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Papaya (*Carica papaya* Linn.) leaf meal as phytobiotic feed supplement improves the production performance of growing Japanese Quails

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Abstract

A feeding trial was conducted to determine the chemical composition of papaya leaf meal (PLM) and its effects on the production performance of growing Japanese quails. One hundred twenty female Japanese quails were randomly assigned into four dietary treatments and laid out in a Completely Randomized Design experimental set-up. The Japanese quails were fed with commercial ration supplemented with graded levels of papaya leaf meal, 0% (T_1), 5% (T_2), 10% (T_3), and 15% (T_4). The bi-weekly body weight gain (BWG), average daily gain (ADG), voluntary feed intake (VFI), and feed conversion ratio (FCR) were observed within 42 days experimental period. The chemical composition of PLM contains 10.72% moisture, 89.28% dry matter, 32.13% crude protein, 1.08% P, 3.34% K, 0.70% Ca, 0.19% Mg, 0.03 Fe (ppm), 0.0048 Zn (ppm), 0.03 Mn (ppm), and 0.0019 Cu (ppm). The results showed significant differences ($p<0.01$) on the final weight, and quails fed with 5% PLM is heavier than those fed without PLM. The VFI of the Japanese quails supplemented with 5% PLM is statistically comparable ($p<0.01$) to the quails fed with 0% and 10% PLM, while quails supplemented with 15% PLM got the lowest feed intake. Numerically, quails fed with 5% PLM improved the BWG, ADG, and FCR compared to the quails fed with 0%, 10%, and 15% PLM. In conclusion, 5% PLM as phytobiotic feed supplements into the diet of Japanese quails revealed better results without adverse effects on the economic traits and growth performance of growing Japanese quails.

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Introduction

The Japanese quail (*Coturnix japonica,* Temminck and Schlegel, 1849) is the smallest avian species and is recognized as a diversified poultry species for commercial meat and egg production (Alkan *et al.,* 2010). It is also reported that quails play a key role in the broiler sector, as they are more efficient in converting feed into meat (Khan *et al.,* 2016). The quail meat is lean, and eggs and meat are low in cholesterol, rich in unsaturated fatty acids, essential amino acids, vitamins, and phospholipids (Tarhyel *et al.,* 2012). Quail farming is a good investment for individuals with limited capital but who look for high returns in a short period of time. Moreover, quail rearing is becoming more popular, and it may be able to help close the gap between supply and demand in the meat industry (Genchev *et al.,* 2008).

One of the primary issues in quail production is the high feed cost, accounting for 70-80% of the total operating expenses (Bitancor, 2008). Moreover, specific quail rations are not widely accessible in the market. As a result, quail raisers tend to use broiler diets, even though quails require higher protein than chickens (BAR, 2012). Feeds provide and satisfy the nutritional requirements of the birds. Thus, the imbalance of nutrients given to quails will negatively affect the production performance. It is a constant challenge for the researchers to search for a new locally available and nutritious feed to meet the nutritional needs of the Japanese quails. Recently, the poultry growers utilized locally abundant plant sources that are phytobiotics and environmentally friendly to increase the production performance and immune system without the added cost of synthetic antibiotics (Mapatac, 2017). Using agricultural waste as a natural feed supplement is one way to lower the high cost of quail ration. Papaya (*Carica papaya* Linn.) from the Caricaceae family is one of the potential agricultural waste items that may be utilized as a natural feed supplement.

Papaya is one of the most grown tropical crops globally, and it is native to the tropics of America (Onyimonyi and Ernest, 2009). The fruit of this plant has a juicy taste. It is rich in antioxidant nutrients like carotene, vitamin B, vitamin C, folate, flavonoids, pantothenic acids, and minerals such as magnesium and potassium (Franco *et al.,* 1993; Fischer, 1998). The primary active ingredient of papaya is "papain" which is a Cysteine protease capable of improving protein digestion and utilization (Ebenebe *et al.,* 2011) and can form new proteins or protein-like compounds called plastering, which is the result of protein hydrolysis (Hasanah, 2005). Furthermore, papaya leaves contain papain (5.3%), a natural enzyme that helps in the digestion of proteins in the digestive tract, and vitamin C (286 mg/100 g), as well as vitamin E (30 mg/100 mg) (Singh *et al.,* 2011). Several studies on the utilization of papaya latex, leaves, peelings, and seeds meal were conducted as feed supplements in broiler chicken diets (Onyimonyi and Ernest, 2009; Feroza *et al.,* 2017; Haruna and Odunsi, 2018). However, limited information on the utilization of papaya leaf meals was conducted in Japanese quails. In view of its relative abundance in the study area, the present study was conducted to analyze the proximate analysis of papaya leaf meal and determine its potential as a phytobiotic feed supplement on the growth performance and economic traits of growing Japanese quails.

