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The Effect of Variable Calorie Protein Ratio with Holding the Dietary Protein, on Growing Chicks.

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A NUMBER of 229 White Plymouth Rock(WPR) and 237 White Plymouth Rock × Fayoumi (WPR × F) were involved. Four rations were used having similar crude protein (CP) level of about 20%, and a stepwise increase of metabolizable energy (ME) (1724, 2044, 2502 and 2808 Kcal ME/kg) and calorie protein (C/P) ratio (81, 103, 119 and 138).

Holding CP level of about 20% and raising the ME level and C/P up to 2502 Kcal ME and 119 C/P ratio, improved live weight rate of growth and feed efficiency for both breeds. The highest ME level (2808 Kcal/kg) and C/P ratio (138) produced a depression in growth without marked change in feed efficiency. The ME efficiency tended to decrease with increasing ME level or widening C/P ratio, while the opposite was true with CP efficiency.

The best net return per bird was recorded with high energy and C/P ratio levels of 2502 Kcal ME and 119 C/P ratio.

Much interest, however has been shown concerning the effect of energy on protein requirement. The general concept of the work in this field is that a relationship between the energy level and protein requirement exists. Hill and Dansky, (1950) and (1954) found that growth was reduced when a high energy low protein ration was fed. However, when the energy was reduced, growth was normal, indicating a close relationship between dietary protein and energy. They reported that feed consumption was determined princi-ply by the energy level of the ration. Biely and March (1954), showed that increasing the energy level of a 19 percent crude protein ration, a depression of both growth and utilization of feed occured. They showed that increasing the energy of the 24 and 28 percent crude protein rations had no effect on growth, but did improve feed efficiency. Sunde (1956) found no effect on growth when the energy level was increased in a 20 percent protein ration. While increasing the protein level to 28 percent, resulted in a growth depression but when the energy level of 28 percent crude protein ration was increased, normal growth was restored becoming approximately equal to that of 20 percent crude protein ration. Shutze *et al* (1958) reported that growth response for chicks to increasing energy levels was no longer evident in the male birds at 8 weeks of age for 20% protein level, however feed efficiency was improved with higher energy levels. O'Neil *et al.* 1962 also found that chicks fed the 20% crude protein diet grew at a faster rate than those receiving 16% crude protein diet, but the response was inconsistent for the three levels of productive energy (750, 850 and 950 Kcal PE/1b with a respective C/P ratio of 38, 43 and 48). The slight depression in growth was observed with the high level of PE, while feed efficiency improved as the levels of productive energy increased.

Other workers (Combs and Romoser 1955, Leong *et al*, 1955, Matterson *et al.*, 1955, Donaldson *et al.*, 1955, Vondell and Ringrose 1958, and Wilkinson 1958) generally, found that dietary crude protein level (from 12 to 42 percent crude protein) must be increased with the increase of energy level (from 700 to 1450 Kcal PE/1b or 1543 to 3197 Kcal PE/kg). Their data concluded that a specific C/P ratio should be considered, irrespective to the level of protein in the diet.

The aim of the present study is to investigate various energy levels with the optimum level of about 20 percent dietary crude protein for growing White Plymouth Rock and its cross with Fayoumi chickens.

Material and Methods

A number of 229 White Plymouth Rock (WPR) chicks and 237 WPR × F chicks were involved. They were fed, for the first week of age, a commercial ration containing 20% crude protein to minimize the influence of the protein in the yolk of the newly hatched chicks.

Four treatments using four rations (Treatments and rations had the same serial number) were involved to study the effect of increasing energy levels, *i.e.* 1724, 2044, 2502 and 2808 Kcal ME per kg, keeping the dietary crude protein (CP) level around 20%, the corresponding calorie protein ratios (C/P) were 81, 103, 119 and 138 Kcal ME/kg diet per one percent CP as indicated in Table 1.

The chicks for each breed were divided into similar number (from 55 to 59 chicks for WPR and from 58 to 60 chicks for WPR × F) for the four treatments. Each treatment contained two replicates of similar chick numbers and liveweights.

The chicks were brooded in electric commercial type batteries untill 7 weeks old, then moved to floor brooders up to 12 weeks old. Male and female chicks were superficially examined. The experiment began in March and finished in June 1967.

