FREE-CHOICE FEEDING OF POULTRY: A REVIEW

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The ability of animals, in general, to select and regulate the intake of nutrients when offered a choice of foods is well recognized (for a review, see Overmann 1976). Studies on diet selection have been conducted with chickens (Funk 1932; Berg and Bearse 1958; Berg 1959; Leeson and Summers 1977) and turkeys (Fry, McGinnis and Jensen 1956; Fry, Jensen and McGinnis 1958; Massey and Fuller 1962). Both species are able to adjust the intake of foods in accordance with their metabolic requirements.

The feeding of energy (cereals), protein, mineral and vitamin supplements on a free-choice basis to poultry was popular until the late 1950's. This system of feeding was abandoned in favour of the "all-mash" system probably because it was easier to automate the delivery of mash to birds housed in cages. The changeover from the free-choice to the "all-mash" system may have also been influenced by some avian nutritionists who suggested at the time (1958) that all the calcium required by the laying hen should be incorporated in the mash (see Taylor 1970). It is now well recognized that the hen can adjust the intake of calcium in relation to the needs of egg production (Taylor 1970, 1972; Hughes 1972; Sauveur and Mongin 1974).

Currently there is a renewed interest in the free-choice system of feeding. This is partly due to the consistent increases in cereal grain prices and fuel-energy costs, which have highlighted the need for a feeding system that would minimize feed and processing costs without decreasing the output of either eggs or poultry meat (Karunajeewa 1978). It appears that the free-choice system is the only hope of improving on the present system of feeding a complete diet on an ad libitum basis (G.C. Emmans, Personal Communication).

In this paper the free-choice feeding of replacement pullets, laying hens, broilers and turkeys is discussed.

Replacement pullets

'The ability of the young chick to balance its ration by selecting food ingredients offered on a free-choice basis has been demonstrated by Funk (1932) and Dove (1935). However, Dove (1935) found a wide range of individual differences in the selection abilities of chickens, Some chicks selected well and grew at a rapid rate, others were simply adequate and grew normally, while a third group was unable to select a ration favourable to, growth. He attributed this variation in selection abilities to possible genotypic differences. The per cent intake of various food ingredients by chicks showing a high selection ability and consequently a high rate of growth is shown in table 1. The composition of this ration consumed voluntarily by the chicks is almost similar to that of conventional starter diets.

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TABLE I. Dietary self-selection by chicks (Dove 1935)

Food ingredient offered free-choice	Intake (As % of total)	Nutrient content of ration	
Maize	52.8	Crude protein	17.9%
Oat meal	8.9	ME	11.44 MJ/kg
Wheat bran	21.3	Calcium	1.3%
Fish meal	11.4	Phosphorus	1.1%
Dried skim milk	2.1		
Bone meal	2.9		
Oyster Shell	0.6		
Total	100.0		

In conventional rearing programmes replacement pullets are fed a high protein (18 - 20%) diet from day-old to 6 - 8 weeks and thereafter a low-protein (12 - 16%) diet to point-of-lay. Recently, however, Leeson and Summers (1977) have reported the results of an experiment which indicate that a reversal of the conventional rearing programme (i.e. low-protein diets from 4 to 12 weeks of age and then high-protein diets to point-of-lay) may be more appropriate in meeting the protein requirements of the growing chick, They found that when pullets were offered a choice between two diets, one containing 45.3% protein and 10.31 MJ, ME/kg and another containing 8% protein and 13.33 MJ, ME/kg, they consumed less protein from 4 to 12 weeks than the controls given a conventional diet containing 15% protein and 11.83 MJ, ME/kg. From 12 to 20 weeks of age, however, the pullets given a choice of diets consumed more protein than the control pullets. A desirable feature among the pullets given a choice of diets was that they grew at a constant rate and attained the desired liveweight at 20 weeks of age while those on the conventional diet grew rapidly in the 4 - 12 week-age period and slowly thereafter to reach the same liveweight at 20 weeks. Preliminary data for the laying phase indicate that the choice-fed pullets matured later and after the initial lag phase (20 to 24 weeks of age) these pullets were laying at a higher rate than the control birds. .

