

EFFECTS OF HIGH TEMPERATURE ON GROWTH PERFORMANCE OF PIGS

by

CHANVIT VAJRABUKKA

Department of Animal Science,

Faculty of Rural Science,

University of New England,

Armidale, N.S.W., 2351,

Australia

Supervisors: Associate Professor D. J. Farrell and Dr. C. J. Thwaites

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TABLE OF CONTENTS

PREFACE	i
ACKNOWLEDGEMENTS	ii
SUMMARY.	iii
LIST OF TABLES	vii
LIST OF FIGURES.	xii
LIST OF PLATES	xv
ABBREVIATIONS USED	xvi
I. GENERAL INTRODUCTION	1
II. LITERATURE REVIEW	3
1.0 THE IMPACT OF HOT CLIMATES ON PIG PRODUCTION	3
2.0 FACTORS AFFECTING HEAT STRESS IN PIGS	5
2.1 Anatomical and Physiological Factors	5
2.2 Climatic Factors.	6
2.2.1 Ambient Temperature	7
2.2.2 Humidity	8
2.2.3 Solar Radiation	9
2.2.4 Wind Velocity	10
2.2.5 Diurnal Variation in Temperature and Humidity	11
2.3 Nutritional Factors	12

3.0	EFFECTS OF A HOT CLIMATE ON THE GROWTH PERFORMANCE	
	OF PIGS.	14
3.1	Voluntary Feed Intake and Daily Rate of Gain . . .	14
3.2	Feed Efficiency	15
3.3	Dressing Percentage	16
3.4	Anatomical Changes and Backfat Depth.	16
4.0	AMELIORATION OF HEAT STRESS BY NUTRITIONAL MEANS	19
4.1	Dietary Protein Levels	19
4.2	Dietary Energy Levels	20
5.0	AMELIORATION OF HEAT STRESS IN PIGS BY UTILIZATION	
	OF WATER	24
5.1	Effect of Hot Climates on Cutaneous Evaporative	
	Cooling	24
5.2	Effect of Sprinkling on the Growth Performance	
	of Pigs	25
5.3	Drinking Water as a Cooling Agent	28
6.0	PROTEIN RETENTION IN PIGS AS INFLUENCED BY HOT	
	CLIMATES	30
7.0	METABOLIC HEAT PRODUCTION IN PIGS	33
7.1	Calorimetry	33
7.2	Metabolic Heat Production and Heat Stress	
	in Pigs	35

8.0	CONCLUSION	39
	 III. EXPERIMENTAL	 40
1.0	INTRODUCTION	40
2.0	FIELD SURVEY - THE PERFORMANCE OF COMMERCIAL PIGS IN DIFFERENT CLIMATIC ZONES IN AUSTRALIA	 42
2.1	Introduction	42
2.2	Materials and Methods	42
2.3	Results	44
2.3.1	Homogeneity Tests	48
2.3.2	Daily Rate of Gain	48
2.3.3	Feed Conversion Ratio	56
2.3.4	Backfat Depth	59
2.4	Discussion	63
3.0	FIELD EXPERIMENTS - THE PERFORMANCE OF COMMERCIAL PIGS AS AFFECTED BY AMBIENT TEMPERATURE AND SEASON OF YEAR	 68
3.1	Introduction	68
3.2	Field Experiment 1	68
3.2.1	Materials and Methods	69
3.2.2	Animals and Husbandry	70
3.2.3	Treatment of Data	70

3.2.4	Analysis of Data	72
3.2.5	Results	72
3.2.6	Discussion	75
3.3	Field Experiment 2	77
3.3.1	Materials and Methods	77
3.3.2	Analysis of Data	79
3.3.3	Results	79
3.3.4	Discussion	84
3.4	Field Experiment 3	86
3.4.1	Materials and Methods	87
3.4.2	Analysis of Data	88
3.4.3	Results	89
3.4.4	Discussion	93

4.0 EFFECTS OF DIETARY ENERGY AND PROTEIN LEVELS ON

	GROWING PIGS AT HIGH AMBIENT TEMPERATURE	96
4.1	Introduction	96
4.2	Materials and Methods	96
4.2.1	The Climate Laboratory	96
4.2.2	Modification of the Climate Laboratory	97
4.2.3	Animals and Husbandry	97
4.2.4	Treatments	101
4.2.5	Analysis of Data	101
4.3	Results	104
4.3.1	Results of Laboratory Experiment 1	104
4.3.2	Results of Laboratory Experiment 2	112
4.4	Discussion	122

