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Research Paper

Performance evaluation of commercial meat quail on supplementing growth promoter and performance enhancer

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ABSTRACT

In order to evaluate the quail performance on supplementation of growth promoter and performance enhancer (GPPE) *via*., different routes, 180-day old unsexed quail chicks were arbitrarily divided into three treatment groups (n=60), consisting of three replicates of 20 birds in each group. Birds of control (C) group were fed maize-soybean based basal diet, whereas in treatment groups, additionally GPPE was supplemented in liquid form (@ 20 ml/100 birds/day) in T_1 group and as dietary additive (@ 5 g/10 kg feed) in T_2 group. The trial lasted for 5 weeks. The efficacy was judged through growth performance, carcass traits, blood biochemical analysis and economics of rearing. The results revealed thatbody weight gain (BWG) (g) and feed conversion ratio (FCR) were significantly ($P<0.05$) better in GPPE supplemented groups during finisher phase, but for whole trial period, FCR was better in T_2 and higher in C, with intermediate values for T_1. There was no significant difference observed for glucose, protein profiling and different carcass traits. Cost benefit ratio was better for T_2 group followed by T_1 group and least in C group. It may be concluded that it is beneficial to supplement GPPE in quail birds for higher BWG and better FCR.

Key words: Cost benefit ratio, growth promoter, growth traits, quail

Japanese quailis ideallysuited for production of table eggs and delicious meat under intensive management and has marketable age of 5 weeks (ICAR, 2013). It has low maintenance cost, earlier returns and is a prolific breeder. These birds have unique properties of achieving earlier sexual maturity,higher exponential growth, heat tolerance andbetter disease resistance in comparison to rest of the poultry species (Khan *et al*., 2022). Its name is also found in numerous religious scriptures and Roman writings (Hasan, 2014), but has no religious taboo. Its meat is considered as a delicacy and has low cholesterol/calories and contains all the amino acids necessary forhuman nutrition (Khalifa *et al*., 2016). In comparison with other meat species, quail has the advantage of having arelatively small body mass that makes it easy to handle, besides offering freshmeat thatsatisfiesthe consumption/requirement in a relatively easy manner. Another important feature of quail meat is that it has good appealing to the consumer as well as organoleptic qualities.

Now-a-days, herbal preparations are looked as replacer of prophylactic antibiotics (Oluwafemi *et al*., 2021) for enhancing the bird performance. Growth promoterand performance enhancer (GPPE) is a herbal additive, which when added in feed and/or water improves the growth traits as well asthe overall performance of birds. Its benefits are attributable to its capacity of providing a number of vital nutrients that are required by the birds to stay healthy and grow properly. Being natural product, it is safe and has no side effects/residual effect. It protects the birds from various diseases by stimulating the immune system, maximizes the productivity, promotes the digestibility and utilization of different nutrients which results in better growth, improved feed conversion efficiency besides curbing the stress. It fills the nutritional gap if any due to growth phase, peak egg production, stress or disease condition. But these products are available either in powdered form as dietary additive or supplemented through drinking water. Keeping the above facts in mind, the current experiment was designed to evaluate the comparative efficacy of these above-mentioned routes of GPPE supplementation over performance of quail birds.

MATERIALS AND METHODS

The location of current study was Livestock Farm Complex (LFC) Division, Faculty of Veterinary Science & Animal Husbandry, SKUAST-Jammu. Day old quail chicks (180 chicks) were randomly divided into three groups (n= 60 birds/group) and each group has three replicates of twenty birds each. All the birds were raised in well partitioned deep litter systemfor 35 days andfed common basal diet consisted of maize-soybean along with other additives. The starter diet (fed for 21 days) had 24.91% crude protein (CP) and 2900 kcal/kg metabolizable energy (ME), whereas finisher diet (fed from 22-35 days of age) had 21.45% CP and 2900 kcal/kg ME (Table 1) as per specifications given by ICAR (2013). Additionally, treatment groups were supplemented with GPPE as liquid form (*Withania somifera*-6%, *Aspargus officinalis*-5%, *Rubia cordifolia*-5%, *Boerhaavia diffusa*-4%, *Ocimum sanctum*-4%, *Vitis vinifera*-3%, *Emblica officinalis*-3%, *Mucuna pruriens*-3%, *Chlorphytum borivillanum*-2%, aqua- q.s.) @ 20 ml/100 birds in T_1, and as powder form/dietary additive (*Withania somifera*-20%, *Aspargus officinalis*-15%, *Eclipta alba*-15%, *Boerhaavia diffusa*-8%, *Ocimum sanctum*-8%, *Vitis vinifera*-6%, *Mucuna pruriens*-8%, *Chlorphytum borivillanum*-4%, *Trigonella foenum-graecum*-8%, *Terminalia chebula*-8%) @ 5 g/10 kg feed in T_2 (provided by Arvind Herbal Labs, Saharanpur, U.P., India).

