Journal of Animal Research: v.12 n.04, p. 591-596. August 2022

DOI: 10.30954/2277-940X.04.2022.19

Effect of Termites (*Neotermes assamensis*) as Protein Source on the Performance of Japanese Quails

N. Deori[1], R. Saikia[2], M. Sonowal[3], M.S. Lahamge[4] and Rushikesh A. Kantale[5*]

[1]Department of Livestock Farm Complex, BHU, Banaras Hindu University, Varanasi, Uttar Pradesh, INDIA
[2]Department of Poultry Science, AAU, Assam Agriculture University, Khanpara, Assam, INDIA
[3]Livestock Research Station Mandira, AAU, Assam Agriculture University, Khanpara, Assam, INDIA
[4]Division of Animal Biochemistry, ICAR-NDRI, National Dairy Research Institute, Karnal, Haryana, INDIA
[5]Division of Livestock Products Technology, GADVASU, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab, INDIA

**Corresponding author: RA Kantale; E-mail: rushikeshkantale23@gmail.com*

Received: 25 May, 2022 **Revised:** 28 June 2022 **Accepted:** 02 July, 2022

ABSTRACT

Research study inspected the performance of Japanese quails nourished with commonly fed accessible termites as a protein source during the rainy season, with the goal of boosting small-scale low-cost quail farming in Assam. 180 no. unsexed Japanese quail young-ones were randomly allocated treatment groups: T_0 (control), T_1 (5 percent dried termite), T_2 (10 percent dried termite), and T_3 (15 percent dried termite) each included 45 chicks, which were subsequently split into 3 replicates of 15 chicks each. The quail chicks were housed in a cage environment and fed according to regular feeding and management techniques. The T_3 group (903.41 g) had the highest overall feed consumption per Japanese quail, whereas the T_0 group had the least (849.07 g). T_3 group (269.51±3.13 g) had the maximum final body weight per Japanese quail, followed by T2 group (264.61±2.84 g), T_1 group (256.45±4.50 g), and T_0 group (251.19±5.05 g). T_3 group (3.35) had the best overall total F.C.R during the full period of the research experimental groups, followed by T_2 (3.36), T_1 (3.37), and T_0 (3.38) respectively. Overall, these findings suggest that incorporating dried termites to a Japanese quail's diet enhances performance by improving in body-weight, total feed consumption and feed conversion ratio.

HIGHLIGHTS

- Termites are reduced feed cost and used as alternative animal (Insect) protein source rich in vitamin, minerals, essential amino acids etc.
- Incorporating dried termites to a Japanese quail's diet enhances performance by improving in body-weight, total feed consumption and feed conversion ratio.

Keywords: Japanese Quail, Termites, Animal Protein, Performance.

Japanese quail (*Coturnix japonica*), which includes to the genus Coturnix, family Phasianidae, order Galliformes, class Aves, is the ancestor of domesticated quail (Lukanov and Pavlova, 2020). Coturnix japonica (Quail) has mainly kept as ornamental, song and fighting purpose in East and Southeast Asia since ancient times. 17^{th} century onwards, Japanese quail reared for eggs and flesh purpose and being very popular in Asia (Lukanov, 2019). The actual domestication of Japanese quail began around the end of the nineteenth and beginning of the twentieth centuries, resulting in significant modifications in egg production and protein value (Cecilia *et al.,* 2004). When quail farming became industrial in the second phase of the twentieth century, meat type quail were chosen in North

How to cite this article: Deori, N., Saikia, R., Sonowal, M., Lahamge, M.S. and Kantale, R.A. (2022). Effect of Termites (*Neotermes assamensis*) as Protein Source on the Performance of Japanese Quails. *J. Anim. Res.,* **12**(04): 591-596.

Source of Support: None; **Conflict of Interest:** None

America and Western Europe, and both they were utilized as an alternative animal protein source commercially (Tavaniello, 2014). Quail are now broadly used for various purposes in the avian industry for egg, meat, alternative animal protein source type, ornamental, fighting and laboratory animals in practically every corner of the world (Ahyani *et al.*, 2020).

