

# The Behaviour of the Pigs Housed in Hot Climatic Conditions

## Správanie ošípaných pri vysokých teplotách ustajnenia

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### Abstract

The effect of high temperature on the behaviour of growing-finishing pigs was studied. The pigs were housed in a climate controlled chamber, the air temperature was kept constant at 30°C and the relative humidity was 32.5% during the whole 3 months. Aggressive behaviour and daily activities of the pigs were recorded during the light hours, from 6:00 till 18:00. Detailed observations showed that during the experiment, the pigs were most of the time lying (72%,  $P < 0.001$ ). Pigs spent more time lying on the floor without bedding (86.65%,  $P < 0.01$ ) compared to floor with bedding (13.35%,  $P < 0.001$ ). The second activity, which occurred most after lying was eating (16%,  $P < 0.001$ ) then standing (10%,  $P < 0.001$ ). From all observation activities, the least amount of time the pigs were sitting (1%) and moving (1%). Drinking and social contacts – aggression were less frequent. After the each week, a significant decrease in aggression was recorded ( $P < 0.001$ ), an aggressive contacts occurred mainly during the eating and drinking. The pigs were active with peaks in the morning and afternoon. This study confirms that the high temperature influences the behaviour of the animals; the pigs are not very active, the most of the time they are lying on the cool places without bedding.

**Keywords:** behaviour, high temperature, pigs

### Abstrakt

V práci bol skúmaný vplyv vysokej teploty na správanie výkrmových ošípaných. Ošípané boli ustajnené v klimatickej komore, kde bola udržiavaná konštantná teplota vzduchu 30°C a relatívna vlhkosť vzduchu 32.5% v priebehu 3 mesiacov. Agresívne správanie a denné aktivity ošípaných boli zaznamenávané počas svetelnej časti dňa, od 06:00 do 18:00. Detailné pozorovanie ukázalo, že v priebehu experimentu, ošípané najčastejšie ležali (72%,  $P < 0.001$ ). Počas oddychu, ošípané viac času ležali na podlahe bez podstielky (86,65%,  $P < 0.01$ ) v porovnaní s podstielkou (13.35%,  $P < 0.001$ ). Druhá najčastejšie sa vyskytujúca aktivita bola žranie (16%,  $P < 0.001$ ) a potom státie (10%,  $P < 0.001$ ). Zo všetkých pozorovaných aktivít, ošípané najmenej času sedeli (1%) a pohybovali sa (1%). Pitie a sociálne kontakty - agresivita boli menej časté. Každým nasledujúcim týždňom dochádzalo k preukaznému zníženiu agresivity ( $P < 0.001$ ), najviac agresívnych kontaktov sa objavovalo pri žraní a pití. Ošípané boli aktívne najviac v ranných a popoludňajších hodinách. Táto štúdia potvrdzuje, že vysoké teploty ovplyvňujú správanie zvierat, ošípané sú menej aktívne a najčastejšie ležia na chladných miestach bez podstielky.

