EFFECT OF DIETARY MAGNESIUM SUPPLEMENTATION DOSE AND DURATION ON PLASMA MAGNESIUM LEVELS IN PIGS

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Introduction

Magnesium is an important co-factor in many enzymatic reactions and is also reported to counteract catecholamine effects in stress situations (Kietzman and Jablonski 1985; D'Souza *et al.* 1998). The primary effect of magnesium appears to be a reduction in neuromuscular stimulation due to the calcium antagonist effects of magnesium. Consequently, studies have been conducted to investigate the influence of dietary magnesium supplementation on reducing the effects of stress and improving ultimate pork quality in pigs (Otten *et al.* 1992; Schaefer *et al.* 1993; D'Souza *et al.* 1998). The studies indicated that dietary magnesium supplementation for 5 days prior to slaughter resulted in improved pork quality with significant reductions in drip loss and the incidence of pale, soft, exudative (PSE) carcasses even when pigs were negatively handled prior to slaughter (D'Souza *et al.* 1998). In addition, comparison of dietary magnesium compounds has shown that cheaper magnesium sources such as $MgSO_4$ and $MgCl_2$ can also improve pork quality (D'Souza *et al.* 1999).

Objectives

A majority of the studies to date indicate that dietary magnesium supplementation can improve pork quality. However, the considerable variation in both the dose and duration of dietary magnesium supplementation used in past studies has resulted in varied effects on pork quality. There also appears to be little published information on dose response using magnesium supplementation in pigs to enable the most appropriate dose required to maximise improvements in pork quality. Hence the aim of this experiment was to determine the appropriate dose and duration of dietary magnesium aspartate (MgAsp) supplementation required to increase plasma magnesium concentrations in pigs.

Methods

Sixteen male crossbred Large White x Landrace pigs at 98 kg live weight (± 1.5 kg) were used in this experiment. The pigs were individually penned and were fed a commercial ration consisting of 17.83 % crude protein and 14.39 MJ/kg digestible energy at 95 % *ad libitum* feed intake and had *ad libitum* access to water via a nipple drinker. The pigs were catheterized via the cephalic vein seven days prior to the start of the dietary MgAsp supplementation (Takken and Williams, 1981). The 16 pigs were randomly allocated to the four diet treatments, which consisted of i) no MgAsp (finisher diet), ii) 20 g MgAsp, iii) 40 g MgAsp and iv) 60 g MgAsp respectively per pig per day. The pigs were fed a finisher diet supplemented with their respective amounts of MgAsp for 10 days. The different amounts of MgAsp were mixed in with finisher feed using a small scale feed mixer. Blood samples (10 ml) were collected in tubes containing 60 µl of a solution containing 15 % EDTA and 60 mg / ml Glutathione to determine plasma magnesium levels. The whole blood samples were centrifuged immediately and the plasma stored at -80°C. Plasma magnesium concentrations were determined using atomic absorption spectrophotometry.

Results and Discussion

Plasma magnesium concentrations are presented in Figure 1 (values adjusted for Day 0). Dietary MgAsp supplementation significantly ($P< 0.001$) increased plasma magnesium concentrations in pigs over the 10 day supplementation period. However, there was no difference ($P>0.05$) in plasma magnesium concentrations in pigs fed the control diet during the 10-day treatment period. Adjusted plasma magnesium concentrations indicate that dietary MgAsp supplementation increased plasma magnesium concentrations in the 20 g, 40 g and 60 g/day MgAsp treatment group by 11 % (Day 1), 16 % (Day 2) and 5 % on (Day 1) respectively. The plasma magnesium concentrations in pigs in the 40 g and 60 g MgAsp dose treatment groups decreased to base (Day 0) concentrations by Day 10 of the dietary MgAsp supplementation period. However plasma magnesium concentrations in pigs in the 20 g MgAsp dose treatment remained elevated by 8 % above the base plasma magnesium concentrations till the end (Day 10) of the dietary MgAsp supplementation period.