Indian poultry industry has the quickest and perhaps most spectacular progress over the several years, emerging as a sunrise sector with an annual growth rate of 8-12 percent compared to 1.5 percent to 2 percent for Agri-crops, generating an annual turnover of 10,000 million dollars, and provides employment opportunities to 20 million citizens (Chatterjee and Rajkumar, 2015). In both developed and developing countries, the poultry sector is a key source of high-quality animal protein (Kantale *et al.*, 2019). In the last two decades, the poultry business has grown tremendously in developing nations. Exponential urbanization and economic development, particularly in developing nations, are driving up global demand for animal-sourced food (Godfray *et al.,* 2010).

Protein is an essential key factor in poultry diets because it aids in the maintenance and repair of tissues, allowing for appropriate development and growth (Cui *et al.,* 2022). The expensive cost of animal protein meals, as well as their role in disease transmission, has placed significant constraints on poultry production around the world (Womeni *et al.*, 2009). To substitute protein sources, it is consequently essential to look for safe, locally available, and low-cost feedstuffs. Because of their high nutrient content and little environmental impact, insects have been considered as a suitable replacement feed for fowl (Bovera *et al.,* 2016). Insect protein in poultry diets was actually suggested by the FAO to reduce feed costs and increase growth and productivity characteristics (Makkar *et al.*, 2014). As a result, alternative, high-quality renewable insect protein sources that can replace or substitute scarce, expensive, and elusive protein source utilize in avian nutrition in order to reduce feed costs, which account for 75 to 80 percent of total production costs.

Grubs as well as other non-traditional insects, such as winged termites, earthworms, and garden snails have now been investigated to evaluate their nutrient content, relative abundance, use and conversion into processed meals, incorporation into formulated diets, and development of technique(s) for on-farm commercial high value production (Ugwumba and Ugwumba, 2003). According to Premrov *et al.* (2021), organisms, insects, arthropods are the simplest source of animal protein. Termites are soft-vertebrate small eusocial insects with the remarkable capacity to breakdown cellulose and synthesis necessary amino acids from non-protein nitrogen (Fadiyimu *et al.,* 2003). Orangutans and mammals both gets benefit from termites as a source of protein, fat, and vital amino acids.Termites are gregarious insects that swarm at certain times of the year, particularly at the start of the rainy season or after significant rainfall. According research scientists it is good providers of protein, fat, and vital amino acids, and they can assist overcome protein inadequacies (Omotoso, 2006). Main goal of this research was to analyze the composition profile of termites as a protein source and their prospective impact on the performance of Japanese quail.

MATERIALS AND METHODS

Experimental investigation and trials apparently occurred in department of poultry science, COVS, Assam, Agri-University Khanapara, Guwahati. 180-day-old Japanese quail chicks were randomly allotted to 4 treatment groups, each with three replications of 15 birds, by the Khanapara, COVS (College of Veterinary Science) Instructional Poultry Farm. Dietary assisted groups were: (a) T_0, basal diet; (b) T_1 – Inclusion of 5% dried termite with the basal diet (c) T_2 – Inclusion of 10% dried termite with the basal diet (d) T_3 – Incorporate of 15% dried termite with the basal diet. Birds had ad libitum access to mash feed and water during the experimental feeding trials. According to the Indian Council of Agricultural Research (ICAR, 2013) as standards take into basal diet formulation include maize, rice polish, soya bean meal, groundnut cake, mineral mixture, and common salt at the prescribed levels (Table 1).

