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EFFECTS OF SUPPLEMENTATION OF SNAIL MEAL IN THE RATION ON GROWTH PERFORMANCES OF JAPANESE QUAILS, *Coturnix coturnix japonica*

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Abstract

One-day-old Japanese quails (*Coturnix coturnix japonica*) obtained from a commercial quail hatchery and breeding were placed in wire mesh battery cages and fed with diets containing the snail meal from 0 (control), 2.5, 5, and up to 7.5%. All the rations contained 26% crude protein (CP) and 2800 kcal/kg of Metabolized Energy (ME). The birds were reared for 6 weeks and then slaughtered. Growth performances, i.e.: Feed Intake (FI), Body Weight (BW), Average Daily Gain (ADG) and Feed Conversion Ratio (FCR) [3]were measured weekly, whereas carcass and breast percentages of quails were observed at the end of rearing. Proximate analysis revealed that snail meal was high in crude protein and calcium content. Level of snail meal in the ration did not significantly influence FI, FCR, carcass and breast percentages of quails. In fact, the final body weight and ADG of birds fed with snail meal was significantly higher than the control birds. In conclusion, large quantity of snail manually collected to suppress golden snail population could be used as source of protein and mineral for quail feed without affecting its growth performances.

Key words: Supplementation, Snail meal, Growth performances, Japanese quail

Introduction

Pomacea insularis, is a serious pest snail of rice plant in many rice growing areas in Asia (Naylor, 1996) and could be found especially during draining of water before harvesting. Control measures implemented in many countries did not seem to work very well since the snail is very difficult to eradicate due to its ability to adapt many severe conditions. Apparently the most effective form of control is by handpicking and pasturing ducks in the paddy field (Naylor, 1996, Anderson, 1993). Sometimes the collected snails were put into sacks and left on the roadside to be overrun by passing vehicle (Anderson, 1993).

Other than destroying, the large quantity of snails collected manually could be put into good use by utilizing them as animal feed such as chickens and ducks (Ulep

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and Buenafe, 1991, Vinoba, 1998). The advantage of snails as animal feed is due to its high content of protein (Ulep and Buenafe, 1991, Pitojo, 1996 and Sri-Anggraeni, 1998). In practice, ducks can also be used to control the snails by herding them into rice field (Halwart, 1994). Studies, so far, have been focussing on the utilisation of snail's flesh as a substitute of fishmeal, meat bone meal or soybean meal for chicken and ducks (Ulep and Buenafe, 1991, Vinoba, 1998, Sri-Anggraeni, 1998, Togatorop, 1998). Thus, in the present study the snail meal made of the whole snails of *P. insularis* were analysed for its proximate value and then used in the ration to substitute Soya Bean Meal (SBM) for feeding of quails to evaluate its growth performances such as Feed Intake (FI), Body Weight (BW), Average Daily Gain (ADG), Feed Conversion Ratio (FCR) and carcasses and breast percentages.

Materials and Methods

Snails were collected from canals and rice fields in infested areas and washed, crushed and oven dried at temperature ± 65 ^{0}C for 3-5 days. The dried snails were ground into fine powder of snail meal.

The moist content was determined by drying the snail meal in an oven at temperature of 105 °C for overnight. Snail meal was burned in a muffle furnace at 550 °C for ash content and followed by determination Ca and P. Soxhlet extraction was used to determine fat content and crude protein was determined by Kjeldahl method. Crude fibre was determined using neutral detergent fibre procedure.

Rations for quail were prepared using feed ingredients such as corn, snail meal, fishmeal, soybean meal and rice bran. Feed formulation and calculation was based on the nutrient contents of snail meal obtained from proximate analysis and other ingredients used from NRC (1994) to get ration with four different levels of snail meal as shown in Table 1.

One day-old Japanese quails, *Coturnix coturnix japonica*, obtained from local quail hatchery were put into battery cages of 50 x 80 cm^2. Twelve cages, each were containing 35 birds were heated using 40-watt bulb to generate temperature up to about 39 ^{0}C. The temperature inside the cages would gradually be reduced to ambient temperature, as the birds were getting older. At 3 weeks old, the birds were transferred to grower cages and provided with hurricane lamp during the night.

Feeding trial was conducted for 6 weeks with 3 replicates for each ration where feed intakes were weekly measured. Drinking water was provided continuously during the trial. Individually bird was weighed weekly until the end of feeding trials before they were slaughtered. The birds were weighed before and after slaughtering. Slaughtering was done by cut off the two passages of oesophagus and trachea and two blood vessels of jugular vein and carotid artery. The birds were manually de-feathered after scalding at temperature of about 50 ^{0}C. Carcass of quails was

obtained by removing the shank, neck, head, liver, heart, digestive and reproductive organs.

