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ALIMENTARY, EXCRETORY AND MOTORIAL BEHAVIOUR IN RABBIT AT DIFFERENT AMBIENT TEMPERATURES.*

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ABSTRACT

The alimentary, excretory and motorial behaviour of the rabbit has been studied placing the animals in a cage served by a device allowing on-line registration. The cage was put in a climatic chamber where the ambient temperature was weekly set at 20, 26 and 32° C, to use the studied physiological parameters as indicators of heat stress conditions. The trends along the trial indicated a reduction of about 50% in feed intake and feces excretion as the temperature rised from 20 to 32° C and conversely an increase of about 150 and 110% for water intake and urine excretion respectively. All the variations were statistically significant ($P < 0.01$), and, since they were strongly correlated, the ratio between the negatively correlated ones was suggested to exploit its magnification effect as a better indicator of heat stress conditions, mainly for extension work. In this case, working in industrial systems, the ratio urine/feces, ranging from 1.9 to 5.3 from 20 to 32° C, is the easiest to be recorded, while for rural breedings the ratio water/feces, ranging rom 1.9 to 11.2, is the easiest to be recorded as well as the best among all the indices.

INTRODUCTION

The alimentary behaviour in the rabbit has been formerly quite extensively studied by Prud'Hon and co-workers by on-line registration of feed and water intake (Prud'Hon *et al.* 1972; Prud'Hon *et al.* 1975; Prod'Hon and Goussoupolos 1976; Reyne *et al.* 1979). Their researches, as well as the ones of other Authors (Hornicke *et al.* 1976; Jilge 1980), contributed to a better understanding of these physiological functions under different conditions.

This technique has been later used to monitor variations of the nycthemeral alimentary patterns as a measure of the effect of different stressors and to discriminate among a) *transitory stresses*, fading very quickly, as the ones induced by sudden noises (Finzi *et al.* 1986),

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b) *zootechnical stresses*, lasting at least 24 hours, as the ones induced by changing the cage (Verità and Finzi 1980), which might influence the production, and c) the stresses which must be classified according to their endurance, as the ones caused by transport (Finzi and Verità 1980).

To widen the knowledge on the physiological functions, the on-line recording has been extended to the feces and urine excretion and to motorial activities. It was then considered if these parameters could represent better indicators of stressing conditions and they were studied in relation to increasing ambient temperatures.

MATERIALS AND METHODS

The study was carried out with 4 female New Zealand White rabbits weighing Kg 2.0 ± 0.05, which were singularly housed in a cage located inside a climatic chamber were the relative humidity was maintained constant at 70% ± 5 and the artificial light programmed at 16L:8D. The temperature was set at 20° C, then at 26° C and at 32° C ± 0.5, for one week respectively.

To measure the feed and water intake the suppliers were directly set on amplified strain gauges, allowing a direct weight recording. This represents an improvement over previous devices which utilized an indirect mechanical (Prud'Hon *et al.* 1972; Finzi and Verità 1975) or indirect electronic (Finzi *et al.* 1985) weight estimation system. A normal feeder with small modifications to minimize feed losses was used and for watering it was used a new commercial model. It was made up by a very small cup supplied by a pressure activated valve which eliminated drip losses.

Below the cage a net separated the feces from the urine. The latter ones were canalized to a container, while each 15 minutes the feces were collected in another container by a timed device which revolved the net. Both the containers were set on amplified strain gauges. The cage was suspended at the 8 edges by balanced springs, allowing the oscillations caused by the rabbit movements to close the contacts of two tilt switches adjusted for big (*jumping*) and small (*grooming*) movements respectively.

The signals were monitored continuously by a data-logger and the parameters were recorded at 15 minutes intervals. To optimize the reduction of the occasional variability the data were summed up every three hours (Finzi and Verità 1975).

RESULTS AND DISCUSSION

The observation of empirical data showed that behavioural traits are strictly individual as found also by Horton *et al.* (1974) and, as a consequence, the work up of a general mean tends to hide the true nycthemeral patterns. To allow to properly analyze the effects of treatments, the parameters analyzed in the figures 1-3 are referred to a single subject, taking into account that the other subjects have different individual nycthemeral patterns, but similar

