UDK 636.083

Izlaganje sa znanstvenog skupa
Conference paper

PHYSIOLOGICAL ADAPTATION OF GROWING PIGS UNDER DIFFERENT SOCIAL CONDITIONS

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Summary

The social confrontation of a young growing pig with a comparable group immediately leads to very frequent agonistic interactions during the first 30 minutes accompanied with a rapid increase of heart rate and catecholamine concentrations and a delayed increase of cortisol concentrations.
Confrontation of the animal with an unfamiliar group results in more agonistic interactions and a higher adrenocortical reaction compared to the confrontation with the familiar group.
High rank animals have more agonistic interactions during the first 30 minutes, accompanied with higher heart rates and a higher adrenocortical reaction but show the ability to cope with the new situation after a short period.
Further research is necessary to evaluate the existence of different adaptation strategies in pigs and the involvement in the observed physiological and behavioural reactions.

Introduction

The existence of consistent behavioural reaction patterns in pigs is controversely discussed (Jensen et al., 1995). However, there is some evidence for a relation between different behavioural patterns, individual performance and/or physiological stress reactions, which may be the result of different adaptation strategies (Mendl et al., 1992; Hessing et al., 1993, 1994). Active coping is characterized by the attempt of the animal to remove the stressor or to flee from it any may be accompanied with an activation of the sympathetic adrenomedullary flee from it and may be accompanied with an activation of the sympathetic adrenomedullary system. In contrast, passive coping is generally accompanied with passive behaviour and an activation of

Paper presented at EUROPEAN ASSOCIATION FOR ANIMAL PRODUCTION (EAAP) 46th Annual Meeting, Prague, September 4-7, 1995

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the hypothalamo-pituitary adrenal axis. It is suggested that these strategies have been shaped by evolution as adaptations to fitness-threatening situations (Weschsler, 1995).

Under group housing conditions of pigs a social rank order is estabished by agonistic interactions, by whish the relations between the animals and the access to resources is arranged. The social rank of the animal may therefore have influence on the behaviour and the physiological reactions in normal and stress situations, which may be the result of different adaptation strategies.

It is the aim of this study to investigate the individual adaptation of growing pigs with different social ranks under single housing conditions and under social stress conditions after regrouping in a familiar and unfamiliar group.

Material and Methods

At the present time four of nine trials with four animals each were carried out. In each trial two groups with nine young growing pigs (12 weeks old, average body weight 31.8 kg, S.D. 6.8 kg) from different litters were formed. The following three days agonistic interactions between the animals were recorded over a period of ten hours a day. The individual values of dominance were calculated by the relations of wins and defeats. Animals with the highest and lowest rank from each group were separated and kept under single housing conditions. After a handling period of seven days a catheter was placed in the external jugular vein in order to obtain blood samples. A biotelemetric implant was placed in the left flank region, which enabled the continous measurement of heart rate, blood pressure and body temperature. *Single housing:* Over a period of 24 hours blood samples were taken every hour starting at 08.00 h with feeding times from 09.00 to 11.00 and 15.00 to 17.00 h. Biotelemetry measurements were made continously over periods of 48 hours before and after the social contact tests.

Social contact tests: Animals were regrouped once in the familiar and once in the unfamiliar group over a period of ten hours, each starting at 08.00 h with feeding times from 09.00 to 11.00 and 15.00 to 17.00 h. Behavioural observations were made to describe the individual behaviour (e.g. lying, standing, walking) in intervals of 3 s (point sampling) and agonistic interactions were recorded as continous sampling. Heart rate was measured continously by the biotelemetric implant. Blood samples were taken before and during the social contact test and analysed for epinephrine, norepinephrine and cortisol concentrations by HPLC and RIA methods. Data were analysed by repeated measurement analysis of variance and/or student's t-test.

Results

24-hour resting period

Results of the first trials indicate the specific circadian pattern of stress hormone release and heart rate during the 24-hour resting period under single housing conditions. The highest plasma cortisol concentrations were found at 06.00 h, decreased during the day and reached their minimum at 20.00 h. The epinephrine concentrations strongly depended on the activity of the animals, with the highest concentrations at the two feeding times and the lowest concentrations at 01.00 h, where most of the animals were sleeping. Norepinephrine concentrations showed no circadian pattern. No differences of stress hormone release between high rank and low rank animals could be detected during the 24-hour resting period. The heart rate of the animals also depended on the activity of the animals, with two maximums at the feeding times and a distinct minimum between 05.00 and 06.00 h. Animals with a low rank showed a higher heart rate during day and night time compared to animals with a high rank, but differences were not significant. (Results for the 24-hour periods not shown).

