

EVALUATION OF PERFORMANCE OF PUREBRED AND  
CROSSBRED GOATS AT TWO LOCATIONS IN MALAYSIA

ABDUL WAHID BIN SULAIMAN

UNIVERSITY OF MALAYA

MAY 1999

Dimikrofilikan pada..... 24-08-2000  
No. Mikrofis..... 14935  
Jumlah Mikrofis..... 3

HAMSAH BT. MOHAMAD ZAHARI

UPR UNIT PERPOTOGRAFI  
PERPUSTAKAAN UTAMA  
UNIVERSITI MALAYA

Ketno

Ael-3641  
INVC...ms... 23/12

EVALUATION OF PERFORMANCE OF PUREBRED AND  
CROSSBRED GOATS AT TWO LOCATIONS IN MALAYSIA

BY

ABDUL WAHID BIN SULAIMAN  
INSTITUTE OF BIOLOGICAL SCIENCES  
FACULTY OF SCIENCE  
UNIVERSITY OF MALAYA

Perpustakaan Universiti Malaya



A509084128

THESIS PRESENTED FOR THE  
DEGREE OF DOCTOR OF PHILOSOPHY  
UNIVERSITY OF MALAYA  
KUALA LUMPUR

1999

DEDICATED TO  
MY WIFE, SITI ZAINUN,  
MY SONS, AL-SHAFIQ,  
AL-SHAMS,  
AL-ABRAR AND  
AL-ZILAL

## **ACKNOWLEDGEMENT**

I wish to express my sincere thanks and special appreciation to Prof. Dr. T. K. Mukherjee, my supervisor and mentor, for his understanding, encouragement, assistance, supervision and guidance, throughout my studies and the preparation of this thesis.

Gratitude is also offered to the Director General of Malaysian Agricultural Research and Development Institute (MARDI) and the Director General of Veterinary Services Malaysia for allowing me to use the data of the two research stations as material for the thesis.

Thanks are also due to Tan Sri Datuk Dr. Ahmad Mustaffa bin Haji Babjee, Dato' Dr. Hadi bin Hashim and Mr. Mohd. Yunus Jaafar who in many ways helped the author in the preparation of this thesis.

Thanks are also extended to the staff of the Computer Units of MARDI and University Malaya for their assistance in the statistical analysis of the data.

Partial sponsorship from the Malaysian Agricultural Research and Development Institute (MARDI) for this study is appreciated.



## **ABSTRACT**

The objectives of this study were to determine the comparative performance of the purebred and crossbred goats (two-breed and three-breed crosses) present at the Institut Haiwan, Kluang, and at the research station of the Malaysian Agricultural Research and Development Institute (MARDI), Serdang, in respect to their growth and milk production. The factors that influenced the performance of the goats were identified and recommendations for improving the growth and milk production were made.

The study consisted of an analysis of the existing accumulated data of purebred Anglo Nubian (AA), purebred Jamnapari (JJ), Anglo Nubian x Katjang (AK) crossbred and Jamnapari x Kajang (JK) crossbred goats at Kluang, which was then followed by a trial utilizing Saanen as an improver breed being crossed with (Anglo Nubian x Katjang) to produce three-breed crossbreds S(AK) and with (Jamnapari x Katjang) to produce S(JK). Similarly in Serdang the existing accumulated data was also analyzed to illustrate the performance of the purebred Katjang (KK) and crossbreds (Anglo Nubian x Katjang - AK) and (Saanen x Katjang - SK). This was then followed by a trial to back cross the two-breed crosses with Katjang (KK) to produce (AK)K and (SK)K breed groups. These back crosses were compared with the contemporary Katjang (KK) breed.

The thesis is presented in a number of chapters followed by a discussion and then terminates with conclusions

and recommendations.

The first chapter deals with the growth of the different purebreds and crossbreds. It describes the analysis of growth performance of goats from the two government farms. The birth weights ranged from 2.07 to 2.57 kg in the AK breed group at Kluang. The birth weight of AK at Serdang was lower by as much as 18.29%. As regards to the JK breed group the birth weight ranged from 2.21 to 2.60 kg at Kluang. There was a similar response in the weaning weights as well as year-old weights. The effect of breed and sex was evident in Kluang but not in Serdang. This was attributed to confounding effect of management practices at the two locations.