**Klíčové slová:** ošípané, správanie, vysoká teplota

## Detailed Abstract

Teplota prostredia je faktor, ktorý ovplyvňuje úžitkovosť zvierat a výrazne zasahuje do ich pohody. Ošípané patria medzi hospodárske zvieratá, ktoré sú veľmi citlivé na vysoké teploty a možnému prehriatiu sa bránia evaporáciou, znižujú produkciu tepla a príjem krmiva. V dôsledku zvýšenia teploty sa mení aj správanie ošípaných. Cieľom práce bolo zhodnotiť vplyv dlhodobej konštantnej vysokej teploty (30°C) a relatívnej vlhkosti 32.5% na správanie ošípaných. Experiment sa uskutočnil v laboratórnych podmienkach Experimentálneho centra hospodárskych zvierat v Nitre pri katedre Špeciálnej zootechniky Slovenskej poľnohospodárskej univerzity v Nitre. Po dobu 3 mesiacov výkrmu boli bravce a prasničky plemena biela ušľachtilá ustajnené v klimatickej komore. Správanie bolo zaznamenávané počas svetelnej časti dňa od 6:00 do 18:00 hodiny pomocou video kamery kontinuálne, etogramy boli vyhodnotené snímkovou metódou s intervalom 1 minúta. Boli sledované sociálne kontakty, najmä agresívne správanie a denné aktivity, ležanie, státie, pohyb, sedenie, žranie a pitie. Z pozorovaní bolo zistené, že zo všetkých sledovaných aktivít, ležanie predstavovalo najvyšší podiel 72%, ( $P < 0.001$ ), žranie 16% ( $P < 0.001$ ), státie 10% ( $P < 0.001$ ), ošípané sa málo pohybovali (1%) a sedeli (1%). Osobitne bolo zaznamenávané ležanie na betónovej podlahe a ležanie na podstielke. Z analýzy výsledkov možno konštatovať, že ošípané ovplyvnené vysokou teplotou viac času ležali na podlahe bez podstielky (86.65%,  $P < 0.01$ ), ako na podstielke (13.35%,  $P < 0.001$ ). Pitie a sociálne správanie bolo sledované kontinuálne, pozorovania poukázali na to, že ošípané sa priemerne napili 0.63 krát za 20 minút a agresívne správanie sa objavilo 0.27 krát za 20 minút. Denné aktivity boli graficky vyhodnotené počas jednotlivých hodín a bolo zistené, že ošípané najviac času venovali ležaniu (98.61%) v čase od 11:00 do 12:00 hodiny. V ranných hodinách sa dĺžka ležania zväčšovala a následne v poobedňajších hodinách došlo k poklesu. Podiel žrania ošípaných pod vplyvom tepla bol najvyšší v čase od 13:00 do 14:00 hodiny (26.78%) a v čase od 16:00 do 17:00 hodiny (28.78%). Ostatné aktivity tvorilo ležanie, státie a pohyb. Na základe pozorovaní možno konštatovať, že ošípané boli najviac aktívne v ranných a popoludňajších hodinách. Pri porovnávaní denného režimu počas jednotlivých dní sa správanie ošípaných výrazne nemenilo, ale z výsledkov bolo zistené, že s narastajúcim vekom dochádza k štatisticky preukaznému zníženiu agresivity ( $P < 0.001$ ). Touto štúdiou bolo potvrdené, že vysoké teploty ovplyvňujú správanie ošípaných, spôsobujú, že zvieratá sú málo aktívne, podstatnú časť dňa preležia a na ležanie uprednostňujú nepodstielanú časť podlahy.

## Introduction

Environmental factors influence the animal production (Blaxter, 1977) and have a great influence on the wellbeing and the behaviour of pigs (Høøk Presto et al., 2008). The first visible sign of how pigs react to increasing temperature is a change in behaviour (Huynh, Aarnink, 2005). Pigs are highly sensitive to even small climate changes (high and low temperatures) mainly due to their missing ability to sweat (Pedersen, et al., 2003). Optimal climatic conditions for fattening pigs depend primary on the body weight of the animals and their level of feeding (Verstegen et al., 1978). Swine spend most time resting and sleeping. Total rest, drowse and sleep time amounts to about 19 h each day with most true sleep occurring during the night and amounting to 5 h (Fraser, 1983). The young pigs spent 55-60% of their time lying,

