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Comparative study on effect of feeding *Moringa oleifera* leaf powder on growth performance of Japanese quail under deep-litter and cage system of management

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Abstract
The present study was conducted to evaluate the growth performance of quails chicks by substituting the four different levels of *Moringa oleifera* leaf powder (0%, 1.5%, 3% and 4.5%) by weight basis in feed. A total of 216 day old chicks were selected and after two weeks of brooding they were randomly divided into four experimental groups. Each group was further subdivided into 3 replicas containing 9 chicks in each. Different combinations of feed were offered to them for a period upto 12 weeks. The findings of above research work showed that birds fed on diets containing *Moringa oleifera* leaf powder (MOLP) gains significantly higher body weight and having more body weight gain than that of birds feeding on control diet (0% MOLP).
It could be concluded that inclusion of MOLP at 1.5%, 3% and 4.5% in quails diet improved the growth performance than control diet however, the best result on growth performance was shown by the birds fed on 1.5-3% MOLP. Along with these the birds reared under cage system of management showed better growth performance over the deep-litter system of management.

Keywords: *Moringa oleifera* leaf powder (MOLP), Japanese quail, growth performance

Introduction
Japanese quail (*Coturnix coturnix japonica*) is the most efficient biological machine for converting feed into animal protein of high biological value and hence is the cheapest source of animal protein for human diets. The Japanese quails serve as a good source of food and provide good animal protein in many underdeveloped areas of world (Chaturvedi, 1973) [1]. Many of the Asian countries are suffering from deficiency of animal protein which can be obtained from milk, meat, fish, and eggs and from the poultry species.
In feed supplementation, herbal plant addition has an added advantage as it lacks any residual contamination effect. It has been observed that the production and other performances of animals vary under different managemental condition. As a herbal plant *Moringa oleifera* (The miracle plant) is having several properties, Which can enchance the growth and reproductive performance and immune status. Thus can act as enhancer of overall growth performance. India is the largest producer of Moringa. Best climatic requirement for growing Moringa is tropical or subtropical. Thus Jharkhand is suitable for production of Moringa and is widely distributed in different hilly and plane regions of Jharkhand. Moringa is grown in the home gardens of West Bengal and Odisha too.
One such plant is commonly known as the drumstick tree (Makker and Becker, 1997) [2]. The leaves of the trees have been reported to have an antioxidant activity due to higher amount of polyphenols (Mayo *et al.*, 2012) [3] and are a rich source of vitamins. Its leaf meal may be a promising source of natural antioxidant for broiler meat. It also possesses antimicrobial activity due to its principle component pterygospermin. There are numerous uses of *Moringa oleifera* as medicine.
The pantropical cultivation and easy propagation of Moringa tree justify more intensive research into its biological and economic possibilities, particularly as useful feed ingredients and medicine. The essential nutrient contents of Moringa leaves/twigs such as Vit A and Vit B, calcium, iron, copper, sulphur and protein and its ability to absorb and neutralize toxic elements in food could justify its significance in developing the plant as one of the major local feed stuffs.

Materials and Methods

The present study was conducted at Avian Research Development Centre, Department of Livestock Production and Management, Ranchi Veterinary College, Ranchi.

The experimental birds and design

Two hundred sixteen (216) day-old chicks of Japanese quail were procured from Avian Research Development Centre, Ranchi Veterinary College, Ranchi. The brooding of the chicks were done for 2 week on standard managemental condition. These chicks were randomly divided into two groups after 2 weeks of brooding, while 108 birds of first group were maintained in deep litter, another 108 birds were maintained under cage system of management at farm. Each group contained four treatment groups (T0, T1, T2, T3) having three replicates of 9 chicks each. Artificial brooding (under farm condition): The brooder house, hover, feeder and waterer were cleaned and disinfected well before starting the experiment. The chicks were brooded up to 2 weeks under hover by using electricity for which 200 watt bulb were fixed in hover and temperature was adjusted to about 95 ºF at first week and 5 ºF temperature were reduced every week up to 6 week of age. After that 65 ºF temp. Was maintained. Brooder houses were provided with adequate ventilation and continuous light. Under deep litter system the litter were made on the floor consisting of saw dust spread over the floor about two inches in thickness. Space were provided as per standard in cage system of management.*Moringa oleifera* leaf powder were prepared by shade drying and the concentrate mixture were taken from the B.P.D unit, RVC, KANKE. Birds under both the system of management were provided equal amount of feed as per NRC, 1994 guidelines. In either system of housing management, MOLP was not included in control diet(T0),while it was included in group T1,T2 and T3at the rates of 1.5, 3.0 and 4.5 percent by weight substituting soyabean oil cake by same properties. The feed were provided twice daily at 8.30 am in morning and at 5 pm in the evening. Water were provided ad lib.

