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Efficiency of different activity sensors for monitoring oestrus in dairy cows

Three diifferent activity sensors were tested simultaneously with 30 cows. The sensors were attached to neck and/or ankle and their efficiency for oestrus monitoring assessed. On the basis of the respective management programs daily alarm lists for cows in heat were produced. To objectively judge the actual occurance of oestrus milk samples were regularly taken and ovulation day determined through the progesterone content. By comparing the alarm lists for the increased cow activity with actual oestrus occurence the system-assessment parameters „oestrus detection rate" and „error rate" were determined.

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Keywords

Dairy cows, heat detection, automatic oestrus detection, pedometer, activity sensors

Visual oestrus identification is extremely time-consuming in increasingly larger herds and the result of cows in heat being overseen is penalties in the fertility performance of the herd [1]. Available from several firms for a few years as aids in oestrus identification are electronic step counters (pedometers). These identify activity increases in cows which in turn typically represent an oestrus characteristic. The increase is automatically recorded and through a herd management program gives warning of imminent oestrus. The systems presently on the market differ in technical design and in the algorithms used for further processing of the activity data. Two different systems (from DeLaval and Westfalia Landtechnik) were investigated for efficiency in oestrus detection in a comparison trial [2].

Dairy cow activity recording

The „Rescounter" from Wesfalia represents a combined system which measures cow activity as well as representing an animal identification system. These are offered for attachment to neck or ankle. Through the activity of the animal a mercury drop within a glass tube is moved back and forward between two contacts whereby electrical impulses are activated and then counted. In the „Rescounter" the transmitted activity data is stored under the cow identification and transferred to the management computer where the actual evaluation takes place (*fig. 1*). The „Rescounter" sensor was attached to the left front leg of the cow. The reading and transmission of activity values to the herd management program occurs in the concentrate feeding stations and milking parlour. According to the number of visits to the feeding station and parlour a different number of activity values form the basis for further calculations (i.e. average activity/hour).

In DeLaval's „Activity recorder" a magnetic metal ball lies in a form between two copper contact points. Movement of the ball between the points induces electric current and resulting impulses are counted with data stored. Unlike the „Rescounter" the „Activity recorder" is activated hourly via central antennae with the computer receiving and processing the activity count. Linking to a PC with extended management program is possible. The „Activity recorder" can be fitted to the neckband as foreseen by the manufacturer. However in the trials reported here it was additionally fixed to the right front ankle so that each of the 30 cows was fitted with three activity sensors.

The activity evaluations were produced in the daily automatic alarm lists from the programs. On these lists the cows were identified whose activity values had exceeded a threshold value adjustable in the respective programs and with that indicated a higher than normal activity. With the Westfalia system the threshold adjustment is defined through the standardised deviation while for the DeLaval system percentage figures were given for the threshold. In the trial presented here the Westfalia management program (DP5) applied the value of 2.5 as alarm limit for an increased activity value, for two increased activity values a value of 1.8 was predetermined. In the Alpro Prozess computer 40 % was set as lower limit. The limit values reflected manufacturers' figures.

From all 30 cows over the complete trial period of 110 days milk samples were taken three times per week from which the progesterone content in the skimmed milk proportion was determined. This procedure allowed the precise determination of ovulation to about a day. The heat periods thus determmined were compared with the respective alarm lists out of the program. In this way the efficiency of the system with respect to oestrus recognition rate could be evaluated. This was also described as sensitivity (hit rate) and represented the relationship of correct-positive alarms to the total number of heats. Also calculated were the error rates, i.e. the number of false-positive alarms in relationship to total number of alarms.

Efficiency of oestrus identification from different systems

From the available data 78 were identified with the 30 cows through the progesterone test. The sensitivity and error rates calcula-

