

Profitable pig farming

through management of heat stress

N H Mohan^{1*}, Prajwalita Pathak and Misha Madhavan M

ICAR-National Research Centre on Pig, Guwahati, Assam 781 131

Exposure of pigs to heat stress, as it commonly occurs during summer season, can cause reduced productive, reproductive performances and increased susceptibility to diseases. The reduced production can lead to economic losses, that can be alleviated by adopting different managerial measures in a pig farm. Measures to reduce heat stress on pig include modification of housing to provide ventilation, adopting optimal feeding, management strategies and planning of animal house construction.

Keywords: Animal production, Heat stress, Pig farming, Thermo-neutral zone

ONE of the major threats of present day farming is the impact of global warming and impending climate change on agriculture and livelihood. The United Nations Intergovernmental Panel on Climate Change has described potential effects of changing climate on various spheres of life with increase of several degrees of global temperature. Annual report of Department of Agricultural Research/Indian Council of Agricultural Research (2011) concludes that due to higher demographic pressure on natural resources and weak mechanisms to offset adverse effects, the impact of climate change on agriculture will have a higher impact of food security in comparison to developed countries like India. It is expected that increasing ambient temperature and other climatic events will adversely impact production and profitability of animal agriculture, including pig farming.

Relevance of pig farming in India

Pigs play an important role in livelihood and nutrition of socio-economically weaker sections of the society. As per 20th Livestock census

released by Government of India, the pig population of the country is 9.055 million. Pigs are the most important livestock for the North Eastern states of India, and also contributes significantly to the livestock economy in many other States such as Uttar Pradesh, Kerala, Tamil Nadu, West Bengal, Odisha, Punjab and Haryana. Therefore, immense scope exists in generation of livelihood, poverty alleviation and nutrition through a medium of pig husbandry. However, physiological limitations for evaporative cooling and increased subcutaneous fat makes pigs increasingly vulnerable to heat stress and hence are one of the livestock species most vulnerable to climate change.

General effects of heat stress on animal production

The impact of heat and climate stress on animal production can be summarized as 1. Reduction in production (milk, meat, egg, wool etc.), reproduction (infertility, decrease in litter size, reduction in semen quality) and reduction in quality of animal products due to direct impact on physiological functions of the body, 2. Higher

ambient, extended range of temperatures can increase incidence of diseases by altering animal immunity, pathogen characteristics and distribution of vectors, and 3. Reduction in the availability and quality of animal feed components, which is further compounded by reduction in fodder farming area.

Effect of heat stress on pig production

Thermo-neutral zone (TNZ) for comfort zone is the ambient temperature range that promotes least stress to the animal, hence maximises performance. It is regarded that thermoneutral zone for pigs broadly ranges between 15 and 25°C in pigs, depending upon age and physiological status of the animal. Swine care book (2003) published by National Pork Board, USA range of TNZ for various categories of pigs, grower/finisher-10-24°C; sow/boar-15-24°C; lactating pigs-16-27°C; piglets-27-33°C. Pigs under heat stress show reduction in growth rate, feed efficiency, digestibility, meat quality due to less protein deposition, increased susceptibility for diseases, decreased farrowing rate and litter size. Primary reason for reduced body weight gain