Table 1.Composition of rations used for feeding trial of quails (%)

Ingredients	Level of snail meal (%)			
	0 (control)	2.5	5	7.5
Snail Meal	0	2.5	5	7.5
Corn	41	41	41	41
Fish Meal	5	5	5	5
Soya Bean Meal	41.70	39.95	38.04	36.05
Rice Bran	8.30	8.30	8.30	8.30
Palm Oil	1.25	0.92	0.65	0.40
Premix	0.10	0.10	0.10	0.10
Limestone, ground	1.20	-	-	-
Sand	1.45	2.23	1.91	1.65
Total	100	100	100	100
Calculated analysis				
Crude Protein (%)	26	26	26	26
Metabolized Energy (Kcal/kg)	2800	2808	2800	2800
Calcium (%)	0.65	0.85	1.50	2.15
Phosphorus (%)	0.59	0.59	0.58	0.58

The parameters observed during feeding trial were growth performances, consisted of Feed Intake, weekly Body Weight, increment, Average Daily Gain (ADG), Feed Conversion Ratio (FCR) and percentage of carcass. Data collected were treated by Analysis of Variance.

Results

Chemical composition of Snail Meal

Analysis of whole and separated parts of snail revealed that the content of crude protein of both whole snail and flesh was high but low in fat and crude fibre. Calcium was found to be abundant in its shell (Table2).

Table 2. Chemical composition of snail meal (%)

Parts	Constituent						
	DM	Ash	CP	Fat	CF	Ca	P
Whole snail	96.7	32.4	32.0	3.17	1.77	26.3	0.29
Shell	99.0	53.8	3.32	0.18	4.66	51.5	0.02
Flesh	91.8	8.4	50.8	3.32	0.58	5.42	0.49

M: dry matter, CP: crude protein, CF: crude fibre, Ca: Calcium, P: Phosphorus

Growth performances of quails

Feed consumption of quails (Table 3) increased rapidly as birds were getting older. At one week old, birds ate 4 – 5 g per bird per day, whereas the mature birds of 6 weeks old ate 22 – 26 g per bird per day. The rate of feeding, however, began to decrease when the birds were 4 weeks old. Birds given ration containing snail meal consumed less than those fed with ration without snail meal in their early stage of development.

Table 3. Feed intake of quail fed with ration containing snail meal (g/bird/day)

Age (week)	Level of snail meal (%)			
	0 (control)	2.5	5	7.5
1	4.4 ± 0.1^{a}	4.6 ± 0.1^{a}	4.3 ± 0.1^{b}	4.2 ± 0.1^{b}
2	9.1 ± 0.5^{a}	8.3 ± 0.7^{ab}	7.9 ± 0.8^{b}	8.8 ± 0.4^{ab}
3	14.0 ± 1.8^{a}	17.6 ± 1.6^{b}	16.4 ± 2.0^{ab}	15.6 ± 2.0^{ab}
4	17.7 ± 1.6^{a}	21.6 ± 0.8^{bc}	21.1 ± 1.8^{bc}	22.2 ± 1.4^{c}
5	19.4 ± 2.1^{a}	21.8 ± 0.9^{ab}	21.5 ± 1.9^{ab}	23.6 ± 0.8^{b}
6	22.9 ± 2.4^{a}	25.5 ± 2.2^{a}	24.4 ± 2.7^{a}	25.7 ± 1.2^{a}

$^{a, b, c}$ Values in the same row with different superscript showed significant different at $P<0.01$

Body's weight of quails fed with or without snail meal increased as the birds was getting older (Table 4). Birds fed with snail meal could reach final body weight of about 157 gram. Although started with initial body weight less than the control, birds fed with ration containing snail meal attained significantly higher body weight at the end of the trial.

Table 4.Body weight of quail fed with ration containing snail mean (g)

Age of bird (week)	Level of snail meal (%)			
	0 (control)	2.5	5	7.5
0	7.4 ± 0.2^{b}	7.0 ± 0.2^{a}	7.0 ± 0.03^{a}	6.8 ± 0.1^{a}
1	18.2 ± 0.9^{b}	16.7 ± 0.5^{a}	16.9 ± 0.3^{a}	16.1 ± 0.4^{a}
2	33.5 ± 0.8^{b}	27.3 ± 4.5^{a}	29.6 ± 2.3^{ab}	28.2 ± 1.5^{ab}
3	57.7 ± 5.4^{a}	53.1 ± 4.6^{a}	54.8 ± 5.4^{a}	51.2 ± 7.0^{a}
4	87.0 ± 10.2^{a}	87.3 ± 5.0^{a}	95.4 ± 0.7^{a}	86.0 ± 10.1^{a}
5	122.8 ± 4.6^{a}	124.3 ± 4.5^{a}	136.5 ± 3.8^{b}	129.8 ± 10.6^{ab}
6	144.0 ± 2.9^{a}	151.1 ± 5.9^{ab}	162.6 ± 6.6^{c}	157.5 ± 8.1^{bc}

$^{a, b, c}$ Values in the same row with different superscript showed significant different at $P < 0.01$

ADG's of birds were not significantly influenced by the levels of snail meal in the ration. However, ADG increased steadily in the early part of growth but it decreased as the birds approached maturity (Table 5). In the first two weeks of trial,

birds fed with ration without snail meal gained slightly heavier body weight than those given rations containing snail meal. As the feeding trial progressed bird fed with ration containing snail meal could catch up their growth eventually attained higher body weight as the birds matured.

