Effect of Garlic (*Allium sativum*) Supplementation on the Growth Performance of Crossbred Calves

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Abstract. Trial was conducted to assess the effects of different garlic supplementation methods on the performance of crossbred calves. Jersey crossbred calves of both sexes were randomly separated into three treatments (T_1, T_2 and T_3) of six calves in each group. Calves in T_1 group were supplemented with garlic powder at the dose rate of 250 mg/kg BW in water whereas calves in the T_2 group were supplemented with 250 mg/kg BW in concentrate feed and the T_3 group was treated as control. The data on growth rate in terms of body weight, average daily gain, feed intake, faecal consistency score, faecal egg count and disease incidence were analysed as per standard procedures. It was found that the calves in T_1 and T_2 group gained significantly higher overall body weight and average daily gain compared with calves in T_3 group. No significant difference was observed in feed intake and feed conversion efficiency between the treatment groups. The faecal consistency score and faecal egg count remained the same in all the treatment groups.

Key words: crossbred calves, Jersey, garlic supplementation, growth parameters

Abstrak. Percobaan dilakukan untuk meneliti pengaruh metode suplementasi bawang putih terhadap performa sapi peranakan silang. Sapi peranakan silang Jersey jantan dan betina dibagi secara acak ke dalam tiga perlakuan (T_1, T_2 dan T_3) masing-masing 6 ekor. Sapi T_1 diberi 250 mg/kg bobot bawang putih bubuk di air, T_2 diberi 250 mg/kg bobot bawang putih bubuk di pakan konsentrat, dan T_3 adalah kontrol. Data tingkat pertumbuhan, penambahan bobot harian, jumlah konsumsi, nilai konsistensi feces, jumlah telur cacing dan kejadian penyakit dianalisis sesuai standar prosedur. Ditemukan bahwa sapi kelompok T_1 dan T_2 memiliki total kenaikan bobot dan penambahan bobot harian yang lebih tinggi dibanding sapi kelompok T_3. Tidak ada perbedaan nyata yang ditemukan pada jumlah konsumsi dan efisiensi konversi pakan antara kelompok perlakuan. Nilai konsistensi feces dan jumlah telur cacing tetap sama di semua kelompok perlakuan.

Kata kunci: sapi perankaan silang, Jersey, suplementasi bawang putih, parameter pertumbuhan

Introduction

Calves are the future replacement stocks for cows and bulls. Calves are often underestimated and neglected because they need financial investment and do not result in any immediate return. However, serious attention should be given to calf rearing because initial growth of an animal is the most important phase of its life and induces immense bearing on the early maturity and production; initial body weight has been found to be correlated with later body weight and the growth rates at any stage of development can also be taken as an aid to selection. Further, the sexual maturity depends mainly on bodyweight rather than age (Ghose et al., 1979). The body weight of the calves is an essential parameter with respect to attainment of sexual maturity, age at first calving and the total number of lactations. Good supplementation of nutrients and feed additives are of paramount importance for calf growth and health. It is proven that supplementation of rumen function modulators, liver tonics and immunomodulators, at an early age helps in strengthening the immunity and to prevent diseases (Prasad et al., 2005). In recent years,

producers worldwide have been looking for better management techniques and products to improve the performance as well as the health of the calves. With the ban on the antibiotic feed additives, substitutes such as probiotics and herbal supplements must be found for the livestock in general, and growing calves in particular.

Many substances have been supplemented in calf diet to get the desired result, and a recent development is the use of herbs. Beneficial effects of herbs in farm animals may arise from the activation of feed intake, immune stimulation, antibacterial, coccidiostatic, anthelmintic, antiviral or anti-inflammatory activity and antioxidant properties. Garlic (*Allium sativum*) has been a subject of considerable interest as a medicine and therapeutic agent worldwide since ancient times. Main pharmacological effects of garlic are attributed to its organosulphur compounds (Tapieroa et al., 2004). Allicin-the main bioactive component of garlic-may account for some effects of garlic (Amagase et al., 2001). In vitro studies have shown that garlic possesses antibacterial, antifungal, antiparasitic, antiviral (Ankri and Mirelman, 1999), as well as antithrombotic, vasodilatory and anticancer (Agarwal, 1996) activities. It has benefits in lowering total plasma cholesterol, reducing blood pressure and decreasing platelet aggregation (Sterling and Eagling, 2001).