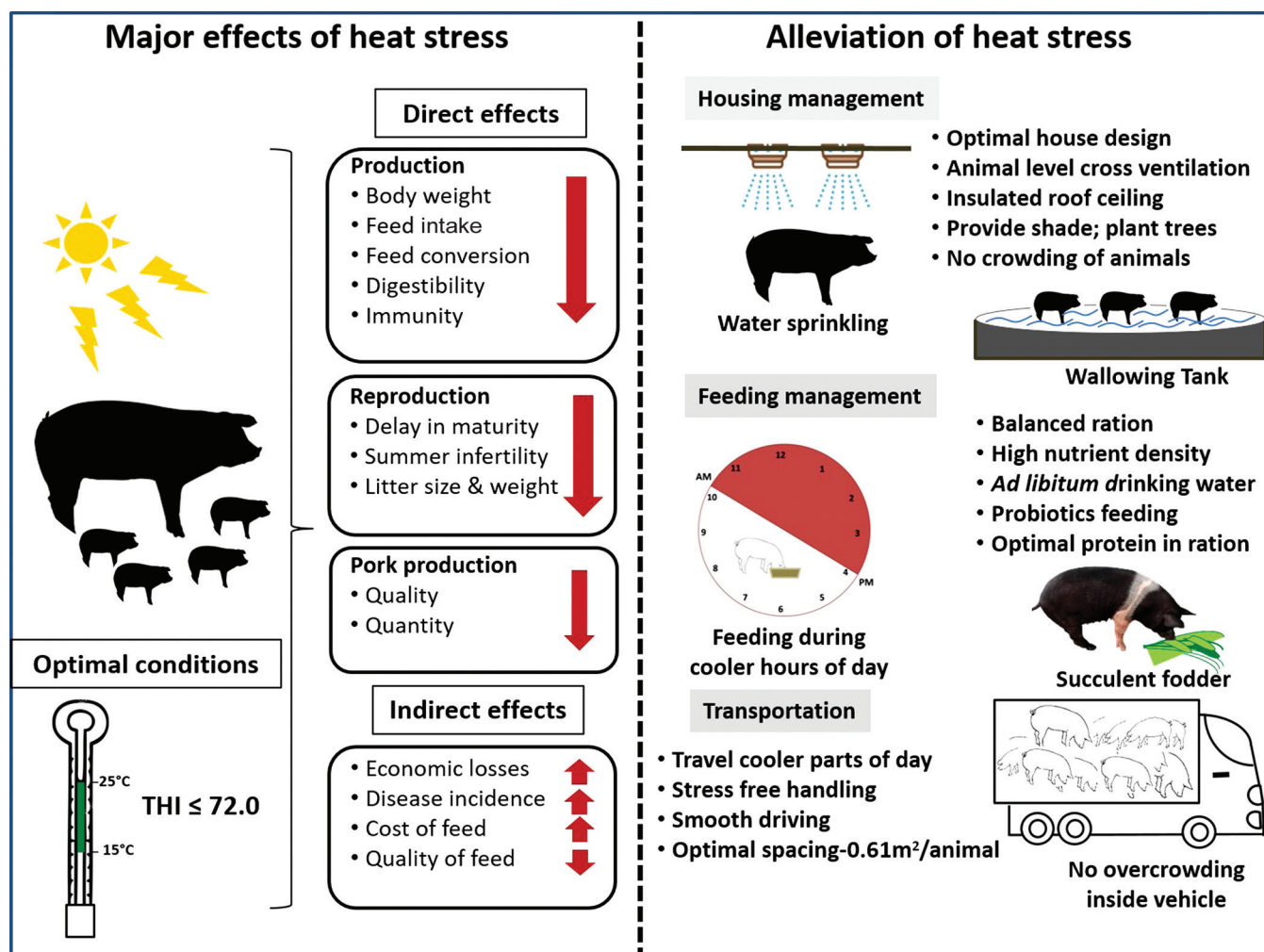


Fig. 1. Major effects of heat stress and its alleviation in pig farms

appears to be due to reduction in feed consumption by pigs under heat stress. The reduction in feed intake depends on extent of stress, influenced by factors such as breed, genetic background, colour of the skin, size of the animal and physiological stage, and environmental factors such as housing, feeding management, climatic parameters (relative humidity, air flow, and ambient temperature), and duration of exposure to inclement weather. In simple terms, an increase of ambient temperature above the upper limit of the thermoneutral zone negatively affects animal performance. The reduced feed intake during thermal stress further magnifies the energy deficit in lactating sows, which can delay reproductive cycle, ultimately reducing productive lifespan of the animal. Exposure of breeding animals to elevated ambient temperatures can result in reduced reproductive

