



Original Research

Effect of Dietary Inclusion of Chocolate Waste on Growth, Carcass Characteristics and Economics in Japanese Quails (*Coturnix coturnix japonica*)

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Rec. Date:	Jan 31, 2018 04:47
Accept Date:	Apr 22, 2018 16:30
DOI	10.5455/ijlr.20180131044751

Abstract

A study was undertaken for five weeks to investigate the effect of graded levels of chocolate waste on growth and carcass characteristics of Japanese quails. A total of 500 straight run Japanese quail chicks were randomly allotted to 4 treatment groups fed with brooder (0 to 3 weeks) and grower diets (4 to 5 weeks) containing varying levels of chocolate waste, viz. control (T_1), 5 % (T_2), 10 % (T_3) and 15 % (T_4). At the end of the 5th week, body weight (g) was 166.09 ± 1.76 , 178.97 ± 1.72 , 180.70 ± 1.72 and 181.14 ± 1.77 in four treatment groups, which was highly significant ($P < 0.01$) in chocolate waste fed groups (T_2 , T_3 , and T_4) than control (T_1). Similar trend was observed in body weight gain and feed efficiency. No significant difference was observed in livability, carcass characteristics except dressing percentage across the dietary treatments. Hence, chocolate waste could be safely incorporated up to 15 % in quail diets without affecting growth performance.

Key words: Japanese Quails, Chocolate Waste, Growth Performance, Carcass Characteristics, Economics

How to cite: Jeyabalan, S., Lingareddy, R., Subbiah, E., & Jayabalan, R. (2018). Effect of Dietary Inclusion of Chocolate Waste on Growth, Carcass Characteristics and Economics in Japanese Quails (*Coturnix coturnix japonica*). International Journal of Livestock Research, 8(9), 202-208. doi: 10.5455/ijlr.20180131044751

Introduction

The poultry Industry has emerged as the fastest growing segment of the livestock sector both globally and in India (Lisa and Shukla, 2015). Japanese quails are rapidly gaining in popularity for its commercial exploitation and in near future may acquire an important segment in rapidly growing Indian poultry industry (Mishra and Shukla, 2014). The shortage of feed resources for livestock and poultry feeding diverted





majority of research in the field of animal nutrition to look into possibilities to overcome this nutritional crisis (Amata, 2014). Efforts to utilize various unconventional feed resources have been tried by several workers one of which is chocolate waste which is obtained during manufacture of chocolates. Chocolate waste is the waste available during production of chocolates due to spillage or due to irregular sizes. Chocolate waste is a good source of energy and contains about 21.1 MJ/Kg gross energy, 4.7 % crude protein, 18.6 % crude fat and a slightly higher nitrogen free extract (71.4 %) (Rudolf *et al.*, 1980). With a low fibre content (1.1 %) and a high NFE, this chocolate wastes are highly digestible. Further, the low moisture content (2.7 %) reduces storage problem resulting in longer shelf life than many organic wastes. Hence, this study was conducted to determine the effect of feeding chocolate waste on growth of Japanese quails.

Materials and Methods

A total of 500 day old Japanese quail chicks were randomly allotted to four treatments with 125 birds in each treatment. The chicks were reared in cage system and offered feed and water *ad-libidum*. The experiment lasted for 5 weeks. Four experimental diets were formulated as follows: T₁ (control), T₂ (5 %), T₃ (10%) and T₄ (15 %) inclusion levels of chocolate waste. The diets were iso-nitrogenous and iso-caloric and formulated as per the BIS Standards (2007). The parameters measured were body weight, weight gain, feed efficiency and livability. The per cent ingredient and nutrient composition of Japanese quail brooder and grower diet is furnished in Table 1.

Table 1: Per cent ingredient and nutrient composition of Japanese quail brooder and grower diets fed from 0 to 5 weeks.