during the 24-h period (Blackshaw, 1981) and according to Morrison et al. (2007) the pigs of age 22 weeks housed in conventional system spent 65% of the time lying, 7% sitting and the frequency of occurrence aggressive behaviour was 0.6 times. Fraser (1984) reported that in the group of pigs, the peak of feeding is in the morning, one or two other peaks are later in day and modest intake is during the hours of darkness. Drinking is related to eating. The ambient temperature affect space requirement of the pigs, group housed pigs cope with increasing temperature by using more space and also activity levels are generally reduced as temperatures increase, more pigs will be lying down (Spoolder et al., 2012). Hillmann et al. (2004) suggested that pig chose different areas for resting depending on ambient temperature. With increasing temperature, pigs used the dung area more often and lay more often without contact pen mates. The observed preferences for pigs to lie on unbedded areas most likely indicates that these pigs are too warm (Arey, 1993). During the rest, pigs choose the unbedded areas once the temperature is increased above 25°C (Fraser, 1985). Bedding also provides thermal comfort and can reduce the critical temperature of growing pigs by as much as 6°C at the higher live weights (Bruce, Clark, 1979). According to Fraser (1985) under warm conditions, straw is likely to benefit pigs because of its recreational value but not as means of improving comfort in resting area. Van Putten and Dammers (1976) found out that the pigs housed on straw perform less of conflict behaviour (chewing of pen-mates, nibbling, massaging) than those without bedding. Fraser et al. (1991) in his experiments showed that both pigs with and without straw, they were more active in the afternoon than in the morning. Lying location changes with increasing temperature, when room temperature is above 30 °C, the percentage of lying pigs on the slatted floor peaked. At high temperatures, 90% of pigs prefer to lie and also they cool themselves by wallowing in excrement (Huynh et al, 2005). During summer, low air velocity combined with high inside temperature caused a greater incidence of animals lying in the dunging area, bad pen hygiene, lower growth rates and a tendency to increased tail-biting (Sällvik, Walberg, 1984). The activity levels reduced from roughly 20 to 8% when temperature increases from 10 to 28°C. This could be interpreted as an increase in lying behaviour of 12% over 18°C temperature (Pedersen et al., 2003). The pig will lie down in a fully recumbent position with their limbs extended, in order to be able to transfer as much heat as possible to the environment (Close et al., 1981). The direct observations of Massabie and Granier (2001) showed, that more than 80% of pigs were lying and this percentage was significantly higher ( $P < 0.01$ ) for pigs raised at 24°C ambient temperature without air movement. According to Ekkel et al. (2003), the results confirmed that pigs of all weight categories were lying for most of the day and that the number of pigs that were lying increased by weight. In a typical winter situation (18°C), the percentage of a day that the piglets spend reposed in a heated nesting site is much higher when compared with an ambient temperature of 26°C (Schormann, Hoy, 2006). The proportions of activities at high temperature and thermoneutral temperature compared also Hyun et al. (2005), Collin et al. (2001) and Quiniou et al. (2000). Hötzel et al. (2009) found out that in the initial period, the frequencies of eating was higher than the other two periods. Drinking, walking and fighting behaviour were less frequent at the final than at the two earlier periods of experiment. Høøk Presto et al. (2008) and Lyons et al. (1995) found out, that aggression, ear manipulation and other-social decreased with increasing age of the pigs. Simonsen (1990) found out that there was significantly more aggression encountered in the feeder and water sections with peaks in the morning and afternoon. Ingram et al. (1980) showed that when the temperature increased to 35°C

during the light period and decreased to 25°C during the dark, the group of pigs was most active in the dark.

## Material and Methods

The experiment was carried out in the laboratory of the Experimental centre of farm animals at Department of Animal Husbandry in Nitra near the Slovak University of Agriculture in Nitra and lasted 3 months, from June till August. In this study, 6 growing pigs of Large White breed were used. The pigs were housed in a climate controlled chamber; sized 4 x 3 m and they were kept there for the whole fattening period. Space allowance was 2 m<sup>2</sup> per pig. In this chamber the air temperature was kept constant at 30°C ± 1.0 during the whole experiment depending on the intervention of swineherd for feeding and bedding and relative humidity was 32.5%. The pigs were weighted on day 0 and also every week. Every weighing was done in the morning. At the beginning of the experiment the average initial body weight of the pigs was 30 kg. The pigs was offered a standard diet ad libitum, feed was humidizing by adjunctive water. In the experiment, a nipple drinker was used and the pigs had free access to water. Daylight was provided from 06:00 to 18:00 h. The air velocity at animal level was approximately 0.13 m.s<sup>-1</sup>. The floor surface area of the chamber was divided into 2 sectors, solid floor with nipple drinker and feeder (feeding-lying area) and solid floor with bedding (lying-fouling area), the floor and the chamber was made from tiles. Urine and faeces were removed every day and the straw was delivered to the lying-fouling area every day. The temperature in the climatic chamber was measured every half an hour by temperature datalogger HDL. From the obtained data, average temperatures were calculated by software EHDLog. When the pigs reached slaughter weight at 100 kg, they were electrically stunned in the station of fattening and slaughter value according to legislation and standard practises STN 466164.

One video camera was used to record the behaviour of the group of six pigs. The camera (fisheye) was installed inside the chamber and covered the whole area of the chamber. The video camera was recording the behaviour of the pigs for 5 times, week after week for one day (Saturday), from 6:00 to 18:00 h, when the pigs were not weighed and they have their typical daily schedule. The data from the camera were transferred to the DVDs on computer. From these video recordings, samples were taken at an interval of 1 minute by the frame method. Then each hour of the observation was divided into 20-min intervals, resulting in 36 observations per day. It was noted how many pigs were lying, standing, sitting, moving, eating. In addition, it was noted whether they were lying on the bedding, or on the floor without bedding. For the each hour and also for the whole day observation, the behavioural activities and the whole duration were count up. From these values hourly and daily means were calculated. From the video recordings aggression and drinking were determined, as well. The observed activities were recorded continuously; any occurrence of this behaviour was recorded.

