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Dietary Incorporation of Papaya Seeds for Determining its Effect on Broiler Growth and Meat Quality

Muskan Fatima[1], Muhammad Ammar Khan[1], Babar Rahi[1] & Waqas Ajmal[1]

1. *Department of Food Science & Technology, Faculty of Agriculture & Environment, The Islamia University Bahawalpur*

Corresponding Author:

M. Fatima
Muskanfatima112244@gmail.com

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ABSTRACT

This research focuses on the proper application of industrial wastes (byproducts) as a supplement to animal feed to lessen mineral shortage in broilers. Because papaya seeds have significant levels of fat, protein, fiber, and minerals, they were utilized as a feed for Cobb broiler chickens. Four treatments, each with seven chicks and five replicates, were designed for this study. Feed intake, live bird weight, weight gain, and feed conversion ratio were evaluated as growth factors. The results showed that the average weekly intake of feed of the broilers was non-significant ($p>0.05$). With elevated concentrations of papaya seeds, there is no effect of any papaya treatment. Furthermore, the live-bird weight of the broilers also showed no impact with respect to time as it was the same in all treatments including PSP0, PSP1, PSP2, and PSP3. The weight gain was observed to be highest in the last week (W5) and increased with respect to time while according to treatments WG was the same in PSP0, PSP1, PSP2, and PSP3. The last growth parameter is the feed conversion ratio which was not affected by the addition of papaya seed powder in the broiler feed. Moreover, the quality of meat was determined by the weight of its cuts and organs and results revealed that carcass weight was constant with the all of PSP concentration in the feed as well as for control while there is no major effect of the PSP inclusion in the feedstuff on the organ's weight of the broilers.

Keywords:

Papaya seeds Papaya seed powder; Papaya seed meal; Waste utilization; Broiler growth performance

1. Introduction

Food safety and food security are primarily related intimately to food waste. Every year, around 1.3 billion tonnes of food are wasted, which might feed approximately one billion people (Gustavsson et al, 2011). Food waste is harmful to both the economy and sustainability. Food production consumes a lot of resources, including water, soil, energy, and other inputs, while also having a negative impact on the environment, including the loss of biodiversity and habitats, the degradation of soil, the reduction of water availability, and the release of greenhouse gas. Greater use of food products and less waste are required to combat the rising food demand, and climate change, and to deplete resources (Dou et al, 2018).

The global population is expected to rise and could reach 9.7 billion people by 2050. People will eventually have more concerns about food security (having access to secure, wholesome food), which is directly related to the ongoing rise in the global population. Moreover, additives offer advantages that increase production capacity by lowering the fatality rate and encouraging weight gain. There are various trivial classes, depending on the attributes and goals (Muazu & Aliyu-Paiko 2020). Land for the production of feed cannot be expanded and has unique constraints due to increased fossil fuel prices, emulation for food-feed-fuel, and other variables because of the growing human population, urbanization, and an industrial profound model of farm animal production. Only when uncommon, equivalent feed supplies are examined does it appear possible to satisfy the nutrient requirements of cattle and to nourish their mass output and efficiency (Wadhwa & Bakshi 2013). The benefit of chicken meat is that it can be found in a wide range of quality and at affordable prices for a wide range of individuals, yet global production costs vary significantly (Bondt & van Horne 2002). Meat and its byproducts supply sufficient amounts of essential nutrients at higher concentrations when compared to alternative diets (Marangoni et al, 2015).

Although the Institute of Medicine's DRI evaluation concluded that there was insufficient scientific evidence to set a rigid protein restriction, it did recommend a macronutrient distribution range for protein intake of between 10 and 35 percent of total energy as a suitable range (Martin et al, 2005).

