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Effect of feeding garden cress (*Lepidium sativum*) seeds on growth performance and nutrient digestibility in New Zealand White rabbits[#]

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Abstract

A study was carried out for a period of 4 months to evaluate the effect of dietary inclusion of garden cress (GC) seeds on growth performance and nutrient digestibility in New Zealand White rabbits. Eighteen New Zealand White female rabbits of four months of age were selected and were divided into three groups of six animals each based on age and body weight. The animals were randomly allotted to three dietary treatments, T1 (control diet with 18 per cent CP and 2700 kcal DE), T2 (concentrate with 5 per cent GC seed on dry matter basis) and T3 (concentrate with 7.5 per cent GC seed on dry matter basis). Data analysis revealed that the growth performance and nutrient digestibility of dry matter, crude protein and ether extract were similar among treatment groups. Furthermore, dietary treatments had no effect on blood biochemical parameters. From the overall results, it can be concluded that GC seeds can be safely incorporated up to 7.5 per cent in rabbit diet without compromising the health status and growth performance in New Zealand White rabbits.

Keywords: *Digestibility, garden cress seeds*, *growth, rabbits*

Rabbitry is becoming a promising enterprise in the present world. The rapid growth rate, high prolificacy, better genetic selection potential, effective feed utilisation ability and the

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excellent nutritive quality of meat had led to the popularisation of rabbit farming among farmers. But the growth of rabbitry is challenged by unavailability of quality feed ingredients and their high cost of procurement (Ozor and Madukwe, 2005). In the present scenario, the key to sustainable livestock production includes search for alternative feed ingredients as a replacement for conventional ingredients. Adoption of cost-effective feed formulations using available alternative feed resources can minimise the cost of production of animals.

Lepidium sativum, commonly known as Garden Cress (GC) is a widely used medicinal plant with seeds rich in protein, dietary fibre, omega-3 fatty acids, iron and phytochemicals (Sharma and Agarwal, 2011). It is a fast-growing annual herb belonging to the family *Brassicaceae.* Pharmacological evaluation suggested that plant possessed antimicrobial, antioxidant, reproductive, gastrointestinal, galactogogue and aphrodisiac effects (Gokavi *et al*., 2004).

In recent years, incorporation of herbal feed supplements in livestock had gained importance owing to their beneficial effects on health status and growth performance in animals (Ashour *et al.,* 2020). Garden cress seed as an alternate feed ingredient in rabbits and its effect on nutrient utilisation need to be assessed. Hence, the present study is envisaged to evaluate the effect of GC seed on growth performance and nutrient digestibility in growing rabbits.

Materials and methods

Location of study

The present research was conducted by the Department of Animal Nutrition and Rabbit Breeding Station, College of Veterinary and Animal Sciences, Mannuthy, Thrissur, Kerala, India.

Experimental animals, management and feeding

Eighteen female New Zealand White rabbits of four months age selected from Rabbit Breeding Station, Mannuthy formed the experimental animals for the study. The animals were divided into three homogenous treatment groups of six animals each based on age and body weight. They were randomly allotted to one of the three dietary treatments (T1, T2 and T3) following the Completely Randomized Design (CRD).

All the experimental animals were housed individually, up to breeding, in metallic cages having facilities for feeding and watering. The concentrate feed was offered in the morning and roughage in the evening. The feed residue if any, in the feeder was collected manually on the next day morning and weighed daily for analysing the moisture content. Clean drinking water was offered *ad-libitum* to all the rabbits throughout the experiment. The animals were maintained under uniform conditions of feeding and management throughout the experimental period.

Three experimental diets T1, T2 and T3 were formulated for the study and are given in Table 1. The three concentrate mixtures were made isocaloric and isonitrogenous with 18 per cent CP (crude protein) and 2700 kcal DE (digestible energy)/kg diet (ICAR, 2013). Fresh green grass was given *ad-libitum* as roughage source to animals. Ingredient composition of concentrate mixture offered to experimental animals is given in Table 2.

Data collection

Data on daily feed and fodder intake and the body weight at weekly intervals were recorded throughout the study. Growth parameters of the rabbit does were calculated during initial two months of feeding trial as the experimental animals started kindling thereafter.

