



Salmonella on U.S. Sheep Operations, 2011

Background

Salmonella can cause abortions, fever, diarrhea, and sometimes death in sheep, resulting in economic losses. In addition, *Salmonella* can be transmitted to people by direct contact or through foodborne transmission, potentially causing diarrhea and, in some cases, more severe disease. To date, there has been very little research on the prevalence of *Salmonella* in U.S. sheep.

The genus *Salmonella* is categorized by species, subspecies, and serotype designations. There are two species (*enterica* and *bongori*). The *enterica* species is further subdivided into six subspecies (*enterica*, *salamae*, *arizonae*, *diarizonae*, *houtenae*, and *indica*, which are designated by Roman numerals I, II, IIIa, IIIb, IV, and VI, respectively). Most serotypes associated with the *enterica* subspecies are given a name (e.g., Typhimurium), while the other subspecies are recognized only by antigenic formula (e.g., IIIb 61:-:1,5, [7]).

Most *Salmonella* infections in humans and livestock in the United States are caused by *Salmonella enterica* subsp. *enterica*. In sheep, however, *Salmonella* infections are often associated with *Salmonella enterica* subsp. *diarizonae*. For example, in Great Britain serotype IIIb:61:k:1,5,[7] is the most common serotype found in sheep and typically accounts for over 60 percent of reported *Salmonella* infections in sheep (AHVLA, 2011). In humans, infections with subspecies *diarizonae* are uncommon. For example, in 2009, there were 86 laboratory-confirmed subspecies *diarizonae* isolates from human sources reported to the CDC compared with over 30,000 subspecies *enterica* isolates (CDC, 2009).

Salmonella has been identified from sheep at slaughter, and occasional outbreaks of *Salmonella* infections in humans have been linked to sheep. A recent study in U.S. sheep found that 14.4 percent of lamb pelts, 4.3 percent of pre-evisceration carcasses, and 1.8 percent of postintervention carcasses at a U.S. slaughterhouse tested positive for *Salmonella*. The most commonly identified serotype was S. Heidelberg (Kalchayanand et al., 2007). Occupational contact with sheep has also been associated with *Salmonella* outbreaks in agricultural workers in New Zealand (Baker et al., 2007).

Salmonella on U.S. sheep and lamb operations

For the Sheep 2011 study, the U.S. Department of Agriculture’s National Animal Health Monitoring System (NAHMS) collected data on sheep health and management practices from a representative sample of operations in 22 of the Nation’s major sheep-producing States. These operations collectively represented 85.5 percent of the U.S. ewe inventory and 70.1 percent of U.S. farms with ewes. Sheep 2011 is the first NAHMS study that examines *Salmonella* prevalence in the U.S. sheep and lamb populations.

During the Sheep 2011 study, 247 operations provided composite fecal samples for testing for enteric pathogens and commensal organisms. Each composite sample was composed of fresh feces from up to six animals. The target age for sampled animals was weaning to 2 years. Up to 5 composite samples were collected on each operation; 1,133 samples were collected between March 14 and June 30, 2011, and 370 composite samples (32.7 percent of total) tested positive for *Salmonella*. A majority of operations (66.4 percent) had at least one positive composite sample. From the 370 positive composite samples, 373 *Salmonella* isolates were cultured.

The proportion of composite samples that were positive for *Salmonella* by primary age group of animals included is shown in table 1.

Table 1. Number and percentage of composite samples positive for *Salmonella*, by sheep type

Sheep type	Number composites	Percent composites positive
Ewes nursing lambs	408	38.2
Nursing lambs, market lambs, and replacement ewes	165	30.9
Pregnant ewes and others	560	29.1
Total	1,133	32.7

The seven identified serotypes are listed in table 2. The *S. enterica* serotype IIIb 61:-:1,5,7 accounted for nearly all of the isolates (94.6 percent). Two serotypes commonly identified in human infections—*S. Enteritidis* and *S. Newport*—accounted for only 4 of the 373 positive samples. *S. Typhimurium*, which is also commonly responsible for salmonellosis in humans, was not found in the samples.

Table 2. Number and percentage of *Salmonella* isolates, by serotype

Serotype	Number isolates	Percent isolates
IIIb 61:-:1,5,7*	353	94.6
Kentucky	3	0.8
Montevideo	10	2.7
Enteritidis	3	0.8
Anatum	2	0.5
Newport	1	0.3
Braenderup	1	0.3
Total	373	100.0

*IIIb is the designation for subspecies diarizonae in an antigenic formula.

Conclusion

The majority of sheep operations (66.4 percent) had at least one *Salmonella*-positive composite fecal sample. *S. enterica* IIIb 61:-:1,5,7 was the most commonly identified serotype in fecal samples from the U.S. sheep population. However, human infections with this subtype of *Salmonella*—and of this general group (subgroup III *diarizonae*)—are extremely rare. Only 46 human cases associated with *diarizonae* have been reported since 1952 (Hoag and Sessler, 2005). The majority of these cases involved individuals with compromised immune systems and exposure to reptiles or reptile products used for medicinal purposes. More studies are needed to further define the relationship between the prevalence of *Salmonella* among individual-animal and composite samples. Further work should be done to monitor *Salmonella* infection rates, the antibiotic resistance of these organisms in the sheep population, and to define the on-farm ecology of this organism.

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