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BIO-THERMO MICROCHIP

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SUMMARY

Horse temperature was measured with a digital rectal temperature (oral) and a RIFD with Bio-Thermo chip implanted in the left side of the neck muscle on the horse. This two method was then compered whit eight other. The results of this research showed that it was a great variation between the two measurements, but that some horses showed great individual results. These mean that the Variation between the two mesurments was low.

The purpose of this study is to establish whether the implantable RIFD with Bio-Thermo chip can replace the digital rectal temperature thermometer. If the chip proves sufficiently reliable, it can provide a fast and efficient method for ensuring that competing horses are indeed healthy.

My hypothesis is that the implantable RIFD Bio-Thermo chip is a good and easy way to measure a horse's body temperature and can supersede the use of digital rectal thermometers.

INTRODUCTION

The horse is classified as a mammal in the Equidae family, genus Equus. Horses have been in human care from the early stage of human civilization. In Western countries, horses have served man as transport, in agriculture and in wars. (Dalin G. 2006) Today they are used for hobby purposes and competitions. Horses' health is an issue of increasing importance, as good health ensures better performance in competitions.

The normal internal temperature for a horse is 37.6–38.5 °C (99.6–101,13 °F) (Green et *al*. 2005). Deviations from this normal range will indicate that something is wrong. An increase or decrease in temperature may indicate infection. On the competition ground, it's generally hard to establish conclusively that the horse is of sound health. Up until now, the holders of the competition have had to rely on the trainer's word. Fast, reliable and accurate methods of temperature measurement are an essential tool in determining a horse's health condition.

Various techniques exist to measure core body temperature, but most of them are difficult to perform on a regular basis. Methods include measuring by thermistors, thermocouples or radiotelemetric devices surgically implanted in subcutaneous tissues or the cranium. Current practice relies on digital rectal temperature measurement. This method—developed for human medicine and later adapted by veterinaries—is reliable, but time-consuming.

The purpose of this project is to determine whether the thermo chip is a more reliable method for temperature measurements on race horses than the digital rectal thermometer, by comparing measurements on 16 yearlings over a period of several weeks.

THEORY

With just a few minutes of activity, a horse's muscle temperature can increase to 42 ^{o}C. (McCutcheon & Roymon,2008) The horse needs to dissipate the heat it produces. The body solves this by transferring heat to the blood and dissipating it through the skin. The horse's thermoregulation system is controlled by integrated neurophysiological mechanisms, which regulate heat production and heat loss throughout the horse's body. The hypothalamus is the body's own thermostat, receiving messages of overheating from thermal receptors in the skin and via changes in blood temperature (McCutcheon & Roymon,2008). It then returns messages to increase the blood flow underneath the skin. This will increase the skin temperature, and the horse will start to sweat, giving off heat. This cools the blood and hence reduces the internal temperature (Attrell *et al*., 2002).

The horse produces heat through muscle work, ie. biological work (muscle contractions) and internal work (smooth muscle activity, molecular synthesis and cell division). 'Energy expenditure can be expressed this way: Total energy expenditure = internal heat production + external work performed + energy stored in the body' (McCutcheon LJ, Roymon JG 2009). Heat production can increase as much as 50% during periods of intense exercise, as compared to periods of rest (Mahmood MT *et al*. 2007).

The basal metabolic rate is the amount of energy expended by the body in order to maintain normal body temperature. The basal metabolic rate is influenced by factors in the environment, which affect the energy levels and thus the animal's heat balance. Factors include exercise, fever, quantity and quality of feed, water intake, cold environments, running speed, the composition and angle of the running surface, the horse's body weight and the weight of the rider/driver (McCutcheon & Roymon,2008). The metabolic rate and heart rate are lower during sleep and higher during exercise and stress (Assenzena *et al*. 2009).

There are differences in heat production between young horses in the growing phase and older animals(McCutcheon & Roymon,2009). There is a connection between body weight and heat production, but it's hard to define because of size variations within each breed (McCutcheon & Roymon 2008).

This candidate is aware of only one published work that compares rectal temperature measurements of horses' temperature with temperature measurements by implantable microchip transponder (Goodwin.1998). The study compares rectal temperature measurements of goats, horses and sheep, with temperature measurements with a microchip inserted beside the elbow. The authors concludes that measurements made with a digital thermometer were the most reliable. But that microchip proved both handy and easy to use, and the technique is substantially faster than using a digital thermometer for rectal use. The rectal temperature was significantly higher than the microchip measurement, with an average temperature of 37.7 °C comparerd to the microchip average temperature readings was 36.1 °C. Horses and goats showed considerable discrepancies between the methods (microchip vs. rectal, r=0.248). In sheep the correlation was moderately better (microchip vs. rectal, r=0.5315).

