



## EFFECT OF SUPPLEMENTARY FEEDING OF AZOLLA ON GROWTH PERFORMANCE OF BROILER RABBITS

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### ABSTRACT

The study was carried out to search for alternatives to concentrates led us to a wonderful plant azolla, which holds the promise of providing a sustainable feed for livestock. The objective of the study is to study the effect of supplementary feeding sun dried Azolla (*Azollapinnata*) on growth performance of broiler rabbits. Thirty weaned rabbits of 410 -420g comparable body weights were selected and were divided into three groups (T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>), so that each group comprised of ten rabbits (six males and four females). T<sub>1</sub> served as control, T<sub>2</sub> contain 1.5 per cent of dried azolla (30 per cent of fresh azolla), T<sub>3</sub> contain 3.0 per cent of dried azolla (60 per cent of fresh azolla) and animals were housed in individual cages. The results revealed non-significant body weight gains in all the treatment groups. The results indicated that the rabbits of control group had significantly higher feed efficiency in T<sub>1</sub> (5.30) compared to T<sub>2</sub> (6.00) and T<sub>3</sub> (6.03) groups. Therefore, might be suggested that the feeding of azolla in dried form resulted in non-significant difference in the performance of rabbits. However, further studies on digestibility were necessary to study the proper utilization of azolla.

**Keywords:** rabbits, azolla, growth rate, body weight.

### INTRODUCTION

In India, 68 per cent of the population lives in rural areas with agriculture being their main occupation. About 58 per cent of the farmers are engaged in rearing of some kind of farm animals. Of the total households in rural areas rearing livestock, notably the majority of livestock population is reared by landless labourers, migratory tribal, small and marginal farmers.

Rabbits like variety of vegetable materials, tree leaves such as biul, mulberry and bamboo. Berseem and Lucerne may also be incorporated as per availability and also utilisation of kitchen and garden refuses, weed, leaves makes to meat and wool production in small enterprise possible independent of available farm land. The shortage of fodder is therefore compensated with commercial feed, resulting in increased costs in meat production. Thus the search for alternatives to concentrates led us to a wonderful plant azolla, which holds the promise of providing a sustainable feed for livestock.

### MATERIAL AND METHODS

An investigation to determine the effect of supplementary feeding of Azolla at different levels for the growth performance on broiler rabbits was carried out at the Department of Livestock Production and Management, Veterinary College, Bangalore.

#### Ethical approval

Ethical approval was obtained Ethical Review Committee, Veterinary College, Bengaluru. Institutional registration No.: 493/01/a/CPCSEA, dtd: 31/10/2001 and the registration number of the feeding trail was LPM/IAEC/183d/2014, dtd: 18/01/2014.

The experiment comprised of feeding trial to compare the growth performance, Thirty weaned rabbits of 410 -420g comparable body weights were selected and were divided into three groups (T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>), so that each

group comprised of ten rabbits (six males and four females). T<sub>1</sub> served as control, T<sub>2</sub> contain 1.5 per cent of dried azolla (30 per cent of fresh azolla), T<sub>3</sub> contain 3.0 per cent of dried azolla (60 per cent of fresh azolla) and were housed in individual cages. Ingredient composition of experimental diet of different treatments was depicted in the Table-1.

**Table-1.** Ingredient composition (kg) of experimental diet.

| Ingredients     | Treatments |      |      |
|-----------------|------------|------|------|
|                 | T1         | T2   | T3   |
| Maize           | 40         | 40   | 40   |
| Wheat bran      | 19.5       | 18.5 | 18.5 |
| Lucerne meal    | 19.5       | 19   | 17.5 |
| Soybean meal    | 19         | 19   | 19   |
| Salt            | 1.5        | 1.5  | 1.5  |
| Mineral mixture | 0.5        | 0.5  | 0.5  |
| Azolla          | -          | 1.5  | 3    |
| Total           | 100        | 100  | 100  |

T<sub>1</sub> = Control with compound mixture

T<sub>2</sub> = 1.5 per cent of dried azolla (30 per cent of fresh azolla) was added along with Control with compound mixture

T<sub>3</sub> = 3.0 per cent of dried azolla (60 per cent of fresh azolla) was added along with Control with compound mixture

Each rabbit had free access to water provided in water droppers. The room in which rabbits were housed was hygienically maintained. Before the start of the experiment, the animal house was fumigated and all the cages were sterilized using blow lamps. The feeders bowls and water bowls were cleaned daily, Individual rabbits were identified by ear tagging method.