Feed and water were supplied *ad* libitum. Individual chick weight and feed consumption were weekly recorded during the first 8 weeks of age and biweekly until the end of the experiment.

TABLE 1. **Percentage composition and proximate analyses of experimental Rations**

Ingredients	Treatment and Ration No.			
	1	2	3	4
	%	%	%	%
Yellow corn	10	10	45.5	54.5
Rice bran (extracted)	37.5	37.5	8	3
Wheat bran	20	20	8	3
Corn gluten feed	4	4	4	4
Decorticated cotton seed meal	15	15	20	21
Sesame seed meal	4	4	5	5
Fish meal	3.5	3.5	3.5	3.5
Blood meal	2.5	2.5	2.5	2.5
Bone meal	1	1	1	1
Lime stone	1.5	1.5	1.5	1.5
Sodium chloride	0.5	0.5	0.5	0.5
Mineral mixture +	0.5	0.5	0.5	0.5
Supplements				
Lard, kg/100	—	6.5	—	3.5
Vitamin mix.*	+	*	+	+
Manganese sulphate, p.p.m.	150	150	150	150
Cost/kg (mils)	22.8	30.5	32.5	38.6
Proximate analyses				
Moisture	9.38	9.22	8.88	9.31
Ash	10.84	10.27	8.34	6.76
Crude fiber	7.83	7.09	5.66	3.95
Ether extract	4.52	10.11	4.16	8.62
N. free extract	46.16	43.46	52.00	51.00
Crude protein	21.27	19.85	20.96	20.36
Metabolizable energy Kcal/kg	1724	2044	2502	2808
Calorie protein ration	81.1	103	119.3	138

+ Commercial grade.

* One Kg of vit. A+D3 mix per ton feed (Each gram of vit. mix. contains 5000. I.U. of Vit. A and 1000 I.U. of Vit. D 3).
One kg. of Vit. B mix. per ton feed (Each kg of vit B mix. contains 8.8 g riboflavin, 8.1 g pantothenic acid, 52.9 g niacin and 229.3 g choline chloride).

The efficiency of utilized feed was calculated as the amount of live weight gain per Megacalorie (Mcal = 1000 Kcal) or per unit of feed intake.

Chemical analyses for moisture, nitrogen, crude fiber, ether extract and ash were made for rations according to the methods of the A.O.A.C., 1965. Metabolizable energy of experimental rations was determined by adiabatic bomb calorimeter as described by Abou-Raya *et al.* (1971) and Selim (1971). Statistical analysis was carried out according to Snedecor (1959).

Results and Discussion

Growth performance for WPR and WPR × F chicks

As shown in Table 2, the initial liveweight for chicks at one week old for all treatments of each breed was entirely similar.

TABLE 2. Average liveweight from one to 12 weeks of age for the WPR and WPR × F chicks

Age in weeks	WPR Rations and Treatment No.				WPR × F Rations and Treatment No.			
	1	2	3	4	1	2	3	4
1	59.5	59.5	59.7	59.4	50.8	51.4	51.5	50.9
	±0.90	±0.87	±0.95	±0.88	±0.68	±0.76	±0.76	±0.68
2	103.6	105.9	105.5	103.7	93.7	95.9	96.8	87.5
3	152.8	170.8	165.4	160.8	152.6	160.6	159.1	135.2
4	227.3b	249.5a	253.4a	226.0b	211.8b	239.6a	240.4a	193.4c
5	290.8	341.6	362.2	319.2	281.5	323.5	335.0	268.6
6	357.2	426.5	450.2	409.8	349.1	401.3	419.4	353.4
7	445.5	526.8	560.5	500.8	411.8	499.0	529.4	449.8
8	459.7d	553.2b	602.5a	522.6c	447.3d	533.8b	575.1a	474.6c
10	609.9	731.4	834.9	748.3	604.5	722.0	789.3	689.9
12	781.9c	942.9b	144.9a	956.4b	772.8c	934.2b	987.8a	893.9b
	±16.4	±17.3	±19.5	±20.6	±13.3	±17.9	±19.8	±17.7
Variability %								
Initial . . .	11.7	11.2	12.1	11.2	10.4	10.9	11.4	10.2
Final . . .	15.7	13.6	13.8	16.3	14.2	14.6	15.6	15.0
Number of chicks								
Initial . . .	59	55	57	58	60	59	60	58
Final . . .	56	55	55	57	58	58	60	57
Mortality %								
	5.1	0.0	3.5	1.7	3.3	1.7	0.0	1.7

(*) Treatmets having different subscripts are statistically significant (P % 0.05) according to Duncan Multiple Range Test.

