

مكتبة جامعة عين شمس  
العلوم البيطرية  
الدراسات العليا  
رقم المكتبة  
46124

# **EFFECT OF RATION AND BREED ON THE DISTRIBUTION OF FAT IN SHEEP**

BY

**FATEN FAHMY MOHAMED**

**A thesis submitted in partial fulfilment  
of  
the requirements for degree of**

**DOCTOR OF PHILOSOPHY**

in

**Agriculture Sciences  
(Animal Nutrition)**

636.31

ق.ع

**Animal Production Department  
FACULTY OF AGRICULTURE  
AIN SHAMS UNIVERSITY**

**(1992)**



## Approval Sheet

# EFFECT OF RATION AND BREED ON THE DISTRIBUTION OF FAT IN SHEEP

BY

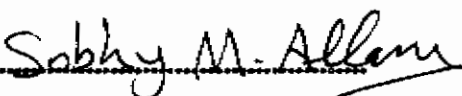
**FATEN FAHMY MOHAMED**

**B.Sc., Agric., (Animal Production), 1974, Ain Shams University**  
**M.Sc., Agric., (Animal Nutrition), 1986, Zagazig University**

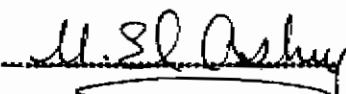
**This thesis PhD degree has been approved by :**

Prof. Dr. F.Z. Swidan 

Prof. of Animal Nutrition, Fac. of Agric., Canal El-Sues  
University, Ismaelia.

Prof. Dr. S.M. Allam 

Prof. of Animal Nutrition, Fac. of Agric., Cairo University,  
El-Payoum.

Prof. Dr. M.A. El-Ashry 

Prof. of Animal Nutrition, Fac. of Agric., Ain Shams Univer-  
sity

Date of examination: 22/10/1992



## **ACKNOWLEDGEMENT**

The author wishes to greatly indebted to Prof. Dr. A. M. El-Serafy, Professor of Animal Nutrition, Department of Animal Production, Faculty of Agriculture, Ain Shams University, for his supervision, suggesting the study, close supervision and revision of the manuscript.

Deep gratitude is due to Prof. Dr. A. M. Aboul-Naga, head of Sheep Production Section, Animal Production Research Institute, Ministry of Agriculture, for his valuable guidance and encouragement and supervision.

Sincerest thank to Prof. Dr. M.A. El-Ashry Professor of Animal Nutrition and Head Department of Animal Production, Faculty of Agriculture, Ain Shams University, for solution all problems and his acceptance to supervision this work and for his valuable guidance and encouragement.

Thanks to Dr. H. Mossa Lecturer of Animal Nutrition, Department of Animal Production, Faculty of Agriculture, Ain Shams University, for his revision this manuscript.

Deep gratitude is due to the staff-members of Sheep Production Section (especially Dr. Esam Shehata, head Department and Mrs. Mona Abd El-Zaher) and Mehalet Mossa Experimental Farm, Animal Production Research Institute, Ministry of Agriculture, for their role in making this work possible.

## CONTENTS

|                                                            | Page |
|------------------------------------------------------------|------|
| 1 - INTRODUCTION                                           | 1    |
| 2 - REVIEW OF LITERATURE                                   | 3    |
| 2 - 1 - Factors Affecting Growth and Fattening Performance | 3    |
| 2 - 1 - 1 - Plane of Nutrition :                           | 3    |
| 2 - 1 - 2 - Breed Group :                                  | 5    |
| 2 - 1 - 3 - Growth period :                                | 7    |
| 2 - 1 - 4 - Type of birth :                                | 8    |
| 2 - 2 - Feed Efficiency :                                  | 9    |
| 2 - 3 - Factors Affecting Carcass Traits :                 | 10   |
| 2 - 3 - 1 - Plane of Feeding :                             | 11   |
| 2 - 3 - 2 - Breed group :                                  | 13   |
| 2 - 3 - 3 - Age and Type of birth :                        | 20   |
| 2 - 4 - Fat distribution and physical composition:         | 22   |
| 2 - 5 - Chemical Analysis:                                 | 29   |
| 2 - 6 - Fat Analysis :                                     | 32   |
| 3 - MATERIALS AND METHODS                                  | 34   |
| 3 - 1 - Materials :                                        | 34   |
| 3 - 2 - Methods :                                          | 36   |
| Sampling :                                                 | 38   |
| a - Blood :                                                | 38   |
| b - Tissues Sampling :                                     | 39   |
| c - Chemical Analysis:                                     | 39   |
| Extraction and purification of tissue lipids :             | 39   |
| Determination of serum cholesterol :                       | 41   |
| Principle :                                                | 41   |
| Procedure (Manual) M :                                     | 41   |
| Determination of tissues total cholesterol :               | 42   |
| Determination of serum and tissues triglycerids :          | 42   |
| Principle :                                                | 43   |
| Procedure (Manual) M :                                     | 43   |
| Determination of fatty acids :                             | 43   |
| Lipid analysis :                                           | 44   |
| Saponification procedure                                   | 44   |
| Methylation of fatty acids for GLC analysis :              | 44   |
| GLC for fatty acid methyl esters                           | 45   |

