Compensatory Growth:

A New Production Concept?

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Feed costs and carcass grades have been major concerns of turkey producers for many years. Producers constantly seek nutritional advice and/or management techniques to simultaneously combat increasing feed costs, maintain carcass quality and improve carcass grades. These concerns formed the basis for studies at North Dakota State University to determine the potential of utilizing compensatory growth capabilities to maximize monetary returns.

Compensatory growth or compensatory gains in animals suggests that they need to catch up in growth. It may be described as an increased growth rate in one time period as a direct result of a growth restriction imposed during an earlier time period. Early growth restrictions could be the result of disease, environmental influences, a lack of adequate nutrition or any combination of these factors.

It has been recognized for years that some animals possess compensatory growth capabilities, yet to exploit these abilities for economical advantages is just beginning to be investigated. This type of research is being conducted with turkeys and swine, since both species can achieve compensatory growth with proper management.

This paper will review the results of a series of experimental trials designed to determine (1) the effects of feeding diets restricted in protein from 10 days to 8 weeks of age on subsequent rate of growth, feed utilization and carcass characteristics of large-type market turkeys, and (2) the economic implications that result from following a restricted protein feeding program.

The data presented were obtained from a series of four trials conducted over a period of four years involving approximately 4,650 male turkeys. The poults used in each trial were floor brooded and raised in confinement to eight weeks of age. After eight weeks, the poults of each trial were relocated to a confinement growing facility and grown to market age. The poults of Trial 1 were grown in the summer season, in Trial 2 during the spring-early summer season, and in Trials 3 and 4 during the late fall-winter seasons.

Isocaloric ration treatments consisting of a control and a series of test rations were fed from 10 days to 8 weeks of age during each trial. During this time interval, the test rations fed contained either 60, 70, 80 or 85 per cent of the protein contained in each respective control ration. The same ration formulation and ingredients were used in the diets of all trials, with corn, barley, soybean meal and animal tallow used to manipulate protein and energy levels. All other ingredients were incorporated at an equal percentage in the rations. The calculated protein level of the starter control ration was 28 per cent. At 5 weeks the protein level was reduced to 24 per cent, with the appropriate reduction made in the respective test rations. In addition, each ration was formulated to contain its appropriate level of the more critical amino acids. For example, the test ration containing only 60 per cent of the level of protein in the control ration would also contain at least 60 per cent of the known minimum requirement for each amino acid deemed critical. The turkeys were allowed full access to feed and water at all times.

After 8 weeks of age, all treatment groups were fed the same ration, which was a continuation of the control ration treatment in each trial. Periodic adjustments were made in protein and energy levels in accordance with the generally accepted conventional feeding programs. The control ration fed during this phase of the growing cycle in Trials 1 through 3 contained the same ingredients as the starter rations and was fed in crumbled form. The ration fed during this phase of Trial 4 consisted of wheat screenings combined with a crumbled commercial turkey grower con-

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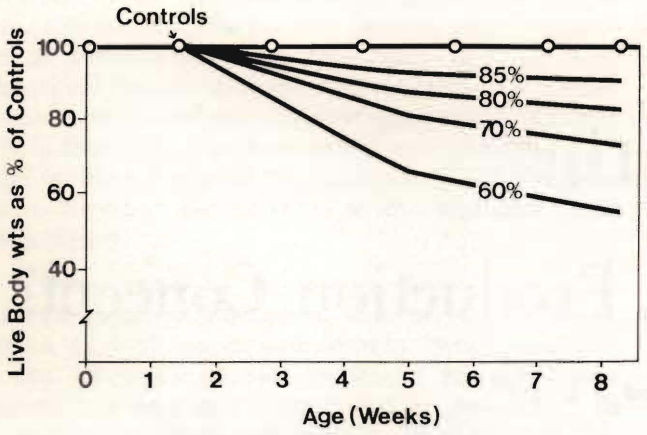

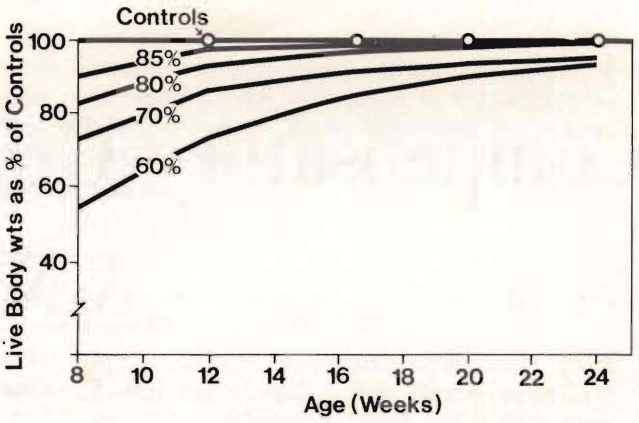

centrate. At both 8 weeks of age and market age, representative turkeys from each treatment group were sacrificed for carcass analysis. Trials 1 through 3 were terminated when the turkeys reached 23 or 24 weeks of age. Trial 4 was terminated as each treatment group reached the same predetermined average live market weight. The turkeys of all trials were processed and graded by a commercial processing firm.

