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Sick sows come later to the electronic feeding station – results of a first statistical analysis

Group housing with electronic sow feeders includes often dynamic groups with more than 60 sows per pen. This makes the individual animal control difficult for the farmer. The present investigation analysed retrospectively, how an illness may influence the feeding order at the electronic sow feeder. The research centre Futterkamp provided the station data and information on treatments of sows because of a disease. It could be shown, that sows entered the feeding station later on the day of their treatment compared with other days.

Keywords
Group housing of sows, electronic sow feeders, feeding order, disease, animal health control

Abstract
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The group housing of sows during gestation period with electronic sow feeders (ESF) becomes more and more important. On one hand, this group management system allows the ideal supply for the individual sow and benefits the movement, because the sows have to change between the lying area and activity area with the feeding place [1; 2; 3; 4]. On the other hand, the exchange of pathogens in dynamic groups increased due to the animals' contact with each other. As a result of that diseases and lameness may occur more frequently if the management is wrong [5; 6]. The management of large sow groups demands a very good animal health control by the pig producer. The detection of an illness of an individual animal is possible with the report print-out of the sows. For example, sick sows refuse the feed intake completely, so they don't appear on the protocol at those days [2; 3; 4; 7]. A new approach for the early detection of sick sows may be the statistical analysis of the feeding order at the ESF.

Feeding order at the ESF as a possible indicator

The feeding order is the order, in which the sows come to the ESF after the start of feeding. Within the scope of this study, it could be shown, that the feeding rank is highly correlated, partly over 0.9, on consecutive days, which means that the sows during a defined period of time approximately have the same feeding order and feeding time respectively. Furthermore, the feeding order is affected by age and parity and reflects the social hierarchy in the group. Older sows and sows with a higher parity number often occupy the forward places of the feeding order [8; 9; 19]. Based on those results, the question should be answered whether sick sows come later to the ESF and whether those shifts in the feeding order may be used as an early warning system in terms of Precision Livestock Farming.

Material and methods

The research centre Futterkamp provided the data of the sows' visits to the ESF (company Schauer) and the documentation of the treatments. The sows were kept in a group of approximately 210 sows on three ESF. All three ESF were available for the sows to use. The sow groups were performed in a one-week rhythm. The information of the ESF-visits contained the data „ESF-number", „date" (year, month, day), „time of access" (hour, minute, second), „animal number", „feed amount" and „time of exit". „Animal number", „date of treatement" and „reason of treatment" were taken from the documentation at the farm. The data basis is shown in **figure 1**. For each ESF and each feeding cycle, the visits of the sows were sequenced by their arrival at each ESF. Each sow got a visit number for each day. Based on the registration list, the treatments have been matched to the corresponding sow number and date. As a result, days with or without treatment were defined. 117 observation days were included in the analysis. 396 sows visited the ESF during this period. A total number of 25 030 station visits were evaluable (analogous to the number of animal days or distributed visit numbers respectively).

Results and discussion

For each sow only the first visit to the ESF after feeding start was included. Feeding start is always at 9:00 pm. Up to 9:00 pm

on the next day, all sows have the chance to get their allocated feed ration. Normally, one sow feeds her complete ration at the first visit in the ESF within 10-15 minutes. This sow can't get the next ration until the next feeding start at 9 pm on the following day. The 25 030 visits in the ESF divided into one third for each ESF. According to that, the frequency of use was distributed equally to all 3 ESF. The 3 stations were employed to capacity with 70 visits of sows per day.

The focus was on the study of the context between diseases and visit number. The visit number of medicated sows on their days without treatment (treatment = 0) was compared to their visit number on their day with treatment (treatment = 1). Those sows represented 5 092 visits in the ESF. **Table 1** shows the descriptive statistics of the visit number.

50 % of all visits to the ESF from the 122 sows on days without treatment took place before visit number 44 (median). It was shown that medicated sows generally visited the ESF later. If the use of the 3 ESF was contributed equally (70 sows visited one feeding station), 50 % of the visits ought to be concluded until visit number 35. In the group of the 122 medicated sows, one or more have been first in the feeding order on their days without treatment (minimum). Up to 81 visits were registered on one ESF on a day without treatment (leading to a maximum visit number of 81). The inter-quartile range showed that the distribution was located equally around the median.