The average liveweight (Table 2) of treatment (Tr) 3 for both breeds progressively surpassed the other treatments during the whole experimental period, while Tr. 1 showed the lowest liveweight values. It could also be seen that Tr. 2 and Tr. 4 showed intermediate values. The average final liveweight ($\pm$ Standard error) at 12 weeks of age was 781.9 $\pm$ 16.4, 942.9 $\pm$ 17.3, 1044.9 $\pm$ 19.5 and 956.4 $\pm$ 20.6 g with WPR and 772.8 $\pm$ 13.3, 934.2 $\pm$ 17.9, 987.8 $\pm$ 19.8 and 893.9 $\pm$ 17.7 g with WPRXF for treatments 1, 2, 3 and 4 respectively. Analysis of variance was carried out for liveweight for both breeds at 4,8 and 12 weeks old for replicates, treatments, breeds, sexes and their interactions. The differences between treatments, breeds and sexes were highly significant. No significant differences were observed between replicates at 4 and 8 weeks old. Although a significant different was shown at 12 weeks old, yet the 'F' value was not high when compared with other tests.

The interaction between breeds and either treatments or sexes was not significant. This indicated that treatments or sexes did not respond differently to breed change. The interaction between treatment and sex was not significant at 4 weeks old and became significant at the advanced age (8 and 12 weeks old) indicating that males and females responded differently to dietary change with the advancing age.

Showing the differences between liveweight of treatments, Duncan multiple range test was carried out at 4, 8 and 12 weeks old. There were significant differences at 4 weeks old between treatments 2 or 3 and treatments 1 or 4. However, the difference between Tr. 2 and Tr. 3 was insignificant for both breeds. At 8 and 12 weeks of age a significant difference was observed for both breeds between all treatments except between Tr. 2 and 4 at 12 weeks old.

Regarding the differences between experimental treatments during the whole period of growth (1 to 12 weeks old), a linear relationship between liveweight in grams (Y) against age in weeks (T) was obtained as shown in Fig. 1 and 2. The regression equations were calculated by the method of least squares and the data were as follows :

Breed		Regression equations	Standard deviation of regression coeff.	't' calc.
WPR :	$\hat{Y}_1$	65.21 T — 29.40	1.898	34.36
	$\hat{Y}_2$	80.32 T — 55.04	2.300	34.92
	$\hat{Y}_3$	91.19 T — 84.98	2.906	31.38
	$\hat{Y}_4$	81.66 T — 77.86	3.303	24.72
WPR×F :	$\hat{Y}_1$	64.92 T — 38.95	1.816	35.75
	$\hat{Y}_2$	79.99 T — 67.81	2.464	32.46
	$\hat{Y}_3$	86.55 T — 87.57	2.831	30.57
	$\hat{Y}$	77.18 T — 87.02	3.778	20.43

It is obvious that the calculated linear regressions were found to be highly significant.

Therefore, it could be concluded that Ration 1 producted significantly lower regression coefficient (growth rate index) for both breeds than other compared rations, while Rations 3 (Tr. 3) produced significantly the highest liveweights and treatments 2 and 4 produced practically similar weights.

Growth pattern for treatments 1, 2, 3 and 4 was entirely due to the diffrences in the rations fed. Ration 1 fed to treatment 1 in which fiber materials such as wheat bran and rice bran, partly (35%) replaced corn of ration3, contained low energy (1724 Kcal ME/kg). The poorest gain of treatments 1 may be due to the compositon of this ration. Such formula, in general may result in enlargement of the feed volume and produce less digestibility (Robertson *et al.*, 1948, Insko and Culton 1949 Hill and Dansky 1954, Richardson *et al.* 1958 and Potter *et al.* 1960).