Table 1: Composition (Ingredient and chemical as %) of quail starter and finisher diet (on DMB)

Attributes	Experimental Diets	
	Starter	Finisher
Ingredient composition (%)		
Maize flakes	52.80	64.08
Meat bone meal (MBM)	5.00	4.90
Soyabean meal (SBM)	39.80	29.76
Salt (Nacl)	0.25	0.25
Sodium bicarbonate	0.01	0.01
Soyabean oil (Refined oil)	1.50	0.30
DL-Methionine (DL-M)	0.15	0.16
Lysine	0.16	0.15
Dicalcium phosphate	0.05	0.00
Limestone powder	0.18	0.26
Vitamin supplement	0.05	0.05
Trace minerals	0.10	0.10
Chemical composition (%)		
Organic matter (OM)	93.68	94.96
Crude protein (CP)	24.91	21.45
Ether extract (EE)	5.81	5.69
Crude fibre (CF)	4.79	4.25
Total ash (TA)	5.12	4.72
ME (kcal/kg) calculated	2900	2950

Feed intake (FI) was recorded daily whereas body weight (BW) was estimated at 0, 21 and 35 days of age in morning hours by using electronic weighing balance. Body weight gain (BWG) was calculated by subtracting the previous body weight of birds (g) from the current body weight (g). Feed conversion ratio (FCR) was assessed by dividing the feed intake (g) of birds by body weight gain (g). Analysis of feed samples wasdone as per AOAC (2012) for proximate composition. ME (kcal/kg) is a calculated value which is computed by adding the respective ME values of different feed ingredients used for preparing ration. Thirty-six birds (4 birds per replicate) were slaughtered on completion of trial for estimating carcass characteristics. Blood was also collected simultaneously to estimate plasma glucose and undergo serum protein profiling by using standard

diagnostic kits. The data generated was then subjected to statistical analysis by using standard statistical procedureas per Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

The data generated on supplementing growth promoter and performance enhancer (GPPE) *via* different routes over growth performance of quail birds is depicted in Table 2. The results revealed that GPPE supplementation had no contrary effect on body weight (BW) and feed intake (FI) during whole trial period. Body weight gain (BWG) was also comparable during starter as well as whole trial phase among different treatment groups. However, during finisher phase of trial, BWG showed significant improvement in both the supplemented treatment groups when compared to control group. The results signified that supplementation of growth promoter in powder form and liquid form through feed and drinking water improved BWG and this may be attributed to antimicrobial, antioxidant and antistress properties (Nalge *et al*., 2017). These results are in line with the findings of earlier researchers who reported that phytoadditive supplementation in graded levels or single dose in feed and/or drinking water resulted in higher BWG in broilers (Odo *et al*., 2010; Darabighane *et al*., 2011; Bolu *et al*., 2013; Bernard *et al*., 2016; Shokri *et al*., 2016; Shokraneh *et al*., 2016; Islam *et al*., 2017; Nalge *et al*., 2017, Singh *et al*., 2017; Akram *et al*., 2019; Sakadzo and Chibi, 2020; Amber *et al*., 2021).

