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Effect of Dietary Inclusion of Papaya Peel Powder on Serum biochemical and Carcass Parameters of Japanese Quails

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ABSTRACT

The present study was carried out to assess the effect of dietary inclusion of Papaya Peel Powder (PPP) on serum biochemical and carcass parametes of Japanese quails. Day old Quails (N=150) were distributed randomly to five groups each with three replicates of 10 birds and were maintained under uniform management conditions. Experimental diets were prepared with inclusion of PPP at 0, 1.5, 3.0, 4.5 and 6.0 percent respectively, and were fed for a period of 0-5 weeks. The serum biochemical profile of quails revealed that there was significant increase ($P<0.01$) in serum total protein, albumin, A/G ratio, HDL-C, calcium and phosphorus with increasing levels of PPP. Whereas, significant decrease ($P<0.05$) in serum cholesterol and LDL-C was observed from 0 to 6% inclusion of PPP in diet. Pre slaughter live weight, carcass weights and dressing percentage were significantly ($P<0.01$) increased in PPP supplemented groups (up to 3%) as compared to control group. Colour, juiciness, tenderness and overall acceptability of meat were increased significantly ($P<0.01$) up to 6.0% PPP inclusion. Based on the results, it can be concluded that PPP can be incorporated up to 6.0% level in the diet for the production of healthy quail and meat with better organo leptic characters.

KEY WORDS: Carcass traits Japanese Quail, Lipid profile Papaya peel powder

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INTRODUCTION

Rearing of Japanese quail is gaining momentum among small and marginal farmers as to gain subsidiary income and an alternative means to meet the demand for meat and eggs of consumers. Quails require high protein diets (24%) when compared with chicken (NRC, 1994). Soybean meal is the major protein ingredient used in quail diet but the cost is more and competes with human food. So there is a need to look for suitable unconventional feed stuffs which increases the possibility of reducing the cost of production. Consumers demand towards food that is enriched with antioxidants, vitamins..viz is increasing day by day. To produce a quality meat, Papaya peel is one, among such cheaply available nutritionally rich protein source and with more antioxidant properties for feeding poultry.

Carica papaya L. belongs to the family of Caricaceae. Papaya (*Carica papaya*) peel has relatively high protein (18.2%) and fibre (11.9%) and low in fat (1.34%) (Omole et al., 2008; Kamaruzzaman et al., 2005). Papaya peel is reported to have antihelmintic, antibacterial and anti coccidial activities (Chota et al., 2010) due to the presence of polyphenols, mainly catechins (Ahn, 2011). This peel is available in plenty from fruit vendors, and also as waste material from food processing industry. Works on inclusion of PPP in diets of quail is scanty. Hence, the current study was carried to assess the impact of PPP in diet of quails on serum biochemical parameters and meat quality to determine health of quail as well as product from quail.

MATERIALS AND METHODS

Diets

Papaya Peel was procured from surrounding areas of the Institute. The peels were then chopped into smaller pieces and shade dried for 72 hours and powdered and stored in air tight container. The proximate composition of Papaya peel powder (PPP) and other feed ingredients utilized in this experiment

and the experimental diets were analyzed as per AOAC (2007). Experimental diets were prepared with inclusion of PPP at 0, 1.5, 3.0, 4.5 and 6.0 percent in T1, T2, T3, T4 and T5, respectively by marginal adjustment with other feed ingredients. All the rations were made isocaloric and isonitrogenous (Table 1).

Table 1. Ingredient and nutrient composition of experimental diets (100kg)

