# SOWS HEAT STRESS

Pigs adapted relatively easily to environmental changes, which is very important for their survival.But for sows, this adaptation has a cost concerning productivity and longevity. Most animals’ species can expel heat to the environment with perspiration and panting which are the two most important tools for maintaining body temperature. However, pigs do not sweat and have relatively small lungs. Because of these physiological constraints and the deposition of subcutaneous fat are susceptible to heat stress. In the U.S., the annual reduction in productivity is directly linked to the increased temperatures in July and August. However, production data suggest that the productivity loss extends from June to October for growing and finishing pigs and from July to November for sows’ units. The net result? For about 40 percent of the time, the productivity of the plant is at risk. Additionally, today's modern genotypes of pigs produce significantly more heat than their ancestors.

A review (Brown-Brandl et al, 2003) of heat and moisture production from pigs suggested that new genetic lines produce almost 20% more heat than their counterparts in early 1980. This trend is likely to be continued in the coming years since this review was conducted and heat production could be increased by up to 10% extra.

When sows use natural coping - resistance mechanisms, for thermoregulation, they must allocate resources away from other body functions.The results may be damaging to sows’ body condition; fertility; milk production and/or piglet survival and growth performance. The most common impact of heat stress is often decreased feed intake and increased breathing. The reduction in feed intake decreases endogenous heat production. Continued heat stress increases excessively water consumption (increasing electrolyte loss) and accumulates acids, produced in the body and causing loss of acid-base balance. This may eventually result in diarrhoea or death in severe cases. A recent publication by Pearce et al. (2013) examined what happened to the intestinal structure when pigs were exposed to heat stress. The research showed that exposure to 35°C for 24 hours significantly damaged the intestinal defence function and also increased plasma endotoxin levels. The authors explained that when pigs are exposed to heat stress (even for as little as two to six hours) their intestinal defence systems are significantly compromised and this provides opportunity for infection as pathogenic bacteria can invade the body more easily. Therefore, heat stress can create secondary infection if sanitary conditions are poor.

As temperatures exceed 24 °C, depending on humidity, sows can begin to experience the negative effects of heat stress (stress), mentioned above. Feed consumption is reduced by about 0.5 kg per day when the temperature rises to 25 °C. Note that sows wellness zone is between 15-19 °C. The influence of temperature in conjunction with humidity is shown in Scheme 1.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Room temperature** | **Relative Humidity** | | | | | | | | | | | | |
| **40%** | **45%** | **50%** | **55%** | **60%** | **65%** | **70%** | **75%** | **80%** | **85%** | **90%** | **95%** | **100%** |
| 35 oC |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 34 oC |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 33 oC |  |  |  |  | **High Risk** | | | | | | | |  |
| 32 oC |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 31 oC |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 30 oC |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 29 oC |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 28 oC |  |  |  |  | **Medium Risk** | | | | | |  |  |  |
| 27 oC |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 26 oC |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 25 oC |  |  |  |  | **Small Risk** | | | | | |  |  |  |
| 24 oC |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 23 oC |  |  |  |  | **No Risk** | | | | | |  |  |  |
| 22 oC |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 21 oC |  |  |  |  |  |  |  |  |  |  |  |  |  |

**Scheme 1.**Temperature and moisture influence on thermal stress.

Thermal stress can also affect boars, resulting in reduction of libido, low sperm count, abnormal sperm and following decreased litter size.

With the rise of temperature, sows increase their breathing rate in an attempt to expel heat. The shortness of breath is an obvious sign of heat stress, and causes sows to spend extra energy. Practically one sow has 15-20 breaths per minute. If exceeded 40 it is apparent that suffers from heat stress. ‘Other symptoms are: the sprawl on the floor or on cold surfaces, lower physical activity, search for water or playing with the drinker and reduced feed intake.

The regulation of environmental conditions on site, can help in addressing the problem. Heat stress can be minimized by adjusting the temperature in the installation. Strategies for sufficient air circulation and cooling include: ventilation, air conditioning and refrigeration units, fresh air inlets and water spraying systems. With any of these systems, the temperature in thesowsunit must be kept between 15-21 °C.

The quantity of the air is an important factor for reducing thermal stress. General recommendations are shown in Table 1 (Data adapted from US). Note that these are averages values and in some areas can be doubled, especially for adult animals.

