# Nutrient Utilisation and Growth Performance of Broiler Rabbits Fed Oat Plant Meal and Tall Fescue Hay

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**ABSTRACT :** Forty five Soviet Chinchilla rabbits weaned at 35 d of age were fed 5 experimental diets prepared by using oat plant meal ($T_2$, $T_4$) and tall fescue hay ($T_3$, $T_5$) at 25% and 50% level along with control ($T_1$). The gain in body weight at 84 d of age decreased with test material substitution, however, the differences were non significant when compared with oat plant meal and were significant ($p<0.05$) with tall fescue hay at both the levels. Feed conversion ratio also deteriorated with test material and its increasing proportion and the differences were significant ($p<0.05$). The performance-index calculated were 42.1, 36.7, 29.4, 33.3 and 18.8 in $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ respectively. Digestibility of all the organic nutrients decreased significantly ($p<0.05$) with test material incorporation, as a result nutritive value of the test diets decreased linearly. Nitrogen balance as per cent of intake was higher in oat plant meal substituted diet compared to tall fescue substituted diet. Cost per kg live weight gain was lowest with 50% oat plant meal followed by 25% oat plant meal incorporation. It was highest with tall fescue hay substitution. Nutritive value of oat plant meal as calculated was DCP 5.1%, TDN 35.8% and that of tall fescue hay was DCP 6.5%, TDN 30.8%. Thus, oat plant meal can be substituted safely up to 25% in the feeding regime of weaner rabbits whereas, for tall fescue hay the safe limit is below 25% level and needs to be ascertained.
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**Key Words :** Oat Plant Meal, Tall Fescue Hay, Growth, Nutritive Value, Rabbit

## INTRODUCTION

Economics of rabbit production is based upon the extent of utilisation of available fodder and forages in the geographical area into its end products as meat, wool and pelt. The digestive system of this species is well adapted for the digestion of the large quantity of forage typical of a herbivorous diet. Satisfactory growth and feed consumption has been observed when *Medicago sativa* was incorporated at a level of seventy five per cent (Chou and Robinson, 1972). When fed under a free choice system, *Medicago sativa* and *Trifolium alexandrium* can fulfil eighty per cent of the dry matter requirements of the rabbit, which can be raised economically with a very low input of concentrates (Prasad et al., 1996a).

Among the top feeds *Puereria thunbergiana* and *Robinia pseudocacia* leaves can be successfully incorporated up to twenty five per cent of the diet (Singh et al., 1994; Bhatt et al., 1996a). *Broussonetia papyrifera* can be used as a sole feed for maintenance of adult rabbits but it needs to be supplemented with barley grain for satisfactory growth (Bhatt et al., 1996b; Bhatt et al., 1997). Leaves of *Ficus hookeri* and *Ficus infectoria* can also be used as a good source of fodder at twenty five per cent of the rabbit diet (Gupta, 1992). *Prosopis cineraria, Zizyphus nummularia* and *Alianthus excelsa* leaves can be consumed up to fifteen per cent of the diet (Prasad et al., 1996b). Non-legumes, grasses like *Setaria sphacelate, Panicum maximum* cv. guinea, *Panicum maximum* cv. hamil and *Thysaenolaena agrostis,* can be used in rabbit feeding up to twenty five per cent of the diet (Gupta et al., 1993). *Cenchrus ciliaris* can also be used up to thirty per cent of the diet for maintenance (Prasad and Karim, 1996).

Sub-temperate pastures like tall fescue (*Festuca arundinacea*) and *Trifolium repens* can be fed along with soaked corn for maintenance purposes (Prasad and Singh, 1996). As a sole fodder, oats can be fed for maintenance (Deshmukh et al., 1990) and can be used at a level of thirty per cent for satisfactory growth (Gupta, 1992). Thus, locally grown fodder can be utilised for rabbit feeding to optimise the cost of production. Tall fescue is a perennial fodder with good forage yield in the sub-temperate climatic conditions. The objective of this study was to evaluate the nutritive value of tall fescue and the production performance in broiler rabbits as compared to feeding oat plant meal.