The median of the visit number on days with treatment moved back 16 places to visit number 60 (mathematically increased). Assuming that the average visit duration was approximately 10 minutes, those sows visited the ESF 2.5 hours later on days with treatment compared to days without treatment. It was shown that half of the visits in the ESF on days with treatment came within the limits of 16 visit numbers (median until maximum). This means that 50 % of the sows on days with treatment fed in the last fourth according to an average of 70 sows per ESF.

The hypothesis that sows with a treatment come later to the ESF was confirmed by the Wilcoxon-test ($p < 0.01$). The Wilcoxon-test showed negative rank sums, too. One third of the sows came earlier than usual to the ESF on the day with treatment. Restrictively, it has to be mentioned, that only one day was defined as „ill". The visit numbers of the days before and after treatment were counted in the calculation for days without treatment. This could have an influence on the medians or the means.

Fig. 1

Station / *station*	Tier / *Animal*	Datum / *Date*	Uhrzeit / *Time*	Reihenfolge / *Order*	Behandlung / *Treatment*
1	A	1.1.	21:00	1	0
1	S	1.1.	21:15	2	0
1	D	1.1.	21:27	3	0
1	E	1.1.	21:46	4	0
1	F	1.1.	22:01	5	0
2	G	1.1.	21:01	1	0
2	H	1.1.	21:14	2	0
2	J	1.1.	21:33	3	1
2	K	1.1.	21:54	4	0
2	L	1.1.	22:06	5	0
1	S	2.1.	21:01	1	0
1	A	2.1.	21:12	2	0
1	G	2.1.	21:35	3	0
1	J	2.1.	21:48	4	0
1	E	2.1.	22:00	5	1
2	D	2.1.	21:03	1	0
2	H	2.1.	21:19	2	0
2	F	2.1.	21:37	3	0
2	L	2.1.	21:59	4	0
2	K	2.1.	22:11	5	0

Anhand der Uhrzeit werden für die einzelnen Stationen die Platzziffern beginnend beim Futterstart (21:00) für jede Fütterungssequenz zugeordnet; Sau S kommt am 1. Januar als zweite Sau an die Station 1 zum Fressen
Based on the time and the station, the visits can be sequenced. Begin is the start time of feeding sequence (21:00). On January 1, sow S visit the station 1 as second sow in the order.

Sau D kommt am 1.1. an 3. Stelle an Station 1 zum Fressen, am 2.1. frisst sie als erste an Station 2. Sie verbesserte sich um 2 Plätze in ihrer Besuchsreihenfolge.
Sow D eats on January 1 at the third place on station 1. On January 2, the same sow eats on the first place of the station 2. She gains two places in her visit-order.

Am 1.1. ist die Sau J behandelt worden, am 2.1. die Sau E. Beide erhalten den Index 1. Die Platzziffer 3 der Sau J bzw. die Platzziffer 5 der Sau E zählen zu den Tiertagen mit Behandlung, während die anderen Platzziffern in die Berechnung zu den Tiertagen ohne Behandlung eingehen.
Sow E and J were medicated (1.1. / 1.2.). Both sows get for this date the index 1 for treatment. The 3rd position of sow J and the 5th position of the sow E of the order belongs to the animal-days with treatment. The other order positions are adopted in the calculations of the animal-days without treatment

Illustration of the data basis

Technical utility at the ESF

A time series analysis on the dynamics of ESF visits with the statistic program SPSS was performed for all sows that stayed more than 100 days in the gestation group. For one sow the result is shown in **figure 2**.

