

DEDICATION

To my dear family, mother, father, brothers and sisters. To my wife Mariam Alnour. To my sons and daughters. With my love and respect I dedicate this work.

Mohammed Adam

AKNOWLEDGEMENT

I am greatly indebted to my main supervisor Professor Osama Alsheikh Yassin and co supervisor Dr Badreldeen Aljack for their supervision, advice, helpful criticism and suggestion. It was solely through invaluable advice that was able to present this thesis. Thanks are due to colleague Mamoun Khalafalla faculty of Agriculture university of Kassala for his encouragement and assistants. Thanks are extended to Professor Mohammed Alkhair, the councilor of university of Kassala for his continuous help. My appreciations are due to staff members of Agricultural research station at New Halfa for providing the research with cereal grains. Thank are due to Mr Alhadi Mahdi from New Halfa metrology station for providing the research metrological data. Thank are due to Dr Imad Khalafalla for his efforts and steps for registration. My appreciations are due to the all members of animal production department faculty of Agriculture university of Kassala, especially to Prof. Mohmmmed Tag eldein and Ustaz Yassin Alamin for their efforts and help in the statistical analysis of data. I am greatly indebted tom my friend Dr Magzoub for sincere help and technical help. Above all I render my thanks to Almighty Allah.

Mohammed Adam

LIST OF CONTENTS

Dedication	i
Acknowledgement	ii
List of contents	iii
List of tables	vii
List of figure	viii
English Abstract	ix
Arabic Abstract	xii
1. CHAPTER ONE INTRODUCTION.	1
2. CHAPTER TWO LITERATURE REVIEW.	3
2.1 Sorghum chemical composition and Nutrition availability.	3
2.1.1 Protein in Sorghum grains.	3
2.1.2 Starch and energy in sorghum grain	5
2.1.3 Sorghum as Poultry feed ingredient.	5
2.2 Pearl millet.	6
2.2.1 Importance of Pearl Millet as grain Crop.	7
2.2.1.1 Feed and food grain.	7
2.2.1.2 Pearl millet chemical composition.	7
2.3 Maize.	9
2.4 Anti nutritional factors in cereal grains.	10
2.4.1 Kafirin.	10
2.4.1.1 Anti nutritive properties of Kafirin.	10
2.4.2 Tannin.	11
2.4.2.1 Anti-nutritive properties of tannin.	13
2.4.3 Phytate.	15
2.4.3.1 Anti-nutritive properties of phytate.	15

2.5 Factors affect broiler performance.	16
2.5.1 The effect of dietary protein level.	16
2.5.2 The effect of dietary protein level on Feed intake.	17
2.5.3 The effect of dietary protein level on Feed Conversion Ratio.	18
2.5.4 The effect of protein on body weight and weight gain.	19
2.5.5. The effect of dietary protein level on carcass yield.	20
2.5.6 Temperature.	20
2.5.6.1 The effect of Temperature on Feed intake.	21
2.5.6.2 The effect of temperature on feed conversion ratio (FCR).	23
2.5.6.3 The effect of temperature in Body weight and Body weight gain.	24
2.5.6.4 The effect of Temperature in Carcass characteristics.	25
3. CHAPTER THREE MATERIALS AND METHODS.	27
3.1 Materials.	27
3.1.1 Experimental site and duration.	27
3.1.2 Experimental house.	27
3.1.3 Experimental birds.	28
3.1.4 Experimental diets.	29
3.2 Methods.	32
3.2.1 Management.	32
3.2.1.1 Feed intake.	32
3.2.1.2 Body weight and weight gain.	32
3.2.1.3 Feed conversion ratio (FCR).	32
3.2.1.4 Mortality percentage.	32
3.2.2 Carcass preparation.	32
3.2.3 Economical analysis.	33
3.2.4 Experimental design.	33
4. CHAPTER FOUR RESULTS.	34
4.1 Broiler performance.	34
4.1.1 Overall Performance results.	34
4.1.2 Mean weekly feed intake (g/bird/day).	43