The use of whole (unground) grains in free-choice feeding systems for replacement pullets has been investigated by several workers (Berg and Bearse 1958; Fry, Jensen and McGinnis 1958; Berg 1959; Fuller 1962). The advantages of feeding whole grains are the savings in energy costs of grinding and mixing and a possible increase in efficiency of utilization. McIntosh et al, (1962) found that 7 to 8 week-old Barred Plymouth Rock chicks utilized the energy in whole grains more efficiently than that in either ground or pelleted grains, even in the absence of hard grit. Berg and Bearse (1958) found that growing pullets given free access to a grower mash and whole sorghum and whole barley developed just as rapidly and more efficiently than those reared on an all-mash regime. The grower mash given to the choice fed pullets during the 8 to 12, 12 to 16 and 16 to 20 week-age periods contained 18%, 16.1% and 14.4% protein, respectively, The proportion of whole grains relative to mash eaten by the pullets increased from 43.4% in the 8 to

12 week-age period to 70.7% in the last four weeks of the growing period. Again, Berg (1959) showed that feeding whole sorghum and mash on the free-choice basis to pullets from 8 to 21 weeks of age resulted in a reduction in feed intake by 3.3% and delayed sexual maturity with no adverse effects on subsequent laying performance. On the other hand, Fuller (1962) observed that White Leghorn pullets allowed self-selection of a 33% protein concentrate, whole maize, whole oats and a mineral mixture from 8 to 21 weeks of age ate 13% less feed and performed more efficiently during the laying phase than those given a choice of a conventional mash (20.8% protein), whole maize and whole oats. In this experiment, it was found that the intake of energy was similar over a wide range of protein intakes, This suggested that growing pullets eat to satisfy their energy needs with little regard for the protein level achieved.

The degree of success achieved in using whole grains in a free-choice feeding programme may depend on the nutritive value of the grains used. Maize and wheat have been found to be more acceptable to chicks than pearled barley (Fry, Jensen and McGinnis 1958), buckwheat or rye (Kare and Scott 1962). For instance, pearled barley that had been treated to improve its nutritive value by the addition of either tallow (Fry, McGinnis and Jensen, 1956) or enzyme supplement or soaking in water (Fry, Jensen and McGinnis 1958) was found to be more acceptable than untreated barley to the chicks.

Another factor that could influence free-choice feeding is the type of higher-protein food used with the cereal, Cowan, Michie and Roelle (1978)' have investigated the feeding of replacement pullets either one of two protein concentrates (49 or 32% protein) or a grower diet (15% protein) offered on a free-choice basis with either whole wheat or barley. They found no significant differences in growth rate between pullets that were choice-fed and those given a complete diet of 15.2% protein mash from 43 to 99 d and a 12.2% protein diet from 99 to 127 d.

However, the pullets given whole barley and the 32% protein-concentrate grew at a slower rate (16.0 vs. 17.0 g/d) despite their higher intake of protein (19.9 vs. 11.8 g/d). Their intake of metabolizable energy (ME), however, was lower (0.91 vs. 0.97 MJ/d) than that of pullets given the complete diet. This emphasises the significance of energy intake rather than protein intake during the growing period in determining the liveweight at 20 weeks of age. Bullock, Morris and Fox (1963) also showed that energy intake has a greater effect than protein intake on the liveweight of pullets at 20 weeks of age (table II).

Cowan, Michie and Roelle(1978) found that pullets offered whole wheat consumed less of the higher protein foods (i.e. the protein concentrates and the grower diet) than those given whole barley. This indicated that the pullets were able to balance the intake of whole wheat and each of the higher protein foods much better than when a low-energy cereal such as barley was used in the free-choice feeding programme, The most 'economical treatment, however, in terms of food, protein and ME intakes appeared to be the choice feeding of whole wheat and the 15% protein-grower diet.