Holden et al. (1998) observed depressed growth rate in weaner pigs supplemented with garlic product in concentrate diet. Dietary supplementation of garlic bulbs at the dose rate of 30 and 60 kg per tonne and garlic husks at the dose rate of 50 and 100 kg per tonne of concentrate feed in growing lambs had no influence on final body weight (Bampidis et al., 2005). In a study on the influence of supplementing natural juice of vegetable and fruitage, lemon, onion, garlic juice on growing buffalo calves Ahamed et al. (2009), observed that using garlic, onion and lemonade juice as natural feed additive at the rate of 2.5, 5, 7.5 percent per kg of ration improved utilization of nutrients and improved growth rate. Ghosh et al. (2010) observed significant ($P<0.01$) increase in body weight in crossbred calves of 0-2 months of age supplemented with garlic extract at the dose rate of 250 mg/kg body weight when compared to non-supplemented calves.

In a study on the growth pattern of Holstein Friesian and Jersey calves, Singh, Belsare and Patel (2001) reported average daily gain of 0.427 ±0.014 kg and 0.339±0.018 kg between 3-6 months of age respectively. In a study on the performance of male crossbred calves as influenced by substitution of grain by wheat bran and addition of lactic acid bacteria to diet, Khuntia and Chaudhary (2002) observed average daily gain in the range of 259-366 g in 0-13 weeks of age. Diack, Sanyang and Corr (2004) reported an overall mean daily weight gain of 0.220±0.104 kg in F_1 crossbred cattle. In a study on the comparative efficacy of calf starter and conventional rations in buffalo suckling calves, Ahamed et al. (2004) reported, average daily weight gain of 0.47 and 0.34 kg respectively. Hadiya et al. (2009) reported that supplementation of garlic based commercial herbal growth promoter and liver tonic products significantly improved liver function, feed assimilation and digestibility of ration ultimately leading to gain in body weight in dairy calves. In a study on the effect of feeding jowar straw in combination with soyabean straw on the growth performance of Holstein Friesian X Deoni crossbred calves, Adangale et al. (2009) observed the average daily gain of 0.204 kg. In a study on growth pattern of crossbred Holstein Friesian heifer calves in an organized farm, Muthuramalingam et al. (2011) reported average daily gain of 0.240±0.075 kg between birth to four months of age and 0.31±0.074 kg between four to eight months of age. In a study on the comparative efficacy of

calf starter and conventional rations in buffalo suckling calves, Ahamed et al. (2004) reported average daily feed intake of 0.95 and 0.57 kg respectively. Ghosh et al. (2010) observed significant (P<0.01) increase in feed intake in crossbred calves of 0-2 months of age, supplemented with garlic extract at the dose rate of 250 mg/kg body weight when compared to non-supplemented calves. In a study on the comparative efficacy of calf starter and conventional rations in buffalo suckling calves, Ahamed et al. (2004) reported feed conversion ratio of 2.00 and 1.70 respectively. Ghosh et al. (2010) observed significant (P<0.01) increase in feed conversion efficiency in crossbred calves of 0-2 months of age, supplemented with garlic extract at the dose rate of 250 mg/kg body weight when compared to non-supplemented calves.

In a study on the effect of *Aspergillus oryzae* extract and *Saccharomyces cerevisiae* fermentation product on intake, body weight gain and digestibility in buffalo calves, Di Francia et al. (2008) reported faecal score in the range of 1.32 to 1.83 for different treatment groups. The faecal consistency score ranged from 1.4 to 1.5 in 0-56 days old Holstein Friesian calves supplemented with selenium yeast (Fokkink et al., 2009). Ghosh et al. (2010) observed significant (P<0.01) decrease in severity of faecal scours in crossbred calves of 0-2 months of age supplemented with garlic extract at the dose rate of 250 mg/kg body weight when compared to non-supplemented calves. In a study on the efficiency of Albendazole in calves Hafiz and Bhattacharyya (2009) reported an EPG count of 980 during pre-treatment and 320 on 7^{th} day and 0 on 14^{th} day of treatment with efficiency of 67.35 per cent and 100 per cent on 7^{th} and 14^{th} day post treatment respectively. Burke et al. (2009) studied the influence of garlic and papaya over gastro intestinal nematodes in goats and lambs. They observed that both garlic and papaya lack control over gastro intestinal nematodes in goats and lambs.

