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THE INFLUENCE OF ENERGY AND PROTEIN ON TURKEYS DURING THE FINISHER PERIOD

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Primary Audience: Turkey Producers, Nutritionists, Poultry Researchers, Processors

SUMMARY

Two experiments attempted to determine if reducing energy with increased protein during the finisher period would affect growth and body composition of male and female turkeys. Diets were formulated to provide protein at 100 and 115% of the National Research Council (NRC) levels and energy at 100 and 112% of the NRC recommendation. At the beginning of the finishing period, half of the birds were placed on a high protein/low energy finisher diet in an attempt to reduce body fat deposition. High energy/high protein diets improved body weight and feed:gain of both male and female turkeys. Dietary metabolizable energy (ME) and crude protein (CP) influenced body fat deposition of male and female turkeys. However, fat deposition can also be reduced in the finisher period by increasing the protein level of the diets.

Key words: Carcass characteristics, dietary fat, energy, performance, protein, turkeys

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DESCRIPTION OF PROBLEM

The turkey poult contains a low amount of body fat and produces a high level of tissue protein during growth. Obviously, the protein requirement of starting and young growing poult is higher than the requirements of broilers [1, 2]. The energy:protein ratio of the diets of the young poult is also considerably narrower than that for young broiler chickens. However, an optimum crude protein (CP) to metabolizable energy (ME) ratio as a constraint in formulation may be inappropriate. The independent effects of both protein and energy should be considered [3]. Supplemental fats are frequently used to increase the

ME concentration in the diets of growing turkeys, and generally favorable effects are well documented [3, 4, 5, 6, 7]. For example, the average body weight and feed efficiency of growing turkeys improved linearly when crude fat was used to increase ME in rations [5]. The relative improvements in feed efficiency resulting from increasing dietary ME are greatest during the latter portion of the rearing period, and higher levels of ME are a basic part of growing and finishing diets [8]. Young animals grow to attain their lipid-free, mature body mass and then their inherent fatness [9]. Subsequently, deposition of body fat accelerates. The degree of this acceleration in turkeys depends to a great extent on the ME concen-

tration of the diet [3, 7, 10]. Two experiments were conducted with male and female turkeys to determine if reducing energy with increased protein during the finisher period would affect growth and body composition.

MATERIALS AND METHODS

Two experiments were conducted. In the first trial toms were reared from 0 to 18 wk of age. In the second trial, hens were reared to 15 wk of age. Diets met the nutrient specifications recommended by the National Research Council [11]. Proximate analysis was performed on all feedstuffs used. The diets contained levels of protein that provided 100 and 115% of the NRC recommendations and two energy levels providing 100 and 112% of the NRC recommendation [11] in a 2 x 2 factorial arrangement of treatments from 0–12 wk for hens and 0–15 wk for toms (Tables 1–6). After the twelve and fifteen week periods, birds were assigned to one of eight treatments in a completely randomized design and fed lysine and sulfur amino acids levels set as a constant percent of CP content. At the

beginning of the finisher period, half of the birds received a high protein/low energy finisher diet in an attempt to reduce body fat deposition. Four replicate pens were assigned to each dietary treatment. All the diets were provided in mash form *ad libitum*.

In both experiments, 1600 poult were randomly allotted to thirty-two pens (fifty/pen). Each pen provided a finishing space of 0.378 m² for toms and 0.192 m² for hens. Pen weight gain, mortality, temperature, humidity, and intake data were collected for both trials on a pen basis. Thermostatic sidewall curtains, thermostatically controlled gas and electric brooders, and ventilation fans regulated temperature. Body weights were measured at 4, 8, 12, 15, and 18 wk of age with the final weight of hens taken at 15 wk. Mortality was recorded as it occurred, with birds weighed for adjustment of feed. At the beginning of the finisher diet stage and at the end of the study, two birds from each pen were selected for average pen weight. These were euthanized and their body composition determined. The data for the experiments were