The ethogram of behaviour was presented in percentage and consisted of the following behavioural elements:

-Lying on the bedding: the pig lies on the floor, in the lying-fouling area, which is covered by straw

- Lying on the floor: the pig lies on the floor, in the feeding-lying area, where it is no bedding
- Standing: the pig stands and it is not eating but it can be drinking
- Sitting: the pig sits up on front legs, and it is not eating but it can be drinking
- Movement: the pig is running, walking or moving in the chamber
- Eating: the pig is standing or sitting, it has its head down in the feeder and it is eating
- Aggression: the pig bites another pig, the pigs fight together
- Drinking: the pig has a nipple drinker in its mouth

From the obtained data in experiment, mean values were calculated. For determining the differences of the behavioural elements of the growing pigs the effects of day and hour were analysed using the two-way analysis of variance. To investigate differences between the means of the five observed days and also between the hours, the post-hoc test was used. All analyses were run with the statistical software package SPSS 11.

## Results and Discussion

The obtained results showed (Fig. 1) that on average the growing pigs influenced by the high temperature during the fattening period laid for 72% ( $P < 0.001$ ) of the 12 hours observation and it represented on average 14.49 minutes ( $\pm 4.55$  min) from the 20 minutes interval what is consistent with the results of Hyun et al. (2005) who found out that pigs at high temperature (28-34°C) had higher proportions of lying activity (72.7%,  $P < 0.05$ ) compared with thermoneutral temperature (65.8%). According to Ekkel (2003), in thermoneutral conditions fattening pigs spent 90% of the day lying and in conventional system the lying represented 65% (Morisson et al., 2007) what is less than in hot temperatures. Huynh et al. (2005) and Close et al. (1981) described that with increasing temperature, pigs became uncomfortable and inactive, they are stretched-out, extending their bodily contact with the floor while lying what was also found out in our experiment. On average, the pigs influenced by heat were lying less on the bedded floor than on an unbedded floor what is consistent with the results of Sällvik and Walberg (1984) and Arey (1993) indicated that these pigs were too warm. During the rest the pigs spent more time lying on the floor without bedding (86.65%,  $P < 0.01$ ) compared to bedding (13.35%,  $P < 0.001$ ) what was also found by Fraser (1985) that pigs' preference for a bedded or concrete floor depends strongly on temperature. The second activity which pigs spent the most after lying was eating (16%,  $P < 0.001$ ), then standing (10%,  $P < 0.001$ ) what is consistent with the results of Hyun et al. (2005) who found out that higher percentages of pigs were standing (17.5% vs. 13.6%) eating (11.5% vs. 9.4%) and sitting (4.8% vs. 4%) at thermoneutral temperature than those in high temperature environment. From all observed activities, the least amount of time the pigs were sitting (1%) and moving (1%). Drinking and social contacts – aggression were less frequent. The pigs drank on average 0.63 times per 20 minutes and contacted each other in negative way 0.27 times per 20 minutes.

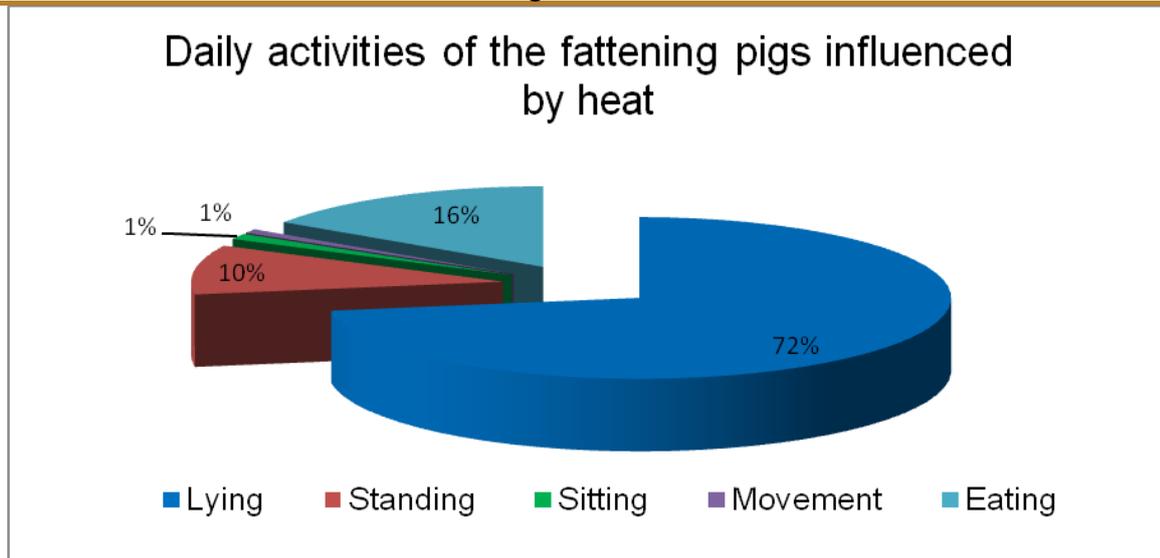


Fig. 1. The ethogram of daily activities of the fattening pigs influenced by heat in %

