Evaluating Accuracy Rate of Oestrus Detection in Dairy Cow by Pedometer

[1]S. Mosaferi, [2]A. Zali Moghadam, [4]Z. Ostadi and [2,3]V. Khodabandeloo
[1]Department of Clinical Science, Faculty of Veterinary Medicine,
[2]Department of Veterinary Medicine, [3]Young Researchers Club,
Tabriz Branch, Islamic Azad University, Tabriz, Iran
[4]Department of Anesthesiology, Faculty of Medicine,
Tabriz University of Medical Science, Tabriz, Iran

Abstract: Without sensor-aided animal data measuring systems far fewer oestrus cycles are recognized because cycle length, oestrus duration and oestrus intensity have developed negatively at high-animal performance rates. This development makes it eminently clear that observation of the mating season in the dairy cattle sector is even more important than assumed so far if the financial losses due to insufficient herd fertility are not to become a business problem. Electronic identification and measuring systems represent key technologies for progressive automation in animal husbandry in modern, future-oriented livestock farming. Suitable objective measuring systems are needed in animal husbandry to quickly and safely recognize illness, normal oestrus cycle, quiet heat or stress in animals. Pedometers and transponders from various companies play an important role in collecting data from animals and assessing animal health and oestrus. Modem sensors (sensors, bio-sensors) increasingly utilize non-invasive measuring and transfer methods to make crucial improvements in the potential for collecting animal data.

Key words: Oestrus, dairy cows, pedometer, transponder, animal husbandry, Tabriz

INTRODUCTION

Economic efficiency in milk production is influenced by feeding, good health of the herd and high-reproduction results from dairy cows. Undetected or late detection of oestrus or of illness of animals has a negative impact on milk and fertility results as well as serviceable life of the herd. For better herd management in dairy cows, measurements systems with pedometer or transponder for measuring animal's activity are used by farmers the gauges record the movement activity of the cow automatically and continuously.

The ansing impulses are counted, stored and questioned and transferred to the PC about reception units installed in the stable or in the milking stand. Fertilization time should lie in the second half of the matting season.

This one the fertilization 12-20 h is best conception results to obtain if after the mating season beginning is carried out.

The conventional visual mating season observation takes much time and presupposes a high degree of experience. Reduced workers and lacking specialist staff are particularly factors in large-scale enterprises which stand contrary to efficient visual mating season control. In the Dutch studies conducted with altogether 1500 dairy cows, the scientists found an oestrus duration of on average only 8-9 h and in some cases of just 4-5 h (Brehme et al., 2008). The researchers in Blacksburg obtained similar results with 2600 dairy cows. Here, the average mating season duration of the Holstein cows was 7.3 h and of the Jersey cows 8.8 h. It was striking that 30% of the Holstein cows showed a toleration reflex for at most only 4 h. The fluctuations in the cycle length lay between 18 and 25 days (Nebel, 2004). As a consequence of this development often only 50% of the oestrus cycles are recognized and even the best herd managers only discover between two-thirds and three quarters of all cows on heat. This development makes it eminently clear that observation of the mating season in the dairy cattle sector is even more important than assumed so far if the financial losses due to insufficient herd fertility are not to become a business problem.

Be average raises of the activity at the time of the mating season from 30-393% indicated in the literature (Kiddy, 1982; Graves et al., 1997). The mating season observation and the correct mating season reconnaissance influence the reproduction performance

Corresponding Author: S. Mosaferi, Department of Clinical Science, Faculty of Veterinary Medicine, Tabriz Branch,
Islamic Azad University, Tabriz, Iran

of a herd substantially. Nebel *et al.* (1994), Dalton *et al.* (2001) and Randel *et al.* (2004) describe several technical possibilities of the mating season reconnaissance, e.g., regular oestrus observation, regular milk progesterone measurement, heat-mount detectors, pedometers, electrical resistance and change from temperature in milk and body. The safest sign for an oestrus is the toleration reflex. The period of time is between first and last on-jump-tm an average 7.1 h. Becoming in this time on an average 8.5 on-jumps of about 4 sec duration tolerated, respectively. Influence factors with an adversely influence of the intensity of the oestrus are slippers floor covering in loose barn, too little place for the mating season activity, seasonal temperature fluctuations and the time of day and the work in the stable (how animal medical activities, feeding, milk). After examinations and studies of Wangler and Schimke (2001), Brehme *et al.* (2004) and Nebel (2004) up to 70% of milking cows fall in heat between 06.00 p.m. and 06:00 a.m. and respectively 07.00 p.m. and 07.00 a.m. To make the mating season reconnaissance easier, different technical aids were developed, different animal data were measured. Best results in oestrus detection years ago delivered pedometers they report the increased activity to animals in mating season (Maatje *et al.*, 1997).