Social contact test:

Immediately after regrouping, the animals were generally attacked by one or more animals from the group and had very frequent agonistic interactions during the first hour. Mean values for plasma catecholamine concentrations after 5 minutes of social contact showed a maximum with a 10-fold increase of norepinephrine and a 8-fold increase of epinephrine compared to the resting values immediately before regrouping. Cortisol concentrations reached their maximum at 09-20 h (4-fold increase) and a second maximum at the feeding time at 15.00 h.

Regrouping of animals in the unfamiliar group tend to result in more agonistic interactions and a higher ratio of norepinephrine vs. epinephrine between 08.00 and 13.00 h than regrouping in the familiar group (Fig. 1,2). Additionally, animals confronted with the unfamiliar group showed a more pronounced increase of cortisol concentrations within the first 90 min. and significant higher cortisol concentrations between 11.00 and 14.00 h (Fig. 3).

Generally, high rank animals tend to have more agonistic interactions during the first 30 minutes after regrouping (Fig. 4) and higher heart rates during the first 90 minutes (Fig. 5). Afterwards, the frequency of agonistic interactions and the heart rate of the high rank animals decreased and was predominantly lower compared to the low rank animals. Additionally, high rank animals showed a significant increase of plasma cortisol concentrations

from 8.00 to 10.00 h compared to the low rank animals (Fig. 6). These differences disappeard after 10.00 h and after the feeding time at 15.00 h cortisol concentrations of the high rank animals were lower than those of the low rank animals. In high rank animals a tendency for a lower ratio of norepinephrine vs. epinephrine was also observed from 08.10 to 16.00 h, which was partly caused by a significant lower norepinephrine release (Fig. 7).

Fig 1. - AVERAGE NUMBER OF AGONISTIC INTERACTIONS OF PIGS REGROUPED IN A FAMILIAR OR UNFAMILIAR GROUP (16 CONTACTS EACH, MEANS OF 30 MIN).

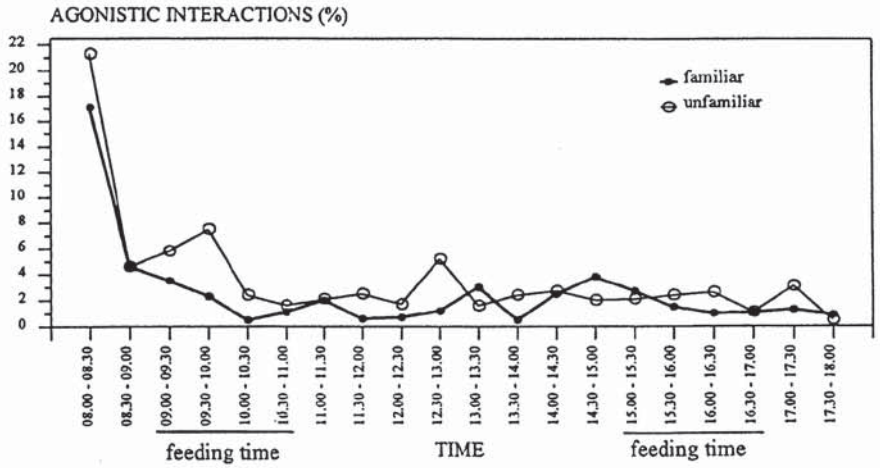


Fig. 2. - RATIO OF NOREPINEPHRINE VS. EPINEPHRINE CONCENTRATIONS IN PLASMA SAMPLES OF PIGS REGROUPED IN A FAMILIAR (11 CONTACTS) AND AN UNFAMILIAR GROUP (9 CONTACTS) AT 8:00 H. DATA SHOWN AS LEAST SQUARE MEAN VALUES.

