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Performance of crossbred calves with dietary supplementation of garlic extract

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Garlic exerts antibacterial activity due to its constituents like thiosulfinates, including allicin which has been explained as a reaction between thiosulfinates and SH groups of essential cellular proteins (Small *et al*. 1949) including bacterial enzymes, thus interfering with bacterial cell metabolism. Garlic also exerts positive effect by additional constituents present in it including steroidal glycosides (Matsuura *et al*. 1988), lectins (Kaku *et al*. 1992), prostaglandins, fructan, pectin, essential oil, adenosine, vitamins B-1, B-2, B-6, C and E, biotin, nicotinic acid, fatty acids, glycolipids, phospholipids, anthocyanins, flavonoids, phenolics and essential amino acids (Fenwick and Hanley 1985). The present study was conducted on crossbred calves at their pre-ruminant stage to see the effects of feeding garlic extract on their performance (body weight gain, feed intake, feed conversion efficiency, fecal score and fecal coliform count) and feed cost of rearing.

The study was conducted at the Dairy Cattle Farm of the Institute. A total of 12 newborn crossbred (HF cross) calves (5-day-old) weaned just after birth were randomly allotted equally into 2 groups and were maintained up to 2 months of age (pre-ruminant stage). Treatment group was supplemented with garlic extract 250 mg/kg BW/day/calf, which was mixed with the milk once in the morning, whereas control group did not receive any such supplementation.

Housing and feeding: The calves were housed in individual pens in a naturally ventilated barn with open area in one side containing water trough. The shed was provided with concrete flooring, covered partly by roof and partly open for free movement. The feeding schedule followed during the experiment is as follows: whole milk fed to the calves @ 1/10th of body weight (BW) up to third week, 1/15th of BW up to seventh week and 1/25th of BW in the eighth week of study; skim milk fed to calves at the 1/25th of BW from fourth to seventh week and then 1/15th of BW on eighth week of study; concentrate fed at the rate of 120 g/calf/day from fourth week to seventh week and 250 g/calf/day at eighth week of study. Green fodder (oat; *Avena sativa*) was supplied at the rate of 700 g, 750 g, 850 g, 1000 g and 1100 g/calf/day at 4, 5, 6, 7 and 8 week of study, respectively.

Garlic extract supplementation: The calves of the treatment group were supplemented with 250 mg/kg BW/day/calf garlic extract from 5 days to 2 months of age (pre-ruminant stage).

Preparation of garlic extract: Garlic bulbs were purchased from local market of Karnal and stored at 4°C. They were weighed then sterilized distilled water was added in the ratio of 1: 2 weight/volume. And then paste was formed in an electrical mixer which was filtered through muslin cloth and filtered liquid was used.

Data recorded: Body weight (BW) was recorded at weekly interval in morning hours before morning feeding. Feed intake (whole milk, skim milk, concentrate and green fodder) was measured twice daily. Proximate composition of feeds and fodder was analyzed at weekly intervals (AOAC 1990). Fecal scores based on a four-point scale were recorded daily as per Larson *et al*. (1977).

Fecal coliform analysis: Rectal fecal samples were collected at weekly interval. Sterile gloves were used to obtain 3 to 5 g of feces following perianal cleansing with dilute Betadine solution. The sample was placed in a sterile disposable petridish, refrigerated, and transferred within 30 min to the laboratory for colifom investigation. For determination of coliform counts, 1 g samples were diluted in 99 ml sterile phosphate buffered saline (pH 7.2) and mixed for 5 min with a magnetic stirrer. Serial dilutions up to 1: 10^6 were prepared from this mixture. Each dilution was plated on Violet Red Bile Agar medium and incubated for 24 h at 35°C (FDA 1998). The number of organisms were expressed as $\log_{10}$ colony forming units (CFU) per gram of feces.

Data were analyzed by standard procedures of analysis of variance to ascertain whether significant differences in the measurements were due to treatment.

Mean body weight gain/calf/day, feed intake and feed conversion efficiency: The mean body weight gain/calf/day

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Table 1. Composition of feed items on dry matter basis

Items	DM%	CP%	TDN%
Whole milk	14.27	3.12	16.05
Skim milk	9.57	2.67	9.14
Concentrate mix.	90.01	20.31	70.16
Green fodder (oat)	23.05	5.93	53.22