TABLE 1. Composition of diets fed to hens and toms from 0 to 4 wk of age

INGREDIENT	DIET NUMBER			
	T1 & T2	T3 & T4	T5 & T6	T7 & T8
Soybean meal (48% CP)	48.971	50.396	59.812	61.300
Ground corn	46.028	37.667	33.400	25.092
Dicalcium phosphate	2.310	2.335	2.239	2.264
Limestone	1.233	1.211	1.207	1.185
Fat	0.768	7.564	2.633	9.429
Salt	0.300	0.300	0.300	0.300
Methionine	0.208	0.217	0.263	0.272
Mineral premix	0.100	0.100	0.100	0.100
Vitamin premix	0.050	0.050	0.050	0.050
Selenium premix	0.050	0.050	0.050	0.050
Choline	0.046	0.047	0.010	0.012
Coban 60 (Monensin)	0.063	0.063	0.063	0.063
CALCULATED ANALYSIS				
Crude protein (%)	28.00	28.00	32.20	32.20
ME, kcal/kg	2800	3136	2800	3136
Calcium (%)	1.20	1.20	1.20	1.20
Available phosphorus (%)	0.60	0.60	0.60	0.60
Met + Cys (%)	1.05	1.05	1.21	1.21
Lysine (%)	1.67	1.70	1.98	2.01

TABLE 2. Composition of diets fed to hens and toms from 4 to 8 wk of age

INGREDIENT	DIET NUMBER			
	T1 & T2	T3 & T4	T5 & T6	T7 & T8
Soybean meal (48% CP)	—	20.128	44.858	46.569
Ground corn	48.060	43.940	44.124	35.476
Fat	2.780	8.400	1.970	9.027
Meat meal (50% CP)	7.380	7.866	7.848	7.677
Soybean meal (44% CP)	40.700	18.774	0.347	0.324
Dicalcium phosphate	0.208	0.183	0.136	0.200
Limestone	0.090	0.000	0.000	0.000
Salt	0.300	0.300	0.300	0.300
Vitamin premix	0.050	0.050	0.050	0.050
Mineral premix	0.100	0.100	0.100	0.100
Coban 60 (Monensin)	0.063	0.063	0.063	0.063
Choline	—	0.020	—	—
Selenium premix	0.030	0.030	0.030	0.030
Methionine	0.140	0.154	0.181	0.189
CALCULATED ANALYSIS				
Crude protein (%)	26.00	26.00	29.90	29.90
ME, kcal/kg	2900	3248	2900	3248
Calcium (%)	1.00	1.00	1.00	1.00
Available phosphorus (%)	0.50	0.50	0.50	0.50
Met + Cys (%)	0.90	0.90	1.05	1.00
Lysine (%)	1.50	1.50	1.74	1.74

analyzed using analysis of variance. Since no consistent interactions occurred, the data was analyzed as a completely randomized design followed by mean separation using the protected Least Significant Difference test [12].

RESULTS AND DISCUSSION

Birds fed the control or high energy/high protein diets were significantly heavier ($P < .05$) than birds on the other treatments. At 4 wk of age, the body weight of male turkeys was significantly different among all the different dietary combinations. At 8, 12, 15, and 18 wk of age, birds fed high energy/high protein (112% ME/115% CP) diets were significantly heavier than all of the birds fed any other diets. At 18 wk of age, all of the birds fed high energy diets were significantly heavier than those fed diets containing the NRC (100%) recommended level of energy (Table 7). In female turkeys, feeding of high energy diets improved body weight signifi-

cantly ($P < .05$). From 0–8 wk, birds fed diets containing 115% CP were significantly heavier than those fed 100% CP (Table 8). In general, body weight improved at an early age (0–4 wk) for birds receiving high energy diets. However, the greatest improvements in body weight associated with added fat and increased energy occurred after 8 wk of age. After this age, high protein concentration did not improve body weight unless combined with high energy concentrations (Tables 7 and 8).

The results obtained in this experiment agree with the data presented by Sell and Owings [5]. This improvement in body weight was significant at an early age. Contrary to the results obtained with the hens, tom turkeys showed some discrepancies in the results obtained for body weight at 4 wk of age.

Feed:gain of male and female turkeys greatly improved with the 112% ME/115% CP diets (Tables 7 and 8). In toms, at 4 wk of age, no significant differences occurred between 100 and 112% ME diets when protein stayed at 100%. This result was not the same for the

TABLE 3. Composition of diets fed to hens and toms from 8 to 12 wk of age

INGREDIENT	DIET NUMBER			
	T1 & T2	T3 & T4	T5 & T6	T7 & T8
Soybean meal (48% CP)	—	—	—	17.364
Ground corn	60.719	51.427	48.831	43.309
Fat	1.730	9.141	3.835	10.000
Meat meal (50% CP)	3.000	3.000	3.000	3.000
Soybean meal (44% CP)	30.169	32.069	40.051	21.991
Dicalcium phosphate	0.454	0.476	0.376	0.442
Limestone	0.377	0.354	0.358	0.333
Salt	0.250	0.250	0.250	0.250
Vitamin premix	0.050	0.050	0.050	0.050
Mineral premix	0.100	0.100	0.100	0.100
Coban 60 (Monensin)	0.050	0.050	0.050	0.050
Fish meal (60% CP)	3.000	3.000	3.000	3.000
Selenium premix	0.050	0.050	0.050	0.050
Methionine	0.025	0.033	0.050	0.061
L-Lysine	0.027	—	—	—
CALCULATED ANALYSIS				
Crude protein (%)	22.00	22.00	25.30	25.30
ME, kcal/kg	3000	3360	3000	3360
Calcium (%)	0.85	0.85	0.85	0.85
Available phosphorus (%)	0.42	0.42	0.42	0.42
Met + Cys (%)	0.75	0.75	0.86	0.86
Lysine (%)	1.30	1.31	1.54	1.55