Ingredients (%)	0 % (T ₁)		5 % (T ₂)		10 % (T ₃)		15 % (T ₄)	
	QB	QG	QB	QG	QB	QG	QB	QG
Maize	50.5	57	44.8	50.7	39.4	45.1	33.1	39.2
Chocolate waste	0	0	5	5	10	10	15	15
Soyabean meal	38.6	26.4	39.4	27.2	40	28	41.3	29
Deoiled rice bran	0	9.9	0	9.9	0	9.9	0	9.9
Dry fish	6.18	3.73	6.18	4.13	6	4.13	6	4.13
Vegetable Oil	3	0.8	2.9	0.9	2.88	0.8	2.88	0.7
Mineral mixture	1	0.7	1	0.7	1	0.6	1	0.6
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
L-Lysine	0	0.3	0	0.3	0	0.3	0	0.3
DL-Methionine	0.15	0.2	0.15	0.2	0.15	0.2	0.15	0.2
Dicalcium phosphate	0	0.4	0	0.4	0	0.4	0	0.4
Feed additives(%)*	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
Total	100	100	100	100	100	100	100	100
Nutrients	0 % (T ₁)		5 % (T ₂)		10 % (T ₃)		15 % (T ₄)	
	QB	QG	QB	QG	QB	QG	QB	QG
ME (kcal/kg)	3022	2903	3022	2903	3022	2903	3022	2903
Crude Protein (%)	24.02	20.04	24.02	20.04	24.02	20.04	24.02	20.04



*QB – J.Quail brooder mash, QG – J.Quail grower mash; *Feed additives (%): Vitamin AB₂D₃K - 0.010, Ultracil – 0.050, Synerox – 0.050, Vetroliv – 0.050, Ultra B12 – 0.010, Perivac plus – 0.020, Choline chloride – 0.100, Spectradfm – 0.010, Larvanil – 0.025.

The carcass (meat) quality as influenced by supplementation of graded levels of chocolate waste was studied in terms of carcass characteristics and sensory evaluation. Six birds (each three birds per sex) per dietary treatment making a total of 24 birds were selected randomly at the end of 5th week, weighed and starved for 12 hours prior to slaughter but water was provided *ad libitum*. The parameters recorded at the time of slaughter include live weight, dressing percentage, eviscerated carcass yield and ready-to-cook yield, giblet weight. Sensory attributes like appearance, flavour, juiciness, tenderness and overall acceptability were assessed as per Panda *et al.*, 1982. The feed samples of Japanese quail (brooder and grower) diets with and without addition of chocolate waste were tested for its microbial quality by standard plate count and coliform method (Marshall, 1992). The feed samples of 100 g were drawn from quail brooder diet stored in gunny bags at 1, 8, 15, 22 and 29 days after feed preparation and grower diet stored in gunny bags at 1, 7, 14, 28 and 35 days after feed preparation.

Statistical Analysis

Data collected in the biological trial was analysed using ANOVA as per, SPSS version 20.0 for windows.

Results and Discussion

The body weight of Japanese quails fed with graded levels of chocolate waste is furnished in Table 2. It was that weekly body weights up to 5 weeks of age was significantly ($P < 0.01$) higher in quails fed with graded levels of chocolate waste T₂ (5 %), T₃ (10 %) and T₄ (15 %) than control (T₁). Ronald *et al* (2009) also observed that the body weight of pigs increased up to 75 per cent inclusion levels of chocolate waste.

Table 2: Body weight of Japanese quails (Mean $\pm$ S.E) fed with and without chocolate waste up to 5 weeks of age

