the 10ml treatment did change significantly over the 13-day experimental period. This suggests that the duration of exposure or observation plays a meaningful role in the outcome when the higher 10ml dose is administered. Similar to Trt_5ml, the effects of Block and the Days * Block interaction were not statistically significant for Trt_10ml, suggesting consistent responses across blocks and no differential effect of days between blocks for the 10ml treatment.

The estimated marginal means provide adjusted average responses for each treatment level, controlling for the effects of days and blocks within the model. The EMM for Trt_5ml was 414.615 (95% CI: 384.265 - 444.966), and for Trt_10ml, it was 447.308 (95% CI: 421.817 - 472.799). While the 10ml treatment had a higher estimated mean, the overlap in the confidence intervals suggests that the average difference between the two treatments over the entire period, accounting for other factors, may not be statistically significant on its own without a direct comparison test (e.g., comparing the EMMs of the two treatments).

The relatively low R-squared values for both ANOVA models (0.205 for Trt_5ml and 0.229 for Trt_10ml) indicate that a substantial portion of the variability in the treatment responses remains unexplained by the factors included in this analysis (Days, Block, and their interaction). This suggests that other variables not accounted for in the model may be influencing the observed outcomes.

Overall, the analysis highlights a key difference between the two treatment levels regarding their temporal dynamics. While the 5ml treatment's effect did not demonstrate a statistically significant change over the 13 days, the 10ml treatment's effect did vary significantly with time. The blocking factor, however, did not appear to have a significant impact on either treatment.

5.2 IMPLICATIONS OF THE FINDINGS

The findings have important implications for the application and further study of this treatment. The significant temporal effect observed for the 10ml of Phyllanthus Amarus dose suggests that the timing of assessment or application is critical when using this higher volume. For the 5ml dose of Phyllanthus Amarus, the lack of a statistically significant temporal effect implies a more stable response over the 13 days, although the marginal significance warrants caution. The non-significant block effects suggest that the experimental setup effectively controlled for the variations intended to be captured by blocking.

5.3 LIMITATIONS OF THE STUDY

This study had several limitations. The specific nature of the treatment and measured variable were not detailed, limiting the ability to provide context-specific interpretations. The analysis focused solely on Days, Block, and their interaction, leaving a large portion of the variability unexplained, suggesting other unmeasured factors are at play. The study was limited to a 13-day period and only two specific dose levels, meaning the findings may not be generalizable to longer durations, different doses, or other experimental conditions.

5.4 RECOMMENDATIONS

Based on the findings and limitations of this study, the following recommendations are made for future research:

a. **Further Investigation of Trt_10ml Over Time:** Given the significant effect of Days on Trt_10ml, future studies should explore the nature of this temporal change. This could involve plotting the estimated marginal means of Trt_10ml of Phyllanthus Amarus for each day to understand the pattern of response over time (e.g., does it increase, decrease, peak, or plateau?). Identifying the optimal time point for the maximal effect of the 10ml treatment would be valuable.

b. **Re-evaluate Trt_5ml with Increased Power:** The marginally non-significant effect of Days on Trt_5ml of Phyllanthus Amarus suggests a potential real effect that this study may not have had sufficient power to detect. Repeating the experiment with a larger sample size per group or extending the duration of the study could provide more definitive evidence regarding the temporal dynamics of the 5ml treatment.

c. **Direct Comparison of Treatment Means**: While the estimated marginal means are provided, a formal statistical test comparing the overall estimated marginal means of Trt_5ml and Trt_10ml of Phyllanthus Amarus would provide a clear answer regarding whether the average effect differs significantly between the two dose levels over the study period, accounting for days and blocks.

d. **Explore Other Influencing Factors:** The relatively low R-squared values indicate that other variables not included in this analysis are contributing to the variation in treatment responses. Future research should aim to identify and incorporate these factors into the experimental design and analysis to build more predictive models. These could include environmental factors, characteristics of the samples being treated, or variations in treatment application.

e. **Consider Different Time Point Analyses:** Instead of treating "Days" as a continuous factor in some analyses, exploring specific critical time points or phases within the 13-day period might reveal more nuanced effects, especially for the 10ml treatment.

5.5 FUTURE DIRECTIONS

Based on the study's findings and limitations, several avenues for future research are recommended:

a. Investigate the specific pattern of change for the 10ml treatment over time (e.g., growth curve analysis) to understand the nature of the significant temporal effect.Conduct studies with increased sample size or longer duration to gain more power to detect potential temporal effects for the 5ml treatment.
b. Formally compare the estimated marginal means of the 5ml and 10ml treatments to statistically confirm if there is an overall difference in average effect over the study period. Identify and incorporate other potential confounding variables into future experimental designs and analyses to build more comprehensive and predictive models.
c. Explore a wider range of dose levels and durations to fully characterize the dose-response and temporal dynamics of the treatment.

5.6 CONCLUSION

Based on the comprehensive data analysis, the following conclusions can be drawn:

- The experimental blocks did not significantly influence the observed effects of either the 5ml or 10ml treatments of Coccidiosis over the 13-day period.

- The effect of the 5ml treatment of Coccidiosis did not change significantly over the 13 days of the experiment at the 0.05 level of significance, although a marginally non-significant trend was observed.

- The effect of the 10ml treatment of Coccidiosis changed significantly over the 13 days of the experiment.

- The interaction between Days and Block was not significant for either treatment, indicating that the pattern of change over time (or lack thereof) was consistent across the experimental blocks.
- While the 10ml treatment of Coccidiosis showed a higher overall estimated marginal mean compared to the 5ml treatment of Coccidiosis, further analysis would be needed to confirm a statistically significant difference in the overall average effect between the two dose levels over the entire period.

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MORTALITY OF THE EXPERIMENTAL UNITS