|                                            | Page |
|--------------------------------------------|------|
| 3 - 3 - Measurements                       | 45   |
| 3 - 4 - Calculations                       | 46   |
| 3 - 5 - Statistical analysis               | 48   |
| 4 - RESULTS AND DISCUSSION                 | 52   |
| 4 - 1 - Fatening performance :             | 52   |
| 4 - 1 - 1 - Effect of feeding level :      | 52   |
| 4 - 1 - 2 - Effect of breed group :        | 56   |
| 4 - 1 - 3 - Effect of type of birth :      | 58   |
| 4 - 2 - Feed dry matter : gain ratio       | 59   |
| 4 - 3 - Carcass performance                | 62   |
| 4 - 3 - 1 - Carcass traits                 | 62   |
| 4 - 3 - 1 - 1 - Effect of level of feeding | 62   |
| 4 - 3 - 1 - 2 - Effect of breed group      | 64   |
| 4 - 3 - 1 - 3 - Effect of age              | 65   |
| 4 - 3 - 1 - 4 - Effect of type of birth    | 67   |
| 4 - 3 - 2 - Carcass edible offals          | 68   |
| 4 - 3 - 2 - 1 - Effect of level of feeding | 68   |
| 4 - 3 - 2 - 2 - Effect of breed group      | 70   |
| 4 - 3 - 2 - 3 - Effect of age              | 70   |
| 4 - 3 - 2 - 4 - Effect of type of birth    | 71   |
| 4 - 3 - 3 - Carcass cuts                   | 72   |
| 4 - 3 - 3 - 1 - Effect of level of feeding | 72   |
| 4 - 3 - 3 - 2 - Effect of breed group      | 74   |
| 4 - 3 - 3 - 3 - Effect of age              | 75   |
| 4 - 3 - 3 - 4 - effect of type of birth    | 75   |
| 4 - 3 - 4 - Fat distribution               | 76   |
| 4 - 3 - 4 - 1 - Effect of level of feeding | 76   |
| 4 - 3 - 4 - 2 - Effect of breed group      | 78   |
| 4 - 3 - 4 - 3 - Effect of age              | 80   |
| 4 - 3 - 4 - 4 - Effect of type of birth    | 81   |
| 4 - 3 - 5 - Carcass Dressing :             | 82   |
| 4 - 3 - 5 - 1 - Effect of level of feeding | 82   |

|                                                      | Page |
|------------------------------------------------------|------|
| 4 - 3 - 5 - 2 - Effect of breed group                | 85   |
| 4 - 3 - 5 - 3 - Effect of age                        | 87   |
| 4 - 3 - 5 - 4 - Effect of type of birth              | 88   |
| 4 - 3 - 6 - The ratio between physical composition : | 88   |
| 4 - 3 - 6 - 1 - Effect of level of feeding           | 88   |
| 4 - 3 - 6 - 2 - Effect of breed group                | 90   |
| 4 - 3 - 6 - 3 - Effect of age                        | 90   |
| 4 - 4 - Chemical Analysis                            | 91   |
| 4 - 4 - 1 - Chemical composition of carcass offals : | 91   |
| 4 - 4 - 1 - 1 - Effect of feeding level              | 91   |
| 4 - 4 - 1 - 2 - Effect of breed group                | 95   |
| 4 - 4 - 1 - 3 - Effect of age                        | 96   |
| 4 - 4 - 1 - 4 - Effect of type of birth              | 97   |
| 4 - 4 - 2 - Chemical composition of carcass cuts     | 97   |
| 4 - 4 - 2 - 1 - Effect of feeding level              | 98   |
| 4 - 4 - 2 - 2 - Effect of breed group                | 103  |
| 4 - 4 - 2 - 3 - Effect of age                        | 105  |
| 4 - 4 - 2 - 4 - Effect of type of birth              | 106  |
| 4 - 4 - 3 - Chemical composition of carcass fat      | 108  |
| 4 - 4 - 3 - 1 - Effect of feeding level              | 108  |
| 4 - 4 - 3 - 2 - Effect of breed group                | 113  |
| 4 - 4 - 3 - 3 - Effect of age                        | 115  |
| 4 - 4 - 3 - 4 - Effect of type of birth              | 117  |
| 4 - 5 - Fat Analysis :                               | 118  |
| 4 - 5 - 1 - Fat analysis on offals and blood serum : | 119  |
| 4 - 5 - 1 - 1 - Effect of feeding level              | 119  |
| 4 - 5 - 1 - 2 - Effect of breed group                | 121  |
| 4 - 5 - 1 - 3 - Effect of age                        | 123  |
| 4 - 5 - 1 - 4 - Effect of type of birth              | 124  |
| 4 - 5 - 2 - Fat analysis of carcass cuts             | 124  |
| 4 - 5 - 2 - 1 - Effect of feeding level              | 125  |
| 4 - 5 - 2 - 2 - Effect of breed group                | 129  |
| 4 - 5 - 2 - 3 - Effect of age                        | 130  |