The purpose of the study was to determine how the cost of chicken meat, eggs, and other items affected residential consumers in the Biringkanaya region of Makassar's demand for chicken eggs (Astaman et al, 2020). The demand for meat is growing due to rising income levels, population growth, and urbanisation across the globe. The study analyses the demand for roughly three forms of meat: chicken, beef, and mutton, using data from the years 2000 through 2017. Chicken and beef are complementary because of the elasticity of cross-price, whereas chicken and mutton are alternative (Selvanathan et al, 2020).

The papaya fruit's black seeds are embedded in the center of the fruit pulp. Ripe papaya seed is typically regarded as a by-product and makes up about 16% of the weight of fresh fruits. Nutritionists have been urged to employ papaya seed as a protein-rich diet item and functional feed for chickens due to its year-round availability and low economic value. Using papaya seed meal enhanced the growth ratio, egg output, and feed efficiency of chicken during production (Sugiharto et al, 2020).

2. Methods and Materials

2.1 Treatments and Plan

One day-old broiler starter birds were purchased from a poultry farm (Bahawalpur, Punjab, Pakistan). The broilers were weighed, then randomly allotted to one of four nutritional treatment groups. They were then allowed to grow until they were 35 days old. Broilers were raised in stainless steel cages that had been cleaned and disinfected prior to the experiment and were kept at the room temperature of 26°C till end. The broilers were fed on a starting diet (23.62 percent crude protein, 14.7 percent crude fat) from days one to twenty-two and a finisher diet from days twenty-two to thirty-five, both bought from a local manufacturer (Asia Poultry Feed Mill, Ahmadpur), and were given with the ad libitum contact to the feedstuff and were provided with water during the whole trial period. Every set (group) contained of seven chicks. The nutritional treatments comprised by the inclusion of Papaya seed powder (PSP) in the finisher feed. PSP amounts were quantified based upon the Broiler's intake of feed (FI) at the end of the former week. The feeding trial phase of this research study was carried out at the veterinary shed of Islamia University Bahawalpur. One-day-old broilers were arbitrarily dispersed into four treatments and nourished viable starter feed from d 1-22 and then

finisher diet mixed with 0, 0.5, 1 and 1.5% PSP for the five weeks. Pre-weighed feed was given to all treatments every morning to monitor feed intake while drinking water were provided. Feed and water were offered to the birds in all the different treatments ad-libitum. All birds were reared without vaccination. Chicks were nurtured under normal photoperiod of 24 hours of light/dark cycles for period of five weeks and cages were cleaned at the end of every week. The experiment lasted for the duration of 5 weeks of 7 days in each week.

2.2 Assessment of Growth and Performance

Growth of the broiler chickens were determined by the parameters which included feed intake (FI) such as total weekly intake of feed (TWIF), live-broiler weight (LBW), acquiring weight or weight gain (WG) and the feed conversion ratio (FCR). Seven chicks (n=7) were randomly selected from the broilers and tested for their growth and performance assessment on d 14, 21, 28 & 35. (Zulqarnain et al, 2017; Song et al, 2018). Arbitrarily chosen chicken with three in number (n=3) of equal size as well as weight from every treatment were subjected to slaughtering (eviscerated) and then subjected to carcass weight calculation evaluation of quality of meat.

2.3 Data Analyzing Technique

The results attained from the evaluation of growth and performance and meat quality assessment on broilers meat after dietary PSP supplementation under different processing conditions were examined for the Analysis of Variance (ANOVA) under Factorial Design with significance level established at $p<0.05$ Statistix software (Version 8.1, USA). The results were presented as Means ± Standard Deviation (S.D).

3. Results and Discussion

3.1. Growth And Performance

3.1.1. Average Weekly Feed Intake

The impact of adding papaya seed powder (PSP) to the poultry diet on average weekly feed intake (AWFI) of broiler chickens was studied.

