

Efficacy of Pantothenic Acid as a Modifier of Body Composition in Pigs

A.S. Leaflet R1955

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Currently, vitamin requirements of swine are largely based on the dietary concentration of a particular vitamin that results in maximum growth of the pigs being evaluated. However, much of the research that these vitamin requirements are based on was conducted in the 1950s and 60s. Since that time, pigs have become more efficient meat-producing animals with an ability to grow more rapidly and to produce more proteinaceous tissue per kg of body weight gain. Stahly et al. (1995) have shown that higher concentrations of one or more of group of five B vitamins (niacin, pantothenic acid, riboflavin, B₁₂, and folic acid) are needed to optimize rate and efficiency of growth in a high vs. moderate lean strain of pig. These results indicate the dietary need for some vitamins may vary among pigs differing in their capacity for proteinaceous tissue growth.

Some vitamins may also elicit metabolic effects that potentially alter the composition in addition to the rate of body growth. Therefore, the dietary concentration of pantothenic acid may affect protein and fat accretion rates in the pig. Previous research lends credence to this hypothesis because additions of pantothenic acid or its metabolites have been shown to have lipid-mediating effects (Stahly and Lutz, 2000; Cupo and Donaldson, 1986; Naruta and Buko, 2001).

With the knowledge that certain B vitamins are needed at higher concentrations by today's modern genetic strains of

pigs and the evidence in the literature that pantothenic acid may be an important vitamin involved in modifying body composition, two experiments were conducted with the objective of determining the efficacy of pantothenic acid as a modifier of body composition in pigs.

In a study conducted by Stahly and Lutz (2001), experimental treatments consisted of a basal diet supplemented with four levels of pantothenic acid (0, 30, 60, 120 ppm) added as d-calcium pantothenate. The basal diet contained 6 to 7 ppm of PA, was adjusted by stage of growth to match the pig's needs for all nutrients (except PA). Pigs were penned individually and fed their respective diets from 10 to 115 kg BW. Fifteen sets (7 barrows, 8 gilts) of four littermate pigs from a high lean strain were evaluated. Pigs were randomly allotted within litter to one of the four dietary treatment groups. As pigs reached 115 kg they were transported to the abattoir where standard carcass measurements were obtained. In addition, several meat quality traits measured in the longissimus muscle such as muscle pH, color, water loss, fat content, and pantothenic acid concentration were evaluated.

Pantothenic acid additions did not alter daily body weight gain, feed intake, or the efficiency of feed utilization in pigs growing from 10 to 115 kg BW. However, dietary PA additions did alter body composition. Specifically, dietary PA addition resulted in carcasses with less backfat (off midline backfat at the tenth rib) and larger longissimus muscle area at the tenth rib (Table 1). Consequently, the percentage of estimated fat-free lean in the carcasses also increased quadratically as dietary PA additions increased (Table 1).

Table 1. Effect of dietary pantothenic acid (PA) concentration on carcass traits.

Item	Supplemental pantothenic acid, ppm			
	0	30	60	120
Backfat thickness (off-midline), mm ^a				
Tenth rib	22.5	20.4	20.7	19.5
Longissimus muscle area, mm ^{2b}				
Tenth rib	43.9	48.0	45.5	47.5
Estimated fat free lean ^a				
% of hot carcass	51.5	53.4	52.5	53.6

^aQuadratic effect of PA, P < .05.

^bQuadratic effect of PA, P = .06.