TABLE 11: Effect of protein and metabolizable energy intake during the growing period (8 - 20 weeks) on subsequent laying performance

Intake/bird Protein	ME	Livewt. at 20 wks.	Age at 50% prodn.	Rate of lay	Hen-housed prodn. to 500 days	Egg wt.
(g/d)	(MJ/d)	(kg/bird)	(d)	(%)	(eggs)	(g)
18.4	1.13	1.89	156	73.4	269	57.3
16.7	1.19	1.90	156	72.8	251	57.3
16.2	0.85	1.67	163	72.2	254	57.7
13.0	1.13	1.81	160	73.8	270	57.9
11.3	0.82	1.56	167	70.2	244	56.1
10.8	1.14	1.72	161	72.2	251	56.8
S.E. of means (df 14)		0.028	0.69	0.82	7.35	0.38

(Bullock, Morris and Fox (1963)

In Australia, the free-choice system of feeding replacement pullets would be economically feasible only if protein concentrates based on meat and bone meal could be used. In an experiment carried out at the Animal Research Institute, Werribee (H. Karunajeewa, unpublished data), the feasibility of feeding pullets from 8 to 20 weeks of age was examined with diets containing a 39.8% protein-concentrate based on meat and bone meal and either wheat, millet (Echinochloa frumentacea var. Shirohie) or paddy rice (Oryza sativa var. Kulu) fed on a free-choice basis. The cereals were offered either in the crushed form or as whole grain. When the pullets were offered whole grain, they ate more feed, particularly the protein concentrate compared to those given the crushed grain. This resulted in higher intakes of both protein and ME for those fed whole grain except for the wheat-fed groups which had similar ME intakes. The relationships between the daily intake of ME, lysine and growth rate appeared to be positive with ME intake exerting a greater influence on growth rate than lysine intake. The pullets given paddy rice gained less liveweight (7.4 g/d) than those given either wheat (12.0 g/d) or millet (11.0 g/d). This was due to their lower intake of energy (0.72 vs. 0.85 MJ/d). Hard grit was offered to all pullets but only those given whole wheat ate a significant amount (1.43 g/d).

The laying data between 20 and 52 weeks of age was compared for the birds subjected to'these rearing treatments. The pullets given whole grain during rearing matured earlier (171 vs. 174 d), laid at a higher rate (61.8 vs. 58.8%) and converted feed to eggs more efficiently (3.34 vs. 3.51 kg feed/kg eggs) than those given crushed grain. The rearing treatments had no significant effect on feed intake during the laying phase. Pullets fed wheat and millet during rearing laid more eggs and converted feed more efficiently than those given paddy rice. Egg weight, however, was greater for those given paddy rice and millet during the rearing period.

One of the disadvantages or problems likely to occur in free-choice feeding of pullets on litter floors is a higher incidence of coccidiosis. The inclusion of a coccidiostat in the protein concentrate

at a level which was six times that included in conventional diets failed to prevent coccidiosis in the pullets. Thus, to rear pullets on litter floors using free choice diets, water medication to prevent coccidiosis would be necessary until a coccidiostat suitable for inclusion in concentrate mixes is found. Grower diets formulated on the basis of the proportion of grain and protein concentrate selected by pullets in the experiment described above are shown in table III. It is interesting to note that with the high-energy cereal (wheat) a higher concentration of dietary protein (17 to 18%) and with low-energy cereals (millet and paddy rice) a lower concentration of dietary protein (13 to 14%) is required.

TABLE III: Grower diet formulations based on the proportion of grain and concentrate selected by crossbred pullets

Ingredient	Wheat		Millet		Paddy Rice	
	Crushed	Whole	Crushed	Whole	Crushed	Whole
	(%)	(%)	(%)	(%)	(%)	(%)
Cereal grain	81.8	79.4	83.8	80.8	77.4	75.5
Meat and bone meal (51.7%)	13.0	14.7	11.6	13.7	16.1	17.5
Lucerne meal (14.1%)	4.6	5.2	4.0	4.8	5.7	6.1
Salt	0.45	0.50	0.40	0.50	0.60	0.60
Premix	0.15	0.20	0.20	0.20	0.20	0.20
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated analysis						
Crude protein (%)	16.9	17.6	13.3	14.2	13.3	14.0
ME (MJ/kg)	12.39	12.26	11.00	10.88	11.20	11.13

Laying hens

Emmans (1975, 1978) provides three reasons for considering choice feeding as a possible practical system for laying hens:-

(1) Nutrient requirements (expressed as a percentage of the diet) vary between and within flocks due to differences in feed intake and egg output. The coefficient of variation for egg output and feed intake between hens in a flock has been estimated to be about 10%.

