

Rodenticide Ingestion in Swine: A Project to Assist Veterinarians with Detection and Establishing Possible Withdrawal Times

Ron Johnson, DVM, PhD, DACVCP; Biomedical Sciences;
Robert Friendship, DVM, MSc, DipABVP, Population Medicine, OVC

Introduction

Accidental ingestion of rodenticides in hogs represents significant food safety concerns, animal welfare issues, as well as substantial economic losses to the producers. The emergence of rodent strains resistant to older or first generation anticoagulant rodenticides¹ has spawned the development of more potent, second generation compounds such as bromadiolone, which increases the potential for toxicity following accidental ingestion and the adulteration of carcasses intended for human consumption.

The true incidence of bromadiolone exposures in hogs is not currently known. Inquiries to the Canadian Global Food Animal Residue Avoidance Databank, Ontario Ministry of Agriculture, Food and Rural Affairs, and Animal Health Diagnostic Laboratory (University of Guelph) regarding accidental ingestion of rodenticides in swine supports their increasing occurrence. Additionally, reports of accidental rodenticide ingestion, or possible exposure, in swine usually involve hogs near market weight and include, most commonly, groups containing large numbers of hogs.

Information pertaining to exposure, tissue depletion and possible withdrawal times of rodenticides in suspected swine toxicities would provide substantial guidance to veterinarians and producers regarding animal disposition given the significant food safety concerns to the public and financial considerations to the producer.

Objectives

- To validate a non-invasive detection test for bromadiolone using blood and fecal samples in swine.
- To determine tissue residue depletion and estimate withdrawal time of bromadiolone in swine.

Materials and Methods

- Two groups of barrows (n=20) and gilts (n=20) were given a single oral dosage of bromadiolone: high dosage group (HD, 0.5 mg/kg BWT) or low dosage group (LD, 0.05 mg/kg BWT).
- Blood and fecal samples were collected for determination of bromadiolone levels and assessment of coagulation parameters in the blood of treated hogs, specifically prothrombin time and partial prothrombin time.
- Animals were sacrificed at 1, 2, 3, 5, 6 weeks (LD group) and 1, 2, 3, 6, 9 weeks (HD group) post-dosing and tissue samples were assayed using High Pressure Liquid Chromatography coupled with Mass Spectrometry for bromadiolone levels to the appropriate limit of detection (LOD) for each sample type.
- The withdrawal time was calculated (where possible) from the regression lines according to FDA/CVM guidelines².

Results

Table 1. Bromadiolone concentrations (ppb) after single oral administration of low dosage (0.05 mg/ kg) in 20 healthy pigs.

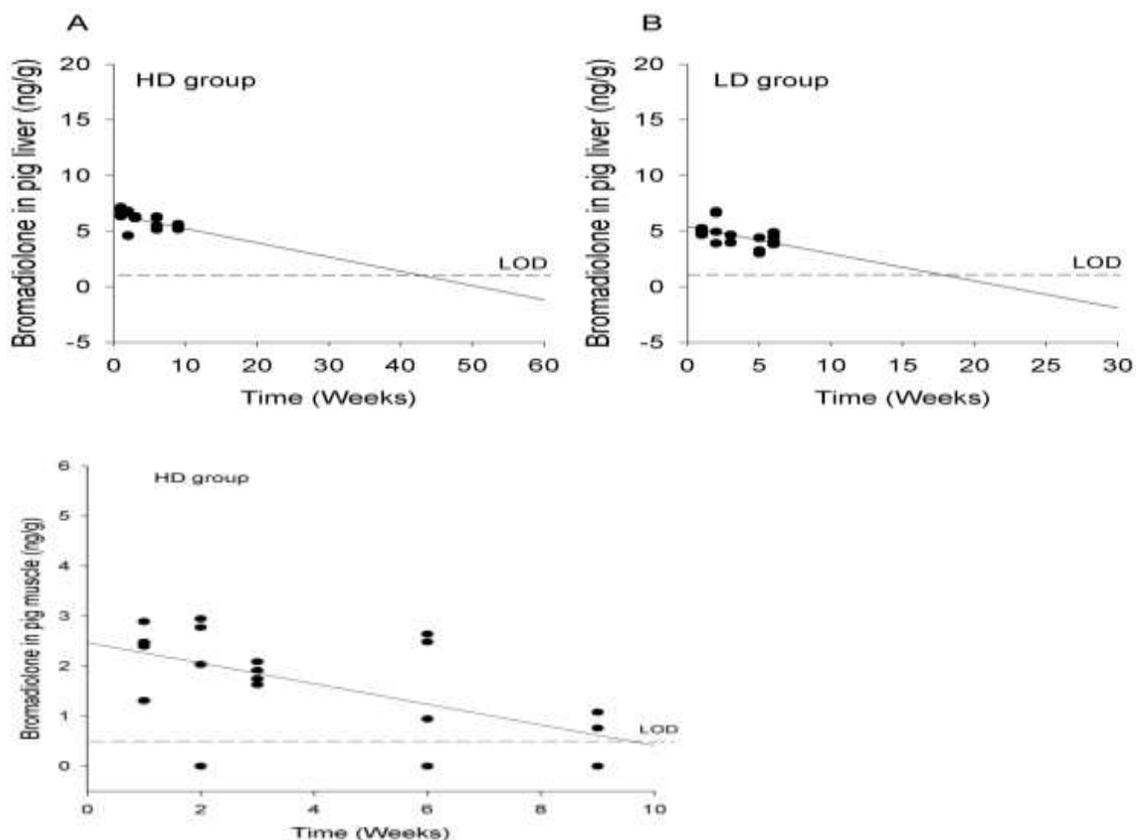
LOD (ppb)	Feces			Liver			Muscle			Plasma			Skin and fat		
	1			3			2			0.5			0.3		
	LL	Median	UL	LL	Median	UL	LL	Median	UL	LL	Median	UL	LL	Median	UL
week-1 (n= 4)	2.9	19.9	73.5	96.9	175.1*	316.5	<LOD			0.4	0.8	1.3	0.9	3.1	10.2
week-2 (n= 4)	3.3	8.9	24.4	87.2	137.3*	216.1	<LOD			0.4	0.6	0.9	0.6	1.6	4.1
week-3 (n= 4)	1.8	4.0	9.1	74.3	107.6*	155.8	<LOD			0.3	0.5	0.7	0.4	0.9	1.8
week-5 (n= 4)		<LOD		40.9	66.1*	106.6	<LOD			<LOD				<LOD	
week-6 (n= 4)		<LOD		27.8	51.8*	96.8	<LOD			<LOD				<LOD	

