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Preventing Sulfa Residues in Pork

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Preventing sulfa residues in pork

Sulfa products and other antibiotics have been widely used in Missouri's swine industry for promoting growth and for reducing disease problems and death in pigs. UMC Guide G2353, "Antibiotics and other additives for swine," outlines some suggested practices and performance benefits that result from incorporating approved products into swine feeds. Table 1 shows a summary of experiments using antibiotics as growth promoters for young pigs. Improvements in performance have been consistent. Pork producers need to comply with regulations and avoid losing these tools in their production systems.

What is the problem?

The benefits of antibiotics, including sulfa, are based on research trials. They are regulated through the amount you add to rations and through the levels inspectors accept as residues in meat tissue. In recent years, the pork industry and governmental agencies have become concerned about the number of hogs going to market with illegal levels of sulfa in their tissue.

The sulfa drugs, or sulfonamides, are one of the most commonly used drugs in pig feeds. The feed additive combinations that include sulfa are: Aureo-SP-250, Chlorachel-250, Tylan-sulfa and CSP-250. The recommended usage of these sulfa products and other additives and their withdrawal period is shown in Table 2.

The regulatory tolerance level for sulfa in pork tissues (liver, kidney or muscle is 0.1 ppm) as established by the FDA. During the early 1970s, the USDA initiated a national monitoring program. It found that about 15 percent of hog carcasses violated sulfa residue limits. In almost all the carcasses tested, the USDA found the sulfonamide sulfamethazine in the tissues.

Through a major effort initiated in 1977, the entire swine industry tried to solve the residue problem through research and educational programs. As the result of these programs, violative levels dropped to about 4 percent by 1981. Since then, however, levels have crept back up, and in 1986, violations were around 6 percent.

The industry fears that if this residue rate remains the same or continues to increase, the regulatory agencies will step up monitoring of the residues, which could lead to sulfonamide-use restrictions. Because many Missouri hogs have been fed sulfa at some time, it is evident such a ban, or even stricter inspections, would increase production costs for many of our producers.

Causes of sulfa residues

What is the reason for the high incidence of sulfa residues, and why has it been so difficult to eliminate the problem? Initially, producers were blamed for not complying with the withdrawal period. However, it was later realized many violations occurred at farms where producers did follow proper withdrawal times.

	Percent improvement over control pigs		
	Number of experiments	*Avg. daily gain*	*Feed/ gain*
Starting pigs (19 to 57 lbs.)[1]			
Antibiotic-sulfa combinations[2]	104	21.7	8.2
Other antibiotics	274	23.7	6.5
Growing pigs (37 to 109 lbs.)[3]			
Antibiotic-sulfa combinations[2]	32	15.4	5.7
Other antibiotics	348	10.7	4.6

[1]Data from 378 experiments, 10,023 pigs.
[2]Aureo-SP-250, Chlorachel-250, Tylan-Sulfa and CSP-250.
[3]Data from 280 experiments, 5,783 pigs.

Table 1. Comparison of antibiotics as growth promoters for young pigs

Table 2. Approved levels and withdrawal periods for feed additives used in swine feeds for improved growth rates and feed efficiency*

Feed additive	Growth promotion level (Grams/ton)	Withdrawal Period
Antibiotics		
Bacitracin, M.D.	10-30	None
Bacitracin, Zinc	20-40	None
Bambermycins	2-4	None
Chlortetracycline	10-50	None
Erythromycin	9.25-64.75	None
Oleandomycin	5-11.25	None
Oxytetracycline	7.7-50	None
Penicillin	10-50	None
Tylosin	10-100	None
Virginiamycin	5-10	None
Chemotherapeutics		
Arsanilic Acid	45-90	5 Days
Sodium Arsanilate	45-90	5 Days
Carbadox	10-25	10 Weeks (75 lb.)
Furazolidone	100-200	5 Days
Roxarsone	12.7-34	5 Days
Combinations		
Arsanilic Acid or Sodium Arsanilate + Streptomycin + Penicillin	45-90 7.5-15 1.5-3	5 Days
Arsanilic Acid or Sodium Arsanilate + Penicillin or Streptomycin or Chlortetracycline or Bacitracin or Oxytetracycline	45-90 50 7.5-50	5 Days
or Furazolidone	100-200	
or Oxytetracycline + Furazolidone	50-100 100-200	
Arsanilic Acid or Sodium Arsanilate + Hygromycin B or Oxytetracycline + Hygromycin B	45-90 12 50 12	15 Days
Chlortetracycline + Roxarsone	10-50 22.7-34	5 Days
Chlortetracycline + Sulfamethazine + Penicillin	100 100 50	15 Days
Chlortetracycline + Sulfathiazole + Penicillin	100 100 50	7 Days
Furazolidone + Oxytetracycline	100-200 50-150	5 Days
Penicillin + Streptomycin	1.5-8.5 7.5-41.5	None
Tylosin + Sulfamethazine	100 100	15 Days
Tylosin + Hygromycin B	10-100 12	15 Days

*1983 Feed Additive Compendium published by the Miller Publishing Company, Minneapolis, MN.

