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Effect of dietary supplementation of giloy herb and ascorbic acid along with different bedding materials on fortnight feed consumption and feed conversion ratio of Japanese quail

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Abstract
The present experiment was conducted on four hundred thirty two (432) seven day-old Japanese quail chicks for a period of 24 weeks to investigates the effects of supplementation (giloy, ascorbic acid and combination of both) along with different bedding materials (sand, saw dust and wheat straw) on body weight and body weight gain of Japanese quails (*Coturnix coturnix japonica*). Birds were randomly and uniformly distributed in total 12 treatment groups comprising of 36 birds in each group and each group further divided into two replicates comprising 18 birds in each replicate. Highly significant ($P<0.01$) effect of incorporation of supplements and different bedding material was found on feed consumption And Feed conversion ratio. The interaction effect of bedding material and supplementation was non-significant on feed consumption and significant for Feed conversion ratio. Minimum and best feed conversion ratio was observed in the group supplemented with combination of giloy and ascorbic acid along with sand bedding material. The highest Fortnight feed consumption of Japanese quail was found in sand bedding material group supplemented with combination. The present studies show that combination of dietary supplements giloy and vitamin C along with sand bedding material significantly improves feed consumption ratio.

Keywords: Ascorbic acid, giloy, bedding material, feed consumption, feed consumption ratio Japanese quail

Introduction
Poultry is one of the fastest growing components of the agricultural sector in India. Poultry plays an important role as animal protein source in human diet in terms of egg and meat. Japanese quail (*Coturnix coturnix japonica*) is one of the most efficient biological machines for converting feed into animal protein of high biological value (Das *et al*., 2012) [7]. In recent years, the use of dietary plant derived natural bioactive compounds (phytobiotics) and feed additive has attracted increased attention to augment performance and health in poultry production. Various types of feed additives such as antibiotics, enzymes, hormones, prebiotics, probiotics, herbal products *etc.*, are being used as growth stimulants in poultry production. *Tinospora cordifolia*, which is known by the common names heart-leaved moonseed, guduchi, and giloy, is an herbaceous vine of the family Menispermaceae indigenous to tropical regions of the Indian subcontinent (Sengupta *et al*., 2011) [18]. Giloy is a rich source of protein and micronutrients, such as iron, zinc, copper, calcium, phosphorus, and manganese. (Saeed *et al*., 2020) [15]. The most clearly established functional role for vitamin C involves collagen biosynthesis. Beneficial effects result from ascorbic acid in the synthesis of "repair" collagen (Bera *et al*., 2010) [4].

In agriculture, Quail litter is a mixture of quail excreta, spilled feed, spontaneously fallen feathers and farm bedding material (Seidavi *et al*., 2015) [17]. Wood sawdust is the most common used bedding material, however there were many alternative materials that may be used such as peanut hulls (Lien *et al*., 1998) [13], rice and wheat straw (Benabdeljelil and Ayachi, 1996) [3], rice hull ash (Chamblee and Yeatman, 2003) [6] and other dry, absorbent, low-cost organic materials. Birds spend their entire life in contact with the litter material. Therefore, its quality is considered a crucial factor of poultry welfare (Savory, 1995) [16].

Hence, the present experimental design was planned to carry out study of effect of bedding materials such as sand, wheat straw and saw dust with dietary supplementation of giloy herb

(*Tinospora cordifolia*) and ascorbic acid and their combination on feed consumption and feed conversion ratio of Japanese quail.

Material and Methods

Location of study area

The present study was conducted at Poultry unit, Livestock Farm Complex, College of Veterinary and Animal Science, Bikaner, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan and the proximate analysis of feed and supplements was carried out at Department of Animal Nutrition, College of Veterinary and Animal Science, RAJUVAS, Bikaner, Rajasthan.

Experimental design of study

The study was undertaken on four hundred thirty two (432) seven day-old Japanese quail chicks which were purchased from central poultry development organization, Chandigarh. The study was conducted for a period of 24 weeks. These birds were equally and randomly divided into twelve treatments groups according to feed supplements and different bedding materials as sand, saw-dust and wheat straw and each treatment group was further replicated into two sub-groups (R_1-R_2) to make sure uniformity in various treatment groups as shown in Table 1. Thus factorial design (3x4) was adopted for the present study to estimate the effect of giloy at 5gm/kg and ascorbic acid at 240mg/kg level alone as well as in combination, along with interaction effect of dietary supplementation and bedding material on body weight and body weight gain and total number of interaction groups was 12 in present study.