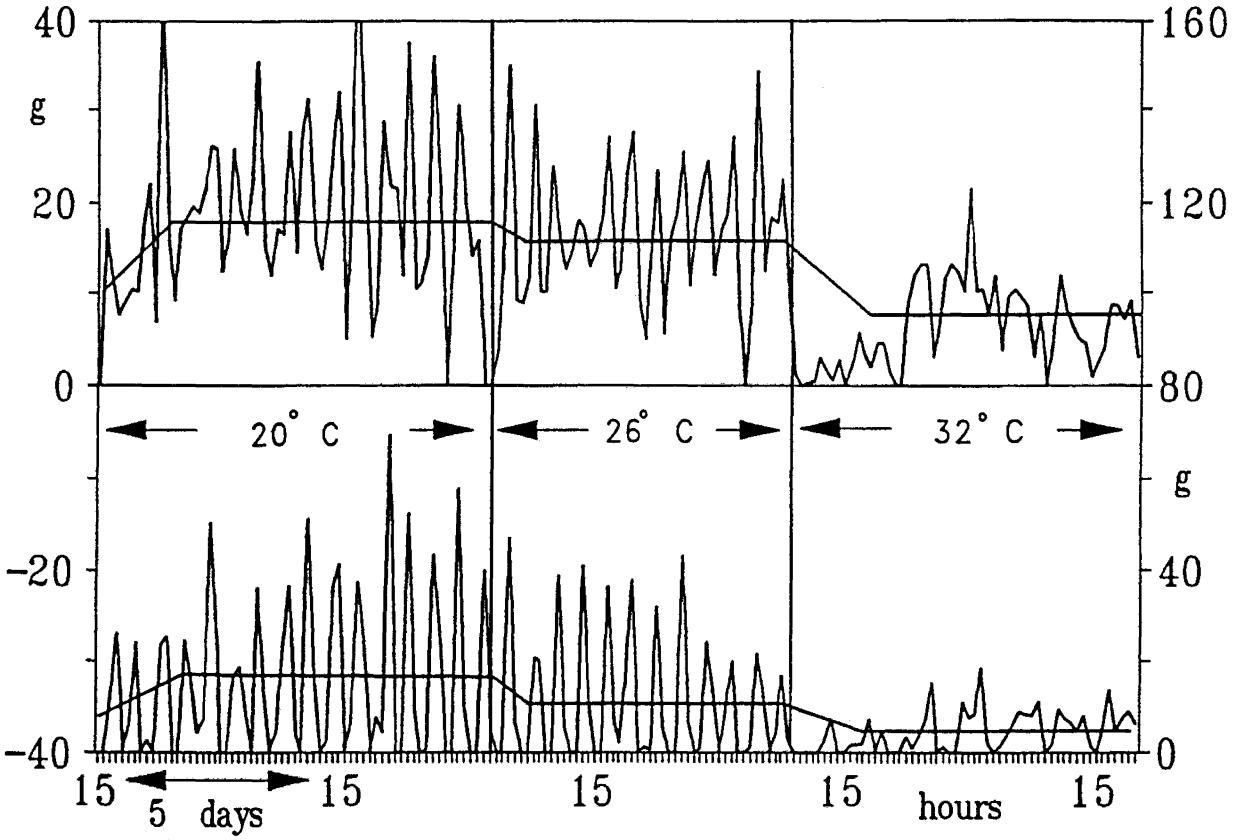

Fig. 1. Feed intake (above) and feces excretion (below).