5.0	EFFECTS OF LEVELS AND TYPES OF DIETARY LIPID ON PIGS	
	GROWING AT HIGH AMBIENT TEMPERATURE	131
5.1	Introduction	131
5.2	Materials and Methods	131
5.3	Treatments	132
5.3.1	Treatments of Laboratory Experiment 3 . . .	132
5.3.2	Treatments of Laboratory Experiment 4 . . .	132
5.3.3	Analysis of Data	135
5.4	Results	135
5.4.1	Results of Laboratory Experiment 3	135
5.4.2	Results of Laboratory Experiment 4	143
5.5	Discussion	151
6.0	NITROGEN RETENTION EXPERIMENT.	157
6.1	Introduction	157
6.2	Materials and Methods	157
6.2.1	The Climate Laboratory	157
6.2.2	Animals and Husbandry	157
6.2.3	Treatments	158
6.2.4	Feeding	158
6.2.5	Collection and Treatment of Samples	160
6.2.6	Analysis of Data	162
6.3	Results	162
6.4	Discussion	167

7.0	EFFECTS OF SPRINKLING DURATION ON TOTAL MOISTURE	
	LOSSES FROM PIGS	171
7.1	Introduction	171
7.2	Materials and Methods	171
	7.2.1 Modifications of the Shinfield Crates . . .	171
	7.2.2 Standard Routine	172
	7.2.3 Pigs, Husbandry and Treatments	173
7.3	Results	175
7.4	Discussion	175
8.0	SPRINKLING TO AMELIORATE THE EFFECTS OF HIGH	
	TEMPERATURE ON GROWING PIGS	179
8.1	Introduction	179
8.2	Materials and Methods	179
	8.2.1 The Climate Laboratory	179
	8.2.2 Animals and Husbandry	180
	8.2.3 Treatments	181
	8.2.4 Measurement	182
	8.2.5 Analyses of Results	184
8.3	Results	184
8.4	Discussion	192
9.0	EFFECTS OF AMBIENT TEMPERATURE ON METABOLIC	
	HEAT PRODUCTION IN PIGS.	196
9.1	Introduction	196
9.2	Materials and Methods	196
	9.2.1 Animals and Husbandry	196

9.2.2	The Calorimeter	198
9.2.3	Mode of Operation	199
9.2.4	The Gas Analysis System	201
9.2.5	Standard Calorimeter Procedures	201
9.2.6	Analysis of Data	204
9.3	Results	205
9.4	Discussion	217

IV. GENERAL DISCUSSION AND CONCLUSION	225
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BIBLIOGRAPHY	231
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APPENDICES	246
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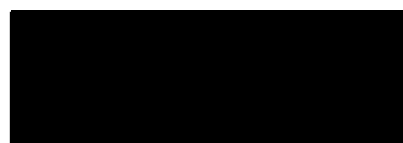
PREFACE

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.

* * * * *

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.

A solid black rectangular box used to redact the author's signature.

(C.Vajrabukka)

March 1984.

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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 performance 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 ($35\pm 1^{\circ}\text{C}$, day; $25\pm 1^{\circ}\text{C}$, 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 $21\pm 2^{\circ}\text{C}$. 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 ($21\pm 2^{\circ}\text{C}$) were pair-fed to their counterparts in the hotroom ($35\pm 1^{\circ}\text{C}$). 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 ($30 \pm 1^\circ\text{C}$ and $11 \pm 1^\circ\text{C}$) 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 ($35 \pm 1^\circ\text{C}$, day; $25 \pm 1^\circ\text{C}$, night and $21 \pm 2^\circ\text{C}$) 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.