At 8 weeks of age, feeding rations restricted in dietary protein resulted in growth depressions of various degrees among treatment groups. The data of Table 1 and Figure 1 show the growth patterns observed and these data indicated that the greater the protein restriction employed the more severe the growth retardation. Even though the same basic diets were fed in all trials, poults of Trial 4 showed somewhat more severe growth retardation at higher levels of protein restriction than the average depressions observed in the first three trials.

These various growth retardations were anticipated and appeared sufficient to test compensatory growth capabilities in large-type market turkeys. In addition to growth retardation, the underfed groups consumed less feed per bird, but required more feed to produce an equivalent unit of gain than did poults of the control groups. Mortality during this growth phase in each trial was unaffected by the various levels of protein restriction.

By market age, or 23 to 24 weeks, in Trials 1 through 3, all groups of previously underfed poults had compensated in body growth. However, some groups were unable to fully recover in the time allotted, as shown in Table 2 and Figure 2. Differences in live market weights among treatment groups designated 80 or 85 and their respective control groups were not significantly different. This indicated that these previously underfed groups which showed average growth depressions of 16.7 and 9 per cent respectively at 8 weeks of age had fully recovered their normal body weight at market age. During this growth phase, all previously underfed groups continued to consume less feed per bird, but as the data of Table 2 further indicate, each group utilized feed more efficiently than did control groups. Thus, feed consumption and feed efficiencies became important economic factors and will be discussed later.

Growth patterns observed in the compensating growth phase of turkeys of Trial 4 are shown in Table 2. These turkeys were grown to a given predetermined market weight, and the data indicate that the turkeys more severely retarded in growth required proportionately more time to re-

Table 1. Average live weight, feed utilization and per cent growth depression at 8 weeks of age.

Variable		Treatment/trial				
		60	70	80	85	100
Body weight (lbs)	$T_{1\ 3}$*	3.41	4.86	5.17	6.27	6.42
	T_4	2.90	4.62	5.70	—	6.86
Feed/unit of gain	$T_{1\ 3}$*	2.55	2.21	2.09	1.93	1.84
	T_4	1.89	1.80	1.70	—	1.39
% Growth depression	$T_{1\ 3}$**	45.2	25.8	16.7	9.0	0.00
	T_4	57.8	32.4	17.0	—	0.00

T_1 denotes experimental trial 1, etc. Value is the average of T_1—T_3.

***Average values determined as per cent of respective controls of T_1—T_3.*

Table 2. Live market weights, feed utilization from 9-24 weeks and per cent growth depression at market weight.

Variable		Treatment/trial				
		60	70	80	85	100
Body weight (lbs)	T_1	25.5	—	27.7	—	25.6
	T_2	—	31.0	—	32.1	32.1
	T_3	31.2	31.9	33.1	—	33.2
	—	—	—	—	—	—
	$T\bar{x}$	28.4	31.5	30.4	32.1	31.2
	T_4*	27.2	27.2	27.3	—	27.3
Feed/unit of gain	T_1	3.42	—	3.60	—	3.77
	T_2	—	3.82	—	3.91	4.05
	T_3	3.41	3.60	3.65	—	3.92
	—	—	—	—	—	—
	$T\bar{x}$	3.42	3.71	3.63	3.91	3.91
	T_4	3.81	3.72	3.79	—	3.93
% Growth depression	T_1	9.38	—	1.56	—	0.00
	T_2	—	4.00	—	0.00	0.00
	T_3	5.96	3.97	0.65	—	0.00
	—	—	—	—	—	—
	$T\bar{x}$	7.67	3.98	1.11	0.00	0.00
	T_4**	14.3	5.40	3.40	—	0.00

x = *mean.*

**Days to market indicated by numbers in brackets for each treatment group.*

***Per cent growth depression at 20 weeks of age (market age of controls).*

cover the average live weight achieved by the control groups at 20 weeks of age. The previously underfed groups, therefore, consumed more feed per bird, but again were more efficient in feed utilization when compared with the control group. Because of the longer growth period required to reach an equivalent market weight, greater feed consumption and better feed utilization by underfed groups were important economic factors in determining the monetary returns to be discussed later.

Market grading data were obtained at a commercial processing firm for each treatment group of the first three trials. The data not shown here indicated very little, if any, differences among treatment groups in per cent downgrading for conformation, flesh and finish. Even though full recovery of body weight had not been fully achieved by groups restricted to 60 and 70 per cent of normal protein, they apparently recovered enough to be scored as high quality carcasses. The only group downgraded to any extent for lack of flesh and finish was one control group. Carcass composition data in terms of per cent protein, fat, ash and moisture on a fresh weight basis were also obtained and again indicated all groups were similar at market age.

