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BARD

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Feed Restriction to Improve Feed Efficiency in Chickens and Turkeys

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Feed Restriction to Improve Feed Efficiency in Chickens and Turkeys

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c. ABSTRACT

In male broiler chicks and turkeys, an early-age severe feed restriction regime resulted at marketing age in improved feed efficiency. Accelerated growth during realimentation was responsible in both species for a complete recovery and in turkeys often in an overshoot in body weight. In female broilers, body weight did not completely recover from feed restriction even at 8 weeks of age. Early feed restriction resulted in chicks but not in turkeys in a decrease in carcass fat by limiting the number of adipocytes.

Pellet feeding during realimentation did not enhance the response to feed restriction although it promoted growth. In chicks, no improvement in the response to feed restriction could be obtained by increasing dietary nutrient density. However, protein (amino acid) requirements in realimentation diets were higher than those of non-restricted birds.

In chicks, the severe restriction (6-7 days) could be applied between 3 and 11 days of age with equal effectiveness. In turkeys, the age of 7 days was found optimal for application of 7-day either total feed or protein restriction regime.

During feed restriction, hepatic enzyme activity associated with lipogenesis was suppressed, followed by an overshoot during realimentation and subsequent suppression during accelerated growth. The concentration of metabolic hormones were not affected by feed restriction although some increase in growth hormone level during accelerated growth was suggested.

A computer model, aimed at optimizing the growth trajectory (as modified by feed restriction) together with computation of optimal diets, was constructed mostly within the framework of BARD No. US-777-86.

d. OBJECTIVES

1. To establish the relationship of consequent growth, feed efficiency and carcass fat to:
 - (I) The restricted nutrient- energy, protein or mineral.
 - (II) Severity, age and duration of restriction.
2. To elucidate the relationship between nutrient density, dietary protein concentration and of pelleting to growth, feed efficiency and carcass fat during refeeding.
3. To establish a computer simulation program for economic optimization of the feeding trajectory in broilers and meat turkeys.
4. To elucidate metabolic pathways in association with the concentration of regulating hormones in an effort to gain insight into the mechanisms of improved feed efficiency and compensatory growth.

f. COOPERATION

(1) The feed restriction experimental protocol was set up in the U.S. with the help of an Israeli coinvestigator - I. Plavnik - who specifically spend one year in Beltsville.

Several joint publications resulted from this cooepration (see list, p. 109).

(2) Experimental protocols and distribution of research efforts were coordinated, and results were discussed during exchange visits of the principal investigators of each of the cooperating institutions.

(3) Samples from Israeli experiments were analyzed in Beltsville.

g. EVALUATION OF RESEARCH ACHIEVEMENTS

When implemented, the agrotechnical system developed in this study can save 4-8% of feed needed for production of broiler and turkey meat, respectively. In terms of the U.S.A. and the Israeli industries, the annual saving can be estimated at \$300-600 million and \$10-20 million, respectively.

Implementation of the system is not complicated and does not involve installation of any special equipment; it requires good professional judgment and extension work in the field.

For full benefit, including the use of the optimization simulation model, several questions regarding the feed restriction system such as breed and strain interactions, environmental interactions, responses to graded restriction, and development of the simulation algorithm to a user-friendly computer program await the completion of BARDS # US-777-86 and BARD # I-1234-87.

h. PUBLICATION LIST

- Hurwitz, S., and Plavnik, I. (1989) Severe feed restriction in pullets during the early growing period: performance and relationships among age, body weight and egg weight at the onset of production. *Poultry Sci.*, in press.
- McMurtry, J.P., Plavnik, I., Rosebrough, R.W. Steel, N.C., and Proudman, J.A. (1988) Effect of early feed restriction in male broiler chicks on plasma metabolic hormones during feed restriction and accelerated growth. *Comp. Biochem. Physiol.* 91A: 67-70.
- McMurtry, J.P., Rosebrough, R.W., Plavnik, I., and Cartwright, A.L. (1988) Influence of early plane of nutrition on enzyme systems and subsequent tissue deposition. In: *Biomechanisms Regulating Growth and Development*, ed. Steffens, G.L. and Rumsey T.S., Kluwer Academic Publishers, Dordrecht, Boston, London.
- Plavnik, I., McMurtry, J.P., and Rosebrough, R.W. (1986) Effects of early feed restriction in broilers. I. Growth performance and carcass composition. *Growth* 50: 68-76.
- Plavnik, I. and Hurwitz, S. (1988) Early feed restriction in chicks: effect of age, duration and sex. *Poultry Sci.* 67: 384-390.
- Plavnik, I. and Hurwitz, S. (1988) Early feed restriction in male turkeys: growth pattern, feed efficiency, and body weight. *Poultry Sci.* 67: 1407-1413.
- Plavnik, I. and Hurwitz, S. (1989) Effect of dietary protein, energy and pelleting on the response of chicks to early feed restriction. *Poultry Sci.*, in press.
- Rosebrough, R. W., Steel, N.C., McMurtry, J.P., and Plavnik, I. (1986) Effect of early feed restriction in broilers. II. Lipid metabolism. *Growth* 50: 217-227.
- Talpaz, H., Hurwitz, S., de la Torre, J., and Sharp, P.J.H. (1988) Economic optimization of a growth trajectory for broilers. *Am. J. Agric. Econ.* 50: 382-390.