Electronic identification and measuring systems represent key technologies for progressive automation in animal husbandry in modern, future-oriented livestock farming. Suitable objective measuring systems are needed in animal's husbandry to recognize animals that are ill, ready to mate, in quiet heat or suffering from stress quickly and safely (Maatje *et al.*, 1997). In the examinations to mating season reconnaissance the measuring parameters animal activity and laying time showed the best results. Other parameters in the examinations did not show satisfactory results. This concerns the vaginal mucus conductivity and the body core temperature (Badinga *et al.*, 1985).

Measuring of milk temperature shows a high interest of false positive animals and the results are not usable. The measuring of progesterone is very expensive arid problematic in his precision (Marion *et al.*, 1950; Villa-Godoy *et al.*, 1990).

Construction and operation of ALT pedometers: The mode of operation of pedometers for the measuring parameter animal activity works on the principle of pulse metering. Only the activity rate of the animal which is counted as an electrical impulse is of interest for statements concerning the animal health and the oestrus cycle. ALT pedometers are an animal data acquisition system developed further on the basis of standard commercial pedometers such as have been used for activity or step counting in the dairy cattle sector for approximately 30 years.

ALT is an acronym for activity, lying time and temperature in the pedometer sector. These parameters are measured to detect oestrus and monitor animal health of dairy cows. The decisive advantages of this type of pedometer over the models used at present in cattle management lie in the following characteristics:

- Measuring of 3 animal-specific parameters (activity, ambient temperature at the pedometer, lying time) instead of one feature (activity). Selectable recording interval for recording all parameters in a measuring range of 1-60 min. Continuous acquisition of measured data, storage and manual or automatic data transmission to the PC by means of radio modem
- The high correspondence between the measuring parameters activity and lying time allow a statement to be made early and safely on
- Animal illnesses and the time of the oestrus cycle

The pedometer contains 4 sensors for recording the ambient temperature at the pedometer (SI), the lying positions (S2, S3) and the step activity (S4), the μ processor, the data memory as well as the radio module for wireless data transmission.

The activity is measured using an analogue piezo sensor, the lying time with digital position sensors and a thermal sensor records the ambient temperature at the pedometer. Two lying sensors were integrated since in addition to their normal lying position (belly position with legs folded beneath) cattle also rest in a side position.

The pedometer is attached to the animal by means of plastic or belt webbing with a Velcro fastener at the pastern of a foreleg at the food.

The μ processor records the step activity and lying positions of the animal continuously and adds these together over the measuring interval configured at the start of the test (1-60 min). After expiry of the selected measuring time the value is stored in the memory unit.

The sum of the step activity, the lying time and the ambient temperature forms one data set. The memory capacity of the ALT pedometer is 1178 data sets which are read out cyclically, optionally via manual or automatic (radio modem) operation (Brehme *et al.*, 2004).

Description ALPRO management system: ALPRO is a totally integrated system for monitoring and controlling milk production on a dairy farm each hour, 24 h a day, 365 days a year, it controls feeding, records milk yields, controls cow activity and gives you immediate access to very important information. This information provides help in finding any type of problem that can occur regarding milking, feeding, breeding and health.

All these together are essential parts in your strive towards improved and successful herd management

(DeLavaL, 2001). With ALPRO system, milk producers have total control over a herd of up to 2800 cows. The ALPRO system is built around a system processor connected to feeding stations, milking parlors, identification, cutter gates and soon.

Daily milk yield recording is one of the most important decision aids for fine tuning the herd. It is possible to view the information either through the processor itself or through the MPC which makes it easy to, e.g., compare today's yield with yesterday's and the 7 days average in the parlor. If a cow milks less than expected (depending on the pre-set alarm level), this will automatically be indicated on the MPC in the parlor. Using ALPRO for reproductive management and breeding in combination from milking information and ALPRO activity meters:

- Identify cows in heat. Research shows that decline in morning milk might indicate oestrus
- Cows with potential health problems early by using milk yield, feed intake, peak flow rate, etc.