Table 2: Comparison of supplementing growth promoter and performance enhancer (liquid and powder form) on growth parameters of quail

Particulars	Groups			SEM	P value
	C	T1	T2		
			Body weight (g)		
Day 0	7.74±0.12	7.51±0.12	7.64±0.16	0.08	0.528
Week 3	97.25±4.47	100.13±3.00	101.91±3.04	1.91	0.667
Week 5	168.18±4.07	180.60±4.44	184.52±5.82	3.45	0.118
			Body weight gain (g)		
0-3 weeks	89.52±4.59	92.62±2.92	94.27±2.89	1.91	0.651
3-5 weeks	70.93^{a}±1.84	80.48^{b}±1.52	82.61^{b}±2.78	2.08	0.017
0-5 weeks	160.44±4.19	173.09±4.34	176.88±5.67	3.45	0.111
			Feed intake (g)		
0-3 weeks	207.49±5.22	214.14±9.63	213.54±6.48	3.82	0.786
3-5 weeks	473.70±7.89	485.56±8.31	484.33±7.58	4.39	0.544
0-5 weeks	681.19±13.10	699.70±17.94	697.87±13.30	8.03	0.649
			Feed conversion ratio (FCR)		
0-3 weeks	2.33±0.14	2.31±0.05	2.27±0.03	0.05	0.890
3-5 weeks	6.69^{b}±0.27	6.03^{a}±0.09	5.87^{a}±0.11	0.15	0.037
0-5 weeks	4.25^{b}±0.17	4.04^{ab}±0.06	3.95^{a}±0.05	0.08	0.044

^{a,b} Mean with different superscripts differs in a row significantly ($p<0.05$)

Likewise, feed conversion ratio (FCR) was found significantly better in T_2 group (powder supplemented) and T_1 group (liquid supplemented) during finisher trial phase, but showed no statistical difference during starter phase. However, whole trial FCR was better in T_2 but T_1 has intermediate values. It may be accredited to better BWG and better utilization of nutrients in GPPE supplemented groups (Chakraboraty *et al*., 2011). Better FCR was reported on supplementation of different phyto-additives in poultry birds by various researchers (Brenes and Roura, 2010; Brzoska *et al*., 2015; Ratika *et al*., 2018; Barman *et al*., 2019; Islam *et al*., 2020; Amber *et al*., 2021; Chowdhary *et al*., 2021). However, numerous researchers found no beneficial effect of use of feed additives supplementation in birds diet/ration (Hasan, 2014; Amini and Vali, 2016; Choudhury *et al*., 2018; Singh *et al*., 2018). These differences reported by different researchers might be due to different source of additives or different species of birds used in their study as well as different climatic conditions.

Different protein parameters *viz*. total protein, albumin, globulin, A:G ratio and plasma glucose was similar amongst different treatment groups and were within the normal range as suggested for quail birds, thus indicating no adverse effect of supplementation of GPPE on biochemical profile of quails (Table 3). Amini and Vali (2016) reported similar glucose values and protein profile of Japanese quails on supplementing different levels of feed additive in powder form. Likewise, many researchers also stated no difference in serum glucose values of broilers on supplementing aloe vera as dietary additive (Mehala and Moorthy, 2008; Bolu *et al*., 2013; Shokri *et al*., 2016).

Contradictory to our results, Singh *et al.* (2013) concluded that aloe vera leaf juice supplementation in drinking water significantly increased glucose, but protein parameters were comparable in different dietary treatments. Amber *et al*. (2021) reported higher values of protein parameters in birds on supplementation of phyto-additives. This difference could be accredited to the different birds as well as varying source of additives used in the study of different researchers.

Table 3: Effect of supplementing growth promoter and performance enhancer on blood biochemical parameters of quail

Particulars	Groups			SEM	P value
	C	T1	T2		
Total Protein (g/dl)	4.41±0.17	4.37±0.19	4.44±0.18	0.10	0.966
Albumin (g/dl)	2.31±0.15	2.34±0.14	2.39±0.15	0.08	0.936
Globulin (g/dl)	2.10±0.23	2.03±0.25	2.05±0.18	0.12	0.972
A/G ratio	1.22±0.25	1.27±0.20	1.22±0.15	0.11	0.981
Glucose (mg/dl)	181.83±3.92	182.73±3.86	181.91±5.05	2.34	0.987

Effect of supplementation of growth promoter and performance enhanceron various carcass traits (live weight, bled weight, defeathered weight, drumstick weight andgiblet weight)of quail birds that were measured in g as well as % live weight showed comparable values amongst different treatment groups (Table 4). Similar results were also reported by different researchers on supplementing phyto-additives in quail's (Tariq *et al*., 2015; Amini and Vali, 2016) and/or broiler's ration (Mehala and Moorthy, 2008; Shokraneh *et al*., 2016; Barman *et al*., 2019).