Table 5. Average Daily Gain of quail fed with ration containing snail meal(g/bird)

Age	Level of snail meal (%)			
(week)	0 (control)	2.5	5	7.5
1	1.58 ± 0.10^{b}	1.38 ± 0.07^{a}	1.37 ± 0.12^{a}	1.32 ± 0.07^{a}
2	2.16 ± 0.19^{a}	1.51 ± 0.59^{a}	1.87 ± 0.44^{a}	1.74 ± 0.16^{a}
3	3.45 ± 0.85^{a}	3.69 ± 0.09^{a}	3.60 ± 0.85^{a}	3.28 ± 0.82^{a}
4	4.18 ± 0.75^{a}	4.88 ± 0.11^{ab}	5.80 ± 0.85^{b}	4.98 ± 1.30^{ab}
5	5.13 ± 1.26^{a}	5.30 ± 0.09^{a}	5.86 ± 0.62	6.26 ± 0.71^{b}
6	3.02 ± 0.32^{a}	3.82 ± 1.47^{a}	3.74 ± 0.84^{a}	3.95 ± 0.93^{a}

[a, b, c] values in the same row with different superscript showed significant different at $P<0.01$

The percentages of body weight increment were highest in the first week of growth and steadily decreased as the birds mature (Table 6). The sharp decrease occurred when the birds were six weeks old where at this stage their ADG were found to be at the lowest. Most birds at this stage became mature and started to lay eggs. Level of snail meal in the ration did not influence the percentage of body increment of quails.

Table 6. Percentage increment of body weight of quail fed with ration containing snail meal (%)

Age	Level of snail meal (%)			
(week)	0 (control)	2.5	5	7.5
1	146.8 ± 20.1	137.8± 9.3	141.4±4.3	135.7±7.8
2	85.3 ± 14.4	63.3 ± 23.1	75.7 ± 16.6	75.4 ±4.9
3	72.2 ± 18.8	96.2 ± 14.4	86.2 ± 27.2	80.7 ±17.0
4	50.5 ± 6.0	64.6 ± 4.9	75.2 ± 18.4	69.5 ± 23.5
5	42.5 ± 15.8	42.6 ± 3.0	43.0 ± 4.7	51.5 ± 9.5
6	17.3 ± 2.4	21.7 ± 8.9	19.2 ± 3.4	21.2 ± 3.7

Feed conversion ratios of all birds regardless of their feeding regimes were lower at the early stage of their development and become higher when the birds were growing to maturity. The use of snail meal in the ration did not influence the conversion rate of feed of quails (Table 7). Bird fed with ration using snail meal had comparable FCR to those birds fed without snail meal.

Table 7. Feed conversion ratio of quail fed with ration containing snail meal

Age (week)	Level of snail meal (%)			
	0 (control)	2.5	5	7.5
1	2.82 ± 0.15	3.32 ± 0.22	3.16 ± 0.25	2.85 ± 1.21
2	4.25 ± 0.50	5.99 ± 1.93	4.36 ± 0.58	5.06 ± 0.24
3	4.37 ± 1.80	4.76 ± 0.45	4.91 ± 1.93	4.95 ± 1.33
4	4.37 ± 1.12	4.42 ± 0.23	3.66 ± 0.29	4.77 ± 1.75
5	3.93 ± 0.99	4.12 ± 0.19	3.67 ± 0.13	3.79 ± 0.32
6	7.67 ± 1.49	7.40 ± 2.83	6.68 ± 1.27	6.56 ± 0.81

Carcass percentage was significantly influenced by the age of quails. Young birds of 2 weeks old yielded fewer carcasses i.e. about 49% of its body weight compared to the adult birds of 6 weeks old that yielded carcass at about 66% of its body weight. The inclusion of snail meal in the ration had affected the carcass percentage of young quails of 2 weeks old but not the older quails of 4 and 6 weeks old.