Table 1. Average weekly feed intake (AWFI) of the broilers after PSP supplementation

Source	DF	SS	MS	*F*	*p*	
Growth Period	2	4.7851	2.39255	496.9	0.000	*
PSP Treatments	3	0.01106	0.00369	0.77	0.519	NS
Growth Period*PSP Treatments	6	0.03372	0.00562	1.17	0.34	NS
Error	48	0.23112	0.00481			
Total	59	5.061				

PSP stands for papaya seed powder. * Stands for significant values. NS stands for non-significant values. The results are significant if $p<0.1205$, n=35.

The effect of PSP treatments on AWFI of broilers was non-significant ($p>0.05$). The Least Significant Analysis (LSD) of the data revealed that the AWFIs of broilers significantly ($p<0.05$) elevated as growth time proceed, e.g. from 1st week to the 5th (Table 2).

The non-significant results of AWFI after PSP supplementation in the basal diet in this experiment were contrary to the findings of an earlier published research, who selected 60 chicks, fed T0: 0% Papaya seed powder (PSP), T1: 0.5% PSP, and T2: 1% PSP till the age of 42 d in an experiment, and observed AWFI of T0: 3498 g, T1: 3462 g, and T2: 4084 g (Muazu & Aliyu-Paiko 2020).

3.1.2. Live-bird Weight

The impact of adding PSP to poultry diet on the live-broiler weights (LBWs) of the Cobb broilers was studied.

The outcome of dietary PSP treatments was non-significant ($p>0.05$) on the broiler's LBWs as shown in (Table 3). Furthermore, the impact of growth period was significant ($p<0.05$) on the LBWs of cobb broilers. Broilers had the maximum LBW values after the 5th week of the growth period ($p<0.05$), superseded by the 4th week and 3rd week, respectively.

Table 2. ANOVA of live-bird weight of the chickens after PSP addition in the broilers diet

Source	DF	SS	MS	*F*	*P*	
Growth Period	2	18.4672	9.23358	836.6	0.000	*
PSP Treatment	3	0.0064	0.00212	0.19	0.901	NS
Growth Period *PSP Treatment	6	0.1301	0.02169	1.96	0.09	NS
Error	48	0.5298	0.01104			
Total	59	19.1334				

PSP stands for papaya seed powder. * Stands for significant values. NS stands for non-significant values.
The results are non-significant because p>0.05 while n=35.

The current study's LBWs trend showed an ordinary growth design as the LBWs grew in relation to the time. As a result, 5th week had the maximum LBWs of all the weeks.
The non-significant results of LBWs after PSP supplementation in the basal diet in this experiment were similar to the findings of an earlier published research, who selected 60 rabbits, fed T0: 0% papaya seed meal (PSM), T1: 10% PSM, and T2: 20% PSM at the age of 10 weeks in an experiment, and observed non-significant LBWs of T0: 874 g, 1176 g, T1: 890 g, 1160, g and T2: 822 g, 986 g (Ayandiran et al, 2021).

3.1.3. Weight Gain

The outcome of the PSP enrichment of broiler feed on the acquiring weight or weight gain (WG) of broiler hens was measured on weekly basis.

Table 3. ANOVA of average weekly weight gain of the broilers after the papaya seed powder (PSP) addition in the broilers diet

Source	DF	SS	MS	*F*	*p*	
Growth Period	1	0.21316	0.21316	42.51	0.000	*
PSP Treatment	3	0.00039	0.00013	0.03	0.994	NS
Growth Period*PSP Treatment	3	0.01276	0.00425	0.85	0.48	NS
Error	32	0.16046	0.00501			
Total	39	0.38677				

PSP stands for papaya seed powder. * Stands for significant values. NS stands for non-significant values.
The results are significant if p<0.05 and non-significant if p>0.05 & n=35

WGs significantly (p<0.05) elevated relating to time and these were maximum at completion of 5th week (on 35th day). The effect of the nutritional PSP supplementation was same on weekly acquiring weight of the chickens to the control.
The non-significant results of WG after PSP supplementation in the basal diet in this experiment were not similar to the findings of an earlier published research, who selected 390 chicks, fed T0: 0% sprouted papaya seed meal (SPSM), T1: 1% SPSM, T2: 2.5% Pawpaw seed meal (PSM), and T3: 2.5% SPSM, & T4: 5% SPSM at the age of 36 d in an experiment, and observed significant (p<0.05) WG of T0: 1351a g, T1: 1194 g, T2: 1339 g, T3: 1273 g, and T4: 1279 g (Sugiharto et al, 2021).

