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Blood meal size of the horn fly, *Haematobia irritans* (L.), estimated by measuring the feeding time.[1)]

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Abstract

To estimate the blood meal size of the horn fly from the feeding time, the relationship between the former and the latter was investigated under several conditions. The meal size of the fly placed at the ambient temperature of 22°C was much less as compared with that of the flies at above 23°C. The meal size of the female was larger than that of the male at least in the case of the first feeding after emergence. Fly weight had no effect on the meal size. There was no significant difference in the meal size and the time-meal size relation between the individual test and the group test. Since high correlation existed between the meal size and the feeding time in all experiments, the measurment of feeding time can be used for the estimation of the meal size of the horn fly.

Introduction

Since the horn fly (*Haematobia irritans* (L.)), both male and female, is an obligate blood feeding parasite of cattle and uses only blood as the nutrient source throughout their adult life (McLINTOCK and DEPNER, 1954: BRUCE, 1964), it is very important to determine its blood meal size in relation to physiological investigations. The meal size of haematophagous insects has been measured mainly by the gravimetric method and by several other characteristic methods such as radioisotope method (REDINGTON and HOCKMYAR, 1976), hemoglobinometry method (BRIEGEL, *et al*, 1978), HiCN method (SCHOWALTER and KLOWDEN, 1979), and amaranth method (KURAMOCHI and NISHIJIMA, 1980). Estimating the blood meal size of the horn fly by the use of these methods may affect adversely the living flies used for subsequent experiments. Furthermore, those methods are so complicated that it is necessary to develop a new simple method of the meal size estimation in order to obtain physiologically undisturbed flies for subseguent physiological investigations.

In this study, the attempt was made to estimate the blood meal size of the horn fly by measuring the feeding time under several conditions.

Materials and Methods

Insects used The eggs laid by field collected flies in the laboratory were inoculated on

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fresh cow dung and kept in an incubator at 25 ±2°C, about 70% RH and continuous light. The larvae hatched were reared on the cow dung to the adult. Newly emerged adult flies starved for at least 12 hr were used for all experiments.

Measurment of meal size The meal size of the flies was measured individually by the gravimetric method and in a group (5 flies together) by the amaranth method described by KURAMOCHI and NISHIJIMA (1980). In the gravimetric method, the starved flies were sexed and weighed, and then each of them was fed with bovine blood adsorbed in a cotton pad in a vial at 22, 23, 24, 25 or 26°C. In the case of the amaranth method, the starved flies regardless of sex and weight were fed with bovine blood including 0.5% amaranth adsorbed in a cotton pad in a rearing cage at 24 to 26°C. After the beginning of blood ingestion, the feeding was interrupted artificially every 10 seconds in the case of a series of the individual test and every 30 seconds in the case of a series of the group test till 120 seconds later. Soon after each interruption, the flies were weighed or dissected for the determination of quantity of amaranth. Experiments involved at least 5 replicates.

Results and Discussion

Fig. 1 shows the regression lines between the meal size and the feeding time of the horn fly at various temperatures of the individual test and Table 1 describes the reqression equation, the correlation coefficient (r) and *t*-value of the relationships. In all degrees of temperature, r-values of the time-meal size relation were very high and statistically significant ($P=0.01$). There was no significant difference in the meal size and the time-meal size relation among above 23°C ($P=0.01$). However, the meal size at 22°C was significantly less than that at high temperartures above 23°C ($P=0.01$). In the stable fly, *Stomoxys cal-*