Ingredients(kg)	T1 (0%)	T2 (1.5%)	T3 (3.0%)	T4 (4.5%)	T5 (6.0%)
Maize	52.0	51.0	49.7	48.5	47.0
Soybean meal	42.0	41.5	41.0	40.5	40.2
De-oiled rice bran	0.0	0.0	0.0	0.0	0.2
Papaya peel powder(PPP)	0.0	1.5	3.0	4.5	6.0
Lime stone	1.3	1.3	1.3	1.3	1.3
Common salt	0.3	0.3	0.3	0.3	0.3
MHA	0.1	0.1	0.1	0.1	0.1
Trace minerals*	0.1	0.1	0.1	0.1	0.1
Liver tonic	0.1	0.1	0.1	0.1	0.1
Vitamins#	0.01	0.01	0.01	0.01	0.01
Dicalcium phosphate	1.0	1.0	1.0	1.0	1.0
Coccidiostat	0.1	0.1	0.1	0.1	0.1
Palm oil	3.1	3.1	3.4	3.6	3.7
Total	100.0	100.0	100.0	100.0	100.0
		Nutrient composition (analysed values)			
ME$ (Kcal/Kg)	2905	2910	2906	2915	2915
CP %	23.8	23.9	24.0	24.1	24.3
Ca %	0.81	0.91	0.92	1.02	1.05
Total Phosphorus %	0.76	0.52	0.67	0.56	0.66

*Manganese sulphate 55g, Ferrous sulphate 50g, zinc sulphate 50g, cobalt sulphate 0.5g, copper sulphate 3g, potassium Iodide 3g, sodium selenite 0.5g in 1 kg

Vitamin A-12.50 MIU, D_3-2.50 MIU, E-8g, K-1.50g, B_1-1g, B_2-5g, B_6-1.50g, B_{12}-0.02g, Calcium D Pantothenate-5g, Folic acid-0.25g, Niacin-12g in a 250g pack

$ calculated

Experimental birds, management and analysis

One hundred and fifty day-old Japanese quail chicks were weighed individually, wing banded and randomly divided into five equal groups of three replicates each with 10 chicks. Each group was allotted to one of the dietary treatments at random. The experiment was conducted from 0-5 weeks of age. All the quail chicks were housed in 5-tier battery cages throughout the experiment under uniform environment conditions. Feed and water were provided *ad libitum*.

Serum biochemical profile: Blood samples were collected from two birds/ replicate at the end of the experiment into anticoagulant free vials and allowed to clot so that the serum got separated. The separated serum was then made clear by centrifugation at 3000 rpm for 10 minutes and stored in a refrigerator at -20! for estimation of serum parameters. Serum parameters like protein and albumin were estimated by using kits. Globulin was derived by subtracting albumin value from total protein, A:G ratio was calculated. Serum lipid profile was done by using kits. Serum cholesterol was estimated colorimetrically by using a diagnostic kit (M/s. ERBA) by enzymatic method of Allian et al. (1974) for *in vitro* estimation.

HDL cholesterol was estimated by using diagnostic kit (M/s. ERBA Diagnostics Mannheim GnbH) by advanced Homogenous Micelle Technology following Trinders reaction. Serum

triglycerides were estimated by using diagnostic kit (M/s. ERBA) by GPO-TRINDER end point method. Other parameters like SGOT, SGPT, Calcium, Phosphorus, BUN and Creatinine were estimated by using kits.

Carcass characteristics and meat quality

At the end of the trial period (5th week), two birds per replicate and thus a total of six birds per treatment were randomly selected, weighed and slaughtered. The data on carcass yield, dressing percentage, ready-to-cook yield, and weight of heart, liver and gizzard were collected, weighed and recorded. Thus relative weights (% of live body weight at slaughter) of carcass yield plus total edible organs were calculated. pH of the meat sample was determined by following the method of Trout et al. (1992) using deluxe digital pH meter (model 101E). The water holding capacity of the meat samples were measured according to the method as described by Wardlaw et al. (1973). For sensory evaluation of meat, the meat samples were cooked and subjected to ten member taste panel for sensory evaluation of colour, appearance, flavour, juiciness, tenderness and overall acceptability on a nine point Hedonic scale.

Statistical analysis

Statistical analysis of the data was carried out according to the procedures suggested by Snedecor and Cochran (1989). The data obtained were subjected to one-way ANOVA. Differences between means were tested at the 5% probability level using Duncan's (1955) LSD test.

RESULTS AND DISCUSSION

The analysed nutrient composition of PPP fed to quails during the experiment were 93.8, 88.4, 18.5, 1.34, 11.9, 56.6, 11.5, 0.59, 3.28 and 0.45% as dry matter (DM), organic matter (OM), crude protein (CP), ether extract (EE), crude fibre (CF), nitrogen free extract (NFE), Total ash (TA), acid in soluble ash (AIA), calcium (Ca) and total phosphorus (P) respectively, whereas, ME value was 2818 kcal/kg (Calculated value).

