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THE USE OF MAGNESIUM ASPARTATE HYDROCHLORIDE IN SWINE DIETS TO MANAGE PORK QUALITY

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INTRODUCTION

For pork exporting countries such as Canada, maintaining a high standard in meat quality is viewed by the swine industry as a high priority (Canadian Pork Council, 1992). Genetic and environmental factors that degrade the quality of the meat and result in the production of pale-soft-exudative (PSE) pork are therefore of concern. A substantial effort has thus been made to understand the underlying genetics (Sather and Murray, 1989) management (Murray *et al.*, 1989) and physiology of factors causing PSE pork (Schaefer *et al.*, 1987; 1990a).

Magnesium supplements have been shown to be effective in reducing handling and management stress in pigs (Kietzmann and Jablonski, 1985; Niemach *et al.*, 1979). The product Magnesium Aspartate Hydrochloride in particular (MgAspHCL; Verlapharm Pharmaceutical Company, Tutzing, Germany) has in fact been found effective as a feed top dressing in improving meat colour and drip loss (Schaefer *et al.*, 1992) in market weight pigs. The current study was undertaken to investigate the effect of MgAspHCL, incorporated into a commercial pelleted feed, on the meat quality and behaviour in genetically stress susceptible and non stress susceptible (halothane gene) pigs fed at two alternate levels.

MATERIALS AND METHOD

The current study was conducted as a 2x3 factorial design using 142 grower finisher pigs represented by two genotypes of pigs (72 halothane positive (Nn) carriers and 70 halothane negative (NN) pigs). Within each genotype three treatment groups were established as (1) control normal feed; (2) low dose MgAspHCL at 5mg/kg body weight for six weeks pre-slaughter and (3) high dose at 40mg/kg body weight for five days pre-slaughter. Each treatment consisted of 24 animals in pens of 12 (9mx3m) balanced by sex. Two pens had only 11 animals per pen.

The pigs were cleaned and bedded daily and fed a standard swine finishing ration *ad libitum*. All pigs had free access to water and lighting was maintained between 0800-1700 daily. The barn temperature was maintained at approximately 17°C.

To test the effect of MgAspHCL on animal behaviour, pig behaviour was monitored both at the piggery pre-shipment and at the abattoir pre-slaughter by direct observation using ethograms described by Schaefer *et al.* (1990b). All behaviour frequency data was analyzed by a general linear models procedure of SAS (1986).

On arrival at the Lacombe Research Station Meats Research Centre the pigs were stunned and dressed according to standard commercial procedures. Carcass lean yield was estimated using the Hennessy grading prove as described by

Sather *et al.*, (1989). Muscle pH and temperature were monitored at 45 minutes post-stunning (initial) and again 48 hours (ultimate) on the *longissimus dorsi* (LD) muscle between the 10^{th} and 11^{th} ribs. Subjective colour and structure scores were assessed two days post-slaughter using a cross section of the LD according to Agriculture Canada Pork Quality Standards (Agriculture Canada 1984). Colour and structure were rated on a 5-point scale (1=extremely pale; 5=extremely dark for colour and for structure; 1=extremely soft and exudative and 5=extremely firm, dry and sticky). Objective colour was determined at the same time as subjective assessment ratings or an LD cross section. A Minolta Chromometer II was used to determine the C.I.E., L*, A* and B* coordinates (Minolta Camera Corp. Meter Division, Ramsey, N.J.). Drip loss was determined gravimetrically from a cross section of the LD posterior to the 12^{th} rib. Drip loss represents the purge resulting from the LD cross section following 48h storage at 2°C. Other meat quality test have been described previously (Murray *et al.*, 1989).

Statistical analysis

All data were analyzed by a factorial design and included main effects and interactions. A general linear models producer of SAS (SAS, 1986) was employed and mean separations were accomplished by single of freedom linear contrast.

RESULTS AND DISCUSSION

In the present study, pigs placed on the low dose MgAspHCL regime displayed a significantly higher growth rate (Table 1) of 60g/day. This factor may be due in part to the lower level of physical activity and feeding frequency observed especially in the halothane carrier pigs (Tables 2 and 3).

With respect to meat quality, the low dose MgAspHCL regime and to a lesser extent the high dose regime appeared to increase ultimate pH especially in the Nn genotype (Table 4). Also, some improvement in the muscle brightness (L*), a* and b* colour coordinates were seen (Table 5) again, particularly in the Nn genotypes. However, the MgAspHCL failed to totally prevent the decline in subjective structure and soluble protein (Tables 5 and 6).

Data from the current study demonstrated that Magnesium aspartate hydrochloride, particularly when administered in a long term low dose regime can bring about improved growth rates and improve some meat quality attributes notably ultimate pH and colour.

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Table 1. Growth and feed intake in market weight pigs as affected by magnesium aspartate hydrochloride. Data represents least squares means ± SE.

