EFFECTS OF HIGH TEMPERATURE ON GROWTH PERFORMANCE OF PIGS

by

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A thesis submitted for the
degree of Doctor of Philoscphy
at the University of New England,
2351 N.S.W., Australia.
March, 1984.

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PREFACE

The studies presented in this dissertation are original and were completed by the author in the Department of Animal Science, Faculty of Rural Science, University of New England, Armidale, New South Wales, Australia. Assistance given by other persons is indicated in the text or in the list of acknowledgements. All references cited are included in a bibliography.

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I certify that the substance of this thesis has not already been submitted for any degree and is not being currently submitted for any other degree.

I certify that any help received in preparing this thesis, and all sources used, have been acknowledged in this thesis.

(C.Vajrabukka)
March 1984.

ACKNOWLEDGEMENTS

The author wishes to express his gratitude to Associate Professor D. J. Farrell and Dr. C. J. Thwaites for their guidance, assistance and criticism during the course of study and the preparation of this thesis. For his valuable advice and assistance in the statistical analysis, Dr. V. J. Bofinger is also acknowledged.

The author wishes to express his appreciation to and acknowledge the technical assistance of both Department of Animal Science and the Department of Biochemistry and Nutrition staff, particularly Mrs B. Ward.

The studies presented in this thesis were carried out with funds provided by the Australian Pig Industry Research Committee. The author wishes to express his sincere thanks to the Australian Pig Industry Research Committee for that support and also for provision of a scholarship during the period of study.

The author wishes to express his sincere thanks to Mrs J. J. Parker and Mrs F. Hughes for willing help during the typing of this manuscript.

Finally, the author wishes to express his gratitude to his wife, Vilaiwan, who not only gave him the necessary support for the completion of these studies, but in addition, helped countless times on weekends in often unpleasant tasks.

SUMMARY

1.0 Field Survey

Data related to the biological performance of pigs were collected from various piggeries in Queensland, N.S.W., Victoria and Tasmania. Climatic zones in the above states were defined and the biological performance data were related to various temperature parameters in different climatic zones.

There were significant relationships between the growth perfcrmance parameters and climatic parameters with a reduction in daily rate of gain, an increase in feed conversion ratio and possibly an increase in backfat depths during the hotter parts of the year.

2.0 Field Experiments

Experiments were conducted under field conditions in central New South Wales in various piggeries to determine the effects of a hot climate on biological performance under practical conditions.

The results were discussed in detail. It was concluded that there is a reduction in growth of 10 g/°C rise in ambient temperature, especially in bacon pigs, during the hot part of the year.

3.0 Laboratory Experiments

Eight experiments were conducted under laboratory conditions at the University of New England, to study the influence of high ambient

temperature on the growth performance of bacon pigs and to try to determine means to ameliorate heat stress.

3.1 Dietary Energy and Protein

Two similar laboratory experiments were conducted using different diets of varying energy and protein concentrations. It was concluded that for pigs living in a hot environment (35±1° C, day; 25±1° C, night), a diet with high energy and high protein concentrations would improve increase the growth rate.

3.2 Inclusion of Animal Fat and Vegetable Oil

Two similar laboratory experiments were carried out using different diets containing added tallow, meat meal, rice pollard and vegetable oil. The results were discussed and it was concluded that added tallow would lift the growth rate of heat-stressed pigs to a similar level to that of control pigs at 21±2° C. Pigs on diets containing supplementary lipids from other sources did not perform as well under high environmental conditions as those on a diet with 5% tallow.

3.3 Nitrogen Retention

A balance experiment was carried out using four diets of varying energy and protein levels and two environmental temperatures. Pigs in the control environment (21±2° C) were pair-fed to their counterparts in the hotroom (35±1° C). The results indicated that under restricted feeding, there were significant differences in terms of nitrogen retention between pigs in the hotroom and control-room. Pigs on diets with higher levels of protein retained more nitrogen than those on lower levels. There was no influence of dietary energy level on nitrogen retention.

