EFFECT OF EXPERIMENTAL INFECTION WITH STOMACH WORM (*Haemonchus contortus*) ON THE PRODUCTIVE PERFORMANCE OF DOES

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Summary

Comparison of body weight changes of does infected with *Haemonchus contortus* (treatment groups 2 & 3) and uninfected does (control group) was made using weekly body weight measurements over 35 weeks. The animals in treatment group 2 weighed significantly ($p < 0.05$) less than animals in the control group from the 5th week to the end of the experiment. Does in treatment group 3 had significantly ($p < 0.05$) lighter body weight than control does from the 13th week to the end of the study. The animals in control group gained an average of 0.75 kg. On the other hand, animals in infected groups 2 and 3 lost an average of 3.90 kg and 4.13 kg body weight, respectively. The animals in groups 2 and 3 also had significantly ($p < 0.05$) lower preslaughter and hot carcass weights than the controls.
(**Key Words** : Experimental Infection, Effect, Productive Performance, *Haemonchus contortus*, Doe)

Introduction

The goat is an important source of food and income for small farmers in tropical areas of the world (Devendra, 1981). In India, Pakistan, Bangladesh, Malaysia and some other parts of East Asia, goat meat fetches the highest meat price and is surpassed only occasionally by top quality pork (Devendra and Burns, 1970; Wahid, 1970). *Haemonchus contortus,* a nematode parasite occurs in the abomasum of sheep and goats. It is of major economic significance to the sheep and goat industry (Soulsby, 1982). It is a predominant gastro-intestinal parasite of goats in the hot, humid areas. Worm infections occur when climatic conditions are favorable and parasites can adversely affect productivity of infected animals (Albers et al., 1989). Despite earlier indications that this parasite could cause substantial losses (Jeffcoate et al., 1988; Leyva et al., 1982), no work has been done to quantify these production losses especially in terms of body weight and hot carcass weight of does.

The experiment reported here investigated the effect of *H. contortus* infection on the body weight and hot carcass weight of 2 groups of experimentally infected does.

Materials and Methods

This study was conducted at the Institute of Animal Science Farm, University of the Philippines at Los Baños, College, Laguna, Philippines. A uniform group of 12 does (adult female goats) aged between 3.5 and 5.0 years was used in the study. The animals were randomly allocated into three treatment groups: $T_1 = 0$ infection (control), $T_2 = 15,000$ infective *H. contortus* larvae and $T_3 = 30,000$ infective *H. contortus* larvae.

Each animal in the treated groups was fed orally with a single dose of the prescribed level of infective larvae in 10 ml physiological saline solution. The animals were fed uniform concentrate mixture at equivalent to 1% of liveweight. The mixed feed was compounded using copra meal (50.5%), tricalcium phosphate (1.7%), rice bran (29.5 %), molasses (15.2%), urea (1.0%), salt (1.0%), limestone (1.0%) and vitamin-mineral (0.1%). Napier grass (*Pennisetum perpureum*) and Guinea grass (*Panicum maximum*) were offered *ad libitum* to satisfy the dry matter requirement of the animals. The animals were housed in individual pens with concrete floors. Strict cleanliness and hygienic measures were adopted to ensure that adventitious infections with nematode parasites did not occur.

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Haemonchus contortus infective larvae were obtained by culturing the feces of kids harboring monospecific infections of the parasite. Counts of parasite eggs in feces of all goats were determined before the experimental infection and thereafter at two weeks intervals. The modified method of Gordon and Whitlock (Gordon and Whitlock, 1939) was adopted. The number of eggs within two ruled areas of McMaster's slide was counted and the number was multiplied by 50 to represent the egg per gram (EPG) of feces.

Body weights were taken weekly for 35 weeks and prior to the slaughter of the animals. The weight of the eviscerated carcass was recorded for all treatment groups. Immediately after slaughter, the animal was skinned and the head, lower limbs and all viscera were removed. The dressed carcass including kidneys and liver was weighed. Postmortem worm counts of the abomasum of all animals were made using a standard method.

A split-plot-in-time analysis of variance was used to test for differences between different levels of larval infection, time periods and larval infection by period interaction. Comparisons based on the least significant difference at $p = 0.05$ were made between the means of T_1, T_2 and T_3 at each time period.

Results and Discussion

Body weight

Weekly body weight measurements were compared to evaluate the body weight changes of infected and uninfected does (table 1). The analysis of variance for this variable indicated significant ($p < 0.01$) interaction effect of stomach worm infection and duration of infection on body weight. There were no significant differences in body weight among groups from the 1st to the 4th week postinfection. From the 5th week to the end of the experiment the does in treatment group 2 registered significantly ($p < 0.05$) lighter body weight than the control group. On the other hand, does in treatment group 3 showed significantly ($p < 0.05$) lighter body weight than that of controls from the 13th week to the end of the study. However, animals in the infected groups (2 and 3) did not show significant ($p > 0.05$) differences in body weight throughout the study period.