|                                                     | Page |
|-----------------------------------------------------|------|
| 4 - 5 - 2 - 4 - Effect of type of birth             | 132  |
| 4 - 5 - 3 - Fat analysis on carcass fat             | 133  |
| 4 - 5 - 3 - 1 - Effect of feeding level             | 133  |
| 4 - 5 - 3 - 2 - Effect of breed group               | 136  |
| 4 - 5 - 3 - 3 - Effect of age                       | 138  |
| 4 - 5 - 3 - 4 - Effect of type of birth             | 139  |
| 4 - 5 - 4 - Fatty acid analysis in blood serum :    | 140  |
| 4 - 5 - 4 - 1 - Effect of feeding level             | 140  |
| 4 - 5 - 4 - 2 - Effect of breed group               | 142  |
| 4 - 5 - 4 - 3 - Effect of age                       | 142  |
| 4 - 5 - 5 - Fatty acid analysis on carcass tissue : | 143  |
| 4 - 5 - 5 - 1 - Effect of feeding level             | 143  |
| 4 - 5 - 5 - 2 - Effect of breed group               | 147  |
| GENERAL DISCUSSION                                  | 149  |
| SUMMARY                                             | 152  |
| REFERENCES                                          | 158  |
| APPENDIX                                            | 174  |
| ARABIC SUMMARY                                      |      |

## LIST OF TABLES

|                                                                                                                                                | Page |
|------------------------------------------------------------------------------------------------------------------------------------------------|------|
| Table 2 - 1 . Chemical analysis.                                                                                                               | 31   |
| Table 2 - 2 . Fatty acid composition.                                                                                                          | 33   |
| Table 3 - 1 . Chemical analysis of feedstuffs.                                                                                                 | 35   |
| Table 4 - 1 . Effect of level of feeding, breed group and type of birth on growth and daily gain of growing sheep.                             | 53   |
| Table 4 - 2 . Dry matter feed intake : live weight gain ratio of growing sheep.                                                                | 60   |
| Table 4 - 3 . Effect of level of feeding, breed group, age and type of birth on carcass traits of growing sheep.                               | 63   |
| Table 4 - 4 . Effect of level of feeding, breed group, age and type of birth on edible offals of growing sheep.                                | 69   |
| Table 4 - 5 . Effect of level of feeding, breed group, age and type of birth on carcass cuts of growing sheep.                                 | 73   |
| Table 4 - 6 . Effect of level of feeding, breed group, age and type of birth on fat distribution of growing sheep.                             | 77   |
| Table 4 - 7 . Effect of level of feeding, breed group, age and type of birth on carcass dressing and physical composition of growing sheep.    | 83   |
| Table 4 - 8 . Effect of level of feeding, breed group and age on lean fat ratio and lean bone ratio of growing sheep.                          | 89   |
| Table 4 - 9 . Effect of level of feeding, breed group, age and type of birth on chemical composition of carcass of growing sheep.              | 92   |
| Table 4 - 10. Effect of level of feeding, breed group, age and type of birth on chemical composition percent of carcass cuts of growing sheep. | 99   |
| Table 4 - 11. Effect of level of feeding, breed group, age and type of birth on chemical composition percent of carcass fat of growing sheep.  | 109  |
| Table 4 - 12. Effect of level of feeding, breed group and type of birth on fat analysis and blood serum of carcass offals of growing sheep.    | 120  |
| Table 4 - 13. Effect of level of feeding, breed group, age and type of birth on fat analysis mg/ g tissue of carcass cuts of growing sheep.    | 126  |
| Table 4 - 14. Effect of level of feeding, breed group, age and type of birth on fat analysis mg/ g of carcass fat of growing sheep.            | 134  |

|                                                                                                                                                                       | Page |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| Table 4 - 15. Effect of level of feeding, breed group, age and type of birth on free fatty acids as a percent from total fatty acids of blood serum of growing sheep. | 141  |
| Table 4 - 16. FFA content of some carcass tissues of growing sheep.                                                                                                   | 144  |