Methodology

Experimental birds, cages, and management

All procedures used in the study followed the Good Animal Husbandry practices guidelines in rearing poultry and livestock animal in the Philippines (PNS/BAFPS, 2008). One hundred twenty (120) female Japanese quails were used in the study and raised at the Poultry experimental house of the College of Agriculture, Sultan Kudarat State University – Lutayan Campus.

Before the arrival of the day-old quails, the brooding pen with a measurement of 4ft (length) × 2.5ft (width) and 1.5ft (height) was disinfected using the commercial disinfectant to prevent the occurrence of diseases. Old newspapers were used as bedding or litter and changed daily to avoid manure accumulation. As a means of artificial heating, two

50-watt electric bulbs were supplied to regulate their body temperature. The behavior of quails was also observed as a basis for the heat provided in the brooding pen. Commercial chick booster mash was fed ad libitum from 1-14 days in the brooding stage.

On the 15th day, the experimental quails were transferred to the grower-layer cages following the recommended space requirement of 16 inches per bird (Capitan, 2003), and the experimental ration for Japanese quails was provided. The PVC water pipe was used as feeders and waterers that measured 91.44cm long, 10.16cm wide, and 5.10cm in height. In addition, provisions for adequate ventilation and avoidance of extreme cold weather conditions were provided.

Feeding and water management

The experimental birds were supplied with their corresponding rations from 15th to 42nd days old on *ad libitum* basis. A separate feeder was provided, and feed refused was collected and weighed every morning. During the entire feeding trial, fresh and clean drinking water was provided.

Preparation of papaya leaf meal

Papaya leaves was collected at Barangay, San Jose, City of Koronadal. The leaves were air-dried for one week to retain their greenish color. After a week, the leaves were sundried for two (2) days, making them crispy to facilitate milling (Ebenebe *et al.,* 2011). The dried papa leaves were then hammer milled and sieved through 1mm to produce papaya leaf meal and stored in a large plastic container. The chemical composition of papaya leaf meal was analyzed following the official methods of the Association of Official and Analytical Chemists (AOAC, 2016).

Experimental design and diet

The experiment was carried out in a Completely Randomized Design experimental set-up replicated three (3) times, having ten (10) birds in every replication. The experimental treatments were as follows:

T_1 – Commercial ration + 0% Papaya leaf meal
T_2 – Commercial ration + 5% Papaya leaf meal
T_3 – Commercial ration + 10% Papaya leaf meal
T_4 – Commercial ration + 15% Papaya leaf meal

Statistical analysis

The data were analyzed using one-way analysis of variance (ANOVA), and the means were compared using Tukey's Honest Significant Difference (HSD). The Statistical Package of Social Science software, version 17.0, was used to analyze the data and results with $p<0.05$ were considered significant.

Results

Proximate analysis of papaya leaf meal

The chemical composition of papaya leaf meal (PLM) contained 10.72% moisture content (MC), 89.28% dry matter (DM), 32.13% crude protein (CP), 1.08% Phosphorus (P), 3.34% Potassium (K), 0.70% Calcium (Ca), 0.19% Magnesium (Mg,) 0.03ppm Iron (Fe), 0.0048ppm Zinc (Zn), 0.03ppm Manganese (Mn), and 0.0019 Copper (Cu) (Table 1).

Table 1. Proximate analysis of papaya leaf meal (PLM)

Component	Chemical analysis
Moisture Content (MC), %	10.72
Dry Matter (DM), %	89.28
Crude Protein (CP), %	32.13
Phosphorus (P), %	1.08
Potassium (K), %	3.34
Calcium (Ca), %	0.70
Magnesium (Mg), %	0.19
Iron (Fe), ppm	0.03
Zinc (Z), ppm	0.0048
Manganese (Mg), ppm	0.03
Copper (Cu), ppm	0.0019

The analysis was performed in triplicate (n = 3) samples following the methods described by the AOAC (2016) 20th edition.

Growth performance

The final weight of the Japanese quails supplemented with graded levels of PLM showed significant differences ($p<0.01$), where T_2 (5% PLM) is heavier than T_1 (0% PLM) (Table 2). Statistically, birds without PLM in the diet showed comparable to quails supplemented with 10% and 15% PLM.