Preparation of termite meal

Local termite varieties were gathered from various parts of Assam by shoving termitarium with a spade to let them erupt and come out, which was then scraped into a plastic container. They were then submerged for a minute in a tub of water. After that, they were then sieved with a traditional bamboo strainer and dried for 12 hours in a hot air oven at 600 degrees Celsius. Up to 6 weeks of age, research

Table 1: Composition and nutrient levels of the basal diets

Ingredient	Quail Starter (0-3 Weeks)				Quail Finisher (4-6 Weeks)			
	T_0	T_1	T_2	T_3	T_0	T_1	T_2	T_3
Maize	33.00	37.50	40.10	39.50	43.50	44.10	43.30	44.50
Rice Polish	6.35	6.00	5.00	4.00	6.30	5.60	6.00	5.50
Ground nut cake	7.15	4.00	5.40	6.00	4.00	4.00	4.00	4.00
Soya bean meal	43.00	37.00	30.00	26.00	33.50	29.00	25.00	19.00
Wheat Bran	7.00	6.00	6.00	6.00	7.20	6.80	6.00	7.00
Termite meal (%)	—	5.00	10.00	15.00	-	5.00	10.00	15.00
Vegetable oil	1.00	2.00	1.00	1.00	3.00	3.00	3.20	2.50
Mineral mixture	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Common salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
TOTAL	100	100	100	100	100	100	100	100
Calculated nutrient levels								
Crude protein (%)	25.1	25.3	25.4	25.3	22.2	22.4	22.5	22.5
Metabolizable energy (kcal/kg) *	2808.09	2802.01	2801.02	2804	2901.04	2903.02	2907.01	2912

N.B. Vitamin premix Provita M was added @ 20g per quintal in both starter and finisher diet.

experimental birds of the different treatment groups were observed in weekly for body weight, body weight gain using a standard weighing balance, Feed Intake, and FCR related production effectiveness. The following formula was used to compute the feed conversion ratios (F.C.R) of distinctive experimental groups:

F.C.R =

$$\frac{\text{Quantity of feed consumed (g) during the week}}{\text{Total body weight gain (g) at the end of the week}}$$

The overall feed conversion ratios:

$$\text{F.C.R} = \frac{\text{Mean total feed consumption (g/bird)}}{\text{Mean final body weight}}$$

STATISTICAL ANALYSIS

Data obtained was subjected to Analysis of variance (ANOVA), reported by Snedecor and Cochran (1994). One-way analysis of variance was done by using SPSS (2012) as software version 21. Statistical approach was being utilized to assess the data composed from the numerous characters under the investigation. For all parameters, each bird served as the statistical unit.

RESULTS AND DISCUSSION

Proximate composition of dried termite

Table 2 illustrates result of the proximate composition of dry termites. Overall crude protein content of dried termites obtained in this study was 47.34 percent, which was consistent to Musa *et al.* (2004)'s observation that roasted termites had 47.34 % crude protein.

Table 2: Chemical composition of termite

Nutrient composition	Termite meal
Dry matter (%)	88.51
Crude protein (%)	47.34
Crude fibre (%)	10.22
Ether extract (%)	17.06
Nitrogen free extract (%)	16.68
Total Ash (%)	8.70

Performance traits

Weekly body weight and body weight gain

Although the birds fed 10 and 15 percent dry termite had exponential body weight than those fed 5 percent dried termite or the control group, experimental research data can be recorded and evaluated for body weight revealed substantial differences across different groups (Table 3). The inclusion of a higher percentage of dried termites, which is regarded a strong source of protein that aids in rapid growth, may have caused the levels to encourage much higher body weight. Researcher Ketaren *et al.* (2001) found a significant (P<0.05) difference in body-weight-gain of broiler chicks fed a diet contained 1.5 percent dried termites and found similar results. The findings were similar to those of Mossad *et al.* (2009) and Sharifi *et al.* (2011), who found that Japanese quails fed medium and high protein diets gained more weight than other group birds provided a low crude protein diet.

Entirely treatment groups of J. quail had a rise in body weight gain as week cum time progressed (Table 4). According to the experimental data findings, average weight gain in the mash feed supplemented group was not (P<0.05) statistically significant from the experimental feed fed group (P<0.05). These findings revealed that an experimental feeding using dried termites as an animal protein source outperforms mash feed and is acceptable to quail chicks. These findings are compatible with scientist Chisowa *et al.* (2015), who showed no significant difference (P>0.05) in average weight-gains for Japanese quail, supplemented fed a meal including winged termites and soyabean.