Ration 2 was obtained by adding 6.5% fat to ration 1 where the ME was raised from 1724 to 2044 Kcal ME/kg. The fat supplemented diet (Ration 2) improved growth performance of treatment 2 than the unsupplemented one (Ration 1) similar results were reported by Richardson *et al.* (1958), Potter *et al.* (1960) and Splittgerber and Gysae (1963).

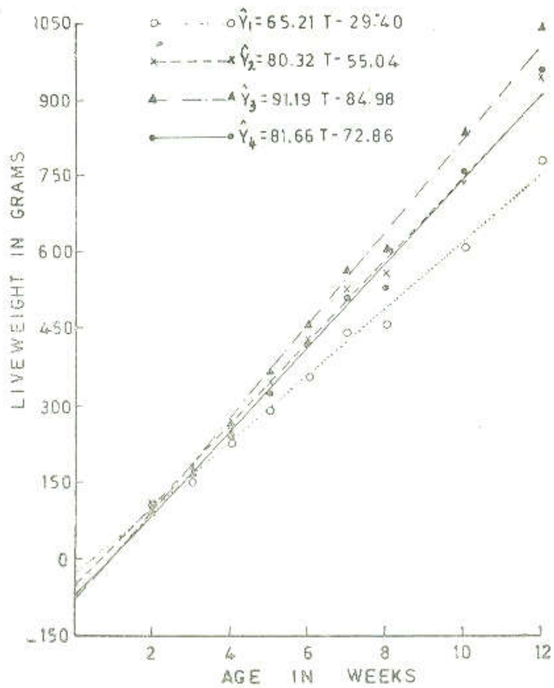

Fig. 1_Relationship between liveweight and age of growing WPR chicks fed different ME and C/P ratio levels with holding CP level.

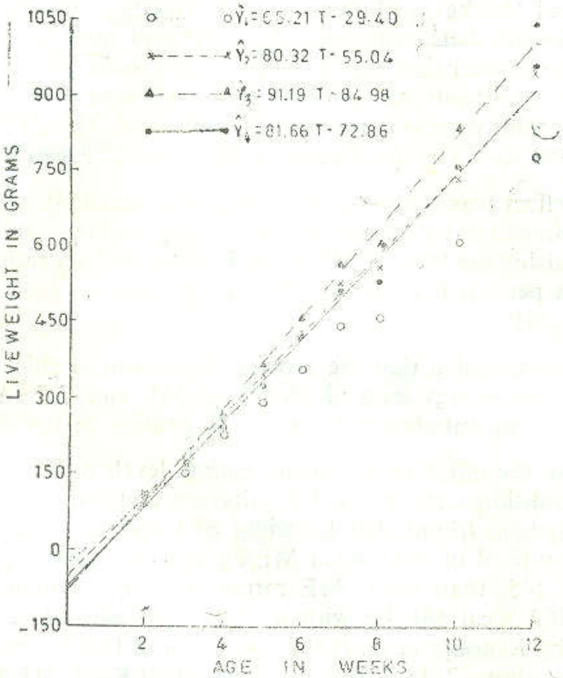

Fig. 1_Relationship between liveweight and age of growing WPR chicks fed different ME and C/P ratio levels with holding CP level.

By raising the energy level up to 2502 Kcal ME/kg (Ration 3) with a C/P ratio of 119.3 Kcal ME/kg per 1% CP, best growth was obtained with treatment 3. It may be concluded that increasing metabolizable energy level from 1724 to 2502 Kcal ME/kg and widening the C/P ratio from 81 to 119 Kcal ME/kg diet per 1% CP, improved growth response. This increase in growth according to the increasing calorie protein ratio would suggest insufficient metabolizable energy for the quality of available protein to chicks. Such conclusion was reported by many investigators. Sunde (1956) found that raising the energy level from 655 to 932 Kcal PE/1b (2070 — 2940 Kcal ME/kg), with diets having 20% CP. improved weight of chicks at both 4 and 10 weeks of age. Mraz *et al.* (1958) reported also that growth was increased by increasing the level of PE from 450 to 670 Kcal PE/1b (1430 — 2085 Kcal ME/kg) with diets containing the same level of CP (20%). Moreover, O'Neil *et al.* (1962) found also that raising the energy level from 750 to 850 Kcal PE/1b (2360 — 2680 Kcal ME/kg) improved growth rate of chicks.

