SELECTION FOR GROWTH RATE, FEED EFFICIENCY AND BODY FATNESS IN JAPANESE QUAIL (*COTURNIX COTURNIX JAPONICA*)

H. Sutedjo and R.A.E. Pym

School of Veterinary Science, University of Queensland, St Lucia Q. 4072, Australia

INTRODUCTION

Food utilisation efficiency and body composition are very important determinants of profitability in poultry meat production. In commercial meat chicken breeding programs, improvement in lean tissue deposition efficiency is typically addressed through within and between line selection for growth rate, food utilisation efficiency for growth, and body composition. Most of the selection studies in this area have been undertaken with chickens, and notwithstanding the recognised role of Japanese quail as a commercial poultry species and as a genetic model for chickens, little work has been undertaken with this species in this area. The purpose of the study described here was to determine in the one selection experiment, the direct and correlated responses to selection for growth rate, food utilisation efficiency and carcass fatness in Japanese quail, to facilitate the assessment of appropriate selection strategies for improvement in the efficiency of lean tissue growth rate in this species.

MATERIALS AND METHODS

The selection experiment. Birds used in the base population from which the lines were selected, were derived from the unselected control line of an earlier selection experiment (Pym *et al.,* 1998). The base population was constituted from matings between 50 males each mated to three females. From each of the four hatches, birds were selected as parents of the selection lines shown in Table 1. Lines were constituted each generation from matings between 10 males each with three females. There were four weekly hatches each generation, three to produce birds from which parents of the subsequent generation could be selected and the fourth to measure direct and correlated responses. For the individual selection lines (HW and FE), approximately 120 birds of each sex were available in each line for selection each generation. (the *i* values in males and females were approximately 1.8 and 1.3 respectively).

Table 1. Selection lines used in the study

Line	Selected for
HW	Increased liveweight at 35d of age
HF	Increased 35d abdominal fatness – by sib selection
LF	Decreased 35d abdominal fatness – by sib selection
FE	Decreased 15-30d FCR – in individual cages
C	Unselected control

All birds were given a crumbled broiler starter diet containing 220 g CP and 12.5 MJ ME/kg from hatch to 35d of age. Selection in the HW line was based on liveweight at 35d of age. The birds were reared to 14d in brooder cages and then transferred to deep litter pens where they were reared to 35 d when they were weighed. In the FE line, following group cage rearing to 14d of age, feed efficiency was determined in individual cages from 15 to 30d. Birds in hatch 1 of the high and low fat lines were reared to 35d as for the HW line birds and, after weighing, two birds per sex per dam family were killed and the abdominal fat pad excised and weighed. For each bird this was expressed as a proportion of liveweight and the dam family averages within each line were ranked on this criterion. Birds in the subsequent two hatches from the selected dam families were retained for breeding.

To reduce the deleterious effects of inbreeding, for the high and low-fat lines, a restriction was placed on the number of males (2) and females (3) from the same full sib family that could be selected as parents within each line and birds were selected from the highest (line HF) or lowest (line LF) full sib families. For the HW and FE lines, no more than two males were selected from any one sire family. There were no restrictions on females, but in all lines there were no full- or half-sib matings. All birds were pedigree wingbanded at hatch.

Selection responses. Direct and correlated responses in performance and body composition traits to selection in the four lines were measured in the second, third and fourth generation. In each generation, responses were determined in a fourth hatch of about 250 birds (50 per line) reared in group cages to 14d of age and then transferred to the single–bird cages and reared there to 30d of age. Birds were weighed at 14 and at 30d of age and individual food intake over the 14 to 30d interval was measured. Following a 10 h fast, the birds were killed on d 31 by neck dislocation and abdominal fat and breast meat were excised and weighed. Responses were calculated from the difference between the control and selected line means for the traits.