3.1.4. Feed Conversion Ratio

Feed conversion ratio of chickens was evaluated to determine effect of PSP addition in the broilers feed by using ANOVA.

According to the ANOVA, the actual impact of PSP treatments on the FCR of Cobb broilers was non-significant (p>0.05). Furthermore, after adding PSP to the poultry feed, the interaction of PSP*GP had a non-significant (p>0.05) effect on the FCR of chickens.

The non-significant results of FCR after PSP supplementation in the basal diet in this experiment were similar to the findings of an earlier published research, who selected 60 chicks, fed T0: 0% papaya seed powder (PSP), T1: 0.5% PSP, and T2: 1% PSP at the age of 42 d in an experiment, and observed non-significant ($p>0.05$) FCR of T0: 1.81, T1: 1.72, and T2: 1.96 (Muazu & Aliyu-Paiko 2020).

Table 4. ANOVA of feed conversion ratio of the broiler chickens after the papaya seed powder (PSP) addition in the broilers feed

Source	DF	SS	MS	*f*	*p*	
GP	1	3.77426	3.77426	416.4	0.000	*
PSP Treatment	3	0.00708	0.00236	0.26	0.853	NS
GP*PSP Treatment	3	0.01404	0.00468	0.52	0.67	NS
Error	32	0.29005	0.00906			
Total	39	4.08543				

PSP stands for papaya seed powder & GP stands for growth period * Stands for significant values. NS stands for non-significant values. The results proved to be significant as $p<0.05$ & $n=35$

3.2. Quality of Organs

3.2.1. Carcass Weight

The study investigated the impact of adding papaya seed powder (PSP) to poultry diets on the carcass weights of broilers. The analysis of variance (ANOVA) showed that the dietary PSP treatments had a non-significant effect ($p>0.05$) on the carcass weights of broilers.

Table. 5 Carcass weight of broilers after PSP supplementation

Source	DF	SS	MS	*f*	*p*	
PSP Treatment	3	0.9928	0.3309	0.07	0.977	NS
Error	8	40.4589	5.0574			
Total	11	41.4517				

PSP stands for papaya seed powder. * stands for significant values. NS stands for non-significant values. The results are non-significant if $p>0.05$, $n=3$.

Sugiharto et al, (2021) found similar results when he evaluated different concentrations of fermented papaya leaf & seed powder (FPLS), multienzyme (mE), low stocking density (LSD), & High stocking density (HSD) in broiler feed and discovered non-significant ($p>0.05$) effect on the weight of carcass in percentages.

3.2.2. Drumstick:

The study also examined the impact of adding papaya seed powder (PSP) to poultry diets on the drumstick weights of broilers. The ANOVA results indicated that the nutritional PSP treatments had a non-significant effect ($p>0.05$) on the drumstick weights of broiler chickens.

Table 6. Drumstick weight of broilers after PSP supplementation

Source	DF	SS	MS	*F*	*P*	
PSP Treatment	3	0.31557	0.1052	0.47	0.708	NS
Error	8	1.77193	0.2215			
Total	11	2.0875				

PSP stands for papaya seed powder. * stands for significant values. NS stands for non-significant values. The values are non-significant if p>0.05, n=3.

The result of drumstick's weight attained from present study matched to the study by Bolu et al, (2009). He discovered comparable drumstick weights (8.71g/100g to the 9.70 g/100 g body weight on 42nd day) by feeding chickens with T0: 0% dried papaya seeds (DPS), T1: 5% DPS, T2: 10% DPS, and T3: 15% DPS till the age of 42 d in an experiment, and observed non-significant impact of the weights of drumsticks of T0: 9.24 g/100 g body weight, T1: 9.70 g, T2: 9.46 g, and T3: 8.71 g.