Table 4: Effect of supplementing growth promoter and performance enhanceron carcass parameters of quail

Particulars	Groups			SEM	P value
	C	T1	T2		
Live weight (g)	167.94±3.54	170.94±3.29	171.60±3.66	1.84	0.744
Bled weight (g)	161.59±3.47	165.16±3.08	165.26±3.22	1.74	0.681
% of live weight	96.22±0.10	96.63±0.10	96.31±0.27	0.11	0.298
Defeathered weight (g)	131.37±4.10	134.27±3.03	135.22±3.83	1.93	0.753
% of live weight	78.19±0.80	78.54±0.26	78.78±0.56	0.30	0.783
Giblet weight (g)	4.18±0.25	4.30±0.34	4.40±0.42	0.18	0.901
% of live weight	2.48±0.09	2.51±0.15	2.56±0.23	0.08	0.943
Drumstick weight (g)	4.84±0.14	5.13±0.07	5.16±0.09	0.07	0.145
% of live weight	2.88±0.08	3.00±0.04	3.01±0.12	0.05	0.543

The cost economics of the quail birds supplemented with growth promoter and performance enhancer is depicted in Table 5.The cost benefit ratio in powder supplemented group was better when compared to liquid supplemented group as well as control group and the reason might be accredited to their improved FCR and better nutrient utilization. These results are in corroboration to the findings of several researchers who reported similar results *i.e*., higher return onsupplementation of different phyto-additives (Darabighane *et al*., 2011; Borgohain *et al*., 2017; Barman *et al*., 2019; Chowdhary *et al*., 2021). Although, Karangiya *et al*. (2016) in his study found that phyto-additives supplementation had no effect on the cost benefit ratio.

Table 5: Effect of supplementing growth promoter and performance enhancer on cost economics of quail

Particulars	C	T1	T2
No. of quail chicks	60	60	60
Cost of birds @Rs. 16/chick	960	960	960
Cost of litter (Rs.)	150	150	150
Cost of starter feed (Rs.)	585.12	603.87	602.18
Cost of finisher feed (Rs.)	1165.30	1194.48	1191.45
Cost of additive including wastage (powder @Rs. 350/kg and liquid @Rs. 250/liter)	0	40	15
Total input cost (Rs.)	2860.42	2948.35	2918.63
Mortality (in no.)	7	4	4
Final body weight (kg)	13.96	15.53	15.87
Income from quail birds (@Rs. 50 per 100 g live bird)	6979.47	7765.80	7934.36
Total difference over control (Rs.)	0	786.33	168.56
Difference over control (Rs.)	0	9.14	1.96
Cost benefit ratio	1.44	1.63	1.72

CONCLUSION

It may be concluded that supplementation of growth promoter and performance enhancerin quails feed and water is beneficial because it improved BWG, FCR and C:B ratio and also had no negative effect on blood glucose, protein profiling as well as carcass characteristics.

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REFERENCES

Akram, M.Z., Salman, M., Jalal, H., Asghar, M.U., Ali, Z., Javed, M.H. and Khan, M. 2019. Evaluation of dietary supplementation of aloe vera as an alternative to antibiotic growth promoters in broiler production. *Turkish Journal of Veterinary Resources*, **3:** 21-26.

Amber, K., Nofel, R., Ghanem, R., Sayed, S., Farag, S., Shukry, M. and Dawood, M. 2021. Enhancing the growth rate, biochemical blood indices, and antioxidative capacity of broilers by including aloe vera gel in drinking water. *Frontiers in Veterinary Science*, **7**: 1-8.

Amini, A.G. and Vali, N. 2016. Effect of using aloe vera and protexin probiotic on performance, carcass characteristics and some blood biochemical in Japanese quails. *CIBTech Journal of Zoology*, **5**: 39-44.