4.1.3 Mean weekly body weight gain (g/b/wk).	48
4.1.4 Mean weekly feed conversion ratio.	53
4.2 Carcass Quality parameters results.	56
4.2.1 Dressing percentage.	56
4.2.2 Carcass Cuts.	58
4.2.2.1 Breast relative weight.	58
4.2.2.2 Thigh relative weight.	60
4.2.2.3 Drum stick relative weight.	62
4.3 Internal organ results.	64
4.3.1 Liver relative weight.	64
4.3.2 Abdominal fat relative weight.	66
4.4 Economical assessment	68
5. CHAPTER FIVE DISCUSSION.	73
5.1 Feed intake (FI).	73
5.1.1 Effect of season on feed intake.	73
5.1.2 Effect of protein level on feed intake.	74
5.1.3 The effect of cereal grain type on feed intake.	74
5.2.1 Effect of season on body weight gain.	75
5.2.2 Effect of dietary protein level on body weight gain.	76
5.3 Final body weight.	77
5.3.1 Effect of season on final body weight.	77
5.3.2 Effect of dietary protein level on final body weight.	78
5.3.3 Effect of cereal grain type on the final body weight.	78
5.4 Feed conversion ratio (FCR).	79
5.4.1 The effect of season on FCR.	79
5.4.2 Effect of dietary protein level on FCR.	80
5.4.3 The effect of cereal grain type on FCR.	81
5.5 The weekly feed intake (FI).	81
5.6 Effect on weekly weight gain.	82
5.7 The mean weekly feed conversion ratio.	83

5.8 The dressing percentage.	84
5.9 Mortality.	86
5.10 The economical assessment	86
6. CHAPTER SIX CONCLUSION AND RECOMMENDATION.	88
6.1 Conclusion	88
6.2 Recommendations	88
REFERENCES	90
Appendices	i

LIST OF TABLES

Table 3.1 Ingredients (%) and chemical composition (%) of experimental diets.	30
Table 3.2: Chemical composition (%) of Sorghum, Millet and Maize.	31
Table 4.1: Effect of energy source and protein level in two seasons on overall performance results for experimental broilers.	37
Table 4.2: Effect of energy source and protein level in two seasons on weekly feed intake for experimental broilers.	46
Table 4.3: Effect of energy source and protein level in two seasons on weekly weight gain/gm for experimental broiler.	51
Table 4.4: Effect of energy source and protein level in two seasons on weekly feed conversion ratio (g feed/ g wt gain) for experimental broilers.	54
Table 4.5: Effect of energy source and protein level in two seasons on dressing percentage for experimental broilers.	57
Table 4.6: Effect of energy source and protein level in two seasons on breast relative weight for experimental broilers.	59
Table 4.7: Effect of energy source and protein level in two seasons on thigh relative weight for experimental broilers.	61
Table 4.8: Effect of energy source and protein level in two seasons on drum stick relative weight for experimental broilers.	63
Table 4.9: Effect of energy source and protein level in two seasons on liver relative weight for experimental broilers.	65
Table 4.10: Effect of energy source and protein level in two seasons on abdominal relative weight for experimental broilers.	67

Table 4.11: Effect of energy source and protein in two season on Economic analysis for experimental broilers. 70

LIST OF FIGURE

Fig. The effect of Season on Total Feed intake	39
Fig. The effect of Protein level on Total Feed intake	39
Fig. The effect of Energy Source on Total Feed Intake	39
Fig. The effect of Season on Total Weight Gain	40
Fig. The effect of Protein on Total Weight Gain	40
Fig. The effect of Energy Source on Total Weight Gain	40
Fig. The effect of Season on Final Body Weight	41
Fig. The effect of Protein on Final Body Weight	41
Fig. The effect of Energy Source on Final Body Weight	41
Fig. The effect of Season on Total Feed Conversion Ratio (FCR)	42
Fig. The effect of Protein on Total Feed Conversion Ratio (FCR)	42
Fig. The effect of Energy Source on Total Feed Conversion Ratio (FCR)	42
Fig. The effect of Season on economical assessment	72
Fig. The effect of protein on economical assessment	72
Fig. The effect of Energy source on economical assessment	72

ENGLISH ABSTRACT

Four experiments were conducted at the Animal Production Department of the College of Agriculture and Natural Resources, Kassala University (New Halfa) to determine the effect of dietary protein level, cereal grain type and season of the year on the general performance and broiler carcass characteristics during the whole experimental period (7 – 42 days).

The experiment was designed on factorial arrangement of three protein feed levels 20, 22 and 24%, three cereal grain types (sorghum, yellow corn (Shamia) and Millet) for two Summers and two Winters combinations.

Summer trials were conducted during the months April – May 2008 and 2009 and the Winter trials during the months January – February 2009 and 2010.

All the feed rations were iso-caloric of 3200 Kcal/ Kg feed in all the four feed rations.

During the period 1 – 7 days and for all the trials only one commercial feed was offered (Pre-starter) which contained crude protein 23% and ME 3100 Kcal/ Kg.

