ABSTRACT

This study measured a physiological effect of known horn fly (Haematobas irritans L.) population densities on dairy cattle. Urinary excretion of the catecholamine metabolite, 3-methoxy-4-hydroxy mandelic acid, was an indicator of physiological response to the parasites. Six lactating Holstein cows were acclimated to the test room prior to a 3-wk control at 21°C. Animals were then exposed to approximately 500 horn flies per cow per day for 4 wk. On days 1 and 21 of exposure, two urine samples were obtained from each cow. Mean urinary values for cows were 13.3 ± 3.1 µg/100 ml in the control period and 18.9 ± 3.4 µg/100 ml during fly exposure. We believe that increased vanilmandelic acid reflects an increase in standing time and nervous activity associated with the physical disturbance due to the biting of the flies.

INTRODUCTION

Economic losses from the horn fly, Haematobas irritans, have been estimated at $179 million annually (1). The horn fly pierces the skin to suck blood, causing pain and interfering with the feeding and resting of the animals (9). Only recently have there been observations of animals exposed to horn flies under controlled conditions by Hedlund et al. (8), who reported that horn flies increased standing time and tail switching in dairy cattle.

Von Euler (14) has suggested that urinary excretion of norepinephrine and epinephrine can be an index of stress. However, free urinary norepinephrine and epinephrine represent only a small fraction of released catecholamines. Their inactivation is a function of reuptake or O-methylation to form metanephrine and normetanephrine (11), and further metabolism takes place via deamination to form vanilmandelic acid (VMA) (2, 3). In this paper, changes in VMA excretion are equated with changes in breakdown of catecholamines that may reflect changes in epinephrine and norepinephrine secretion.

The purpose of this study was to assess the effect of a known horn fly population on VMA excretion of Holstein cattle maintained under controlled thermoneutral conditions.

MATERIALS AND METHODS

Six lactating cows from the University of Missouri dairy herd were housed in the Missouri Climatic Laboratory during the experiment and fed an ad libitum diet consisting of 37% corn, 37% cottonseed hulls, molasses, soybean oil, meal, vitamins, and minerals. Alfalfa cubes were fed ad libitum. Temperature and humidity were maintained at 21°C, 65% relative humidity (RH). Initial production ranged from 17 to 23 kg/day. Sixteen days were allowed for acclimation of the cows before the control 21 days began. Treatment consisted of exposure of the cows to approximately 500 flies each for 28 days. The actual number on a given cow at a given time was variable as indicated by Table 1. Urine samples obtained during the control and treatment periods were frozen until analysis. Vanilmandelic acid was analyzed colorimetrically according to the technique of Sunderman (13). Statistical analysis consisted of Student’s t-test.

RESULTS AND DISCUSSION

Effects of horn flies on VMA excretion of lactating Holstein cattle are in Table 1. The
TABLE 1. Effect of horn flies on urinary VMA excretion of lactating Holstein cattle.

<table>
<thead>
<tr>
<th>Cow no.</th>
<th>Avg. no. of flies</th>
<th>Control VMA µg/100 ml</th>
<th>SE</th>
<th>Fly exposure* VMA µg/100 ml</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>674</td>
<td>15.5</td>
<td>1.5</td>
<td>22.0</td>
<td>.2**</td>
</tr>
<tr>
<td>2</td>
<td>608</td>
<td>24.5</td>
<td>.5</td>
<td>29.0</td>
<td>.5</td>
</tr>
<tr>
<td>3</td>
<td>482</td>
<td>10.5</td>
<td>.5</td>
<td>20.5</td>
<td>.5</td>
</tr>
<tr>
<td>4</td>
<td>522</td>
<td>11.5</td>
<td>.5</td>
<td>19.5</td>
<td>.5</td>
</tr>
<tr>
<td>5</td>
<td>405</td>
<td>7.5</td>
<td>.5</td>
<td>13.5</td>
<td>1.0</td>
</tr>
<tr>
<td>6</td>
<td>428</td>
<td>8.5</td>
<td>.5</td>
<td>12.8</td>
<td>.7</td>
</tr>
<tr>
<td>Average</td>
<td>543</td>
<td>13.3</td>
<td>3.1</td>
<td>18.9</td>
<td>3.4</td>
</tr>
</tbody>
</table>

*Five hundred flies per cow per day.
**Average of days 1 and 21 exposure.

VMA values for individual cows and the average number of flies for the exposure period are indicated. Each value represents the mean of four samples. The control values ranged from 7.5 µg VMA/100 ml to 24.5 µg VMA/100 ml with a mean of 13.3 µg VMA/100 ml. The treatment value ranged from 12.8 to 29.0 µg VMA/100 ml with a mean of 18.9 µg VMA/100 ml. The differences due to fly exposure were significant at .05.

There seemed to be a general relationship between average number of flies on the animals and VMA although the data are too limited for correlations. All animals were annoyed continuously by the flies as evidenced by kicking and switching of their tails. Behavioral data reported on these animals by Hedlund et al. (8) showed a positive correlation between fly density and tail switching activity in all cows (r=.58). Milk production was significantly reduced in four of the cows (7). All of these are indicators of moderate physiological disturbance.

Other environmental factors increasing catecholamines are cold (4) and heat (11). Heat and cold (12) and exercise have increased VMA excretion in animals and man (10).

The mechanism by which the flies caused an increase in VMA excretion is not clear. "Blood-letting" in rats increased plasma catecholamines (5). However, those rats were bled from the carotid artery, and the catecholamines probably were secreted in response to the resulting hypotension. Horn flies would not take enough blood to cause a hypotensive crisis in a 600-kg cow although the cows were experiencing discomfort and pain. Possibly the discomfort and pain initiated an emotional or nonspecific type stress response in the cow causing an increase in urinary catecholamines. Such a situation of anxiety seems to occur in human pilots in that VMA excretion was higher in pilots who had less flying experience than others (6). The greater standing time and tail switching of the fly-exposed animals (8) may in some manner influence catecholamines. Regardless of the different neural pathways, increased physical annoyance or disturbance to the animals may be quantified by changes in urinary VMA. This procedure offers promise as a rather sensitive indicator of animal comfort or discomfort in various environmental situations although more data are required before the technique may be used positively as a "comfort index."

REFERENCES

7 Hahn, L., G. D. Thomas, R. L. Harris, H. D.