## MATERIALS AND METHODS

An experiment was conducted on 45 Soviet Chinchilla weaners (35 d old), divided into 5 groups of 9 animals each with equal sex ratio (5 males + 4 females). Five experimental diets were formulated in the mash form by incorporating oat (*Avena sativa*) plant meal ($T_2$, $T_4$) and tall fescue (*Festuca arundinacea*) hay ($T_3$, $T_5$) at 25% and 50% along with control ($T_1$). Dietary composition (%) of feed in the control group was Groundnut cake - 10, Sunflower cake - 10, Mustard cake - 8, Soyaflakes - 5, Maize - 23,

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Barley - 10, Wheat bran - 15, Rice polish - 7, Fish meal - 2, Molasses - 8, Mineral mixture - 1 and Common salt - 1.

Daily feed and water was offered *ad lib* to rabbits. Feed intake and body weights were monitored from 35 to 84 days of age. During the last week of the experiment, a metabolic trial was conducted for seven days to assess the digestibility of organic nutrients and nitrogen balance. Total faeces voided and urine excreted were collected during the experimental period. Feed, faeces and urine samples collected during the trial were analysed for proximate components and calcium (AOAC, 1990), feed samples were analysed for fibre (Goering and Van Soest, 1984). At the end of the feeding trial all the animals were slaughtered to record the dressing percentage.

The data generated were subjected to statistical analysis using analysis of variance (ANOVA) (Snedecor and Cochran, 1967). Performance index (final live weight × 100/ feed conversion ratio) was calculated according to North (1981). Cost of production was calculated on the basis of the prevailing market rates of feed ingredients.

## RESULTS AND DISCUSSION

The chemical compositions of the experimental diets and test materials are given in the table 1. The crude protein (CP) content in all the experimental diets decreased with the incorporation of oat plant meal (OPM) and tall fescue hay (TFH). The decrease in CP content was higher in OPM substituted diets ($T_2$ and $T_4$). Crude fibre (CF) was increased with test material and was higher in TFH based diets ($T_3$ and $T_5$) than OPM based diets ($T_2$ and $T_4$). The level of cellulose was increased with test material incorporation.

Biological performance of the rabbit is given in table 2. At the beginning of the feeding trial (35 d), live weights were similar but the final weights were significantly ($p<0.05$) higher in the group fed OPM ($T_2$ and $T_4$) as compared to TFH ($T_3$ and $T_5$). Differences among levels were not observed in the group fed OPM whereas live weights decreased significantly ($p<0.05$) with an increase in level of TFH. Similar results were observed with respect to gain in weight during the experimental period. Feed intakes were higher with TFH and OPM when compared to control. Feed conversion ratio (FCR) deteriorated both at 25 and 50% levels with incorporation of plant materials. With OPM, FCR was statistically similar at 25 and 50% levels, whereas the differences were significant ($p<0.05$) with TFH among all levels. The results indicate that despite higher feed intake at 25% levels with both OPM and TFH, growth rates decreased non-significantly in OPM but significantly ($p<0.05$) with TFH diet. At the 50% level the growth rates decreased more in TFH than OPM indicating lower nutrient availability from TFH than OPM. For dressing percentage the differences were non-significant for control and OPM based diets ($T_2$ and $T_4$) and were significant ($p<0.05$) for TFH based diet ($T_5$). Cost per kg live weight gain (Rs.) was lowest in the OPM based diets ($T_2$ and $T_4$) and highest in TFH based diets ($T_3$ and $T_5$).

Daily fresh faecal output was lowest in the control and $T_5$ groups followed by $T_3$ and was highest in the OPM based diets ($T_2$ and $T_4$) with maximum excretion (129.1g) in $T_4$ group (table 3). The moisture percent in faeces was highest in the OPM based diet ($T_4$) followed by the control. The lowest values were recorded in TFH based diets. For DM digestibility significant ($p<0.05$) differences were observed at 25% levels whereas these were non-significant at the 50% levels between OPM and TFH based diets. The differences between the 25 and 50% levels in the group fed TFH were non-significant. Feed protein digestibility was observed to be lower in the group fed OPM and TFH. The differences were non-significant between OPM and TFH at the 25% level while it was significant ($p<0.05$) at the 50% level of inclusion for both the test materials compared to control. No differences were observed between the test