Feeding was done two times daily at 11 am and 3.30 pm provided with clean and potable water. It was made available throughout the day. The duration of the feeding trial was twelve weeks. During the feeding trial period, growth rate and feed intake were recorded. Weighed quantities of feeds were fed to individual rabbits daily. Left over if any, was weighed on the subsequent day and average daily dry matter intake was calculated. The dry matter of the feed was analyzed before the start of the experiment. Dry matter was analyzed by drying samples at 105°C to a constant weight and Rabbits were weighed every week on Wednesday at 08:30 am before providing any feed. Weights were recorded in grams. Average daily gain was calculated by dividing the weight gain during the period by the number of days and expressed as grams per day (g/d).

Data on, daily feed consumption, dry matter intake and growth rate were analyzed by analysis of variance with animal and treatment as main effects using GraphPad Prism version 5.1. Individual differences between means were tested using Tukey's Multiple Comparison Test when treatment effect was significant

## RESULT AND DISCUSSIONS

The chemical composition of the azolla and the mixed or complete feed (mash form) fed to the broiler rabbits of the treatment groups, during the experimental period have been presented in Table-2 and Table-3, respectively.

**Table-2.** Chemical composition of azolla (% DM).

| Nutrients      | Azolla |
|----------------|--------|
| Dry matter     | 4.60   |
| Organic matter | 82.66  |
| Crude Protein  | 22.48  |
| Ether extract  | 4.50   |
| Crude fibre    | 14.70  |
| Total ash      | 17.34  |
| NFE            | 40.98  |

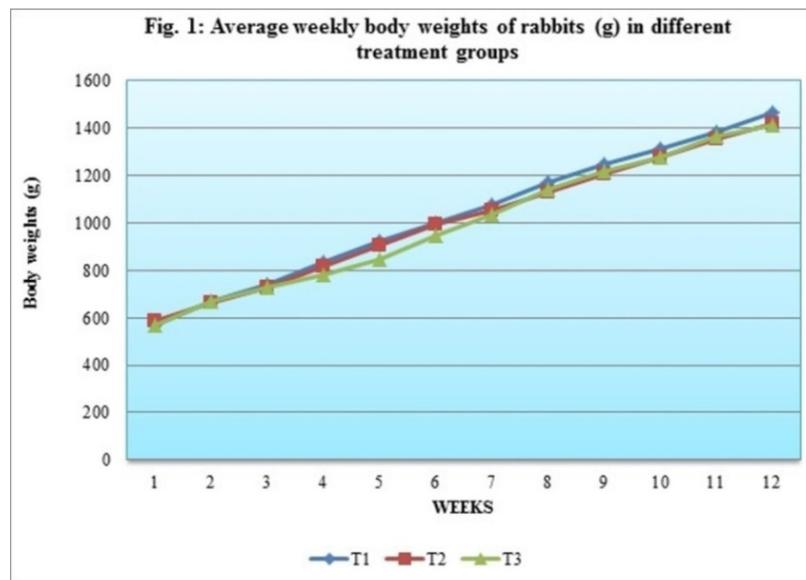
**Table-3.** Chemical composition of Experimental diets.

| Nutrients      | Treatments |       |       |
|----------------|------------|-------|-------|
|                | T1         | T2    | T3    |
| Dry matter     | 85.63      | 86.2  | 86.42 |
| Organic matter | 93.95      | 94.28 | 94.27 |
| Crude Protein  | 17.56      | 17.97 | 18.24 |
| Ether extract  | 2.28       | 2.26  | 1.84  |
| Crude fibre    | 10.25      | 10.56 | 11.6  |
| Total ash      | 6.05       | 5.72  | 5.73  |
| NFE            | 63.86      | 63.49 | 62.59 |

The chemical compositions of the three experimental diets were found to be well within the prescribed values (NRC, 1977). Crude protein content of all the diets were similar with best efforts to make all the diets isonitrogenous. However the crude protein content of concentrate mixture was comparable to the NRC (1977) recommendation of 16% for growth in rabbits. The optimum level of crude fibre of about 10 % prevalent among all the three diets, even though the range of 10-12% of the diet as stipulated by NRC, 1977. The minor variation in the levels of nutrients among three diets was mainly due to the concerned ingredients per se in a given diet. The Average weekly body weights (g) changes of broiler rabbits in different treatment groups, during the experimental period have been presented in Table 4 and graphically represented in the Figure-1.