Age	Chocolate Waste				P value
	0 % (T ₁)	5 % (T ₂)	10 % (T ₃)	15 % (T ₄)	
Hatch weight ^{NS}	8.91 $\pm$ 0.12	8.74 $\pm$ 0.43	8.79 $\pm$ 0.53	8.71 $\pm$ 0.12	0.46
1 st week ^{**}	20.86 ^c $\pm$ 0.42	23.60 ^b $\pm$ 0.42	25.65 ^a $\pm$ 0.42	26.16 ^a $\pm$ 0.42	0
2 nd week ^{**}	46.31 ^c $\pm$ 0.84	55.50 ^b $\pm$ 0.83	60.22 ^a $\pm$ 0.84	60.87 ^a $\pm$ 0.82	0
3 rd week ^{**}	75.53 ^c $\pm$ 1.30	91.62 ^b $\pm$ 1.27	97.54 ^a $\pm$ 1.29	100.22 ^a $\pm$ 1.27	0
4 th week ^{**}	124.67 ^c $\pm$ 1.67	139.37 ^b $\pm$ 1.64	142.05 ^a $\pm$ 1.63	145.44 ^a $\pm$ 1.67	0
5 th week ^{**}	166.09 ^b $\pm$ 1.76	178.97 ^a $\pm$ 1.72	180.70 ^a $\pm$ 1.72	181.14 ^a $\pm$ 1.77	0

^{**}Highly significant ($P < 0.01$); NS - Not significant

The body weight gain in quails also reflects similar trend related to final body weight. At the end of 5th week, the body weight gain was significantly higher ($P < 0.01$) in quails fed with chocolate waste at all levels than in control birds. The cumulative feed efficiency of Japanese quails fed with graded levels of

chocolate waste is furnished in Table 3. At the end of 5th week, feed efficiency in quails fed chocolate waste at 5, 10 and 15 % were 2.79, 2.77 and 2.77 respectively which was statistically higher ($P < 0.01$) compared to control birds. The results of the present study are similar to the findings of Ronald et al (2009) who reported that feed efficiency was highest in pigs fed chocolate waste at 100 per cent than control pigs.

Table 3: Cumulative feed efficiency of Japanese quails (Mean $\pm$ S.E) fed with and without chocolate waste up to 5 weeks of age

Age	Chocolate Waste				P value
	0 % (T ₁)	5 % (T ₂)	10 % (T ₃)	15 % (T ₄)	
1 st week**	1.42 ^c $\pm$ 0.91	1.14 ^b $\pm$ 0.12	1.03 ^a $\pm$ 0.21	0.99 ^a $\pm$ 0.23	0
2 nd week**	2.18 ^c $\pm$ 0.13	1.76 ^b $\pm$ 0.11	1.63 ^a $\pm$ 0.35	1.62 ^a $\pm$ 0.32	0
3 rd week**	2.37 ^c $\pm$ 0.10	1.91 ^b $\pm$ 0.07	1.79 ^a $\pm$ 0.36	1.74 ^a $\pm$ 0.35	0
4 th week**	2.70 ^c $\pm$ 0.59	2.41 ^b $\pm$ 0.44	2.36 ^{ab} $\pm$ 0.47	2.31 ^a $\pm$ 0.46	0
5 th week**	3.02 ^b $\pm$ 0.08	2.79 ^a $\pm$ 0.06	2.77 ^a $\pm$ 0.56	2.77 ^a $\pm$ 0.54	0

**Mean values bearing different superscripts in a row differ significantly ($P < 0.01$)

The per cent livability of Japanese quails fed with graded levels of chocolate waste is furnished in Table 4. The non-significance in the per cent livability indicates that chocolate waste has no toxic factors affecting the growth performance of Japanese quails.

Table 4: Per cent livability in Japanese quails fed with and without chocolate waste up 5 weeks of age (Mean $\pm$ S.E)

Age ^{NS}	Chocolate Waste				P value
	0 % (T ₁)	5 % (T ₂)	10 % (T ₃)	15 % (T ₄)	
1 st week	98.40 $\pm$ 0.98	96.80 $\pm$ 1.50	96.00 $\pm$ 1.26	97.60 $\pm$ 0.98	0.54
2 nd week	96.80 $\pm$ 0.80	96.00 $\pm$ 1.26	96.00 $\pm$ 1.26	96.80 $\pm$ 0.80	0.9
3 rd week	96.80 $\pm$ 0.80	95.20 $\pm$ 0.80	96.00 $\pm$ 1.26	96.80 $\pm$ 0.80	0.59
4 th week	94.40 $\pm$ 0.98	93.60 $\pm$ 0.98	94.40 $\pm$ 0.98	93.60 $\pm$ 0.98	0.88
5 th week	93.60 $\pm$ 0.98	92.80 $\pm$ 0.80	94.40 $\pm$ 0.98	93.60 $\pm$ 0.98	0.7