After that the birds were distributed randomly into nine groups of thirty chicks each and in three replicates for each of the four experiments giving a total of 1080 unsexed Hubbard chicks.

By the end of the experiments at 42 days 12 birds were slaughtered from each trial to examine carcass characteristics and some commercial cuts.

The results, at the termination of the trials showed that the final body weight and weight gain were better for the Winter raised birds at ($P < 0.05$) than those raised in summer.

The statistical analyses for the final weight and weight gain showed statistical significance for the birds fed rations that contained 22% and 24% CP as they gave higher weights than those fed on the lower protein 20%.

The analyses also, showed statistically significant difference for the final weight and weight gain for the birds fed different cereal types. Sorghum recorded the least final weight and weight gain while both millet and yellow corn gave the better results without any significant difference between them.

The study indicated the effect of season on feed consumption during the experimental period, as the birds reared in winter consumed more feed than in summer at a significance level of ($P < 0.01$).

For the effect of feed protein levels the study indicated that birds fed on 20% CP ration consumed significantly less feed than the 22% and 24% levels.

The type of cereal grain used had significant effect on feed consumed as sorghum registered the least consumed feed ration compared with millet and yellow corn which both did not show any significant difference between them.

The trials showed that feed efficiency and feed conversion were affected by season as birds raised in winter showed significantly better conversion than birds raised in summer.

Feed protein level showed statistically significant effect on feed conversion as it indicated improvement with increasing protein ratio in the feed as 24% increased total feed conversion in respective of cereal grain type. It also showed the best weekly feed conversion which was best in the third week in respective of season or protein level or the cereal type under study. For feed conversion and energy source there was no significant

difference between millet and yellow corn but sorghum showed lower effect at ($P < 0.01$) level comparatively which indicates that the cereal grain types or energy source in the feed rations has significant effect on feed conversion.

The study of carcass characteristics indicated dressing percentage and some cuts which contained the breast, thigh and drum stick and also the abdominal fat and liver weight at the end of the experimental trials (42 days).

The dressing percentage showed statistically significance differences due to season, protein level and cereal type effects.

For cuts the results indicated that the thigh was affected by season and protein level, the drum stick was statistically affected by the protein level and cereal type. Liver relative weight was affected by cereal type only. The abdominal fat was not affected by season or protein level in the diet but cereal type showed statistically significant effect when the sorghum ration showed the highest weight for abdominal fat among the feed ration.

The economic analysis indicated differences in total income and net returns due to season of the year, protein level and used cereal types. Sorghum rations had the least total cost but the net return out of it was not the best.

The study showed that the best profitability was from the yellow corn and protein ratios of 22 and 24% compared with the other feed rations.

ARABIC ABSTRACT

ملخص الأطروحة

اجريت تجارب هذه الدراسة في قسم الانتاج الحيواني لكلية الزراعة والموارد الطبيعية بجامعة كسلا (حلفا الجديدة) لتحديد اثر مستوي البروتين ونوع الحبوب المستخدمه وفصل السنه علي الاداء العام وعلي خصائص ذبيحه فراخ اللحم علي مدي طول فترة التجربة (7 – 42 يوم).

صممت التجربة علي طريقة العشوائية المتعددة او تجربة العاملية علي ثلاثة مستويات غذائية من البروتين 20 و 22 و 24% وثلاثة انواع من الحبوب شملت الذرة الرفيعة والذرة الصفراء (الشامية) والدحن علي مدي موسمين صيف وموسمين شتاء واجريت تجارب الصيف خلال الاشهر ابريل ومايو للعامين 2008 و 2009م والتجارب الشتوية خلال الاشهر يناير وفبراير للعامين 2009 و 2010م وكانت جميع العلائق التسع متساوية في محتواها من الطاقة 3200 كيلوكالوري/كيلوجرام علف في كل التجارب الاربعه.

خلال الفترة من 1 الي 7 يوم ولجميع التجارب تم تقديم نوع واحد من العلف التجاري (علف ما قبل البادئ) والذي يحتوي علي بروتين خام 23% وطاقة 3100 كيلوكالوري/ كيلوجرام علف وبعدها تم توزيع الطيور عشوائياً الي تسع مجموعات كل مجموعة تضمنت 30 كتكوت في ثلاث مكررات لكل تجربة من التجارب الاربعه ليكون العدد الكلي 1080 من نوع الهبرد الغير مجنس.

في نهاية التجربة عند 42 يوم تم ذبح 12 طائر من كل معاملة لاختبار صفات الذبيحة وبعض القطعيات التجارية.