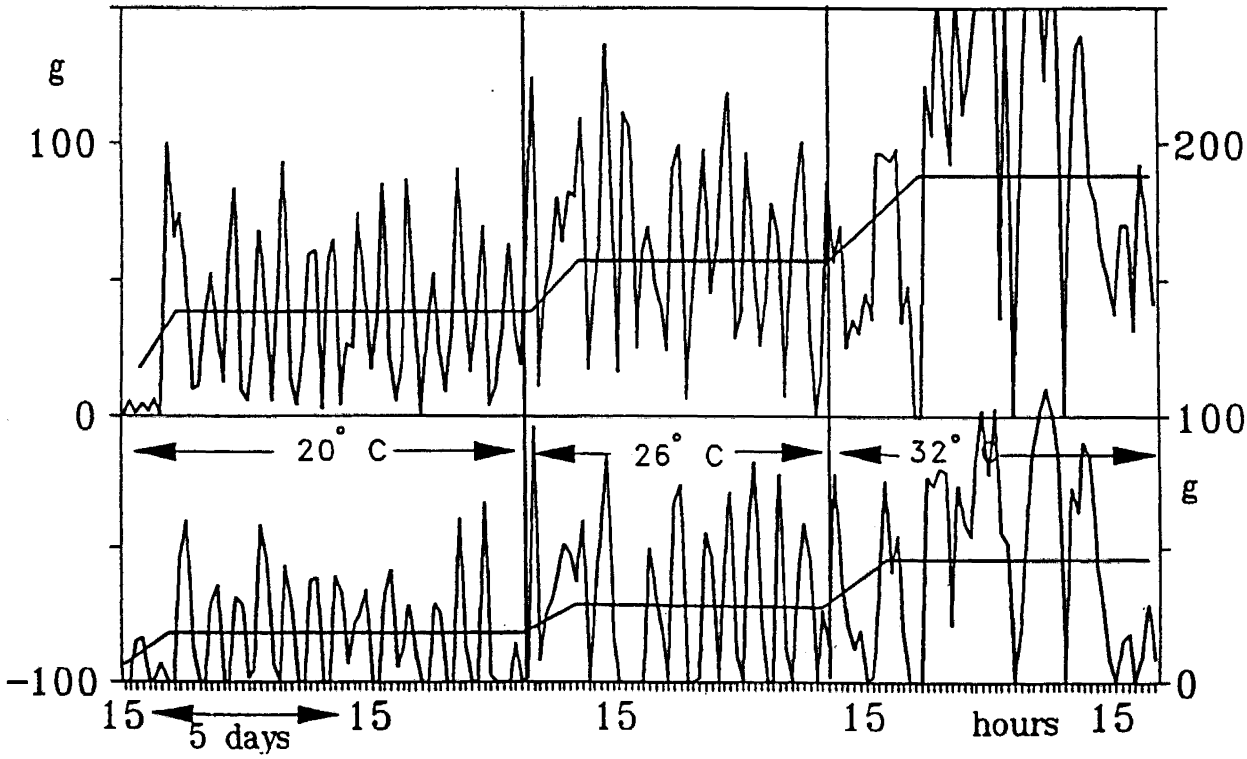

Fig. 2. Water intake (above) and urine excretion (below).

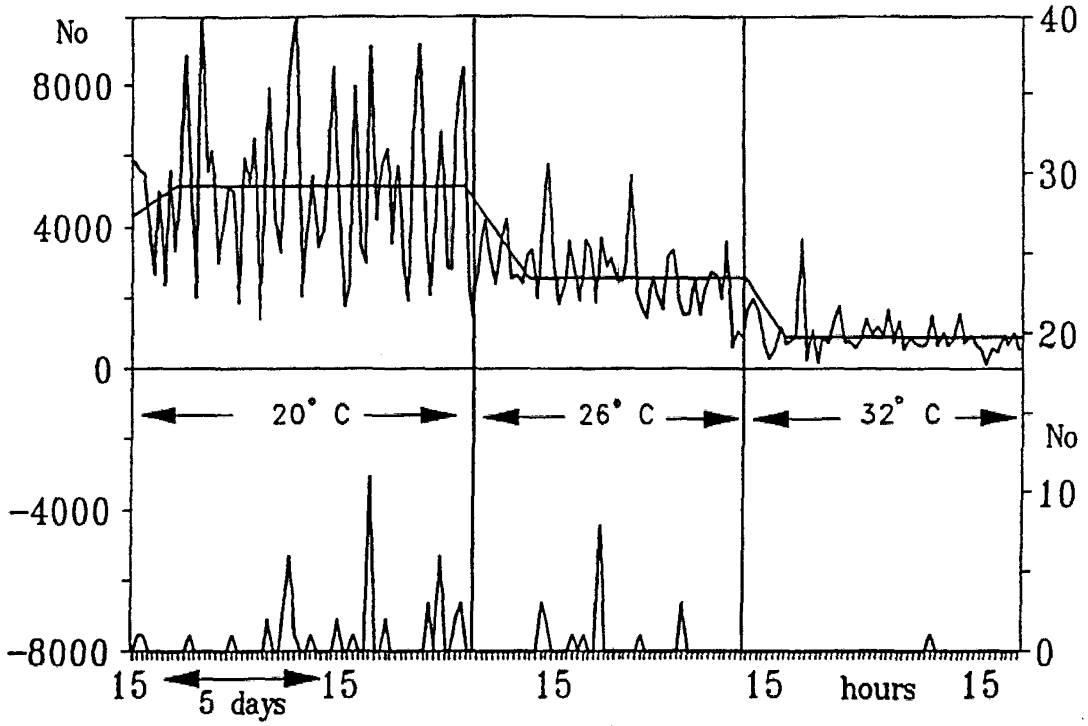

Fig. 3. Small (above) and big (below) movements

general trends if related to treatments. The data reported in the tables are referred to all subjects.

In Fig. 1 the trend of feed intake and feces excretion are reported. Both the parameters decrease as the ambient temperature rises. The opposite happens with reference to water intake and urine excretion (Fig. 2). Before the figures stabilize at a roughly constant level, an adaptative period of 2-3 days occurs. This can be referred, in the first thermal treatment, to an effect of cage changing (Verità and Finzi 1980) and subsequently to the adaptation to new environmental conditions.