(2) Consequently, diet formulations based on the average nutrient requirements of the flock will result in some potential high-producers being undersupplied with nutrients while the poor layers would be oversupplied with nutrients. Choice feeding would allow each hen to balance her intake of nutrient in relation to metabolic needs.

(3) Since cereals constitute the bulk of a layer ration, feeding it in the form of whole grain would lead to some savings in fuel energy.

The ability of the hen to choose between a complete diet and ground barley in relation to her metabolic needs has been demonstrated by Emmans (1977). He found that hens offered a choice had egg outputs not significantly different from those given only the complete diet but substituted some barley for the complete diet so that their intake of nutrients was reduced (table IV).

TABLE IV: Performance of laying hens given either a choice of a 17.3% protein layer diet and ground barley or the layer diet only from 41 to 56 weeks of age (Emmans 1977)

	Choice		No choice	
Strain	Babcock	Warren Studler	Babcock	Warren Studler
Rate of lay (%)	84.2	86.0	81.5	85.7
Egg output (g/bird d)	51.8	53.4	50.4	53.3
Liveweight gain (g/bird d)	0.71	1.17	0.78	1.07
Food intake/bird:				
Complete diet (g/d)	102.5	111.5	119.4	131.1
Ground barley (g/d)	18.8	23.70	--	--
Ground barley (%)	15.5	17.5	--	--

Blair, Dewar and Downie (1973) showed that laying hens ate 6.5% less food when given a cereal mixture consisting of kibbled maize, whole wheat and barley together with a 41% protein-concentrate and oyster shell grit in the ratio of 70:23:7. Their egg output was similar to that of hens given the conventional mash, However, when the calcium supplement, in the form of ground limestone, was incorporated in the protein-concentrate and fed to the hens in the afternoon and the cereal mixture given in the morning, there was an increase in food intake. This result indicates that the hens should be able to select the calcium supplement separately from the other dietary components or else they would overconsume other nutrients in trying to satisfy their requirement for calcium. Sauveur and Mongin (1974) found that variations of food intake in relation to ovulation and oviposition disappeared when oyster shell grit was offered separately in the afternoon.

The response to choice feeding of laying hens is influenced by the type of cereal and the feather condition of the hens. Karunajeewa (1978) found that when crossbred hens on litter were offered a choice of either whole wheat or barley and a 31% protein-concentrate, their food intake was reduced by 7 and 15% respectively, as compared to that of hens given mash diets based on either wheat or barley. Rate of lay was unaffected by choice feeding but egg weight was increased during the latter half of the laying cycle. The hens in this experiment were fairly well-feathered with an average of 2.6 on a 4-point scale of feather score. Consequently, the daily intake of whole grains was consistent throughout the laying year with only a slight increase in ME intake as the hens

aged (table V). In another experiment, however, poorly feathered hens (score of 1.9) offered a choice of whole wheat and a protein concentrate increased their ME intake by 8.7% with increasing age while those not

TABLE V: Effect of cereals, age and choice feeding of whole grain, protein concentrate and shell grit on the daily intake of feed per hen (Karunajeewa 1978)

Cereal	Age in weeks	Whole grain	+ Concentrate	+ Shell grit	= Total	Layer mash	+ Shell grit	= Total
		(g)	(g)	(g)	(g)	(g)	(g)	(g)
Wheat	25-49	89.4	21.9	4.1	115.4	117.3	3.6	120.9
	49-73	88.4	25.2	4.6	118.2	123.9	3.8	127.7
Barley	25-49	94.1	19.7	4.2	118.0	132.1	3.5	135.6
	49-73	93.4	24.5	4.7	122.6	141.9	4.0	145.9

given a choice of foods increased their ME intake by 12.4% (Karunajeewa and Bagot 1978). On the other hand the ME intake of well-feathered hens (score of 3.3) given a choice of foods did not increase with age but the hens on the complete diets (no choice) increased their ME intake by 9% (table VI).