But the response was not consistent, showing a decline in growth rate with birds fed Ration 4, treatment 4, having highest metabolizable energy of 2808 Kcal/kg of feed with C/P ratio of 138. This growth depression agreed with the findings of Combs and Romoser (1955) who found that growth rate of broilers was not affected up to 41.5 — 42 Kcal PE/1b of feed per 1% CP

(130 — 133 Kcal ME/kg). Matterson *et al.*, (1955) also noted a growth depression in chicks fed diets containing 20% CP and high levels of PE. Mraz *et al.* (1958) also proved that growth was reduced with 20% protein level and 900 PE/1b with a C/P ratio of 45 (2840 Kcal ME with C/P of 142 Kcal ME/kg). Similar results were obtained by O'Neil *et al.* (1962) when the energy was raised to 950 Kcal PE/1b (3000 Kcal ME with C/P ratio of 150).

A similar effect was noted by Biely and March (1954) when 19% protein diet was supplmented by either 5% or 7.5% tallow. Alzodzadzi (1964) reported that raising the level of ME from 3160 to 3960 on ration had the same CP of 19.76 at periods from 45 to 75 days, growth declined above the level of 3360 Kcal ME.

It could be concluded that the growth depression of chicks in the present study with the high energy level of 2808 Kcal ME and C/P ratio of 138 (Tr. 4) would suggest an imbalance of energy to protein in the diet.

Considering the effect of increasing energy levels on live-weight of chicks under local conditions, the present results are confirmed by those reported by Selim (1964) who found that livewight of Fayoumi chicks was depressed at a high energy level of 2972 Kcal ME/kg diet on a 20% protein diet with a C/P ratio of 145, than lower ME ration (having similar level of protein 20.15%) of 2702 Kcal ME/kg with a C/P ratio of 134.1. Similar results were reported by Kotoury *et al.* (1969), who found that by increasing productive energy level above 2143 Kcal/kg of feed (3060 Kcal ME/kg) on iso-nitrogenous diets, growth performance was impaired.

Variability for Liveweights

It is indicated generally, that no marked effect on variability for final liveweights (Table 2) was observed among treatments. This would be in agreement with those of Mraz *et al.* (1958). Their data showed that holding constant the level of CP (20%) and varying the levels of productive energy (PE) from 992 to 1984 Kcal/kg did not affect the variability. Results also were similar to those obtained by Selim *et al.* (1971) with the same breeds, indicating that variability was not affected by changing ME ad CP levels keeping constant C/P ratio.

Mortality %

The data in Table 2 showed that mortality rate ranged between 0.0 and 5.1% among treatments for both breeds. The rate was low, being satisfactory and indicating no treatment effect on mortaility.

Efficiency of feed utilization

The daily feed intake (Table 3) might be the same as that with chicks fed on rations having a certain range of energy. With pure breed, the range was higher (1724 from Tr. 1 to 2502 Kcal ME/kg for Tr. 3), than with crosses (1724 for Tr. 1 to 2044 Kcal/kg for Tr. 2). Feed consumption tended to decrease with the increase of energy level. This would affect directly the growth performance.

TABLE 3. **Daily feed metabolizable energy and crude protein consumption and their utilization together with net return during the whole experimental period (1-12 weeks old).**

Breed / Treatment Ration No.	WPR				WPR × F			
	1	2	3	4	1	2	3	4
Feed intake g	46.3	45.6	45.3	40.2	45.9	46.0	43.0	39.4
Feed efficiency :								
kg gain/kg feed	0.202	0.250	0.280	0.290	0.203	0.249	0.282	0.277
kg feed/kg gain	4.950	4.000	3.571	3.448	4.926	4.016	3.546	3.610
Metabolizable energy								
Intake, kcal	79.9	93.3	113.5	112.8	79.2	94.0	107.6	111.1
Crude protein intake g.	9.85	8.99	9.50	8.18	9.77	9.13	9.01	8.03
Efficiency of ME, kg, gain/M cal	0.117	0.122	0.112	0.103	0.118	0.122	0.113	0.099
Efficiency of crude protein, kg gain/kg CP	0.950	1.258	1.337	1.425	0.954	1.253	1.348	1.361
Net return								
Selling price/bird mills	271	331	370	336	271	331	351	316
Food cost/bird	81	108	114	119	81	108	108	117
Money return	190	223	255	217	190	243	223	199

It was shown from the foregoing discussion that chicks of treatment 1 being fed the low energy diet (Ration 1) were chiefly bound to consume more feed to fulfil their necessary requirement of nutrients for maintenenance and growth. Similarly, Fisher and Weiss (1966), reported that reducing energy levels by adding fibrous sources would stimulate feed consumption.

