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Automated Sow Condition Feeding at the „Nipple Mash Feeder“

Assessing the breeding condition of sows - even more difficult in group keeping systems - often underlies misjudgement with only visual control of the condition. The goal of a DFG-sponsored project was to develop a technique, which makes group sow keeping in combination with individual feeding and computer-aided automatic acquisition of the condition status through measuring backfat thickness with ultrasound possible and automatically adjusting the feed quantity to the condition.

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Keywords

Backfat-thickness measurement, ultrasound, sow's condition, feeding

The investigation took place on two research stations of the Federal Research Institute of Agriculture and two commercial farms on 260 modern hybrid-sows in total and 70 sows of the German Landrace as well as 22 fattening pigs. The following substantial results were obtained:

In order to ensure a standard position of the animals during the measurement, the „nipple mash feeder“ („Brei-Nuckel“) was selected as single animal feeding station. In contrast to trough feeding [1], a reduction of the animal movement during the feed intake is enabled due to the voluntary adjustment of the animals to the feed pipe.

In the investigation A-Scan and B-Scan-devices were examined regarding their measuring accuracy and suitability for automation. The A-Scan-device USM 22 F of the company Agfa NDT GmbH convinced by its precise back-fat thickness registration and its functional security of operation as well as its equipment (e.g. serial interfaces).

Moreover, in literature study different back-fat-thickness recording methods were found. In the investigation the ABC-6-Methode was used since investigations of [3] showed that the measuring spots in the front back give the most reliable information for a condition evaluation. After [3] the backfat thickness on the front back varies during the cycle at most and therefore fulfils rather the function of a fat depot than the back-fat on the last rib.

Efforts to define an, in a technical view, excellent measuring spot within the shoulder range of the animals had unfortunately to be rejected since within this range no sufficient correlation to the conventional ABC-6-spots could be found. Therefore a measurement construction (*Fig 1*) was designed, which made a heading of the ultrasonic sensor to the measuring spots on the animal's back possible.

By the development of two functional software programs a controlling of the measuring arm could be realised, as well as an automatic processing of the collected backfat thickness values (RSD) for the backfat-thickness-orientated feed quantity computation and allotment.

Measuring accuracy of the measuring arm

The measuring accuracy of the measuring arm, as *Fig. 2* illustrates, showed a mean difference of 1.5 (± 1.4) mm after standardisation of the data in an attempt group (n = 31

Fig. 1: Automatic backfat-thickness measurement

sows) compared with the weekly manually obtained backfat thicknesses. In two further groups of sows (n = 11, n = 10), however a normal distribution of the data could not be obtained, which indicates that the precision of the measuring arm certainly is satisfying, a sufficient accuracy however is not yet given.

Since displacements at the feeding station and a different feeding behaviour seem to result in a presently still unsatisfactory precision of the system, it is suggested to install the „nipple mash feeder" technology into a feeding station in the future, in order to eliminate the disturbing factors of influence mentioned.

Development of a backfat-thickness-orientated feed curve

For the development of an backfat-thickness-orientated feed curve the connection between feed quantity and RSD change should be determined. Since no scientific references existed, a feeding experiment was necessary.

Six groups of sows with 94 animals in total were supplied with different feed quantities on basis of their individual backfat-thickness and a certain backfat-thickness-target-value. On the basis of the determined data an involution model could be provided for the first time, which enables the calculation of the necessary feed quantity (feed, MJ ME/week) for a desired backfat-thickness change (? RSD, mm/week):

$$\Delta RSD = -0.35 (\pm 0.09) + 0.0028 (\pm 0.0004) \bullet feed$$

($R^2 = 0.34$)

This might possibly open new perspectives for a purposeful condition-feeding of sows. Further research project should examine the model for its validity and modify it for other breeds if necessary.