efficiency. In female pig, exposure to heat stress causes delayed puberty, reduction in farrowing rate and litter size, especially when exposed happens during late gestation. In boar, exposure to elevated ambient temperatures causes reduction in semen quality, sperm output, increased number of abnormal spermatozoa and infertility. A major effect of hot summer season on reproduction, often referred to as summer infertility, manifests as anestrus, prolonged weaning interval, conception failure and poor semen quality. Weak estrus symptoms and failure to detect heat, subsequently missing optimal artificial insemination/mating time has been frequently observed under field conditions in India. Heat stress also modifies animal behaviour, seeks shade, wallows in water tanks and cold floor to mitigate discomfort. Long exposure to heat stress, even short transport during hot summer

day can induce changes in muscle and deteriorate meat quality.

Economic losses due to heat stress

In general, pigs under thermal stress or hot season reduce their feed intake, which directly impacts growth rate and body weight gain. The reduction in body weight gain and number of viable piglets forms the economic losses at the farmer level. The larger and more productive animal will have a larger impact of heat stress than a smaller sized pig. The National Research Council (NRC) document on effect of environment on nutrient requirement of animals (1981) states that as compared to animals maintained at 21°C, the pigs exposed to 32°C consumed less by 60-100g/°C, corresponding to a decrease in body weight gain of 35 to 57 g/day/°C. It was reported (NRC 1981; Annual Report, ICAR-NRCP, 2012) that the loss of body weight per day can range



Fig. 2. Bamboo mat ceiling, fans and improved cross ventilation can reduce temperature inside pig houses

from 30 to 500 grams depending upon the size of the animal and extent of thermal stress. Unfortunately, the actual quantification of loss of body weight/day are quite difficult to assess at field level for want of controlled conditions or previous knowledge regarding the actual growth accrual of the animal for a given stage of growth. In a conservative estimate, if one considers a loss of 100 gram/day, it translates to 3.0kg/month, and for final three months before sale, the loss of body weight is around 9.0kg. At prevalent market price of ₹ 280/kg pork, the loss/animal is around ₹ 1,764/animal ($6.30 \text{ kg} \times ₹ 280$, assuming 70% dressing percentage). Besides this, the monetary loss due to reduction or death of piglets due to heat stress is approximately ₹ 3,000/piglet. However, when a piglet is lost due to death or reduction in litter size, an entire production chain that can be obtained from the animal is lost. In a nutshell, the heat stress in pigs causes insensible, not easily quantifiable economic losses, which needs to be prevented or reduced by taking appropriate mitigating measures by the swine producers.

Measures for reducing heat stress in pig

The following section provides mitigating strategies for reducing thermal stress briefly. There are four principal methods to improve animal

performance during the period of thermal stress. Major effects of heat stress and its alleviation in pigs farms are summarised in Fig. 1.

Modification of ambient environment through optimal housing conditions

The basic aim of modification is to reduce heat and moisture through providing optimal ventilation in the houses. Generally, pig house in India are constructed as semi-open with or without a wallowing tank in an open area. The semi-open construction ensures proper ventilation and wallow allows surface cooling of pigs during hotter parts of the day. Providing water sprinklers also can reduce ambient temperature, even though it increases humidity inside the animal house. Providing fans to increase evaporative cooling has also been used successfully in many farms. Some of the specific interventions to reduce ambient temperature inside pig houses that can be suggested are:

- a. Provide green cover over the roof, trees to be planted around the pens,
- b. Placing insulating material below the roof in the form of ceiling using bamboo mats or insulation sheets, and
- c. Providing slots/holes in walls of pig house, to provide animal level cross ventilation (Figs. 2-4).

In general, we observed that well ventilated animal house will have few degrees lesser temperature than the ambient temperature outside farm

premises. Fixing of solar panel (Fig 3) on the roof of pig sheds can reduce inside temperatures and generate electricity, thus reducing carbon footprint of the farm. All the essentially advocated biosecurity measures have to be adopted in the farms as per the advice of a veterinarian to prevent and control diseases.