The body weight gain (BWG) and average daily gain (ADG) were significantly affected ($p<0.05$) at 29-42days, where T_2 (5% PLM) obtained the highest weight gains but statistically comparable to all treatments. However, the final cumulative BWG and ADG from 15th to 42nd days revealed no significant differences ($p>0.05$) among treatments. Still, numerical values showed that quails supplemented with 5% PLM had the highest weight gains. In terms of the voluntary feed intake, quails with 0% PLM obtained the highest fed intake ($p<0.01$) but statistically comparable to T_2 (5% PLM) and T_3 (10% PLM), while quails in T_4 fed with 15% PLM got the lowest feed intake. The fed conversion ratio of the Japanese quails supplemented with graded levels of PLM was not statistically affected, but quails supplemented with 5% PLM showed better FCR than other treatments.

Table 2. Effects of papaya leaf meal on the growth performance of growing Japanese quail.

Parameters (days)	Treatments					
	T1 0%	T2 5%	T3 10%	T4 15%	CV[1]	p-value
Final Weight (g)						
15-28	91.33±2.08	93.33±1.15	91.33±2.52	89.00±2.00	2.191	0.148^{ns}
29-42	135.67±2.08^{b}	142.33±0.58^{a}	134.33±2.52^{b}	130.33±3.21^{b}	1.702	0.002**
15-42	135.67± 2.08^{b}	142.33 ±0.58^{a}	134.33± 2.52^{b}	130.33± 3.21^{b}	1.702	0.002**
Body weight gain (g)						
15-28	51.33± 0.58	53.33± 5.51	52.67± 1.15	50.67± 4.73	7.087	0.806^{ns}
29-42	44.33± 2.89^{ab}	49.00± 1.00^{a}	43.00±4.36^{ab}	41.33±1.53^{a}	6.233	0.045*
15-42	95.67± 3.21	102.33±5.13	95.67±3.79	92.00±5.00	4.520	0.100^{ns}
Average Daily Gain						
15-28	3.66±0.04	3.81±0.39	3.76±0.09	3.62±0.34	7.080	0.803^{ns}
29-42	3.17±0.21^{ab}	3.50±0.07^{a}	3.07±0.31^{ab}	2.95±0.11^{b}	6.229	0.046*
15-42	6.93±0.23	7.31±0.36	6.83±0.27	6.57± 0.36	4.520	0.101^{ns}
Voluntary Feed Intake (g)						
15-28	204.40±1.74^{a}	201.57±1.29^{ab}	200.83±1.53^{ab}	196.53±4.05^{b}	1.205	0.025^{ns}
29-42	273.40±2.17^{a}	271.90±1.73^{ab}	272.57±2.02^{a}	267.50±0.89^{b}	0.653	0.015**
15-42	477.80±2.79^{a}	473.47±2.55^{a}	473.40±2.85^{a}	464.03±4.37^{b}	0.682	0.005**
Feed Conversion Ratio(kg)						
15-28	3.98±0.07	3.81±0.37	3.81±0.07	3.89±0.27	6.059	0.776^{ns}
29-42	6.19±0.43	5.55±0.12	6.38±0.62	6.48±0.22	6.483	0.081^{ns}
15-42	5.00±0.19	4.64±0.21	4.94±0.22	5.05±0.23	4.320	0.150^{ns}

[1]CV: Coefficient of Variance; ns: not significant ($p>0.05$); ^{ab}Means ±SD with different superscripts in the same row differ significantly ($p<0.05$); * ($P<0.05$); ** ($P<0.01$).

Return above feed and chick cost (RAFCC)

The data indicated that quails in T_2 (5% PLM) obtained the highest RAFCC with 30.28PhP, followed by T_1 (0% PLM) with 28.16PhP, T_3 (10% PLM) with 26.86PhP while T_4 (15% PLM) got the lowest RAFCC (Table 3).