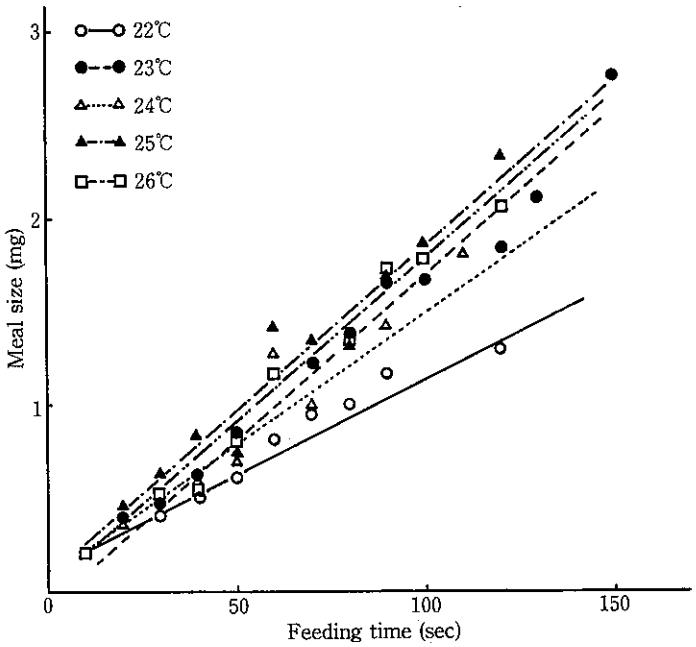

Fig. 1. Regression analysis between the meal size and the feeding time of the horn fly at 22, 23, 24, 25 and 26°C in the individual test.

citrans, no significant difference also exists in the amount of blood ingested at one time above 23°C (SMITH and HANSENS, 1975) and the feeding activity is restricted under 21°C (BAILEY and MEIFERT, 1973). Thus around 22°C may be an important temperature in the feeding behavior of the horn fly. Further studies on the temperature in relation to the feeding habit of the horn fly are needed.

Table 1. Regression equation, correlation coefficient (r) and *t*-value of the relationship between the meal size and the feeding time of the horn fly at each temperature.

Temperature (°C)	Regression equation	*r*	t
22	Y = 0.010x + 0.012	0.97	9.77
23	Y = 0 018x + 0.064	0.98	13.97
24	Y = 0.014x + 0.092	0.94	7.97
25	Y = 0.018x + 0.074	0.98	15.97
26	Y = 0.018x + 0.043	0.99	18.57

In both male and female, the relation between the meal size and the feeding time was statistically significant (Fig. 2, P = 0.01). The meal size of the female was significantly greater than that of the male (P = 0.01) and the time-meal size relation was different between female and male. In the horn fly and the stable fly, it was reported that the meal size of the mature female was larger as compared with that of the male (BRUCE, 1964: SUENAGE, 1965: HARRIS *et al*, 1974: SCHOWALTER and KLOWDEN, 1979: VENKATESH and MORRISON, 1980: KUNZ, 1982). In these experiments, it was also clarified that the meal size of the first female than in the male. Fig 3 shows the regression lines between the meal size and feeding time of the flies different in weight eding time of the flies different in weight (above or below 3.5mg). In both cases, the relationships were statistically significant, but there is no difference in the meal size (P=

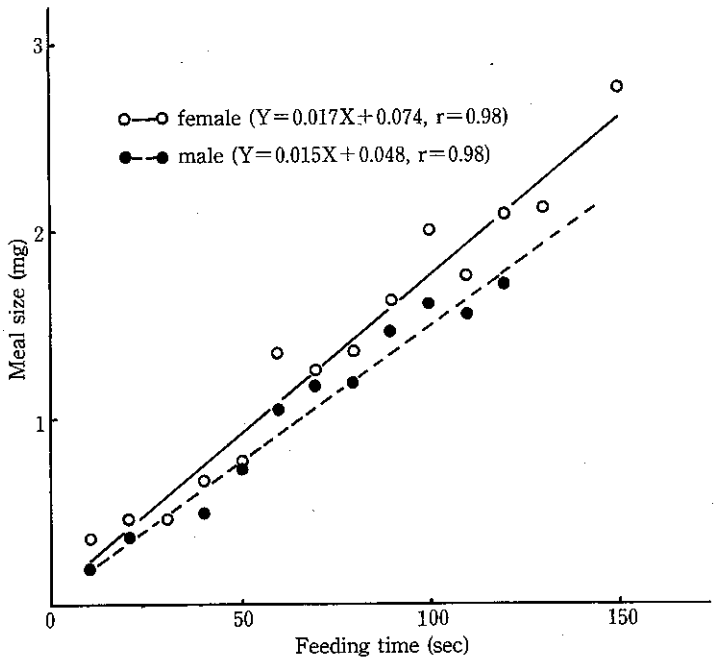

Fig. 2. Regression analysis between the meal size and the feeding time of male and female horn flies in the individual test.