**Table-4.** Average weekly body weights of rabbits (g) in different treatment groups.

| Week        | Treatments     |                |                |
|-------------|----------------|----------------|----------------|
|             | T <sub>1</sub> | T <sub>2</sub> | T <sub>3</sub> |
|             | Mean ± SE      | Mean ± SE      | Mean ± SE      |
| Initial wt. | 420.0 ± 23.91  | 414.0 ± 36.81  | 418.5 ± 24.97  |
| 1           | 566.0 ± 26.19  | 589.0 ± 40.01  | 569.0 ± 26.35  |
| 2           | 669.0 ± 33.48  | 664.0 ± 35.71  | 667.5 ± 28.05  |
| 3           | 742.5 ± 34.54  | 729.5 ± 34.20  | 726.5 ± 28.93  |
| 4           | 833.0 ± 47.13  | 815.5 ± 33.30  | 783.0 ± 38.55  |
| 5           | 926.0 ± 50.17  | 908.0 ± 33.04  | 844.0 ± 37.28  |
| 6           | 1001.0 ± 52.09 | 994.5 ± 27.86  | 945.5 ± 46.48  |
| 7           | 1079.5 ± 51.88 | 1055.0 ± 34.72 | 1035.0 ± 47.43 |
| 8           | 1173.5 ± 49.15 | 1132.5 ± 46.74 | 1142.0 ± 37.48 |
| 9           | 1247.5 ± 43.40 | 1207.5 ± 52.91 | 1220.0 ± 37.31 |
| 10          | 1313.0 ± 42.57 | 1277.0 ± 58.99 | 1275.5 ± 43.92 |
| 11          | 1387.0 ± 48.33 | 1357.5 ± 52.92 | 1368.5 ± 47.92 |
| 12          | 1464.5 ± 52.25 | 1422.0 ± 53.65 | 1414.5 ± 47.50 |



The Average cumulative weekly body weight gained (g) by broiler rabbits in different treatment groups, during the experimental period has been presented in Table-5.

**Table-5.** Average weekly body weights gain (g) of rabbits in different treatment groups.

| Week | Treatments |         |       |         |       |         |
|------|------------|---------|-------|---------|-------|---------|
|      | T1         |         | T2    |         | T3    |         |
|      | Mean       | ± SE    | Mean  | ± SE    | Mean  | ± SE    |
| 1    | 146.0      | ± 16.75 | 175.0 | ± 19.00 | 150.5 | ± 19.18 |
| 2    | 103.0      | ± 20.55 | 75.0  | ± 16.41 | 98.5  | ± 15.44 |
| 3    | 73.5       | ± 09.19 | 65.5  | ± 14.31 | 59.0  | ± 13.98 |
| 4    | 90.5       | ± 16.37 | 86.0  | ± 18.22 | 56.5  | ± 13.68 |
| 5    | 93.0       | ± 09.35 | 92.5  | ± 11.84 | 61.0  | ± 13.14 |
| 6    | 75.0       | ± 08.63 | 86.5  | ± 16.45 | 101.5 | ± 20.30 |
| 7    | 78.5       | ± 04.78 | 60.5  | ± 13.95 | 89.5  | ± 12.66 |
| 8    | 94.0       | ± 12.17 | 77.5  | ± 23.74 | 107.0 | ± 13.91 |
| 9    | 74.0       | ± 08.88 | 75.0  | ± 15.83 | 78.0  | ± 13.21 |
| 10   | 65.5       | ± 10.94 | 69.5  | ± 12.05 | 55.5  | ± 10.26 |
| 11   | 74.0       | ± 12.53 | 80.5  | ± 12.92 | 93.0  | ± 13.73 |
| 12   | 77.5       | ± 14.67 | 64.5  | ± 13.59 | 46.0  | ± 14.98 |
| Mean | 87.0       | ± 06.23 | 84.0  | ± 08.73 | 83.0  | ± 09.42 |

The cumulative weight gain (g) at the end of 12<sup>th</sup> week was 87.04 ± 6.23, 84.0 ± 8.73 and 83.0 ± 9.42 in groups T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> respectively. Statistical analysis revealed that there were no significant differences (P ≥ 0.05) between the treatments.