Weekly feed intake and total feed consumption

The data revealed no significant changes in overall feed consumption between the experimental groups (Table 5). Comparative to the control group, the T_3 group with 15% dried termite had the maximum feed intake, followed by T_2 (10% dried termite) and T_1 (5%) dry termite. Excessive feed intake in the dried termite-fed treatment groups could be due to the high content fiber present in dried termites, which enables the fowl to ingest additional feed to fulfill their production, growth and development requirements (Ranjhan, 2001). Scientist, Chisowa *et al.* (2015) observed that quails fed a winged termite's protein-based diet had a greater average daily feed consumption than quails fed a soya bean protein conventional diet. The highest overall

Table 3: Mean ± SE of weekly body weights (g) of Japanese quails under different treatment groups

Groups Weeks	T_1 (Control)	T_1 (5% dried termite)	T_2 (10% dried termite)	T_3 (15%dried termite)
1st week	$31.67^a \pm 0.80$	$31.38^a \pm 0.49$	$31.75^a \pm 0.55$	$33.47^a \pm 0.67$
2nd week	$75.49^a \pm 1.29$	$75.52^a \pm 1.02$	$76.55^a \pm 1.14$	$77.93^a \pm 1.51$
3rd week	$124.93^a \pm 3.53$	$126.88^a \pm 2.84$	$129.36^a \pm 3.42$	$130.29^a \pm 3.12$
4th week	$175.65^b \pm 2.79$	$177.43^{ab} \pm 2.18$	$182.16^{ab} \pm 2.68$	$184.18^a \pm 2.05$
5th week	$217.84^b \pm 5.11$	$221.33^b \pm 5.32$	$226.93^{ab} \pm 3.53$	$235.42^a \pm 3.80$
6th week	$251.19^c \pm 5.05$	$256.45^{bc} \pm 4.50$	$264.61^{ab} \pm 2.84$	$269.51^a \pm 3.13$

Means bearing same superscripts in a row did not differ significantly (P>0.05).

Table 4: Mean ± SE of weekly body weight gains (g/ bird) of Japanese quails under different treatment groups

Groups Weeks	T_0 (control)	T_1 (5% dried termite)	T_2 (10% dried termite)	T_3 (15% dried termite)
1st	$24.84^a \pm 0.80$	$24.69^a \pm 0.49$	$25.02^a \pm$ **0.52**	$26.67^a \pm 0.68$
2nd	$43.81^a \pm 1.01$	$44.14^a \pm 0.84$	$44.80^a \pm 1.08$	$44.42^a \pm 1.21$
3rd	$49.44^a \pm 3.16$	$51.36^a \pm 2.82$	$52.82^a \pm 3.25$	$52.36^a \pm 2.90$
4th	$50.72^a \pm 2.45$	$50.55^a \pm 2.00$	$52.80^a \pm 2.64$	$53.89^a \pm 2.59$
5th	$42.19^a \pm 3.71$	$43.90^a \pm 4.71$	$44.77^a \pm 2.37$	$46.24^a \pm 3.14$
6th	$33.35^a \pm 2.54$	$35.12^a \pm 2.45$	$37.68^a \pm 2.45$	$39.09^a \pm 3.07$
Total	244.35 ± 13.67	249.76 ± 13.31	257.89 ± 12.31	262.67 ± 13.59

Means bearing same superscripts in a row did not differ significantly (P>0.05).