LIST OF TABLES

Table 1	Summary of the reported effects of different sprinkling regimes on the Daily Rate of Gain (DRG) of pigs.
Table 2	Predicted pig performance using computer-simulation of pigs fed a diet containing 15.9 MJ/kg <i>ad libitum</i> and standing in an environment of 55% R.H. and 1 m/s wind velocity (Adapted from Stombaugh and Oko, 1980).
Table 3	Heat production of pigs of different ages and liveweights when fed different amounts of energy under thermoneutral conditions (Adapted from Holmes and Close, 1977).
Table 4	The metabolic heat production of pigs living at various environmental temperatures.
Table 5	Location of data sources and their closest meteorological stations.
Table 6	Results of homogeneity tests conducted on the data collected from 14 commercial piggeries in the field survey.
Table 7	Overall trends in the relationships between month of year and monthly maximum, minimum and mean air temperatures and the Daily Rate of Gain (DRG) of pigs raised under commercial conditions in different climatic zones in Australia.
Table 8	Overall trends in the relationships between month of year and monthly maximum, minimum and mean air temperatures and Feed Conversion Ratio (FCR) in pigs raised under commercial conditions in different climatic zones in Australia.
Table 9	Overall trends in the relationships between month of year and monthly maximum, minimum and mean air temperatures, and Backfat Depth (P2) of pigs raised under commercial conditions in different climatic zones in Australia.
Table 10	Mean values for overall Daily Rate of Gain (DRG _e), Feed Conversion Ratio over the experimental period (FCR _e), Dressing Percentage (Dress%) and Backfat Depth (P2) in four groups of pigs raised in each of three seasons.
Table 11	Composition of the standard feed used in Field Experiment 2 (air dry basis).
Table 12	Mean values of Daily Feed Intake (DFI), Daily Rate of Gain (DRG), Feed Conversion Ratio (FCR), Backfat Depth (P2) and Dressing Percentage (Dress%) for pigs in Field Experiment 2.

Table 13	Composition of the three rations containing different levels of total lysine in Field Experiment 3 (air dry basis).
Table 14	Mean values of Daily Feed Intake (DFI), Daily Rate of Gain (DRG), Feed Conversion Ratio (FCR), Backfat Depth (P2) and Dressing Percentage (Dress%) of pigs in Field Experiment 3.
Table 15	Diet composition (g/kg) in Laboratory Experiment 1 (air dry basis).
Table 16	Diet composition (g/kg) in Laboratory Experiment 2 (air dry basis).
Table 17	Mean values of Daily Rate of Gain (DRG), Dressing Percentage (Dress%), Daily Dry Matter Intake (DMI), Feed Conversion Ratio (FCR) Daily Energy Intake (EI) and Energy Conversion Ratio (ECR) of pigs on different dietary and environmental temperature treatments in Laboratory Experiment 1.
Table 18	Means of Apparent Digestibility of Dry Matter (ADM), Protein (ADP), Energy (ADE), Digestible Energy (DE) and Crude Protein (DCP) of diets given to pigs living in either hot or cold environments in Laboratory Experiment 1.
Table 19	Means of Carcase Backfat Depth (P2) measured by ultrasonic (Scanoprobe) and optical (Introscope) methods, Carcase Length (CL), Chest Depth (CD) and Girth of pigs which received different dietary and environmental temperature treatments in Laboratory Experiment 1.
Table 20	Means of Respiration Rate (RR), Rectal (RT) and Skin (ST) Temperatures of pigs which received different dietary and environmental temperature treatments in Laboratory Experiment 1.
Table 21	Mean values of Daily Rate of Gain (DRG), Dressing Percentage (Dress%), Daily Dry Matter Intake (DMI), Feed Conversion Ratio (FCR) Daily Energy Intake (EI) and Energy Conversion Ratio (ECR) of pigs on different dietary and environmental temperature treatments in Laboratory Experiment 2.
Table 22	Means of Apparent Digestibility of Dry Matter (ADM), Protein (ADP), Energy (ADE), Digestible Energy (DE) and Crude Protein (DCP) of diets given to pigs living in either hot or cold environments in Laboratory Experiment 2.
Table 23	Means of Carcase Backfat Depth (P2) measured by ultrasonic (Scanoprobe) and optical (Introscope) methods, Carcase Length (CL), Chest Depth (CD) and Girth of pigs which received different dietary and environmental temperature treatments in Laboratory Experiment 2.