Although supplementation of 6.5% fat to ration 1 to be Ration 2 raised the energy level from 1724 to 2044 Kcal ME per kg diet, similar amount of feed was consumed by the chicks of Tr. 2 as that of Tr. 1. This produced a higher daily intake of energy (ME) for Ration 2 and better growth than for Ration 1. This result fairly agreed with that obtained by Richardson *et al.*, (1958).

Present results indicated generally, that above the range of energy for Tr. 2 with WPR × F and for Tr. 3 with WPR, feed consumption was adjusted by the birds to avoid excess energy intake by restricting their feed intake. Such results are in good agreement with those obtained by Donaldson *et al.*, (1955) and Vermeersch and Vanschlbrousk, (1968) who found that increasing energy levels in isointrogenous rations above a certain level, reduced feed consumption. It was also proved by Wells (1963) that dietary energy has governed the feed intake.

Obviously raising the energy level from 1724 Kcal ME/kg for Tr. 1 to 2502 Kcal ME for Tr. 3 or widening C/P ratio from 81 to 119, respectively, an increase in feed efficiency was noted. Above that energy level or on higher C/P ratio about 138 for Tr. 4, a slight improvement in feed efficiency was shown as for Tr. 4. with WPR or a decline in efficiency was found as with WPR × F chicks. The lowest feed efficiency for Tr. 1 which had low energy was in agreement with the findings obtained by Robertson *et al.*, 1948) Insko and Culton 1949) Hill and Dansky (1954) Richardson *et al.*, 1958) and Mraz *et al.*, 1958).

Increasing the energy of Ration 1 from 1724 to 2044 Kcal ME with the addition of 6.5% fat (Ration 2), improved feed efficiency. It is evident that the addition of fat to a ration containing fibrous feeding stuff tended to overcome its deleterious effect on feed conversion as explained by Richardson *et al.*, 1958) and reported by Potter *et al.*, (1960).

It was clear that improvement was consistent with the increase of energy up to a certain level of 2501 Kcal ME (Ration 3 used for Tr. 3). Above that level the improvement in feed efficiency was little as shown for Tr. 4 with WPR, while reduction in feed efficiency occured with crosses. The reports of Matterson *et al.*, 1955) Sunde 1956), Mraz *et al.*, (1958) and O'Neil *et al*,. 1962) indicated that efficiency of feed utilization increased with increasing the energy level of the diet. However the results of Biely and March (1954) and Selim *et al.*, (1971) indicated that improvement of feed utilization was only acheived by increasing both energy and protein levels.

According to the data obtained by Selim (1964) with 20% CP and 2702 Kcal ME/kg and Kotoury *et al.*, (1969) with 15% CP and 3050 Kcal ME/kg a depression in feed efficiency was observed with the increase of energy up to that level.

As indicated in Table 3, the daily energy intake was the lowest for Tr. 1, being intermediate for Tr. 2 and highest for Tr. 3 and 4 of which energy intake was similar to WPR and slightly higher for Tr. 4 than for Tr. 3 with WPR × F. It was clear that the level of ME and CP intakes per day was dependant on feed consumption and the levels of ME and CP in the rations. It is of interest to note that with rations containing higher energy (Rations 3 and 4) adjustment of birds for feed consumption occured so that the daily calorie consumption remained nearly similar for both Tr. 3 and 4. These results agreed those obtained by Bedell and Watts (1966).

It could be seen from Table 3 that raising the energy level of Ration 1 (Tr. 1), by adding fat, from 1724 to 2044 Kcal ME/kg (Tr. 2) and C/P ratio from 81 to 103 had no appreciable effect on ME efficiency. This indicated that within this range of energy in feed having about 20% CP, birds coull practically utilize ME with the same efficiency. Above this range of energy a noticeable decrease in ME efficiency was shown as forTr. 3, (Ration 3), with a further drop in efficiency for Tr. 4 (Ration 4) by an excessive increase in the energy level.

