

Environmental temperature and Turkey performance: the use of diets containing increased levels of protein and use of a choice-feeding system

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Summary

Female turkeys kept under an 18 or 25 °C environmental temperature regime were fed from 72 d of age until the end of the experiment at 100 d of age on one of five diets each containing a different level of protein (178, 209, 240, 272, 303 g/kg). Further birds under each temperature regime were offered a high-protein concentrate (488 g protein/kg) free-choice with whole wheat. Turkeys which received the conventional diets (178 or 209 g protein/kg) grew significantly faster and consumed food at a significantly greater rate under the 18 °C regime compared with the 25 °C regime. Turkeys which received diets 4, 5 or 6 at 18 °C or diets 5 or 6 at 25 °C exhibited the highest growth rates. Treatment means for body weight, at 72 d prior to feeding the experimental diets, and at the end of the experiment for each diet were markedly lower for the 25 °C regime.

The choice-fed birds apparently overconsumed protein to a considerable extent compared with those fed the 178 or 209 g protein/kg diets. The choice-fed turkey appears to meet its lowered dietary energy requirement at higher temperatures by reducing intake of the whole cereal.

Introduction

HELLICKSON *et al.* (1967) kept turkeys (*Meleagris gallopavo*) at environmental temperatures of 10, 15.6, 21.1 and 26.7 °C. Growth rate was significantly lower at 26.7 °C compared with 21.1 °C. The present experiment was designed to investigate the performance of the turkey kept under an 18 or 25 °C environmental temperature regime and offered, from 72 days of age, one of five diets each containing a different level of protein from 178 to 303 g/kg. Further birds under each temperature regime were offered a high-protein concentrate free-choice with whole wheat.

Materials and Methods

The 25 °C temperature regime consisted of 25 °C from 29 d of age until the end of the experiment. The 18 °C regime consisted of 23 °C from 29 to 36 d, 20 °C from 36 to 43 d and 18 °C from 43 d of age. Composition of the experimental diets is given in Table 1. Five of the feeding treatments consisted of feeding diets 1, 2, 3, 4 and 5 respectively. The sixth feeding treatment consisted of feeding diet 6 free-choice with whole wheat. The experimental foods were offered from 72 to 100 d of age. Diets were all fed in pellet form (4.8 mm).

Female large white turkeys (British United Turkeys Triple 6) were used. On arrival from the hatchery birds were distributed around the 24 pens of a controlled environment house, 73 birds per pen. Each pen had a floor area of about 13.5 m² and had wood shavings litter. Birds were brooded until 29 d old using infra-red lamps and a background temperature of 25 °C. The infra-red lamps were switched off at 29 d old. Prestarter crumbs (by calculation, 272 g crude protein and 11.20 MJ ME/kg) were fed until the turkeys were 30 d old when a pelleted (4.8 mm) starter diet containing by calculation 252 g crude protein and 11.41 MJ ME/kg was substituted. Regulated quantities of flint grit were supplied during brooding and rearing. The turkeys were debeaked at 8 d old.

The controlled environment house had four rooms, six pens per room. At 29 d of age doors between the rooms were closed and the 18 and 25 °C temperature

TABLE 1

Composition of the experimental diets (g/kg)
Composition des régimes expérimentaux (g/kg)

	1	2	Diet 3	4	5	6
Ground barley	360	257.5	150	100	...	...
Ground wheat	200	175	180	75	74.5	...
Ground maize	250	300	325	400	425	...
White fish meal	59.5	85	110.5	136.8	161.7	300
Meat-and-bone meal	59.5	85	110.5	136.8	161.7	300
Soyabean meal	59.5	85	110.5	136.8	161.7	300
Vitamin-mineral supplement (1)	11.5	12.5	13.5	14.5	15.5	62.5
L-lysine HCL	0.7	...	...	...	...	...
Steamed bone flour . . . . .	...	...	...	...	...	37.5
<i>Calculated analysis (2) :</i>						
ME (MJ/kg)	11.64	11.66	11.66	11.65	11.65	9.67
Crude protein	178	209	240	272	303	488
<i>Determined analysis :</i>						
Crude protein (3)	180	198	214	220	253	406

(1) Standard turkey grower supplement (COWAN and MICHIE, 1978a).

(2) Based on values from published tables. The whole wheat fed as the food free-choice with diet 6 was considered to contain 104 g crude protein and 12.18 MJ ME/kg.