3.2.3. Breast:

The study investigated the impact of adding papaya seed powder (PSP) to poultry diets on the breast weights of broiler chickens. The treatment-wise breast weights ranged from 17.55±1.21 to 18.52±1.74, with the lowest value observed for PSP1 and the highest value observed for PSP2 and PSP3.

Table 7. Breast weight of broilers after PSP supplementation

Source	DF	SS	MS	*f*	*P*	
PSP Treatment	3	2.0249	0.675	0.45	0.721	NS
Error	8	11.8755	1.4844			
Total	11	13.9004				

PSP stands for papaya seed powder. * stands for significant values. NS stands for non-significant values. The values are non-significant if *p*>0.05, n=3.

The current study's findings were consistent with those of Widiastuti et al, (2021), who observed a non-significant (p>0.05) influence on breast weights after adding A bilimbi-acidified pawpaw leaf and seed meal (APLS) in range of T0: 0%APLS, T1: 1% APLS, T2: 2.5% APLS, and T3: 5% APLS to chicken diet and observed non-significant (p>0.05) breast weight of T0: 33.5% LBW, T1: 35.9, T2: 34.1, and T3: 32.6.

3.2.4. Neck:

The impact of adding papaya seed powder (PSP) to poultry diets on the neck weights of broiler chickens was also examined.

Table 8. Neck weight of broilers after PSP fortification

Source	DF	SS	MS	f	p	
PSP Treatment	3	0.02367	0.0079	0.23	0.873	NS
Error	8	0.27433	0.0343			
Total	11	0.298				

PSP stands for papaya seed powder. * stands for significant values. NS stands for non-significant values. The results are non-significant if *p*>0.05, n=3.

The current study's findings were consistent with those of Widiastuti et al, (2021), who observed a non-significant (p>0.05) influence on breast weights after adding A bilimbi-acidified pawpaw leaf and seed meal (APLS) in range of T0: 0%APLS, T1: 1% APLS, T2: 2.5% APLS, and T3: 5% APLS to chicken diet and observed non-significant (p>0.05) breast weight of T0: 33.5% LBW, T1: 35.9, T2: 34.1, and T3: 32.6.

3.2.5. Liver:

The impact of adding papaya seed powder (PSP) to poultry diet on the liver weights of chickens was investigated. The analysis of variance (ANOVA) indicated that the effect of nutritional PSP treatments on liver weight was non-significant (p>0.05).

Table 9. Liver weight of broilers after PSP supplementation

Source	DF	SS	MS	f	p	
PSP Treatment	3	0.0578	0.0193	0.14	0.935	NS
Error	8	1.12167	0.1402			
Total	11	1.17947				

PSP stands for papaya seed powder. * stands for significant values. NS stands for non-significant values. The figures are non-significant if $p>0.05$, n=3.

The addition of the PSP to chicken meal led in the liver weights ranging from 34 to 38 g, or around 2.01 to 2.2 percent of the mean live-broiler weight. Broiler's weights were compatible with the liver weights T0: 2.85% LBW, T1: 2.14%, T2: 2.39%, and T3: 2.15% of chickens with the treatments of T0: 0% A bilimbi-acidified pawpaw leaf and seed meal (APLS), T1: 1% APLS, T2: 2.5% APLS, and T3: 5% APLS, as stated by (Widiastuti et al, 2021).

3.2.6. Heart:

The effect of adding papaya seed powder (PSP) to poultry diet on heart weights of broilers was examined. The ANOVA results indicated that the nutritional PSP treatments had a non-significant impact (p>0.05) on heart weight. The treatment-wise heart weight of broilers ranged from 0.47±0.03 to 0.52±0.05 with increasing treatment dose. The non-significant outcomes of heart weight after PSP supplementation were consistent with previous studies that also reported non-significant changes in heart weight with different treatments.