Table 5: Mean weekly feed intake (g/ bird) and total feed consumption (g/ bird) under different treatment groups

Groups / Weeks	T_0 (control)	T_1 (5% dried termite)	T_2 (10% dried termite)	T_3 (15% dried termite)
1st	40.50	42.70	43.05	44.10
2nd	90.86	91.53	93.18	94.50
3rd	125.30	125.57	132.74	133.10
4th	165.20	169.09	169.34	172.80
5th	191.80	193.17	196.70	198.80
6th	235.41	242.23	254.97	260.11
Total	849.07	864.29	889.98	903.41

Table 6: Mean weekly feed conversion ratios (FCR) of Japanese Quails under different groups treatment

Groups / Weeks	T_0 (control)	T_1 (5% dried termite)	T_2 (10% dried termite)	T_3 (15% dried termite)
1st	1.63	1.72	1.74	1.65
2nd	2.07	2.07	2.07	2.12
3rd	2.53	2.44	2.51	2.54
4th	3.25	3.34	3.20	3.20
5th	4.54	4.40	4.39	4.29
6th	7.05	6.89	6.76	6.65
Overall	3.38	3.37	3.36	3.35

feed consumption per quail was in the T_3 group (903.41 g) and the least would be in the T_0 group (849.07 g).

Feed Conversion Ratio

When compared to other groups, treatment group quail birds which consumed 15% dried termite had a higher FCR value (Table 6). T3 had the highest overall FCR during the entire research-experiment trial (3.40), followed by T_2 (3.44), T_1 (3.45), and T_0 (3.46). The feed conversion ratio, on the other hand, can be attributed to the Japanese quails' greater feed usage. Sharifi *et al.* (2011) issued a similar observation. However, Musa *et al.* (2004) observed that Japanese quails fed a research-experimental diet of roasted termite and commercial chick mash feed performed similarly.

CONCLUSION

Orangutans and humans get ultimate benefits from the termites used as substitute source of insect-protein, fat, and vital amino acids. It might have been utilized in poultry (J. quail) sector for feeding to enhancement level of quail production, development and performance dramatically, which can help to reduce protein inadequacies. As a result, attempts are being made to minimize feed input costs by utilizing high-protein sources. The current study's experiment show that termite meal could be used as a partial replacement for soya bean meal in the feed of Japanese quails. It also introduces a unique segment on the potential use and benefits of termites (*Neotermes assamensis*) as Japanese quail feed ingredients. To validate the current findings, more research with varying quantities of dried termite as a substitute protein source in Japanese quail may be required.

REFERENCES

Ahyani, H., Mahfud, M., Waluyo, R. and Ulya, W. 2020. The potential of halal food as a driver of the economic development in regional community. *J. Sains. Terap. Pariwisata.,* **4**(2): 163-182.

Bovera, F., Loponte, R., Marono, S., Piccolo, G., Parisi, G., Iaconisi, V. and Nizza, A. 2016. Use of *Tenebrio molitor* larvae meal as protein source in broiler diet: Effect on growth performance, nutrient digestibility, and carcass and meat traits. *J. Anim. Sci.*, **94**(2): 639-647.

Cecilia, H., Catherine, G.H., Sophie, L. and Jean-Pierre, R. 2004. Daily organization of laying in Japanese and European quail: effect of domestication. *J. Exp. Zool. A. Comp. Exp. Biol.*, **301**(2): 186-194.

Chatterjee, R.N. and Rajkumar, U. 2015. An overview of poultry production in India. *Indian J. Anim. Res*., **54**(2): 89-108.

Chisowa, D.M., Mupeyo, B. and Kasamba, R.T. 2015. Evaluation of winged termites on sole sources of protein in growing Japanese quails. *Eur. J. Acad. Res.*, **2**(12): 15214-15227.

Cui, P., Li, M., Yu, M., Liu, Y., Ding, Y., Liu, W. and Liu, J. 2022. Advances in sports food: sports nutrition, food manufacture, opportunities and challenges. *Int. Food Res. J.*, 111258.

Fadiyimu, A.A., Ayodele, A.O., Olowu, P.A. and Folorunso, O.R. 2003. Performance of finishing broilers fed graded levels of termites' meal as replacement for fish meal. In *Proceedings of the 28th Annual Conference of the Nigerian Society for Animal Production*, **2**(281): 211-212.

