COMPARATIVE STUDY OF THE EFFECT OF DIETARY ENERGY ON FEMALE CARCASS QUALITY AND CHEMICAL COMPOSITION OF TWO BROILER STRAIN CROSSES

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ABSTRACT

This study was conducted at the Poultry Farm of the Animal Resources Department during the first three months of 1999 , College of Agriculture and Forestry - University of Mosul , to investigate the effect of using different dietary levels of metabolizable energy on the carcass quality and chemical composition of two female broiler strains reared under conventional environmental conditions in Iraq . One - day old White Ross and Iraqi Fawbro broiler chicks were reared on a deep litter at the rate of 180 birds per strain . The birds from each strain were randomly distributed to three dietary treatments with different metabolizable energy levels (2812,2709,2896) and (2839,2744,2918) for T1, T2, and T3 during both starting and growing periods, respectively.Each treatment contained three replicates with 20 birds per replicate .

The results revealed that no significant differences among female broilers of both strains in carcass yield were observed . Females of White Ross fed the low level energy diet showed no significant differences in the percentage weights of giblets and abdominal fat , but a relative decline was observed , whereas those of Fawbro gave high percentages . Ross female broilers on the high energy diet showed a significant ($p < 0.01$) increase in breast cut yield , but no differences in leg quarters yield were observed .

Carcass leg quarters of Ross female broilers fed on the low energy diet showed significantly ($p < 0.01$) high levels of moisture and protein and low levels of fat and ash. Ross female broiler breast cut contained significantly ($p< 0.01$) higher level of protein and lower level of fat than that of Fawbro females .

The results also indicated that differences exist between Ross and Fawbro broilers in the percentage weight and chemical composition of female carcass parts ; and that dietary energy level has an effect on these parameters. The data further suggest that Fawbro broilers would probably be considered as slow growing strain .

دراسة مقارنة لتضريبين من فروج اللحم لتأثير طاقة الغذاء على النوعية والتركيب الكيميائي لذبائح الإناث

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المستخلص

أجريت هذه الدراسة في حقل الطيور الداجنة– قسم الثروة الحيوانية– كلية الزراعة و الغابات– جامعة الموصل، لمعرفة تأثير استخدام علائق مختلفة بمستوى الطاقة الممثلة في نوعية الذبائح وتركيبها الكيميائي لتضريبين من إناث فروج اللحم ربيت تحت الظروف البيئية الشائعة في العراق.ربيت أفراخ الروز الأبيض والفاوبرو العراقي بعمر يوم واحد وبمعدل 180 طيراً من كل تضريب وعلى الفرشة. وزعت الأفراخ من كل تضريب عشوائياً على ثلاثة معاملات غذائية بمستويات مختلفة من الطاقة الممثلة ، واحتوت كل معاملة على ثلاثة مكررات وبواقع 20 طيراً للمكرر الواحد .

أظهرت النتائج عدم وجود فروق معنوية بين إناث فروج اللحم لكلا التضريبين في نسبة التصافي ولم تحصل فروق معنوية في النسبة المئوية للأجزاء الداخلية المأكولة ونسبة دهن البطن في إناث الروز الأبيض عند تغذيتها على المستوى المنخفض للطاقة، ولكن ظهر انخفاض نسبي لها. بينما أظهرت إناث الفاوبرو ارتفاعاً بالنسبة لهاتين الصفتين. وظهرت زيادة معنوية($أ<0.01$) في النسبة المئوية لوزن الصدر في إناث الروز المغذاة على العليقة ذات المستوى المرتفع بالطاقة، ولكن لم تظهر هناك فروق معنوية بالنسبة لوزن الفخذ والوصلة الفخذية.

احتوت ذبائح إناث الروز التي تمت تغذيتها على العلائق ذات المستوى المنخفض للطاقة على نسب عالية معنوياً($أ<0.01$) لكل من الرطوبة والبروتين، ولكن نسب منخفضة معنوياً لكل من الدهن والرماد وذلك في قطعة الفخذ والوصلة الفخذية.

إما بالنسبة لقطعة الصدر في إناث الروز فقد احتوت على نسبة عالية معنويا ً ($أ<0.01$) من البروتين ونسبة منخفضة معنوياً ($أ<0.01$) من الدهن عند مقارنتها بتلك لإناث الفاوبرو.