AOAC, 2012. Official methods of analysis (19th ed.). Association of Official Analytical Chemists. Washington, DC.

Barman, S., Samanta, A., Das, B., Goswami, R., Gali, J. and Devi, P. 2019. Effect of dietary supplementation of aloe vera and *Lactobacillus acidophilus* on growth performance, nutrient utilization and carcass characteristics of broiler birds. *International Journal of Livestock Research*, **9**: 102-112.

Bernard, N., Mohammed, A., Edwards, A. and Bridgemohan, P. 2016. Effect of aloe barbadense leaf and gel aqueous extracts during the starter and finishing phases of broiler production. *International Journal of Poultry Science*, **15**: 15-20.

Bolu, S., Babalola, T., Elelu, N., Ahmed, R., Oyetunde, S., Ademola, P. and Jiddah, S. 2013. Effect of supplemental aloe vera gel in drinking water on some performance histology, hematology, serum constituents and growth of turkey poults challenged with E. coli. *Wudpecker Journal of Agricultural Research*, **2**: 223-229.

Borgohain, B., Mahanta, J., Islam, R., Sapcota, D., Sarma, S. and Borah, M. 2017. Effect of feeding garlic (*Allium sativum*) as prebiotic on the performance of broiler chicken. *International Journal of Livestock Research*, **7**: 225-233.

Brenes, A. and Roura, E. 2010. Essential Oils in Poultry Nutrition: Main Effects and Modes of Action. *Animal Feed Science and Technology*, **158**: 1-14.

Brzóska, F., OEliwiñski, B., Michalik-Rutkowska, O. and OEliwa, J. 2015. The effect of garlic (*Allium sativum* L.) on growth performance, mortality rate, meat and blood parameters in broilers. *Annals of Animal* Science, **15**: 961-975.

Chakraborty, P.S., Ali, S.A., Kaushik, S., Ray, R.K., Yadav, R.P., Rai, M.K., Singh, D., Bhakat, A.K., Singh, V.K., John, M.D., Das, K.C., Prasad, V.G., Nain, S.S., Singh, M., Chandra, P.K., Singh, D.K., Rai, Y., Singh, P., Singh, O., Singh, A.K.N., Shah, M., Pradhan, P.K., Bavaskar, R., Debata, L., Nayak, C., Singh, V. and Singh, K. 2011. Curcuma longa- A multicentric clinical verification study. *Indian Journal of Research in Homoeopathy*, **5**: 19-27.

Choudhury, D., Mahanta, J., Sapcota, D., Saikia, B. and Islam, R. 2018. Effect of dietary supplementation of turmeric (*Curcuma longa*) powder on the performance of commercial broiler chicken. *International Journal of Livestock Research*, **8**: 182-191.

Chowdhary, S., Khan, N., Sharma, R.K., Sasan, J.S. and Mahajan, V. 2021. Effect of dietary inclusion of turmeric (*Curcuma longa*) and garlic (*Allium sativum*) powders as feed additives on performance of broiler chicken. *Indian Journal of Animal Nutrition*, **38**: 92-99.

Darabighane, B., Zarei, A., Shahneh, A.Z. and Mahdavi, A. 2011. Effects of different levels of aloe vera gel as an alternative to antibiotic on performance and ileum morphology in broilers. *Italian Journal of Animal Science*, 189-194.

Hasan, M. 2014. Effect of aloe vera and vitamin C on productive performance and qualities trails of eggs in Japanese laying quail. *Euphrates Journal of Agriculture Science*, **6**: 17-29

ICAR, 2013. Nutrient requirement of Animals-Poultry (ICAR-NIANP), Indian Council of Agriculture Research, New Delhi.

Islam, M.D., Ali, M.D. and Dadok, F. 2020. Effect of supplemental aloe vera gel and amla fruit extract in drinking water on growth performance, immune response, hematological profiles and gut microbial load of broiler chicken. *Journal of Biosciences and Agricultural Research*, **24**: 2030-2038.

Islam, M.M., Rahman, M.M., Sultana, S., Hassan, M.Z., Miah, A.G. and Hamid, M.A. 2017. Effects of aloe vera extract in drinking water on broiler performance. *Asian Journal of Medical and Biological Research*, **3**: 120-126.