Discussion

The result of the proximate analysis indicates that PLM can be a good source of feedstuff. The moisture content (MC) of PLM contained 10.72% and a dry matter of 89.28% on a fed basis. According to PCAARRD (2000), the recommended MC of stored feedstuff must be less than 12% to prevent spoilage. Moreover, Mutayoba *et al.* (2011) and Hamito (2010) reported that feedstuff with a dry matter content of less than 85% is not recommended since mold growth will degrade feed quality, especially in tropical areas with high temperatures and relative humidity. The crude protein content of the PLM used in the current study is higher than the analysis reported by Onyimonyi and Ernest (2009) and Ebenebe *et al.* (2011), who reported that PLM has 30.12% and 28.20% CP, respectively. Moreover, the CP content of PLM is higher than the CP analysis of papaya seed meal reported by Bolu *et al.* (2009) with 30.08%. However, this CP analysis is higher compared to other plants such as *Azadirachta indica* leaf meal with 24.06% CP (Onyimonyi and Ernest, 2009), *Trichantera gigantea* leaf meal with 18.21% (Jaya *et al.*, 2008), and *Leucaena leucocephala* with 25.8% (Agbede and Aletor, 2004). The high CP content of the papaya leaf meal further suggests its potential as a feed supplement in diets for growing Japanese quails. The chemical composition of PLM also provides macro and micronutrients such as Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg), Iron (Fe), Zinc (Zn), Manganese (Mg), and Copper (Cu). The variation of the proximate chemical composition could be due to the harvesting interval, stage of maturity, soil fertility, and environmental and weather conditions (Mutayoba *et al.,* 2011), where plants are cultivated.

Table 3. Return Above Feed and Chick Cost (Php) per head of Japanese quails supplemented with graded levels of papaya leaf meal.

	Particular					
Treatments	Day-old quail (Php)	Feed Cost (Php)	PLM Cost (Php)	Total Operating Costs (Php)	Gross Income (Php)	RAFCC# (Php)
T_1 (Commercial ration + 0% PLM)	12	10.51	0.00	22.03	50.20	28.16
T_2 (Commercial ration + 5% PLM)	12	9.90	0.94	22.39	52.66	30.28
T_3 (Commercial ration + 10% PLM))	12	9.37	1.89	22.84	49.70	26.86
T_4 (Commercial ration + 15% PLM))	12	8.68	2.78	23.06	48.22	25.16

#All costs were shown in PhP (Philippine peso) 1 USD = 50.30 PhP

Feed consumption multiplied by current unit cost.

Total Operating Cost is the sum of prices of day-old quail, feed cost, and papaya leaf meal

Gross Income was based on the average final weight of quails and 35 pesos selling price on a live weight basis.

Return Above Feed and Chick Cost was based on the gross income minus price of quail chicks, feed cost, and papaya leaf meal.

The growth performance characteristics indicate that supplementation of graded levels of papaya meal significantly improves the final weight of the growing Japanese quails. The significant increase in the final weight of Japanese quails supplemented with PLM might be attributed to the crude protein content of PLM. The crude protein content of feedstuff plays an essential role in poultry nutrition as it serves vital metabolic functions, repairing body cells, building and constructing body tissues, and maintaining good health (Beski *et al.,* 2015). The cumulative findings of the body weight and average daily gain of quails with 5% PLM showed a numerical increase compared to birds fed without PLM and with 10% and 15% PLM in the diet.

The increase of the bodyweight gains could be due to the "papain" in PLM that did aid protein digestion. Furthermore, papain is a Cysteine protease capable of improving protein digestion and utilization and can form new proteins or protein-like compounds called plastering, which is the result of protein hydrolysis (Ebenebe *et al.*, 2011; Hasanah (2005). Thus, enhancing the release of amino acids which is necessary to enhance the growth performance of quails (Onyimonyi and Ernest, 2009).

The increase in the final weight of the Japanese quails supplemented with 5% PLM is comparable to the results of Bolu *et al.* (2009), who reported that 5% papaya seed meal obtained the highest final weight and more than 5% inclusion of papaya seed meal in a diet resulted in a decreased weight gain. The body weight gains of growing Japanese quails were not significantly affected. However, the numerical values revealed that the higher levels of PLM supplemented in the diet decrease the bodyweight gains. This observation might be a result of intrinsic anti-nutritional factors in PLM.

It is reported from the previous studies that papaya also contains some anti-nutritional factors. The anti-nutritional factors present in papaya include phytate, oxalate, condensed and hydrolyzable tannin (Adetuyi *et al.,* 2008; Adesuyi and Ipinmoroti, 2011). According to Nath and Dutta (2016), papaya leaves have 2.66% tannin and 3.57mg/ml saponin contents. Thus, higher levels of PLM supplemented in the diet may inhibit quails from absorbing and utilizing nutrients, including minerals.

There were significant differences in the voluntary feed intake of quails. Statistically, feed intake of quails supplemented with 0%, 5%, and 10% PLM is comparable, while quails supplemented with 15% PLM got the lowest feed intake. Although quails fed with 15% PLM got the lowest feed intake, the cumulative body weight gains from the whole duration of the feeding trial were not statistically affected.