تشير نتائج هذه الدراسة الى وجود فروق بين الفاوبرو والروز في النسب المئوية للاوزان والتركيب الكيميائي لقطعيات ذبائح فروج اللحم. كما وجد ايضا ان لمستويات الطاقة الممثلة المختلفة في العلائق تاثيرا واضحا في هذه الصفات . وتشير ايضاً الى إن فروج اللحم الفاوبرو ربما يعد من الهجن البطيئة النمو.

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INTRODUCTION

The increased carcass fat that has accompanied by rapid growth of the modern broiler chicken continues to be a health concern of consumers . In addition , the abdominal and visceral fat are considered to be waste products to the poultry processor , and this add to the problems of waste management . Because of that , broiler production industry is always looking for ways to improve its product in order to meet consumers demands .

The most important economic concerns of broiler production are carcass yield and nutritional quality . It has been reported that carcass composition is affected by a number of factors , such as ration composition (5, 7 , 14 , 19) ,feed consumption (15) , genetics (3) photoschedule (11) , and environmental temperature (16) . It has also been reported that carcass weight of Ross strain broilers fed on rations produced in the UK was higher than that of those raised on rations produced in the USA (9) . When broilers of different strain crosses were fed rations with different energy levels , it was observed that slow growing strain produced the highest percentage of carcass fat (13) . It was reported that reduced abdominal fat may occur during periods of compensatory gain , and it was predicted that fat deposition of fast - growing broilers would be regulated by feed restriction (10, 20) . It has been reported that pure strain or cross differences in the quantity of abdominal fat of market - age broilers exist (6) .

The objective of this study was to investigate the effect of using rations with different levels of metabolizable energy on female carcass quality and chemical composition of two broiler strain crosses reared under conventional Environmental conditions in Iraq .

MATERIALS AND METHODS

This study was conducted at the Poultry Farm of theAnimal Resources Dept. during the first three months of 1999 - College of Agriculture and Forestry - University of Mosul . One - day old White Ross and Iraqi Fawbro broiler chicks were reared on a deep litter at the rate of 180 birds per strain . Unsexed birds were weighed individualy , wing banded and both sexes were reared in 2 x 3 m pens posthatching . From each strain and after the secondary sex characteristics on birds after three weeks of age were appeared , females were randomly distributed to three treatments and each treatment consisted of three replicates with 20 females per replicate .

Three corn - soybean meal rations (treatments) are shown in Tables(1 and 2) with three levels of metabolizable energy (2812 , 2709 , 2896) and (2839 , 2744 , 2918 ,) in rations 1 ,2 and 3 and fixed protein levels (21.1 ,21 , 21.5) and (18.1 , 18.2 , 18) in rations 1 ,2 and 3 were used during both starting and growing periods ,respectively . All facilities and requirements for rearing were supplied to birds . Feed and water were provided for *ad libitum* consumption .

Table 1. Levels and composition of starter rations fed to broiler chickens used in this study .

Feed ingrediends	Ration (1) (control)	Ration (2) (low energy)	Ration (3) (high energy)
Ground yellow corn	54	51	59
Ground Barly	6	4.5	3.5
Soybean meal (44%C.P.)	22.5	22	24
Protein concentrate (50%C.P.)[1]	10	9	10
Wheat bran	6	12	2
Limeston	0.5	0.5	0.5
Table salt (NaCl)	0.5	0.5	0.5
Vitamins and minerals premix [2]	0.5	0.5	0.5
Total	100	100	100
Calculated Analysis :			
Crude protein (%)	21.1	21	21.5
Metabolizable energy (Kcal/kg)	2812	2709	2896
C:P Ratio	133.2	129	134.6
Methionine + Cystine (%)	0.680	0.674	0.681
Lysine (%)	1.070	1.051	1.086

Each kilogram contains the following :
Crude protein 50% , lysine 2.8% , methionine 1.7% ,methionine and cystine 2.3%, calcium 8.0% , phosphorus 3.2% ,sodium 1.5 % ,
Metabolizable energy 2400 kcal .
Each kilogram contains the following :Vit.A 10.000.000 IU , Vit. D3 ,2500.000 IU , Vit. D 8000 mg , Vit. K 3000 mg , Vit. B1 3000 mg , Vit. B2 2500 mg , pantothenic acid 3000 mg , nicotinic acid 8000 mg , Vit. B6 500 mg , Vit. B12 5 mg , biotin 600 µgm , Vit. C 4000 mg , iron 15000 mg , manganise 25000 mg , cupper 2500 mg , zinc 10000 mg , iodine 200 mg .