**Table 1.** Chemical composition of diets containing oat plant meal and tall fescue hay (% on DM basis)

| Nutrient | $T_1$ Control | $T_2$ OPM 25% | $T_3$ TFH 25% | $T_4$ OPM 50% | $T_5$ TFH 50% | OPM | TFH |
|---|---|---|---|---|---|---|---|
| Crude protein | 20.3 | 17.5 | 18.2 | 15.8 | 17.3 | 12.7 | 14.9 |
| Crude fibre | 9.2 | 12.4 | 12.9 | 15.3 | 17.1 | 25.2 | 27.3 |
| Ether extract | 1.2 | 1.0 | 0.9 | 0.9 | 0.8 | 1.9 | 1.5 |
| Total ash | 8.0 | 8 | 8.5 | 8.2 | 9.5 | 9.8 | 10.7 |
| Acid insoluble ash | 1.3 | 1.9 | 2.5 | 1.5 | 2.9 | 1.3 | 1.4 |
| Nitrogen free extract | 61.3 | 61.1 | 59.3 | 59.9 | 55.3 | 50.5 | 45.8 |
| Acid detergent fibre | 14.9 | 17.9 | 20.1 | 20.5 | 26 | 35.5 | 41.7 |
| Lignin | 3.5 | 3.8 | 3.9 | 5 | 5.8 | 5.1 | 7.2 |
| Cellulose | 11.4 | 14.1 | 16.2 | 15.5 | 20.2 | 30.4 | 34.5 |
| Digestible energy (kcal/kg) | 2,799 | 2,693 | 2,598 | 2,578 | 2,321 | - | - |
| Calcium | 1.1 | 0.9 | 1.0 | 1.0 | 1.2 | 0.9 | 1.7 |
| Phosphorus | 0.8 | 0.8 | 0.8 | 0.6 | 0.7 | 0.5 | 0.5 |

**Table 2.** Biological performance of rabbit fed oat plant meal and tall fescue hay (from 35 to 84 d of age)

| Parameter | $T_1$ Control | $T_2$ OPM 25% | $T_3$ TFH 25% | $T_4$ OPM 50% | $T_5$ TFH 50% |
|---|---|---|---|---|---|
| Initial body weight (g) | 510 | 510 | 508.8 | 508.8 | 512.2 |
| Final body weight (g) | 1,687.5$^a$ | 1,645.5$^a$ | 1,501.1$^b$ | 1,600$^a$ | 1,267.5$^c$ |
| Gain in weight (g) | 1,177.5$^a$ | 1,135.5$^a$ | 992.3$^b$ | 1,091.2$^a$ | 755.3$^c$ |
| Gain/day (g) | 24.0 | 23.2 | 20.3 | 22.3 | 15.4 |
| Dry matter intake (g·day$^{-1}$·head$^{-1}$) | 96.5 | 103.9 | 103.5 | 106.9 | 103.9 |
| Feed conversion ratio | 4.0$^a$ | 4.5$^{ab}$ | 5.1$^b$ | 4.8$^{ab}$ | 6.7$^c$ |
| Performance Index* | 42.1 | 36.7 | 29.4 | 33.3 | 18.8 |
| Dressing percentage | 47.5$^a$ | 46.1$^a$ | 43.6$^a$ | 46.5$^a$ | 41.8$^b$ |
| Plane of nutrition (g·day$^{-1}$·head$^{-1}$) | | | | | |
| Digestible crude protein intake | 13.8 | 11.8 | 12.9 | 10.4 | 10.6 |
| Total digestible nutrient intake | 64.9 | 61.2 | 59.3 | 56.1 | 52.7 |
| Cost of production | | | | | |
| Cost of diet (Rs./kg) | 6.9 | 5.7 | 5.7 | 4.5 | 4.5 |
| Cost / kg live weight gain (Rs.) | 28.1 | 25.7 | 29.3 | 21.6 | 30.3 |

Figures bearing different superscripts in a row differ significantly ($p < 0.05$) from each other.

$$\text{* Performance Index} = \frac{\text{Final live weight (kg)} \times 100}{\text{Feed conversion ratio}}$$