n= 125 per treatment; NS - Not significant

The carcass characteristics and sensory attributes of meat obtained from Japanese quails fed with and without chocolate waste are tabulated in Table 5 and 6. The dressing percentage is significantly higher ($P < 0.01$) in quails fed with chocolate waste in the three treatment groups compared to control. The highly significant increase in the dressing percentage in quails fed with chocolate waste indicates that chocolate waste does not interfere with production of edible parts especially muscles. The other parameters such as eviscerated carcass weight, ready- to- cook yield, cut up parts and sensory attributes were not statistically different among the treatment groups.

Table 5: Carcass characteristics in Japanese quails fed with and without chocolate waste at 5 weeks of age (Mean $\pm$ S.E)

Carcass Characteristics	Chocolate Waste				P value
	0 % (T ₁)	5 % (T ₂)	10 % (T ₃)	15 % (T ₄)	
Pre slaughter live weight, g *	170.70 $\pm$ 4.14 ^b	183.43 $\pm$ 3.95 ^{ab}	192.06 $\pm$ 6.99 ^a	192.85 $\pm$ 6.41 ^a	0.03
Eviscerated yield, % ^{NS}	57.42 $\pm$ 1.27	58.37 $\pm$ 0.55	58.39 $\pm$ 1.29	59.91 $\pm$ 0.66	0.39
Ready- to- cook yield, % ^{NS}	62.81 $\pm$ 1.36	63.62 $\pm$ 1.21	64.07 $\pm$ 0.30	65.21 $\pm$ 0.70	0.41
Giblets yield ^{NS}	5.69 $\pm$ 0.12	5.40 $\pm$ 0.27	5.25 $\pm$ 0.18	5.60 $\pm$ 0.22	0.35
Breast yield ^{NS}	42.96 $\pm$ 1.34	43.90 $\pm$ 1.12	45.19 $\pm$ 2.15	45.23 $\pm$ 3.87	0.9
Thigh yield ^{NS}	14.22 $\pm$ 1.26	14.28 $\pm$ 0.74	14.37 $\pm$ 0.44	14.52 $\pm$ 0.44	0.99

n=6 per treatment; * Significant; NS – Not significant

Table 6: Sensory attributes in Japanese quails fed with and without chocolate waste at 5 weeks of age (Mean $\pm$ S.E) in the scale range of 0 to 10 (unacceptable to acceptable)

Sensory attributes ^{NS}	Chocolate Waste				P value
	0 % (T ₁)	5 % (T ₂)	10 % (T ₃)	15 % (T ₄)	
Appearance	7.84 $\pm$ 0.12	7.75 $\pm$ 0.05	7.60 $\pm$ 0.20	7.48 $\pm$ 0.17	0.33
Flavour	7.73 $\pm$ 0.12	7.66 $\pm$ 0.09	7.62 $\pm$ 0.08	7.70 $\pm$ 0.12	0.91
Juiciness	7.46 $\pm$ 0.20	7.43 $\pm$ 0.19	7.44 $\pm$ 0.16	7.45 $\pm$ 0.15	0.1
Tenderness	7.61 $\pm$ 0.32	7.37 $\pm$ 0.17	7.43 $\pm$ 0.17	7.46 $\pm$ 0.22	0.89
Overall acceptability	7.59 $\pm$ 0.02	7.45 $\pm$ 0.21	7.44 $\pm$ 0.21	7.59 $\pm$ 0.02	0.92

NS – Not significant

The microbial quality of Japanese quail brooder and grower diets in the control and treatment diets at different storage periods are presented in Tables 7 and 8.