RESULTS AND DISCUSSION

The direct and correlated responses in the four lines are shown in Figs 1 a-f. Whilst selection for high 35 d bodyweight in the HW line resulted in a marked correlated increase in both 14 d bodyweight and 14-30 d weight gain, selection for improved feed efficiency in the FE line actually resulted in a significant depression in 14 d body weight, but an overall positive response by generation 4, in 14-30 d weight gain. In the FE line, the reduced maintenance requirement at commencement of the food intake test interval as a result of the low initial body weight (Fig 1a), combined with the relatively high growth rate (Fig 1b), contributed to the improved feed efficiency in this line (Fig 1d). Both 14 d weight and weight gain were initially lower in the low-fat LF line birds than in their high-fat HF counterparts, but by generation 4 they were similar and showed little deviation from the control birds. The latter finding is in keeping with the published results from a number of studies (Leclercq, 1988 ; Whitehead and Griffin, 1984 ; Cahaner *et al*., 1986 ; Pym, 1987), where little difference in growth rate was observed between high and low fat lines of chickens. The corollary to the overall lack of growth response in the HF and LF lines, is the essential lack of response in abdominal fat proportion in the HW line (Fig 1e), which supports the contention of Pym (1987) that selection for increased growth rate in chickens does not result in an increase in fatness, particularly when birds are measured at a given body weight.