Table 1. Experimental diets of rabbits maintained in the study

Treatment	Experimental diets
T1	Control - Concentrate with 18 per cent CP and 2700 kcal DE
T2	Concentrate with 5 per cent GC seed on dry matter basis
T3	Concentrate with 7.5 per cent GC seed on dry matter basis

Table 2. Ingredient composition of experimental diets offered to rabbits, %

Ingredient	Per cent composition		
	T1	T2	T3
Yellow maize	42	40	38
Soybean meal	6	5	5
Corn gluten fibre	8	11	6.5
Wheat bran	8	9	7.5
Black gram husk	7	6	13
Rice polish	10	10	10
Alfalfa pellet	9	8	8
Garden cress seed	-	5	7.5
Deoiled rice bran	9.25	5.25	3.75
Supplevite-M*	0.25	0.25	0.25
Salt	0.5	0.5	0.5
Total	100	100	100

* Supplevite-M (250 g contains 5,00,000 IU of Vitamin A, 1,00,000 IU of Vitamin D3, 0.2 g of Vitamin B2, 75 units of Vitamin E, 0.1 g of Vitamin K, 0.25 g of Calcium Panthothanate, 1 g of Nicotinamide, 0.6 g of Vitamin B12, 15 g of Choline chloride, 75 g of Calcium, 2.75 g of Manganese, 0.1 g of Iodine, 0.75 g of Iron, 1.5 g of Zinc, 0.2 g of Copper, 0.045 g of Cobalt.

Analysis of feed, fodder and faecal samples

A digestibility trial of three days duration was carried out towards the end of feeding trial by total collection method. Proximate analysis of GC seed, feed, green grass and faecal samples were done as per the standard procedures (AOAC, 2016). Minerals like calcium and phosphorous in the feed and fodder were analysed by conventional precipitation and titration method as per AOAC (2016). Various macro minerals *viz*., Ca and Mg and micro minerals *viz*., Fe, Cu, Mn and Zn in GC seed were estimated using Atomic Absorption Spectrophotometer (PERKIN ELMER 3110, US. Instrument division, Norwalk, U. S. A.) Phosphorous in the seed was estimated using colorimetric method.

Haematological studies

Blood samples were collected from all the experimental animals at the end of feeding trial from marginal ear vein, using sterile disposable needles. Serum was separated after centrifugation at 3000 rpm for 10 minutes for estimation of creatinine (modified Jaffe method) and the activities of alanine transaminase (ALT) and aspartate aminotransferase (AST). The standard biochemical kits used for these assays were purchased from Agappe Diagnostics Limited, Ernakulam, Kerala.

Statistical analysis

Data obtained on various parameters during the experiment were analysed statistically as per Snedecor and Cochran (1994) by analysis of variance (ANOVA) technique, using the software Statistical Programme for Social Sciences (SPSS) version 24.0.

Results and discussion

Chemical composition of garden cress seeds

The per cent chemical composition of GC seeds used in the experimental diet on dry matter basis is presented in Table 3. Garden cress seeds had 92.46 ± 0.01 per cent of dry matter. The CP, CF (crude fibre), EE (ether extract), TA(total ash) and NFE (nitrogen free extract) were 23.01 ± 0.01, 10.90 ± 0.02, 18.50 ± 0.005, 5.67 ± 0.007 and 41.92 ± 0.01 per cents, respectively. Findings of the present study are in well accordance with the values obtained by Mohammed (2012) and Zia-Ul-Haq *et al*. (2012) on proximate analysis of GC seeds.

Mineral composition of GC seed is given in Table 4. Garden cress seed used in the present study contained 0.31, 0.61 and

Table 3. Chemical composition[1] of Garden cress seeds, %

Parameter	%
Dry matter	92.46 ± 0.01
Crude protein	23.01 ± 0.01
Crude fibre	10.90 ± 0.02
Ether extract	18.50 ± 0.01
Total ash	5.67 ± 0.01
Nitrogen free extract	41.92 ± 0.01

[1]Mean values based on six replicates; on dry matter basis

Table 4. Mineral composition of Garden cress seeds

Minerals	Quantity
Ca (g per cent)	0.31
P (g per cent)	0.61
Mg (g per cent)	0.39
Fe (mg per cent)	83.00
Cu (mg per cent)	6.12
Zn (mg per cent)	5.12
Mn (mg per cent)	3.01

[1] Mean values based on six replicates; on dry matter basis

0.39 g per cents of Ca, P and Mg and 83.0, 6.12, 5.12, 3.01mg per cents of Fe, Cu, Zn and Mn, respectively. Sood and Sarada (2002) and Doke and Guha (2014) also reported more or less similar observations on mineral profiling of GC seeds.

Chemical composition of feed and fodder

The per cent chemical composition on dry matter basis of the experimental feed and fodder offered to the rabbits is given in Table. 5. On chemical analysis, the crude protein contents of T1, T2, T3 and fodder were 18.16 ± 0.01, 18.21 ± 0.02, 18.28 ± 0.01 and 9.38 ± 0.01 per cent, respectively. The crude fibre contents were 9.84 ± 0.01, 8.72 ± 0.01, 8.65 ± 0.01 and 34.50 ± 0.26 per cent for T1, T2, T3 and fodder, respectively. Chandran *et al*. (2023) also reported similar nutrient composition on 5 and 10 per cent dietary inclusion of *indhukantham kashayam* residues in rabbit diet. The chemical composition of fodder recorded in the study was also comparable with the findings of Biju *et al.* (2016) and Seethal (2018).