The significant decrease in the feed intake might be due to the bitter taste of papaya leaf meal as it also contains Carpaine alkaloid (Julianti *et al.,* 2014). On the other hand, the FCR of quails was not statistically affected, but numerical data shows that quails supplemented with 5% PLM have better FCR than other treatments.

This finding is contrary to Ebenebe *et al.* (2011), who reported that birds supplemented with dried mushroom and papaya leaf meal had the highest FCR. However, the result of the present study is supported by Onyimonyi and Ernest (2009) and Kanyinji and Zulu (2014), who reported that papaya leaf meal supplementation significantly improves the FCR compared to the birds without PLM in the diet.

It should be noted that FCR is a rate that measures how efficient the bodies of quails convert feed into the required output, which indicates that the lower the number, the more efficient the birds are at converting feed to live weight.

In terms of the return above feed and chick cost, the data shows that quails with 5% PLM got the highest gross income and RAFCC with 52.66PhP and 30.28PhP, respectively. This would mean that supplementation of 5% PLM in growing quails positively impacted profit gaining. The inclusion of leaf meals in poultry rations has been proved to be a means of reducing cost and improving profit margin (D'Mello, 1995; Odunsi *et al.,* 1999; Onyimonyi and Ernest, 2009)

Conclusion

The results showed significant differences in the final weight and voluntary feed intake of growing Japanese quails. The VFI of quails supplemented with 5% PLM is statistically comparable to those fed with 0% and 10% PLM, while quails supplemented with 15% PLM got the lowest feed intake. Although quails fed with 15% PLM got the lowest feed intake, the cumulative body weight gains and FCR were not statistically affected. Numerically, quails fed with 5% PLM improved the BWG, ADG, and FCR compared to the quails fed with 0%, 10%, and 15% PLM. In terms of the return above fed and chick cost, quails supplemented with 5% PLM is more profitable. However, a future feeding trial in laying Japanese quails is recommended to assess the egg production performance and egg quality traits. In conclusion, 5% PLM as a phytobiotic feed supplement into the diet of Japanese quails can be a good source of feedstuff in growing Japanese quails without adverse effects on the economic traits and growth performance of Japanese quails.

Conflict of interest

The author declared no conflict of interest.

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References

Adesuyi AO, Ipinmoroti KO. 2011. The nutritional and functional properties of the seed flour of three varieties of *Carica papaya*. Current Research in Chemistry **3(1),** 70-75.
http://dx.doi.org/10.3923/crc.2011.70.75

Adetuyi FO, Akinadewo LT, Omosuli SV, Lola A. 2008. Antinutrient and antioxidant quality of waxed and unwaxed pawpaw C*arica papaya* fruit stored at different temperatures. African Journal of Biotechnology **7(16),** 2920-2924.

Agbede JO, Aletor VA. 2004. Chemical characterization and protein quality evaluation of leaf protein concentrates from *Glyricidia sepium* and *Leucaena leucocephala*. International Journal of Food Science and Technology **39,** 253-261.

Alkan S, Karabag K, Galic A, Karsli T, Balcioglu MS. 2010. Determination of Body Weight and Some Carcass Traits in Japanese Quails (*Coturnix coturnix japonica*) of different lines. Kafkas Universitesi Veteriner Fakultesi Dergisi **16(2),** 277-280.
http://dx.doi.org/10.9775/kvfd.2009.687

AOAC. 2016. Official Methods of Analysis of the Association of the Official Analytical Chemists. 20th ed. Washington, D.C., USA.

BAR. 2012. Bureau of Agricultural Research. Poultry/1334-chicken-production.
http://www.bar.gov.ph/agfishtech-home/livestock-poultry/216-

Beski SSM, Swick RA, Iji PA. 2015. Specialized protein products in broiler chicken nutrition: A review. Animal Nutrition **1(2),** 47-53.
http://dx.doi.org/10.1016/j.aninu.2015.05.005

Bitancor CE. 2008. Growing and Laying Responses of Quail Fed with Varying Levels of *Tricanthera gigantea* Leaf Meal. Masters of Science. College of Agriculture. Department of Animal Science, VSU, Visca, Baybay, Leyte.

Bolu SAO, Sola-Ojo FR, Olorunsanya OA, Idris K. 2009. Effect of Graded Levels of Papaw (*Carica papaya*) Seed on the Performance, Haematology, Serum Biochemistry and Carcass Evaluation of Chicken Broilers. International Journal of Poultry Science **8(9),** 905-909.