latter periods, when increasing ME to 112% improved feed:gain significantly compared with treatments containing 100% ME (Table 7).

The feed:gain ratio obtained in both trials demonstrated that as the energy increases, feed:gain decreases. The major differences in feed:gain ratio can be observed after the starter period. In this experiment, 115% of the NRC protein recommendations did not improve conversion after 4 wk of age unless combined with higher energy (Tables 7 and 8). The results obtained in this experiment are in agreement with our hypothesis and with other favorable responses obtained by other authors [5, 8]. Owings and Sell [6] observed an improved feed efficiency with fat supplementation of corn-based or milo-based diets. Efficiency of protein utilization improved consistently when fat was included in the diets, particularly in those with a non-adjusted ME:nutrient ratio. Toms and hens in this experiment responded favorably to early fat sup-

plementation. These results do not agree with Sell [13], who reported that turkeys have a limited ability to utilize dietary fat during early life. The ME of the diet fed during the starter period might influence body fat deposition during later growth [3, 7, 10].

At 15 wk of age for toms and 12 wk for hens, the abdominal fat pads from birds fed diets containing 112% ME were significantly heavier than those from birds fed diets containing 100% ME. Increasing ME to 112% NRC without increasing CP% resulted in significantly increased abdominal fat pad weights. High protein, 100% ME diets significantly decreased abdominal fat pad weights (Tables 9 and 10). These data on body composition suggest that increased protein may aid in reducing body fat. There were no significant differences among breast weight or drumstick of toms or hens fed different dietary treatments (Tables 9 and 10). Thus, increased dietary ME increased body fat deposition of male and female turkeys ($P < .05$).

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TABLE 4. Composition of diets fed to toms from 12 to 15 wk of age

INGREDIENT	DIET NUMBER			
	T1 & T2	T3 & T4	T5 & T6	T7 & T8
Soybean meal (48% CP)	26.585	28.232	33.973	35.619
Ground corn	69.146	59.963	60.517	51.334
Fat	1.607	9.130	2.887	10.410
Dicalcium Phosphate	1.307	1.335	1.259	1.287
Limestone	0.828	0.804	0.811	0.786
Salt	0.250	0.250	0.250	0.250
Vitamin Premix	0.050	0.050	0.050	0.050
Mineral Premix	0.100	0.100	0.100	0.100
Coban 60 (Monensin)	0.050	0.050	0.050	0.050
Selenium Premix	0.050	0.050	0.050	0.050
Methionine	0.026	0.036	0.053	0.063
CALCULATED ANALYSIS				
Crude Protein (%)	19.00	19.00	21.85	21.85
ME, kcal/kg	3100	3472	3100	3472
Calcium (%)	0.75	0.75	0.75	0.75
Available Phosphorus (%)	0.38	0.38	0.38	0.38
Met + Cys (%)	0.65	0.65	0.75	0.75
Lysine (%)	1.01	1.04	1.23	1.26

TABLE 5. Composition of diets fed to hens from 12 to 15 wk of age

INGREDIENT	DIET NUMBER			
	T1	T2, T4, T5, & T8	T3	T6 & T7
Soybean meal (44% CP)	30.344	38.807	32.358	40.818
Ground corn	63.400	53.194	53.756	43.551
Fat	3.501	5.304	11.172	12.974
Dicalcium phosphate	1.242	1.175	1.264	1.197
Limestone	0.850	0.833	0.826	0.809
Salt	0.300	0.300	0.300	0.300
Vitamin premix	0.100	0.100	0.100	0.100
Mineral premix	0.100	0.100	0.100	0.100
Coban 60 (Monensin)	0.063	0.062	0.063	0.063
Selenium premix	0.030	0.030	0.030	0.030
Methionine	0.025	0.051	0.033	0.059
L-Lysine	0.045	0.044	-	-
CALCULATED ANALYSIS				
Crude protein (%)	19.0	21.85	19.0	21.85
ME, kcal/kg	3100	3100	3472	3472
Calcium (%)	0.75	0.75	0.75	0.75
Available phosphorus (%)	0.38	0.38	0.38	0.38
Met + Cys (%)	0.65	0.75	0.65	0.75
Lysine (%)	1.08	1.30	1.08	1.30

