SELECTION FOR BREAST MEAT YIELD IN JAPANESE QUAIL (*Coturnix coturnix japonica*) USING REAL TIME ULTRASOUND

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SUMMARY

Seven generations of selection in Japanese quail for breast meat weight (line BWI) or proportion (lines BPI (up) and BPD (down)) using prediction equations based on liveweight and measures of breast muscle length, width and depth (by ultrasound), resulted in substantial response in breast yield in all lines. Response in breast weight was achieved through combined response in breast proportion and liveweight in the BWI line, and through response in proportion alone in the BPI and BPD lines. The yield of other cuts was not decreased in the BWI and BPI lines.
keywords: selection, breast meat, quail, ultrasound

INTRODUCTION

The breast meat of chickens commands a high price relative to other cuts because of its low fat content and tenderness which provides a considerable incentive to maximise the production of breast meat in the carcass. Whilst a genetic approach is indicated, it has been hampered in the past by the lack of an accurate, non-destructive measure of breast meat yield in the live bird. The alternative is to kill birds for measurement and to use sib selection, which is slow, labour intensive and inefficient.

Komender and Grashorn (1991) reported on the use of real-time ultrasonic scanning as a means of measuring breast muscle depth in live chickens and obtained a correlation of +0.72 between breast muscle depth and breast muscle weight, both expressed relative to the liveweight of the bird. Using this approach we determined the prediction of breast meat yield of measures including real-time ultrasound in both chickens (Popovic *et al.* 1994) and Japanese quail (*Coturnix coturnix japonica*) (Popovic and Pym, 1995) and, using optimum prediction equations, selected Japanese quail for seven generations for different aspects of growth and breast meat yield. This paper describes the direct and correlated responses to that selection.

BREAST MUSCLE PREDICTION

In a series of studies with Japanese quail we determined optimum prediction equations for breast meat yield from measures on liveweight and on breast muscle length, width and depth (by real-time ultrasound). In each experiment, following weighing each bird at 42d, accurate measures were made on each bird of breast muscle length and width (two places) using vernier calipers and depth was measured at two standard positions at each side using a 5.0 MHz probe attached to an Aloka SSD-500 real-time ultrasound scanner. Prior to depth measurement, feathers were gently removed and vegetable oil was applied to the measurement site. The probe was aligned along the axis of the bird about 10 mm to one side of the keel bone and the two measurements were taken before the probe was moved to a similar position on the other side of the keel bone. Following ultrasound measurement the birds were sacrificed by cervical dislocation and the breast muscle was removed using standard dissection procedures and weighed.

Prediction equations were determined for breast weight expressed both as an absolute weight (g) and as a proportion of liveweight (g/kg). The equations were determined using a stepwise multiple linear regression procedure where the model chosen in each step was the one with the greatest R-square value of all the models including that number of traits. The overall optimal prediction equation was determined as the one where the addition of further traits resulted in only marginal improvement in the prediction of breast meat yield.

The across-experiment mean prediction equations for breast meat yield expressed either in absolute terms (g) or relative to liveweight (g/kg) took the following approximate form:

$$\text{Breast weight (g)} = 0.04LW + 0.30BL + 0.80BD + 0.25BWi \quad \text{......(1)}$$
$$\text{Breast proportion (g/kg)} = -0.05LW + 0.30BL + 0.09BD + 0.25BWi \quad \text{......(2)}$$

where : LW = 42d liveweight (g), BL = breast length (mm)
BD = mean breast depth (mm), BWi = mean breast width (mm)

THE SELECTION EXPERIMENT

From a population of Japanese quail previously selected for increased 42d liveweight for about ten generations, 60 males were each mated to three females to produce two hatches of chicks which constituted the zero generation of a selection experiment. These birds were grown in cages on a broiler starter diet containing 12.5 MJ and 230g CP/kg and measurements were made at 42d of liveweight and breast muscle depth, length and width, as described above. Within each full and half-sib family, birds were randomly and equally allocated as breeders to each of five lines selected for: Line LWI -increased liveweight at 42 days; Line BWI - increased breast meat yield (g); Line BPI - increased breast meat proportion (g/kg); Line BPD - decreased breast meat proportion (g/kg); and Line C -random control line.

Each line was generated from matings between 12 males and 36 females, selected using individual selection from about 180 birds of each sex across three hatches. (i =1.60). Birds in line BWI were selected on prediction equation 1 above whereas birds in lines BPI and BPD were selected on the basis of prediction equation 2, with the BPD breeders selected from birds with the lowest values of the index. In each generation no more than two of the 12 male breeders per line were allowed to come from the same sire family, and full- and half-sib matings were avoided.

RESPONSES TO SELECTION

Birds from a fourth hatch of each of the five lines were grown each generation to 42d and killed by cervical dislocation prior to dissection of breast muscle. In generation 4, measures were made of food utilisation efficiency in replicated sexed cage groups of birds from a fifth hatch of the five lines and in generation 6, measures were made of body fat and of thigh and drumstick yield in the hatch four birds sacrificed for determination of breast meat yield. The responses to seven generations of selection in the four lines in 42d live-weight, breast weight and breast proportion are shown in the figure.