With the integration of milk recording and feeding, it is possible to compare this data with e.g., manually observed signs of heat. A dairy cow that is in heat normally drops slightly in milk production and might reduce her feed intake. All this can easily be evaluated with the ALPRO system where you have all the information stored in the processor. The system uses a radio link to collect the activity information once an hour. This high number of daily readings in combination with a smart filter ensures that the farmer will get early information which makes it possible to plan inseminations and separations well before a milking session. These benefits together will have a great impact on the dairy's calving interval and overall profitability. To get the best possible heat indications, the ALPRO system provides the herd manager with the following data:

- Activity
- Expected heat date
- Individual feed consumption
- Individual milk yield development

The system also produces an attention list containing valuable breeding information such as:

- Cows due to be inseminated
- Cows expected to be in heat
- Cows to be checked for pregnancy
- Cows to be dried off

- Cows to be steamed up before calving
- Cows that are due to calve

It is evident in all investigations that the ALT pedometer recognizes substantially more oestrus cycles. The proportion of cycles additionally registered lies between 25 and 61%. In a direct comparison with the ALPRO activity meter was ascertained that the ALT pedometers report the incipient oestrus 1 day earlier and show the exact time of oestrus beginning. This is due to the shorter cyclical selection interval of the ALT pedometer. The problem for better results from ALPRO system in the comparison was that the data of the activity meter were taken only twice daily in the milking stand. ALT pedometer will be carried out a data transmission with that considerably more at the within 4 h cycle; therefore 6 times on the day, better and more detailed information for the farmer about the animals is given. An oestrus climax can be recognized by it more exactly and faster through the integrated real watch in ALT pedometer. Changes are also transmitted fast and for certain to the activity with that within the night hours. Table 1 shows the results of both systems and the visual monitoring of the stable staff in the test period.

As a result, it becomes clear that more and more accurate insemination measures can be carried out with sensor-supported data measuring systems. A comparison of the registered oestrus cycles shows this between the technical systems, ALPRO and ALT pedometer and the visual oestrus monitoring by the stable staff in the test time period. The ALPRO system recognized 23 and the ALT pedometer _40_ oestrus cycles. By the visual oestrus monitoring of the stable staff only 17 oestrus cycles could be registered. But it can also be ascertained that the ALT pedometer measuring system with two measuring parameters (activity and lying time) registered in the direct comparison with the system ALPRO with only one measuring parameter (activity) 57, 5% more oestrus cycles in the same period under the same attempt terms.

In particular, the recognition of quiet oestrus proves to be a key area of on-farm visual oestrus monitoring. The analysis shows that different aspects regarding the difficulties in recognizing quiet or weak oestrus can be mentioned here. The number of registered oestrus cycle between 06:00 p.m. and 06:00 a.m. is possible 60%. After the end of the stable working time within the night hours

Table 1: Comparison of three system each other in the oestrus

Accuracy	System
40	ALT system
23	ALPRO system
17	Visual monitoring of the stable staff

no more oestrus monitoring control is made by the stable staff. This is the reason for the low number of ascertained oestrus cycles with the stable staff.

For the whole test period, researchers registered by ALT pedometer system at the experimental animals together 40 oestrus cycles. From it 23 detected oestrus cycles fall in the night period between 06:00 p.m. and 06:00 a.m. These cycles very often are short and not typically distinctive, they called quiet oestrus or silent oestrus and only still seldom stated by the stable staff in the next morning.

The ALPRO system lies with 23 recognized oestrus cycles clearly under the recognition rate of the ALT pedometer, in addition the oestrus announcement from ALPRO system came always 1 day later than from the ALT pedometer. ALPRO only works with a measuring parameter (activity), the data transmission from the actiometer to the PC is carried out when milking only twice daily. The pedometer system transfers the stored measuring data in a cycle of 4 h to the PC or laptop. As a result of reduced oestrus intensity and mating season duration quiet oestrus and shorter, less intensive cycles then no longer recognized. The cycles with weak oestrus intensity or quiet oestrus recognized by ALT pedometer very frequently show oestrus symptoms only under the measuring parameter lying time.

In these phases on an oestrus cycle the cows do not lie down for many hours. The reason is cows in heat have great trouble with her partners in the group. They attack the cow in heat, they will mount the cow and they never get quiet. A cow in heat is restless in this time and do not find time for lie down.

These results you can only see in the values from measurement parameter lying time. In the investigations, it has been found out that cows in heat do not lie down for 6-17 h in time of oestrus cycle.

MATERIALS AND METHODS

To search at dairy cattle containing 900 numbers of cows was done. All reviewed cows were from the number of Holstein. Sucking at mentionable cattle was 3 times in 24 h and the average of produced milk was 30 ± 1 kg. All inseminations were done by insemination officer, settled at the cattle with frozen sperm.

Pregnancy diagnostic at mentionable cattle was done by ultrasonography set in 30th days.