Antioxidants in garlic extract such as the organosulphur compound, protect against oxidative damage there by reduced the risk of injury to vital molecules and prevented the onset and progression of diseases (Gutteridge, 1993). Supplementation of Ruchamax, herbal based product containing garlic as a major ingredient increased the digestibility of rations specially roughage and crude fiber (Pradhan and Bishwas, 1994). Supplementation of garlic extract resulted in proper maintenance of liver function because it has an important protective role against liver toxicity caused by a variety of medicinal and environmental substances (Borek, 2001). Kongmun et al. (2011) studied the influence of supplementation of seven per cent coconut oil plus 100 g of garlic powder on rumen fermentation and ecology of swamp buffaloes. They observed coconut oil and garlic supplementation improved the rumen ecology and reduced the methane gas production by nine per cent without changing nutrient digestibility. Garlic supplementation through feed, in particular, has many favourable experimental and clinical effects, which include stimulation of immune function, enhanced foreign compound detoxification, and restoration of physical strength and resistance to various stresses (Amagase et al., 2001). Considering the above facts the present study has been conducted to study the influence of garlic supplementation on the growth performance of crossbred calves and to study the effect of garlic supplementation on the health status of crossbred calves.

Materials and Methods

Metha dairy farm, Madhavaram in Chennai, Tamil Nadu, India, was selected as the study area for conducting the research work. The station is situated approximately at 13.5°N latitude and 80.24°E longitude and at a height

of 13 meters above mean sea level. Being nearer to East coast of India it enjoys a tropical maritime monsoon climate. Jersey crossbred calves in the age group of 2-3 months were taken for the study. The experimental trial was conducted for a period of 150 days. Calves in T_1 group were supplemented with garlic powder at the dose rate of 250 mg/kg BW in water whereas calves in the T_2 group were supplemented with 250 mg/kg BW in concentrate feed and the T_3 group was treated as control.

Eighteen numbers of Jersey crossbred calves in the age group of 2-3 months were randomly allotted based on the bodyweight to three groups of six animals each with equal number of male and female calves. During the entire experimental period no mortality was recorded. The calves were managed in intensive system with concrete floor and monitor type roof pattern with asbestos roof material. At the start of the experimental trial, all the calves were provided with concentrate ration at the rate of 500 g/day and subsequent increments were given at the rate of 100 g/month. Hybrid cumbu-napier (CO_4) green fodder was provided at the rate of 2 kg/calf/day and increased at the rate of 1 kg/calf in the subsequent months. The experimental calves were provided with calf starter from 3-4 months and with calf grower from 5-7 months of age.

Garlic was purchased from the local market and was dried under the shade for a period of ten days. After drying the outer husks were removed and the bulbs were ground to powder by electrical mixer. Calves in the group T_1 were supplemented with garlic powder at the dose rate of 250 mg per kg body weight per day mixed in water. Calves in the group T_2 were supplemented with garlic powder at the dose rate of 250 mg per kg body weight per day mixed in concentrate feed. Calves in the group T_3 were treated as control with no supplementation. All the experimental calves were dewormed at the start of the experiment and at six months of age with broad spectrum anthelmintic Fenbendazole and Albendazole. Vaccination against Foot and Mouth disease was done during the month of February when the calves were at 4 months of age.

Body weight. The body weight of all the experimental animals was recorded at fortnightly intervals. The measurement was made in kilogram (kg) by individually weighing the calves using spring balance of 100-gram (g) accuracy.