Fig. 2 shows the daily activities from the five observation days during the twelve hours, from 6:00 to 18:00 h. On average, pigs housed in climatic chamber spent the most of the time lying than moving and sitting. The observation hour influenced the frequency of observed activities. It was found out that there was a significant effect of the hour on the proportion of time spent lying ( $P < 0.001$ ), moving ( $P < 0.01$ ) and eating ( $P < 0.001$ ). On average, the pigs were lying from 11.03 minutes to 19.72 minutes per 20 minutes interval. At the beginning of the observation, in the morning the pigs were lying (82.28%) more than the moving (1%) and eating (12.11%), other activities were sitting and standing. Then lying was decreasing, the pigs were lying less (51.33%) from 9:00 to 10:00 h and they started to eating more (19.50%). After the 10:00 am pigs were lying more and eating less. From 11:00 till 12:00 h the frequency of lying was the highest (98.61%) and after that is had a decreasing tendency what was also found out by Fraser et al. (1991), his experiments showed that the pigs were more active in the afternoon than in the morning. There was also an interaction between the observed hours and eating, where the time spent by eating differed during the experimental hours. From 6:00 am till 9:00 h the eating represented 12.11% - 19.50%, then the pigs were eating less and from 11.00 to 12.00 h no pigs were eating or moving. After that the proportion of time spent by eating was increasing and the pigs were eating the most from 13:00 to 14:00 h (26.78%), lying represented 60.44% and moving 0.8% and they were eating most from the 16:00 to 17:00 h (28.78%), while lying represented 55.17% and moving 0.9%, other activities were standing and sitting, what is consistent with the results of Simonsen (1990), that pigs were active with peaks in the morning and afternoon. Ingram et al. (1980) showed that if temperature is constant (25°C), pigs exposed to 12 h light and 12 h dark are generally much more active during the light phase, and show a gradual increase in feeding and other activities during the daylight hours. According to Collin et al. (2001) the duration of the meals (consumption time) was numerically decreased at 33% (3-9 min vs. 5-9 min, on average) compared to thermoneutrality and the results of Quiniou et al. (2000) showed that the ingestion time increased with decreasing temperatures (60 and 75 min/d at 22 and 12°C, respectively,  $P < 0.05$ ) and it decreased with increasing temperatures (64 and 46 min/d at 19 and 29°C, respectively,  $P < 0.001$ ). The results show that the pigs influenced by high temperature were more lying than moving. The time spent by moving was highest during the

fourth observed hour (2.28%), the moving represented 0.17 to 2.28% from all activities.