Table 10. Heart weight of broilers after PSP supplementation

Source	DF	SS	MS	f	p	
PSP Treatment	3	0.00509	0.0017	1.39	0.313	NS
Error	8	0.00973	0.0012			
Total	11	0.01483				

PSP stands for papaya seed powder. * stands for significant values. NS stands for non-significant values. The results are non-significant if $p>0.05$, n=3.

The non-significant results of heart weight after PSP supplementation in the basal diet in this experiment were similar to the findings of an earlier published research, who selected 120 chicks, fed T0: 0% pawpaw latex (PL), T1: 0.1% PL, T2: 0.15% PL, and T3: 0.2% PL at the age of 49 d in an experiment, and observed non-significant heart weight of T0: 0.45%, T1: 0.44%, T2: 0.45%, and T3: 0.41% (Haruna & Odunsi 2018).

3.2.7. Feet:

The impact of adding papaya seed powder (PSP) to poultry diet on the weight of feet of chickens was investigated. The ANOVA results revealed that the nutritional PSP treatments did not have a significant effect (p>0.05) on feet weight. The treatment-wise feet weight of broilers ranged from 3.48±0.24a to 3.92±0.61a with increasing treatment dose. The weight of feet ranged from 67 to 74 g, which represented approximately 3.7% to 4.2% of the average live broiler weight. These findings were consistent with the non-significant results reported in previous studies.

Table 11. Feet weight of broilers after PSP supplementation

Source	DF	SS	MS	f	p	
PSP Treatment	3	0.36623	0.1221	0.41	0.751	NS
Error	8	2.38593	0.2982			
Total	11	2.75217				

PSP stands for papaya seed powder. * stands for significant values. NS stands for non-significant values. The resulrs are non-significant if p>0.05, n=3.

3.2.8. Gizzard:

The impact of adding papaya seed powder (PSP) to poultry diet on the weights of gizzard of chickens was examined. The ANOVA results indicated that the nutritional PSP treatments had a non-significant impact (p>0.05) on gizzard weight. The treatment-wise gizzard weight of chickens ranged from 0.91±0.10 to 0.97±0.15 with increasing treatment dose. The conclusions of this study were consistent with a previous study that also reported non-significant results for gizzard weight with A bilimbi-acidified pawpaw leaf & seed meal (APLS) treatments. However, the significant results observed in another study with pawpaw latex (PL) treatments were not consistent with the findings of this study.

Table 12. Gizzard weight of broilers after PSP supplementation

Source	DF	SS	MS	f	p	
PSP Treatment	3	0.01149	0.0038	0.21	0.883	NS
Error	8	0.14253	0.0178			
Total	11	0.15403				

PSP stands for papaya seed powder. * stands for significant values. NS stands for non-significant values. The results are non-significant if p>0.05, n=3.

The conclusions of recent study were in concurrence with the research outcomes of the Widiastuti et al, (2021) who found non-significant results of gizzard weight, who selected 200 chicks, fed T0: 0% A bilimbi-acidified pawpaw leaf & seed meal (APLS), T1: 1% APLS, T2: 2.5% APLS, and T3: 5% APLS at the age of 35 d in an experiment, and observed gizzard weight of T0: 1.47% LBW, T1: 1.60%, T2: 1.75%, and T3: 1.74%.

3.2.9. Thigh:

The impact of adding papaya seed powder (PSP) to poultry diet on the thigh weights of broilers was studied. The analysis of variance (ANOVA) showed that the effect of nutritional PSP treatments on thigh weight was non-significant (p>0.05). The treatment-wise thigh weights ranged from 9.94±0.40a to 10.73±1.29a with increasing treatment dose. These results were comparable to previous studies that also found non-significant changes in thigh weight with different quantities of papaya seeds in the diet.