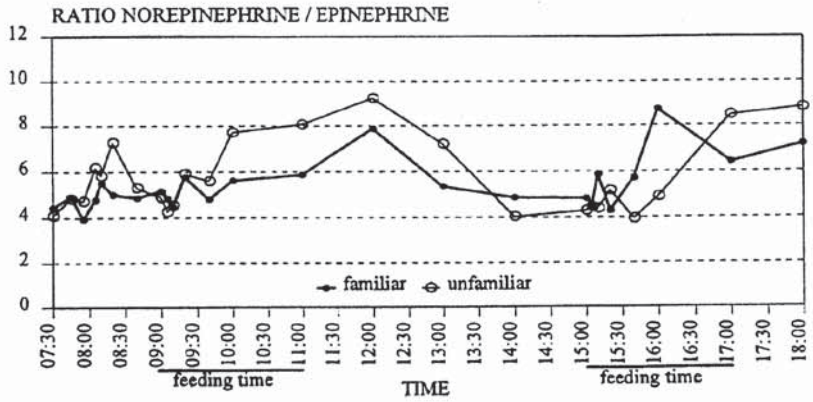


Fig. 3. - PLASMA CORTISOL CONCENTRATIONS IN CATHETERIZED PIGS REGROUPED IN A FAMILIAR (11 CONTACTS) AND AN UMFAMILIAR GROUP (9 CONTACTS) AT 8:00 H. DATA SHOWN AS LEAST SQUARE MEAN VALUES. SIGNIFICANT DIFFERENCES WERE OBSERVED BETWEEN 11:00 AND 14:00 H ($p < 0.05$).

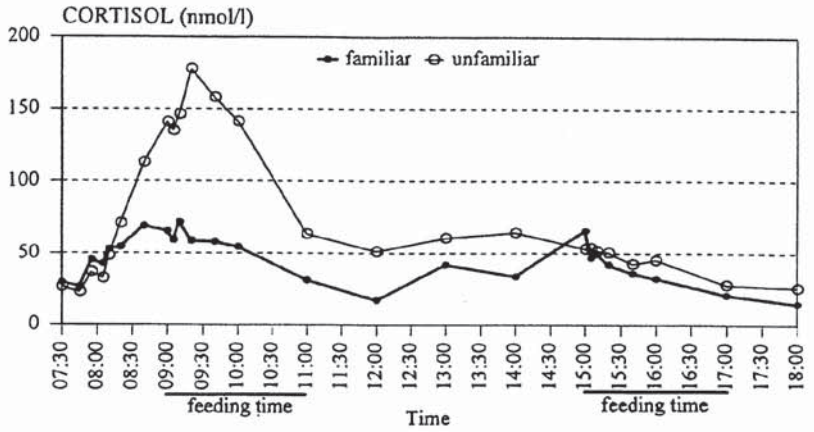
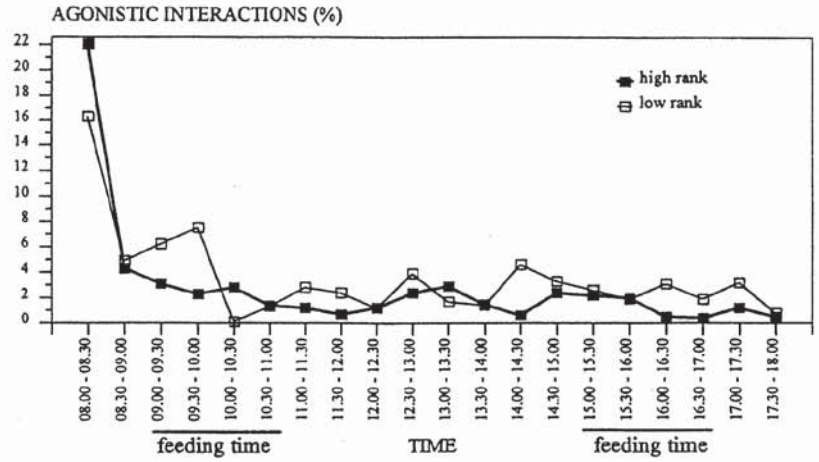


Fig. 4. - AVERAGE NUMBER OF AGONISTIC INTERACTIONS OF HIGH OR LOW RANK PIGS AFTER REGROUPING (16 CONTACTS EACH, MEANS OF 30 MIN).



Comparing the frequency of agonistic interactions and the percentage of wins and losses, animals with a low rank regrouped in the unfamiliar group had the most agonistic interactions during the testing period and the highest percentage of losses. In contrast, high rank animals regrouped in the familiar group showed the lowest number of agonistic interactions and the lowest percentage of losses (Fig. 8).

Fig. 5. - AVERAGE HEART RATE OF HIGH RANK (10 CONTACTS) AND LOW RANK PIGS (9 CONTACTS) BEFORE AND AFTER REGROUPING AT 08:00 H (MEANS OF 15 MIN).