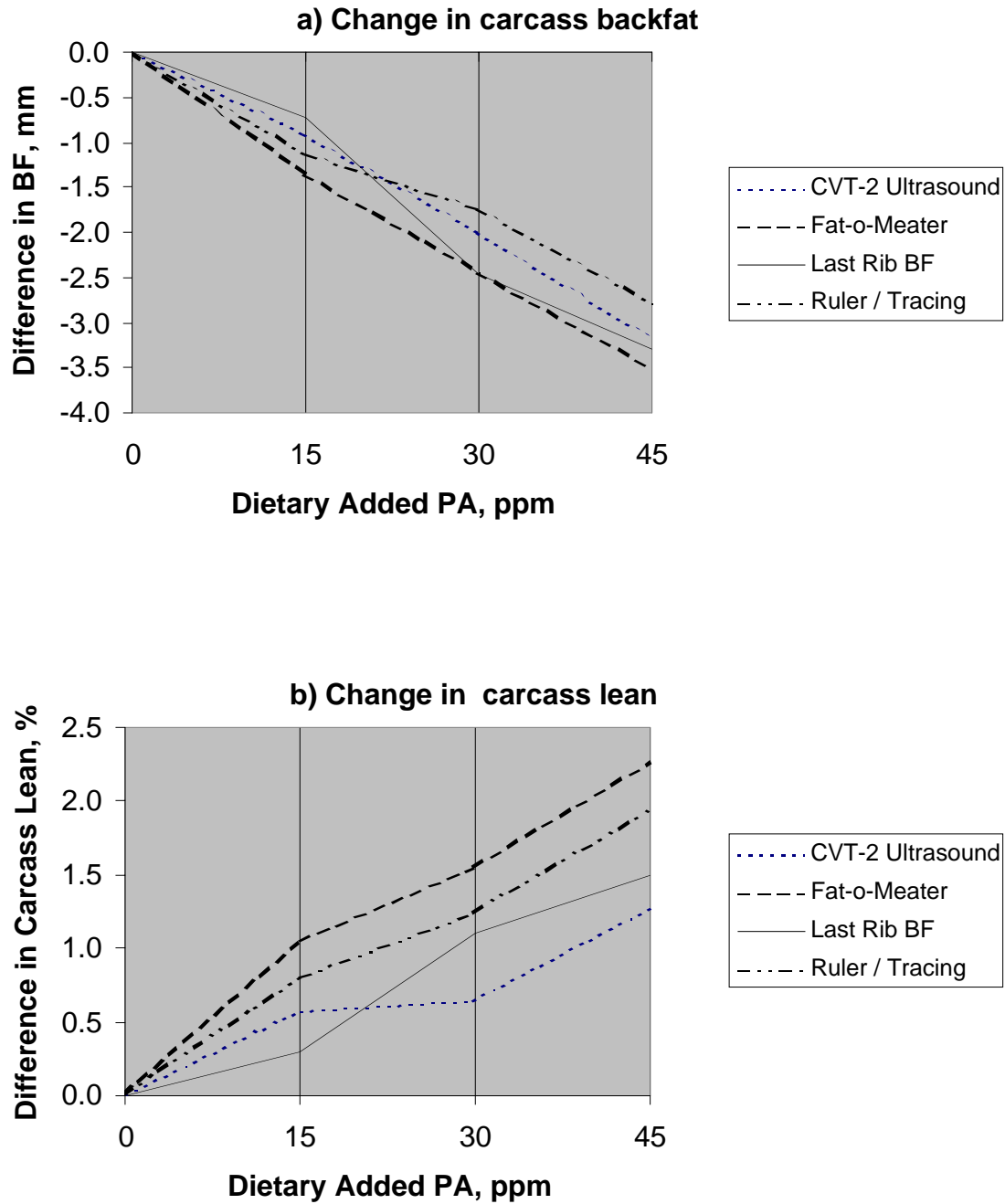
Quality traits of the longissimus muscle including postmortem muscle pH, Hunter L and a scores, and intramuscular fat and water contents at 24 hr postmortem were not influenced by dietary PA regimen. Water losses during a 72 hr retail storage period also were not altered by dietary PA additions. However, the concentration of PA in the longissimus muscle increased linearly (3.7, 6.3, 8.1, 9.9 ppm) as dietary PA additions increased from 0 to 120 ppm.