Effect on serum profile

The mean serum total protein, albumin and A/G ratio were increased significantly (P<0.01) with increasing levels (0, 1.5, 3.0, 4.5 and 6.0%) of PPP in the diet of quails (Table. 2). Corresponding to the present results, Bolu et al. (2009) and Ezenwosu et al. (2022) revealed that total serum protein level and albumin values were significantly(P<0.05) increased as dried papaya seed (DPS) and papaya leaf extract (PLE) increased respectively, in broiler diets. In contrary, Muazu and Aliyu-paiko (2020) reported that the addition of papaya seed powder (PSP) had no significant (P >0.05) effect on serum total protein level. Sugiharto et al. (2021) found that serum total protein and albumin values were significantly (P <0.01) decreased in 2.5% sprouted-papaya seed meal (SPSM) fed group. PPP had no effect (P >0.05) on serum globulin level (Table.2). Similarly, Ezenwosu et al. (2022) reported that the inclusion of PLE had no significant (P >0.05) effect on serum globulin values in broilers. In contrary, Bolu et al. (2009) revealed that total serum globulin level was significantly (P <0.05) increased as DPS increased in broiler diets. This variation might be due to part of papaya incorporation in diets.

Table 2. Effect of feeding graded levels of PPP on serum biochemical profile of J. quail

Treatment (PPP%)	Total protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	A/G ratio
T1 (0.0)	5.40^{c}±0.08	2.18^{c}±0.06	3.21±0.05	0.68^{c}±0.02
T2 (1.5)	5.71^{b}±0.06	2.45^{b}±0.04	3.26±0.07	0.75^{b}±0.03
T3 (3.0)	5.76^{b}±0.14	2.55^{b}±0.07	3.21±0.09	0.79^{ab}±0.03
T4 (4.5)	5.98^{ab}±0.07	2.73^{a}±0.05	3.25±0.03	0.84^{a}±0.01
T5 (6.0)	6.13^{a}±0.05	2.83^{a}±0.03	3.30±0.04	0.85^{a}±0.01
SEM	0.06	0.05	0.03	0.02
n	6	6	6	6
P	0.001	0.001	0.854	0.001

Values bearing different super scripts within the column differ significantly.

Effect on Serum lipid profile

Serum total cholesterol and LDL cholesterol were significantly (P<0.01) decreased in quails with increased levels of PPP in the diet (Table 3). The results are in corroboration with the findings of Oloruntola et al. (2018) who reported that supplementation of leaf meals showed significantly (P<0.05) lowered serum cholesterol and LDL cholesterol levels compared with control group. In contrary to present findings, Ezenwosu et al. (2022) reported that the inclusion of PLE significantly (P<0.05) increased the serum cholesterol levels and no significant effect (P>0.05) on serum LDL cholesterol in broilers. Serum HDL cholesterol was significantly (P<0.01) increased in quails with increased levels of PPP in the diet (Table 3). The results are in corroboration with the findings of Sugiharto et al. (2021) who observed that feeding SPSM at 2.5% resulted in higher (P<0.05) serum HDL-C level than either the control or papaya seed meal (PSM) diet. Tamiru et al. (2021) and Ezenwosu et al. (2022) concluded that serum HDL-C levels were significantly (P<0.05) increased with increasing papaya pomace meal (PPM) and PLE levels respectively, compared to control group.

There was no significant difference (P>0.05) in serum VLDL cholesterol and triglyceride values with increase in PPP in diet (Table 3). The results obtained in the present study was in agreement with those of Tamiru et al. (2021) where, the inclusion of PPM had no significant (P>0.05) effect on serum triglyceride values in laying hens. Increased fiber content in diet with increased incorporation of PPP in diet may be the reason for hypolipdemia in the groups with high PPP. According to Sarikhan et al. (2009), consuming insoluble fibre may increase bile acid and cholesterol excretion in the faeces, which lowers the levels of cholesterol, triglycerides, and LDL-cholesterol in the blood of broilers.