The ideal backfat-thickness

There are a lots of recommendations for the optimal backfat thicknesses in sows in the literature. The multiplicity of the published measuring procedures and value recommendations nearly makes it impossible to evaluate the validity and the reproducibility of these investigations. Approximate values exist according to several measuring methods, but no defined measuring spots were mentioned to be compared with one another and discussed. In addition, some authors do not describe exactly the used method.

Partial goal of the project was to determine an ideal RSD. The determination of the ideal backfat-thickness-value was finally not possible, since in non of the feeding variants a significant influence of the backfat-thickness on the animal's performance could be proven. An average increasing backfat-thickness during pregnancy (35.-108. day p.c.) by 0.0 to 0.7 mm in each week was recorded.

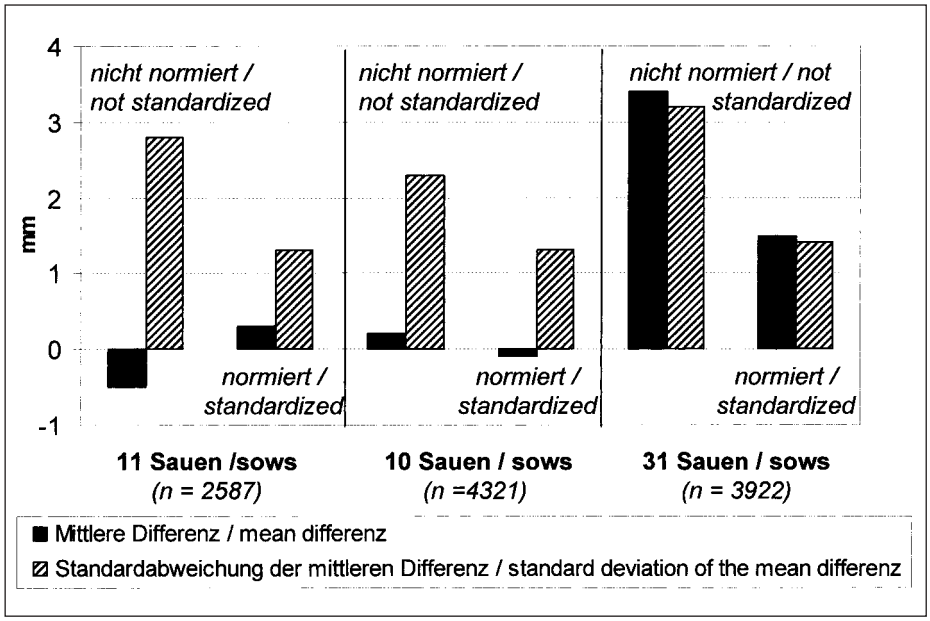

Fig. 2: Mean differences of the averaged auto-data and their standard deviation versus manual measured backfat-thickness before and after standardisation from three experimental groups with 11, 10 and 31 sows

Body-Condition-Score (BCS) in comparison to the ultrasound measurement

Apart from the weekly backfat thickness measurement by means of ultrasound all sows condition were judged by the BCS according [4]. A significant relation between backfat-thickness measurement and Body-Condition-Score was determined, whereas in individual cases the ultrasound measurement permits a much more precise estimation of the condition. By means of a further regression analysis, a theoretical model could be provided, which makes the determination of the backfat-thickness on the basis of the BCS note possible:

$$RSD = 7.24 (\pm 0{,}31) + 2.86 (\pm 0.09) \bullet BCS$$

($R^2 = 0.44$)

It is to be noted that this model is based on the data raised in the investigation. Another observer possibly causes, due to a changed estimate [2], another frequency distribution of the BCS notes compared with the actual RSD, whereby the values of the involution coefficients in the involution model can change. Further deviations can occur by breed differences. Modern breed lines might be falsely classified e.g. frequently after BCS as too fat [2]. The involution model should be used therefore only for the German land race.

Result

With the enclosed work the fundamental conditions for an automated condition registration and condition-feeding of sows in group housing systems was realised, whereby the precision of the system still shows improvement potentials.

Literature

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