The average CP efficiency, during the whole experimental period was increased gradually with the increase in enegry levels and C/P ratio. The effect of the treatment on CP efficiency was generally in the opposite direction of ME efficiency. The present results agreed with those reported by Biely and March (1954), who found that with raising the energy of rations, the level of protein which might be utilized efficiently was higher than in rations of lower energy content. Donaldson *et al.*, (1955, 1956) found that when the C/P ratio increased, more gain was produced per unit CP improving the efficiency of CP utilization and indicating a possible sparing effect of energy on protein. They also concluded that the reverse effect of ME efficiency was decreased as the C/P ratio was widened above 44 Kcal PE/1b or 144 Kcal ME/kg per 1% CP in the diet. The results obtained in this experiment also agreed with the finding of Mraz *et al.*, (1958).

Net return of gain per bird

The net return value was used in the present study instead of thr use of economic efficiency (out-put/in-put) which was considered a missleading value as explained and discussed by Selim 1971. The net return was obtained (Table 3) by the difference between the selling price of gain and its feed cost per bird. The results indicated that Tr. 3 (Ration 3) produced by highest money return followed by Tr, 2, 4 and 1. Both breeds produced practically the same net return with Tr. 1 and 2.

It was therefore clear, that applying Ration 3 for both breeds would produce more return per bird than other rations in the same period under similar conditons, using the same system of housing and management. Moreover, it could be noted that the addition of fat to Ration 1 containing high percent of by-product to form Ration 2 increased the liveweight and consequently the selling price. The return from Ration 2 per bird was higher than with Ration 4 (Tr. 4) containing higher energy level and costing more. If maize is not available to formulate Ration 3, the alternative would be to formulate Ration 2 to produce a lower net return than the best (Ration 3). Generally, it was clear that the higher feeding cost of the high energy rations, could produce better net return than low energy ones, when considering the amount of product obtained in a certain period.

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تأثير تغيير النسبة بين مستويات الطاقة والبروتين مع ثبات البروتين الخام فى العليقة على الكتاكيت النامية

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شملت هذه التجربة على عدد ٢٢٩ كتكوت بليموث ابيض و ٢٣٧ كتكوت خليط البليموث الابيض مع الفيومى وقسمت الى اربعة معاملات ، غذيت على أربعة علائق احتوت على نفس النسبة من البروتين الخام (حوالى ٢٠٪ ونسب متدرجة من الطاقة الممثلة (١٧٢٤، ٢٠٤٤، ٢٥٠٢، ٢٨٠٨ كيلوكالورى لكل كجم عليقة) ونسب متدرجة من الطاقة الى البروتين

$$\frac{\text{(كيلوكالورى طاقة(ط) الكيلو جرام عليقة}}{\text{٪ بروتين (ب) الغذاء}}$$

٨١، ١٠٣، ١١٩، ١٣٨) .

وتتلخص النتائج فيما يلى :ـ

ظهر تحسن فى الوزن ومعدل النمو والكفاءة التحويلية للغذاء عند ثبات نسبة البروتين الخام حوالى (٢٠٪) وزيادة الطاقة الممثلة الى مستوى ٢٥٠٢ كيلو كالورى $\frac{ط}{ب}$ ١١٩ ، وقد ظهر نقص فى النمو بدون تغير فى الكفاءة التحويلية بزيادة الطاقة الممثلة الى ٢٨٠٨ كيلو كالورى / كجم و ($\frac{ط}{ب}$) الى ١٣٨ . تميل الكفاءة التحويلية للطاقة الى النقص بزيادة مستويات كل من الطاقة الممثلة ونسبة $\frac{ط}{ب}$ وكان العكس صحيحا مع الكفاءة التحويلية للبروتين .

يمكن الحصول على احسن دخل صافى لكل طائر باستعمال العليقة المرتفعة فى الطاقة الممثلة (٢٥٠٢ كيلو كالورى / كجم ونسبة $\frac{ط}{ب}$ ١١٩) .