**Table1.**Recommended Ventilation Rates in cubic meters / minute / animal

|  |  |  |  |
| --- | --- | --- | --- |
| **Production phase** | **Minimum** | **Mild weather** | **Warm weather** |
| **Sows with litter** | 6 | 25 | 152 |
| **Piglets 6 - 12 kgs** | 0,6 | 3 | 7,6 |
| **Piglets 12 - 35 kgs** | 0,9 | 4,5 | 13,7 |
| **Fatteners 35 - 70 kgs** | 2 | 7,3 | 23 |
| **Fatteners 70 - 130 kgs** | 3 | 10,6 | 36,5 |
| **Gestation** | 3,6 | 12 | 76,2 |
| **Breeding** | 4,3 | 15 | 91 |

Because in a gestation chamber there are sows at various stages of pregnancy, the design must be careful to help prevent heat stress. The first 30 days and the last two weeks of pregnancy are the periods where thermal stress can have the most critical negative effect on litter size and survival of piglets.

Pregnant sows start experiencing thermal stress, when the ambient temperature is greater than 28 ° C. Heat loss by evaporation from the skin of the pig is minimal and for this reason exceptionally effective methods to reduce temperature must be used. The basic tools - methods that are used, in various combinations, for cooling pregnant and replacement sows are shading, air circulation, and some type of spraying systems with water or with the use of cooling panels. The most reliable method of controlling air movement during hot weather is mechanical ventilation of the room rather than a physical way as wind is meager during the hot summer months. Efficiency will be higher using air cooling methods. The incoming air stream is passed through a fluid bed (panel), and because of air heat the moisture from this layer evaporates. Although the relative humidity in the building increases, the dry air temperature is reduced. The effectiveness of these systems depends on the relative humidity of the outside air. The comparisons between different approaches is difficult due to weather differences in each region, but the cooling systems work best in hot, dry climates, while spraying of animals and evaporation of water work best in humid climates.

The maintenance of the ventilation system is necessary in each chamber. This should include cleaning of fans (vanes and louvers) to remove dust. Louvers must be cleaned from both sides to open easily.

The activation of the cooling systems should be based on Scheme 1. Check and repair of cooling panels, nozzles, emitters, louvers, etc. must be done before temperature becomes too high. Dust should be removed particularly from panels and they have to be tested for the deposition of salts. It is advisable to measure the amount of air passing through the panel to ensure the necessary ventilation. Measurement of outdoor temperature and relative humidity will help to achieve the optimal system configuration. It is proposed to start operating the cooling systems when the temperature reaches 25,5oC in farrowing rooms and 24 °C in pregnancy. Thefans should alwayswork before the startup of the cooling systems.

**Semen and breeding management**

Generally all animal activities should be programmed either in morning or evening hours to reduce stress during the hottest hours of the day.

Concerning semen, the minimum and maximum storage temperature must be checked daily. To have more accurate measurements it is recommended the sensor to be placed in a container with water, in order the measurements not to be affected by the open and close of the semen cabinet.The temperature in the premises where the diluted semen is kept, should be 21-22 °C in order not to affect the right operation of the cabinet. If the semen is purchased from an external supplier the temperature should also be check, depending on the package. The insemination should be done early in the morning before rising of the temperature. Detectors boars used for stimulation of oestrus, should only be used for 30-45 minutes to ensure that a sufficient amount of pheromones is available to stimulate females. To improve the libido of these boars it is suggested to conduct either a mating or a semen collection per week. During the process it is advisable the detector boar to be exposed to small groups of sows and insemination to be done as soon as possible. If sows are thin flushing is recommended. Also, it would be better if more personnel is involved in this sector at such times to complete the process earlier.

**Sows management**

Administratively the negative effects of heat stress can be reduced by placing cooling systems, if there are none. Also the body condition of sows entering the farrowing room,must be controlled more intensively, to avoid having overweight animals in summer time. Flow control should be done on all the drinkers. If it is necessary time should be devoted for training firstborn sows in the use of a drinker. Water is an important factor in feed intake. It should not only be always available to sows but should have a temperature up to 15 °C and a flow rate of about 2 liters per minute, with a minimum of 1.5 liters / minute. If there is a water tower this should be insulated and protected to maintain the water temperature at an ideal level.

Increase of the temperature from 15 to 16 °C to 30 °C will increase water consumption by the sows of over 50%. A rule of thumb is to maintain a water to feed ratio of 5: 1. A sow usually consumes 9-18 liters in gestation and twice in lactation.These quantities may be doubled in warm periods. The existence of a pressure pump and moreover a second (backup unit) is necessary. It should be noted that the quality of drinking water is an important factor. Finally, optimal conditions must be present in the places where replacement sows are kept so as not to affect their reproductive behavior.