Capitan S. 2003. The Science and Practice of Quail Production. College of Agriculture. University of the Philippines Los Banos College, Laguna 4031, Philippines

D'Mello JPF. 1995. Leguminous leaf meals in Non-ruminant nutrition. In tropical legumens in Animal Nutrition. 1st ed. Wellingfox, Oxon, A.B International p 247-280.

Ebenebe CI, Itedue O, Ebere-Ohameje TC, Okonkwo JC. 2011. Fortification of the Nutririve Value of Mushroom (*Termitomyces microcarpus*) with Pawpaw Leaf Meal for Broiler Chicks Diet. Pakistan Journal of Nutrition **10(2),** 155-158.
http://dx.doi.org/10.3923/pjn.2011.155.158

Feroza A, Arijo AG, Zahid IR. 2017. Effect of papaya and neem seeds on *Ascaridia galli* infection in broiler chicken. Pakistan Journal of Nematology **35(1),** 105-111.
http://dx.doi.org/10.18681/pjn.v35.i01.p105-111

Genchev A, Mihaylova G, Ribarski S, Pavlov A, Kabakchiev M. 2008. Meat quality and composition in Japanese quails. Trakia Journal of Sciences **6(4),** 72-82.

Hamito D. 2010. Considerations in buying feed for sheep and goat production. Ethiopia Sheep and Goat Productivity Improvement Program (ESGPIP), p 13

Haruna MA, Odunsi AA. 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.

Hasanah E. 2005. Pengaruh Penambahan Antioksidan dan Pengkelat Logam Terhadap Aktifitas Proteolitik Enzim Papain. Skripsi Fakultas MIPA-IPB. Bogor.

Jaya A, Soriano M, Vallador D, Intong R, Carpentero B. 2008. Utilization of Madre De Agua (*Trichanthera gigantea* var. *guianensis*) Leaf Meal As Feed For Growing-Finishing Pigs. Philippine Journal of Veterinary and Animal Sciences **34(2),** 118-126.

Julianti T, Oufir M, Hamburger M. 2014. Quantification of the Antiplasmodial Alkaloid Carpaine in Papaya. Planta Medica **80,** 1138–1142. http://dx.doi.org/10.1055/s-0034-1382948

Kanyinji F, Zulu C. 2014. Effects of Partially Replacing Soybean Meal in Grower Diets with Pawpaw (*Carica papaya*) Leaf Meal on Nutrient Digestibility and Growth Performance of Japanese Quails (*Cortunix japonica*). International Journal of Livestock Research **4(5),** 7-14. http://dx.doi.org/10.5455/ijlr.20140729121259

Khan RU, Chand N, Ali A. 2016. Effect of Organic Acids on the Performance of Japanese Quails. Pakistan Journal of Zoology **48(6),** 1799-1803.

Mapatac L. 2017. Potency of Medicinal Leaves in the GrowthPerformance of Broiler Chicks. Recolitos Multidisciplinary Research Journal **3(1),** 197–206. https://doi.org/10.32871/rmrj1503.01.16

Mutayoba SK, Dierenfeld E, Mercedes VA, Frances Y, Knight CD. 2011. Determination of chemical composition and ant-nutritive components for tanzanian locally available poultry feed ingredients. International Journal of Poultry Science **10(5),** 350–357. https://doi.org/10.3923/ijps.2011.350.357

Nath R, Dutta M. 2016. Phytochemical and Proximate Analysis of Papaya (Carica papaya) Leaves. Scholars Journal of Agriculture and Veterinary Sciences **3(2),** 85-87.

Odunsi AA, Farinu GO, Akinola JO, Togun VA. 1999. Growth, carcass characteristics and body compositions of broiler chickens fed wild flower (*Tithonia diversifolia*) forage meal. Tropical Animal Production Investigation **2,** 205-211.

Onyimonyi AE, Ernest O. 2009. An assessment of Pawpaw leaf meal as protein ingredient for finishing broiler. International Journal of Poultry Science **8(10),** 995-998.

Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development. (PCAARRD). 2000. The Philippines Recommends for Livestock Feed Formulation **64,** 36-81.

PNS/BAFPS. 2008. Code of Good Animal HusbandryPractices. Philippine National Standard Bureau of Agriculture and Fisheries Product Standards **60,** 1-14.

Tarhyel R, Hena SA, Tanimomo BK. 2012. Effects of age on organ weight and carcass characteristics of Japanese Quail *(Coturnix japonica).* Scientific Journal of Agricultural **1(1),** 21-26.