TABLE VI: Effect of feather condition and choice feeding of whole wheat and protein-concentrate on feed and nutrient intake of crossbred layers (Karunajeewa and Bagot 1978)

Feather condition/score	Feeding method	Intake/bird/day					
		Feed		Protein		ME	
		25-49 wks	49-73 wks	25-49 wks	49-73 wks	25-49 wks	49-73 wks
		(g)	(g)	(g)	(g)	(MJ)	(MJ)
Good/3.3	Choice	98.6	100.0	16.3	17.1	1.10	1.10
	No choice	109.3	120.5	15.8	19.3	1.17	1.29
Poor/1.9	Choice	106.1	112.4	17.9	19.1	1.16	1.27
	No choice	118.0	135.1	17.0	21.6	1.27	1.45

The age at which choice feeding is introduced seems to have some effect on laying performance. Dun (1977) found that when choice feeding was introduced at 51 weeks of age, there was a decrease in rate of lay by 5% for the first 4-week period. After this adaptation period, the choice fed hens maintained the same egg weight and rate of lay from 55 to 70 weeks

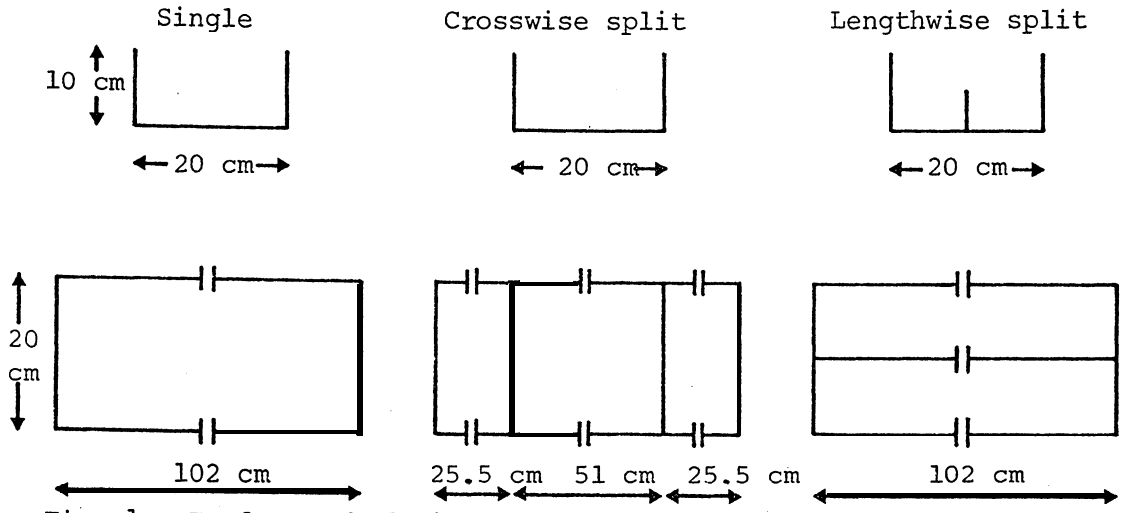

Fig. 1. Feed trough designs tested in choice feeding of layers

of age as the hens on the conventional mash. It appears that choice feeding should be introduced prior to sexual maturity for optimum biological performance.

Investigations into the design of food troughs for use in choice-feeding have shown that egg production was reduced when the cereal was nearer the hens in lengthwise split trough or in the centre of the trough in a crosswise split trough shown in figure 1 (Dun et al, 1978). It seems that further work is required to determine the effects of accessibility and the position of foods offered free-choice on laying performance.

Holcombe, Roland and Harms (1976) showed that hens given a choice between a 12% and 16% protein diet were able to balance the intake of protein from the two diets so as to maintain the same level of egg output as the hens given a 16% protein diet. Perhaps, as an interim measure, it would be advisable to offer Laying hens in cages a mixture of pelleted diets of differing nutrient densities. This procedure could be adopted until the technical difficulties involved in delivering whole grains, protein concentrate and shell grit to hens in cages are solved.