The data on body weight changes are summarized in table 2. There were no significant ($p > 0.05$) differences in initial body weight of does among the treatment groups. At the end of experiment, the animals in control group gained an average of 0.75 kg. On the other hand, animals in treatment groups 2 and 3 lost an average of 3.90 kg and 4.13 kg body weight, respectively.

TABLE 1. AVERAGE WEEKLY BODY WEIGHT (kg) OF DOES AS AFFECTED BY DIFFERENT LEVELS OF STOMACH WORM (*Haemonchus contortus*)

Time (W)	Body weight		
	T_1 (0 larva)	T_2 (15,000 larvae)[1]	T_3 (30,000 larvae)[1]
w1	20.05^{efA}	18.30^{a-fA}	18.30^{aA}
w2	19.80^{efA}	17.95^{b-hA}	18.20^{abA}
w3	19.78^{efA}	17.86^{b-iA}	18.25^{aA}
w4	19.78^{efA}	17.56^{e-jA}	18.18^{abA}
w5	19.90^{efA}	17.35^{d-kB}	18.10^{abAB}
w6	20.05^{efA}	16.93^{f-lB}	17.88^{abAB}
w7	19.95^{efA}	16.63^{g-mB}	17.78^{abAB}
w8	19.68^{fA}	16.45^{i-mB}	17.70^{abAB}
w9	19.43^{fA}	16.23^{i-nB}	17.50^{abAB}
w10	19.48^{fA}	16.08^{k-nB}	17.33^{abAB}
w11	19.48^{fA}	16.08^{k-nB}	17.25^{abAB}
w12	19.55^{fA}	16.23^{i-nB}	17.25^{abAB}
w13	19.60^{fA}	16.43^{i-mB}	17.00^{abB}
w14	19.63^{fA}	16.53^{h-mB}	16.85^{abB}
w15	19.98^{efA}	16.73^{g-lB}	16.85^{abB}
w16	20.05^{efA}	19.88^{f-lB}	16.88^{abB}
w17	20.15^{efA}	17.03^{e-lB}	16.80^{abB}
w18	20.35^{defA}	17.20^{e-kB}	16.90^{abB}
w19	20.25^{defA}	17.38^{d-kB}	16.70^{bB}
w20	20.35^{defA}	17.60^{e-jB}	16.80^{abB}
w21	20.53^{defA}	17.76^{e-iB}	16.95^{abB}
w22	20.85^{e-fA}	18.08^{b-gB}	17.10^{abB}
w23	20.80^{e-fA}	18.25^{a-fB}	17.28^{abB}
w24	20.93^{e-fA}	18.45^{a-cB}	17.30^{abB}
w25	21.20^{b-cA}	18.73^{a-dB}	17.43^{abB}
w26	21.63^{a-dA}	18.98^{abcB}	17.43^{abB}
w27	22.10^{abcA}	19.23^{abB}	17.65^{abB}
w28	22.50^{abA}	19.25^{abB}	17.75^{abB}
w29	22.88^{aA}	19.63^{aB}	17.85^{abB}
w30	19.85^{dfA}	15.63^{l-eB}	14.75^{eB}
w31	19.90^{efA}	15.30^{mneB}	14.65^{eB}
w32	20.20^{defA}	14.98^{neB}	14.45^{eB}
w33	20.40^{defA}	14.63^{eB}	14.30^{eB}
w34	20.55^{defA}	14.55^{eB}	14.28^{eB}
w35	20.80^{e-fA}	14.40^{eB}	14.18^{eB}
T-Mean	20.35	17.06	16.91

[1] Average of four replications. Means in the same column with a common small letter, and in a row with similar capital letter are not significantly ($p > 0.05$) different.

The body weights of treatment group 2 animals were significantly lower than those of the controls at the time

TABLE 2. SUMMARY OF BODY WEIGHTS CHANGES, DRESSING PERCENTAGE OF DOES AS AFFECTED BY DIFFERENT LEVELS OF STOMACH WORM (*Haemonchus contortus*)

Treatment (T)	Initial weight[1] (kg)	Final weight (kg)	Total gain[1] (kg)	Total loss (kg)	(%) loss
T_1 (0 larva)	20.05	20.80a	0.75b	0.00a	0.00a
T_2 (15,000 larvae)	18.30	14.40b	−3.90a	4.65b	595.00ab
T_3 (30,000 larvae)	18.30	14.18b	−4.13a	4.88b	650.00b