	Control	Low Dose	High Dose	P
ADG* (kg)	0.87±0.02[a]	0.93±0.02[b]	0.82±0.02[a]	0.03
Feed intake/d (kg)	3.53±0.09	3.62±0.09	3.59±0.02	0.78
Feed/gain ratio	4.15±0.15	4.05±0.15	4.41±0.15	0.27

* Average Daily Gain.

Table 2. Pig behaviour frequency per two hours across genotype as affected by magnesium aspartate hydrochloride treatment. Data represents least squares means ± SE.

	Treatment		
	Control	Low Dose	High Dose
Aggression	2.6 ± 0.3[a]	2.1 ± 0.3[a]	3.5 ± 0.3[b]
Pen Investigation	10.0 ± 0.6	10.2 ± 0.6	11.0 ± 0.6
Feeding	4.4 ± 0.4[ab]	3.8 ± 0.4[a]	4.8 ± 0.4[b]
Drinking	3.4 ± 0.3[a]	4.3 ± 0.3[b]	3.8 ±0.3[ab]
Sleeping	2.3 ± 0.2	2.5 ± 0.2	2.7 ± 0.2

[a,b] Means with different superscripts within rows are statistically different ($P \leq 0.05$).

Table 3. Pig behaviour frequency per² day by genotype as affected by magnesium aspartate hydrochloride treatment. Data represents least squares means ± SE.

	Halothane negative (N/N) Control	Low Dose	High Dose
Aggression	1.07 ± 0.4^{a}	1.5 ± 0.4^{a}	3.4 ± 0.4^{b}
Pen investigation	9.2 ± 0.9	11.7 ± 0.9	10.0 ± 0.9
Feeding	4.7 ± 0.6	4.8 ± 0.6	4.7 ± 0.6
Drinking	3.5 ± 0.4^{a}	5.3 ± 0.4^{b}	3.7 ± 0.4^{a}
Sleeping	2.6 ± 0.3	2.8 ± 0.3	2.2 ± 0.3

	Halothane Positive Carrier (Nn) Control	Low Dose	High Dose
Aggression	3.5 ± 0.4	2.8 ± 0.4	3.6 ± 0.6
Pen investigation	10.8 ± 0.9^{ab}	8.9 ± 0.9^{a}	12.0 ± 0.9^{b}
Feeding	4.0 ± 0.5^{a}	2.7 ± 0.6^{b}	$4.9 \pm 0.5^{a*}$
Drinking	3.4 ± 0.4	3.3 ± 0.4	3.9 ± 0.4
Sleeping	2.3 ± 0.3^{a}	2.1 ± 0.3^{a}	3.3 ± 0.3^{b}

[a,b] Means with different superscripts within rows and genotype are statistically different ($P = \leq 0.05$).
[*] $P \leq 0.08$.

Table 4. Carcass yield and meat quality in market weight pigs as affected by magnesium aspartate hydrochloride. Data represents least squares means ±SE.

	Control	Low Dose	High Dose	P*
Plant wt, kg	103.91±1.56	101.93±1.59	101.29±1.56	0.47
Commercial hot wt, kg	84.04±1.28	82.64±1.31	80.96±1.29	0.24
Hennessy index	96.75±1.28	99.11±1.30	96.31±1.28	0.24
Hennessy % yield	47.73±0.24	47.84±0.25	48.07±0.25	0.61
Initial pH	6.02±0.02	5.98±0.02	6.00±0.02	0.64
24h pH	5.38±0.01	5.38±0.01	5.36±0.01	0.26
Ultimate pH	5.37±0.01[a]	5.42±0.01[b]	5.40±0.01[ab]	0.003
Initial temp.	39.99±0.11	40.24±0.11	39.90±0.11	0.08
24h temp.	1.86±0.07	2.07±0.07	1.88±0.07	0.09
Subjective colour	2.76±0.08	2.66±0.08	2.73±0.08	0.69
Subjective structure	2.80±0.08	2.61±0.08	2.73±0.08	0.24
Subjective marbling	7.07±0.17	7.06±0.17	7.49±0.17	0.12
Minolta L*	55.81±0.50	55.95±0.51	56.37±0.50	0.71
Minolta a*	9.25±0.19	9.57±0.19	9.31±0.19	0.45
Minolta b*	4.44±0.20	4.47±0.21	4.62±0.21	0.79
Drip loss mg/g	51.59±2.14	52.46±2.17	52.37±2.14	0.95
Shear, kg	6.96±0.18	6.81±0.18	7.06±0.18	0.60
Moisture, g/100g	73.51 ±0.11[ab]	73.41 ±0.11[b]	73.78 ±0.11[a]	0.04
Intramuscular fat, g/100g	6.57±0.24	6.74±0.25	5.95±0.24	0.06
Soluble protein, mg/g	168.83±4.01	160.36±4.08	166.89±4.02	0.31
Marbling AMSA %	492.61 ±16.81	494.46 ±17.10	450.83 ±16.85	0.12

Table 5. Carcass and meat quality effects of magnesium aspartate hydrochloride by genotype in stress susceptible carrier pigs (Nn). Data represents least squares means ±SE.