(3) Mean of 10, 9, 12, 11, 13 and 8 samples respectively.

regimes started. Rooms had been randomly allocated to the two temperature regimes, two rooms per regime. The six pens of each room were randomly assigned to the six feeding treatments. All foods were supplied *ad libitum*. Four feeders, in the same relative positions, per pen were used to supply the experimental foods. For the pens which received the choice of foods, wheat and diet 6 were placed in two feeders each. Position of the two foods in the pen was balanced between the two pens which received the choice treatment for each temperature regime. Food consumption was recorded from 72 to 100 d. The birds were maintained under continuous lighting and weighed at 72 and 100 d of age.

The average rate of growth and food intake per bird was determined for each pen for the period 72 to 100 d of age. Pen data were subjected to analyses of variance. All possible simple effect comparisons were selected *a priori* and done using the analysis of variance *t*-test.

Results

The treatment means and results of the statistical analyses for the rate of growth, and food intake, final body weight and mortality (including culls) for the period 72 to 100 d of age are shown in Table 2.

Growth rate

Turkeys which received diets 1 to 4 had a significantly faster growth rate when given the 18 °C temperature regime compared with the 25 °C regime. For the 18 °C regime turkeys offered diet 6 free-choice with wheat and diets 4 and 5 had a significantly higher growth rate than the turkeys given diet 3. Turkeys on the 25 °C regime which received diet 6 free choice with wheat or received diet 5, grew at a significantly faster rate than the diet 4 fed birds (Table 2).

Food intake rate

Turkeys given diets 1 to 4 had a significantly greater food intake rate on the 18 °C regime compared with the 25 °C regime. For the 18 °C regime, birds given diets 4, 5 and 6 consumed food at a significantly higher rate than those on diets 1 to 3. For the 25 °C regime, birds on diet 5 and diet 6 with wheat consumed food at a significantly greater rate than those on diets 1 to 4 (Table 2).

Choice feeding

The choice-fed birds consumed whole wheat on average at 124.9 g/bird/d under the 18 °C regime and at 103.4 g/bird/d under the 25 °C regime. Diet 6 was consumed at rates of 111.0 and 116.5 g/bird/d on average, under the 18 and 25 °C regimes respectively.

TABLE 2

Treatment means and results of the statistical analysis for the rate of growth, food intake, crude protein intake (g/bird/d) and metabolisable energy intake (MJ/bird/d), final body weight (kg/bird) and mortality (p. cent)
Moyennes selon les traitements et résultats des analyses statistiques pour le taux de croissance, les consommations de nourriture, de protéine (g/dinde/j) et d'énergie métabolisable (MJ/dinde/j), le poids vif à 100 jours (kg/dinde) et la mortalité (p. cent)

	Main Effect ⁽⁴⁾		Temp × diet	Tempe- rature regime (°C)	I	2	Diet			5	6/wheat	Critical (5) difference a b
	Temp	Diet					3	4				
Growth.	*	***	**	18	65.7	75.6	74.4	80.5	83.6	79.7	10.1	4.8
Food intake.	*	***	*	25	49.4	60.4	58.9	69.6	80.8	79.1		
Protein intake ⁽¹⁾	*	***	**	18	196.2	206.6	204.1	221.0	223.9	235.9	29.6	14.3
Protein intake ⁽²⁾	*	***	**	25	150.6	165.0	158.7	178.9	203.2	219.9		
Protein intake ⁽³⁾	*	***	**	18	34.9	43.2	49.0	60.1	67.9	67.2	7.6	3.7
ME intake ⁽¹⁾	*	***	**	25	26.8	34.5	38.1	48.7	61.6	67.6		
ME intake ⁽²⁾	*	***	**	18	35.3	40.9	43.7	48.6	56.7	58.1	6.5	3.1
ME intake ⁽³⁾	*	***	*	25	27.1	32.7	34.0	39.4	51.4	58.0		
Body Weight, 100 d ⁽³⁾	**	***	NS	18	2.283	2.499	2.380	2.575	2.609	2.594	0.352	0.171
Mortality	NS	*	NS	25	1.753	1.924	1.851	2.085	2.307	2.386	0.556	0.301
				18	4.370	4.648	4.566	4.856	4.836	4.785		
				25	3.710	3.974	3.909	4.222	4.635	4.560		
				18	0.8	1.5	0	0	0.8	0	5.6	2.8
				25	0	4.9	0	2.3	0.8	3.8		

⁽¹⁾ Using the calculated figures for concentration of crude protein or metabolisable energy from Table 1.