[1] Average of four replications. In a column, means with a similar letter are not significantly ($p > 0.05$) different.

of breeding (9th to 11th week). Body weights of groups 1 and 2 increased immediately after breeding. Animals in group 3 had increased body weights 12 weeks after conception. These variations between the animals in two infected groups could be attributed to the difference in level of infection and the increasing weights of fetuses during pregnancy which were consistent with the findings of Jeffcoate et al. (1988). In their study, the infected and uninfected ewes continued to increase liveweight and body condition scores during pregnancy. In the present work, all animals irrespective of the treatment lost weight after parturition. The animals in control group gained weight after 2 weeks of parturition. On the other hand, the animals in treatment groups 2 and 3 did not regain the lost weight, rather, they lost respectively, 3.90 and 4.13 kg of body weight by the end of the experiment. Leyva et al. (1982) found 4.5 kg liveweight loss during a 6 week period in ewes. In this study, postmortem examination of the abomasum and duodenum of animals (control) showed no worm. However, fecal examination showed very small number of eggs in the feces of control does. This indicated that only very small numbers of worms were present in the stomach or intestine. Symons et al. (1981) demonstrated that small numbers of nematodes in sheep were insignificant with respect to production.

Animals in treatment groups 2 and 3 received different levels of infection which resulted in a reduction in overall weight of about 595 and 650%, respectively, of the gain of the control animals in 35 weeks. Coop et al. (1988) estimated that the daily dose rate of 25,000 *Ostertagia circumcincta* larvae would have caused a reduction in overall liveweight of about 20% by week 13 in sheep.

A reduction in body weight due to abomasal parasitism could result not only from reduced digestion of exogenous or endogenous protein but also from increased endogenous losses into the alimentary tract, such as leakage of serum, protein, digestive secretion or cell sloughing (Sykes and Coop, 1977). In the present study, losses of exogenous and endogenous protein might have occurred through the abomasum which resulted to body weight losses. Reduction of food intake was also noticed. However, the reduced appetite did not have any pattern or sequence. As compared to the control, the appetite of all infected animals was found to be lower which could be explained by the irritation of abomasal glands by the worm. In the study of Leland et al. (1960), sheep infected with 100,000 or more *Trichostrongylus axei* larvae showed marked reduction in weight throughout the observation period. They reported that the postinfection weights of all sheep were below than those of the uninfected controls. In the present study, the infected animals registered 3.90-4.13 kg lower body weights than their initial weights as compared with the uninfected controls which did not manifest any weight loss. Rather they gained 0.75 kg at the end of the experiment. Cobon and O'Sullivan (1992) reported that lactating ewes infected with 2,000-3,000 *H. contortus* larvae significantly ($p < 0.01$) reduced the liveweight gain.

Postmortem findings

There was significant ($p < 0.01$) effect of larval infection on post-mortem worm counts (table 3). The abomasum and duodenum of control animals yielded no worms on postmortem analysis. This indicated that the

TABLE 3. AVERAGE POSTMORTEM WORM COUNT OF DOES AS AFFECTED BY DIFFERENT LEVELS OF STOMACH WORM (*Haemonchus contortus*)

Treatment (T)	Worm count[1]		
	Ranks	Means	Recovery (%)
T_1 (0 larva)	3	0.00b	0.00b
T_2 (15,000 larvae)	2	1,137.50a	7.58a
T_3 (30,000 larvae)	1	1,650.00a	5.50a
Mean		929.17	

[1] Average of four replications. Means in the same column with a common letter are not significantly ($p > 0.05$) different.

control animals were harboring very small number of worms in their intestines or no worms in the abomasum. Four consecutive pretreatment and all posttreatment fecal sample analyses showed very low levels of worm infections in the animals of the control group. Animals in group 3 showed a higher number of worm on postmortem examination than the animals in group 2. However, the difference in worm counts between groups 2 and 3 is not statistically significant ($p > 0.05$).

The average preslaughter age and weight, hot carcass weight and dressing percentage are shown in table 4. At the end of the experiment, the animals in treatment groups 2 and 3 had significantly ($p < 0.05$) lower preslaughter and hot carcass weights than the controls. There was no significant ($p > 0.05$) difference for both parameters between the animals in the infected groups receiving two levels of *H. contortus* larvae. Statistical analysis also indicated no significant ($p > 0.05$) difference in dressing percentage of animal in infected and control groups.