For this sow the statistic program chose the time series model „simple". The line „observed" illustrates the real visit number. The dashed lines show the upper and lower 95 % confidence interval in which the visit number should reside. At day 33, the actually reached visit number 56 was above the 95 % confidence interval. For the rest of the time, the visit numbers constantly showed one-number figures. This sow was not treated. The increase of the visit number above the

Table 1

Descriptive visit number statistics of medicated sows (n = 122) at their animal days without (healthy) or with treatment

Tiertag / *Animal day*	Median / *Median*	Min. / *Min.*	Max. / *Max.*	25 %-Quartil / *25 %-Quartile*	75 %-Quartil / *75 %-Quartile*
Gesund / Healthy	44	1	81	25	59
Behandlung / Treatment	60,5	2	76	36,5	68

95 % confidence interval at some days could give a hint on health problems of this sow. After defining an algorithm, the management-software could activate an alarm-function for this sow if such a variation in the visit number appeared. The farmer could use this alarm-function to have special attention to this sow and detect a possible disease earlier. However, the 95 % confidence interval is inappropriate for the detection. It gave many false reports and only a few treatments were identified. That implies that the task for next studies is to define a „normal“ range for the visit number. Visit numbers which are outside the „normal“ range could be reckoned as an indication for a disease or another disturbance. As a result an alarm could be activated to visualize this sow number to the farmer. This might represent a valuable tool for the farmer to detect the beginning of a disease earlier.

Conclusions

The current investigation has shown that under certain conditions sick sows can be identified by using their visit numbers in the ESF. There was a strong tendency that sows with a disease came later to the ESF on their days with treatment than on days without treatment. In further investigations it has to be analyzed to what extent this variation of the visit number from one day to another has to occur to provide high probability for the detection of a sick sow with this indicator. Implemented in the software-system of the ESF, this could be a valuable management tool for the farmer and an additional contribution for Precision Livestock Farming.

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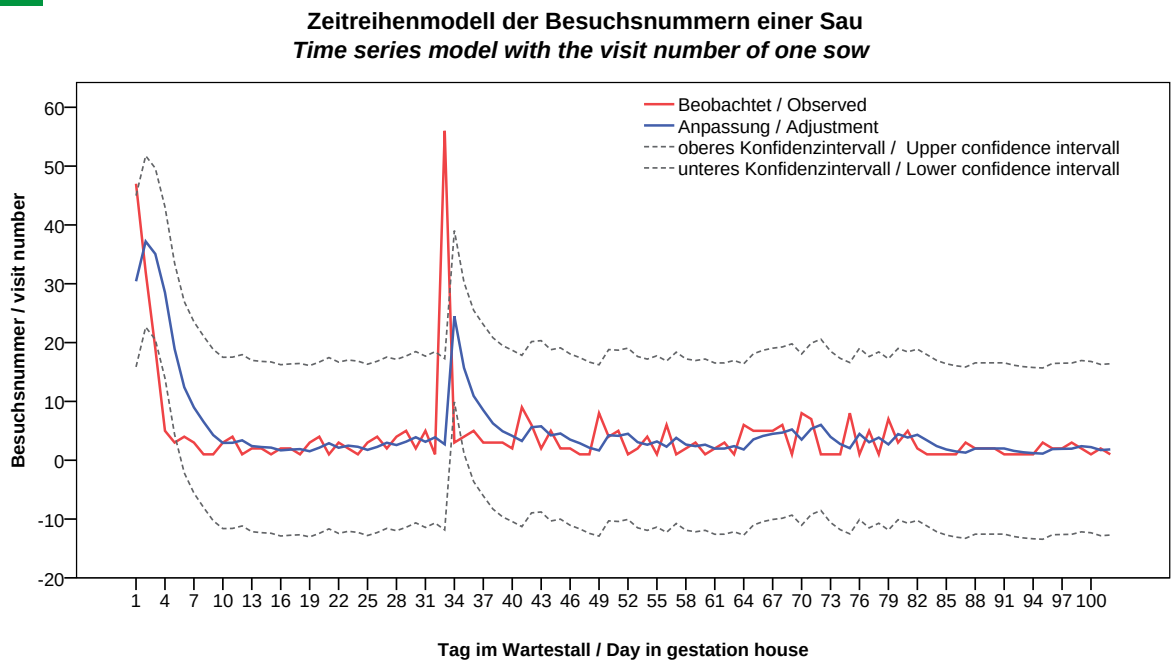
Fig. 2



Aufenthalt: 2. März bis 11. Juni; nicht stationstreu; keine registrierte Behandlung; gewähltes Modell durch PASW Statistics 18: Einfach

Sheltering: 2 March to 11 June; not constant on one ESF, no registrated treatment, elected model of PASW Statistics 18: simple

Time series model with the visit numbers of one sow

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