Table 3. Effect of feeding graded levels of PPP on serum lipid profile of J. Quail (mg%)

Treatment (PPP %)	Total Cholesterol	HDL Cholesterol	LDL Cholesterol	VLDL Cholesterol	Triglycerides
T1 (0.0)	185^{a}±0.47	92.3^{d}±1.05	61.9^{a}±0.75	30.9±0.16	154±0.84
T 2(1.5)	181^{b}±1.72	94.6^{cd}±0.76	56.2^{b}±1.66	30.6±0.17	153±0.88
T 3(3.0)	179^{b}±2.17	96.1^{bc}±0.74	52.5^{b}±1.72	30.5±0.14	152±0.71
T 4(4.5)	173^{c}±0.89	98.2^{b}±1.01	42.5^{c}±0.97	30.4±0.15	152±0.76
T 5(6.0)	171^{c}±0.58	101^{a}±1.33	41.4^{c}±1.72	30.3±0.28	1518±1.40
SEM	1.10	0.72	1.57	0.09	0.43
n	6	6	6	6	6
P	0.001	0.001	0.001	0.289	0.289

Values bearing different super scripts within the column differ significantly.

Effect on liver enzymes

Inclusion of PPP up to 6.0% level in the diet had no effect (P>0.05) on SGOT content (IU/L) and SGPT content (IU/L) of quails as compared to the control (Table 4). Corroborating to the findings of the present study, Muazu and Aliyu-paiko (2020) and Tamiru et al. (2021), reported that there was no significant (P>0.05) effect on SGPT and SGOT levels of birds fed PSP and PPM respectively. Contradicting the present findings, Bolu et al. (2009) noticed that the SGOT and SGPT levels in dried papaya seed (DPS) fed birds were significantly (P<0.05) higher than that of control. The liver is reported to contain enzymes like SGOT and SGPT, it releases these enzymes into blood stream when it got damaged (Sherwin, 2003). Elevation of SGOT and SGPT can occur with states of altered hepatocellular membrane permeability either due to circulatory hypoxia, exposure to toxins and toxemia, inflammation, metabolic disorders or proliferation of the hepatocyte. Thus, no effect on SGOT and SGPT levels in the present study may collectively reflect the normal liver and intestinal functions of quail fed diets with PPP. This further indicates that inclusion

of PPP in diets did not have a detrimental effect on Japanese quail health.

Effect on minerals

Inclusion of PPP up to 6.0% level in the diet of quails showed that significant (P<0.01) increase in serum calcium and phosphorus content with increasing levels of PPP up to 6.0% in the diet (Table 4). These results are very much in line with the Ezenwosu et al. (2022) where, PLE caused significant (P<0.01) increase in serum calcium and phosphorus values among the treatment groups.

Effect on kidney function

In the present study supplementation of PPP up to 6.0% level in the diet had no effect on serum blood urea nitrogen content (mg/dl) and serum creatinine content (mg/dl) of quails (Table 4). The results are in corroboration with the findings of Ezenwosu et al. (2022) and Muazu and Aliyu-paiko (2020) who reported that the inclusion of PLE and PSP had no significant effect on serum urea levels and creatinine levels respectively, in broilers. Contradicting to the present findings, Bolu et al. (2009) noticed that the serum urea levels and creatinine levels were significantly (P<0.05) increased with increase of dried papaya seed (DPS) in broiler diets. Creatinine has been generally used as a marker for protein metabolism. During stressful situations, higher levels of corticosterone are typically linked to increased muscle protein catabolism and, as a result, higher levels of creatinine in the circulation (Sugiharto, 2021). Thus, no effect on serum creatinine content observed in the present study indicates that PPP might help quails to cope up with stressful conditions. Serum glucose was not influenced by the increasing levels of PPP in the diet (Table 4). The results obtained in the present study was in disagreement with those of Bolu et al. (2009) and Ezenwosu et al. (2022) who noticed that the serum glucose level was significantly (P<0.05) increased with increase of DPS and PLE respectively, in broiler diets.