Average daily gain. The average daily gains in body weight achieved during 3 to 7 months was calculated by subtracting the initial weight from the final weight and dividing it by number of days. The average daily gain was calculated using the formula $R= W_2-W_1/ t_2-t_1 \times 1000$ g. Where, R=average daily gain (in grams), W_2-W_1=gain during the experiment period (kg), t_2-t_1 =period of gain in days

Feed intake. Feed intake was calculated on dry matter basis. The difference in the total quantity of feed left over after 24-hours was taken to calculate the average feed intake. Feed conversion efficiency was calculated following Banerjee (1998) i.e., feed consumed (kg)/body weight gain (kg)

Faecal consistency score. The faecal score was done by faecal diarrhoea score suggested by Larsonet al. (1977) method which namely Normal (Code 1)-Firm but not hard. Original form is distorted slightly after dropping to floor and settling, Soft (Code 2)-Does not hold forms, piles but spreads slightly (i.e., soft serve ice milk), Runny (Code 3)-spreads readily to about 6 mm depth (i.e., pancake batter) and Watery (Code 4)-liquid consistency, splatters. (i.e., orange juice).

Faecal egg count. Dung samples were collected and Egg per gram (EPG) was counted for the

samples using New Triple-Chambered McMaster counting slide.

Disease incidence. The incidence of disease during the experimental period was observed and recorded.The data collected were subjected to statistical analysis as per the method of Snedecor and Cochran (1994) to assess the effect of garlic supplementation on the growth performance and health status of crossbred calves.

Results and Discussion

Results

The performance of crossbred calves under different methods of garlic supplementation was studied.

Body weight. Mean±SE of body weight of crossbred calves during the start of experimental trail under different methods of garlic supplementation were 25.83±2.33, 25.75±1.46 and 25.67±2.34 kg respectively. Their final body weight at 10^{th} fortnight was 63.07±2.67, 63.27±1.77 and 60.78±2.45 kg for the treatment group T_1, T_2 and T_3 respectively. The overall gain in body weight for the experimental period was 37.23±0.59, 37.52±0.54 and 35.12±0.55 kg respectively for the treatment groups T_1, T_2 and T_3. There was no significant difference in overall body weight gain between the garlic supplementation in water and garlic supplementation in concentrate feed. However, there was significant difference ($P<0.05$) between the garlic treated and control group.

Average daily gain. Mean±S.E of average daily gain of crossbred calves under different methods of garlic supplementation at various fortnights ranged from 227.78±9.95 to 257.78±9.69, 221.11±12.93 to 273.33±14.50 and 215.00±12.25 to 248.89±5.07 g for the treatment groups T_1 (garlic in water), T_2 (garlic in concentrate feed) and T_3 (control) respectively. The overall average daily gain in body weight for T_1, T_2 and T_3 were 248.22±3.92, 250.11±3.59 and 234.11±3.67 g respectively. The results revealed no significant difference in average daily gain between garlic supplemented groups, but ($P<0.05$) average daily gain was significantly different between garlic supplemented and non-supplemented groups.

Feed intake. The monthly mean daily dry matter intake ranged from 0.97±0.02 to 2.00±0.04 kg from first to fifth month of experimental trial for calves supplemented with garlic in water (T_1). For the calves supplemented with garlic in concentrate feed it ranged from 0.95±0.01 to 2.03±0.10 kg (T_2) and for the calves in the control group it ranged from 0.92±0.02 to 1.98±0.70 kg (T_3). Statistical analysis revealed no difference in dry matter intake between the calves in different treatment groups.

Feed conversion efficiency. The feed conversion efficiency ranged from 3.85±0.11 to 7.87±0.23 for the calves supplemented with garlic in water. While calves with garlic-supplemented in concentrate and control group ranged from 4.07±0.12 to 8.02±0.44 and 4.14±0.10 to 8.52±0.29, respectively. The feed conversion efficiency remained the same in calves across treatment groups.

Faecal consistency score. The faecal consistency scores for the three treatment groups T_1, T_2 and T_3 were 1.17±0.11, 1.17±0.11 and 1.25±0.11 respectively during the start of the experimental trial. The faecal consistency score ranged from 1.00±0.00 to 1.75±0.11, 1.00±0.00 to 1.58±0.20 and 1.00±0.00 to 1.75±0.17 for the treatment groups T_1, T_2 and T_3 respectively. Statistical analysis revealed no difference in fecal consistency score between the treatment groups.