Tympanic infrared thermometers have also been tested on horses. The device is inserted into the ear canal. Tests concluded that the method is not really suitable for horses, as many of them resist insertion of the device. However, test results showed some correlation between measurements by digital rectal thermometer and tympanic infrared thermometer r=0,345 (Goodwin, 1998).

MATERIALS AND METHODS

The study encompasses 16 young standard-bred horses (2 years of age), with a body weight of 430–450 kg. All the horses have had uniform conditions, with identical training programs. During the measurement period the horses were exercised 4–5 times a week. The horses spent the nights together in the field, and were taken into the stalls every morning for measurements and health checks. Temperature measurements were recorded at 0630 to 0700 a.m. for 27 days from the onset of October, outside temperatures varied from +5 °C to –5 °C.

Each horse has an implantable a RIFD with Bio-Thermo chip in to the left side in the neck muscle, which provides information on the horse's registration number and muscle temperature. Every morning for 4 weeks, the horses' temperatures were measured with a digital rectal thermometer and the implanted chip. Muscle temperatures were measured after exercise. These measurements were made using the chip only.
RIFD with Bio-Thermo chip contains a passive transporter, a sensor and an integrated circuit that enables a person with a scanner to determine the horses' muscle temperature and verified ID. The scanner displays this information on its screen. All results were collected in Excel tables and processed with the program- Statistical Analysis Systems package 9.2 (SAS Institute Inc. Cary, NC, USA). Values are presented as means ± standard error of the mean.

After collating the data, it became apparent that the first week of measurements yielded substantially different results from the next three. During the first week, deviations between chip and rectal measurements were well within the acceptable correlation range (<0.001). During the subsequent weeks, the deviations increased beyond this range. There seemed to be a distinct possibility that at least some of this increase could be related to inaccurate measurement procedures. Accordingly, a new series of tests were conducted under stricter conditions and personal supervision.

The new measurements were made on three consecutive days, using the same population of horses. Measurements commenced at 0530 a.m., with two persons working through the population twice consecutively. A fresh thermometer was used, inserted 8 cm into the rectum and angled right to assure proper contact with the mucous membrane. Over three days, the procedure yielded 96 rectal measurements and 96 chip measurements. Care was also taken to establish whether the chips had moved through the muscle tissue, and whether this might influence the measurements. In this period, the horses kept in the stables at night and out in the paddock during the day.

RESULTS

Table 1 Average temperature from the first 4 weeks.

Methods	Temperature (mean ± SD) °C	Correlation
Chip	38.19 ± 0.36	0.36
Rectal	38.07 ± 0.45	0.45

Table 2 the second test on 3 days.

Methods	Temperature (mean ± SD) °C	Correlation
Chip	37.79 ± 0.32	0.32
Rectal	37.47 ± 0.26	0.26

Table 3 *Average temperature for 16 horses during the first 4 weeks.*

Horse	Temperature Chip (Mean ± SE) °C	Temperature Rectal (Mean ± SE) °C	Correlation
A	38.3 ± 0.25	38.0 ± 0.22	0.03
B	38.5 ± 0.34	38.2 ± 0.61	0.27
C	38.1 ± 0.22	37.9 ± 0.41	0.18
D	37.7 ± 0.17	38.0 ± 0.19	0.02
E	38.3 ± 0.52	38.2 ± 0.59	0.07
F	38.3 ± 0.21	38.1 ± 0.30	0.08
G	38.1 ± 0.37	37.2 ± 0.49	0.11
H	37.9 ± 0.50	37.9 ± 0.47	0.02
I	38.4 ± 0.16	38.1 ± 0.25	0.18
J	38.0 ± 0.32	38.8 ± 0.29	0.03
K	38.3 ± 0.19	38.1 ± 0.30	0.11
L	38.1 ± 0.28	38.1 ± 0.36	0.08
M	38.0 ± 0.32	38.0 ± 0.36	0.03
N	38.2 ± 0.31	37.8 ± 1.03	0.73
O	38.3 ± 0.29	38.2 ± 0.37	0.07
P	38.1 ± 0.18	38.0 ± 0.17	0.03
Total	**38.1 ± 0.38**	**38.0 ± 0.40**	**0.31**

