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THE EFFECT OF PORCINE SOMATOTROPIN AND DIETARY CRUDE PROTEIN LEVEL ON VALINE FLUX AND PROTEIN DEPOSITION IN SWINE

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INTRODUCTION

Porcine somatotropin (pST) has been demonstrated to be effective with respect to improving lean growth, feed efficiency and reducing carcass fat (Etherton, 1988; Bechtel *et al.*, 1988; Campbell *et al.*, 1989; Boyd and Bauman, 1989; McNamara *et al.*, 1991). However, as discussed by Easter (1987), Evock *et al.* (1988) and Buonomo and Baile (1991) nutrition is likely to be one of the primary factors limiting the anabolic response to porcine somatotropin.

Treating pigs with somatotropin is reported to cause an increase in protein synthesis (Hart and Johnson, 1986; Tomas *et al.*, 1992) and nitrogen retention (Wray-Cahen *et al.*, 1991). These processes are known to be facilitated by dietary protein levels (Reeds and Fuller, 1983) which suggests that at a fixed pST treatment level, conventional swine finishing diets may be inadequate to meet the needs of somatotropin treated pigs (Newcomb *et al.*, 1988; Smith and Kasson, 1991).

The purpose of the present study was to examine amino acid kinetics and protein deposition in finishing pigs fed varying levels of dietary crude protein. A flooding dose with $^{15}N/^{14}N$ valine (Schaefer and Scott, 1993) was used to partially fulfil this goal.

MATERIALS AND METHODS

Twenty-four Lacombe and York breed finishing pigs averaging 82kg and represented by both barrows and gilts were used to the current study. The animals were allocated by weight to one of four isoenergetic dietary crude protein treatment groups (six pigs per treatment). The diets offered to the pigs were based on barley-wheat-soybean mixtures with lysine levels of not less than 1%. The four dietary treatments were as follows:

1) 14% crude protein with no pST injections (control);
(2) 14% crude protein with a daily subcutaneous injection (neck region) of 3mg pST for a minimum of 42 days;
(3) 18% crude protein with pST injections; and
(4) 22% crude protein with pST injections.

Feed intake and body weights of the pigs were monitored throughout the study. On the day prior to experiment, the pigs were fitted with bilateral indwelling ear vein catheters using procedures described earlier (Schaefer *et al.*, 1987).

On the day of the isotope experiments (24 hours after catheterization), ^{15}N valine was administered as a continuous infusion in a 16:1 mixture of $^{14}N/^{15}N$ valine dissolved in sterile saline and infused at 4g/h. Serial blood samples were collected over the next four hours from the non-infusion line, after which time the pigs were humanely sacrificed for tissue collection using methods described previously (Schaefer *et al.*, 1984). Animal lean and fat yield

predictions were obtained using the Hennessy grade probe (Jones *et al.*, 1993).

The analysis of isotope enrichment in the plasma and intracellular free tissue pools was accomplished by gas chromatography-mass spectrometry.

The calculation of kinetic values was based on the procedures described by Reeds *et al.* (1980) and Schaefer and Krishnamurti (1988). Statistical analysis was completed using a general linear models procedure (SAS Institute Inc., 1986).

RESULTS AND DISCUSSION

In terms of growth performance, the pST-treated pigs placed on 18 and 22% crude protein diets displayed higher growth rates of 1.1 and 1.0kg gain per day compared to 0.70 and 0.64kg per day for the 14% protein control and 14% protein pST treated animals respectively. In addition, the 18 and 22% crude protein dietary treatments with pST required two to three fewer days on test to reach market weight.

In terms of carcass performance, all of the pST-treated pigs showed a higher carcass yield (Table 1) with less fat. However, among the pST-treated pigs, the fat reductions did not vary with dietary protein level. With respect to predicted muscle yield, there was a trend for a higher muscle yield with increasing dietary protein. This observation of a protein effect *per se* is consistent with previous findings in our lab (Jones *et al.*, 1993).

Compared to control pigs which displayed a valine flux of approximately 33mmol/day the pST-treated pigs showed an increase in valine flux of 13, 18 and 6% for the 14%, 18% and 22% crude protein diets, respectively. As is evident from Figure 1, the plasma ^{15}N enrichment also appeared to arrive at a plateau quite early on in the infusion protocol.

It is apparent from the present study that, in general, pST treatment resulted in a more rapid growth of lean carcasses in finishing pigs. Data from the current study also suggest that this process may be facilitated by an increase in dietary crude protein. Based on valine flux data, this process may be optimized at approximately 18% dietary crude protein in pigs receiving 3mg/d of pST. The increase in lean muscle yield also suggests that the observed elevation in valine flux is likely due to increased use for protein synthesis rather than oxidation. Further analysis of the valine kinetic data will likely clarify this relationship.

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Table 1. Carcass, fat and lean yield in somatotropin-treated pigs given three levels of dietary crude protein.

Dietary Treatment	% Carcass Yield x ± SE	% Carcass Fat x ± SE	% Lean (muscle) Yield x ± SE
14% (Control)	47.9 ± 0.5^{a}	25.7 ± 1.4^{a}	47.5 ± 2.9^{a}
14% pST	50.4 ± 0.5^{b}	19.0 ± 1.2^{b}	49.9 ± 2.7^{ab}
18% pSt	50.8 ± 0.5^{b}	18.2 ± 1.4^{b}	51.2 ± 2.9^{ab}
22% pST	50.6 ± 0.5^{b}	19.3 ± 1.2^{b}	55.0 ± 2.6^{b}

[a,b] Means within a column are statistically different at $P<0.05$.
Dietary