Faecal egg count. The pre-treatment and post treatment mean±SE of egg per gram at 3rd and 6th months age for crossbred calves under different treatment groups are presented in the Table 1. The EPG for the three treatment groups T_1, T_2 and T_3 at the start of the experiment were 800±23.09, 820.00±38.30 and 800.00±23.09 respectively. The EPG at 7th day for the treatment groups were 220.00±8.94, 226.67±16.87 and 220.00±13.66 respectively. The EPG at 14th day for the treatment groups were 20.00±8.94, 33.33±12.29 and 40.00±14.61, respectively. The drug efficacy ranged from 72.35 to 72.50 percent at the 7th day for the treatment groups and from 95.00 to 97.50 percent at 14th day of treatment. Statistical analysis revealed no difference in EPG between the three different treatment groups.

The EPG for the three treatment groups T_1, T_2 and T_3 at the sixth month of the experiment were 410.00±19.15, 400.00±11.55 and 420.00±17.89 respectively. The EPG at 7th day for the treatment groups were 113.33±8.43, 110.00±6.83 and116.67±6.15 respectively. The EPG at 14th day of the treatment were 20.00±8.93, 40.00±14.61 and 33.33±12.29 respectively. The drug efficacy ranged from 72.22 to 72.5 per cent at the 7th day for the treatment groups and from 90.24 to 95.00 percent at 14th day of treatment. Statistical analysis revealed no difference in EPG between the three treatment groups.

Disease incidence. No incidence of diseases was observed during the entire experimental trial period. This shall be attributed to proper housing, scientific feeding and health care (timely deworming and vaccination) management.

Discussion

Body weight. The mean initial body weight of the experimental animals ranged from 25.67±2.34 to 25.83±2.33 kg. No significant difference in body weight was observed between garlic supplemented and non-supplemented calves from the first to tenth fortnight. However garlic supplemented calves (T_1 and T_2) had significantly ($P<0.05$) higher overall weight gain (37.23±0.59 to 37.52±0.54 kg) than the non-supplemented calves (35.12±0.55 kg). No significant difference was observed in body weight between calves supplemented with garlic through water and through feed (T_1 and T_2). It was in line with Ghosh et al. (2010) reporting significantly ($P<0.01$) higher body weight in garlic supplemented crossbred calves than non-supplemented calves in the 0-2 month age group. Similar results of positive influence of garlic supplementation on the growth performance were also observed by Ahamed et al. (2009) in growing buffalo calves.Contrary to the present findings no positive influence was observed in growth performance by garlic supplementation in growing lambs by Bampidis et al. (2005) and in growing pigs by Chen et al. (2008).However depressed growth rate due to garlic supplementation was observed by Holden et al. (1998) in weaner pigs and Javandele et al. (2008) in broiler birds.

Body weight gain. However the garlic supplemented calves had significantly ($P<0.05$) higher overall average daily gain in body weight (248.22±3.92 to 250.11±3.59 g) than non-supplemented calves (234.11±3.67 g). No significant difference in overall average daily gain was observed between garlic supplemented groups (T_1 and T_2). In a similar study on the influence of garlic on growth performance of crossbred calves Ghosh et al. (2010) and Hadiya et al. (2009) observed significantly higher average daily Table 2. Mean±SE and analysis of variance of faecal egg per gram (EPG) of crossbred calves under different methods of garlic supplementation EPG - 3rd month of age gain in garlic

Table 1. Egg per gram at 3rd and 6th months age for crossbred calves under different treatment

Treatment	0th day	7th day	14th day
T_1	800.00±23.09	220.00±8.94 (72.5%)	20.00±8.94 (97.5%)
T_2	820.00±38.30	226.67±16.87 (70.5%)	33.33±12.29 (95.93%)
T_3	800.00±23.09	220.00±13.66 (72.5%)	40.00±14.61 (95.00%)
P value	0.1869^{NS}	0.0741^{NS}	0.4320^{NS}

T_1: supplemented with garlic powder at the dose rate of 250 mg/kg BW in water; T_2: supplemented with 250 mg/kg BW in concentrate feed T_3: control

Table 2. Influence of garlic on growth performance

	Treatment EPG - 6th month of age		
T_1	410±19.15	113.33±8.43 (72.5%)	20.00±8.93 (95.00%)
T_2	400±11.55	110.00±6.83 (72.3%)	40.00±14.61 (90.24%)
T_3	420±17.89	116.67±6.15 (72.22%)	33.33±12.29 (92.06%)
P Value	0.1579^{NS}	0.0806^{NS}	0.7100^{NS}