In some cases, violations were being reported on farms where pigs had no access to sulfa medication.

Finally, research conducted at Iowa, Illinois and Kentucky shed new light on the problem. Researchers found that very small amounts of sulfamethazine in the feed would cause a residue problem in the tissue. An early study at Kentucky showed as little as 1 gram of sulfamethazine per ton of feed would cause a high incidence of residues in the liver. Table 3 illustrates data from a later study in which 2 grams of sulfamethazine per ton of feed was found to cause a violative residue in liver tissue. A higher level of sulfamethazine (8 grams per ton) was required before a violative level of sulfa occurred in the muscle.

Sulfathiazole is excreted more rapidly than sulfamethazine and, therefore, is less likely to cause residue problems. Table 3 shows that feed can be contaminated with up to 16 grams of sulfathiazole per ton before a residue occurs.

In addition to the failure to withdraw at the proper time, other causes of residue may include manure or lagoon water recycling, contaminated manure packs, delivery errors and obtaining contaminated ingredients or feed from the feed supplier. The main problem, however, is cross-contamination of non-medicated withdrawal feed from on-farm mixing and handling. A study of Indiana farms indicated at least four major factors are strongly associated with cross-contamination. They are:

1. Use of powdered sulfamethazine instead of the new granular form.

An Iowa study found that because bulk sulfamethazine powder is cheaper than granuals, some producers illegally continue to use it instead of approved granulated products. The powder is extremely electrostatic and dusty, however and the test results show it is practically impossible to use without a risk of carryover.

2. Level of sulfa fed to livestock.

The use of higher-than-approved levels, which is illegal, also contributes greatly to carryover.

3. Percentage of the total feed that was sulfa medicated.

The more medicated feeds that go through the mixing and delivery systems, the greater the chances of mixing medicated feed with "clean" feed. This also reduces the number of flush feeds available. Just 20 pounds of medicated feed (100 grams of sulfamethazine/ton), mixed with one ton of non-medicated finishing feed, can cause violative tissue levels.

4. Sequencing in flushing and cleaning methods.

Essential to the overall cross-contamination picture of a given farm is the pattern of sequencing and flushing of the feeding system. Cleaning the delivery and mixing equipment following the use of sulfa is also important. Producers who keep good records and have a definite sequencing, flushing and cleaning plan have far less sulfa carryover into the finishing feed than those without the plan.

Generally, if the producer uses granular products at the approved level and has a conscientious sequencing, flushing and cleaning program, cross-contamination is not a problem. However, if feeds containing powdered sulfamethazine at higher-than-recommended levels are used, even an excellent sequencing and flushing routine is no guarantee that cross-contamination does not exist.

Compliance and enforcement

Producers found in violation of regulatory standards for sulfa residue face serious disruptions in their production and marketing activities. The USDA Food Safety and Inspection Service is responsible for enforcing of sulfa residue regulations. The service assures meat is safe and wholesome and condemns meat with violative drug residues.

Prosecutions can occur for producers who misuse sulfa or other medications. USDA meat inspectors randomly sample pork carcasses at each slaughter plant for sulfa and other drug and chemical residues. If they find violative levels of sulfa, they notify the producer and a marketing embargo is placed on the farm until a sample of five hogs is tested and found to be free of sulfa residues. This can result in marketing delay of two to three weeks. The USDA is currently developing screening tests for use on the farm, at buying stations or in the plant. With the possibility of increased checking and testing for sulfa residues, producers may want to look at some of the new on-farm testing producers that are becoming available.

Health concerns

The present tolerance level, set by the FDA's Center for Veterinary Medicine, is based on short-term toxicological studies with rats and dogs fed high levels of sulfonamides. Some of the animals in these studies developed thyroid toxicosis, which in one study progressed to thyroid carcinomas. The 0.1 ppm tolerance level, however, provides at least a 2,000-fold safety margin for humans.

Another concern is for the small percentage of humans hypersensitive to sulfa drugs. Hypersensitive people could have an allergic reaction to sulfa drugs even in small amounts—like the amounts found in residue-containing meat. Sulfa also poses potential risks to people who continuously handle and mix medicated feed.