Table 2 . Levels and composition of growing rations fed to broiler chickens used in this study.

Feed ingredients	Ration (1) (control)	Ration (2) (low energy)	Ration (3) (high energy)
Ground yellow corn	56.5	54	63
Ground barley	10.5	8	6
Soybean meal (44% C.P.)	15	14	20
Protion concentrate (50% C.P)[1]	8	8.5	4.5
Wheat bran	8.5	14	5
Limeston	0.5	0.5	0.5
Table salt (Na Cl)	0.5	0.5	0.5
Vitamins and minerals premix[2]	0.5	0.5	0.5
Total	100	100	100
Calculated Analysis :			
Crude protein (%)	18.1	18.2	18
Metabolizable energy (Kcal/kg)	2839	2744	2918
C:P Ratio	157	150.8	162
Methionine	0.597	0.60	0.60
Lysine (%)	0.854	0.856	0.874

1- Each kilogram contains the following :
Crude protein 50% , lysine 2.8% , methionine 1.7% , methionin and cystine 2.3% , calcium 8.0% , phosphorus 3.2% , sodium 1.5% , metabolizable energy 2400 kcal.

2- Each kilogram contains the following :
Vit. A 10.000.000 IU , Vit.D3 , 2500.000 ,Vit. D 8000 mg ,Vit.K 3000 mg , Vit. B1 3000 mg , Vit. B2 2500 mg , pantothenic acid 3000 mg, nicotinic acid 8000 mg , Vit. B6 500 mg , Vit. B12 5 mg , biotin 600 µgm,Vit. C 4000 mg , iron 15000 mg , manganise 25000 mg , cupper 2500 mg , zinc 10000 mg , iodine 200 mg .

At 56 days and after a 12 - hr period of feed withdrawal but continued water availability , ten females from each replicate were randomly taken. Exsanguination was carried out after individual birds were hung by their feet on a rail using a hand - held knife . After a 4 - min . bleeding time , each carcass was scalded in a 60 ºC Vat for 2 min. , feathers were removed in a rotary drum picker set on a 30 sec . cycle , and the carcass was manually eviscerated .Carcasses were chilled in ice water for approximately one hour , drained for 10 min. , weighed and cut up into various parts after hand separation of abdominal fat .

From the leg quarters and breast , samples (without bones) were separately ground in a meat grinder fitted with a 2-mm screen . Duplicate samples from each part were removed for the determination of protein , fat , carbohydrates * and ash using the Approximate Analysis System (2) .

STATISTICAL ANALYSIS

Data were subjected to statistical analysis of a complete randomized design (CRD) by using procedures of SAS® software (12) , and Dancan's Multiple Range Test (18) .

RESULTS AND DISCUSSION

The results of carcass yield and percentages of giblets and abdominal fat of female broiers of the two strain crosses are shown in Table (3) . There were no significant differences among females observed in carcass yield when birds of the two strains were fed rations with different levels of metabolizable energy . These results agree with those obtained by Leeson *et al.* (7) , who found no significant differences in carcass yield when birds fed diluted rations ; but not in agreement with those results obtained by Malone *et al.* (8) who stated that broilers of Arbor- acres gave higher carcass yield than those of Hubburd .

Significant differences ($p < 0.01$) were observed among female carcasses in the percentage weight of giblets . Females of the White Ross fed the high energy level (T3) showed a decline in the percentage weight of giblets when compared with that of the control (T1) group . The differences among female birds in the percentage giblets weight were significantly ($P<0.01$) observed between the Fawbro and White - Ross birds in the control group (T1) . This result agrees with that found by Malone *et al.* (8) who stated that significant differences were observed in the percentage weight of giblets among different strains.

The percentage weight of abdominal fat in females of the White Ross fed the high level of energy (T3) was lower than those in other treatments , but not significant ;the only difference appeared was that among brids of the Ross in treatment 3 and those of Fawbro in treatment 1 . Nosignificant differences appeared in this trait among birds in other treatments .

***Determined by substraction method.**

Table 3. Effect of dietary energy levels of Fawbro and Ross female broilers on carcass yield , giblets and abdominal fat percentags at 8 weeks of age* .