Table 4. Liver and kidney function of Japanese quail fed with varying levels of PPP from day old to five weeks of age

Treatment (PPP%)	SGOT (IU/L)	SGPT (IU/L)	Serum Calcium(mg/dl)	Serum phosphorus (mg/dl)	Serum BUN (mg/dl)	Serum Creatinine (mg/dl)	Serum Glucose(mg/dl)
T1 (0.0)	245±0.44	23.3±0.52	8.07^{b}±0.19	6.45^{b}±0.11	2.25 ± 0.16	0.53 ± 0.03	117 ± 0.62
T 2(1.5)	245±0.51	23.5±0.31	8.11^{b}±0.09	6.64^{b}±0.14	2.15± 0.23	0.51 ± 0.05	118 ± 1.01
T 3(3.0)	245±0.66	23.6±0.42	8.30^{b}±0.15	6.74^{b}±0.10	1.95 ± 0.08	0.47± 0.03	119 ± 1.23
T 4(4.5)	244±0.72	23.7±0.27	8.45^{b}±0.09	6.77^{b}±0.08	1.85 ± 0.67	0.45 ± 0.02	120 ± 0.95
T 5(6.0)	245±0.22	23.3±0.19	8.85^{a}±0.12	7.14^{a}±0.08	1.80 ± 0.68	0.43 ± 0.02	120 ± 1.31
SEM	0.24	0.15	0.08	0.06	0.06	0.01	0.48
N	6	6	6	6	6	6	6
P	0.462	0.91	0.002	0.002	0.124	0.284	0.249

Values bearing different super scripts within the column differ significantly

Effect on carcass traits

Significantly higher (P<0.05) pre slaughter live weights were observed in groups fed upto 3% level and lowest in control group (Table 5). The results are similar with observations of Motin and Mostofa (2000) who reported that pre-slaughter live weights were significantly (P<0.01) higher in NNP (Neem, nishyinda and papaya leaves) treated group compared to control. In contrast, Kamaruzzaman et al. (2005) reported that the addition of dried papaya skin had no significant effect (P> 0.05) on the slaughter weight of broilers. Sitanggang et al. (2020) reported that Papaya leaf flour and Turmeric leaf flour had no significant effect (P>0.05) on the slaughter weight of broilers.

In the present study, feeding varying levels (0, 1.5, 3.0, 4.5 and 6.0%) of PPP showed no significant effect (P>0.05) on percent liver, heart and gizzard weights in quails (Table 5). The results are similar with observations of Abdalla et al. (2013), who represented that DPLP had no significant (P>0.05) effect on liver weights of spent hens. In contrast, Oloruntola et al. (2018) revealed that there was a significant (P<0.01) decrease in liver weight at 5% PLM compared to the control. Whereas, Motin and Mostofa (2000), Kamaruzzaman et al. (2005) and Onyimonyi and Ernest (2009) who reported that significantly (P<0.05) higher liver weights in broilers fed NNP, 120 g/kg of DPS, 2 % PLM respectively compared to control.

These findings of heart weights are in corroboration with Haruna and Odunsi (2018); Oloruntola et al. (2018) and Oloruntola et al. (2020) who reported that there was no significant difference in heart weight. In contrast, Motin and Mostofa (2000) concluded that there was a significant (P<0.05) increase in heart weight in treatment group compared to control. These findings of gizzard weghts are in corroboration with Motin and Mostofa (2000) and Sorwar et al. (2016) who concluded that there was no significant (P>0.05) difference on gizzard weight among dietary groups. In contrast, Haruna and Odunsi (2018) reported that significantly (P<0.05) higher gizzard weights in all PL supplemented groups than control.

Significantly (P<0.01) higher carcass weights were observed in groups fed with 3% level and lowest in control group (Table 5). The results are similar with observations of Laurentius et al. (2016) who reported that there was a significant (P<0.05) increase in carcass weight compared to the control. In contrary, Bolu et al. (2009) revealed that DPS did not affect the carcass weight significantly (P>0.05). Oloruntola (2019) and Sitanggang et al. (2020) showed that there was no significant (P>0.05) effect on the carcass weight of broiler chicken by supplementation of PCM and PLF respectively.