The results from this experiment indicate that dietary MgAsp supplementation increased plasma magnesium concentrations within the first two days of the supplementation period. The results also indicate that the highest increases in plasma magnesium concentrations did not correspond with the highest dose. Pigs supplemented with 60 g MgAsp per day had the lowest increase in plasma magnesium levels compared with pigs fed 20 g and 40 g MgAsp per day. Following the initial increase, plasma magnesium concentrations in pigs fed diets supplemented with 40 g and 60 g MgAsp per day declined to pre-treatment levels. In comparison, pigs fed the diet supplemented with 20 g MgAsp maintained the increase in plasma magnesium levels till the end of the supplementation period. These results suggest that increases in plasma magnesium concentrations when pigs are fed diets supplemented with MgAsp are not dose-related. In addition, the results also suggest that the absorption of magnesium decreases with time in pigs fed diets supplemented with 40 g and 60 g MgAsp per day. While the exact physiological mechanisms that are involved in regulating plasma magnesium levels in pigs are not yet clearly understood, the main regulatory sites appear to the gastrointestinal tract and the kidneys (Aikawa, 1978). The magnesium levels in pigs reported in this experiment following 'low' (20 g MgAsp), 'intermediate' (40 g MgAsp) and 'high' (60 g MgAsp) magnesium supplemented diets reflected a similar trend to Graham *et al.* (1960) where pigs fed the 20 g MgAsp per pig per day had the highest plasma magnesium levels at the end of the magnesium supplementation period compared to pigs fed diets supplemented with higher (40 g and 60 g MgAsp) amounts of magnesium. It is possible that plasma magnesium concentrations in pigs are regulated via absorptive mechanisms from the gut as well as urinary excretion. If this were the case, then a lower dietary magnesium supplementation dose would be more effective at increasing plasma magnesium concentrations in pigs in comparison with a higher dietary magnesium dose.

Pertinent Literature

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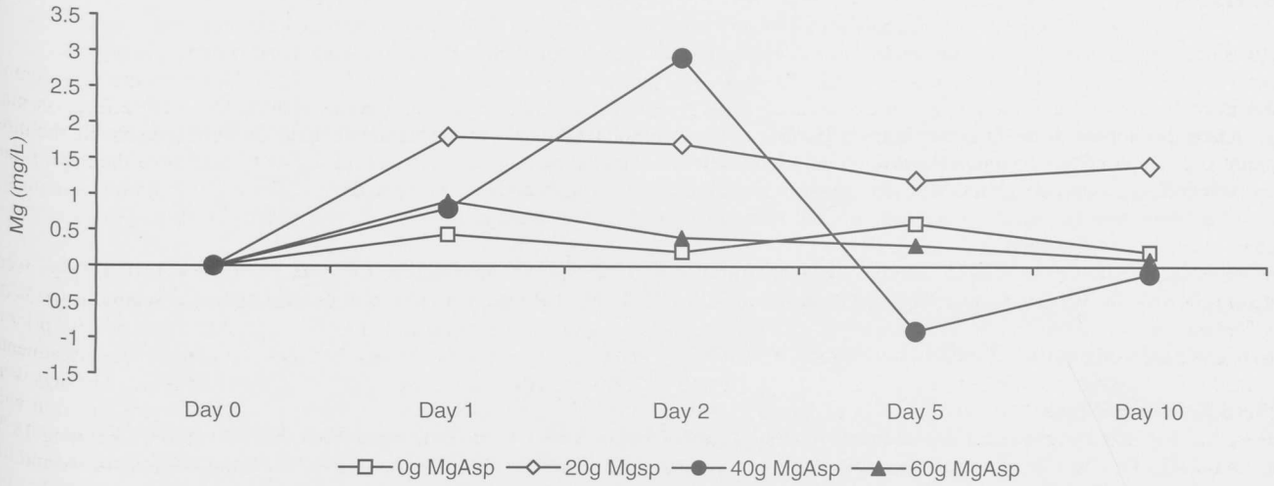

Figure 1. The effect of dietary magnesium aspartate (MgAsp) supplementation on plasma magnesium concentrations (adjusted for Day 0) in pigs.