Table 7: Standard plate count (log 10 cfu/ml) in Japanese quail brooder diet with and without chocolate waste at graded levels

Chocolate Waste	Standard Plate Count (log 10 cfu/ml) ^{NS}				
	Day 1	Day 8	Day 15	Day 22	Day 29
T ₁ (0 %)	10.24 $\pm$ 0.02	10.34 $\pm$ 0.05	10.26 $\pm$ 0.04	10.34 $\pm$ 0.04	10.26 $\pm$ 0.03
T ₂ (5 %)	10.23 $\pm$ 0.04	10.34 $\pm$ 0.04	10.34 $\pm$ 0.02	10.34 $\pm$ 0.05	10.33 $\pm$ 0.02
T ₃ (10 %)	10.26 $\pm$ 0.03	10.28 $\pm$ 0.02	10.28 $\pm$ 0.03	10.28 $\pm$ 0.03	10.28 $\pm$ 0.01
T ₄ (15 %)	10.34 $\pm$ 0.04	10.30 $\pm$ 0.06	10.24 $\pm$ 0.05	10.26 $\pm$ 0.04	10.30 $\pm$ 0.04
P value	0.15	0.22	0.17	0.16	0.23

n=number of samples screened per treatment and for each storage period; NS – Not significant

It was found that there was no significant difference in the colony forming units per ml in 10⁹ dilutions by standard plate count method in all the representative samples of brooder and grower diets during specified storage periods. Similarly, the coliform count was not observed in 10² dilutions in any of the representative samples in brooder and grower diets during specified storage periods. The results of the present study indicate that the microbial load of the Japanese quail brooder and grower diets due to inclusion of chocolate

waste even after storage for 5 weeks, does not damage or deteriorate the quality of finished feeds. Hence, the feed containing chocolate waste can be stored up to 5 weeks without any deterioration in the quality of the feed.

Table 8: Standard plate count (log 10 cfu/ml) in Japanese quail grower diet with and without chocolate waste at graded levels

Chocolate Waste	Standard Plate Count (log 10 cfu/ml) ^{NS}				
	Day 1	Day 7	Day 14	Day 28	Day 35
T ₁ (0 %)	10.26 ± 0.02	10.30 ± 0.03	10.20 ± 0.01	10.20 ± 0.02	10.20 ± 0.01
T ₂ (5 %)	10.26 ± 0.03	10.30 ± 0.02	10.36 ± 0.03	10.30 ± 0.04	10.26 ± 0.03
T ₃ (10 %)	10.23 ± 0.01	10.24 ± 0.01	10.26 ± 0.02	10.24 ± 0.03	10.23 ± 0.02
T ₄ (15 %)	10.11 ± 0.04	10.26 ± 0.05	10.30 ± 0.03	10.26 ± 0.01	10.30 ± 0.04
P value	0.14	0.17	0.24	0.18	0.16

n=number of samples screened per treatment and for each storage period; NS – Not significant

The cost effectiveness of including chocolate waste in Japanese quail diet is furnished in Table 9. The total feed cost per bird decreased with increase in the inclusion levels of chocolate waste. The highest return per bird was found in 15 % chocolate waste fed group. Thus, chocolate waste can be incorporated in the Japanese quail diet up to 5 weeks to reduce the feed cost and cost of production and to increase the profit.

Table 9: Cost effectiveness in Japanese quail diet fed with and without chocolate waste from 0 to 5 weeks of age

Parameters	Control	Chocolate Waste		
	0 % (T ₁)	5 % (T ₂)	10 % (T ₃)	15 % (T ₄)
Total feed cost / bird (Rs.)	11.26	11.04	10.59	10.24
Total cost of production / bird (Rs)	19.26	19.04	18.59	18.24
Sale price / bird @ Rs. 40.00	40	40	40	40
Return / live bird (Rs.)	20.74	20.96	21.41	21.76
Sale price / bird @ Rs. 0.40 / g dressed wt	41.86	45.82	46.98	47.1
Return / kg dressed meat (Rs.)	22.6	26.78	28.39	28.86

Conclusion

It could be concluded that chocolate waste is a rich source of energy. Chocolate waste could be safely incorporated up to 15 % without affecting the growth performance in Japanese quails replacing relatively costly cereal grains.

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