Significantly higher (P<0.01) dressing percentage was observed in groups fed with 3% level and lowest in control group (Table 5). The results were similar with observations of Onyimonyi and Ernest (2009) who revealed that the inclusion of PLM in the diets of broilers significantly (P<0.05) enhanced the dressing percentage compared to control. In contradiction, Motin and Mostofa (2000) reported that NNP had no significant (P>0.05) effect on dressing percentage. Similarly, Haruna and Odunsi (2018) observed no significant (P>0.05) difference in dressing percentage in birds fed with PL at 0, 3, 6 and 9% when compared to control.

Table 5. Effect of feeding graded levels of PPP on carcass traits of J. quail

Treatment (PPP %)	Carcass traits						
	Pre slaughter live weight(g)	Liver weight (%)	Heart weight (%)	Gizzard weight (%)	Giblet weight (%)	Carcass weight (g)	Dressing percentage
T1 (0.0)	180^{d}±2.40	3.16±0.15	1.51±0.13	3.10±0.23	7.78±0.34	121^{d}±1.70	67.7^{b}±1.32
T2 (1.5)	192^{b}±1.04	3.01±0.33	1.24±0.03	2.57±0.19	6.83±0.37	133^{b}±1.02	69.3^{b}±0.39
T3 (3.0)	203^{a}±1.16	3.49±0.04	1.21±0.03	2.65±0.10	7.37±0.11	147^{a}±1.08	72.5^{a}±0.82
T4 (4.5)	194^{b}±0.76	3.04±0.15	1.31±0.07	2.54±0.18	6.90±0.18	134^{b}±0.92	69.3^{b}±0.42
T5 (6.0)	184^{c}±1.17	3.11±0.24	1.31±0.09	3.01±0.18	7.43±0.41	126^{c}±0.88	68.3^{b}±0.63
SEM	1.58	0.14	0.05	0.10	0.21	1.68	0.45
N	6	6	6	6	6	6	6
P	0.001	0.491	0.134	0.115	0.188	0.001	0.003

Values bearing different super scripts within the column differ significantly

The present study revealed that inclusion of PPP up to 6.0% in the diet from day old to 5 weeks of age had no effect on pH, ERV, WHC of quail meat (Table 6). ERV values were observed in the range of 19 to 21. WHC values were observed in the range of 22.8 to 24.1. The pH was ranged from 5.36 to 5.57 in the present study. These values were within the normal range.

Table 6. Mean meat pH, ERV and WHC of Japanese quail fed with varying levels of PPP from day old to five weeks.

Treatment / PPP (%)	pH	ERV	WHC
T1 (0.0%)	5.45±0.12	20±0.50	24.1±0.70
T2 (1.5%)	5.36±0.06	21±0.76	23.2±0.54
T3 (3.0%)	5.41±0.08	21±0.57	22.8±0.60
T4 (4.5%)	5.57±0.65	19±0.31	23.5±0.76
T5 (6.0%)	5.48±0.10	21±0.79	23.3±0.76
SEM	0.389	0.294	0.294
n	6	6	6
P	0.548	0.119	0.716

Values bearing different super scripts within the column differ significantly
pH:Potential of Hydrogen, ERV: Extract Release Volume, WHC: Water Holding Capacity

The mean sensory evaluation scores of Japanese quail meat was significantly (P<0.01) increased in treatment groups pertaining to colour, juiciness, tenderness and overall acceptability (Table 7) over the control group in this study. The highest score for overall acceptability was recorded at highest level (6%) of incorporation in diet in current study. Papain is commonly used to get softness to meat while cooking and it had properties to improve the colour through oxycarotenoids which impart yellow colour to broiler meat (Opara, 1996). This might be the reason for increased overall acceptability with increased levels of PPP in diet. Similarly, Onyimonyi and Ernest (2009) reported that the organoleptic evaluation of cooked meat for sensory attributes, viz. appearance, flavour, juiciness, tenderness showed significantly (P<0.01) higher values in PLM fed groups than control in broiler chicken. Abdalla et al. (2013) noticed that addition of dried papaya leaves powder to spent hen ration had significantly (P<0.05) increased the tenderness of meat.