The findings show that the well known relationship between feed and water intake (Bagliacca *et al.* 1991) does not hold any longer when the increase of the temperature the animals are exposed to is taken into account. While the animals reduce the feeding activity to minimize the internal heat production, they increase the water intake both to match the higher breathing water losses and to exploit the considerable latent heat of the water, as shown by the increased urine excretion. Beside the variation of the mean values, the nycthemeral patterns loose regularity as the temperature rises.

The figures for the motorial activities (Fig. 3) behave similarly to the ones represented in Fig. 1, but the magnitude of the effect is much higher. The jumping movements disappear completely at 32° C of ambient temperature, while the small movements are reduced to a minimum, which is maintained probably in relation to the increased drinking activity.

All the observed variations, related to increasing ambient temperatures, are statistically significant ($P < 0.01$), thus all the studied parameters can be used as sensible indicators of heat stress conditions. Among them, the most efficient (Tab. 1) are represented by the water intake and urine excretion, that show the highest per cent variation (+150.6% and +111.6%

respectively from 20 to 32° C). After these the best estimators are the motorial activities (-98.3% and -82.3% for the big and small movements respectively).

	20° C	26° C		32° C	
	mean	mean	diff. (%)	mean	diff. (%)
feed	20.7	16.5	-20.4	10.6	-48.7
feces	18.5	10.6	-43.0	7.9	-57.0
water	35.4	57.9	63.6	88.7	150.6
urine	19.9	26.5	33.2	42.1	111.6
big mov.	1.7	0.4	-78.2	0.0	-98.3
small mov.	4815	2261	-53.0	850	-82.3

Table 1. Means and per cent variation of the physiological traits (per cent differences are related to means at 20° C).

A result of the research is the identification of new parameters which, at least in relation to heat stress, are more sensible than the one previously studied and they should be taken into consideration for research purposes.

A measurement of stressing conditions could also be very useful for extension work in field environment, but observations cannot be very precise in this case. Leaving aside the movements that require electronic devices to be monitored, the weight parameters can be registered also in operative conditions. The variation of the parameters related to increasing ambient temperatures are highly correlated between them as shown in table 2 and, since some values are negative, a magnified index can be obtained through their ratio as shown in table 3. It is evident that variations in the range of 300-500% can tolerate also a rough approximation of the measurements.

	feed	feces	water
feces	0.93		
water	-1.0	-0.93	
urine	-0.99	-0.87	0.99

Table 2. Correlation coefficients between the physiological traits.

Field conditions are represented by industrial systems and rural breeding. In the industrial systems water intake cannot be easily measured, while it is possible to weight the feed and the collected feces and urines. The best index in this case is the urine/feces ratio, which rises from 1.1 to 5.5 (+392.6%) when rabbits suffer an increase of ambient temperature from 20 to 32° C.

In the rural breeding it is very difficult to measure the feed intake since different feedstuffs are used, roughage included; on the contrary it is rather easy to measure water intake if containers or siphon bottle systems are used and feces can be collected in a net or even directly from the floor. In this case the ratio water/feces (+483.4%) is not only recommendable, but even the best among all the possible ratios.

ratio	20° C	26° C		32° C	
	mean	mean	diff. (%)	mean	diff. (%)
water/feed	1.7	3.5	105.5	8.3	388.6
urine/feed	1.0	1.6	67.3	4.0	312.6
water/feces	1.9	5.5	186.8	11.2	483.4
urine/feces	1.1	2.5	133.5	5.3	392.6

Table 3. Means and per cent variation of the ratio between the negatively correlated parameters.

When single parameters are used, a hard stressing condition can be assessed when a decrease of about 50% is observed in feed intake or in feces excretion, or when an increase of 100% is observed in urine excretion or of 150% in water intake (Tab. 1).

When ratios are taken into consideration, excluding the ratio urine/feed, which is less workable and less sensible, it can be deemed that the increase of the other ratios in the range of 100-200% indicate a moderate heat stressing condition, while it becomes strong when the ratios rise over 400%.

In the extension work it can thus be assumed (Tab. 3) that when the urine/feces ratio is about 2-3 a moderate heat stress condition is present and when the value rises at about 5 any system able to improve the environment should be applied to maintain the production and even to save the life of the animals if figures are going over this limit. Likewise when the ratio water/feces is considered, a range of 5-6 is revealing a moderate stress, while values over 10 indicate a need of intervention.

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