The correlationship between body weights at different ages were significant ( $P < 0.05$ ) at both locations except in the indigenous breed - Katjang (KK). The increase in body weight was also demonstrated by increment in body measurements. The Average Daily Gain (ADG) was comparable with most of the Asian small-sized breed groups such as the Bengal, Malabari, Teddy as well as the West African Dwarf. The growth pattern of the different breed groups is illustrated and the prediction equations for the various body measurements are given.

The next chapter consists of studies on milk production which demonstrated that by crossbreeding with Saanen the milk production in the 3-way cross progeny could be increased by 93-110% which is highly significant ( $P < 0.001$ ) and strongly justified the use of Saanen as an improver breed

to improve the mothering ability of the progeny.

The subsequent chapter discusses the results of the previous chapters and finally, the last part presents the conclusions and recommendations for the formulation of breeding plans to improve overall performance of the goats through genetic methods.

## **ABSTRAK**

Matlamat kajian ini adalah untuk membuat perbandingan diantara perlakuan kambing baka tulen dan baka kacukan (kacukan 2-baka dan 3-baka) yang berada di Institut Haiwan, Kluang, dan di stesen penyelidikan Institut Penyelidikan dan Pembangunan Pertanian (MARDI), Serdang, keatas pertumbuhan dan pengeluaran susu. Faktor-faktor yang mempengaruhi pertumbuhan telah dikenalpasti dan cadangan-cadangan untuk meningkatkan prestasi pertumbuhan dan penghasilan susu adalah diutarakan.

Kajian ini melibatkan analisis data terkumpul pada baka-baka tulin Anglo Nubian (AA) dan Jamnapari (JJ), dan baka-baka kacukan Anglo Nubian x Katjang (AK) dan Jamnapari x Katjang (JK) di Kluang yang mana diikuti dengan satu percubaan menggunakan baka Saanen sebagai baka pembaik yang mana dikacukan dengan (Anglo Nubian x Katjang) untuk menghasilkan S(AK) dan dengan (Jamnapari x Katjang) untuk menghasilkan S(JK). Di Serdang pula data yang sedia ada telah dianalisis untuk memberi gambaran terhadap perlakuan baka tulin Kambing Katjang (KK) dan baka-baka kacukan (Anglo Nubian x Katjang - AK) dan (Saanen x Katjang - SK). Ini juga diikuti dengan satu percubaan dimana kedua baka kacukan diatas dikacukan dengan Katjang (KK) untuk menghasilkan baka kacukan (AK)K dan (SK)K. Baka-baka kambing yang terhasil ini dibandingkan dengan baka tulin Katjang (KK).

Tesis ini dikemukakan dalam beberapa bab dan diikuti dengan perbincangan serta disudahi dengan kesimpulan

dan cadangan.

Bab pertama adalah berhubungkait dengan pertumbuhan baka-baka tulin dan kacukan. Ia menjelaskan perihal analisis pertumbuhan kambing dari kedua ladang ternakan kerajaan. Berat lahir anak kambing baka AK di Kluang adalah dari 2.07 hingga 2.57 kg. Berat lahir baka AK di Serdang ada-lah rendah sedikit dengan kadar 18.29% berbanding dengan berat badan di Kluang. Berhubung dengan JK, berat lahir anak kambing mencapai 2.21 hingga 2.60 kg di Kluang. Respon yang serupa telah diperolehi pada berat badan masa leraai susu dan juga pada umur setahun. Kesan dari ciri-ciri baka dan jantina adalah ketara di Kluang tetapi tidak di Serdang. Ini adalah disebabkan oleh kesan yang mengelirukan dari amalan pengurusan di kedua lokasi.