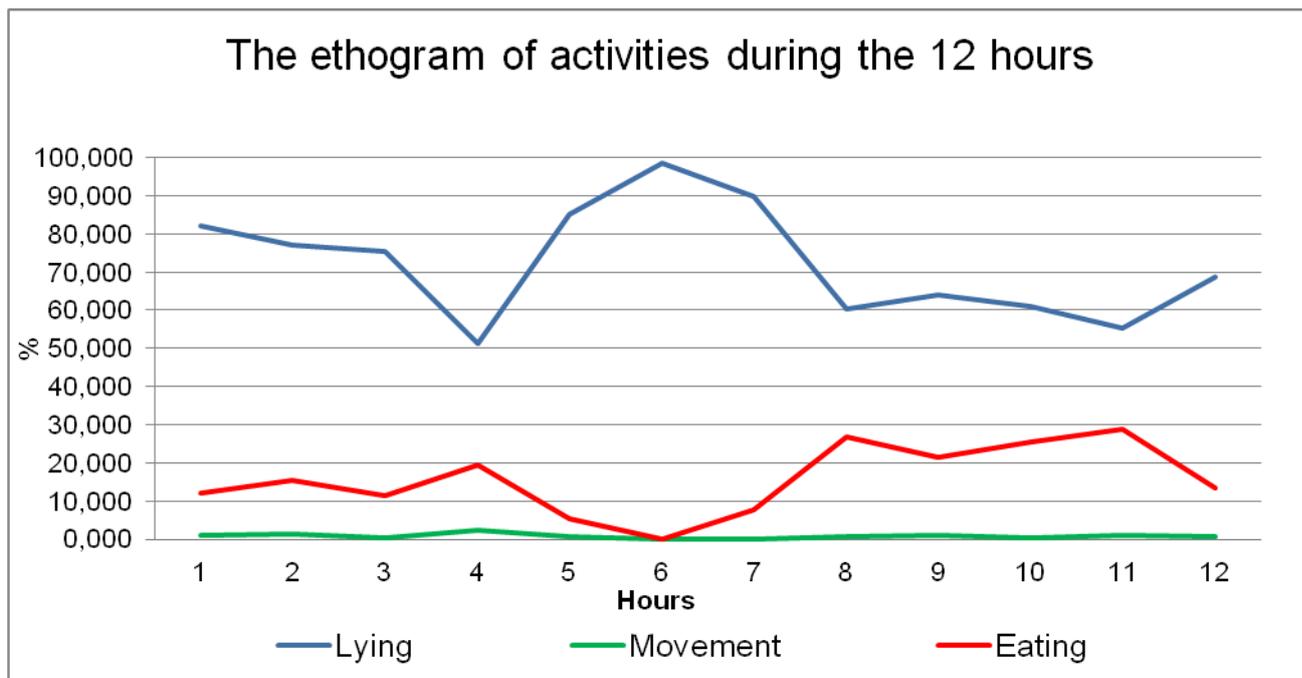


Fig. 2 The ethogram of activities during the 12 hours in %

The observation period of the day influenced the frequency of social contacts – aggression ( $P < 0.05$ ) and drinking ( $P < 0.05$ ). In the first period of the day, the frequencies of negative contacts and drinking were lower than the other period. Mostly, the pigs were drinking during the eating and also there were more negative contacts. It was found that the frequency of negative contacts was highest from 13:00 to 15:00 h, on average 0.49 (Fig.3), when the pigs were eating and drinking. Fraser (1984) reported that with adequate amounts of dry food, pigs drink principally at meals times.