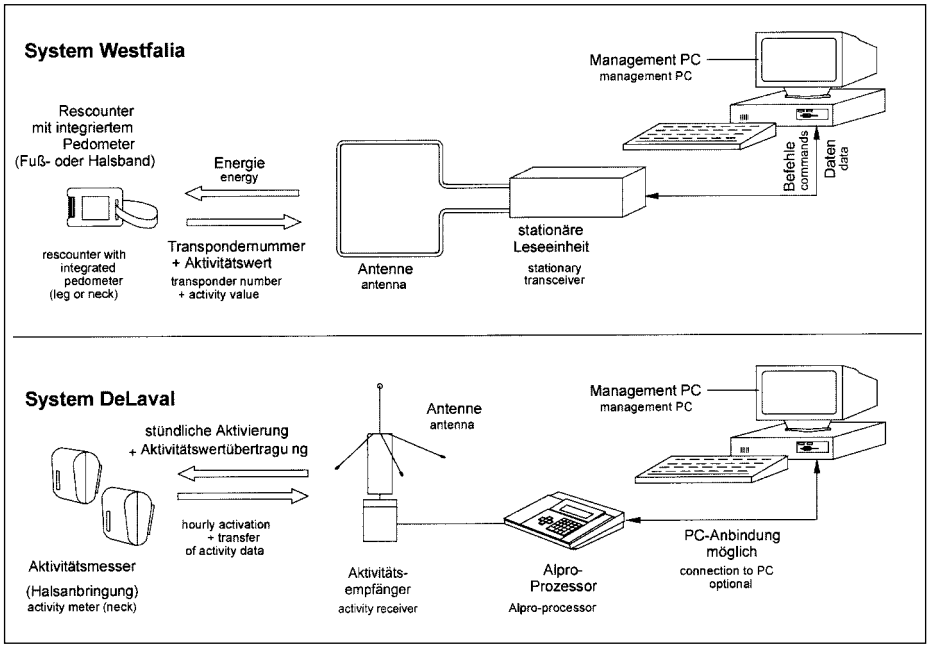

Fig. 1: Principle scheme of electronic activity measurement for dairy cows (systems: Westfalia and DeLaval)

ted for these oestrus periods from the three activity sensors applied are shown in *figure 2*. Whereby the „Activity recorder" detection rates of 78.2% for the neck and 88% for the ankle attachment sensors were achieved. However, definite differences in the eror rates could be determined. Whilst the error rates with the neck-attached „Activity recorder" was 41.3% it was only 29% with the first time investigated ankle attachment of the same system. Observation of both attachment points showed clearly the advantages from ankle attachment. However it must be noted that the „Activity recorder" was not planned for this attachment point so that perhaps technical adjustments might be needed for general application.

A good result was also achieved from the Wesfalia system with ankle attachment with an achieved sensitivity of 91%. Contrary to the DeLaval results, the error rate here lay by 64.3% however. It must be noted that a direct comparison can only be made to a limited extent because of the differing calculation methods and the threshold value adjustments. In order to reduce the error rate higher threshold values should have been fixed for the Wesfalia system.

Conclusions

In general it can be established that an increase in activity during oestrus recorded by sensors at the ankle is better recorded whereas measurements at the neck are more often distributed over a greater band breadth. The sensitivity should never, however, be evaluated without simultaneous observation of the error rate. Thus, high sensitivity can be achieved, for instance, by setting the threshold value very low. However the error rate would then rise over-proportionately. Alongside the possibilitiy of selecting the height of the threshold value, further adjustments can be made through herd and farm specific settings of the respective herd management software. This means that pedometers represent a very good aid for oestrus identification. The threshold setting should be carried out farm-individually so that an as high as possible identification rate can be achieved at the same time a low error rate.

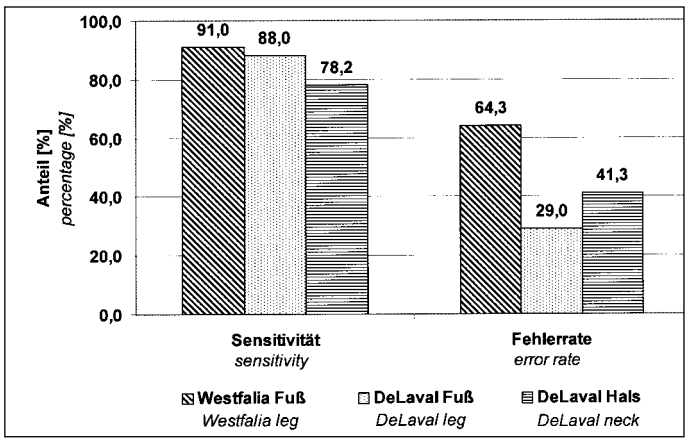

Fig. 2: Sensitivity and error rate of three activity sensors

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