Evaluation of the Tecniplast E-Chiller™, an electronically refrigerated collection chiller for metabolic cages

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Abstract

Objectives

To determine the performance of a new electronic chiller, E-Chiller™, to keep at a controlled low temperature urine and feces separated through the use of metabolic cages for rats.

Methods

The urine temperature in the collection tubes was measured at the end of each experiment.
Food and water intake, urine and feces output and body weight were measured in Lewis rats with E-chiller in two conditions: up and running or switched off, comparing the recorded parameters in the two scenarios.

Results

The collected samples were effectively kept at 4°C, as set through the instrument. No evident difference in physiological parameters were found between the two scenarios. Animal behaviour seemed to be unaffected by the presence of the E-chiller™ in working condition.

Conclusions

E-chiller™ keeps efficiently and precisely at the set temperature the biological samples collected through the use of Tecniplast metabolic cages. The system does not interfere with laboratory rat physiological parameters, nor do animals show visible signs of stress when E-chiller™ is working.

ANALYSIS

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Introduction

Metabolic cages have been extensively used in lab animal research to run metabolic-related studies across many disciplines, from pharmacology to nutrition through toxicology, and many others.

Once collected and separated, through the use of specifically designed metabolic cages, feces and urine may undergo evaporation, pH modification, bacterial growth or other adverse effects that may affect the results of the research.

Figure 1: Metabolic cages on a rack equipped with traditional chillers.

To avoid this, traditionally, a classic chiller has been used in conjunction with metabolic cages to refrigerate the biological samples collected (Figure 1).

A classic chiller consists of a plastic container filled with a refrigeration liquid that is able to keep a low temperature for a certain amount of time, similar in its idea to the ones domestically used to refrigerate thermos bags.

As a matter of fact, it is of basic importance to remember to refrigerate the chillers in a -20°C fridge the day prior to the beginning of the experiment and overall it is difficult/impossible to guarantee a strict control of the chiller temperature, because the chiller temperature tends to equilibrate to the ambient one.

The new Tecniplast E-Chiller™ (Figure 2) is an electronic device that is able to maintain urine and feces collected by means of a metabolic cage at a pre-set temperature and time. It is possible to set a temperature within the range of 4 to 20 °C, and a time length from 1 minute to infinite and achieve a strict control of it.

Figure 2: the E-Chiller™

Materials and Methods

E-chiller™ (red rectangle in Figure 3) was adapted to a standard rack for metabolic cages (Tecniplast) for rats.

Metabolic cages with one Lewis rat each (weighing 150–300 g) were located around the E-chiller™ plate (light blue shapes in Figure 3).

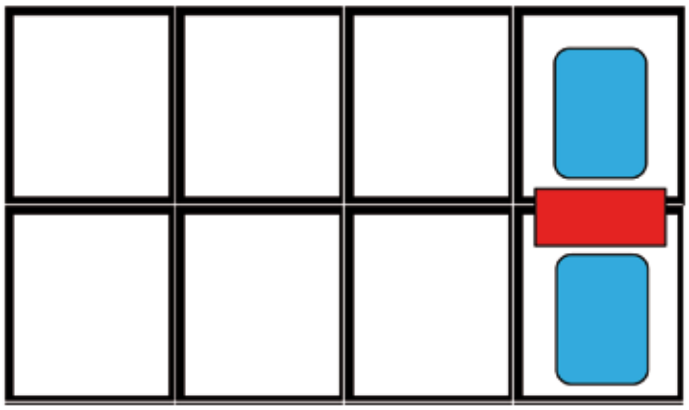

Figure 3. Schematic representation of the rack: red rectangle represents the E-chiller™ and light blue shapes the positions of the metabolic cages with rats.

The metabolic rack with cages and E-chiller™ were positioned in a light-controlled room kept at a temperature of about 22 °C and a relative humidity of 55%, with a supply of filtered pathogen-free air, and food and water ad libitum.

At the end of each experiment that consisted of positioning the rat in a metabolic cage for separation of feces and urine (typically within 12 to 24 hours), the temperature of the collected urine in the E-chiller™ urine tube was measured through a calibrated thermometer.

Also the following parameters have been measured for each metabolic cage on the rack, and recorded: food and water intake, urine and feces output, body weight and behaviour.

The test has been repeated over and over a period of two months in two different conditions: with E-chiller™ functioning and with E-chiller™ switched off.

E-chiller™ was set at a constant temperature of 4°C.

Results

• Food and Water Intake; Urine and Faeces Output; Body Weight:

Metabolic cage (E-Chiller™ in working conditions)					
Rat no.	**Diuresis**	**Water Intake**	**Food Intake**	**Body Weight before metabolic cage experiment**	**Body Weight after metabolic cage experiment**
	(ml/24h)	(ml/24h)	(g/24h)	(g)	(g)
1	10	20	21	445	452
1	10	25	22	450	458
1	10	25	19	480	482
1	8	25	23	493	490
2	10	20	23	433	439
2	10	25	22	444	451
2	8	20	20	468	472
2	12	20	24	487	488
3	11	20	20	-	-
3	10	25	18	483	488
3	11	20	18	486	489
3	10	20	16	488	492
4	10	20	22	-	-
4	10	25	15	462	456
4	9	20	16	459	458
4	10	20	20	462	461
5	10	25	15	418	413
5	8	20	17	435	442
5	9	30	20	438	442
5	10	20	19	440	440
6	10	20	20	445	449
6	12	20	20	485	480
6	10	20	21	486	492
6	10	20	21	492	496
Mean±	**9,92**	**21,88**	**19,58**	**462,68**	**465,00**
SD	1,02	2,88	2,54	23,15	23,01
n	24	24	24	22	22
SE	**0,21**	**0,59**	**0,52**	**4,94**	**4,91**

Metabolic cage (E-Chiller™ switched off)					
Rat no.	**Diuresis**	**Water Intake**	**Food Intake**	**Body Weight before metabolic cage experiment**	**Body Weight after metabolic cage experiment**
	(ml/24h)	(ml/24h)	(g/24h)	(g)	(g)
1	10	30	23	440	445
1	10	25	23	476	488
2	10	30	23	425	436
2	10	20	20	464	465
3	10	30	20	445	445
3	8	20	16	475	480
4	8	30	20	423	420
4	8	20	18	448	452
5	9	30	20	416	420
5	9	20	20	435	435
6	8	30	21	440	448
6	11	20	19	477	481
Mean±	**9,25**	**25,42**	**20,21**	**447,00**	**451,25**
SD	1,06	4,98	2,10	21,49	22,94
n	12	12	12	12	12
SE	**0,30**	**1,44**	**0,61**	**6,20**	**6,62**

• Urine temperature and behaviour:

Urine temperature in the collection tube in the E-chiller™ was measured and found to be effectively preserved at a constant temperature at 4°C (data not shown).

During the daily observations animal behaviour did not seem to be affected by the presence of E-chiller™, irrespectively if in working condition or switched off.

Due to the temperature differential between the E-chiller™ refrigerating block and the room temperature, condensation has been found on the surface of the block housing the collection tubes, but this did not create any issue nor did it affect the results.

Conclusions

E-chiller™ is able to maintain urine and feces at the constant set temperature through time without adding undesired variables or inducing stress to the animals.

No changes in the measured physiological parameters have been detected, independently from the cage position. Food and water intake, urine and feces output of the cages equipped with E-chiller™ were similar to those recorded on the other metabolic cages in different rack positions, irrespectively if E-chiller™ was switched on or off.

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