Result and Discussion

The present study was conducted on 216 day-old Japanese quails to observe the effect of *Moringa oleifera* leaf powder (MOLP) at different conc. 1.5%, 3% and 4.5% under two different systems of management on body weight, body weight gain, upto 12weeks of age. All day-old Japanese quails were maintained under similar feeding and managemental conditions for a period of two weeks (brooding period) and after that, they were divided into two groups i.e. 108 quails in deep litter and 108 quails in cage system. They were further divided into four groups T0, T1, T2, and T3 in both the systems of management. Each group contained 27 birds. The results obtained after the Studies on effect of feeding *Moringa oleifera* leaf powder on growth performance of Japanese quail under deep litter and cage system of managementare being presented under the following heads.

Body weight

The values of average body weight during different periods of growth reared with or without MOLP in deep litter system and in cage system of management are presented in (Table 1and 3). The average body weight of Japanese quail in Deep litter system of management at day old was 6.04±0.08 and 12th weeks of age was 172.50±6.97, 193.33±4.58, 202.83±0.7, 199.33±3.87 (g) in T0, T1, T2 and T3 treatments, respectively. The average body weight of Japanese quail in Cage system of management at day old was 5.94±0.04 and 12th weeks of age was 185.67±3.63, 201.17±7.10, 202.17±5.13, 195.50±4.78 (g) in T0, T1, T2 and T3 treatments, respectively.

Under deep litter system of management, effect of MOLP shows significantly higher body wt. at 6th weeks and 11th weeks ($P\leq0.01$) of age and also from 5$^{th=}$ to 12th weeks ($P\leq0.05$).In the above mentioned period the average body wt. under different treatment (T1, T2 and T3) of MOLP shows significant higher body wt. in comparison to the control group. Overall highest body wt. was found in T1 group (120.40±17.06)g than other treatment groups, however it was not significantly different from other treatment groups (T1 and T3).

Under cage system of management, effect of MOLP shows significantly ($P\leq0.05$) higher body wt. at 5th weeks of age onwards upto 11th weeks except at 7th weeks of age. At 5th, 6th, 8th, 9th and 10th weeks of age the average body weight of T1 and T3 groups are significantly higher ($P\leq0.05$) than T2 and control group, where as in case of 11th weeks of age average body wt. of all the treatments group were significantly ($P\leq0.05$) higher than control group. In 7th weeks of age average body weight. We're not significantly different and the lowest average body wt. was observed for T2 group (107.50±12.93)g. In 12th weeks of age effect of MOLP was not found significant ($P\leq0.05$) on average body wt. of quails and the lowest body wt was observed for control group (185.67±3.63)g. Overall highest body wt. was found in T3 group (126.55±17.83)g than other treatment groups, however it was not significantly ($P\leq0.05$) different from other treatment groups (T1 and T2).

The effect of MOLP on average body wt. under different housing system was also found to be significant at 4th, 8th, 9th, 10th and 11th weeks of age. At 4th weeks of age the average body wt. of cage system (50.75±1.11)g of management was significantly lower ($P\leq0.05$) than deep litter system (57.42±1.02)g where as it was significantly higher ($P\leq0.05$) at 8th, 9th, 10th and 11th weeks of age. The mean value for 8th, 9th, 10th and 11th weeks of age were 136.67±3.40 153.25±3.12, 164.13±2.95, 181.54±3.07g and 121.67±4.03, 134.33±3.47, 151.25±2.40, 172.67±2.76g for cage and deep litter system respectively.

In general, the birds reared under cage system of management showed better growth performance in terms of average body wt. than that of deep litter system of management.