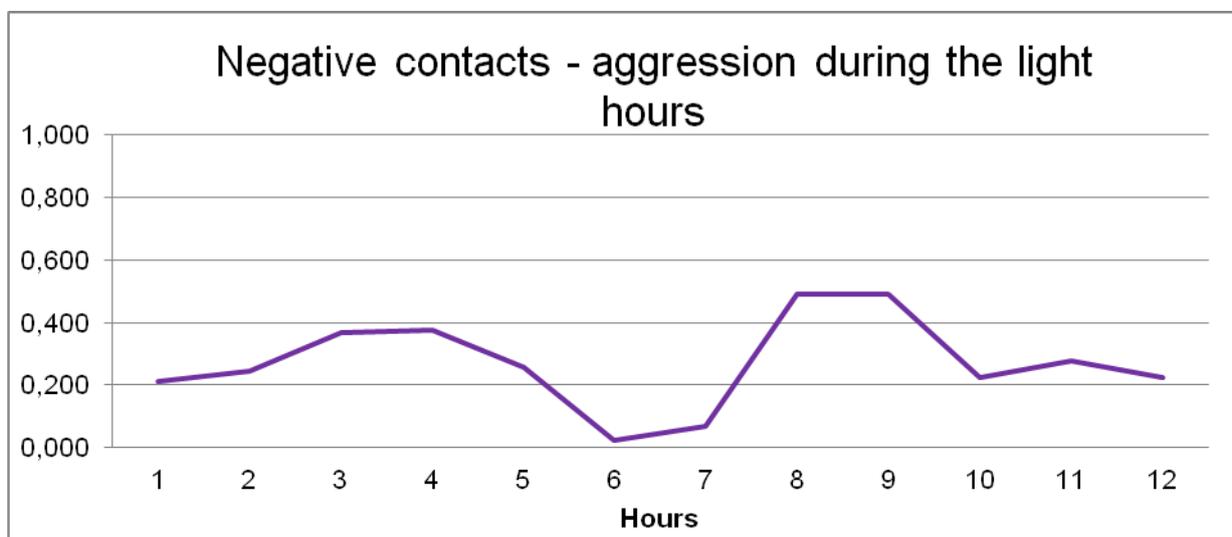


Fig. 3 The aggressive contacts during the 12 hours

The proportion of daily activities of the pigs influenced by high temperature during the five days is presented in Figure 4. The obtained results showed that there is a significant effect of the observation day to the proportion of time spent moving ( $P < 0.001$ ). There was found no interactions for lying and eating. In the first day the occurrence of lying represented 73.94%, in the second day of the observation pigs spent the most time lying (74.61%) and during the third to fourth day it was from 70.60% to 72.71%, on the contrary the lying behaviour was lowest during the last day of the observation (70.46%). On average, the pigs influenced by heat were lying 14.09 to 14.92 minutes per 20 minutes interval during the five observed days, what was the most occurred activity from the all observed activities, it was also showed by the results of Huynh et al. (2005), Massabie and Granier (2001) and Ekkel et al. (2003). When lying behaviour of pigs was compared, the pigs spent more time on the floor without bedding than those with bedding. The choice for the bedded area was highest on the last experimental day (2.90 minutes) and it was lowest on the first day (0.58 minutes) and on the other day pigs were lying the most on the unbedded area (14.20 minutes) on the first day and they were lying the least on the last day (11.19 minutes). The pigs spent less time eating after the lying and it was the second activity which occurred the most. It was found that the pigs were eating at least on the last observed day (14.35%); eating behaviour represented 14.35% to 16.60% and did not differ very much. The results showed that the pigs housed in the climatic chamber spent more time moving or idling during the first day (2.06%) than the other days (0.40% to 0.58%) as was also found out by Hötzel, et al. (2009).

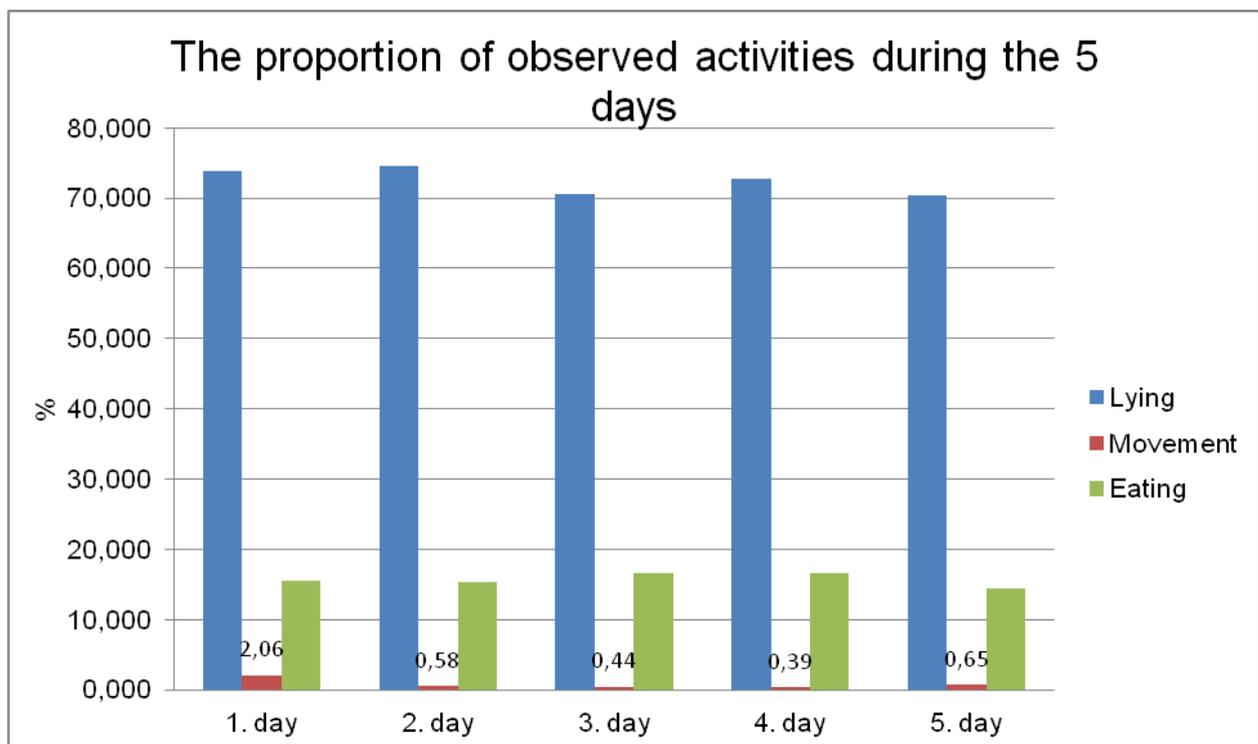


Fig. 4 The proportion of daily activities during the five days in %

The observation day influenced the frequency of observation of the aggression in fattening pigs influenced by heat ( $P < 0.001$ ). In the initial period, the frequencies of occurrence social contacts – aggression, fighting behaviour was highest when the animals were youngest during the first day and decreased thereafter (Fig. 5) what is