Table 13. Thigh weight of broilers after PSP supplementation

Source	DF	SS	MS	f	p	
PSP Treatment	3	1.21749	0.4058	0.44	0.734	NS
Error	8	7.46	0.9325			
Total	11	8.67749				

PSP stands for papaya seed powder. * stands for significant values. NS stands for non-significant values. The results are non-significant if p>0.05, n=3.

Recent conclusions were comparable to those of Bolu et al, (2009), who found that fortification of broilers feed with different quantities of dried papaya seeds (DPS) T0: 0% DPS, T1: 5% DPS, T2: 10% DPS, and T3: 15% DPS gives non-significant (p>0.05) changes in the thigh's weight of T0: 8.48 g/100g body weight, T1: 8.71, T2: 8.28, and T3: 7.04.

3.2.10. Intestine:

The impact of adding PSP to poultry diet on intestine weights of broiler chickens was examined. The ANOVA results indicated that the nutritional PSP treatments had a non-significant effect on intestine weight (p>0.05). The treatment-wise intestine weights ranged from 112.90±8.28 to 126.73±5.60 with increasing treatment dose.

Table 14. Intestine weight of broilers after PSP supplementation

Source	DF	SS	MS	f	P	
PSP Treatment	3	339.149	113.05	2.91	0.101	NS
Error	8	310.72	38.84			
Total	11	649.869				

PSP stands for papaya seed powder. * stands for significant values. NS stands for non-significant values. The results are non-significant if p>0.05, n=3.

3.2.11. Skin:

The skin weight of Cobb broilers remained non-significant (p>0.05) following dietary modification with PSP. The average skin weight ranged from 261 to 268 g, corresponding to 14.88 to 15.37 percent of the birds' mean live body weight. Previous research also reported non-significant changes in skin weight with the addition of dried papaya skin to the diet.

Table 15. ANOVA of the skin weight of broilers after PSP inclusion in chicken's feed

Source	DF	SS	MS	f	P	
Treatment	3	5.39E-27	1.80E-27	0	1	NS
Error	8	22.3112	2.7889			
Total	11	22.3112				

PSP stands for papaya seed powder. * Stands for significant results. NS stands for non-significant results. NS: Results for which p>0.05 shows that it is non-significant & n=3

The non-significant results of intestine length after PSP supplementation in the basal diet in this experiment were similar to the findings of an earlier published research, who selected 100 chicks, fed T0: 0% Dried papaya seeds (DPS), T1: 5% DPS, T2: 10% DPS, and T3: 15% DPS at the age of 42 d in an experiment, and

observed non-significant intestine length of T0: 147.5 cm, T1: 144 cm, T2: 137.5 cm, and T3: 118.5 cm (Bolu et al, 2009).

3.2.12. Wings (Niblets):

The impact of adding PSP to poultry diet on the niblet weights of chickens was studied. The ANOVA results showed that the nutritional PSP treatments had a non-significant effect on niblet weight ($p>0.05$). The treatment-wise niblet weights ranged from 1.64±0.20 to 1.72±0.29 with increasing treatment dose. Similar non-significant results were reported in a previous study that examined the effects of fermented papaya leaf and seed powder on wings weight.

Table 16. Nibblet weight of broilers after PSP supplementation

Source	DF	SS	MS	f	p	
PSP Treatment	3	0.01183	0.0039	0.12	0.947	NS
Error	8	0.26613	0.0333			
Total	11	0.27797				

PSP stands for papaya seed powder. * stands for significant values. NS stands for non-significant values. The values are non-significant if $p>0.05$, n=3.

Primary function of skin of chicken is to protect and cushion the body from the environmental and physical stressors. It is 2nd most common source of the microbial contamination after the intestines, according to Salehi et al, (2016), since it harbors a variety of bacteria such as Campylobacter, Salmonella, and Listeria as reported (Park et al, 2017).