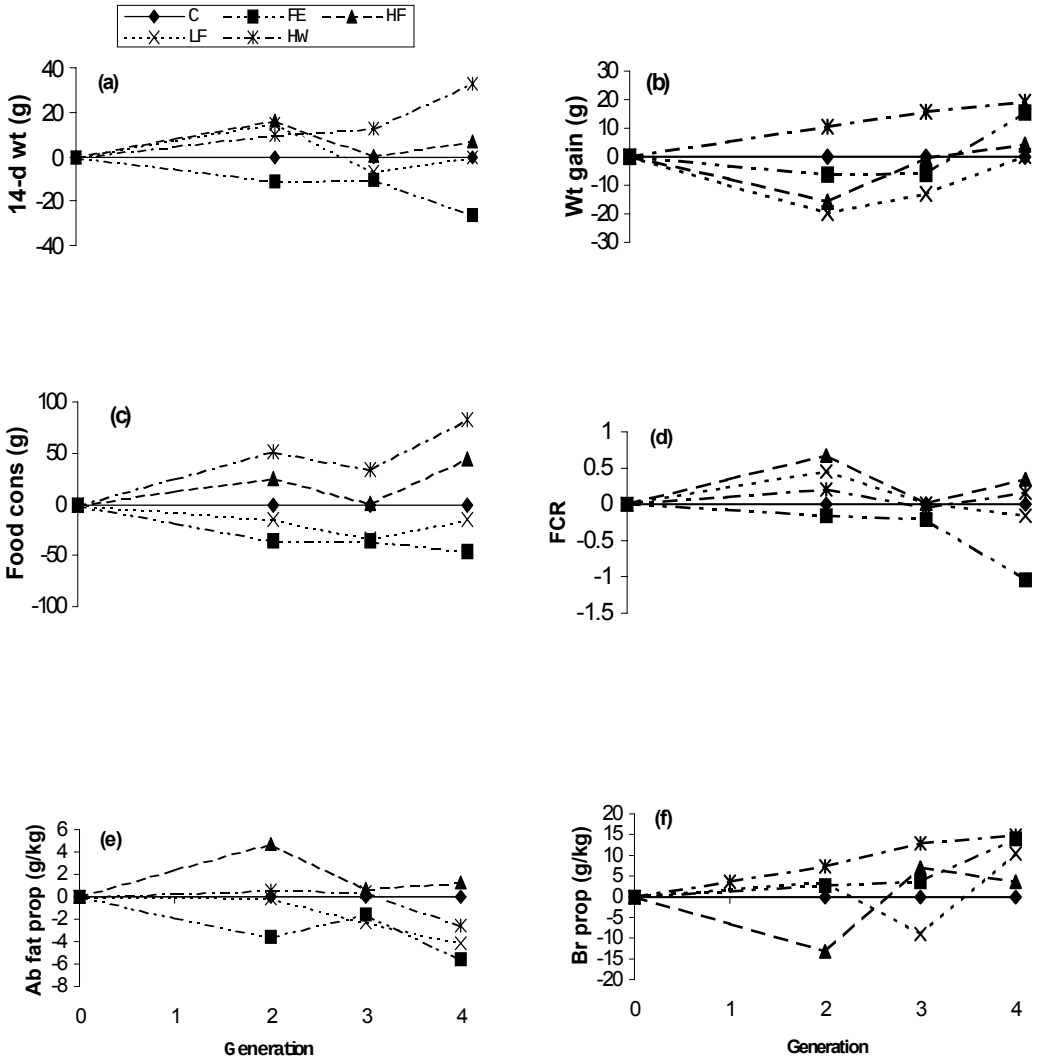

Figure 1. Direct and correlated responses in 14 d body weight (g), 14-30 d weight gain (g), food consumption (g) and FCR, and the proportion (g/kg) of abdominal fat and breast muscle in the carcass at 31 d in the four selected lines

There was marked divergent correlated response in food consumption in the HW and FE lines (Fig 1c), which combined with the response in weight gain (Fig 1b), resulted in a substantial negative direct response in FCR in the FE line (Fig 1d), but a small positive response in the HW line. The absence of the typically observed positive response in feed efficiency in high growth rate chicken lines (see review by Chambers, 1990), is possibly associated with the greater proportional contribution of maintenance cf. growth towards energy intake in Japanese quail than in chickens, and is supported by the findings of the earlier study with Japanese quail (Pym *et al.,* 1998). The divergent correlated response in FCR to divergent selection for fatness in the HF and LF lines is in agreement with findings of similarly selected lines of chickens (Leclercq, 1988 ; Whitehead and Griffin, 1984 ; Cahaner *et al*., 1986 ; Pym 1987) and confirms the high energetic cost of fat deposition.

The divergent direct response in abdominal fatness in the HF and LF lines (Fig 1e) was essentially as anticipated. However, the similar response in the LF and FE lines suggests that individual selection for feed efficiency is as effective in reducing fatness as direct sib-selection for reduced fatness. Results from the chicken selection experiment of Leenstra and Pit (1987) showed the same directional responses, but sib selection for reduced fatness was shown to be more effective in reducing body fat than selection for low FCR. Many factors may be implicated in the differential response, but the results tend to discount any suggestion of body fat playing an important role in insulation to heat loss and energy retention, with its effect on food utilisation, in the smaller species. Whilst the responses in breast yield in the HF and LF lines were not consistent across generations (Fig 1f), both the HW and FE lines showed positive response in this trait.

CONCLUSION

The results of this albeit relatively short term selection experiment, suggest that an improvement in overall efficiency of lean tissue deposition in Japanese quail is not achievable by selection for growth rate or reduced fatness alone and is likely to require some direct selection pressure on dietary nutrient utilisation. Comparison with reported results from chicken selection studies show some notable differences in responses between the two species.

REFERENCES

Cahaner, A., Nitsan, Z. and Nir, I. (1986) *Poult. Sci*. **65** : 215-222.

Chambers, J.R. (1990) In “Poultry Breeding and Genetics”, p. 599-643, Editors R.D. Crawford, Elsevier, Amsterdam.

Leclercq, B. (1988) In “Leanness in Domestic Birds”, p. 25-40, Editors B. Leclercq and C.C. Whitehead, Butterworths, London.

Leenstra, F.R. and Pit, R. (1987) *Poult. Sci.* **66** : 193-202.

Pym, R.A.E. (1987) In “Recent Advances in Animal Nutrition in Australia”, p. 222-227, Editors D.J. Farrell, The University of New England, Armidale, Australia.

Pym, R.A.E., Popovic, B. and Bodero, D.A.V. (1998) *Proc. 6th WCGALP* **24** : 290-293.

Whitehead, C.C. and Griffin, H.D. (1984) *Br. Poult. Sci*. **25** : 573-582.