**Table 3.** Digestibility coefficient, nutritive value and nitrogen balance in rabbit fed oat plant meal and tall fescue hay

| Parameter | $T_1$ Control | $T_2$ OPM 25% | $T_3$ TFH 25% | $T_4$ OPM 50% | $T_5$ TFH 50% |
|---|---|---|---|---|---|
| Faecal Excretion (g/d) | | | | | |
| Fresh | 68.3$^a$ | 96.7$^b$ | 88.3$^b$ | 129.1$^c$ | 71.2$^a$ |
| Dry | 28.9$^a$ | 43.3$^{bc}$ | 39.8$^b$ | 49.9$^c$ | 33.2$^a$ |
| Moisture (%) | 58.1$^{bc}$ | 55.3$^b$ | 53.9$^a$ | 60.9$^c$ | 53.2$^a$ |
| Nutrient | | | | | |
| Dry matter | 69.5$^a$ | 61.7$^b$ | 58.3$^c$ | 54.4$^d$ | 56.4$^{cde}$ |
| Crude protein | 70.4$^a$ | 68.7$^a$ | 68.2$^a$ | 61.6$^b$ | 59.1$^b$ |
| Crude fibre | 17.2$^a$ | 8.6$^b$ | 9.9$^b$ | 4.9$^c$ | 7.3$^b$ |
| Ether extract | 72.2$^a$ | 63.2$^b$ | 59.4$^c$ | 58.7$^c$ | 57.9$^c$ |
| Nitrogen free extract | 80.6$^a$ | 73.7$^b$ | 71.4$^{bc}$ | 68.1$^c$ | 69.2$^{bc}$ |
| Nutritive value (g/d) | | | | | |
| Digestible crude protein | 14.3 | 11.9 | 12.4 | 9.7 | 10.2 |
| Total digestible nutrient | 67.3 | 58.9 | 57.3 | 52.5 | 50.8 |
| Nitrogen balance (g/d) | | | | | |
| Intake | 3.5 | 3.7 | 3.6 | 3.5 | 3.2 |
| Faeces | 1.0 | 1.2 | 1.1 | 1.4 | 1.3 |
| Urine | 1.2 | 1.6 | 1.4 | 1.4 | 1.1 |
| Balance | 1.4 | 0.9 | 1.1 | 0.8 | 0.8 |
| Nitrogen retention as % of intake | 50.9$^a$ | 40.2$^b$ | 34.2$^c$ | 34.2$^c$ | 27.4$^d$ |

Figures bearing different superscripts in a row differ significantly ($p<0.05$) from each other.

materials when they were fed at the same level.

Fibre digestibility decreased with test material, however it was higher in the group fed TFH than the OPM. The differences were significant ($p<0.05$) both at 25 and 50% levels when compared to the control. They were similar at 25 and 50% levels for TFH and different for the OPM based diets. The differences were non-significant among test material at 25% level but were significant ($p<0.05$) among levels at 50% level of incorporation. The differences in the digestibility of EE were significant ($p<0.05$) at 25% level between TFH and OPM but were not significant at 50% levels. Digestibility of EE decreased significantly ($p<0.05$) both at 25 and 50% level in the group fed OPM as well as TFH.

Digestibility of nitrogen free extract (NFE) decreased with test material and the differences were higher in the groups fed TFH than OPM. The digestibility decreased ($p<0.05$) with increasing level of plant material and the differences between 25 and 50% levels were significant ($p<0.05$) in OPM and TFH based diets. Digestible crude protein (DCP) and total digestible nutrients (TDN) were lower in test material substituted diets. Nitrogen retention as percent of intake was lower in test diets and the differences were significantly ($p<0.05$) higher for TFH substituted diets than OPM substituted diets when compared to control.

Contents of CP and ether extract (EE) decreased, with test material incorporation. The decrease in CP was higher with OPM than TFH due to compositional differences among the test materials. Level of fibre fractions (ADF and cellulose) levels were comparatively higher in TFH based diets ($T_3$ and $T_5$) than OPM based diets ($T_2$ and $T_4$) due to proportionately higher levels of these constituents in TFH. The nutrient composition of OPM indicated higher CP, NFE, lower CF and EE than reported by Gupta (1992), whereas the values are comparable to that reported by Deshmukh et al. (1990). The OPM used in this experiment was harvested in the pre-bloom stage. The value of protein content and structural carbohydrates in TFH were comparable to that reported by Zanzalari et al. (1989) and higher than that given by Cheeke (1987). All the nutrients in the experimental diets were within the permissible limits (NRC, 1977).

The gain in weight was highest in the control group, followed by OPM based diets ($T_2$ and $T_4$) and was significantly ($p<0.05$) lower for TFH based diets ($T_3$ and $T_5$). Despite higher CP in TFH than OPM containing diets (table 1) growth performance of the rabbits was lower. Lower EE and NFE, higher fibre and its fractions along with poor digestion of protein and NFE as compared to OPM based diets may be responsible for poor growth performance in these groups. Boling et al. (1975) have shown that tall fescue contains the alkaloid perloline, which decreased cellulose and protein digestion. Steen et al. (1979) also suggested that these alkaloids could influence performance in cattle.