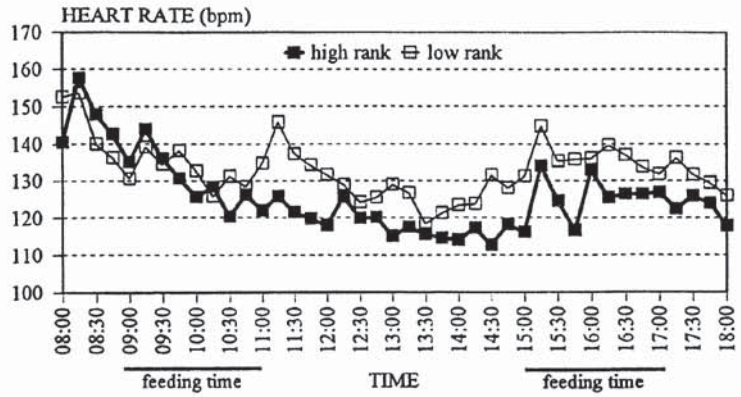
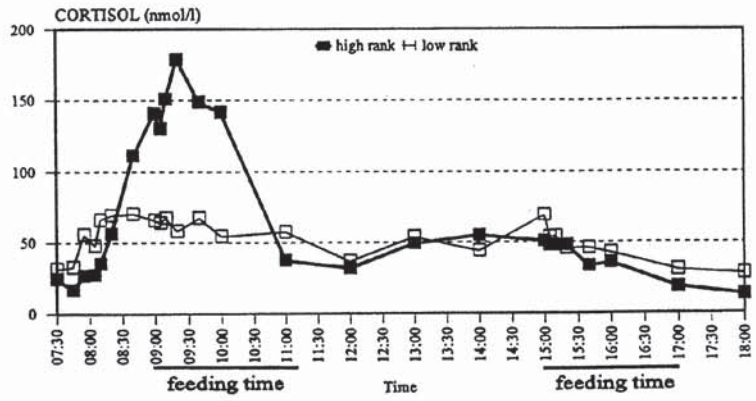


Fig. 6. - PLASMA CORTISOL CONCENTRATIONS IN HIGH RANK (9 CONTACTS) AND LOW RANK PIGS (11 CONTACTS) BEFORE AND AFTER REGROUPING AT 8:00 H. DATA SHOWN AS LEAST SQUARE MEAN VALUES. SIGNIFICANT DIFFERENCES WERE FOUND FOR THE INTERACTION RANK X TIME ($p < 0.05$).



Discussion

The preliminary results indicate that pigs with different social ranks regrouped in a familiar or unfamiliar group react with different physiological adaptations. Whereas under resting conditions during single housing no significant differences between high and low rank animals could be detected, the social stress caused by regrouping and the following agonistic interactions resulted in different physiological reactions depending on the social rank and on the familiarity of the group.

Fig. 7. - RATIO OF NOREPINEPHRINE VS. EPINEPHRINE CONCENTRATIONS IN PLASMA SAMPLES OF HIGH RANK (9 CONTACTS) AND LOW RANK PIGS (11 CONTACTS) BEFORE AND AFTER REGROUPING AT 8:00 H. DATA SHOWN AS LEAST SQUARE MEAN VALUES.

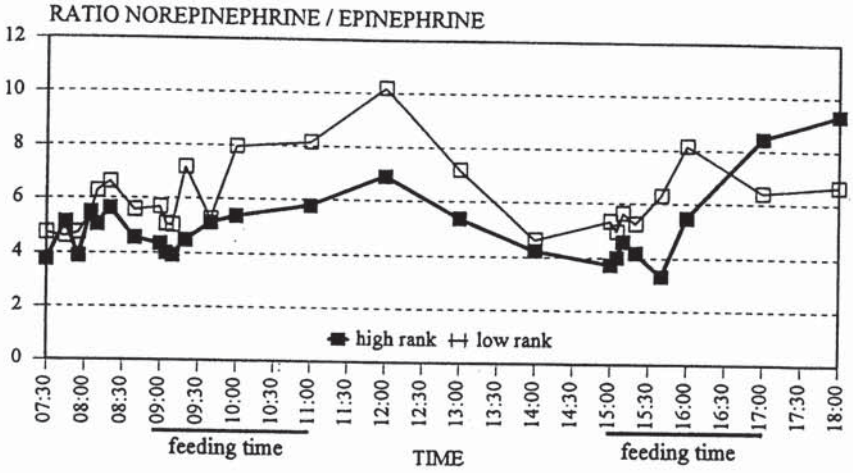
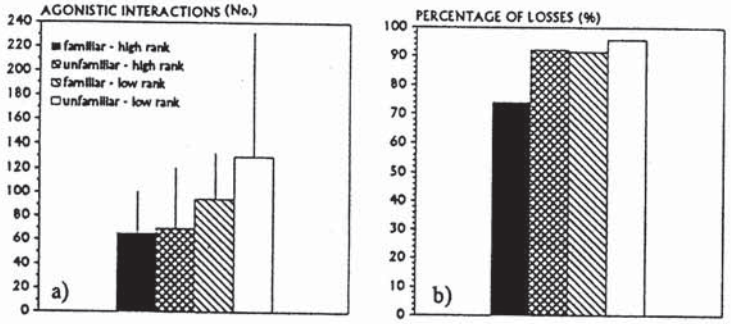