Table 5. Chemical composition[1] of feed and fodder offered to the rabbits maintained on three experimental diets, %

Parameters	Experimental concentrate feed			Fodder
	T1	T2	T3	
Dry matter	89.70 ± 0.06	89.79 ± 0.06	89.78 ± 0.04	21.43 ± 0.10
Crude protein	18.16 ± 0.01	18.21 ± 0.02	18.28 ± 0.01	9.38 ± 0.01
Crude fibre	9.84 ± 0.01	8.72 ± 0.01	8.65 ± 0.01	34.50 ± 0.26
Ether extract	4.72 ± 0.01	5.32 ± 0.01	4.93 ± 0.09	1.65 ± 0.07
Total ash	7.17 ± 0.01	6.39 ± 0.01	5.09 ± 0.01	12.19 ± 0.13
Nitrogen free extract	60.11 ± 0.03	61.36 ± 0.03	63.05 ± 0.01	42.28 ± 0.33
Acid insoluble ash	1.03 ± 0.01	1.01 ± 0.08	1.04 ± 0.07	3.32 ± 0.09
Calcium	0.62 ± 0.04	0.63 ± 0.01	0.74 ± 0.01	0.60 ± 0.02
Phosphorus	0.64 ± 0.01	0.59 ± 0.01	0.61 ± 0.01	0.32 ± 0.01

[1] Mean values based on six replicates; on dry matter basis

Table 6. Summarised data on body weight[1], total weight gain, total dry matter intake (kg/animal), average daily dry matter intake (kg/animal) and average daily gain (g) of rabbits maintained on three dietary treatments during initial two months of feeding trial

Parameters	Experiment diets			*p*-value
	T1	T2	T3	
Initial body weight (kg)	1.23 ± 0.15	1.25 ± 0.12	1.28 ± 0.08	0.90 ^{NS}
Final body weight (kg)	2.34 ± 0.12	2.60 ± 0.15	2.42 ± 0.14	0.44 ^{NS}
Total weight gain (kg)	1.11 ± 0.09	1.35 ± 0.12	1.14 ± 0.12	0.29 ^{NS}
Average daily gain (g)	17.65 ± 1.73	21.56 ± 2.20	19.88± 2.30	0.29 ^{NS}
Total dry matter consumed (kg/animal)	5.79 ± 0.33	6.38 ± 0.43	6.74 ± 0.30	0.59 ^{NS}
Average daily dry matter consumed (g/animal)	92.19 ± 5.94	102.06 ± 7.71	117.75±5.51	0.59 ^{NS}

[1] Mean values are based on six replicates; NS – non significant

Growth performance of experimental animals

The total dry matter intake, weekly average daily dry matter intake, initial and final body weight, total body weight gain and average daily body weight gain at weekly intervals of experimental animals maintained on three experimental diets during initial two months of feeding trial are presented in Table 6. On statistical analysis of the recorded data, the total dry matter intake and weekly average daily dry matter intake were comparable across treatment groups. These findings were in agreement with Brenes *et al.* (2010) who compared the growth performance of broiler chicken fed with Grape seed extract (0.6, 1.8 and 3.6 g /kg) for forty two days. Alagbe (2018) also obtained similar results on supplementation of dried water melon peel (rind) to rabbits. On contrary, Mahmoud *et al.* (2021) reported higher feed intake in rabbits fed diets containing broccoli byproducts at a rate of 1 and 3 per cent levels compared to control. Statistical analysis of the body weight showed that total body weight gain and average daily gain of rabbits did not differ significantly (P>0.05) among the three treatment groups. Similar findings were reported by Choi *et al*. (2010) on dietary supplementation of grape seed and grape peel extracts at 0.1and 0.2 per cent levels in New Zealand White rabbits. Seethal (2018) also found similar body weight gain in control group and the calves fed diets containing *dhanwantharam thailam* residue. On disagreement with above findings, Wafar *et al.* (2017) reported lower final body weight, total body weight gain and average daily gain in rabbits when fed raw kapok seed meal at different levels compared to control whereas Zeedan *et al.* (2015) reported significantly higher final body weight and total weight gain in rabbits on feeding dried *cactus opuntia* cladodes at 10, 20 and 30 per cent levels when compared to other treatments.