Dry matter intake (DMI) improved marginally with the addition of test material. Low nutrient density and higher fibre level of test material than control diet are the reason for higher DMI with test material incorporation. Deshmukh and Pathak (1989) reported higher DMI by rabbits from oat than other fodder and tree leaves. Significant ($p<0.05$) deterioration in FCR with the incorporation of test materials might be due to increased fibre and its fractions, acid insoluble ash. As dietary fibre level rises from 5-20% level, the rabbit increases feed intake to maintain a constant energy intake, FCR declines and carcass fat decreases (Franck and Coulmin, 1979). The magnitude of deterioration was highest in TFH based diets ($T_3$ and $T_5$). In these diets crude fibre, acid insoluble ash and cellulose levels were higher than in the OPM based diet ($T_2$ and $T_4$). Pote et al. (1980) reported low growth rate and higher feed intake in weanling rabbits fed higher fibre level (ADF<19.1%) from alfalfa based diet. The significantly ($p<0.05$) low dressing percentage in 50% TFH based diet ($T_5$) was due to low slaughter weight of animals in the group (Bhatt et al., 1996a). Poor gain of animals fed test diets may be responsible for low dressing yield in these groups.

Plane of nutrition including digestible protein and energy intake per day was highest in the rabbits fed the control diet and decreased with increase in proportion of test material and was related with the growth performance of rabbits. Digestible crude protein (DCP) intake ($g \cdot day^{-1} \cdot head^{-1}$) was higher with TFH based diet; whereas total digestible nutrients (TDN) intake ($g \cdot day^{-1} \cdot head^{-1}$) was higher with diet containing OPM, thus indicating relatively higher availability of digestible energy yielding components from OPM than TFH. The nutritive value of OPM and TFH were calculated as DCP 5.1%, TDN 35.8% and DCP 6.5%, TDN 30.8%, respectively. The value calculated for OPM are lower than reported by Deshmukh et al. (1990). However, they used green oat fodder as the sole feed for calculating nutritive value.

Higher excretion of faeces from OPM based diets than TFH and control diet may be due to their different bulk density and swelling capacity. The higher moisture absorption by faeces in OPM based diets than TFH based diets and control is indicative of higher swelling capacity by these diets. Cheeke (1987) reported that feeds with same fibre and energy contents but differing in bulk density and swelling capacity may have different transit rates through the digestive tract and differentially affect feed intake through swelling effect on stomach capacity.

Digestibilities of all the proximate principles decreased with the incorporation of the test material. Besedina (1969) and Sandford (1986) showed that as the fibre content of the dry matter increased the digestibility of total organic matter decreased. The digestibility of crude protein was not affected when the test material was incorporated at 25% level whereas at 50% level significant ($p<0.05$) differences were observed. Digestibility of all the components of the diet has been reported to decrease with rise in fibre level of the diet (Jarl, 1944). Digestibility of crude protein has been reported to increase with rise in fibre level of the diet (Glover and Duthie, 1958), but this factor is not important over the ranges of fibre level which are usually consumed.

Digestibility of crude fibre decreased significantly ($p<0.05$) with test material incorporation, and this was correlated with ADF and cellulose contents of the diets. Fibre of OPM based diets ($T_2$ and $T_4$) was less digestible than that of TFH based diets ($T_3$ and $T_5$). In spite of high lignin in TFH and its diets the CF digestibility was higher.

It might be due to higher bulk density and swelling capacity of OPM fibre than that of TFH which resulted in low CF digestibility in OPM based diets than TFH based diets. Cheeke (1987) also reported poor fibre utilisation in feeds with high bulk density and swelling capacity. Digestibility of ether extract also decreased, however the depression was higher for TFH based diets than OPM based diets. Fat contained in conventional raw materials is linked to plant structures and is poorly digested (Xiccato, 1998). The cost of rabbit production decreased with OPM whereas TFH proved inferior.

From this experiment it is concluded that OPM can be safely added up to 25% level in a complete mash diet whereas for TFH the safe level is below 25% and needs to be ascertained.

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