In another study conducted by Autrey et al. (2002), sixty-four pens and 320 pigs from a high lean strain were evaluated in this study. Sixteen pens were allotted to each dietary treatment. Dietary treatments consisted of a basal diet containing 6 to 7 ppm PA supplemented with four levels of pantothenic acid (0, 15, 30, 45 ppm) added as d-calcium pantothenate. Pigs were penned in groups of five. One half of the pens contained all barrows and one half of the pens contained all gilts. Pigs were randomly allotted at weaning within gender to treatments from outcome groups based on pig weight and litter. Pigs were allowed to consume ad libitum their respective diets from 8 to 119 kg BW. As the second, third, and fourth pig in each pen reached a market weight of 119 kg, the pig was removed and was transported to the abattoir where they were slaughtered. Hot carcass measurements were taken using CVT-2 ultrasound, Fat-O-Meater, and last rib backfat ruler.

Pigs were then placed in a cooler and standard cold carcass measurements were taken at 24 hours post-slaughter.

Pantothenic acid additions did not alter daily body weight gain or the efficiency of feed utilization in pigs growing from 8 to 119 kg BW. However, as observed in the authors' previous studies, dietary PA additions resulted in linear ($P<.01$) reductions in backfat depth as measured on hot carcasses using Fat-o-Meater, CVT-2 ultrasound, and last rib backfat ruler, as well as on chilled carcasses using backfat ruler and loin tracing (Figure 1a). Specifically, addition of PA at 45 ppm resulted in a reduction of backfat on the hot carcass (mm) of 3.5 using Fat-o-Meater, 3.6 using CVT-2 ultrasound, and 3.3 using last rib backfat ruler. PA additions also resulted in linear increases ($P<.01$) in estimated carcass lean content as measured on hot carcasses using Fat-O-Meater, CVT-2 ultrasound, as well as the last rib backfat ruler (Figure 1b). Specifically, addition of PA at 45 ppm resulted in an increase in carcass lean percentage (%) of 2.27 percentage units using Fat-o-Meater, 1.47 using CVT-2 ultrasound, and 1.48 using last rib backfat ruler. Estimated fat-free lean content was also linearly increased ($P<.01$) on the chilled carcasses using a backfat ruler and loin tracing (Figure 1b). The concentration of the vitamin (PA) in the longissimus muscle (3.5, 4.9, 6.2, 7.5) also increased linearly as dietary PA additions increased from 0 to 45 ppm.

Figure 1. Effect of dietary PA concentration on carcass backfat and lean content as detected by four systems of measurement



The current NRC (1998) estimates of the dietary pantothenic acid requirement of pigs is 10 ppm for 5 to 10 kg pigs and then declines linearly to 7 ppm for pigs weighing 120 kg. Our data would indicate that these dietary pantothenic acid concentrations are adequate to support maximal rates of body weight gain and energy accretion in high health, high lean pigs though pigs in the current studies had superior rates of body weight gains and efficiency of feed utilization compared with that of pigs in the studies used to establish the NRC pantothenic acid requirements. However, when basing pantothenic acid needs on maximizing proteinaceous tissue and minimizing fatty tissue in the pigs' bodies, dietary PA concentrations that are substantially greater than current NRC (1998) estimates seem to be needed.

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Dietary PA addition up to 45 ppm resulted in linear reductions in carcass backfat as well as an increase in carcass lean content. Pantothenic acid additions reduce body fat accretion and support more of the economically valuable proteinaceous tissue to be accrued. Pantothenic acid additions also have the ability to alter nutritive value of pork muscle by increasing pantothenic acid content of the edible muscle.

Based on these data, pantothenic acid at dietary concentrations above that needed to maximize BW gain is an efficacious modifier of body lean content of pigs. The modifications in carcass lean induced by PA have also been found to be detectable using the measurement systems used in commercial pork processing systems. These findings demonstrate that pantothenic acid represents an efficacious and economical modifier of body composition in pigs.

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