⁽²⁾ Using the determined figures for concentration of crude protein from Table 1. The calculated value presented in Table 1 was used for whole wheat (fed free-choice with diet 6).

⁽³⁾ 72 d body weight: 18 °C, 2.533 kg/bird; 25 °C, 2.310 kg/bird. Critical difference, 0.256.

⁽⁴⁾ NS, not significant; *, p < 0.05; **, p < 0.01; ***, p < 0.001.

⁽⁵⁾ (a) between the same or different feeding treatments for different temperature regimes.
 (b) between feeding treatments for same temperature regime.

Discussion

Diets with protein levels, relative to metabolisable energy, similar to those of diets 1 or 2 in the present study would normally be fed to the female turkey from 10 to 14 weeks of age (N.R.C., 1971). Significantly higher growth rates were shown by the turkeys which were offered diets 4 and 5.

Table 2 presents results for protein intake. These are compatible with the hypothesis that the growth rate depression of the turkey at high environmental temperatures such as 25 °C is much reduced when given the same intake of protein as at lower temperatures. However, it is important to investigate whether the introduction of higher-protein diets at the commencement of the different temperature regimes, would eliminate or greatly reduce the high-temperature depression in final body weight (COWAN and MICHIE, 1978b).

WAIBEL, EL HALAWANI and BEHREND (1976) kept male large white turkeys on a 9, 14, 20 or 27 °C environmental temperature regime from 4 weeks of age and offered, 6 to 18 weeks of age, one of four complete diet regimes to investigate protein requirements. Weight gain and food consumption, 6 to 18 weeks of age, and weight gain for intermediate periods were presented. Their results for growth, 6 to 16 weeks, appear to support the findings of the present study. Growth performance, 16 to 18 weeks, was poor in the 27 °C environment.

The apparent high level of protein intake shown by the birds choice fed with a high-protein concentrate and whole wheat, compared with feeding a conventional diet, has also been recorded for the male turkey (COWAN and MICHIE, 1977). Comparison of the treatment means for whole wheat intake and diet 6 intake for the 18 and 25 °C temperature regimes suggests that the turkey when choice fed with whole grain attempts to meet its lowered dietary energy requirement at higher temperatures by reducing its intake of the whole cereal, the birds at the higher temperature maintaining their level of protein intake by increasing consumption of the higher-protein food (COWAN and MICHIE, 1978c).

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Résumé

Des dindes élevées sous une température soit de 18 °C soit de 25 °C ont été nourries à partir de l'âge de 72 jours jusqu'à la fin de l'essai à l'âge de 100 jours avec l'un des cinq régimes formulés pour apporter une quantité différente de protéine (178, 209, 240, 272, 303 g/kg). A d'autres dindes élevées sous les deux températures on offrait en libre choix un aliment riche en protéine (488 g protéine/kg) et du blé entier. La composition des régimes expérimentaux figure au tableau 1.

Dès la sortie du local d'éclosion les dindes ont été logées dans un poulailler comprenant quatre salles, six cases par salle, 73 dindes par case. Deux des salles, choisies au hasard étaient chauffées à 18 °C, les deux autres à 25 °C; les six régimes alimentaires ont été répartis dans les six cases de chaque salle.

Les moyennes obtenues selon les traitements et les résultats des analyses statistiques sont rapportés au tableau 2. Les animaux auxquels on a imposé les régimes classiques (178 g ou 209 g protéines/kg) ont eu une croissance considérablement plus rapide et une consommation nettement plus élevée sous une température de 18 °C comparée à 25 °C. Les dindes auxquelles on a imposé les régimes 4, 5 ou 6 à 18 °C et les régimes 5 ou 6 à 25 °C montrent la croissance la plus élevée. Cependant les moyennes, selon les traitements, du poids vif à 72 jours et à la fin de l'essai de chacun des régimes sont plus élevées à 18 °C.

Les dindes nourries en libre choix semblent avoir consommé un excès considérable de protéines par rapport à celles nourries avec les régimes classiques (178 g ou de 209 g de protéines/kg). La dinde nourrie en libre choix semble compenser la réduction de ses besoins énergétiques aux températures élevées par une consommation plus faible de céréales entières.

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