Table 24	Means of Respiration Rate (RR), Rectal (RT) and Skin (ST) Temperatures of pigs which received different dietary and environmental temperature treatments in Laboratory Experiment 2.
Table 25	Diet composition (g/kg) in Laboratory Experiment 3 (air dry basis).
Table 26	Diet composition (g/kg) in Laboratory Experiment 4 (air dry basis).
Table 27	Mean values of Daily Rate of Gain (DRG), Dressing Percentage (Dress%), Daily Dry Matter Intake (DMI), Feed Conversion Ratio (FCR) Daily Energy Intake (EI) and Energy Conversion Ratio (ECR) of pigs on different dietary and environmental temperature treatments in Laboratory Experiment 3.
Table 28	Means of Apparent Digestibilities of Dry Matter (ADM), Protein (ADP) and Energy (ADE) and Digestible Energy (DE) and Crude Protein (DCP) contents of diets given to pigs living in either hot or cold environments in Laboratory Experiment 3.
Table 29	Means of Carcase Backfat Depth (P2) measured by ultrasonic (Scanoprobe) and optical (Introscope) methods, Carcase Length (CL), Chest Depth (CD) and Girth of pigs which received different dietary and environmental temperature treatments in Laboratory Experiment 3.
Table 30	Means of Respiration Rate (RR), Rectal (RT) and Skin (ST) Temperatures of pigs which received different dietary and environmental temperature treatments in Laboratory Experiment 3.
Table 31	Mean values of Daily Rate of Gain (DRG), Dressing Percentage (Dress%), Daily Dry Matter Intake (DMI), Feed Conversion Ratio (FCR) Daily Energy Intake (EI) and Energy Conversion Ratio (ECR) of pigs on different dietary and environmental temperature treatments in Laboratory Experiment 4.
Table 32	Means of Apparent Digestibilities of Dry Matter (ADM), Protein (ADP) and Energy (ADE) and Digestible Energy (DE) and Crude Protein (DCP) contents of diets given to pigs living in either hot or cold environments in Laboratory Experiment 4.
Table 33	Means of Carcase Backfat Depth (P2) measured by ultrasonic (Scanoprobe) and optical (Introscope) methods, Carcase Length (CL), Chest Depth (CD) and Girth of pigs which received different dietary and environmental temperature treatments in Laboratory Experiment 4.
Table 34	Means of Respiration Rate (RR), Rectal (RT) and Skin (ST) Temperatures of pigs which received different dietary and environmental temperature treatments in Laboratory Experiment 4.

- Table 35 Composition (g/kg) of the diets used in Laboratory Experiment 5 (air dry basis).
- Table 36 Mean Values of Total Dry Matter Intake (TDMI), Apparent Digestibilities of Dry Matter (ADM), Energy (ADE), Nitrogen (ADN), Total Nitrogen Retained (TNR) and as a Percentage of Nitrogen Ingested (TNR%).
- Table 37 Diet composition (g/kg) used in Laboratory Experiment 7 (air dry basis).
- Table 38 Mean Values of Daily Dry Matter Intake (DMI), Daily Rate of Gain (DRG), Feed Conversion Ratio (FCR) and Dressing Percentage (Dress%) of pigs which received different water and environmental temperature treatments in Laboratory Experiment 7.
- Table 39 Means of Carcase Backfat Depth (P2) measured by ultrasonic (Scanoprobe) and optical (Introscope) methods, Carcase Length (CL), Chest Depth (CD) and Girth of pigs which received different water and environmental temperature treatments in Laboratory Experiment 7.
- Table 40 Means of Respiration Rate (RR), Rectal (RT) and Skin (ST) Temperatures of pigs which received different water and environmental temperature treatments in Laboratory Experiment 7.
- Table 41 Mean values for Daily Energy Intake (EI), Energy Conversion Ratio (ECR), Apparent Digestibilities of Dry Matter (ADM), Protein (ADP), Energy (ADE), Digestible Energy (DE) and Crude Protein (DCP) contents of the diet given to pigs in Treatments 1 and 6 in Laboratory Experiment 7.
- Table 42 Composition of the diet used in Laboratory Experiment 8 (air dry basis).
- Table 43 Means of Daily Dry Matter Intake (DMI), Daily Rate of Gain (DRG), Feed Conversion Ratio (FCR), Respiration Rate (RR) and Rectal Temperature (RT) of the pigs in Laboratory Experiment 8, over the experimental period.
- Table 44 Means of Daily Dry Matter Intake (DMI), Daily Rate of Gain (DRG), Feed Conversion Ratio (FCR), Respiration Rate (RR) and Rectal Temperature (RT) of the pigs in Laboratory Experiment 8, over two weeks prior to calorimeter runs; Average Weight (WT) is that of the pigs during the calorimeter runs (Periods I and II).
- Table 45 Means of Daily Dry Matter Intake (DMI), Daily Rate of Gain (DRG), Feed Conversion Ratio (FCR), Respiration Rate (RR) and Rectal Temperature (RT) of the pigs in Laboratory Experiment 8 over two weeks prior to calorimeter runs. Average Weight (WT) is that of the pigs during the calorimeter runs.