Broilers

The rationale behind choice feeding of broilers is based on the assumption that if birds are able to balance their intake of nutrients as demonstrated by Funk (1932) and Dove (1935), then the female broilers having a lower protein requirement will eat a greater proportion of cereal than the males. For instance Scott and Heuser (1957) found that 25% of the food consumed by female broilers consisted of grain, when they were allowed free access to cracked maize and wheat and a starter diet from 3 to 12 weeks of age. These broilers were also slightly heavier than those given only the starter diet.

Recently two experiments have been conducted in the United Kingdom to test the hypothesis that female broilers offered a choice of cereal and a higher-protein food would consume more cereal and consequently less protein than those given only a complete diet. In the first experiment, conducted at North of Scotland College of Agriculture, Cowan and Michie

(1978) studied the effect of feeding male and female broilers either a complete diet (diet A) or whole wheat and one of two higher-protein foods (Diets B and C). Diet B was formulated by omitting some and diet C all of the cereal from the complete diet (see table VII for nutrient content of diets).

TABLE VII. Performance of broilers offered a choice of whole wheat and either a low protein (25%) or high protein (51.5%) concentrate from 21 to 54 days of age (Cowan and Michie 1978).

Age: 21-54 days	Males			Females		
	Complete diet A	Low prot diet B/ wheat†	High prot diet C/ wheat	Complete diet A	Low prot diet B/ wheat	High prot diet c/ wheat
Livewt gain/ bird (g/d)	54.7	54.0	52.6	43.3	42.1	41.4
Feed intake/bird						
Complete feed (g/d)	131.3	--	--	109.1	--	--
Concentrate feed (g/d)	--	70.3	33.2	--	53.6	23.8
Wheat (g/d)	--	56.9	90.3	--	53.2	80.9
Wheat (%)	--	44.7	73.1	--	49.9	77.3
Protein intake/ bird (g/d)	23.2	23.5	26.5	19.3	18.9	20.7
Lysine intake/ bird (g/d)	1.29	1.34	1.67	1.07	1.05	1.26
Methionine intake/ bird (mg/d)	482	489	603	403	392	464
ME intake/bird (MJ/d)	1.54	1.48	1.43	1.28	1.25	1.23

Diet A contained 17.7% protein and 11.72 MJ, ME/kg
Diet B contained 25.0% protein and 11.26 MJ, ME/kg
Diet C contained 51.5% protein and 10.09 MJ, ME/kg
†Whole wheat contained 10.4% protein and 12.18 MJ, ME/kg

The growth rate from 21 to 54 d of age of the males given whole wheat and the lower-protein food (diet B) was not significantly different from the growth rate of those given the complete diet. The growth' rates of the males on the other choice treatment (whole wheat and diet C) and of females on both choice treatments were significantly lower by 3.8, 2.8 and 4.4%, respectively, than that of the comparable groups fed the complete diet A. The food intake of broilers on the choice-treatment groups, however, was lower than that of the control groups by 3.1 and

5.9% respectively for the males and by 2.2 and 4.0% respectively for the females. Although the females did consume about 5% more wheat than the males, there was no reduction in protein intake compared to that of females given the complete diet. The results of this experiment indicate that cereal-free, higher-protein foods are unsuitable when broilers are choice-fed from 3 weeks of age.

In the second experiment (P. Lowe, unpublished data) conducted at Kesteven Agricultural College in Lincolnshire, England the same strain of male and female broilers as that used by Cowan and Michie (1978b) were given from 20 to 48 days of age either a complete diet or a choice of whole wheat and a higher-protein food (see table VIII for nutrient content of diets). Despite the higher density of nutrients in the diets

TABLE VIII: Performance of broilers offered a choice of whole wheat and balancer pellet from 20 to 48 days of age[$]

Age: 20 - 48 days	Males		Females	
	Complete diet[+]	Whole wheat/ Balancer pellets[+]	Complete diet	Whole wheat/ Balancer pellets
Liveweight gain/bird (g/d)	52.0	47.2	43.9	40.2
Feed intake/bird				
Complete diet (g/d)	124.4	--	108.8	--
Balancer pellets (g/d)	--	50.7	--	40.4
Wheat (g/d)	--	69.3	--	61.7
Wheat (%)	--	57.8	--	60.4
Protein intake/bird (g/d)	26.7	22.6	23.3	18.7
Av. lysine intake/ bird (g/d)	1.24	1.14	1.09	0.93
Methionine intake/ bird (mg/d)	572	499	501	410
ME intake/bird (MJ/d)	1.62	1.50	1.41	1.28

