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Minimizing environmental effects on nutritional needs of growing finishing pigs

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Abstract

Swine have a great ability to grow and reproduce in a variety of environments and facilities. This ability is documented by profitable production in both the most elaborate and the most simple facilities. Efficiency and profitability in environmental extremes are highly variable but performance level during environmental stress is generally less than maximum. The thermal environment strongly influences pig performance with air temperature having the primary effect. All too often, producers fail to consider the total environment of the pig. Air movement, humidity, and, in some instances, solar radiation contribute to how the pig feels. We must consider the total heating or cooling power of the environment. We often refer to this temperature as effective temperature.; Swine Day, Manhattan, KS, November 19, 1987

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MINIMIZING ENVIRONMENTAL EFFECTS ON NUTRITIONAL NEEDS OF GROWING FINISHING PIGS

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Swine have a great ability to grow and reproduce in a variety of environments and facilities. This ability is documented by profitable production in both the most elaborate and the most simple facilities. Efficiency and profitability in environmental extremes are highly variable but performance level during environmental stress is generally less than maximum.

The thermal environment strongly influences pig performance with air temperature having the primary effect. All too often, producers fail to consider the total environment of the pig. Air movement, humidity, and, in some instances, solar radiation contribute to how the pig feels. We must consider the total heating or cooling power of the environment. We often refer to this temperature as effective temperature.

Figure 1 shows the relationship of energy flow and temperature for the pig. Fortunately, the pig has a range of temperature at which production efficiency is maximal. This allows a great deal of flexibility in facility design and temperature control. The major determinant of heat loss or production is the difference between body and environmental temperatures. The greater the difference the greater the heat loss. If the pig is exposed to temperatures below its comfort zone, some of the energy previously available for growth must be shunted to maintain its body temperature at a constant 102.5 F.

The pig can employ several mechanisms to minimize or maximize heat loss in order to adjust to the challenge of his environment. Blood can be directed from the core to the body surface or vice versa. In addition, the ability to huddle with pen mates during cold stress or stretch out to maximize body surface area during heat stress allows the pig to have a comfort zone versus a comfort temperature.

When temperatures drop below or rise above the critical level, the pig's primary response is a change in appetite. Cold stimulates intake, whereas heat has a severely depressing effect on appetite. The response of intake and changes in maintenance requirement reduce energetic efficiency in conversion of feed to tissue or product.

The three factors that influence feed efficiency for the pig are 1) rate of intake, 2) level of maintenance or energy demand to maintain a constant body temperature, and 3) composition of gain. For purposes of this discussion, we will be concerned only with the first two factors, which are greatly influenced by air temperature or effective temperature of the environment.

If we look at the energy flow of the pig, we see several losses. Energy is lost in feces, urine, meeting body temperature requirements, and formation of a stored product. Energy is also utilized for chemical reactions in the building up or breakdown of muscle and bone. Air temperature will have its greatest influence on energy for maintenance of body temperature demands.

The pig eats to meet its nutrient needs for energy, protein, minerals and vitamins. When the pig is exposed to temperatures outside its comfort zone, nutrient requirements change. With the exception of energy, the influence of effective temperature on nutrient requirements is not well understood. When pigs are exposed to temperatures below the lower critical temperature, heat production and intake must increase to maintain body temperature.

It is important to realize that the pig has an increased energy requirement both above (heat stress) and below (cold stress) the comfort zone. Energy can be supplied in several forms. The basic decision about the degree of environmental modification must be based on the relative price of energy versus fuel. The trade-off between feed and fuel relates to the uses the pig has for energy. Since pigs are homeothermic or warm-blooded, the temperature control system of the pig strives to keep body temperature constant. It cannot be overemphasized that maintaining body temperature is the first priority of the pig. Only after this need has been met will energy be used for production of stored product in the form of lean or fat tissue. Pigs will first "eat for heat" and then produce "meat."

Producers basically have two choices: 1) alter the environment to minimize temperature stress or 2) allow the pig to increase its heat production in cold by increasing energy intake. As the pig is exposed to colder temperatures, the additional heat loss exceeds feed intake and consequently daily gain declines. Feed intake will be influenced first, followed by change in daily gain.

The first alternative is costly to the producer in the form of fuel energy, and the second is costly from a feed energy standpoint. To determine the influence of air temperature on feed efficiency, it is important to examine the factors that influence critical temperature of the pig.

SIZE OR WEIGHT. As the pig increases in size, the ability to perform well over a wide range of temperatures increases.

GROUP SIZE. As group size increases, critical temperature drops because huddling with pen mates reduces the exposed area of the pig, and consequently, heat loss is reduced.

FLOOR MATERIAL. Straw will help insulate the pigs agains heat loss, but heat loss is increased with slatted and wet floors.

AIR MOVEMENT. Convective heat loss is affected by air movement.

Table 1 illustrates the influence of air temperature on intake, gain, and feed to gain ratio. Feed intake is greatly influenced at temperatures above and below the comfort zone. Pigs exposed to freezing temperatures consumed excessive quantities of feed to offset heat loss demands. On the other extreme, or heat stress, feed intake is extremely low. During heat stress feed intake the major production problem.