Treatment Number	Metabolizable energy (k cal / kg)		Strain cross	Carcass Yield (%)	Giblets (%)	Abdominal Fat weight (%)
	Starting period	Growing Period				
1 (control)	2812	2839	Fawbro ebro	66.80	7.58 b	3. 90 a
			Ross	66.62	8.38 a	3.72 ab
2 (low level)	2709	2744	Fawbro	68.60	8.11 ab	3.50 ab
			Ross	66.46	7.74 ab	3.10 ab
3 (high level)	2896	2918	Fawro	67.31	8.34 ab	3.44 ab
			Ross	68.10	7.35 b	2.97 b
Probabilities				N.S	P< 0.01	P< 0.01

*** Means within columns subgroups lacking a common superscript are significantly different .**

The data in Table(3) showed that the females of Fawbro contained high levels of abdominal fat than those of White Ross . This result agrees with that obtained by Sizemore and Siegel (13) . It seems possible that interaction between these two strains and nutrition in the level of abdominal fat exists , because some researchers (4 , 13) indicated that carcasses of slow growing strains contained high level of fat than those of fast growing straines .

The results of the effect of dietary energy on the yield of carcass parts of Fawbro and Ross female broilers are presented in Table (4) . Significant differences ($p < 0.01$) were obtained among females in the percentage weight of breast in treatment 3 in both crosses . Ross female broilers showed a significant increase ($p< 0.01$) in breast yield when they were fed the diet of high level (T 3) of energy , compared with that of Fawbro females . No significant differences were observed among females in the percentage weight of leg quarters in all treatments of both crosses , but females of Fawbro broilers in treatment 2 (low level of energy) showed a relative decrease in the percentage weight of leg quarters . Although there were no significant differences in the percentage weight of wings in all treatments in both crosses, the percentage weight of wings of females in both crosses in treatment 3 was relatively higher than those in other treatments . The lowest percentage weight of back cut appeared in females of Ross , while the highest percentage appeared in females of Fawbro . These results are in agreement with those observed by some researchers (8) , who stated that strain cross differences exist among broilers in the percentage weight of carcass cuts ; and by others (5) who found that the nutrition has a significant effect on the percentage weight of broiler carcass cuts .

Table 4. Effect of dietary energy levels of Fawbro and Ross female broilers on carcass parts yield at 8 weeks of age . *

Treatment Number	Metabolizable Energy (kcal/kg)		Strain Cross	Carcass parts (%)				
	Starting period	Growing Period		Breast	Leg-quarter	Wings	Back	Neck
1 control	2812	2839	Fawbro	24.92 ab	30.00	13.57	24.68 a	6.83 a
			Ross	26.20 a	30.21	13.58	23.1 bc	6.91 ab
2 low level	2709	2744	Fawbro	25.37 a	29.32	13.77	24.22ab	7.14 ab
			Ross	25.80 a	30.38	13.30	23.68bc	6.51 b
3 high level	2896	2918	Fawbro	24.35 b	30.42	14.21	23.72bc	7.31 a
			Ross	26.41 a	30.68	13.83	22.37c	6.71 a
Probabilities				P< 0.01	N.S	N.S	P<0.01	P<0.01

*** Means within column subgroubs lacking a common superscript are significantly different .**

The effects of dietary energy levels on the chemical composition of breast cut (without bones) of Fawbro and White Ross female broilers are presented in Table(5) . Significant differences ($p < 0.01$) between Fawbro and White Ross female broilers were observed in moisture content in breast cut . As the dietary energy level was increased (T3) , in both strain crosses , moisture content and protein content were decreased , but fat content was increased , when this was compared with that of the control group (T 1) . Ross female broiler breast contained higher level of protein and lower level of fat than that of the Fawbro

female broilers . When the dietary energy level was increased (T3) the breast of Fawbro female broilers contained low levels of ash and carbohydrate , comparing this with that of the control group (T1) . These results are in agreement with those observed by other workers (16 , 17) .

Table 5. The effect of dietary energy levels of Fawbro and Ross female broilers on the chemical composition of the breast cut (without bones) at 8 weeks of age * .