Form and level of Sulfa	Sulfa residue		Violations[2]	
	Liver	Muscle	Liver	Muscle
	ppm	ppm	%	%
Sulfamethazine[3] in feed, g/ton				
0	<.01	<.01	0	0
1	.04	.01	0	0
2	.09	.02	38	0
4	.20	.05	100	0
8	.43	.09	100	40
16	.88	.19	100	100
100	4.55	1.52	100	100
Sulfathiazole[4] in feed, g/ton				
0	.01	<.01	0	0
1	<.01	<.01	0	0
2	.01	<.01	0	0
4	<.01	<.01	0	0
8	.03	.01	0	0
16	.07	.02	20	0
100	.30	.05	78	6

[1]University of Kentucky and University of Nebraska, 1981, 16 pigs/treatment.
[2]Percent of samples having .1 ppm or more of sulfa, based on two assay methods: colorimetric (corrected for background) and GLC.
[3]Sixteen pigs per treatment were fed 100 grams of sulfamethazine per ton for two weeks. Then these levels were fed for 15 days prior to slaughter.
[4]Sixteen pigs per treatment were fed 100 grams of sulfathiazole per ton for two weeks. Then these levels were fed for seven days prior to slaughter.

Table 3. Effects of form (sulfamethazine vs. sulfathiazole) and level of sulfa in finisher feed on sulfa residues in pork[1]

Preventing access to sulfa-containing manure

A study at Illinois indicates sulfa residues can occur when pigs have access to sulfa-containing manure. Swine housed on solid floors that allow accumulation of urine are more likely to experience recycling of sulfa than swine housed on slotted floors.

Following sulfa withdrawal, move pigs to a clean pen or thoroughly clean the pen at the time of withdrawal. These pens need to be cleaned daily for two-three days following withdrawal. Don't let pigs have access to manure in trucks or holding pens or places where other sulfa-treated hogs were kept. Avoid using pens where pools of urine are allowed to form.

Proper mixing of feeds

Producers who mix their own feed on the farm must follow good feed mixing practices to ensure uniform dispersal of drugs and other microingredients. They must use accurate scales and must calibrate volumetric mills often to ensure proper mixing. Producers must be certain to use only approved levels of drugs and approved combinations of drugs. Levels and combinations of drugs are regulated by the FDA and are published in the Feed Additive Compendium (Miller Publishing Co., Minneapolis, MN).

Producers should use a recording system to keep track of medicated feeds. (See Figure 1.) A good record system also will help you avoid mixing errors.

Date mixed	Tank number	Description of feed	Tons	Medication	g/ ton
10-14-82	2	Gestation, 14%	3	—	—
10-16-82	1	Starter, 18%	1	Tylan-Sulfa	100-100
10-16-82	3	Lactation, 14%	3	Neo-terramycin	50-50
10-21-82	4	Finisher, 13%	5	Aureo-mycin	50

Figure 1. Feed-mixing record sheet

Sulfa residue prevention checklist

- Read and follow label instructions.
- Use proper dosage.
- Follow established withdrawal times.
- Keep complete records of where and when medications are used (Write it down; don't rely on memory).
- Premix concentrated medications into soybean meal or supplement to ensure uniform dispersement.
- Weigh ingredients accurately.
- Calibrate scales and volumetric mills regularly.
- Make one person responsible for adding medicated premixes.
- Establish a sequencing pattern. After making all medicated feeds, mix and grind non-medicated flush feeds that are to be fed to non-medicated animals. Make withdrawal feeds last.
- Flush at least 5 percent of the mixer capacity with ground feed or cracked grain to purge the system.
- Clean mixing equipment and rooms by vacuum or remove as much dust and feed residue as possible on a routine basis.
- Make sure you are getting uncontaminated feed ingredients from your feed supplier. Insist on clean delivery trucks.
- Avoid delivery errors by clearly marking medicated and non-medicated bins and feeders.
- Clean out or totally flush conveying equipment, augers, holding bins, delivery wagons, portable grinder-mixers and trucks before putting non-medicated feed into them.
- Avoid using feeders for both medicated and non-medicated feed whenever possible. Just one mouthful of crushed, medicated feed residue from the lip of a feeder can cause violative tissue levels.
- Use separate waterlines for medicated and non-medicated water, if possible. If you must use the same line, flush the system completely before market animals drink from it. Install cut-off valves to prevent back flush.
- Do not mix hogs receiving sulfa with market animals. If possible, keep market animals in a separate building.
- Prevent urine and manure recycling. After sulfa withdrawal, move pigs to a clean pen. Clean pen daily for three to four days.
- Do not ship hogs to market in trucks containing waste from other hogs. Insist that your hogs are not mixed with others and are placed in clean pens at the stockyards or slaughter plant if they are to be held for more than one or two days.

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