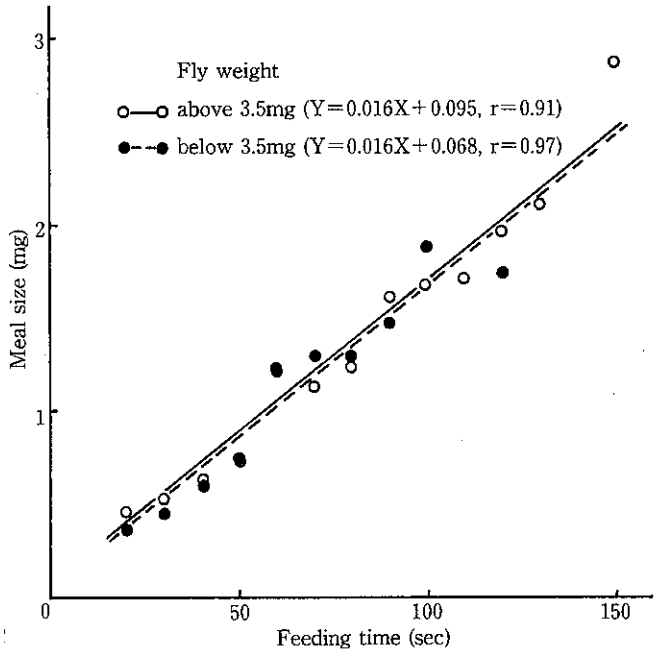

Fig. 3. Regression analysis between the meal size and the feeding time of light weight horn fly (below 3.5mg) and heavy weight horn fly (above 3.5mg) in the invividual test.

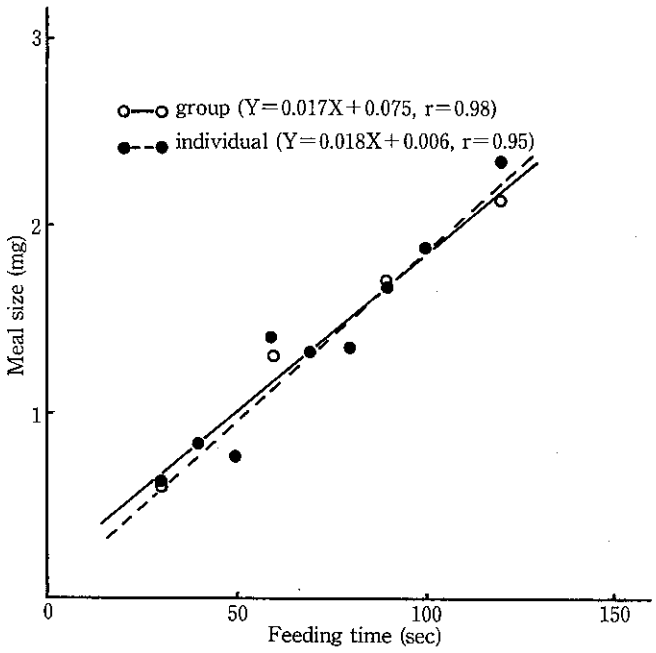

Fig. 4. Comparison of regression analysis between the meal size and the feeding time of the horn fly between the group test and the individual test.

0.01) and the time-meal size relationship between the two groups. So, the fly weight has no effect on the meal size of the fly.

The regression line between the meal size and the feeding time in the group test was shown in Fig. 4. The relation was statistically significant ($P=0.01$). The comparison of the meal size between the individual test (average value of 24, 25 and 26°C) and the group test is also shown in Fig. 4. Since the meal size measured by amaranth method is 105% of the meal size by the gravimetric method (KURAMOCHI and NISHIJIMA, 1980), the values were revised. There was no significant difference in the meal size and the time-meal size relation between the individual test and the group test.

From these results, the meal size could be estimated by measuring the feeding time of the fly individually or in a group, paying attention to the sex of the fly and ambient temperature. This feeding time method was very simple and had no injurious effect on the physiological conditions of the horn fly. Consequently, this method should be a very useful method for the estimation of meal size of the horn fly which is to be used for subsequent physiological experiments.

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ノサシバエの吸血時間測定による吸血量の推定法

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ノサシバエの吸血量を推定する新しい方法として，吸血時間を測定することによる方法を検討した。室内においていくつかの条件下において実験を行なった。外気温が22°Cの時の吸血量は，それより高い場合に比べて有意に少なかった。羽化後第1回目の吸血においても雌の吸血量は雄のそれに比べて高かった。成虫の吸血前の体重の変化は吸血量に影響をおよぼさなかった。個別的に吸血させた場合と5頭を集団で吸血させた場合の吸血量および吸血時間—吸血量関係に差は認められなかった。すべての実験において，吸血量と吸血時間の間にはきわめて高い直線相関が認められたことから，吸血時間を測定することによる吸血量の推定法は有効な手段であると思われる。

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