Table 1: Random distributions of birds (Japanese quail) and experimental feeds offered in different treatment groups

S.N.	Type of bedding materials	Treatments Groups		Treatment details	Number of birds (Japanese quail)
1.	B_1 (sand)	T_{10}	$T_{10}R_1$	Basal diet	18
			$T_{10}R_2$	Basal diet	18
		T_{11}	$T_{11}R_1$	Basal diet + 5 g/kg giloy**	18
			$T_{11}R_2$	Basal diet + 5 g/kg giloy**	18
		T_{12}	$T_{12}R_1$	Basal diet + 240 mg/kg ascorbic acid**	18
			$T_{12}R_2$	Basal diet + 240 mg/kg ascorbic acid**	18
		T_{13}	$T_{13}R_1$	Basal diet + mixture of 5 g/kg giloy and 240 mg/kg ascorbic acid**	18
			$T_{13}R_2$	Basal diet + mixture of 5 g/kg giloy and 240 mg/kg ascorbic acid**	18
2.	B_2 (saw-dust)	T_{20}	$T_{20}R_1$	Basal diet	18
			$T_{20}R_2$	Basal diet	18
		T_{21}	$T_{21}R_1$	Basal diet + 5 g/kg giloy**	18
			$T_{21}R_2$	Basal diet + 5 g/kg giloy**	18
		T_{22}	$T_{22}R_1$	Basal diet + 240 mg/kg ascorbic acid**	18
			$T_{22}R_2$	Basal diet + 240 mg/kg ascorbic acid**	18
		T_{23}	$T_{23}R_1$	Basal diet + mixture of 5 g/kg giloy and 240 mg/kg ascorbic acid**	18
			$T_{23}R_2$	Basal diet + mixture of 5 g/kg giloy and 240 mg/kg ascorbic acid**	18
3.	B_3 (wheat straw)	T_{30}	$T_{30}R_1$	Basal diet	18
			$T_{30}R_2$	Basal diet	18
		T_{31}	$T_{31}R_1$	Basal diet + 5 g/kg giloy**	18
			$T_{31}R_2$	Basal diet + 5 g/kg giloy**	18
		T_{32}	$T_{32}R_1$	Basal diet + 240 mg/kg ascorbic acid**	18
			$T_{32}R_2$	Basal diet + 240 mg/kg ascorbic acid**	18
		T_{33}	$T_{33}R_1$	Basal diet + mixture of 5 g/kg giloy and 240 mg/kg ascorbic acid**	18
			$T_{33}R_2$	Basal diet + mixture of 5 g/kg giloy and 240 mg/kg ascorbic acid**	18
	Total birds				432

** Prepared at farm by manual mixing of giloy and ascorbic acid in basal diet

Parameters studied

Fortnightly average feed consumption (FC)

Fortnightly feed consumption of each treatment group was recorded and average feed intake in gram/chick/fortnightly was calculated by total amount of feed consumed in that period, divided by the number of chicks in particular pen. Cumulative feed consumption for experimental period was also calculated.

Feed conversion ratio (FCR)

FCR was calculated for different treatment groups during each fortnight as follows.

$$FCR = \frac{\text{Average Feed Consumption (g)during the fortnight}}{\text{Average body weight gain (g)during the fortnight}}$$

Statistical analysis

The data obtained in the experiment were analysed statistically for main effect of Geloi or ascorbic acid alone as well as interaction (Geloi x Ascorbic acid) and effect of different bedding material as well as interaction with feed supplementation in factoral design (3X4) by factorial analysis of variance interaction design technique (Snedecor and Cochran, 1989) [20] using statistical package SPSS software (*Ver.* 26.0, 2005). The means of different experimental groups were tested for statistical significance by Duncan's New Multiple Range Test (DNMRT) as modified by Kramer (1956).

Result and Discussion

Effect of dietary supplementation, bedding material and their interaction on feed consumption

The effect of dietary supplementation and various bedding materials on mean feed consumption (gm/bird) throughout the experimental period was found highly significant (P<0.01) from 3rd week to 24th week. Mean feed consumption was found numerically higher in T_3 of dietary group. While, B_3

group show higher feed consumption from rest of the groups except at 3rd and 5th week of age. The mean cumulative feed consumptions (g/bird) of Japanese quail of various treatment groups according to dietary supplementation at 24th week were found to be 3390.36, 3506.46, 3448.49 and 3585.67g for T_0, T_1, T_2 and T_3 groups, respectively (Table 2). Mean values of cumulative feed consumption (g/bird) in various groups based on bedding materials as B_1, B_2 and B_3 were found to be 3430.21, 3470.14 and 3547.88 g/bird, respectively (Table 2). Non-significant effect of interaction between incorporation of dietary supplementation and different bedding materials on feed consumption was observed throughout the experiment except 3rd and 9th week of study (Table 3).