in treatment group was significantly (P<0.01) higher than control group. The mean dry matter (DM), total digestible nutrient (TDN) and crude protein (CP) intake/calf/day significantly (P<0.01) differed between treatment and control groups. There was no significant difference of feed conversion efficiency (FCE) of DM, TDN and CP intake/kg body weight gain between treatment and control groups (Table 2). The improved body weight gain and nutrient intake in the present study might be due to positive effect exerted by garlic extract on the balance of gut microbial populations (Lewis *et al.* 2003), proper maintenance of liver function (Borek 2001), enhancement of the activities of pancreatic lipase and amylase, enhancement of the titres of digestive enzymes in pancreatic tissue (Rao *et al*. 2003) and antioxidants in garlic extract such as the organosulphur compounds (Gutteridge 1993, Borek 1997). Further feeding garlic resulted in the reduction in crypt depth in the ileum (Demir *et al*. 2003) which result in better absorption of nutrients and thereby better growth and nutrient intake. Similar results were reported like increased feed intake in piglets (Krusinski 2004, Kleczkowski *et al*. 2004); and body weight gain in piglets (Grela *et al*. 2003, Krusinski 2004, Kleczkowski *et al*. 2004) and lambs (Badias and Yaniz 2004). Also in rabbit, feeding dried garlic for 8 weeks resulted in significant improvement in daily live weight gain (El-Wafa *et al*. 2002). However, Lovatto *et al*. (2005) reported that there was no difference in body weight gain between piglets fed diets with or without garlic. In contrast to the present findings, garlic feeding resulted in increased feed conversion efficiency in piglets (Onibala *et al*. 2001, Krusinki 2004) and in rabbit (El-Walfa *et al*. 2002).

Table 2. Least square means of performance of calves supplemented with garlic extract

	Control	Treatment
BW gain/calf/day (g)	223.78^{a} ±24.19	410.43^{b} ±24.74
Feed intake/calf/day (g)		
DM	657.49^{a} ±27.58	765.27^{b} ±34.34
TDN	175.32^{a} ±12.49	196.16^{b} ±13.94
CP	34.04^{a} ±2.45	38.45^{b} ±2.77
Feed conversion efficiency (Feed intake: BW gain) (kg/kg)		
FCE of DM	8.085±1.142	2.231±1.187
FCE of TDN	1.859±0.223	0.569±0.289
FCE of CP	0.362±0.047	0.112±0.049
Fecal score (scale 1 to 4)	2.145^{a} ±0.098	1.270^{b} ±0.096
Foecal coliform count (log CFU^{6}/g feces)	8.389±0.565	4.852±0.986
Feed cost (Rs)/calf/day	45.29^{a} ±0.91	55.01^{b} ±0.81
Feed cost (Rs)/kg gain in BW	240.97 ±16.04	159.23 ±18.02

[a,b] Means within a row with different superscripts differ significantly (P<0.01); BW, body weight; DM,dry matter; TDN,total digestible nutrient; CP, crude protein; FCE,feed conversion efficiency; CFU,colony forming unit.

Fecal score: The mean fecal score was significantly (P<0.01) lower in the treatment group than the control group (Table 2). This may be due to the fact that diets containing garlic extract exert a positive effect on the balance of gut microbial populations (Lewis *et al*. 2003) eliminating pathogenic bacteria responsible for toxin production which causes intestinal hyperactivity, secretion and diarrhea (Giannella 1983). Diarrhoea is one of the important diseases of neonatal calves causing mortality affecting herd health and economy adversely. Better fecal score in the present study associated with lower incidence of diarrhea and due to better calf health and performance. The numbers of suffered calves from diarrhoea in the treatment and control groups were 1 and 4, respectively, during the study.

Fecal coliform count: There was no significant difference in mean fecal coliform count (log CFU/g feces) between treatment and control groups (Table 2), although control group showed higher value than the treatment group. This may be due the duration and small sample size in the present study. However, several laboratory studies indicated that garlic extract had significant inhibitory effect on coliform (Dawit *et al*. 2002, Leuschner and Zamparini 2002, Nikolic *et al*. 2004).

Feed cost/calf/day and feed cost/kg gain in body weight: The mean feed cost (Rs)/calf/day in treatment and control groups was 55.01±0.81 and 45.29±0.91 respectively (Table 2) differing significantly (P<0.01). The mean feed cost (Rs)/kg body weight gain in treatment and control groups were 159.23±18.02 and 240.97±16.04 respectively (Table 2). The feed cost/kg body weight gain in treatment group is lower than that in the control group but they did not differ significantly which might be due to small number of experimental animals.

In conclusion, garlic extract supplementation in the calf's diet significantly improved growth and performance at their pre-ruminant stage. Therefore, garlic extract can be used in the calf's diet for better growth and performance. Moreover garlic extract as feed supplement seems to be practically feasible, economical and can be easily prepared and adopted by the farmers at home.

SUMMARY

Twelve calves (Holstein cross) in their pre-ruminant stage were used to study effect of garlic extract feeding on their performance and they were randomly allotted into treatment and control groups in equal number. Treatment group received garlic extract supplementation @ 250 mg/kg BW/day/calf. Performance was evaluated by measuring average body weight

(BW) gain, nutrient intake (DM, TDN and CP), feed conversion efficiency (DM, TDN and CP), fecal score, fecal coliform count and feed cost of rearing. There was significant increase in average body weight gain and feed intake and significant decrease in severity of scours as measured by fecal score in the treatment group compared to the control group. The results suggested that garlic extract can be supplemented to the calves for better performance.

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