RESULTS AND DISCUSSION

Research on 100 numbers of cows after showing the oestrus by ALPRO system was reviewed by the
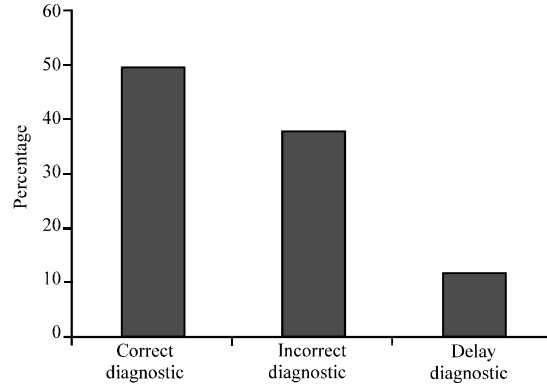

Fig. 1: Comparison of data obtained from ALPRO system

insemination officer that in 100 reviewed items in ALPRO system 50 out 100 were right (correct) diagnostic, 38 out of 100 were incorrect diagnostic and 12 out of 100 diagnostic were shown by delay (Fig. 1).

That in spite of incorrect diagnostic, delayed (diagnostic with delay) is one of the problem of this system that at research (Brehme *et al.*, 2004) low diagnostic ability of ALPRO system in comparison with ALT system and also announcing the oestrus with delay (1 day later) in comparison to ALT system has been shown.

CONCLUSION

From the study, the researchers can pull the following results:

- The development from a new sensor-aided measurement system for improvement in oestrus detection and animal illness for cattle was a right decision
- Through combination from two important physiological parameters, activity and lying time, the researchers might get better results in oestrus detection and animal illness. The higher interdependence and combination of these measuring parameters allows safe and exact oestrus cycle forecasts. The new system also allows early forecasts of animal illness (lameness, metabolic illnesses)
- The researchers recognize more oestrus cycles over the day, the researchers recognize the cycles earlier and faster
- The improved cycle recognition is attributable to the fact that approximately 60% of all oestrus cycles start after the end of the stable work between 06:00 p.m. and 06:00 a.m. Oestrus cycle controls are not conducted continuously during this period on dairy cattle farms

- For better results in fertility and animal health it is significant that dairy cattle farms without technical systems this means extension and intensification of visual oestrus monitoring during evening and night hours too

RFFERENCES

Badinga, L., R.J. Collier, W.W. Thatcher and C.J. Wilcox, 1985. Effects of climatic and management factors on conception rate of dairy cattle in subtropical environment. J. Dairy Sci., 68: 78-85.

Brehme, U., U. Stolberg, R. Holz and T. Schleusener, 2004. Sichere Brunsterkennung mit sensorgestutzten ALT-Pedometer. Landtechnik, 59: 230-231.

Brehme, U., U. Stolberg, R. Holz and T. Schleusener, 2008. ALT pedometer-New sensor aided measurement system for improvement in oestrus detection. Comput. Electronics Agric., 62: 73-80.

Dalton, J.C., S. Nadir, J.H. Bame, M. Noftsinger, R.L. Nebel and R.G. Saacke, 2001. Effect of time of insemination on number of accessory sperm, fertilization rate and embryo quality in nonlactating dairy cattle. J. Dairy Sci., 84: 2413-2418.

Graves, W.M., H.H. Dowlen, K.C. Lamar, D.L. Johnson, A.M. Saxton and M.J. Montgomery, 1997. The effect of artificial insemination once versus twice per day. J. Dairy Sci., 80: 3068-3071.

Kiddy, C.A., 1982. Veterinary Reproduction and Obstetrics Theriogenology. 5th Edn., Bailliere Tindall, London, ISBN-13: 9780702009235, Pages: 501.

Maatje, K., S.H. Loeffler and B. Engle, 1997. Predicting optimal time of insemination in cows that show visual signs of oestrus by estimating onset of oestrus with pedometers. J. Dairy Sci., 80: 1098-1105.

Marion, G.B., V.R. Smith, T.E. Wiley and G.R. Barrett, 1950. The effect of sterile copulation on time of ovulation in dairy heifers. J. Dairy Sci., 33: 885-889.

Nebel, R.L., 2004. Brunsterkennung-mussen wir umdenken. Elite, 2: 40-42.

Nebel, R.L., W.L. Walker, M.L. McGilliard, C.H. Allen and G.S. Heckman, 1994. Timing of artificial insemination of dairy cows: Fixed time once daily versus morning and afternoon. J. Dairy Sci., 77: 3185-3191.

Randel, R.D., R.E. Short, D.S. Christensen and R.A. Bellows, 1973. Effects of various mating stimuli on the LH surge and ovulation time following synchronization of estrus in the bovine. J. Anim. Sci., 37: 128-130.

Villa-Godoy, A., T.L. Hughes, R.S. Emery, E.P. Stanisiewski and R.L. Fogwell, 1990. Influence of energy balance and body condition on estrus and estrous cycles in Holstein heifers. J. Dairy Sci., 73: 2759-2765.