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EFFECTS OF VAMPIRE BAT CONTROL ON BOVINE MILK PRODUCTION[1]

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Abstract: Milk production and blood indicators were measured in 58 cows from a dairy herd near Quito, Ecuador, and in 28 cows near Managua, Nicaragua, before and after vampire bat parasitism (averaging 2–4 fresh bites per cow per night) was reduced 97–100 percent by systemic treatment of the cattle. After vampire control, blood packed-cell volumes increased ($P < 0.05$) in both herds but milk production and hemoglobin counts increased only in Nicaragua. Severe vampire parasitism has little or no influence on milk production of healthy cows in a mild climate but is detrimental to cows already under stress from poor diet, stressful climate, and other parasites.

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Vampire bats (family Desmodontidae) feed exclusively on the blood of live vertebrates and commonly attack cattle in many areas of Latin America (Acha 1968, Constantine 1970, Ditmars and Greenhall 1935). Bats of the family's 3 genera, especially *Desmodus* (the most abundant), are important carriers of paralytic rabies, considered by many to be the most serious animal health problem in Latin America (Malaga-Alba 1959, Steele 1966, WHO 1966). A survey by the Food and Agriculture Organization of the United Nations showed that about 2 million cattle a year succumb to vampire-borne rabies in Latin America, amounting to a direct annual loss of more than $100 million (Steele 1966, Constantine 1970). Associated indirect losses caused by malnutrition, myiasis, blood loss, and reduced meat and milk production approach a quarter of a billion dollars (Steele 1967, Constantine 1970).

Even where rabies is not present, repeated attacks by vampires are believed to have a debilitating effect on health and production of livestock (Greenhall 1961, 1964, 1968, 1970). Some allege that livestock subjected to frequent attacks by vampires are eventually bled to the point of extreme weakness or pronounced emaciation (Villa 1968, Ditmars and Greenhall 1935, Dalquest 1955).

While such claims are numerous, there is little evidence to support them. To our knowledge, there have been no attempts to measure the effects of vampire parasitism on cattle. Presumably this was due in part to the lack of an effective method of vampire control. Recently, 2 selective and highly effective means of reducing vampire populations were developed (Linhart et al. 1972, Thompson et al. 1972). We used the systemic treatment with an anticoagulant, diphenadione (2 diphenylacetyl-1,3 indandione) (Thompson et al. 1972) to reduce severe parasitism on high-producing dairy cows in Ecuador and on low-producing cows in Nicaragua. We measured the resulting changes in milk production and hematological indicators.

We thank Dr. P. Anhalzer, owner of Hacienda San Antonio, for allowing part of the study to be conducted on his farm and for his kind hospitality during the course of the work. The Ministry of Agriculture of Ecuador, especially Dr. L. A. Narvaez, was most cooperative. The faculty of Veterinary Med-

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METHODS

Study Sites

Ecuador.—Hacienda San Antonio is typical of a well-run highland dairy farm in tropical Latin America. It is located approximately 26 km south of Quito, Ecuador, at 2,600 m above sea level. The climate is ideal for dairying with an average temperature of about 13 C. At the time of the test (June 1974), the herd consisted of 130 Holstein cows. Sound management and husbandry practices were followed and accurate records kept of all phases of the operation. We studied 58 animals from this herd. Average individual milk production exceeded 11 kg a day before vampire control. The cows were healthy and had no ticks, bot fly (*Dermatobia hominus*) larvae, or other apparent parasites or infections. The elevation above sea level was sufficent to minimize hemoparasitic infection. Vampire parasitism averaged about 4 fresh bites per cow per day.

Nicaragua.—Quinta Dora was selected to represent a small dairy operation of the warm lowland regions which are probably more typical of tropical America. It is located at Kilometer 137 on the Matagalpa–Jinotega Highway. Elevation above sea level is 800 m and the average temperature is about 23 C. At the time of the test (May 1975), the herd consisted of 44 mixed-breed cows. Management and husbandry practices were minimal and no production or other records were kept. We studied 28 cows from the herd. They were heavily infested with ticks and bot fly larvae and in general appeared to be in poor condition. Records obtained during the investigation showed that individual milk production averaged 3 kg a day before control. Vampire parasitism averaged about 2 fresh bites per cow per day.