Table 46 Means of Metabolic Heat Production in Kilojoules per unit Metabolic Weight per day ($\text{kJ/kgW}^{0.75}/\text{d}$) or in Kilojoules per Kilogram Liveweight per day (kJ/kg/d) and of Total Heat Production (MJ/pig/d) and Respiratory Quotient (R.Q.) of pigs in Laboratory Experiment 8 when analysed separately for each calorimeter run.

Table 47 Means of Metabolic Heat Production in Kilojoules per unit Metabolic Weight per day ($\text{kJ/kgW}^{0.75}/\text{d}$) or in Kilojoules per Kilogram Liveweight per day (kJ/kg/d) and of Total Heat Production (MJ/pig/d) and Respiratory Quotient (R.Q.) of pigs in Laboratory Experiment 8 when analysed during both Periods I and II together.

LIST OF FIGURES

- Figure 1 Climographs of the 3 zones illustrated in Figure 2. The separate frames shown for zones 1 and 2 are those from each of the individual meteorological stations concerned.
- Figure 2 Map showing the geographical locations of the 15 sources (see Table 5) that contributed seasonal production data and the boundaries of the climatic zones into which they are divided.
- Figure 3 Daily Rate of Gain (DRG) of pigs in zones 1+2 over a 12 month period.
- Figure 4 Daily Rate of Gain (DRG) of pigs in zones 1+2 as related to the mean monthly maximum temperature.
- Figure 5 Daily Rate of Gain (DRG) of pigs in zones 1+2 as related to the mean monthly temperature.
- Figure 6 Daily Rate of Gain (DRG) of pigs raised in zone 1 as related to the mean monthly temperature.
- Figure 7 Daily Rate of Gain (DRG) of pigs raised in zone 1 as related to the mean monthly minimum temperature.
- Figure 8 Daily Rate of Gain (DRG) of pigs raised in zone 2 as related to the mean monthly maximum temperature.
- Figure 9 Daily Rate of Gain (DRG) of pigs raised in zone 2 as related to the mean monthly temperature.
- Figure 10 Daily Rate of Gain (DRG) of pigs raised in zone 2 as related to the mean monthly minimum temperature.
- Figure 11. Feed Conversion Ratio (FCR) of pigs in zones 1+2 as related to the mean monthly maximum temperature.
- Figure 12 Feed Conversion Ratio (FCR) of pigs in zones 1+2 as related to the mean monthly temperature.
- Figure 13 Backfat Depth (P2) of pigs in zones 1+2+3 as related to the mean monthly maximum temperature.
- Figure 14 Backfat Depth (P2) of pigs in zones 1+2+3 as related to the mean monthly temperature.
- Figure 15 Backfat Depth (P2) of pigs at Gatton, Queensland, as related to the mean monthly maximum temperature.
- Figure 16 Location within the shed of the pens in field experiment No. 1 (●-position of the thermohygrographs).