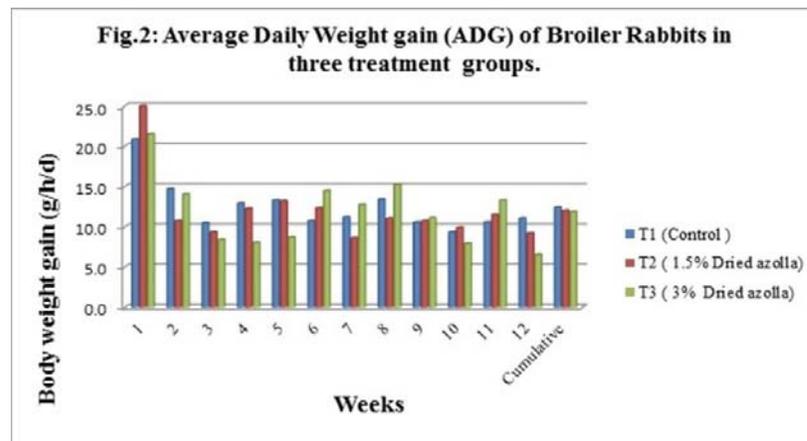
The body weight (g) changed from 420.0 ± 23.91, 414.0 ± 36.81 and 418.2 ± 24.97 on day 1 of experiment to 1464.5 ± 52.25, 1422.0 ± 53.65 and 1414.5 ± 47.5 at 12<sup>th</sup>

week of experiment in groups T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> respectively. Statistical analysis revealed that there were no significant differences (P > 0.05) between the treatments.

The Average Daily weight Gain (g) calculated every week during the 12 week feeding trial period is presented in Table-6 and is graphically represented in Figure-2.

**Table-6.** Average daily weight gain (g) of rabbits in different treatment groups.

| Week        | Treatments |         |      |         |        |         |
|-------------|------------|---------|------|---------|--------|---------|
|             | T1         |         | T2   |         | T3     |         |
|             | Mean       | ± SE    | Mean | ± SE    | Mean   | ± SE    |
| Initial wt. | 420.0      | ± 23.91 | 414  | ± 36.81 | 418.5  | ± 24.97 |
| 1           | 20.9       | ± 2.39  | 25   | ± 2.71  | 21.5   | ± 2.74  |
| 2           | 14.7       | ± 2.94  | 10.7 | ± 2.34  | 14.1   | ± 2.21  |
| 3           | 10.5       | ± 1.31  | 9.4  | ± 2.04  | 8.4    | ± 2.00  |
| 4           | 12.9       | ± 2.34  | 12.3 | ± 2.60  | 8.1    | ± 1.95  |
| 5           | 13.3       | ± 1.34  | 13.2 | ± 1.69  | 8.7    | ± 1.88  |
| 6           | 10.7       | ± 1.23  | 12.4 | ± 2.35  | 14.5   | ± 2.90  |
| 7           | 11.2       | ± 0.68  | 8.6  | ± 1.99  | 12.8   | ± 1.81  |
| 8           | 13.4       | ± 1.74  | 11.1 | ± 3.39  | 15.3   | ± 1.99  |
| 9           | 10.6       | ± 1.27  | 10.7 | ± 2.26  | 11.1   | ± 1.89  |
| 10          | 9.4        | ± 1.56  | 9.9  | ± 1.72  | 7.9    | ± 1.47  |
| 11          | 10.6       | ± 1.79  | 11.5 | ± 1.85  | 13.3   | ± 1.96  |
| 12          | 11.1       | ± 2.10  | 9.2  | ± 1.94  | 6.6    | ± 2.14  |
| Mean        | 12.4       | ± 0.97  | 12.0 | ± 1.25  | 11.9   | ± 1.23  |
| Final wt.   | 1464.5     | ± 52.25 | 1422 | ± 53.65 | 1414.5 | ± 47.50 |



The ADG (g) in the experiment was  $12.4 \pm 0.97$  (T<sub>1</sub>),  $12.0 \pm 1.25$  (T<sub>2</sub>) and  $11.9 \pm 1.23$  (T<sub>3</sub>). Statistical analysis revealed that there was non-significant difference ( $P > 0.05$ ) between the treatments. The results were in agreement with findings of [15&12]. However, [8], [1] and [16] reported that decrease in weight gain with increase in azolla.