اظهرت النتائج عند نهاية التجارب ان الوزن النهائي والوزن المكتسب كامن اعلي في الطيور المربأه شتاءً ($0.01 < \alpha$) عن الطيور المربأه صيفاً.

واظهر التحليل الاحصائي فروقاً معنوية للوزن النهائي والوزن المكتسب للطيور التي غذيت علي علائق احتوت بروتين خام 22 و 24% حيث اعطت اوزاناً اعلي من تلك التي غذيت علي البروتين الاقل 20%.

اظهر التحليل وجود فروق احصائية معنوية للوزن النهائي والوزن المكتسب للطيور التي غذيت علي انواع مختلفة من الحبوب وسجلت الذرة الرفيعة اقل وزن نهائي واقل وزن

مكتسب بينما سجل كل من الدخن والذرة الصفراء افضل النتائج دونما فروق احصائية معنوي بينهما.

اوضحت الدراسة تاثر استهلاك العلف بالموسم خلال فترة التجارب حيث استهلكت الطيور المربأه شتاءً كمية اكبر من العلف ($0.01 < \alpha$) عن تلك المربأه صيفاً. ولتاثير مستوي بروتين الغذاء فقد اظهرت الدراسة ان الطيور المغذاه علي عليقة 20% بروتين استهلكت كمية غذاء منخفضة معنوياً عن المستويين 22 و 24% بروتين. اما نوع الحبوب المستخدمة فقد كان له تاثير معنوي علي كمية العلف المستهلك حيث سجلت الذرة الرفيعة اقل استهلاكاً مقارنة بالدخن والذرة الصفراء دونما اظهار فروقات معنوية احصائية بينهما.

واظهرت التجارب ان كفاءة استخدام الغذاء ومعدل التحويل الغذائي تاثر بفصل السنه حيث سجلت الطيور المربأه شتاءً كفاءة تحويل غذائي افضل معنوياً من تلك التي ربيت صيفاً.

مستوي بروتين الغذاء اظهر فروقات احصائية معنوية لصفة معدل التحويل الغذائي والذي اظهر تحسناً معنوياً مع زيادة نسبة البروتين في العلف واشرت الدراسة الي ان مستوي البروتين في العلف الاعلي 24% ادي الي زيادة كفاءة التحويل الغذائي الكلية بغض النظر عن نوع الحبوب المستخدم واعطي احسن مستوي لمعدل التحويل الغذائي الاسبوعي والذي كان الاحسن في الاسبوع الثالث بغض النظر عن الموسم او مستوي البروتين او نوع الحبوب قيد الدراسة.

ولكفاءة التحويل الغذائي الكلية لمصدر الطاقة لم يكن هناك فرق احصائي معنوي بين الدخن والذرة الصفراء الا ان الذرة الرفيعة اوضحت انخفاضاً معنوياً ($0.01 < \alpha$) بالمقارنه مما يعني ان نوع الحبوب او مصدر الطاقة في مخلوط العلف له تاثير معنوي معنوي علي كفاءة الحويل الغذائي.

دراسة خصائص الذبيحة تضمنت نسبة التصافي وبعض القطعيات والتي شملت الصدر والارجل والفخذ وشملت دهن البطن ووزن الكبد عند نهاية التجارب (42 يوم). اشارت نسبة التصافي الي فروقات معنوية ناتجة من الموسم ومستوي البروتين ونوع الحبوب.

وبالنسبة للقطعيات اشارت النتائج ان الارجل تاثرت معنوياً بالموسم ومستوي البروتين والفخذ تاثرت معنوياً بمستوي البروتين ونوع الحبوب اما وزن الكبد النسبي فقد تاثر بنوع الحبوب وان وزن دهن البطن لم يناثر بالموسم او مستوي البروتين في العلف

الا ان الحبوب كان له تاثير معنويا وكانت عليقة الذرة الرفيعة الاعلي وزنا لدهن البطن بين الخلطات العلفية الاخري.

اشار التحليل الاقتصادي الي اختلافات في الدخل الكلي وصافي العائد من تاثير فصل السنه ونسبة بروتين العلف ونوع الحبوب المستعملة وكانت خلطات الذرة الرفيعة الاقل تكلفة كلية الا ان صافي العائد منها لم يكن الاحسن. ووضحت الدراسة ان الاكثر ربحية كانت خلطات الذرة الصفراء ونسبة البروتين 22 و 24% مقارنة بالخلطات العلفية الاخري.