TABLE 6. Composition of diets fed to toms from 15 to 18 wk of age

INGREDIENT	DIET NUMBER			
	T1	T2, T4, T5, & T8	T3	T6 & T7
Ground corn	77.108	61.657	66.865	51.832
Fat	1.908	5.302	9.922	13.188
Soybean meal (44% CP)	6.341	30.813	10.231	32.759
Soybean meal (48% CP)	9.004	0.0	7.348	0.0
Meat meal (50% CP)	5.000	0.0	5.000	0.0
Dicalcium phosphate	0.049	0.980	0.069	1.004
Limestone	0.097	0.749	0.072	0.724
Salt	0.250	0.250	0.250	0.250
Vitamin premix	0.050	0.050	0.050	0.050
Mineral premix	0.100	0.100	0.100	0.100
Coban 60 (Monensin)	0.063	0.063	0.063	0.063
Selenium premix	0.030	0.030	0.030	0.030
Methionine	0.035	0.005	0.060	0.015
CALCULATED ANALYSIS				
Crude protein (%)	16.5	19.0	16.5	19.0
ME, kcal/kg	3200	3200	3584	3584
Calcium (%)	0.65	0.65	0.65	0.65
Available phosphorus (%)	0.33	0.33	0.33	0.33
Met + Cys (%)	0.55	0.63	0.55	0.63
Lysine (%)	0.80	1.05	0.80	1.05

TABLE 7. Body weight and feed:gain of tom turkeys fed different levels of CP and ME from 0 to 18 wk of age

DIET	CP/ME	CP/ME ^A	4th WEEK ^B		8th WEEK ^B		12th WEEK ^B		15th WEEK ^B		18th WEEK ^C		
			B.W.	F:G	B.W.	F:G	B.W.	F:G	B.W.	F:G	B.W.	F:G	
T1		100/100										29.10 ^a	2.81 ^c
	100/100		2.06 ^d	1.49 ^b	7.92 ^b	1.83 ^d	18.22 ^a	2.26 ^d	24.08 ^a	2.56 ^b			
T2		115/100										29.82 ^{ab}	2.84 ^c
T3		100/112										30.27 ^{bc}	2.37 ^{ab}
	100/112		1.75 ^a	1.49 ^b	7.60 ^a	1.64 ^b	17.98 ^a	1.98 ^b	24.49 ^a	2.19 ^a			
T4		115/100										29.86 ^{ab}	2.44 ^c
T5		115/100										29.35 ^a	2.79 ^c
	115/100		1.87 ^b	1.57 ^c	7.95 ^b	1.74 ^c	18.40 ^a	2.17 ^c	24.27 ^a	2.51 ^b			
T6		115/112										30.54 ^{bc}	2.65 ^d
T7		115/112										30.94 ^c	2.33 ^a
	115/112		1.94 ^c	1.38 ^a	8.47 ^c	1.56 ^a	19.35 ^b	1.91 ^a	25.39 ^b	2.14 ^a			
T8		115/100										30.27 ^{bc}	2.41 ^{bc}
SEM			0.02	0.01	0.07	0.01	0.16	0.01	0.17	0.01	0.28	0.02	

^ACP% and ME% for the finisher period
^BEight pens/treatment
^CFour pens/treatment
^{a-c}Means in the same column followed by the same letter are not significantly different (P > .05).

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Feed intake declined with the use of high energy diets. Low energy diets do not appear to be as detrimental to turkeys as they are to broilers because of the turkey's ability to adjust its intake level when fed lower energy rations [13]. High energy diets resulted in reduced feed intake. Performance of birds fed high

energy diets can be affected if protein does not increase. Maximum weight gain resulted from high energy/high protein diets in both male and female turkeys. These observations could be an important economic consideration with respect to effective use of supplemental fat in turkey feeding programs.