The results of present experiment are in tune with the reports of Banjo (2012) [4] who revealed that the inclusion of *Moringa oleifera* leaf meal with 1,2 and 3% levels in the diet of the broilers significantly ($P<0.05$) increased their weight at 1% level which was significantly higher than the control. Similarly, the findings of Dey and De (2013) [5] are also in accordance, they reported that 0.25 or 0.40% MOLM in broiler diets shows a significant ($P<0.01$) improvement in body weight in comparison to control group. The present results are also in agreement with the findings of Teteh *et al*. (2013) [6] was observed that overall chick weights was increased significantly with age ($P<0.05$) using 1 and 2% MOLM in comparison to the control group.

On the other hand findings of Makanjuola *et al*. (2014) [7] are not in harmony with the above findings, they found no significant changes in final body wt of broiler chickens when fed with 0.2, 0.4 and 0.6% MOLM to the diets for 28 days.

Similarly, Paguia *et al*.(2014) [8] also reported non-significant changes in body wt when 0.20%, 0.30%,0.40% and 0.50% MOLM were incorporated into the diets of broiler chicken.

Present results are in harmony with Kumar (2006) [9] who reported higher body weight in caged birds as compared to birds reared under deep litter system of management. Ahuja *et al*. (1992) [10] also observed that the birds grown on deep litter weighed heavier beyond 4 weeks than those in cages.

The results of above research works were due to the more protein content and higher digestibility of MOLP. In cage system of management, higher body weight might be attributed to the more body wt. gain and due to less movement in comparison to deep litter system.

Table 1: Effect of MOLP on average body weight (g) of Japanese quail under deep litter system of management

Age/treatment	To	T1	T2	T3	F value
O day	6.04±0.08				
1st wk	11.34±0.56(brooding period) (108)				
2nd wk	20.31±0.20(brooding period) (108)				
3rd wk	34.50±1.96	38.17±0.70	36.00±0.96	36.83±0.65	1.654^{ns}
4th wk	57.50±2.78	60.83±2.24	55.83±1.04	55.50±1.38	1.505^{ns}
5th wk	63.50±3.40	63.17±2.24	67.00±2.68	72.17±3.91	1.789^{ns}
6th wk	81.50±2.51^{a}	100.50±1.72^{b}	101.17±4.28^{b}	105.50±2.21^{b}	13.99**
7th wk	102±2.95^{a}	124.83±2.71^{b}	113.67±8.71^{b}	122.17±2.54^{b}	4.110*
8th wk	104.50±5.05^{a}	127.00±7.72^{b}	132.83±9.57^{b}	123.17±5.60^{b}	2.791*
9th wk	125.67±3.64^{a}	148.67±5.52^{b}	151.67±7.55^{b}	147.33±6.04^{b}	4.133*
10th wk	139.50±2.74^{a}	161.67±3.50^{b}	152.83±5.20^{b}	151.00±3.13^{b}	5.856*
11th wk	155.00±5.36^{a}	182.50±1.92^{b}	179.33±2.48^{b}	173.83±3.35^{b}	12.158**
12th wk	172.50±6.97^{a}	193.33±4.58^{b}	202.83±0.79^{b}	199.33±3.87^{b}	8.533*
Overall	103.61±14.20	120.40±17.06	119.32±17.32	118.68±16.48	

Table 2: Effect of MOLP on average body weight gain (g) of Japanese quail under deep litter system of management.

Age/treatment	To	T1	T2	T3	F Value
1st wk	5.15±0.32 (brooding period) (108)				
2nd wk	9.30±1.10 (brooding period) (108)				
3rd wk	15.73±0.39	16.17±0.33	16.00±0.25	16.03±0.31	0.821^{NS}
4th wk	20.37±0.42	20.52±0.48	20.27±0.20	20.33±0.33	0.971^{NS}
5th wk	10.60±0.30^{a}	18.94±0.46^{c}	14.72±0.46^{b}	15.17±0.60^{b}	51.91**
6th wk	14.93±0.23^{a}	33.00±0.57^{b}	12.17±5.10^{a}	31.67±1.20^{b}	17.11*
7th wk	14.10±0.58^{a}	21.10±0.49^{c}	19.45±0.86^{c}	17.48±0.53^{b}	22.35**
8th wk	14.13±0.69^{a}	14.15±0.51^{a}	15.48±1.25^{a}	18.61±0.58^{b}	6.64*
9th wk	15.07±0.58	15.49±0.47	15.88±0.84	14.60±1.17	0.463^{NS}
10th wk	8.55±0.58^{a}	9.35±0.52^{a}	13.33±0.49^{b}	8.24±0.50^{a}	19.90**
11th wk	13.29±0.66^{b}	14.29±0.39^{b}	21.33±0.88^{c}	10.33±0.88^{a}	40.35**
12th wk	15.67±0.33^{c}	15.00±0.57^{c}	11.00±0.57^{a}	12.67±0.33^{b}	20.79**
Overall	14.244±0.99	17.802±2.00	15.963±1.09	16.513±2.04	

Each value is the average of 27 observations.