Trt. No.	Metabolizable Energy (kcal/kg) Start. Perio.	Grow. Perio.	Strain cross	Moist. (%)	Dry Matter (%)	Crude protein (%)	Ether Extr. (%)	Ash (%)	CHO (%)
1 cont.	2812	2839	Fawb.	c 66.19	33.81	e 17.37	B 12.20	a 0.82	a 3.42
			Ross	d 65.95	32.08	b 20.55	e 9.10	d 0.64	c 1.79
2 low level	2709	2744	Fawb.	b 66.89	33.11	c 20.27	D 10.24	c 0.71	c 1.89
			Ross	a 68.39	31.61	a 21.93	f 6.99	e 0.27	b 2.42
3 high level	2896	2918	Fawb.	d 65.94	33.08	f 16.06	A 14.28	b 0.78	c 1.96
			Ross	c 66.20	33.80	d 19.75	c 11.51	d 0.64	c 1.90
Probabilities				p<0.01	N.S	P<0.01	P<0.01	P<0.01	P<0.01

*** Means within column subgroups lacking a common superscript are significantly different .**

The effects of dietary energy levels on the chemical composition of leg quarters in female broiler carcasses of the two strain crosses are shown in Table(6) . Ross female leg quarters of broilers on the low level of dietary energy (T2) exhibited significantly (p < 0.01) higher level of moisture (67.89 %) than those in all other treatments ; whereas leg quarters of females of the same strain cross in treatment 3 (high dietary energy) showed significantly (p< 0.01) low level of miosture . There were no significant differences in the level of dry matter were observed . Leg quarters of Ross female broilers in treatment(2) (low dietary energy) gave the highest (p< 0.01) level of protein , but the lowest level of fat . Leg quarters of the Fawbro female broilers showed significantly (p< 0.01) higher level of ash , but lower level of carbohydrates (CHO) than those of Ross females .

In general, leg quarters of Ross female broilers in treatment(2) (low level of energy) contained high levels of moisture and protein , but low levels of fat and ash . While leg quarters of Fawbro female broilers contained low levels of moisture , protein and carbohydrate , but high levels of fat and ash when birds were fed the high energy diet (T3) . The results of this study agree with those obtained in a privious study (1) on the effect of energy on males of two strain crosses , when it was found that there were differences between the two crosses exist in the percentage weight of carcass cuts and their chemical composition . These results are also in agreement with those obtained by some other researchers (17 , 19) , who stated that increasing the dietary energy level of broilers caused an increase in fat level, , but a decrease in protein and moisture levels. The data of this study indicate that protein level in breast cut of both strain crosses is significantly (p < 0.01) higher than that in leg quarters (Tables 5 and 6) , but the level of fat in leg quarters was higher than that in breast cut .

Table 6 . The effect of dietary energy levels of Fawbro and Ross female broilers on the chemical composition of the leg quqrters (without bones) at 8 weeks of age * .

Trea. No.	Metabolizable Energy (kcal/kg) Starting period	Groing period	Strain Cross	Moisture (%)	Dry Matter (%)	Crude Protein (%)	Ether Extract (%)	Ash (%)	CHO (%)
1 control	2812	2839	Fawbro	d 64.63	35.37	e 15.43	b 15.85	a 0.92	d 3.17
			Ross	b 66.42	33.58	b 16.88	e 11.75	e 0.44	b 4.52
2 low level	2709	2744	Fawbro	b 66.31	33.69	d 16.07	c 14.72	c 0.58	e 2.32
			Ross	a 67.89	32.11	a 17.40	f 10.21	d 0.49	c 4.02
3 High level	2896	2918	Fawbro	c 64.99	35.01	f 14.13	a 16.90	b 0.73	d 3.25
			Ross	d 64.61	35.39	c 16.28	d 13.85	f 0.39	a 4.87
Probabilities				P<0.01	N.S	P<0.01	P<0.01	P<0.01	P<0.01

***Means within column subgroups lacking a common superscript are Significantly different .**

The results of this study indicated that there are some differences between Fawbro and White Ross broilers in the percentage weight and chemical composition of the female carcass cuts ; the data also indicate that dietary energy

level has an effect on these parameters . These data confirm the results of a previous study (1) dealt with the effect of energy on male broilers of Fawbro and White Ross strain crosses . The data also suggest that Fawbro broilers could probably be considered as slow growing strain cross , since it has been reported (13) that when commercial broiler strains were fed rations with different levels of metabolizable energy , the slow growing strain contained higher level of carcass fat than that of the fast growing strain .

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