This type of feeding system must show some advantage or benefit other than the ability to produce a bird equal in size and quality to a bird fed in a more conventional manner. The data presented in Table 3 are used as a summary to emphasize the economic implications observed as a result of feeding rations restricted to various levels of protein. These data are typical of those observed during each trial conducted. These results showed that each previously underfed group consumed less feed than the control group over the complete feeding cycle. Even though actual weight gains were somewhat less for each respective underfed group, each used what feed was consumed more efficiently. Thus, the poor feed conversions observed during the retardation stage were more than compensated for during the compensatory growth stage. As a result of the improved feed conversions a reduced feed cost per bird fed was realized.

Since grade and per cent yield were essentially the same in all groups, an equivalent return per pound of live weight was also realized. Also, since feed cost was the only variable cost associated with production cost differences regardless of season, each previously underfed group of poults returned more to the producer per pound of live weight. The group most severely restricted returned $2.47 per bird over feed cost as compared to $2.14 per bird for the normal-fed group, a difference of 33 cents per head marketed.

The economic picture of birds fed in the fourth trial was somewhat different as a result of the different feeding scheme practiced. Even though underfed groups consumed more feed than control groups and used it less efficiently, they were still able to show a reduced feed cost per pound of body weight gain for the entire growth cycle. However, feed cost in this trial was not the

Table 3. Economic implications from 10 days to market age.

Economic variable per bird (Trial 3)	Treatment 60	70	80	100
Feed consumed (lbs)	103	108	112	117
Total gain (lbs)	30.9	31.5	32.6	32.8
Overall feed/gain	3.33	3.43	3.42	3.57
Feed cost	$ 4.97	$ 5.23	$ 5.44	$ 5.77
Dollar return	$ 7.44	$ 7.58	$ 7.85	$ 7.91
Return over feed cost	$ 2.47	$ 2.85	$ 2.41	$ 2.14
Return/lb live weight over feed cost	$ .080	$ .075	$ .074	$ .065

Economic variable per bird (Trial 4)	Treatment 60	70	80	100
Days to market	157	146	143	140
Feed consumed (lbs)	97.3	91.5	90.8	89.3
Total gain (lbs)	26.7	26.7	26.8	26.8
Feed cost	$ 4.48	$ 4.48	$ 4.59	$ 4.73
Overall feed/gain	3.64	3.42	3.38	3.32
Feed cost/lb gain	$ .168	$ .168	$ .171	$ .176
Return/lb live weight* over feed costs (20 weeks)	—	$ .157	$ .152	$ .147

**Based on an assumed equal market return/lb live weight at 20 weeks of age.*

only production cost variable as compared with the previous trials. Production costs must be considered associated with housing and managing the compensating turkeys for longer periods of time than was needed for the control group. These costs, although not determined, could offset the reduced feed cost observed in the compensating turkeys. It was noted, however, that turkeys previously restricted to 70 and 80 per cent of normal protein, had by 20 weeks of age reached an acceptable market weight.

The economic implication based on this observation, together with an assumed equivalent return per pound of live market weight then was similar to that of previous trials. The data indicate groups designated 70 and 80 would have returned more per pound of live weight over feed costs than the control groups, had they been marketed at 20 weeks of age.

It appears from these studies that some advantages can be gained from restricted feeding and yet, not quite so apparent, some disadvantages also exist. The ability of the large turkey to compensate in considerable amounts following certain degrees of growth retardation is well demonstrated. With proper management, mortality does not appear to be a problem, but the "man" in management must really be emphasized. Man is the key to success of this type of endeavor.

Improved feed conversions by compensating turkeys can have a wide variety of advantages. Not only is feed cost per bird reduced, but less feed needs to be handled and stored, or possibly more birds could be grown on a given amount of feed. Apparently, the concern of sacrificing grade as a result of underfeeding protein to reduce production costs has no basis in fact. However, the skilled management necessary not only from a nutritional standpoint but also from the technical point of view can be a limiting factor. The potential of over-retardation exists, so programs must be carefully scheduled and adhered to. Also, how well large numbers of poults kept in crowded conditions, as practiced in the field, would respond to this type of production program has not been evaluated. This remains to be assessed before a complete cycle of testing has been completed.

If a producer is feeding his birds to a specific market weight rather than an age, it's almost certain more time will be required to reach that weight when restriction during early growth is practiced. In this instance, market weights will be influenced by degree of growth retardation and the market size desired. The longer housing time required will increase production costs, thereby possibly offsetting any gains achieved by reduced feed costs.

These studies suggest that it may be beneficial to feed market turkeys for less than maximum growth from an economic standpoint, particularly during early stages of growth. But these studies also suggest top-notch management is very essential in achieving any degree of success when feeding for compensatory gains.