[+] Complete diet contained 20.0% crude protein and 12.99 MJ, ME/kg

[+] Wheat contained 11.5% crude protein and its ME content was assumed to be 12.18 MJ/kg

Balancer pellet contained 28.8% crude protein and 13.01 MJ, ME/kg

[$] Data from P. Lowe, A.D.A.S., U.K.

used in this experiment, the mean growth rate of the broilers was lower than that in the experiment of Cowan and Michie (1978b). The growth rate for both males and females given the choice treatment was lower than that

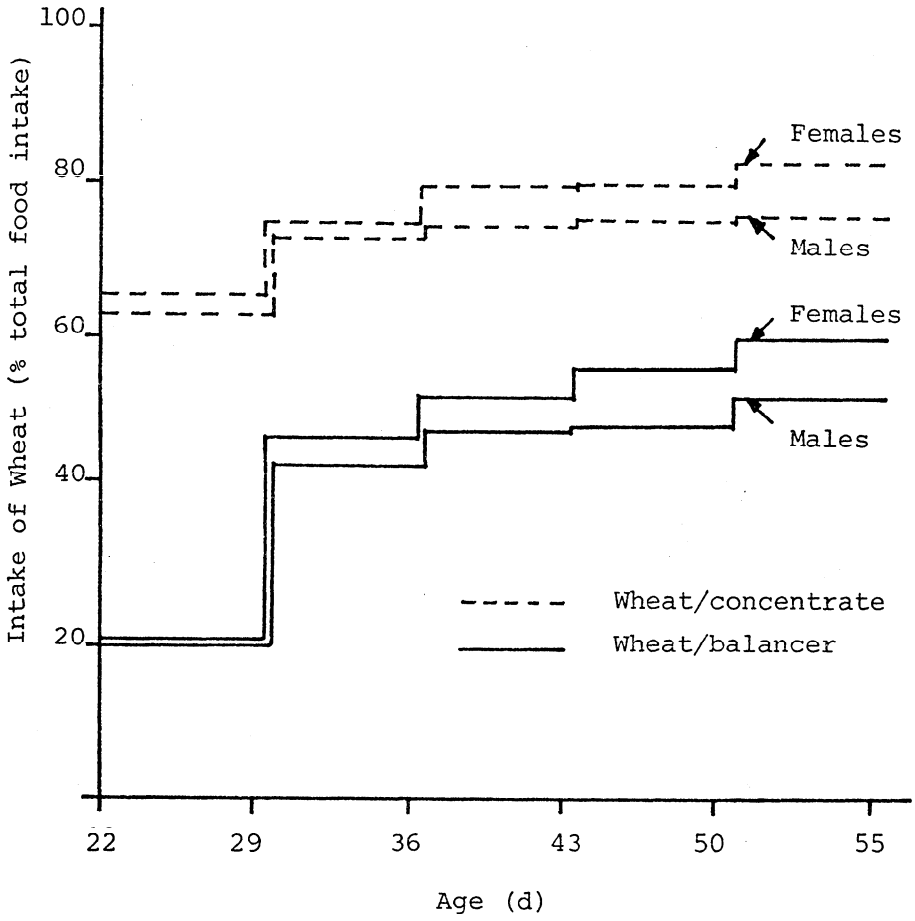

Fig. 2. Intake of wheat in choice-fed birds (Michie 1977)

for the' control treatment by 9.2 and 8.4%, respectively, Food intake of the choice fed broilers, however, was lower than that of the controls by 3.5 and 6.2%, respectively for the males and females. As a result of this lower food intake and due to the fact that 57.8 and 60.4% of the total food intake of choice fed broilers was whole wheat, their economic performance was superior to the performance of those fed the complete diet.