Perkorelasi antara berat badan pada lainan umur adalah ketara pada tahap ( $P < 0.05$ ) di kedua lokasi kecuali pada baka tulin Katjang (KK). Peningkatan berat badan juga ditunjukkan dengan peningkatan ukuran badan. Kenaikan berat badan harian (Average Daily Gain - ADG) adalah sama seperti baka-baka kecil yang lain dari Asia seperti baka Bengal, Malabari dan juga West African Dwarf. Bentuk peningkatan berat badan baka-baka adalah dijelaskan dan persamaan peramalan untuk beberapa ukuran badan adalah dikemukakan. -

Bab berikutnya melibatkan kajian untuk menghasilkan susu yang mana menunjukkan bahawa pengkacukan dengan Saanen boleh meningkatkan pengeluaran susu hingga ketahap 93-110% yang mana adalah sangat ketara ( $P < 0.001$ ) dan membuktikan

keupayaan baka Saanen untuk memperbaiki ciri-ciri keibuan pada anak kambing.

Bab berikutnya membincangkan keputusan-keputusan dalam bab-bab sebelumnya dan bab terakhir mengemukakan kesimpulan dan mengutarakan syor-syor untuk meningkatkan prestasi menyeluruh pada kambing dengan menggunakan kaedah-kaedah genetik.

## LIST OF CONTENTS

	<u>Page</u>
ACKNOWLEDGEMENTS	i
ABSTRACT	ii
ABSTRAK	v
LIST OF CONTENTS	viii
LIST OF TABLES	xiii
LIST OF FIGURES	xvi
1.0 INTRODUCTION	001
1.1 Historical background	001
1.2 Status of goats in the world	002
1.3 The indigenous goat of Malaysia	003
1.4 Breed improvement	006
1.5 Crossbreeding	007
1.6 Studies of body growth in goats	009
1.7 Objectives of study	010
1.8 Presentation of thesis	011
2.0 LITERATURE REVIEW	013
2.1 Birth weight as criteria of growth	013
2.1.1 Effect of sex	014
2.1.2 Effect of birth type/litter size	016
2.1.3 Effect of parity	017
2.1.4 Effect due to breed of dam	018
2.1.5 Effect due to breed of sire	018
2.1.6 Effect of genotype of kid	019
2.1.7 Effect of year	020
2.1.8 Effect of season	021

	<u>Page</u>
2.1.9 Effect of nutrition	021
2.2 Pre-weaning and weaning weight	022
2.2.1 Effect of sex	022
2.2.2 Effect of litter size	024
2.2.3 Effect of breed of dam	024
2.2.4 Effect of breed of sire	025
2.2.5 Effect of genotype of kid	025
2.3 Post-weaning weight/adult weight	026
2.3.1 Effect of sex	026
2.3.2 Effect of litter size	027
2.3.3 Effect of birth type	027
2.3.4 Effect of genotype of kid	028
2.3.5 Effect of year	029
2.3.6 Effect of season	029
2.3.7 Effect of nutrition	030
2.4 Body measurements as criteria of growth	030
2.4.1 Correlation of body weight and body measurements	032
2.5 Growth rates	034
2.6 Growth curves	036
2.7 Crossbreeding	042
2.8 Factors affecting milk production in goats	044
2.8.1 Variation due to genotype	049
2.8.2 Effect of persistency	051
2.8.3 Effect of nutrition	052
2.8.4 Effect of age and weight of doe	053
2.8.5 Effect of season	055



	<u>Page</u>
2.8.6 Effect of milking technique	056
3.0 MATERIALS AND METHODS	057
3.1 Location of study	057
3.2 Number of animals	059
3.3 Mating Plan	063
3.4 Animal Husbandry	065
3.4.1 Housing	066
3.4.2 Feeding	066
3.4.3 Management	067
3.4.4 Tagging	068
3.4.5 Record keeping	068
3.4.6 Health	068
3.5 Data Collection	069
3.5.1 Age	069
3.5.2 Body weight	069
3.5.3 Body measurements	070
3.5.4 Milk production	071
3.5.5 Statistical Analysis of Data	072
4.0 RESULTS	078
4.1 The growth performance of purebred and crossbred goats at Kluang and Serdang	078
4.1.1 Birth weight of goats at Kluang	078
4.1.2 Adult weight	082
4.1.3 Correlation between body wights at different ages	085
4.1.4 Body measurements	093
4.1.5 Average daily gain (ADG)	099