Digestibility of nutrients in experimental diets

The digestibility coefficient of nutrients for T1, T2 and T3 were observed in the study are given in Table 7. The statistical analysis revealed a significant difference among the groups in their digestibility of CF and NFE, whereas the digestibility of DM, CP and EE were statistically similar (p>0.05) among the treatment groups. Suliman *et al.* (2015) also reported 64.61 and 61.84 per cent DM digestibility in rabbits on supplementation of 20 per cent chemically and biologically treated castor meal, respectively. However, Adeyeye *et al.* (2021) found lower dry matter digestibility in rabbits fed diets containing 30 per cent processed kola nut pod-husk meal compared to control. Digestibility of CP in the present study is in well accordance with Celia *et al*. (2016) who supplemented Digestarom in rabbit diets. But, Ajagbe *et al.* (2022) observed higher crude protein digestibility in rabbits offered with watermelon rind supplemented diets than control.

El-sheikh *et al*. (2016) reported similar ether extract digestibility in rabbits fed conventional diet and diets with 0.4 per cent *Moringa peregrine* leaves. However, El-Neney *et al*. (2019) reported higher EE digestibility on 30 per cent dietary inclusion of prickly pear peels in rabbit diet. The analysis showed that nutritive values of digestible CF in T1 was significantly higher (p<0.05) than T2 and T3, whereas values were comparable among T2

Table 7. Digestibility coefficient[1] of nutrients of ration fed to rabbits under three dietary treatments, %

Parameters	Experimental diets			*p*-value
	T1	T2	T3	
DM	61.66 ± 0.47	63.82 ± 1.25	63.08 ± 1.15	0.34 NS
CP	68.73 ± 1.24	72.66 ± 0.76	70.43 ± 1.96	0.06 NS
CF	38.03 ± 0.30^{b}	34.91 ± 0.69^{a}	35.68 ± 1.10^{a}	0.03*
EE	72.92 ± 1.35	74.56 ± 0.84	71.73 ± 0.35	0.13 NS
NFE	70.52 ± 0.39^{a}	71.43 ± 0.15^{b}	71.66 ± 0.17^{b}	0.02*

[1]Mean value based on six replicates; NS- non significant (p>0.05); *Mean of different treatment having different alphabets as superscripts within a row differ significantly (p < 0.05)

and T3. Findings of the present study are similar with the observations of Akuru *et al*. (2021) who observed lower CF digestibility in rabbits offered with the diet containing 30 per cent cowpea hull meal compared to that of control group. On contrary, Chen *et al.* (2019) reported similar digestibility of CF in rabbits fed control diet and those fed pigeon pea leaf supplemented diets. Digestibility coefficient of NFE was significantly lower (p<0.05) in T1 compared to T2 and T3. Digestibility of NFE was comparable between T2 and T3. These observations were similar to Zeedan *et al.* (2017) who supplemented dried *cactus opuntia* cladodes at 20 per cent level in diets of rabbit whereas Chandran *et al.* (2023) observed similar NFE digestibility in rabbits in all the treatment groups.

Blood biochemical parameters

Serum biochemical parameters of rabbits such as alanine transaminase (ALT), aspartate aminotransferase (AST) and serum creatinine (CRT) are given in Table 8. On statistical analysis, there was no significant difference between the treatments. The values obtained in the study are in well accordance with Melillo (2007) who reported that the biochemical reference ranges of AST (U/L), ALT (U/L) and serum creatinine (mg/dL) in rabbits lie between 35-130 U/L, 45-80 U/L and 0.5-2.5 mg/dL, respectively.

Similarly, Ingweye and Akpan (2017) found that rabbits fed diets containing ripe *Gmelina arborea* fruit pulp which replaced maize at 25, 50, 75 and 100 per cent levels showed no significant difference in the values of AST, ALT and CRT. Ogbuewu *et al.* (2019) also reported that supplementation of ginger (*Zingiber officinale*) rhizome powder in growing rabbit diets resulted in no significant difference in ALT, AST and CRT concentrations. On disagreement with the present findings, studies conducted by Garba and Mohammed (2015) reported increased serum concentrations of ALT and AST in rabbits fed diets containing 20 per cent yam peels.

Conclusion

Findings of the study suggested that GC seeds constitute a nutrient rich herbal feed supplement that can be effectively used in rabbitry. GC seeds can be incorporated up to 7.5 per cent in rabbit diet without compromising the health status and growth performance of animals. Further studies should be conducted to commercialize the usage of garden cress seeds as a herbal feed supplement in rabbits.

Conflict of interest

The authors declare that they have no conflict of interest.

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Table 8. Blood biochemical parameters1 of the rabbit does maintained on three experimental diets

Parameters	Experimental diets			*p*-value
	T1	T2	T3	
AST (U/L)	69.65 ± 8.90	57.83 ± 7.23	77.16 ±11.26	0.35^{NS}
ALT (U/L)	55.90 ± 1.94	52.90 ± 1.04	61.18 ± 6.04	0.30^{NS}
CRT (mg/dL)	1.45 ± 0.10	1.21 ± 0.07	1.51 ± 0.07	0.07^{NS}

[1]Mean values based on six replicates; NS- non significant (p>0.05).

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