TABLE 4. AVERAGE PRESLAUGHTER AGE AND WEIGHT, HOT CARCASS WEIGHT AND DRESSING PERCENTAGE OF DOES AS AFFECTED BY DIFFERENT LEVELS OF STOMACH WORM (*Haemonchus contortus*)

Treatment (T)	Preslaughter age (year)	Preslaughter weight (kg)	Hot carcass weight (kg)	Dressing percentage
T_1 (0 larva)	5.17	20.80a	9.28a	44.79
T_2 (15,000 larvae)[1]	5.05	14.40b	6.64b	46.16
T_3 (30,000 larvae)[1]	5.05	14.18b	6.59b	46.60
T-Mean	5.09	16.46	7.50	45.85

[1] Average of four replications. Means in the same column with common letter are not significantly ($p > 0.05$) different.

Examinations of the abomasum for inhibited larval stages showed no inhibition of larval stages of worms at the end of the experiment. The findings were in agreement with those of Ritchie et al. (1966) who did not find any inhibited larvae in single infection of calf with *Ostertagia circumcincta* larvae. The absence of histotropic stages in the abomasal mucosa after the onset of postparturient rise was in conformity with the results of Brunsdon and Vlassoff (1971). In the present study, chronic nature of the infections meant there was very less chance of inhibition of larval stages. All the worms recovered during postmortem worm collection from each animal at slaughter were examined microscopically and all of them were *H. contortus*. The worm count data (ref. to tables) from the infected does partially supported the view of Brunsdon (1970) that the loss of immunity that occurs in does at the time of postparturient rise is not a reflection of the availability of infective larvae. The inhibited larvae present in the abomasum might have resumed their growth and developed to maturity. Pregnancy, parturition and lactation lowered the resistance of the infected animals (Connan, 1968; O'Sullivan and Donald, 1970). Further, the above stressful physiological stages of animal might have helped mobilized the inhibited stages of worm, if any.

The number of worms recovered during postmortem examination at the end of the experiment was lower than those reported by Leland et al. (1960) in sheep trichostrongylosis. They recovered about 8% of worms from all sheep after 97 days infection. In the present work, the duration of infection was longer and the doses of infections were fewer than those used by Leland et al. (1960). The recovery of these very small number of worms at the end of experiment could be attributed to death and natural elimination of the worms during the course of infection.

Fecal egg count

Results of the fecal egg counts of does in three treatment groups are presented in figure 1. The worms that were fed did not start laying their eggs during fortnight 1. Egg production by the induced worms started during the second fortnight and followed an irregular pattern in 2 groups of infected animals. The EPG of feces of infected groups indicated the patency of infection from 3rd fortnight and irregular fluctuation in egg counts were found till 14th fortnight. From the 15th fortnight the EPG of feces of animals in groups 2 and 3 showed higher values which persisted till the end of the experiment. Some fecal samples of the animals in control and infected groups showed insignificant number of nematode parasite eggs other than *Haemonchus* during the sampling periods.

It may be concluded that *H. contortus* infection significantly lower the body weight gain, preslaughter weight and hot carcass weight in does. Haemonchosis affects the productive and reproductive performances of infected does causing economic loss to the goat raisers in the tropical countries.

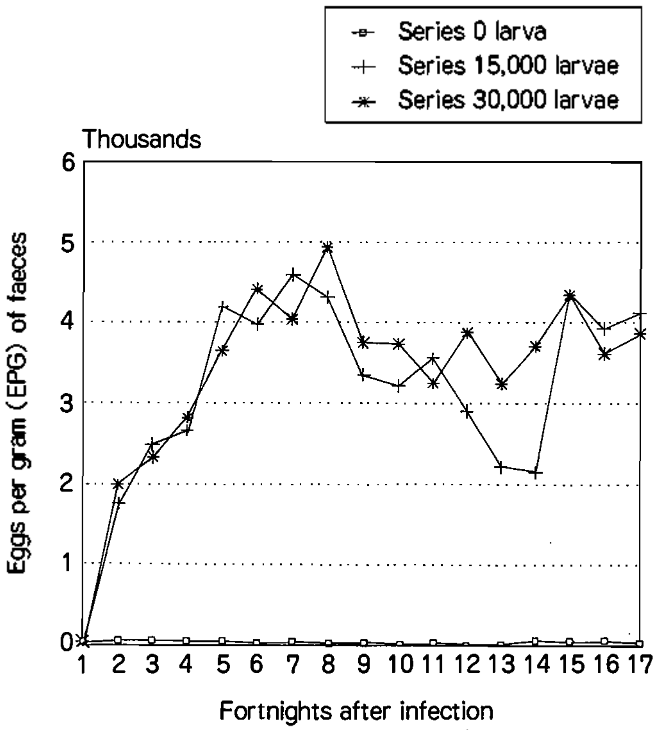

Figure 1. Average fortnightly faecal egg per gram (EPG) of faeces of does as affected by different levels of stomach worm (*Haemonchus contortus*).

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