	Control	Low Dose	High Dose	P*
Plant wt, kg	104.29±2.16	102.92±2.22	100.93±2.16	0.83
Commercial hot wt, kg	85.26±1.78	83.72±1.83	82.66±1.78	0.94
Hennessy index	97.42±1.76	98.97±1.82	97.25±1.76	0.81
Hennessy % yield	47.33±0.34	47.10±0.35	47.40±0.34	0.70
Initial pH	5.98±0.03^{a}	5.85±0.03^{b}	5.86±0.03^{b}	0.01
24h pH	5.36±0.01^{a}	5.33±0.001^{a}	5.30±0.01^{b}	0.01
Ultimate pH	5.33±0.02^{a}	5.41±0.02^{b}	5.37±0.02^{b}	0.04
Initial temp.	39.81±0.15^{a}	40.66±0.15^{b}	40.52±0.15^{b}	0.01
24h temp.	1.59±0.10^{a}	2.25±0.10^{b}	2.56±0.10^{c}	0.03
Subjective colour	2.71±0.12	2.53±0.12	2.54±0.12	0.55
Subjective structure	2.79±0.11^{a}	2.39±0.12^{b}	2.50±0.11^{a}	0.02
Subjective marbling	6.88±0.23	6.82±0.24	7.29±0.23	0.98
Minolta L*	57.65±0.69^{a}	58.64 ±0.71^{ab}	59.88±0.69^{b}	0.03
Minolta a*	9.30±0.26^{a}	10.00±0.26^{b}	9.88±0.26^{ab}	0.06
Minolta b*	4.94±0.28^{a}	5.36±0.29^{ab}	5.91±0.28^{b}	0.02
Drip loss mg/g	57.67±2.95	63.90±3.04	62.11±2.95	0.20
Shear, kg	6.93±0.24	6.91±0.25	7.38±0.24	0.34
Moisture, g/100g	73.64±0.15	73.27±0.15	73.50±0.15	0.28
Intramuscular fat, g/100g	6.43±0.34	6.79±0.35	6.03±0.34	0.77
Soluble protein, mg/g	168.12 ±5.55^{a}	143.14 ±5.72^{b}	144.28 ±5.55^{b}	0.01
Marbling AMSA %	512.50 ±23.26	518.08 ±23.96	470.83 ±23.26	0.98

Table 6. Carcass and meat quality effects of magnesium aspartate hydrochloride by genotype in non-stress susceptible pigs (NN). Data represents least squares means ±SE.

	Control	Low Dose	High Dose	P*
Plant wt, kg	103.53±2.25	100.93±2.26	101.65±2.26	0.83
Commercial hot wt, kg	82.81±1.86	81.57±1.86	79.26±1.86	0.94
Hennessy index	95.73±1.84	99.24±1.85	95.37±1.85	0.81
Hennessy % yield	48.14±0.35	48.48±0.35	48.74±0.35	0.70
Initial pH	6.05±0.03[a]	6.12±0.03[b]	6.15±0.03[b]	0.04
24h pH	5.39±0.01[a]	5.43±0.01[b]	5.42±0.01[b]	0.06
Ultimate pH	5.41±0.02	5.44±0.02	5.42±0.02	0.39
Initial temp.	40.16±0.16[a]	39.81±0.16[a]	39.29±0.16[b]	0.02
24h temp.	2.14±0.11[a]	1.90±0.11[a]	1.19±0.11[b]	0.01
Subjective colour	2.82±0.12	2.79±0.12	2.91±0.12	0.55
Subjective structure	2.82±0.12	2.82±0.12	2.96±0.12	0.60
Subjective marbling	7.29±0.23	7.27±0.24	7.69±0.24	0.98
Minolta L*	53.96±0.72	53.25±0.72	52.87±0.72	0.50
Minolta a*	9.20±0.27	9.13±0.27	8.74±0.27	0.47
Minolta b*	3.95±0.30	3.57±0.30	3.34±0.30	0.36
Drip loss mg/g	45.52±3.08	41.02±3.10	42.62±3.10	0.20
Shear, kg	6.99±0.25	6.70±0.25	6.75±0.25	0.34
Moisture, g/100g	73.38 ±0.15[a]	73.54 ±0.15[a]	74.06 ±0.15[b]	0.02
Intramuscular fat, g/100g	6.72±0.35	6.69±0.35	5.87±0.35	0.77
Soluble protein, mg/g	169.55 ±5.80[a]	177.58 ±5.82[ab]	189.50 ±5.82[b]	0.02
Marbling AMSA %	472.73 ±24.29	470.83 ±24.39	430.83 ±24.39	0.98

[a,b] Means with different superscripts within row [and genotype] are significantly different.
P* = Statistical probability level.