- Figure 17 Relationships between Daily Feed Intake (DFI), Feed Conversion Ratio (FCR), Backfat Depth (P2) and Dressing Percentage (Dress%) and mean shed temperature in Field Experiment 2.
- Figure 18 Relationships between Daily Feed Intake (DFI), Daily Rate of Gain (DRG), Backfat Depth (P2) and Dressing Percentage (Dress%) and mean shed temperature in Field Experiment 3.
- Figure 19 Air movement (m/s) measured at 15 cm above the wire mesh floor and 30 cm in from the corners of each pen and in the middle of each of the six pens.
- Figure 20 Positions at which Backfat Depth (P2) was measured.
- Figure 21 Plots of linear regressions of liveweights of pigs which received different dietary and ambient temperature treatments over days of experiment in Laboratory Experiment 1.
- Figure 22 Plots of linear regressions of liveweights of pigs which received different dietary and ambient temperature treatments over days of experiment in Laboratory Experiment 2.
- Figure 23 Plots of linear regressions of liveweights of pigs which received different dietary and ambient temperature treatments over days of experiment in Laboratory Experiment 3.
- Figure 24 Plots of linear regressions of liveweights of pigs which received different dietary and ambient temperature treatments over days of experiment in Laboratory Experiment 4.
- Figure 25 Rectal Temperature (RT) of pigs when exposed to constant environmental temperatures in the hotroom ($\rightarrow*$) and the control-room ($\rightarrow\ominus$) over a typical 24 hour period in Laboratory Experiment 5.
- Figure 26 Respiration Rate (RR) of pigs when exposed to constant environmental temperatures in the hotroom ($\rightarrow*$) and the control-room ($\rightarrow\ominus$) over a typical 24 hour period in Laboratory Experiment 5.
- Figure 27 Diagrammatic representation of the modified Shinfield crate used to measure total evaporative moisture losses from pigs.
- Figure 28. Evaporation following sprinkling of water on pigs for 0, 30, 60 and 120 seconds at the rate of 800 ml/min.
- Figure 29 Evaporation following sprinkling water on pigs for 0 and 90 seconds at the rate of 800 ml/min.
- Figure 30 Watering systems used in Laboratory Experiment 7.
- Figure 31 Equipment used for measuring the water intake of the pigs.

- Figure 32 Average daily water consumption per pig in each treatment.
- Figure 33 Plots of linear regressions of liveweight of pigs which received different water and environmental temperature treatments over days of experimental period in Laboratory Experiment 7.
- Figure 34 Calorimeter system used in Laboratory Experiment 8.
- Figure 35 The relationship between Total Heat Production per pig per day and Daily Dry Matter Intake (DMI) measured during two weeks prior to calorimeter runs in both Periods I and II for pigs exposed to high environmental temperature only.
- Figure 36 The relationship between Respiratory Quotient (R.Q.) and Daily Dry Matter Intake (DMI) measured during two weeks prior to calorimeter runs in both Periods I and II for pigs exposed to high environmental temperature only.
- Figure 37 The relationship between Liveweight (WT) during calorimeter runs and Rectal Temperature (RT) of pigs in the hotroom measured during two weeks period prior to the calorimeter runs in Periods I and II.
- Figure 38 The relationship between Respiratory Quotient (R.Q.) and the Daily Rate of Gain (DRG) of pigs in the hotroom measured during two weeks period prior to the calorimeter runs in Periods I and II.
- Figure 39 The relationship between Respiratory Quotient (R.Q.) and Rectal Temperature (RT) of pigs in the hotroom measured during two weeks period prior to the calorimeter runs in Periods I and II.
- Figure 40 Rectal Temperature (RT) of pigs from the hotroom (\pm) and control-room (\circ) when put through the standard procedure of calorimeter run with the respiratory hoods lifted.
- Figure 41 Rectal Temperature (RT) of pigs in the hotroom (\ast) and control-room (\ominus) over a 24 hour period in Laboratory Experiment 8.
- Figure 42 Respiration Rate (RR) of pigs in the hotroom (\ast) and control-room (\ominus) over a 24 hour period in Laboratory Experiment 8.

LIST OF PLATES

- Plate 1 An intensive piggery with galvanized sheet-metal pen partitions.
- Plate 2 An intensive pig unit with steel mesh partitions.
- Plate 3 An extensive pig production system.
- Plate 4 Feeding stalls being tilted into the vertical (non-feeding) position to maximize space allowance after feeding.
- Plate 5 An experimental pig in one of the "Shinfield" metabolic crates used in the determination of nitrogen retention. The feeder/water container is at the left, the urine collecting bottle underneath and the faeces collecting tray immediately behind the pig.
- Plate 6 A pig in the modified Shinfield crate while evaporation rate was being measured.
- Plate 7 Acid trap and air-flow meter system used to sample air flow through the modified Shinfield crate and to measure evaporation rate.
- Plate 8 Pigs in the hotroom being sprinkled in Laboratory Experiment 7.
- Plate 9 A pig panting in the hotroom at 35°C ambient temperature.
- Plate 10 A pig in a cage under the hood of one of the respiration chambers.

ABBREVIATIONS USED

<i>ad lib.</i>	<i>ad libitum</i>
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 carcass weight, head on)
DRG	Daily Rate of Gain
ECR	Energy Conversion Ratio (energy/liveweight)
EI	Average Daily Energy Intake
<i>et al.</i>	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 ($P < 0.001$)