Daily gain is a function of feed intake and maintenance requirement. As the environment demands more energy to be shifted to keep the pig warm, less energy is available for gain.

Feed to gain ratio or feed efficiency is also shown in table 1. Within the temperature range of 50-77 F, no real difference in feed efficiency exists. Feed to gain ratio is extremely high at 41 F and 32 F, since the pig is consuming large quantities of feed to keep warm.

During heat stress, feed to gain ratio also increases. In contrast to cold stress, this ratio is not as greatly influenced, since pigs exposed to heat stress are neither eating nor gaining.

If we express efficiency purely on feed to gain ratio, the heat-stressed pig is relatively efficient. However, the reduced gain and increased time on feed must also be considered.

Air quality has also been studied to determine its influence on feed efficieny. Generally speaking, the air quality normally found in most facilities has been shown to have little effect on feed efficiency. However, the young pig is much more susceptible to manure and noxious gases than the older pig.

In conclusion, air temperature does have a significant effect on feed efficiency. We continually strive to maximize feed efficiency by changes in nutrition, disease, genetics, and in the pig's environment. With current prices of fuel versus feed, producers need to take a hard look at the costs of energy to the pigs. It may be more economical to let the pig eat for heat instead of meat. The decision on degree of modification must be based on the relative price of feed versus fuel. The merit of maximizing feed efficiency from an environmental standpoint may be questionable with current prices of feed.

Table 1. Effect of Temperature on Finishing Pig Performance

Temp, F	Daily Intake, lb	Daily Gain, lb	F/G
32	11.16	1.18	9.45
41	8.27	1.17	7.10
50	7.70	1.76	4.37
59	6.93	1.74	3.99
68	7.09	1.87	3.79
77	5.78	1.58	3.65
86	4.87	.98	4.91
95	3.33	.68	4.87

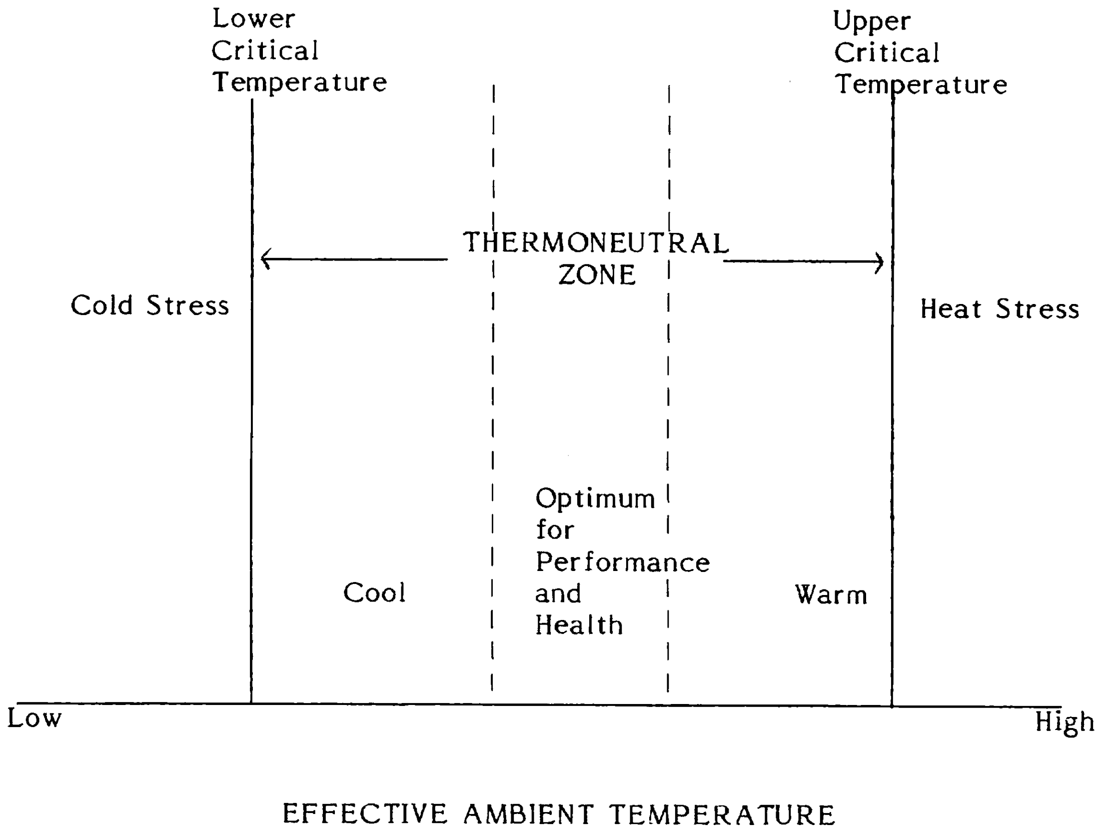

Figure 1. From NRC 1981.