The similar result of dietary supplementation of giloy on feed consumption was observed by Dharmaraj (2015) [9] and Jain (2018) [12] in poultry. Similarly, the present results were also agreed with the findings observed in Japanese quails by Ipek *et al*. (2006) [11] and Shit *et al*. (2012) [19]. Present results are in agreement with Giri (2004) [10], Ramadan *et al*. (2013) [14] they concluded significant effect of different bedding materials on quail performance including feed consumption. Dhaliwal *et al*. (2018) [8] also reported significant effect of bedding materials on broiler performance.

Table 2: Effect of dietary supplements and bedding material on Feed Consumption (g) at different weeks

Supplement effect	Age in weeks												
	3rd	5th	7th	9th	11st	13rd	15th	17th	19th	21st	23rd	24th	Cumulative
T_0	186.86^{a}	243.52^{a}	304.12^{a}	295.13^{a}	310.28^{a}	312.46^{a}	314.61^{a}	315.33^{a}	316.37^{a}	318.25^{a}	316.51^{a}	156.87^{a}	3390.36^{a}
T_1	212.77^{c}	257.35^{b}	308.83^{c}	324.59^{c}	316.29^{c}	318.53^{c}	320.48^{c}	321.43^{b}	322.76^{c}	323.48^{b}	320.76^{b}	159.14^{b}	3506.46^{c}
T_2	205.33^{b}	252.94^{b}	306.71^{b}	302.13^{b}	313.29^{b}	315.21^{b}	317.27^{b}	317.88^{a}	319.52^{b}	321.10^{b}	318.82^{ab}	158.24^{ab}	3448.49^{b}
T_3	221.46^{d}	271.55^{c}	314.08^{d}	337.12^{d}	321.18^{d}	323.13^{d}	325.29^{d}	326.61^{c}	328.01^{d}	328.95^{c}	326.41^{c}	161.83^{c}	3585.67^{d}
SEM	1.84	1.65	0.55	1.44	0.56	0.70	0.80	0.86	0.78	0.80	0.90	0.53	7.03
Bedding effect	**3rd**	**5th**	**7th**	**9th**	**11st**	**13rd**	**15th**	**17th**	**19th**	**21st**	**23rd**	**24th**	**Cumulative**
B_1	195.81^{a}	248.38^{a}	306.52^{a}	311.40^{a}	311.54^{a}	313.34^{a}	315.61^{a}	316.32^{a}	317.90^{a}	319.23^{a}	316.89^{a}	157.23^{a}	3430.21^{a}
B_2	199.39^{a}	251.49^{a}	308.2^{b}	316.11^{b}	315.01^{b}	316.98^{b}	318.89^{b}	320.08^{b}	321.53^{b}	322.77^{b}	320.58^{b}	159.07^{b}	3470.14^{b}
B_3	224.62^{b}	269.16^{b}	310.59^{c}	316.72^{b}	319.23^{c}	321.69^{c}	323.74^{c}	324.54^{c}	325.56^{c}	326.83^{c}	324.41^{c}	160.76^{c}	3547.88^{c}
SEM	1.59	1.43	0.48	1.25	0.49	0.60	0.69	0.75	0.68	0.69	0.78	0.46	6.09

Means having different superscripts in a column differ significantly (P≤0.05)

Table 3: Effect of dietary supplements × bedding materials Interaction on Feed Consumption (g) at different weeks

Interaction Effect	Age in weeks												
	3rd	5th	7th	9th	11st	13rd	15th	17th	19th	21st	23rd	24th	Cumulative
T_{10}	182.02^{ac}	237.95	302.00	289.06^{a}	306.18	307.39	310.10	310.75	311.98	313.98	312.48	155.1	3339.01
T_{11}	201.77^{def}	247.91	306.76	321.50^{de}	311.60	313.33	315.68	316.59	318.16	318.94	316.74	157.18	3446.18
T_{12}	192.55^{bd}	244.59	305.81	294.44^{ab}	310	312.65	315.06	315.87	317.6	319	316.37	156.99	3400.94
T_{13}	206.90^{ef}	263.07	311.52	340.61^{f}	318.4	319.99	321.61	322.1	323.88	325	321.97	159.66	3534.74
T_{20}	185.95^{ab}	239.47	304.50	291.47^{ab}	311.58	314.02	316.16	316.61	317.05	318.60	316.5	157.08	3389.02
T_{21}	203.65^{ef}	253.10	308.26	326.85^{e}	316.25	318.17	319.68	321.02	323.08	323.09	320.81	159.06	3493.05
T_{22}	196.87^{de}	245.3	305.47	297.50^{bc}	312.17	313.75	315.65	316.59	318.02	319.99	318.06	157.62	3417.02
T_{23}	211.09^{f}	268.10	314.56	348.62^{g}	320.05	321.97	324.08	326.11	327.97	329.42	326.94	162.53	3581.46
T_{30}	192.63^{bcd}	253.15	305.86	304.87^{c}	313.07	315.99	317.57	318.65	320.08	322.16	320.57	158.43	3443.06
T_{31}	232.88^{g}	271.05	311.48	325.41^{e}	321.03	324.11	326.10	326.67	327.05	328.42	324.73	161.19	3580.15
T_{32}	226.57^{g}	268.95	308.84	314.47^{d}	317.71	319.23	321.11	321.19	322.94	324.32	322.03	160.13	3527.51
T_{33}	246.4^{h}	283.49	316.17	322.14^{de}	325.10	327.44	330.17	331.64	332.17	332.44	330.31	163.31	3640.82
SEM	3.19	2.86	0.96	2.50	0.98	1.21	1.39	1.50	1.36	1.39	1.56	0.92	12.18