Table 7. Mean scores for sensory evaluation of meat of Japanese quail fed with varying levels of PPP

Treatment/ PPP (%)	Colour	Flavour	Juiciness	Tenderness	Overall acceptability
T1 (0.0%)	7.41^{c}±0.17	7.13±0.07	7.88^{b}±0.11	7.10^{c}±0.12	8.21^{b}±0.05
T2 (1.5%)	7.65b^{c}±0.13	7.18±0.09	8.03^{b}±0.18	7.15^{bc}±0.14	8.33^{b}±0.07
T3 (3.0%)	7.86^{b}±0.08	7.33±0.17	8.11^{b}±0.10	7.20^{bc}±0.06	8.52^{a}±0.09
T4 (4.5%)	7.90^{b}±0.07	7.55±0.17	8.28^{ab}±0.15	7.48^{ab}±0.09	8.58^{a}±0.83
T5 (6.0%)	8.30^{a}±0.13	7.36±0.10	8.51^{a}±0.07	7.71^{a}±0.11	8.49^{a}±0.55
SEM	0.137	0.232	0.067	0.063	0.050
N	6	6	6	6	6
P	0.001	0.227	0.022	0.002	0.001

Values bearing different super scripts within the column differ significantly

CONCLUSION

Based on the results, it can be concluded that PPP can be incorporated up to 6.0% level in the diet for the production of healthy quails and meat with better organoleptic characters.

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REFERENCES

Abdalla, H. O., Ali, N. N. A., Siddig, F. S. and Ali, S. A. M. 2013. Improving tenderness of spent layer hens meat using papaya leaves (*Carica papaya*). Pakistan Veterinary Journal. 33(1): 73-76.

Ahn, J. 2011. Characterization of (+)-catechin and quercetin from pawpaw pulp. Doctoral dissertation, Ohio University.

AOAC. 2007. Official methods of analysis. 18th Edn. Association of Analytical Chemists, Washington, D.C, USA.

Bolu, S. A. O., Sola-Ojo, F. E. and Olorunsanya, O. A. 2009. Effect of graded levels of dried pawpaw (*Carica papaya*) seed on the performance, haematology, serum biochemistry and carcass evaluation of chicken broilers. International Journal of Poultry Science. 8(9): 905-909.

Chota, A., Sikasunge, C. S., Phiri, A. M., Musukwa, M. N., Haazele, F. and Phiri, I. K. 2010. A comparative study of the efficacy of piperazine and *Carica papaya* for the control of helminth parasites in village chickens in Zambia. Tropical Animal Health and Production. 42(3): 315–318.

Duncan, D. B. 1955. Multiple range and multiple F tests. Biometrics. 11; 1-42.

Ezenwosu, C., Okeke, C. O. and Machebe, N. S. 2022. The Impact of Pawpaw (*Carica papaya)* leaves extract on some biochemical markers, organ and carcass traits of broiler chickens in Nsukka-Nigeria. Asian Journal of Research in Biosciences. 4(2):7-14.

Haruna, M. A. and Odunsi, A. A. 2018. Growth performance and carcass quality of broiler chickens fed dried pawpaw (*Carica papaya linn*) latex. Journal of World Poultry Research. 8(2): 31-36.

Kamaruzzaman, M., Chowdhury, S. D., Podder, C. K. and Pramanik, M. A. H. 2005. Dried papaya skin as a dietary ingredient for broiler chickens. British Poultry Science. 46(3): 390-393.

Laurentius, R., Endang, P., Ivonne, M.U. and Wisje L. T. 2016. The effect of papain crude extract addition in diets on broilers production performances. Animal Production. 18(1):30-35.

Motin, K. J. A. and Mostofa, M. 2000. Effects of Neem, Nishyinda and Papaya leaves as growth promoters in broiler chicks. Journal of Natural and Social Sciences. 2(2): 49-55.

Muazu, U. and Aliyu-paiko, M. 2020. Evaluating the potentials of *Carica papaya* seed as

phytobiotic to improve feed efficiency, growth performance and serum biochemical parameters in broiler chickens. IOSR Journal of Biotechnology and Biochemistry. 6(1): 8-18.