consistent with the results of Høøk Presto et al. (2008). The number of the negative social contacts decreased during the whole experiment, what was also found out by Lyons et al. (1995). According to van Putten, Dammers, (1976) the pigs housed on straw perform less of conflict behaviour. Straw reduces the abnormal behaviours such as apathy, stereotypes and anti-social activity (Arey, 1993). Obtained results showed that there was more aggression encountered in the nipple drinker what is closely consistent with Simonsen (1990) who reported that the decrease in aggression from 12.33 to 5.46 events between the two trials with 24 pigs in the pen was statistically significant ( $P < 0.001$ ). Also the frequency of drinking was highest on the first observation day ( $P < 0.001$ ), the pigs drank 0.81 times per 20 minutes and decreased on the second (0.44 times per 20 minutes) and fourth day (0.54 times) and on the other hand it increased on the third (0.74) and fifth day (0.64).

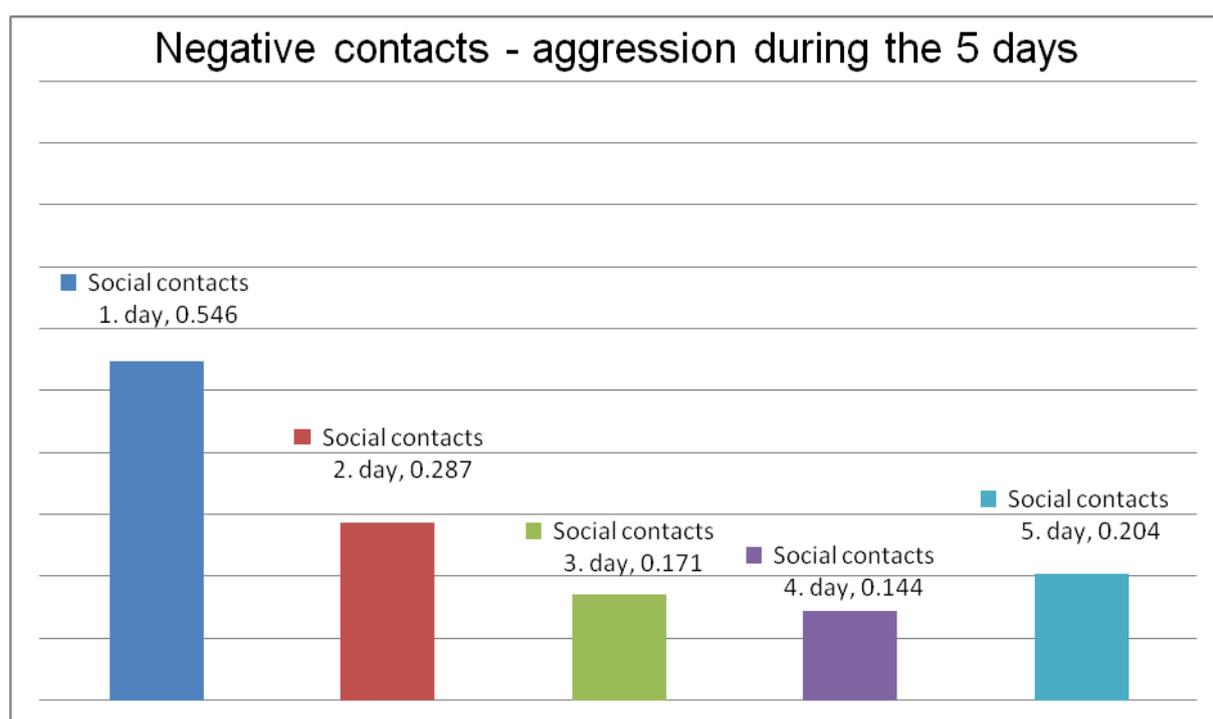


Fig. 5 Negative social contacts – aggression during the five days

## Conclusion

It can be concluded from this study that the high temperature influences the behaviour of the growing and finishing pigs. Under thermoneutral conditions the pigs have higher proportions of standing, moving and eating activity compared to hot temperatures. The lying behaviour increases with the increased temperature. The pigs housed at high ambient temperatures are not very active, most of the time they are lying and prefer unbedded and cool areas for resting. The daily activities of the pigs were not changing during the observed days. It was found out that the negative contacts were decreasing during the experiment; the weight did not affect the aggressive behaviour.

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