	<u>Page</u>
4.1.6 Growth pattern	104
4.1.7 Comparative growth performance in some breed groups of goat as demonstrated in a trial at Kluang	119
4.1.7.1 Birth weight	119
4.1.7.2 Adult weight	124
4.1.7.3 Body measurements	126
4.1.7.4 Average Daily Gain	132
4.1.7.5 Growth curves	134
4.2 Growth performance of goats at Serdang	140
4.2.1 Birth weight	140
4.2.2 Adult weight	142
4.2.3 Body measurements	146
4.2.4 Average Daily Gain (ADG)	148
4.2.5 Growth rate	151
4.2.6 Growth curve	157
4.2.7 Comparative growth performance in some selected breed groups of goat as observed in a trial at Serdang	160
4.2.7.1 Body weight	160
4.2.7.2 Body measurements	168
4.2.7.3 Average Daily Gain (ADG)	170
4.3 Milk production in goats	173
4.3.1 Milk production in Serdang	173
4.3.1.1 Lactation yield	173
4.3.1.2 Lactation length	179
4.3.1.3 Butterfat content	183
4.3.1.4 Solids-non-fat	186

	<u>Page</u>
4.3.1.5 Specific gravity	186
4.3.2 Milk production of goats at Kluang	189
4.3.2.1 Lactation yield	189
4.3.2.2 Lactation length	191
4.3.2.3 Butterfat content	193
4.3.2.4 Specific gravity (SG)	196
4.3.2.5 Solids-non-fat (SNF)	196
5.0 DISCUSSION	199
5.1 Growth performance of goats	199
5.1.1 Birth weight and subsequent body weight	199
5.1.1.1 Effect of year of birth	200
5.1.1.2 Influence of season	200
5.1.1.3 Sex effect	201
5.1.1.4 Influence of litter size	204
5.1.1.5 Effect of parity	205
5.1.1.6 Effect of dam weight	206
5.1.2 Growth rate / Feed efficiency	207
5.2 Milk Production and quality	207
6.0 CONCLUSIONS AND RECOMMENDATIONS	210
7.0 REFERENCES	222

# LIST OF TABLES

<u>Table</u>	<u>Page</u>
1.01 World Goat and Sheep Population for year 1986-1996	004
4.01 Least square means ( $\pm$ S.E) for birth, weaning and 12-month body weights in purebred and crossbred goats at Kluang	079
4.02 Mean body weights of different grades of Jamnapari x Katjang crossbred goats at Kluang	081
4.03 Least square means for main factor effects on birth, weaning and year-old body weight of the four breed groups of goat at Kluang	083
4.04 Correlation coefficients of body weights at different ages for purebred and crossbred goats at Kluang	085
4.05 Correlation coefficients of body weights at different ages for purebred and crossbred Anglo Nubian goats at Kluang	087
4.06 Correlation between body weights at different ages for different grades of Jamnapari x Katjang (JK) goats at Kluang	091
4.07 Correlation coefficients of body weights at different ages for male and female Jamnapari crossbreds at Kluang	092
4.08 Best simple and multiple regression coefficients for predicting year-old weight in purebred and crossbred goats at Kluang	094
4.09 Range of body measurements of some breed groups of goat in Asia	095
4.10 Phenotypic correlation between body weight and body measurements at 6 and 12 months of age	096
4.11 Prediction equations of body weight with the help of one variable in purebred and crossbred Katjang goats at Kluang	098
4.12 Prediction equations of body weight with the help of nine variables in purebred and crossbred Katjang goats at Kluang	100