NRC.1994. Nutrient requirements of Poultry. 9th Revised Edn. National Academy of Sciences. National Academy Press, Washington, D.C, USA.

Oloruntola, O. D. 2019. Effect of pawpaw leaf and seed meal composite mix dietary supplementation on haematological indices, carcass traits and histological studies of broiler chicken. Bulletin of the National Research Centre. 43(1): 1-12.

Oloruntola, O. D., Ayodele, S. O. and Oloruntola, D. A. 2018. Effect of pawpaw (*Carica papaya*) leaf meal and dietary enzymes on broiler performance, digestibility, carcass and blood composition. Revue d'élevage et de médecine vétérinaire des pays tropicaux. 71(3): 121-129.

Oloruntola, O. D., Ayodele, S. O., Adeyeye, S. A., Jimoh, A. O., Oloruntola, D. A. and Omoniyi, I. S. 2020. Pawpaw leaf and seed meals composite mix dietary supplementation: effects on broiler chicken's performance, caecum microflora and blood analysis. Agro-forestry Systems. 94(2): 555-564.

Omole, A. J., Ajasin, F. O., Oluokun, J. A., Obi, V. and Owosibo, A. 2008. Performance characteristics of weaned rabbits fed plantain peel as replacement for maize (review). Nutrition and Food Science. 38: 559– 563.

Onyimonyi, A. E. and Ernest, O. 2009. An assessment of pawpaw leaf meal as protein ingredient for finishing broiler. International Journal of Poultry Science. 8(10): 995-998.

Opara, C.C. 1996. Studies on the use of *Alchornia cordifolia* leaf meal as feed ingredient in poultry diets. M.Sc Thesis, Federal University of Technology, Owerri, Nigeria.

Sarikhan, M., Shahryar, H. A., Nazer-Adl, K., Gholizadeh, B. and Behesht. B. 2009. Fecal excretion of cholesterol and bile acids. International Journal of Agricultural Biology. 11(1):73-76.

Sherwin, J.E. 2003. Liver Function. In: Clinical Chemistry: Theory, Analysis, Correlation, Kaplan LA, Pesce AJ, Kazmierczak SC, (Eds.). 4th Edn, Chapter 27, Elsevier Science, St. Louis, MO., USA, ISBN-13: 9780323017169, 492-506.

Sitanggang, R. D. P., Umar, S. and Ginting, N. 2020. The effect of papaya leaf flour and turmeric flour on the broiler carcasses. Journal Peternakan Integratif. 8(1):15-18.

Snedecor, G.W. and Cochran W.G. 1989. Statistical Methods (9th Edn). Iowa State University Press, IOWA, USA.

Sorwar, M. G., Mostofa, M., Hasan, M. N., Billah, M. and Rahman, M. T. 2016. Effect of kalo jeera seeds and papaya leaf supplementation on the performance of broiler. Bangladesh Journal of Veterinary Medicine. 14(1): 37-42.

Sugiharto, S., Widiastuti, E., Isroli, I., Wahyuni, H. I. and Yudiarti, T. 2021. Effect of a fermented mixture of papaya leaf and seed meal on production traits and intestinal ecology of the Indonesian indigenous crossbred chickens. Acta Universities Agriculture et Silviculture Mendelianae Brunensis. 68(4): 707–718.

Tamiru, B., Alkhtib, A., Tamiru, M., Demeke, S., Burton, E., Tolemariam, T., Debela L. and Janssens, G. P. 2021. Evaluation of dried papaya pomace meal in laying hen diets. Veterinary Medicine and Science. 7(5): 1914-1920.

Trout, E.S., Hunt, N.C., Jhonson, D.E., Claus, J.R., Kastner, C.L. and Kropf, D.H. 1992. Chemical, physical and sensory characterization of ground beef containing 5 to 30% fat. Journal of Food Science. 57: 25-29.

Wardlaw, F. B., Maccaskill, L. H. and Acton, J. C. 1973. Effect of postmortem muscle changes in poultry meat loaf properties. Journal of Food Science. 38: 421–424.