Similar studies like [3, 4, 6, 7, 11] conducted in poultry also showed non-significant results. The results of [13], indicated decrease in weight gain in broiler birds.

The treatment effect in general was not significant ( $P > 0.05$ ), possibly because rabbits were still in growing stage. The apparently lower ADG in broiler

rabbits in the present study was probably due to tropical condition under which rabbits were reared. [9] reported that ADG of 10 to 20 g in tropics in comparison to 35 to 40g of temperate Climate. The inconsistent trend in the daily weight gains cannot be attributed to any particular pattern, indicating that the limitation in either in protein or energy or high fibre contribution from the azolla might have caused such changes. Hence it may be inferred that the azolla meal can be potential non-conventional source of rabbit ration, without affecting feed consumption and can support growth. The average DMI (g/day) for the three treatment groups were presented in Table-7.

**Table-7.** Average daily feed consumption (g) of rabbits in different treatment groups.

| Week | Treatments   |              |              |
|------|--------------|--------------|--------------|
|      | T1           | T2           | T3           |
|      | Mean ± SE    | Mean ± SE    | Mean ± SE    |
| 1    | 51.65 ± 4.13 | 54.33 ± 3.00 | 59.32 ± 1.70 |
| 2    | 55.91 ± 3.14 | 58.87 ± 1.66 | 60.81 ± 1.49 |
| 3    | 57.63 ± 2.60 | 60.64 ± 1.42 | 58.84 ± 2.22 |
| 4    | 58.69 ± 3.96 | 64.49 ± 0.82 | 59.67 ± 3.27 |
| 5    | 64.16 ± 2.60 | 67.36 ± 1.00 | 64.71 ± 1.87 |
| 6    | 62.00 ± 3.17 | 66.63 ± 1.38 | 65.86 ± 1.93 |
| 7    | 68.43 ± 1.26 | 68.49 ± 0.81 | 64.69 ± 1.57 |
| 8    | 66.44 ± 1.77 | 68.43 ± 0.48 | 66.64 ± 1.89 |
| 9    | 62.23 ± 3.02 | 68.31 ± 0.70 | 65.91 ± 1.81 |
| 10   | 69.03 ± 0.47 | 67.26 ± 1.90 | 67.26 ± 1.90 |
| 11   | 67.07 ± 1.05 | 65.06 ± 1.75 | 65.06 ± 1.75 |
| 12   | 70.36 ± 0.73 | 69.49 ± 1.17 | 69.49 ± 1.17 |
| Mean | 62.80 ± 1.69 | 64.95 ± 1.34 | 64.02 ± 1.01 |

Average DMI (g/day) was  $62.80 \pm 1.69$ ,  $64.95 \pm 1.34$  and  $64.02 \pm 1.01$  respectively for T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> groups. Despite the higher feed intake observed in current study, the results indicated non-significant DMI among the

treatment groups. The results found in study were in agreement with the findings of [15]. [3] reported higher levels of feed intake in NZW rabbits when compared to



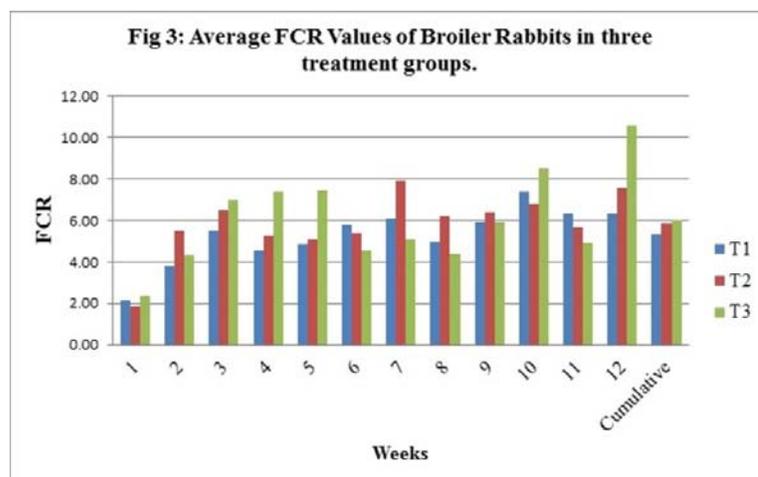
NZWB rabbits. [2] who reported significantly lower feed intake in azolla fed groups.