Nutritional management

A suggested nutritional strategy to reduce heat stress is to increase the nutrient density in general and specifically energy density to compensate for the reduction in the feed intake by animal. Addition of extra protein, fat and reduction in fibre content in the feed are some important points in the pig feed preparation during hotter months of the year. The heat stressed animals have reduced protein retention and has therefore increased requirement of protein in the diet. The importance of clean *ad libitum* drinking water cannot be over emphasized and must be available at all times of the day. Pigs will consume 2.5 to 3.0 litres of water per kg of feed consumed. Feeding of probiotics and other supplements including mineral and vitamins (Vitamin E, C) have also been reported to alleviate thermal stress. Providing balanced nutrition throughout the animal's lifetime is one of the key measures to ensure maximum performance and successful pig farming as feeding contributes to about 70% of animal raising costs.

Selection and breeding of heat tolerant animals

It has been observed that there is variation in the thermotolerance among various individual animal. This could be made useful while selecting animals for breeding. It has been observed that exotic breeds of pig such as Hampshire, Large White Yorkshire maintained under agro-climatic conditions of India for a long period of time performs excellently in the farmers field. The crossbreds of these exotic breeds with indigenous animals also seem to be well adapted to the climatic conditions of India.



Fig. 3. Solar panels on roof can reduce temperature inside pig house and generate electricity



Fig. 4. Roof, wall structure and slots improve cross-ventilation inside pig houses

Stress management during transport

Transportation of pigs from the farm to slaughter house plant exposes animals to heat stress, which can nullify the efforts taken at farm level. Increased ambient temperature and humidity with poor ventilation and overcrowding can subject animals to severe thermal stress that can result in poor meat quality and loss of animal at extreme conditions. Government of India has notified detailed guidelines for transport of various animals including pigs and modes of transport should be followed strictly. Adequate measures are to be taken during transportation to reduce heat stress and promote welfare and safety. Some of the non-exhaustive measure include:

- Journey should be planned during cooler parts of the day, as far as possible.
- Adequate spacing in the animal

area ($0.61\text{m}^2/\text{animal}$) promote ventilation and prevent overcrowding.

- Availability of adequate drinking water and feed.
- Gentle handling of animals at all times especially during unloading and reloading of animals.
- Measures for avoiding fight amongst animals while travel such as non-mixing of unfamiliar animals, different age groups, partitions in animal space for different categories of pigs.
- All animals should be declared fit for transport by a registered Veterinary Practitioner.
- Not more than 8 hours of continuous journey, and gap of 48 hrs between two separate journeys for the same animal.
- Transporting vehicle should have appropriate permits and licensed

driver should be trained for smooth driving.

- Insure the animals during the transport.

SUMMARY

Thermal stress in pigs, especially during hot summer seasons, can severely impact profitability of pig farming. Some of the key measures to alleviate stress on animal will include adopting optimal management options including housing, modified managerial practices, genetic selection of animals with increase stress tolerance, improved biosecurity for prevention, early diagnosis and treatment of animal diseases and development of alternate feed resources.

¹Principal Scientist. Corresponding author's e-mail: mohan.nh@icar.gov.in

Jai Kisan, Jai Vigyan

- A total of ₹ 788.33 crores have been sanctioned for opening six new agricultural colleges for eastern India under Central Agricultural University, Imphal, and a new Central Agricultural University in Meghalaya.
- For the establishment of two new Agricultural Research Institutes in Assam and Jharkhand, a sum ₹ 100 crores is allocated.
- First academic session of the Rani Lakshmibai Central Agricultural University has been allocated for four new Agricultural Colleges in Ditiya and Jhansi.
- A Memorandum of Understanding was signed for transforming the Rajendra Central Agricultural University, Pusa, Samstipur, Bihar. A proposal of ₹ 400 crores is submitted in EFC.
- Post-Graduate Institute of Horticulture is being established in Amritsar, Punjab.
- Foundation stone of the Indian Institute of Agricultural Biotechnology is laid in Ranchi for promoting Agricultural Biotechnology.