TABLE 8. Body weight and feed:gain of hen turkeys fed different levels of CP and ME from 0 to 15 wk of age

DIET	CP/ME	CP/ME ^A	4th WEEK		8th WEEK		12th WEEK		15th WEEK	
			B.W.	F:G	B.W.	F:G	B.W.	F:G	B.W.	F:G
T1		100/100							17.21 ^{ab}	2.67 ^c
	100/100		1.64 ^a	1.70 ^d	6.41 ^b	1.95 ^d	12.28 ^a	2.39 ^d		
T2		115/100							17.06 ^a	2.67 ^c
T3		100/112							18.58 ^c	2.32 ^a
	100/112		1.84 ^c	1.52 ^b	7.09 ^c	1.72 ^b	13.06 ^b	2.13 ^b		
T4		115/100							17.79 ^{abc}	2.45 ^b
T5		115/100							17.33 ^{ab}	2.63 ^c
	115/100		1.74 ^b	1.66 ^c	6.67 ^a	1.91 ^c	12.59 ^a	2.33 ^c		
T6		115/112							18.15 ^{bc}	2.47 ^b
T7		115/112							18.30 ^c	2.34 ^a
	115/112		1.91 ^d	1.47 ^a	7.38 ^d	1.68 ^a	13.52 ^c	2.10 ^a		
T8		115/100							17.80 ^{abc}	2.46 ^b
SEM			0.02	0.01	0.07	0.01	0.14	0.01	0.27	0.02

^ACP% and ME% for the finisher period
^{a-d}Means in the same column followed by the same letter are not significantly different (P > .05).

TABLE 9. Body composition of turkey toms fed different levels of CP and ME from 0 to 18 wk of age

DIET	CP/ME	CP/ME ^A	FAT (%)		BREAST (%)		DRUMSTICK (%)	
			15 Wk	18 Wk	15 Wk	18 Wk	15 Wk	18 Wk
T1		100/100		1.10 ^{ab}		20.5 ^a		4.86 ^a
	100/100		0.81 ^{ab}		21.5 ^a		4.70 ^a	
T2		115/100		0.88 ^a		22.7 ^a		4.99 ^a
T3		100/112		1.66 ^c		21.3 ^a		4.82 ^a
	100/112		1.16 ^{bc}		19.3 ^a		4.66 ^a	
T4		115/100		1.50 ^{bc}		20.2 ^a		4.87 ^a
T5		115/100		0.73 ^a		23.3 ^a		4.93 ^a
	115/100		0.65 ^a		19.5 ^a		4.70 ^a	
T6		115/112		1.05 ^{ab}		22.3 ^a		4.73 ^a
T7		115/112		1.12 ^{abc}		21.1 ^a		4.44 ^a
	115/112		1.33 ^c		20.7 ^a		4.33 ^a	
T8		115/100		1.19 ^{abc}		21.8 ^a		4.88 ^a
SEM			0.13	0.17	0.64	0.84	0.23	0.14

^ACP% and ME% for the finisher period.
^{a-c}Means (eight or four pens, respectively) in the same column followed by the same letter are not significantly different (P > .05).

TABLE 10. Body composition of turkey hens fed different levels of CP and ME from 0 to 15 wk of age

DIET	CP/ME	CP/ME ^A	FAT (%)		BREAST (%)		DRUMSTICK (%)	
			12 Wk	15 Wk	12 Wk	15 Wk	12 Wk	15 Wk
T1		100/100		1.54 ^{ab}		20.6 ^a		4.43 ^a
	100/100		0.70 ^a		21.3 ^a		4.57 ^a	
T2		115/100		1.43 ^{ab}		20.6 ^a		4.56 ^a
T3		100/112		1.62 ^{abc}		21.6 ^a		4.55 ^a
	100/112		1.24 ^b		20.8 ^a		4.47 ^a	
T4		115/100		1.62 ^{abc}		22.0 ^a		4.23 ^a
T5		115/100		1.01 ^a		21.3 ^a		4.49 ^a
	115/110		0.56 ^a		21.4 ^a		4.57 ^a	
T6		115/112		1.76 ^{bc}		23.0 ^a		3.92 ^a
T7		115/112		2.21 ^b		22.2 ^a		4.04 ^a
	115/112		1.29 ^b		20.5 ^a		4.63 ^a	
T8		115/100		1.59 ^{abc}		21.9 ^a		4.29 ^a
SEM			0.10	0.19	0.38	0.90	0.08	0.17

^ACP% and ME% for the finisher period

^{a-c}Means (eight or four pens, respectively) in the same column followed by the same letter are not significantly different ($P > .05$).

CONCLUSIONS AND APPLICATIONS

1. High energy/high protein diets improved body weight and feed:gain of both male and female turkeys.
2. High energy diets resulted in reduced feed intake and in some cases in low protein intake if CP% was not increased.
3. Dietary energy influenced body fat deposition of both male and female turkeys.
4. Using high protein/low energy finishing diets did not result in significantly reduced fat deposition.

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