*P<0.05, **P<0.01, NS = Non-Significant

Table 3: Effect of MOLP on average body weight (g) of Japanese quail under cage system of management

Age/treatment	To	T1	T2	T3	F value
O Day	5.94±0.04				
1st wk	11.63±0.46 (brooding period) (108)				
2nd wk	20.85±0.70 (brooding period) (108)				
3rd wk	36.83±1.97	35.17±1.77	34.00±1.67	37.00±1.91	0.605^{NS}
4th wk	52.17±1.53	51.17±2.72	49.50±2.40	50.17±2.56	0.246^{NS}
5th wk	61.33±1.74^{a}	72.83±2.73^{b}	65.67±4.13^{a}	74.33±3.07^{b}	4.032*
6th wk	86.83±1.19^{a}	107.83±3.57^{b}	88.17±8.59^{a}	111.50±3.94^{b}	6.418*
7th wk	110.67±3.44	130.50±2.30	107.50±12.93	129.83±8.30	2.365^{NS}
8th wk	126.67±2.94^{a}	146.83±4.35^{b}	124.00±8.46^{a}	149.17±3.20^{b}	6.329*
9th wk	142.17±3.60^{a}	161.00±3.18^{b}	146.00±8.53^{a}	163.83±3.73^{b}	4.212*
10th wk	152.50±4.47^{a}	171.83±2.70^{b}	160.67±7.84^{a}	171.50±4.37^{b}	3.220*
11th wk	167.00±5.77^{a}	185.33±2.52^{b}	191.17±7.52^{b}	182.67±3.74^{b}	3.858*
12th wk	185.67±3.63	201.17±7.10	202.17±5.13	195.50±4.78	2.028^{NS}
Overall	112.18±16.21	126.37±18.24	116.88±18.42	126.55±17.83	

Table 4: Effect of MOLP on average body weight gain (g) of Japanese quail under cage system of management

Age/treatment	To	T1	T2	T3	F value
1st wk	4.95±0.54 (brooding period) (108)				
2nd wk	9.94±0.98 (brooding period) (108)				
3rd wk	16.17±0.44	16.83±0.44	16.00±0.28	16.52±0.28	0.444^{NS}
4th wk	20.37±0.42	20.52±0.48	20.27±0.20	20.33±0.33	0.971^{NS}
5th wk	8.95±0.23^{b}	5.51±0.41^{a}	9.69±0.37^{b}	12.64±0.83^{c}	32.33**
6th wk	20.23±0.39^{a}	37.00±0.57^{c}	33.33±0.88^{b}	33.00±1.52^{b}	59.75**
7th wk	18.34±0.59^{a}	24.67±0.88^{b}	18.30±0.35^{a}	16.95±0.53^{a}	31.16**
8th wk	5.32±10.51^{a}	9.02±0.66^{b}	14.67±1.45^{c}	5.39±0.20^{a}	27.03**
9th wk	17.02±0.44^{b}	18.33±0.88^{b}	12.00±1.15^{a}	11.85±0.93^{a}	14.24*
10th wk	12.78±0.61^{b}	11.60±0.76^{b}	4.39±0.76^{a}	5.44±0.47^{a}	51.46**
11th wk	10.65±0.32^{a}	17.85±0.71^{c}	16.00±0.57^{b}	15.00±0.57^{b}	29.13**
12th wk	11.67±0.88^{a}	12.00±1.15^{a}	19.12±0.58^{b}	19.33±1.20^{b}	18.69*
Overall	14.15±1.60	17.33±2.83	16.37±2.41	15.64±2.52	

Each value is the average of 27 observations.
*P<0.05, **P<0.01, NS = Non-Significant

Table 5: Effect of MOLP on average body weight. (g) of Japanese quail under different systems of management.