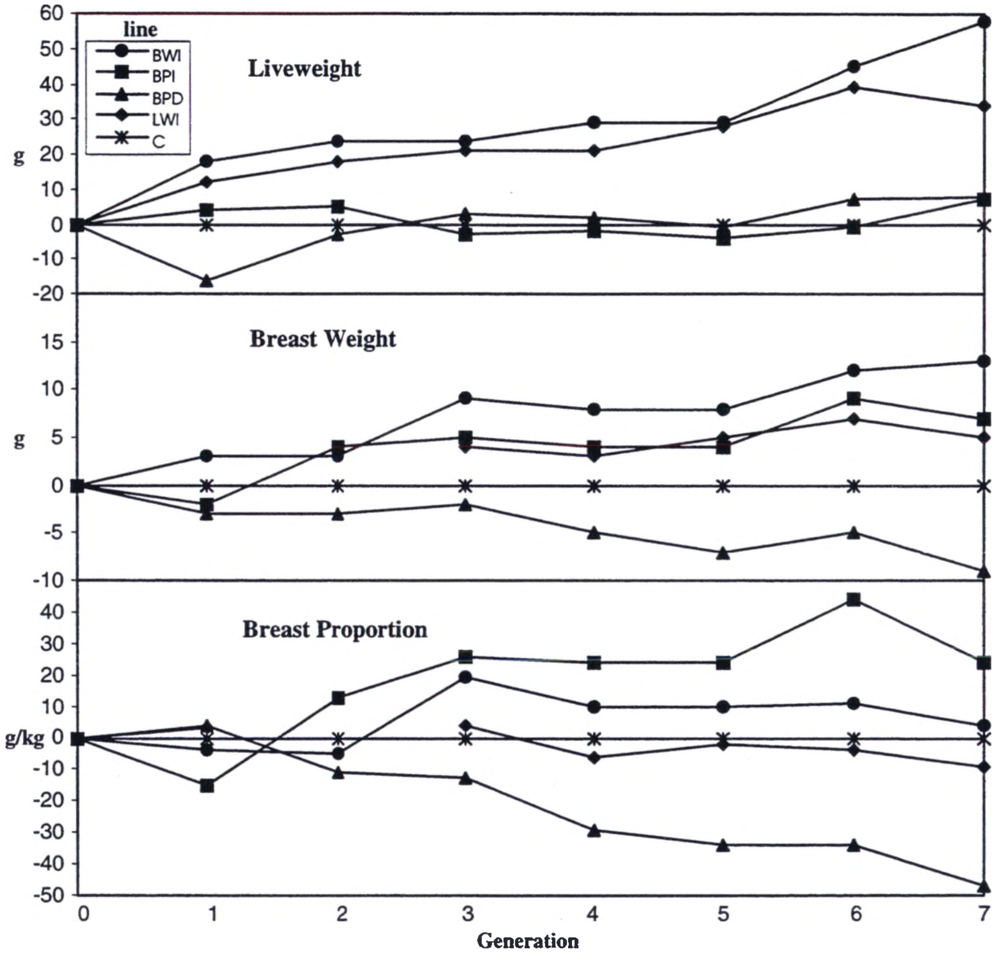

Figure. Responses in liveweight, breast weight and breast proportion to seven generations in the four lines.

There was a considerable increase in liveweight in the two lines selected for increased breast weight and liveweight, whereas there was essentially no response in liveweight in the high and low breast proportion lines. There was considerable response in breast weight in the BWI line, moderate response in the LWI and BPI lines and moderate negative response in the BPD line.

There was a substantial divergent response in breast proportion in the BPI and BPD lines, indicating the general accuracy of the prediction equation-selection index used in these lines. The lack of response in the LWI line suggests that selection for increased liveweight improves breast yield only through its effect on liveweight. Line differences in FCR after four generations of selection and in proportional yield of drumsticks, thighs and abdominal fat after six generations of selection, are shown in the table.

Table. FCR and yield of drumsticks, thighs and abdominal fat in the five lines (standard errors in parenthesis).

Line	FCR		Drumsticks	Thighs	Abdominal fat
	14-28d	28-42d	g/kg	g/kg	g/kg
LWI	2.64 (0.04)	4.11 (0.18)	57.9 (2.2)	93.9 (2.6)	27.6 (3.3)
BWI	2.62 (0.04)	4.35 (0.18)	59.7 (1.2)	95.4 (2.3)	26.2 (2.3)
BPI	2.67 (0.04)	4.12 (0.08)	59.6 (1.8)	97.6 (2.3)	15.3 (2.3)
BPD	2.84 (0.04)	4.74 (0.18)	58.5 (1.6)	89.7 (2.3)	36.9 (3.0)
C	2.64 (0.04)	4.23 (0.18)	58.2 (0.9)	92.7 (1.6)	26.9 (2.2)

Over both measurement periods the BPD line showed a higher FCR than all other lines, which were essentially similar. There was no effect of line on the proportional yield of drumsticks whereas the BPI line had a higher proportional yield of thighs than the BPD line. There was a marked divergent correlated response in abdominal fat in the BPI and BPD lines, with the three other lines similar and intermediate.

Selection for breast proportion has thus had some quite profound effects on anatomy and metabolism. The low breast proportion-selected line (BPD) birds had high levels of body fat, poor feed efficiency and a low yield of breast and thigh meat, whereas the high proportion line (BPI) birds had generally very good fleshing and were considerably leaner than all other lines. Selection for increased breast meat yield in the BWI and BPI lines did not result in any compensatory reduction in the yield of drumsticks or thighs.

There would thus appear to be an opportunity to effectively select for increased breast meat yield in poultry using prediction equations incorporating liveweight and measures of breast muscle depth (by ultrasound), width and length. Given the genetic and physiological similarity between chickens and quail, it is not unreasonable to expect that relative responses in chickens would be essentially similar. The present results suggest that there should be no untoward effects of such selection on the yield of other cuts.

REFERENCES

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