In both experiments, the lower biological performance of the choice fed broilers was probably due to their lower intake of ME. In the experiment of Cowan and Michie (1978b) the males and females given whole wheat and the higher-protein food (diet C) consumed 7.1 and 3.9% less ME, respectively than the groups fed the complete diet. In P. Lowe's experiment, the ME intake of choice-fed males and females was lower than that of the control groups by 7.4 and 9.2%, respectively. Michie (1977) has shown that the intake of wheat during the first week of choice-feeding is much lower than during the subsequent weeks (Fig. 2). This suggested that a period of adjustment to the diets is involved. Perhaps, if the broilers are trained to eat whole wheat from the day-old stage, then the low intake of ME seen when free-choice feeding is introduced at 21 d of age may be alleviated to some extent. In choice feeding,

wet litter is likely to be a problem during the first two weeks. During the adjustment period birds tend to eat more of the high-protein food -with a consequent increase in intake of water.

It appears that considerable refinement in the free-choice method of feeding broilers is necessary before the biological performance of choice-fed broilers could equal that of broilers fed the conventional diets,

Turkeys

Free-choice feeding of whole grains and higher-protein foods to turkeys has been practised widely, As in broilers, the female turkey has a lower requirement for protein than the male. In general, the free-choice feeding of turkeys, depending on the cereal used, is more successful than is the case with broilers,

Massey and Fuller (1962) found that male and female turkeys given a choice of a 28.8% protein-starter diet and whole maize and oats from 8 to 24 weeks of age gained more liveweight than those on a complete dietary regime. Chamberlain et al, (1962) observed that after 16 weeks of age, female turkeys given a choice of a 32% protein-concentrate and whole maize consumed a greater ratio of maize to protein-concentrate than the males. This indicated that the energy requirement of the females was higher than that of the males during this period, Biellier and Kohne (1970) have shown that Broad Breasted Bronze males were able to balance the consumption of 38% protein-concentrate and whole sorghum from 9 to 25 weeks of age without affecting liveweight gains or market grades. They found that the feed cost/bird for the choice fed group was 16% lower than that for the control groups which were fed a complete diet with protein and energy contents adjusted at 4-weekly intervals to meet the changing nutrient requirements of the growing turkey.

The success of free-choice feeding programmes for turkeys, however, appear to depend on the nutritive value of the cereal used., Cowan and Michie (1977) found that Large White males overconsumed protein when given a choice of a concentrate containing 48.8% protein and 9.67 MJ, ME/kg and either whole barley or oats, but not when either whole wheat or whole maize was provided.

The turkeys overconsumed protein even when the barley was given in a pelleted form or when given a choice of a barley-based finisher diet and a starter diet (Cowan and Michie (1978a). It appears that free-choice feeding of turkeys is more successful when high-energy cereals (maize, wheat, sorghum) rather than cereals of low nutritive value (barley) are used, The introduction of whole grains before 8-weeks of age may increase the initial rate of grain consumption in choice-fed turkeys. Biellier and Kohne (1970) noted that a two-week period of adjustment was required when changing turkeys from a complete ration to a concentrate and whole'grain system, So as in the case of broilers, the introduction of whole grains early in the life of the turkey should prevent the overconsumption of protein in choice-fed turkeys. This should also prevent the problem of wet litter which may occur with turkeys fed wheat and a protein concentrate (W. Michie, Personal Communication).

Summary

1. Recently, free-choice feeding of poultry has received considerable attention aimed at refining and adapting this system of feeding to meet the current needs of the poultry industry,

2. In general, economic benefits resulting from choice feeding occur with replacement pullets, laying hens, broilers and turkeys. The major benefits result from reductions in food intake and savings in fuel-energy costs due to the use of whole grains.

3. The biological response to choice feeding, however, has been variable. Poor responses are due, in most cases, to an inadequate intake of ME, particularly during the learning or adjustment period, Use of cereals of low nutritive value (barley) and non-separation of the calcium supplement for laying hens, are also responsible for lower biological performance of choice fed birds,, These are the problem areas requiring further research and solution before the choice feeding system would be more readily accepted.

4. Investigations in food trough designs and delivery systems that suit choice feeding of two or more foods are being carried out in the U.K.

5. Increasing poultry food prices, the need for conservation of energy and surplus production of eggs and poultry meat are likely to provide the impetus needed for the more widespread adoption of choice feeding of poultry in the future.

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