## LIST OF FIGURES

|                                                                          | Page |
|--------------------------------------------------------------------------|------|
| Figure 3 - 1 . Location of samples                                       | 37   |
| Figure 4 - 1 - 1. Effect of level of feeding on growth of growing sheep. | 54   |
| Figure 4 - 1 - 2. Effect of breed group on growth of growing sheep.      | 55   |

## LIST OF APPENDIX

|                                                                                                                                                                                                              | Page |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| AP - 1 . ANOVA of interaction between (Breed x Feeding), (Age x Feeding), (Type of birth x Feeding), (Breed x Age), (Breed x Type of birth), and (Type of birth x age) on carcass traits.                    | 174  |
| AP - 2 . ANOVA of interaction between (Breed x Feeding), (Age x Feeding), (Type of birth x Feeding), (Breed x Age), (Breed x Type of birth), and (Type of birth x age) on carcass cuts.                      | 175  |
| AP - 3 . ANOVA of interaction between (Breed x Feeding), (Age x Feeding), (Type of birth x Feeding), (Breed x Age), (Breed x Type of birth), and (Type of birth x age) on carcass offals.                    | 176  |
| AP - 4 . ANOVA of interaction between (Breed x Feeding), (Age x Feeding), (Type of birth x Feeding), (Breed x Age), (Breed x Type of birth), and (Type of birth x age) on carcass fat.                       | 177  |
| AP - 5 . ANOVA of interaction between (Breed x Feeding), (Age x Feeding), (Type of birth x Feeding), (Breed x Age), (Breed x Type of birth), and (Type of birth x age) on carcass dress.                     | 178  |
| AP - 6 . ANOVA of interaction between (Breed x Feeding), (Age x Feeding), (Type of birth x Feeding), (Breed x Age), (Breed x Type of birth), and (Type of birth x age) on chemical analysis of offals.       | 179  |
| AP - 7 . ANOVA of interaction between (Breed x Feeding), (Age x Feeding), (Type of birth x Feeding), (Breed x Age), (Breed x Type of birth), and (Type of birth x age) on chemical analysis of carcass cuts. | 180  |
| AP - 8 . ANOVA of interaction between (Breed x Feeding), (Age x Feeding), (Type of birth x Feeding), (Breed x Age), (Breed x Type of birth), and (Type of birth x age) on chemical analysis of carcass fat.  | 181  |
| AP - 9 . ANOVA of interaction between (Breed x Feeding), (Age x Feeding), (Type of birth x Feeding), (Breed x Age), (Breed x Type of birth), and (Type of birth x age) on Fat analysis of carcass offals.    | 182  |
| AP - 10. ANOVA of interaction between (Breed x Feeding), (Age x Feeding), (Type of birth x Feeding), (Breed x Age), (Breed x Type of birth), and (Type of birth x age) on fat analysis of carcass cuts.      | 183  |

|                                                                                                                                                                                                        | Page |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| AP - 11. ANOVA of interaction between (Breed x Feeding), (Age x Feeding), (Type of birth x Feeding), (Breed x Age), (Breed x Type of birth), and (Type of birth x age) on fat analysis of carcass fat. | 184  |
| AP - 12. Effect of breed group on carcass traits at 4 months of age.                                                                                                                                   | 185  |
| AP - 13. Effect of breed group on edible offals at 4 months of age.                                                                                                                                    | 186  |
| AP - 14. Effect of breed group on carcass cuts at 4 months of age.                                                                                                                                     | 187  |
| AP - 15. Effect of breed group on fat distribution at 4 months of age.                                                                                                                                 | 188  |
| AP - 16. Effect of breed group on chemical composition of carcass offals at 4 months of age.                                                                                                           | 189  |
| AP - 17. Effect of breed group on chemical composition of carcass cuts at 4 months of age.                                                                                                             | 190  |
| AP - 18. Effect of breed group on chemical composition of carcass fat at 4 months of age.                                                                                                              | 191  |
| AP - 19. Effect of breed group on fat analyses of carcass offals at 4 months of age.                                                                                                                   | 192  |
| AP - 20. Effect of breed group on fat analyses of carcass cuts at 4 months of age.                                                                                                                     | 193  |
| AP - 21. Effect of breed group on fat analyses of carcass fat at 4 months of age.                                                                                                                      | 194  |
| AP - 22. Effect of feeding level, breed group, age and type of birth on carcass score.                                                                                                                 | 195  |
| AP - 23. Effect of feeding level, breed group, age and type of birth on carcass measurements                                                                                                           | 196  |

## **LIST OF ABBREVIATIONS**

**DM** = dry matter

**R** = Rahmani

**FR** = 1/4 Finnish Landrace x 3/4 Rahmani

**RoR** = 1/4 Romanove x 3/4 Rahmani

**TG** = triglycerid

**Cho** = cholesterol

**gm** = gram

**gm t** = gram tissue

# INTRODUCTION