Karangiya, V.K., Savsani, H.H., Patil, S.S., Garg, D.D., Murthy, K.S., Ribadiya, N.K. and Vekariya, S.J. 2016. Effect of dietary supplementation of garlic, ginger and their combination on feed intake, growth performance and economics in commercial broilers. *Veterinary World*, **9**: 245-250.

Khalifa, A.H., Omar, M.B., Hussein, S.M. and Abdel, H.E. 2016. Nutritional value of farmed and wild quail meats. *Assiut Journal of Agricultural Sciences*, **47**: 58-71.

Khan, N., Gupta, A., Sehar, M.A., Parihar, S., Kumar, D. and Mahajan, V. 2022. Effect of supplementing herbal antimicrobial growth promotor on performance of quail. *International Journal of Life Sciences and Applied Sciences*, **4**: 01-09.

Mehala, C. and Moorthy, M. 2008. Effect of aloe vera and *Curcuma longa* (Turmeric) on carcass characteristics and biochemical Parameters of broilers. *International Journal of Poultry Science*, **7**: 857-861.

Nagle, P.S., Koley, K.M., Bhave, K.G. and Maiti, S.K. 2017. Effect of aloe vera leaf extract on performance parameters in broiler birds. *Advances in Bioresearch*, **8**: 60-65.

Odo, B.I., Ekenyem, B.U. and Nwamo, A.C. 2010. Effect of aloe vera as leaf protein concentrate on growth performance of cockerels. *International Journal of Poultry Science*, **9**: 426-428.

Oluwafemi, R.A., Uankhoba, I.P. and Alagbe, J.O. 2021. Effects of turmeric oil as dietary supplement on the haematology and serum biochemical indices of broiler chickens. *Biomedical Journal of Scientific and Technical Research*, **37**: 29124-29128.

Ratika, K., Singh, R.K.J. and Singh, R.K. 2018. Effect of garlic (*Allium sativum*) and turmeric (*Cucurma longa*) powder supplementation on blood parameters of starter and finisher growth phase of broilers. *International Journal of Pure and Applied Bioscience*, **6**: 562-567.

Sakadzo, N. and Chibi, M. 2020. Effects of drinking water containing aloe vera extracts om growth and palatability of black Australorp and Koekkoek ecotype chickens. *Acta Scientific Agriculture*, **4**: 73-80.

Shokraneh, M., Ghalamkari, G., Toghyani, M. and Landy, N. 2016. Influence of drinking water containing aloe vera (*Aloe barbadensis Miller*) gel on growth performance, intestinal microflora, and humoral immune responses in broilers. *Veterinary World*, **9**: 1197-1203.

Shokri, A.N., Ghasemi, H.A. and Taherpour, K. 2016. Evaluation of aloe vera and symbiotic as antibiotic growth promoter substitutions on performance, gut morphology, immune responses and blood constitutes of broiler chickens. *Animal Science Journal*, **88**: 306-313.

Singh, H., Ali, N., Kumar, J., Kumar, R. Singh, S. and Kansal, A. 2017. Effect of supplementation of aloe vera on growth performance in broilers chicks. *Chemical Sci. Review and Letters*, **6**: 1238-1243.

Singh, J., Koley, K., Chandrakar, K. and Pagrut, S. 2013. Effects of aloe vera on dressing percentage and hemato-biochemical parameters of broiler chickens. *Veterinary World*, **6**: 803-806.

Singh, P.K., Kumar, A., Tiwari, D.P., Kumar, A. and Palod, J. 2018. Effect of graded levels of dietary turmeric (*Curcuma longa*) powder on performance of broiler chicken. *Indian Journal of Animal Nutrition*, **35**: 428-435.

Snedecor, G.W. and Cochran, W.G. 1994. Statistical methods. 8th Edition, The lowa state university, lowa U.S.A.

Tariq, H., Roa, P.V.R., Raghuvanshi, R.S., Mondal, B.C. and Singh, S.K. 2015. Effects of aloe vera and clove powder supplementation on carcass characteristics, composition and serum enzymes of Japanese quails. *Veterinary World*, **8**: 664-668.