<u>Table</u>	<u>Page</u>
4.13 Preweaning and Postweaning average daily gain (ADG) purebred and crossbred goats at Kluang	101
4.14 Average absolute growth rate (AAGR) of goats at Kluang	105
4.15 Average relative growth rate (ARGR) of goats at Kluang	106
4.16 Instantaneous relative growth rate (IRGR) of four breed groups of goat at Kluang	107
4.17 Regression equations to show the trend in growth rates for the four breed groups of goat at Kluang	117
4.18 Mean (S.E.) of birth weights of a sample of kids in different types of litters	120
4.19 Least square means of birth, weaning and year old weights of four breed groups of goat at Kluang	122
4.20 ANOVA for body weight at birth, weaning and year-old of goats at Kluang	125
4.21 Mean body measurements (height, length and girth) of the four breed groups of goat at Kluang	127
4.22 Mean (+S.E.) of some live body measurements in a selected number of the four breed groups of goats at Kluang	129
4.23 Correlation coefficient matrix of body weight and body measurements of the four breed groups of goat at Kluang	130
4.24 Phenotypic correlation between live and carcass measurements of goats	131
4.25 Pre-weaning and post-weaning average daily gain (gm/day) of four breed groups of goat at Kluang	133
4.26 The adequate prediction models for growth parameters against age	136
4.27 Regression statistics of body weight and body measurements on age in goats	137
4.28 Mean birth weight, weaning weight and 364-day body weight of purebred and crossbred Katjang goats at Serdang	141

<u>Table</u>	<u>Page</u>
4.29 ANOVA to show effect of year of birth, breed group and sex on birth, weaning and year old body weights of purebred and crossbred Katjang goats at Serdang	145
4.30 Means $\pm$ S.E. of body measurements at weaning and year-old in purebred and crossbred Katjang goats at Serdang	147
4.31 Simple correlation coefficients of some variables in purebred and crossbred goats at Serdang	149
4.32 Multiple regression of yearling weight on height, length and girth of purebred and crossbred Katjang goats at Serdang	150
4.33 Mean average daily gain (ADG) of purebred and crossbred Katjang goats at Serdang	152
4.34 Instantaneous relative growth rate , average relative growth rate and average absolute growth rate of purebred and crossbred goats at Serdang	153
4.35 Least square means ( $\pm$ S.E.) for birth, weaning, year-old and two-year old body weights of purebred and crossbred goats at Serdang	161
4.36 Comparative mean body weights of indigenous Katjang and some imported exotic breeds of goat	165
4.37 Least square means ( $\pm$ S.E.) for birth, weaning and year old body weights for breed of sire effect in goats at Serdang	167
4.38 Average daily gain (gm/day) at preweaning and postweaning for different breed groups of goat as illustrated in the trial at Serdang	171
4.39 Milk productivity of AK and JK dam breed groups of goat at Serdang	174
4.40 Effect of introduction of Saanen on quantity and quality of milk of the goats at Kluang	190

## LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1.01 Goat and sheep development in the world (1986-1996)	005
4.01 Body weights of four breed groups of goat at Kluang	080
4.02 Average absolute growth rate of purebred and crossbred goats at Kluang	109
4.03 Average relative growth rate of four breed groups of goat at Kluang	110
4.04 Instantaneous relative growth rate of four breed groups of goat at Kluang	111
4.05 Comparative trend of growth rates for Anglo Nubian	113
4.06 Comparative trend of growth rates for Jamnapari	114
4.07 Comparative trend of growth rates for Anglo Nubian x Katjang	115
4.08 Comparative trend of growth rates for Jamnapari x Katjang	116
4.09 Body weight increase in AK and JK breed groups when crossed with Saanen at Kluang	123
4.10 Mean monthly body weight of KK, AK and SK breed groups of goat at Serdang	143
4.11 Average absolute growth rate in purebred and crossbred goats at Serdang	154
4.12 Instantaneous relative growth rate in purebred and crossbred goats at Serdang	155
4.13 Average relative growth rate in purebred and crossbred goats at Serdang	156
4.14 Gompertz growth curve for body weight of KK, AK and SK breed groups of goat at Serdang	159
4.15 Mean body weight increment in different breed groups of goat in a trial at Serdang	162

<u>Figure</u>	<u>Page</u>
4.16 Milk production of goats at Serdang	175
4.17 Milk production trend in AK and JK breed groups of goat at Serdang	180
4.18 Butter fat in milk of goats at Serdang	181
4.19 Milk production curve of goats at Serdang	182
4.20 Solids-non-fat in milk of goats at Serdang	185
4.21 Specific gravity of goat milk at Serdang	187
4.22 Milk production curves of four breed groups of goat at Kluang	192
4.23 Butter fat in milk of four breed groups of goat at Kluang	194
4.24 Specific gravity of goat milk at Kluang	197
4.25 Solids-non-fat in milk of goats at Kluang	198