Means having different superscripts in a column differ significantly (P≤0.05)

Effect of dietary supplementation, bedding material and their interaction on feed conversion ratio (FCR)

The feed conversion ratio (FCR) was calculated on the basis of fortnightly at 3rd and 5th week body weight gain in relation to fortnightly feed consumption. The highly significant effect (P<0.01) of dietary supplements and different bedding material on mean feed conversion ratio was reported during 3rd and 5th week of the experimental period. The cumulative mean feed conversion ratio was found to be 3.13, 3.31, 3.10 and 3.08 for T_0, T_1, T_2 and T_3 dietary treatment groups, respectively. Thus, minimum and best feed conversion ratio was observed in the group supplemented with combination of giloy and ascorbic acid (T_3) as compared to rest of the groups (Table 4). The mean cumulative FCR on the basis of bedding material was found to be 2.96, 3.10 and 3.41 in B_1, B_2 and B_3 groups, respectively, in which sand was found to be best for FCR when used as bedding material, followed by B_2 and B_3 group (Table 4).

The effect of interaction between incorporation of dietary supplementation and different bedding materials on feed conversion ratio was also observed to be highly significant during 3rd and 5th week of the experiment. The lowest FCR was reported in interaction group T_{13} in which sand was used as bedding material with supplementation of both combination of giloy and ascorbic acid (Table 5).

Similar result was shown by Ipek (2006) [11] and Abou-Zeid *et al*. (2000) [1] who found significant (P≤0.05) effect of ascorbic acid on feed conversion ratio in Japanese quails. The findings of the above experiment were in close agreement with Jain (2018) [12] in broilers also.

The results of the present study were supported by Chakma *et al*., (2012) [5] who observed that at 35 days the body weight of chicken reared on sawdust recorded best FCR than other litters. Similarly, Asaniyan *et al*. (2007) [2] reported improved broiler FCR by use of different litter materials.

Table 4: Effect of dietary supplements and bedding material on Feed Conversion Ratio (FCR) at different weeks

Supplement effect	Age in weeks		Cumulative
	3rd	5th	
T_0	2.35[a]	3.92[c]	3.13[a]
T_1	2.63[c]	4.00[d]	3.31[b]
T_2	2.46[b]	3.73[b]	3.10[a]
T_3	2.53[b]	3.64[a]	3.08[a]
SEM	0.02	0.02	0.02
Bedding effect	**3rd**	**5th**	**Cumulative**
B_1	2.36[a]	3.56[a]	2.96[a]
B_2	2.41[a]	3.79[b]	3.10[b]
B_3	2.71[b]	4.11[c]	3.41[c]
SEM	0.01	0.02	0.01

Means having different superscripts in a column differ significantly (P≤0.05)

Table 5: Effect of dietary supplement × bedding material Interaction on Feed Conversion Ratio (FCR) at different weeks

Interaction Effect	Age in weeks		Cumulative
	3rd	5th	
T_{10}	2.30[a]	3.66[c]	2.98[ab]
T_{11}	2.51[c]	3.61[bc]	3.06[b]
T_{12}	2.30[a]	3.51[ab]	2.91[a]
T_{13}	2.34[ab]	3.46[a]	2.90[a]
T_{20}	2.34[ab]	3.97[de]	3.15[c]
T_{21}	2.49[c]	4.05[ef]	3.27[d]
T_{22}	2.36[ab]	3.60[bc]	2.98[ab]
T_{23}	2.44[bc]	3.56[abc]	3.00[ab]
T_{30}	2.40[abc]	4.11[f]	3.26[d]
T_{31}	2.89[e]	4.33[g]	3.61[f]
T_{32}	2.74[d]	4.07[ef]	3.41[e]
T_{33}	2.81[de]	3.90[d]	3.36[de]
SEM	0.03	0.04	0.01

Means having different superscripts in a column differ significantly (P≤0.05)

Conclusion

Combination of giloy and vitamin C provides the highest positive effect on feed consumption in Japanese quails. The lowest feed conversion ratio (FCR) was obtained in birds which were reared on sand bedding material with supplementation of both combination of giloy and ascorbic acid, which is beneficial for poultry economy.

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