**Facing heat stress through nutrition**

Apart from environmental control, nutrition of sows has an important role in their productivity during summer. It is a fact that there is a direct correlation between heat and reduced feed intake. Thermally distressed sows eat less because the process of digestion increases their body temperature.

Lactating sows will retain their litter and then utilize the nutrients from the feed to maintain their body condition. This means that sows that are not eating enough can lose their body condition faster. A malnourished sow is less likely to be reproduced with the usual rates so they need to remain in good condition.

Technical solutions to reduce heat stress are often time consuming and expensive, eg installing cooling systems in plants. A nutritional approach may prove more adaptable and faster to implement. Based on the information available there are ways of improving the productivity of pigs during heat stress periods.

The most common measure is the use of *denser diets*. This applies to the energy content of the diet and is being done to compensate for the reduction in feed intake in lactating sows. Using more attractive feed and generally increasing the attractiveness of the diet has a positive effect. These measures include the preparation of wet rations if the properattention is given to avoid spoilage of feed due to heat. Also the use of pellets instead of mash feed.

*Replacement of starch with fat as an energy source.* Fats are excellent sources of energy for pigs to compensate for the reduction feed intake. Fat is also a more digestible component and produces less metabolic (endogenous) heat during digestion compared to starch.

*Reducing the level of crude protein in the diet.* Study on nursing sows under heat stress, showed that, they lose less weight if their diet contains a lower amount of crude protein (Table 2. Noblet et al, 2000). The explanation is that in the course of digestion, proteins generate more endogenous heat than fats (26% vs. 9%), because of complex reactions for the metabolism of amino acids that they are composed.

**Table 2.** Effect of the level of crude protein in the diet with respect to the temperature in sow productivity

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Temperature** | **20 οC** | | **29 οC** | |
| Crude protein (%) | 17,6 | 14,2 | 17,6 | 14,2 |
| Feed intake in kg / day | 6,71 | 6,51 | 3,56 | 4,05 |
| Piglet weight at weaning | 10,5 | 10,3 | 10,4 | 10,3 |
| Milk production in kg / day | 10 | 9,6 | 7,4 | 7,7 |
| Sow weight loss in kg | 16 | 15 | 41 | 29 |

*Less fiber.* The higher the content of a feed and thus a ration in crude fiber, the harder is to digest. Not digested fibers reach the colon where stimulate the growth of microorganisms (especially when there are also available undigested nitrogenous substances and amino acids), which generate heat from the fermentation processes.

*Adjustment of feed portions.* As mentioned above, the digestion of feed causes endogenous heat production, which affects body temperature. Large meals induce these phenomena. Providing smaller and more frequent meals during the day and / or feeding at night and early morning, reduce overall endogenous heat production.

The transition from 2 large meals to three smaller, increases total feed consumption by 10-15%. In some cases, ad libitumfeeding could be applied to lactating sows. Today, there are some computerized feed delivery systems that can help. In this case special attention should be payed to the amount of the meal and the frequency of administration so that feed does not remain for long time in the trough and degraded due to high temperatures. The feeders should be kept clean and supplied feed to be always fresh.

*Maintaining acid-base balance.* With increasing temperature, the intensity of respiration of the animal also increases. The faster breathing, takes more carbon dioxide from the blood stream which then is exhaled. This changes the pH levels in the blood, leading to metabolic acidosis and lower feed intake. The addition of sodium or potassium bicarbonate can help in restoring acid-base balance and increased feed intake.

*Use of additives to increase the antioxidant substances of thediet.* The simplest measure is the addition of an extra amount of vitamin E, C, and betaine. Also the use of acidifiers can help to adjust the pH of the body and the digestive tract. Enzymes such as amylase, protease, xylanase, etc., increase the density of the diet and reduce the "cost" of digestion of the ingredients. From various manufacturers various formulations are suggested that claim to help in this direction in conjunction with increasing the attractiveness of feed, reduce inflammatory reactions etc.

*Reassessment of participation levels, fortrace minerals, vitamins and amino acids.* All this should be in balance to the energy content of feed. In the case of amino acids,it was mentioned above that their excess leads to growth of microorganisms in the colon, with negative consequences on the health of the animal and increased production of heat.For the other nutrients it is considered necessary, by many researchers, to increase their inclusion levels in periods of heat stress.

*Dealing with toxins that adversely affect animal health.* The warm and humid weather increases the likelihood of contamination by mycotoxins inside and outside the unit. In heat stress conditions the liver of the animals is often under pressure. This appears as a poor use of nutrients and / or chronic inflammation of the liver. It is important to maintain the liver as healthy as possible and avoid further stress by toxins, e.g. mycotoxins.