T_1: supplemented with garlic powder at the dose rate of 250 mg/kg BW in water; T_2: supplemented with 250 mg/kg BW in concentrate feed T_3: control

supplemented calves. The overall average daily gain observed in the present study (234.11 to 248.22 g) was in agreement with Khuntia and chaudhary (2001) (259-366 g), Diack et al. (2004) (220 g) and Adangalae et al. (2009) (204 g). However, higher average daily gain was observed for the same age group by Singh et al. (2001) (339 g), Lohakarae et al. (2006) (337 to 367 g), Ahamed et al. (2004) (470 g) and Muthuramalingam et al. (2011) (320 to 47o g). This shall be due to the higher initial birth weight and initial body weight. Contrary to the present findings, no positive influence on average daily gain due to garlic supplementation was observed in growing lambs by Bampidis et al. (2005).

Feed intake. The average daily dry matter intake ranged from 0.95±0.01 to 2.03±0.10 kg from first to fifth month of experimental trial for the treatment group (T_1 and T_2) and the same ranged from 0.92±0.02 to 1.98±0.70 kg for calves in the control group (T_3). Statistical analysis revealed no difference between the treatment and control groups. This shows that garlic supplementation has not influenced the feed intake in calves. In concurrence with the present findings Horton et al. (1991) in wether lambs. On the contrary, Holden et al. (1998) and Cullen et al. (2005) in growing pigs observed that garlic supplementation significantly reduced the feed intake, whereas Ghosh et al. (2010) in crossbred calves.

Feed conversion efficiency. The feed conversion efficiency for the treatment groups from first to fifth month of experimental trial in treatment group (T_1 and T_2) and control group (T_3) ranged from 3.85±0.11 to 8.02±0.44 and 4.14±0.10 to 8.52±0.29, respectively. Statistical analysis had no difference in feed conversion efficiency between the treatment groups implying garlic supplementation has not influenced the feed conversion efficiency. It was in line with Bampidis et al. (2005) on growing lambs. However, Ghosh et al. (2010) in crossbred calves, Cullen et al. (2005) in finishing pig and Baltini et al. (2011) in broiler chicken

observed significant improvement in feed conversion efficiency due to garlic supplementation.

Faecal consistency score. The faecal consistency score ranged from 1.00±0.00 to 1.75±0.17 for the calves in the treatment groups (T_1, T_2 and T_3). There was no significant difference in faecal consistency score between the three different treatment groups. Thefaecal consistency score observed in the present study is in agreement with the findings of Di Francia et al. (2008) in buffalo calves. However,Ghosh et al. (2010) observed a higher faecal consistency score of 2.06 in garlic supplemented crossbred calves.

Faecal egg count. The faecal egg count (EPG) remained the same in crossbred calves of all the treatment groups suggesting that garlic supplementation had no influence on gastro intestinal parasites. Burke et al. (2005) also observed that garlic lacked control over gastro intestinal nematodes in goat and lambs.

Disease incidence. No incidence of diseases was observed during the entire experimental trial period. This shall be attributed to proper housing, scientific feeding and health care (timely deworming and vaccination) management.

Conclusion

The study was carried out to find the effect of different methods of garlic supplementation on the growth performance of crossbred calves. No significant difference in body weight was observed between garlic supplemented and non-supplemented calves from 1st to 10th fortnight. However garlic supplemented calves had significantly higher overall body weight gain than the non-supplemented calves. No significant difference was observed in body weight between the calves supplemented with garlic through feed and water. The garlic supplemented calves had significantly higher overall average daily gain in body weight than the non-supplemented calves. There was no difference in feed intake between the treatment groups implying that garlic supplementation had not influenced the feed intake in calves. Statistical analysis revealed no difference in feed conversion efficiency between the experimental groups.Statistical analysis revealed no difference either in faecal consistency score or in faecal egg count between the treatment groups indicating that garlic supplementation had no effect on gastro intestinal parasites. From the above study it can be concluded that garlic supplementation resulted in improved growth rate of crossbred calves. However no significant difference was observed in growth rate between calves supplemented with garlic through water and feed. Garlic supplementation had not influenced feed intake, feed conversion efficiency, faecal consistency score, and faecal egg count.

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