Table 4 *Average from 16 horses during the second (3-day) measurement period..*

Horse	Temperature Chip (Mean ± SD) °C	Temperature Rectal (Mean ± SD) °C	Correlation
A	38.0 ± 0.06	37.5 ± 0.09	0.34
B	37.9 ± 0.17	37.5 ± 0.08	0.36
C	38.1 ± 0.12	37.6 ± 0.16	0.05
D	37.4 ± 0.30	37.3 ± 0.18	0.23
E	37.8 ± 0.25	37.8 ± 0.23	0.21
F	38.0 ± 0.08	37.6 ± 0.08	0.65
G	38.0 ± 0.08	37.2 ± 0.14	0.89
H	37.5 ± 0.22	37.5 ± 0.15	0.008
I	37.7 ± 0.38	37.4 ± 0.29	0.41
J	37.3 ± 0.38	37.2 ± 0.17	0.01
K	37.9 ± 0.13	37.3 ± 0.10	0.02
L	37.7 ± 0.24	37.4 ± 0.14	0.14
M	37.6 ± 0.14	37.5 ± 0.38	0.01
N	37.9 ± 0.02	37.6 ± 0.16	0.74
O	37.3 ± 0.40	37.0 ± 0.31	0.06
P	37.9 ± 0.05	37.6 ± 0.12	0.29
Total	**37.7 ± 0.32**	**37.4 ± 0.26**	**0.13**

16 yearlings were observed for two periods of 27 days and 3 days respectively, yielding a total of 1056 temperature measurements. The first tap (tap 1) show us the average temperature from the first 4 weeks this show were beyond the acceptable range (<0.001), (R=0.33128). After seeing the results we agreed to make a new attempt to take new measurement, to prove that the first test was right. (*This happen whit 5 months apart*) The second test gave us Average temperature from the last 3 days of measurements, confirming the results from the first tests. The Digital rectal measurements and the chip measurements did not give us the results we wonted. We did find that the chip measurements were more settled when we was looking in to the individual. Tab 3 shows us the results from the first measurement period showed that 2 horses (D and H) had significantly lower coefficients. The second measurement (tab 4) period yielded better results than the first measurements. The horses H, J and M showed better coefficients

DISCUSSION

At present, the normal method for measuring a horse’s temperature is by digital rectal thermometer. This method is quite time-consuming. Each measurement takes one minute. Thus, it will require 1 hour for one groom to measure a stable of 30 horses. This includes getting the horse out of the box, tethering it in a cross tie, making the measurement and returning it to the box. In this day and age, we are always looking for better and faster solutions. Not only is the rectal thermometer time-consuming, but there is an added risk of contamination of the thermometer or the groom’s hands or clothes by disease-carrying bacterial flora.

The implantable chip and its sensor are pleasantly fast and easy to use. There is no need to take the horse out to perform temperature measurements. A drawback is that by not taking the horse out of the box, one may miss subtler signs such as swellings in the legs, small injuries and limps. However, in open spaces such as on a racetrack, this is less of an issue.

The coefficients from the first period of measurements (table 1) were beyond the acceptable range (<0.001), (R=0.33128) giving rise to a suspicion that the method might have been deficient. However, the second measurement period (table 2) yielded similar results (R=0.45569), confirming the results from the first tests.

Although the variation of the coefficients were generally outside the acceptable range, individual horses showed significantly better results. The implant is not located in exactly the same place on individual horses, and it might be that these horses had their chips in places with high blood flow, or had significantly better blood flow overall. Another source of variation may be malfunctioning chips. According to the manufacturer’s own research, there is substantial variation between individual horses, and some chips have turned out to not work at all under certain conditions. (Information provided by Ulf Hedenström, veterinary at Wangen Travskola).

According to these studies, the sensor responds more slowly at temperatures under –25 °C, and the display becomes hard to read. Another survey indicates that the sensor did not detect the actual body temperature as measured by rectal thermometer (Robinson, 2008). This may be an issue in warmer climates than Scandinavia. The same survey showed lower temperature measurements from the chip than the digital rectal thermometer, contrary to this study, where chip measurements have been higher. One reason for this may be that this study was carried out in autumn/winter, while the other tests were made in summertime. To clarify this, further research will be necessary.

Another issue—prompted by recent environmental legislation—is the question of how slaughterhouses should handle horses with implanted chips. Furuset AB in Norway was consulted in the matter, but do not have a solution as yet. Part of the problem is that implanted chips will move around from time to time. The actual lifespan of the Micro Bio-Thermo chip is also uncertain. Again, further research is called for.

This product enables and encourages more people to measure their horses' temperatures on a daily basis, not only when the horses look sick or the day before a race. In the future this method may become an important factor in our race horses' health care.

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