Table 8.Carcass and breast percentages of 6 weeks old quail fed with ration containing snail meal

	Level of snail meal (%)			
	0 (control)	2.5	5	7.5
Carcass	67.2 ± 3.9	65.4 ± 3.4	66.2 ± 3.5	65.9 ± 4.4
Breast	27.8 ± 3.1	27.9 ± 4.6	27.8 ± 2.0	27.8 ± 2.4

The major and meatiest part of quail carcass was breast. Breast percentage was significantly influenced by the age of quails. Young quail of 2 weeks old yielded less breast percentage i.e. about 16% of its body weight compared to the adult of 6 weeks old that yielded breast percentage at about 28% of its body weight. The inclusion of snail meal in the ration significantly affected the breast percentage of quails of 2 weeks old. Breast percentage of control birds was higher than the treated birds. But there was not any significant difference of breast percentages for the older birds.

Discussion

Whole snail meal contained 32 % CP, which was lower than that of its flesh (50.8%). Sri-Anggraeni (1998), however, reported a slightly lower content of crude protein in *Pomacea canaliculata* flesh meal (43.2%). The present results were however, comparable to those reported by Ulep and Buenafe (1991) that the snail

fleshes meal contained 51% CP. Although *Pomacea canaliculata* contained less CP as compared to giant African snail (*Achatina fulica*) meal that contained 64.1% (Pitojo, 1996) and fish meal (63.6% CP) it was higher than soya bean meal (44% CP) (NRC, 1994). Tillman *et al.* (1983) stated that any feed ingredients containing 20% CP or more were categorised as sources of protein. Therefore, snail meal could be categorised as source of protein for poultry. Furthermore, the shell of snail is also a good source of mineral especially calcium since it contained 51.5% calcium which was higher than the limestone that contained only 38% calcium (NRC, 1994). Therefore, whole snail meal was unquestionable a good feed ingredient to provide protein and mineral for the poultry.

Quails fed with ration containing whole snail meal could grow normally performed as good as the control birds. Feed intake of birds was comparable among the treatments. Levels of snail meal in the ration did not influence the performance of quails. Thus inclusion of 5% snail meal in the ration was sufficient for the quails to grow normally. The benefit of using snail meal in the ration of quail was substantiated by similar result shown by the performance of chickens fed with snail meal (Ulep and Buenafe, 1991).

Growth performances of quails fed with ration containing snail meal were better than those birds fed without snail meal, though there were no differences statistically between the control and the treated birds. The rations containing snail meal were accepted and also satisfying the bird requirement upon the nutrients they needed.

Results of this study had shown that bird fed with snail meal had better performance than that has been reported by Shanaway (1994) on growth and feed conversion by Japanese quail fed with commercial feed. In this study, the initial weight of 7 g had increased to about 155 g in 6 weeks, which was about 22 folds increment. This was significantly higher that those of Shanaway (1994) birds of 7 g attained final weight of 118 g in 6 weeks. The increment was about 16 folds.

Although the broiler quails were slaughtered at the age of about 6 weeks, the males could be marketed earlier at the age of five weeks. As described by Shanaway (1994), slaughter age is influenced by market forces, and can be determined in a variety of ways; the most profit-oriented of which is to base the decision on the rate of body weight gain (growth rate). Optimal slaughter age occurs one week after the inflection point in the growth curve. Under good conditions of feeding, environment and management, the inflection point occurs at between four to five weeks, therefore *Coturnix* quail can be slaughtered at five or six weeks. The inflection points of birds from the present study occurred at five weeks, which was in agreement with what was reported by Shanaway. Thus, birds could be slaughtered at six weeks. Another testimony that the birds fed with snail meal performed as good as or slightly better than those fed with commercial feed.

Carcass and breast percentages of quails fed with different level of snail meal in the ration were not significantly different. Shanaway (1994) stated that carcass yield

(or dressing percentage) is the ratio between the eviscerated weight of the carcass and live weight. In quail it ranges from 60 to 80 percent with an average of 75%, which is much higher than that of broiler chickens of the same age. The percentage of yield depends on many factors including species, sex, age and management. Legare *et al* (1986) reported that yield percentages of quail carcass were 66.2% and 72.3% from birds reared with 2 different photoperiods of 8 and 24 hours respectively. Tseveni-Gousi and Yannakopoulos (1986) reported lower of breast percentage of quails i.e. 21.4% compared to the results of present study i.e. 28%. Results from this study had also shown that the carcass (65%) and the breast (28%) percentages fell within the values obtained by the above workers.

Assuming that the snail meal is cheap source of protein and mineral provided from abundance supply of *Pomacea insularus* in infested areas, the quail growers will benefit from collection to control snail and eventually it can cut the feed cost.

Conclusions

The conclusions that could be drawn from the feeding trials were 1) snail meal was unfamiliar nutritious feedstuff having high content of crude protein and mineral, 2) quails fed with ration containing snail meal performed well in term of life and slaughter performances.

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