Age/treatment	Deep litter	Cage	T value
O Day	5.99±0.03		
1st wk	11.48±0.41 (brooding period) (108)		
2nd wk	20.58±0.50 (brooding period) (108)		
3rd wk	36.38±0.65	35.75±0.89	0.569^{NS}
4th wk	57.42±1.02^{b}	50.75±1.11^{a}	5.313*
5th wk	66.46±1.64	68.54±1.79	0.732^{NS}
6th wk	97.17±2.34	98.58±3.32	0.121^{NS}
7th wk	115.79±2.94	119.63±4.32	0.538^{NS}
8th wk	121.67±4.03^{a}	136.67±3.40^{b}	8.070*
9th wk	134.33±3.47^{a}	153.25±3.12^{b}	4.500*
10th wk	151.25±2.40^{a}	164.13±2.95^{b}	4.43*
11th wk	172.67±2.76^{a}	181.54±3.07^{b}	4.59*
12th wk	192.00±3.27	196.13±2.82	0.909^{NS}
Overall	114±16.04	120±17.61	

Table 6: Effect of MOLP on average body weight gain (g) of Japanese quail under different systems of management

Age/treatment	Deep litter system	Cage system	T value
1st wk	5.05±0.43(brooding period) (108)		
2nd wk	9.62±1.04(brooding period) (108)		
3rd wk	16.38±0.18	15.98±0.14	1.66518 ^{NS}
4th wk	20.37±0.16	20.37±0.16	0.000^{NS}
5th wk	9.20±0.79^{a}	14.86±0.91^{b}	4.67043**
6th wk	30.89±1.95^{b}	22.94±3.06^{a}	2.18561*
7th wk	19.56±0.0.94	18.03±0.83	1.21878^{NS}
8th wk	8.60±1.20^{a}	15.59±0.65^{b}	5.111**
9th wk	14.80±0.95	15.26±0.37	0.44734^{NS}
10th wk	8.55±1.13	9.87±0.65	1.00193^{NS}
11th wk	14.88±0.83	14.81±1.25	0.04312^{NS}
12th wk	15.53±1.19	13.58±0.56	1.46035^{NS}
Overall	15.87±2.14	16.12±1.14	

Each value is the average of 27 observations.
*P<0.05, **P<0.01, NS = Non-Significant

Table 7: Of Chemical composition *Moringa oleifera* leaf powder (MOLP)

Constituents	Amount (per 100g)
Moisture	9
Protein	28.65
Lipid	7.09
Ash	10.9
Carbohydrate	44.36
Calcium(mg)	2.97
Magnesium(mg)	1.9
Zinc	1.58

Table 8: Starter and Grower Ration (0 To 6 Weeks of Age)

Ingredients	Control ration (cp%=24.81)	Treatment ration 1 (cp%=24.53)	Treatment ration 2 (cp%= 24.25)	Treatment ration 3 (cp%=24.41)
Yellow maize (%)	48	48	48	48
Soyabean cake (%)	32	30.50	29	27.50
Wheat bran (%)	6.50	6.50	6.50	6.50
Fish meal (%)	11	11	11	11
Molp (%)	0	1.5	3	4.5
Min. mix (%)	2	2	2	2
Salt (%)	0.50	0.50	0.50	0.50

Table 9: Layer Ration (6 Weeks onwards up to Experimental Period)

Ingredients	Control ration (cp%=20.95)	Treatment ration 1 (cp%=20.67)	Treatment ration 2 (cp%=20.40)	Treatment ration 3 (cp%=20.12)
Yellow maize (%)	54.50	54.50	54.50	54.50
Soyabean cake (%)	25	23.50	22	20.50
Wheat bran (%)	5.50	5.50	5.50	5.50
Fish meal (%)	8.50	8.50	8.50	8.50
Molp (%)	0	1.5	3	4.5
Oyster shell grit	4	4	4	4
Min. mix (%)	2	2	2	2
Salt (%)	0.50	0.50	0.50	0.50

Conclusion

On the basis of above finding it could be concluded that inclusion of *Moringa oleifera* leaf powder (MOLP) at levels of 1.5-3% of the quail's diet improved growth performance. Along with the above findings cage system of management showed better growth performance over the deep-litter system of management.

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