The cumulative feed intake levels observed in current study were in agreement with the results of [5, 4, 6] in broiler chicken diet containing azolla meal. The results indicated non-significant differences in azolla fed group in broiler chicken. On the other hand the reports of reported significant difference in intake when azolla was increased. [3, 7] reported that there was significant increase in in feed intake with increase in azolla levels up

to 30 per cent levels in rabbits. The difference in the results obtained from different researchers' studies may be dependent on the environment, value and quality of consumed azolla. It can be said that increase in feed intake in broiler fed diets containing high level of azolla powder may be due to their palatability. Hence, it can be conclusively stated from the result in this study that azolla meal in broiler rabbit ration up to 3.0 per cent level did not had any influence on feed intake. The average feed conversion ratio is presented in Table-8 and the Figure-3.

**Table-8.** Average feed conversion ratio (FCR= g DMI/ g body weight gain) of rabbits.

| Week | Treatments |        |      |        |       |        |
|------|------------|--------|------|--------|-------|--------|
|      | T1         |        | T2   |        | T3    |        |
|      | Mean       | ± SE   | Mean | ± SE   | Mean  | ± SE   |
| 1    | 2.12       | ± 0.49 | 1.86 | ± 0.61 | 2.36  | ± 0.55 |
| 2    | 3.80       | ± 0.68 | 5.49 | ± 0.45 | 4.32  | ± 0.46 |
| 3    | 5.49       | ± 0.57 | 6.48 | ± 0.70 | 6.98  | ± 0.70 |
| 4    | 4.54       | ± 0.79 | 5.25 | ± 0.66 | 7.39  | ± 1.12 |
| 5    | 4.83       | ± 0.42 | 5.10 | ± 0.75 | 7.43  | ± 0.70 |
| 6    | 5.79       | ± 0.56 | 5.39 | ± 0.88 | 4.54  | ± 0.49 |
| 7    | 6.10       | ± 0.39 | 7.92 | ± 0.58 | 5.06  | ± 0.50 |
| 8    | 4.95       | ± 0.58 | 6.18 | ± 2.21 | 4.36  | ± 0.51 |
| 9    | 5.89       | ± 0.50 | 6.38 | ± 1.22 | 5.92  | ± 1.21 |
| 10   | 7.38       | ± 0.88 | 6.77 | ± 1.03 | 8.48  | ± 1.01 |
| 11   | 6.34       | ± 0.58 | 5.66 | ± 0.78 | 4.90  | ± 1.20 |
| 12   | 6.35       | ± 0.98 | 7.54 | ± 1.25 | 10.57 | ± 1.96 |
| Mean | 5.30       | ± 0.37 | 6.00 | ± 0.52 | 6.03  | ± 0.52 |



The FCR in the present study was found to be  $5.30 \pm 0.37$  (T<sub>1</sub>),  $6.00 \pm 0.52$  (T<sub>2</sub>) and  $6.03 \pm 0.52$  (T<sub>3</sub>). The results were statistically non-significant. Similar findings were also reported by [1, 14]. The contradictory results with poorer FCR were reported by [8] where in the male rabbit slightly had a better feed conversion ratio. [2]

reported increase in FCR in azolla fed group when compared to others. Similar results were reported by [5, 3, 4, 7, 11, 6], in chicks having azolla meal and did not follow any striking pattern. Based on the results of this experiment, it was clear that dried azolla could be used in rabbit ration up to 3.0 per cent level without any adverse



effect on feed efficiency. Poorer FCR was observed with increase of azolla level might be due to higher levels of silica, lignin and tannins in azolla this may be responsible for decreased nutrient utilization and ultimately decreased FCR.

From this study, it can be concluded that azolla can be included at 1.5 and 3.0 per cent levels in the feed did not cause any significant changes in body weight gains and growth performance. However, longer duration studies as well as beyond 12 weeks of age until marketing age or till its adulthood is necessary to study the effect of azolla on growth performance in rabbits. Further, proper utilisation of azolla in the system needs to be explored through digestive trials.

#### AUTHORS' CONTRIBUTIONS

The present study is a thesis part of MVSc degree of AKC. YBR is major advisor who designed the experiment and AKC done the research under the guidance of YBR. TMP is the member of Advisory Committee and also guided during the experiment. MVP guided in data entry and statistical analysis. JSS guided in data entry, statistical analysis and final manuscript preparations and PKA helped in collection of literature.

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