3.2.13. Drummet:

The impact of adding papaya seed powder (PSP) to poultry feed on the drummet weights of Cobb broiler chickens was studied. The analysis of variance (ANOVA) indicated that the nutritional PSP treatments had a non-significant effect ($p>0.05$) on the drummet weight of chickens. The treatment-wise drummet weights ranged from 2.32±0.02 to 2.46±0.13 with increasing treatment dose, with the lowest value observed for PSP3 and the highest value observed for the control group.

Table 17. Drummet weight of broilers after PSP supplementation

Source	DF	SS	MS	f	p	
PSP Treatment	3	0.03153	0.0105	2.18	0.168	NS
Error	8	0.03853	0.0048			
Total	11	0.07007				

PSP stands for papaya seed powder. * stands for significant results. NS stands for non-significant results. The results are non-significant if $p>0.05$, n=3.

3.2.14. Fats:

The impact of adding papaya seed powder (PSP) to poultry diet on the weights of fat of chickens was examined. The treatment-wise fats weight of chickens varied from 2.45±0.23 to 2.61±0.24 with increasing treatment dose, with the lowest value observed for PSP1 and the highest value observed for the control group. The ANOVA results indicated that the nutritional PSP treatments had a non-significant effect ($p>0.05$) on the fats weight of chickens.

Table 18. Fats weight of broilers after PSP supplementation

Source	DF	SS	MS	f	p	
PSP Treatment	3	0.06483	0.0216	0.37	0.778	NS
Error	8	0.46873	0.0586			
Total	11	0.53357				

PSP stands for papaya seed powder. * stands for significant values. NS stands for non-significant values. The outcomes are non-significant if $p>0.05$, n=3.

3.2.15. Feathers:

The impact of adding papaya seed powder (PSP) to poultry diet on the feathers of chickens' weights was investigated. The ANOVA results revealed that the nutritional PSP treatments had a non-significant effect ($p>0.05$) on the feathers weight of chickens. Additionally, the feathers weight of all the PSP treatments was found to be similar to that of the control group. The treatment-wise weight of feathers of chickens ranged from 14.76±0.64 to 15.69±0.37 with increasing treatment dose, with the lowest value observed for PSP2 and the highest value observed for PSP3.

Table 19. Feathers weight of broilers after PSP supplementation

Source	DF	SS	MS	f	P	
PSP Treatment	3	1.5562	0.5187	0.9	0.483	NS
Error	8	4.61967	0.5775			
Total	11	6.17587				

PSP stands for papaya seed powder. * stands for significant values. NS stands for non-significant values. The results are non-significant if $p>0.05$, n=3.

Conclusion

The research concludes that malnutrition is a major global concern, closely linked to food security and food waste. As the world population continues to grow, ensuring proper food consumption and recycling is essential to meet the challenges of food availability. The demand for dairy products and meat is increasing, making meat an important component of a healthy diet. The study focuses on utilizing industrial by-products, specifically papaya seeds, as a supplement in broiler chicken feed to address mineral deficiencies. The objectives of the study were to investigate the effects of papaya seeds on broiler growth, performance, and meat quality. The results indicated that the supplementation of papaya seeds did not significantly affect feed intake, live-broiler weight, or weight gain. Feed conversion ratios were similar among treatments. There was a slight increase in carcass weight with higher papaya seed inclusion, but no significant impact on organ weight.

Conflict of Interest

The authors declare no conflict of interest.

Acknowledgement

I hereby declare that the content of the thesis ***"Dietary Incorporation of Papaya Seeds for Determining its Effect on Broiler Growth and Meat Quality"*** is my own research, and no part has been copied from any published source (except the references, standard mathematical models / equations / formulae / protocols, etc.). I further declare that this work has not been submitted for the award of any other diploma / degree. The university may take action if the information provided proved to be inaccurate at any stage. In case of any fault, the scholar will be proceeded against as per HEC plagiarism policy.

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