Values are expressed as median (or geometric mean); n = number per group in parenthesis; ppb, parts per billion; LOD, limit of detection. Data were analyzed by an ANOVA followed by multiple t-test. *P < .05, vs. other tissues within a time point.

Table 2. Bromadiolone concentrations (ppb) after single oral administration of high dosage (0.5 mg/ kg) in 20 healthy pigs.

LOD (ppb)	Feces			Liver			Muscle			Plasma			Skin and fat		
	1			3			2			0.5			0.3		
	LL	Median	UL	LL	Median	UL	LL	Median	UL	LL	Median	UL	LL	Median	UL
week-1 (n= 4)	20.6	67.3	220.2	348.8	596.4*	1019.9	6.1	9.6	15.2	1.4	2.3	3.8	2.7	8.2	24.5
week-2 (n= 4)	13.8	37.5	101.9	333.6	524.7*	825.3	5.3	7.8	11.5	1.2	1.8	2.7	2.8	7	17.7
week-3 (n= 4)	8.8	20.9	49.6	312.1	461.6*	682.6	4.5	6.4	8.9	0.9	1.3	1.9	1.8	6.1	13.4
week-6 (n= 4)	1.4	3.6	9.2	205.4	314.2*	480.6	2.4	3.4	4.9	0.4	0.6	0.9	1.6	3.8	9.1
week-9 (n= 4)		<LOD		106.7	213.9*	428.8	<LOD				<LOD		0.6	2.4	10.1

Values are expressed as median (or geometric mean); n = number per group in parenthesis; ppb, parts per billion; LOD, limit of detection. Data were analyzed by an ANOVA followed by multiple t-test. *P < .05, vs. other tissues within a time point.



Conclusions

- Blood as well as fecal samples could be used, prior to slaughter, to identify suspected bromadiolone rodenticide toxicity in pigs.
- Administration of a single oral low or high dosage of bromadiolone to hogs showed considerable accumulation in the liver with concentrations persisting for a prolonged period of time (see bromadiolone levels in pig liver figure above).
- Administration of a single high dosage of bromadiolone to hogs also showed considerable accumulation in the muscle with concentrations persisting for a prolonged period of time (see bromadiolone in pig muscle figure above).
- Results of this study will provide veterinarians with a non-invasive (blood or feces) bromadiolone detection system that may be used to rule out exposure of hogs to bromadiolone.
- Results of this study may assist CgFARAD with establishing possible withdrawal times in hogs that are exposed to bromadiolone.

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References

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2. Food and Drug Administration. Guidance for Industry: General principles for evaluating the safety of compounds used in food-producing animals. U.S. Department of Health and Human Services. Food and Drug Administration Center for Veterinary Medicine, Rockville, MD, USA. July 25, 2006.

<http://www.fda.gov/downloads/AnimalVeterinaryGuidanceComplianceEnforcement/GuidanceforIndustry/ucm052180.pdf>