Test Procedure

Milk production of each test animal was measured daily for at least 15 days before and 60 days after vampire control treatment. On the day of treatment, each test cow was carefully examined, fresh vampire bites recorded and 10 ml of blood was drawn from the jugular vein. Then all cows in the herd were treated systemically for vampire control: We estimated each cow's body weight with a cattle weighing tape and injected 2 ml/100 kg of Motomco Suspension Vampiracida Difenadiona (equivalent to 1 mg/kg of diphenadione) into the rumen. (Reference to trade names does not imply endorsement of commercial products by the U.S. Government or its agencies.)

At 30 and 60 days after treatment, test cows were again examined for fresh vampire bites. Posttreatment blood samples were collected during the 30-day examination in Ecuador and during both examinations in Nicaragua.

Packed cell volumes (PCV) were determined with standard microhematocrit procedures. Hemoglobin values were measured with a General Science Corporation (GSC) model MK-9 hemoglobinometer.

Pre- and posttreatment milk production, fresh bite counts, and hematological readings were compared by paired *t*-tests. Values given are accompanied by their standard errors.

RESULTS AND DISCUSSION

Numbers of fresh bites significantly decreased in both groups of animals treated with diphenadione. In Ecuador, the number of bites per cow per day decreased from 4.0 ± 0.5 before treatment to 0.12 ± 0.06 at 30 days after treatment and to 0.07 ± 0.01 by the end of the 60-day observation period, which is a 99 percent reduction. In Nicaragua, bites per cow per day decreased from 2.6 ± 0.4 before treatment to 0 by the end of the 60-day test.

Cows in both herds showed hematological responses to the near-elimination of vampire parasitism. In Ecuador, PCV levels significantly increased ($P < 0.05$) from 33.0 ± 0.5 percent before treatment to 33.8 ± 0.4 percent 30 days after treatment. Similarly, in Nicaragua PCV levels increased ($P < 0.05$) from 28.0 ± 0.4 percent before treatment to 30.2 ± 0.6 percent at 30 days and to 31.6 ± 0.5 percent at 60 days after treatment.

In Ecuador, hemoglobin was 11.3 ± 0.16 g percent pretreatment and 11.5 ± 0.15 g percent 30 days after vampire control, a nonsignificant change ($P > 0.05$). However, in Nicaragua, hemoglobin averaged 12.7 ± 0.2 g percent 30 days after treatment and 12.6 ± 0.3 g percent at the end of the 60-day observation period, which is higher ($P < 0.05$) than the 11.3 ± 0.3 g percent pretreatment level.

The marked decrease in bat attacks and the increases in PCV and hemoglobin were reflected in a significant increase in milk production in Nicaragua but not in Ecuador. Milk production in Nicaragua averaged 3.1 ± 0.2 kg/cow per day prior to vampire control and increased 16 percent to 3.6 ± 0.2 kg/cow per day by the end of the 60-day test period. In Ecuador pretreatment milk production averaged 12.9 ± 0.5 kg/cow per day and did not significantly change after vampire attacks were eliminated. The fact that milk yield did not increase after treatment may be attributed to stage of lactation and persistency of individual cows.

These findings do not support previous reports concerning the debilitating effects of vampire bat parasitism on health and milk production of cattle. While posttreatment increases in PCV and hemoglobin indicate that control had a beneficial effect on health, it should be emphasized that pretreatment hematological values were within normal ranges reported for Holstein and mixed-breed cattle (Schalm 1965). Our findings suggest that healthy lactating cattle are able to tolerate blood loss from severe vampire parasitism without adverse effects on milk yield. This may be explained by the fact that 4 bats, each consuming 25 ml of blood daily, would take less than 0.2 percent of the blood volume of a 500-kg cow. Presumably the erythropoietic capability of bone marrow and spleen is sufficient to offset a daily blood loss of this magnitude. This would appear to be especially true where cattle are well managed and the climate is mild as in the Ecuador study area. Under these conditions, and where bat-borne rabies is not a factor, the economic benefits of vampire control may only be marginal.

On the other hand, under more typical tropical conditions like those in the Nicaragua study area, animals may be under stress, not only from vampire attacks, but from such factors as the extreme climate, inadequate diet, arthropod parasites, and hemoparasitic and other infections. Such animals should exhibit more definite responses when the degree of stress is lessened by eliminating the daily blood loss to vampires. If this is true, it would indicate that control of vampire bats, even when rabies is not present, would be economically beneficial to those ranchers and farmers who need the most help—the small operators with few

animals and the least resources to invest in their care and management.

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