3.4 Water Consumption and Sprinkling

A preliminary experiment was carried out to determine the effects of duration of sprinkling water on cutaneous evaporation from the pig. The results indicated that the amount of moisture available for evaporation from the skin of pigs increased with increased duration of sprinkling. On this basis, two sprinkling durations (30sec/30min, 120sec/30min) were selected for comparison of their effects on the biological performance of heat stressed pigs.

Drinking water at different temperatures (30±1° C and 11±1° C) was included to determine its possible cooling effects on growth performance. Pair-feeding treatments were also included to determine the extent to which the depressed growth performance found under high ambient temperature could be attributed to depressed voluntary feed intake.

The results indicated that the reduced growth of heat stressed pigs was possibly due to a combination of depressed voluntary feed intake and an increased energy requirement for the extra-thermoregulatory activities. The sprinkling duration of 2min/30min eliminated the influence of heat stress while the 30sec/30min treatment was intermediate in its benefits. Cooled drinking water did not ameliorate the effects of heat stress and consumption of cooled water by pigs was highest while that on the warm drink was lowest in the hot environment.

3.5 Metabolic Heat Production

Pigs were grown from 45 to 90 kg liveweight at different environmental temperatures (35±1° C, day; 25±1° C, night and 21±2° C) and their metabolic

heat production was measured in respiration chambers at 24° C during two 24 hour periods in the course of the experiment. There was no significant difference in metabolic heat production between the heat stressed and control pigs. Two possible explanations were given:

a) Reduction in dry matter intake by heat stressed pigs would be expected to result in a lowering of metabolic heat production.

b) Pigs from both the hotroom and control-room were measured at 24° C environment. Different results may have been obtained if the calorimeter had been capable of maintaining the 21° C and 35° C temperatures utilized in the growth segments of the experiment.

Relationships between total heat production per pig per day and respiratory quotient and daily dry matter intake were established. The results indicated that the animals with higher daily dry matter intakes had higher total heat production and respiratory quotient values.

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ABBREVIATIONS USED

ad lib.	*ad libitum*
ADE	Apparent Digestibility of Energy
ADM	Apparent Digestibility of Dry Matter
ADN	Apparent Digestibility of Nitrogen
ADP	Apparent Digestibility of Protein
b	breaths
CD	Chest Depth
CL	Carcase Length
cm	centimetre
DCP	Digestible Crude Protein
DE	Digestible Energy
DFI	Daily Feed Intake
DM	Dry Matter
DMI	Average Daily Dry Matter Intake
Dress%	Dressing Out Percentage (hot carcase weight, head on)
DRG	Daily Rate of Gain
ECR	Energy Conversion Ratio (energy/liveweight)
EI	Average Daily Energy Intake
et al.	and others
FCR	Feed Conversion Ratio (feed/liveweight)
g	gram
GIR	Girth
h	hour

HH	High energy - High protein
HL	High energy - Low protein
iu	international unit
J	Joule
kg	kilogram
kJ	kilojoule
kPa	kilo-Pascal
kW	kilo-Watt
l	litre
LH	Low energy - High protein
LL	Low energy - Low protein
m	metre
ME	Metabolizable energy
mg	milligram
min	minute
MJ	Mega Joule
ml	millilitre
mm	millimetre
N	Normal concentration
n	number of readings
N.A.	Not Available
N.S.	Not Significant
P	Probability
P2	Backfat depth at P2 position
R^2	Multiple correlation coefficient
R.Q.	Respiratory Quotient
RR	Respiration Rate

RSD	Residual Standard Deviation
RT	Rectal Temperature
sec	second
ST	Skin Temperature
TDMI	Total Dry Matter Intake
TNR	Total Nitrogen Retention, total of 5-day collection
TNR%	Total Nitrogen Retention as a percentage of total nitrogen ingested
°C	Degree Celsius
-	Approaching significant ($0.05<P<0.10$)
*	Significant at ($P<0.05$)
**	Significant at ($P<0.01$)
***	Significant at ($P<0.001$)