Godfray, H.C.J., Beddington, J.R., Crute, I.R., Haddad, L., Lawrence, D., Muir, J.F. and Toulmin, C. 2010. Food security: the challenge of feeding 9 billion people. *Sci.*, **327**(5967): 812-818.

Gope, B. and Prasad, B. 1983. Preliminary observation on the nutritional value of some edible insects of Manipur. *J. Adv. Zool*., **4**(1): 55-61.

ICAR. 2013. Nutrient requirement of animal – poultry. Indian council of Agricultural Research-NIANP Publication, India

Kantale, R.A., Kumar, P., Mehta, N., Chatli, M.K., Malav, O.P., Kaur, A. and Wagh, R.V. 2019. Comparative efficacy of synthetic and natural tenderizers on quality characteristics of restructured spent hen meat slices (RSHS). *Food Sci. Anim. Resour.*, **39**(1): 121.

Ketaren, P.P., Sinurat, A.P., Purwadaria, T., Kompiang, I.P. and Amir, M. 2001. Use of termite (*Glyptotermes montanus*) as poultry feed. *J. Ilmu Ternak Dan Veteriner*., **6**(2): 100-106.

Lukanov, H. 2019. Domestic quail (*Coturnix japonica domestica*), is there such farm animal. *Worlds Poult. Sci. J.*, **75**(4): 547-558.

Makkar, H.P., Tran, G., Heuze, V. and Ankers, P. 2014. State-of-the-art on use of insects as animal feed. *Anim. Feed Sci. Technol.*, **2**(197): 1-33.

Mossad, G.M.M. and Iben, C. 2009. Effect of dietary energy and protein levels on growth performance, carcass yield and some blood constituents of Japanese quails (*Coturnix japonica*). *Bodenkultur*., **60**(4): 39-46.

Musa, U., Yusuf, J., Haruna, E.S., Karsin, P.D. and Ali, U.D. 2004. Termites as possible animal protein supplement for Japanese quail (*Coturnix japonica*) chicks feed. *Niger. J. Biotechnol*., 15(1): 48-51.

Omotoso, O.T. 2006. Nutritional quality, functional properties and anti-nutrient compositions of the larva of *Cirina forda* (Westwood) (Lepidoptera: Saturniidae). *J. Zhejiang Univ. Sci. B.*, **7**(1): 51-55.

Premrov Bajuk, B., Zrimsek, P., Kotnik, T., Leonardi, A., Krizaj, I. and Jakovac Strajn, B. 2021. Insect Protein-Based Diet as Potential Risk of Allergy in Dogs. *Animals*, **11**(7): 1942.

Ranjhan, S.K. 2001. Animal Nutrition in the Tropics. Revised 5" Edition, Vicas Publishing House.

Sharifi, M.R., Shams-Shargh, M., Dastar, B and Hassani, S. 2011. Effect of dietaery protein levels and symbiotic on performance parameters blood characteristics and carcass yields of Japanese quail (*Coturnix coturnix japonica)*. *Ital. J. Anim. Sci*., **10**(1): 17-21.

Snedecor, G.W. and Cochran, W.G. 1994. Statistical methods. 11th Edn. The Iowa State University Press, Ames, IA., pp. 267.

SPSS. 2012. Statisical package for windows. Chicago, IL, USA.

Tavaniello, S. 2014. Effect of cross-breed of meat and egg line on productive performance and meat quality in Japanese quail (*Coturnix japonica*) from different generations.

Ugwumba, A.A.A. and Ugwumba, A.O. 2003. Aquaculture Options and future of fish supply in Nigeria. *Zoologist*., **2**(2): 96-122.

Womeni, H.M., Linder, M., Tiencheu, B., Mbiapo, F.T., Villeneuve, P., Fanni, J. and Parmentier, M. 2009. Oils of insects and larvae consumed in Africa: potential sources of polyunsaturated fatty acids. *Oil Corps. Gras Lipides.*, **16**(4-5-6): 230-235.