Fig. 8. - AGONISTIC BEHAVIOUR OF HIGH OR LOW RANK PIGS AFTER REGROUPING IN A FAMILIAR OR UNFAMILIAR GROUP FOR 10 H (8 CONTACTS EACH)
A) TOTAL NUMBER OF AGONISTIC INTERACTIONS
B) PERCENTAGE OF LOSSES OF ALL AGONISTIC INTERACTIONS



Regrouping of animals in the unfamiliar group resulted in more frequent fights during the first five hours, which was accompanied with a strong increase and higher levels of cortisol concentrations nearly over the whole testing period. These results may indicate a higher adrenocortical reaction after regrouping in an unfamiliar group compared to regrouping in a familiar group. The differences decreased after seven hours, indicating a possible integration of the animals in the new group.

Animals with a high rank showed very frequent agonistic interactions immediately after regrouping, accompanied with higher heart rates and a pronounced increase of cortisol concentrations. All values decreased after a specific period and were predominantly lower compared to the low rank animals for the rest of the testing period. A lower excitement of high rank animals after coping with the new situation is not only shown by lower heart rates, but may also be idicated by the lower ratio of norepinephrine vs. epinephrine and the lower norepinephrine concentrations. These results indicate that high rank animals may be more active immediately after regrouping in order to keep a better social rank and have the ability to cope with the associated social stress.

REFERENCES

1. Hessing, M.J.C., A.M. Hagelsø, W.G.P. Schouten, P.R. Wiepkema and J.A.M. van Beek (1994): Individual behavioral and physiological strategies in pigs. *Physiol. Behav.* 55: 39-46.
2. Hessing, M.J.C., A.M. Hagelsø, J.A.M. van Beek, P.R. Wiepkema, W.G.P. Schouten and R. Krukow (1993): Individual behavioural characteristic in pigs. *Appl. Anim. Behav. Sci.* 37: 285-295.
3. Jensen, P., J. Rushen, B. Forkman (1995). Behavioural strategies or just individual variation in behaviour? - A lack of evidence for active and passive piglets. *Appl. Anim. Behav. Sci.* 43: 135-139.
4. Mendl, M., A.J. Zanella, D.M. Broom (1992): Physiological and reproductive correlates of behavioural strategies in female domestic pigs. *Anim. Behav.* 44: 1107-1121.
5. Wechsler, B. (1995): Coping and coping strategies: A behavioural view. *Appl. Anim. Behav. Sci. 43:* 123-134.

FIZIOLOŠKO PRILAGOĐAVANJE SVINJA U RASTU U RAZNIM SOCIJALNIM UVJETIMA

Sažetak

Socijalno suočavanje mlade svinje u rastu s usporednom skupinom brzo dovodi do vrlo čestih agonističkih interakcija u prvih 30 minuta praćenih naglim ubrzanjem rada srca i koncentracijom katekolamina te usporenim porastom koncentracija kortizola.

Suočavanje životinje s nepoznatom skupinom dovodi do većih agonističkih interakcija i veće reakcije adrenokortizola u usporedbi sa suočavanjem s poznatom skupinom.

Najbolje životinje imaju više agonističkih interakcija u prvih trideset minuta praćenih ubrzanijim radom srca i višom adrenokortikalnom reakcijom ali pokazuju sposobnost snalaženja u novoj situaciji nakon kratkog razdoblja.

Potrebna su daljnja istraživanja da se ocijene različite strategije prilagođavanja u svinja i uključivanje u promatrane fiziološke reakcije i reakcije ponašanja.

Primljeno: 4.12.1996.