Testing feeds for salmonella

Since feed and feed ingredients are known sources of salmonella contamination in poultry, sensitive methods that minimize false-negative observations should be used.

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It has been known for many years that salmonella are present in feedstuffs, particularly animal byproducts. In 1948, *Salmonella bareilly* and *Salmonella typhimurium* were isolated from samples of chicken feed, and the source of these bacteria was thought to be the egg powder in the feed (Edwards et al., 1948).

In 1955, *Salmonella oranienburg* was isolated from commercially prepared and distributed poultry feeds — from mash, granules and concentrate, but not from feeds sold as ground (Edwards et al., 1955).

Since that time, salmonella contamination of animal feeds and feed ingredients has been reported many times and is presently a well-recognized source of contamination of poultry (Davis et al., 1997; Shiroti et al., 2003). In fact, Swedish scientists have asserted that the elimination of salmonella from poultry feed is imperative and is an important source of contamination of poultry (Mead et al., 2010).

With that in mind, the accurate detection of feed and feed ingredients is critical, and the internationally recognized and frequently used standard laboratory procedures for these materials need to be thoroughly analyzed and assessed.

Presently, lactose broth (LB) is recommended by the Food & Drug Administration in the "Bacteriological Analytical Manual" for dry samples and feedstuffs (Andrews and Hammack, 2011) in the U.S., while buffered peptone water (BPW) is recommended by the International Organization for Standardization (2003) for feed samples in the European Union.

LB and BPW are nonelective pre-enrichment media, and in a classical cultural technique for salmonella detection, a standard sequence is usually followed.Whenever the organism to be detected has been stressed or is present in very low numbers, an 18- to 24-hour incubation in a nonelective pre-enrichment broth such as LB or BPW is always the initial step.

With a sample such as commercial poultry feed, it has undergone a heating process or processes such as conditioning and/or pelleting. Then, in addition to these heating stresses, there is a dry stress, since the water activity of feeds must be kept low to prevent mold growth. So, the logical initial step for samples such as these is overnight incubation in a pre-enrichment broth. In a recent study (Cox et al., 2013),

A variety of finished broiler, layer and turkey feeds, plus an assortment of poultry feed ingredients — canola, dried distillers grains plus solubles, ground corn, sorghum, soybeans, wheat and wheat middlings — were individually incubated from 18 to 48 hours in four different pre-enrichment media: LB, BPW, minimal salts medium and universal pre-enrichment.

Following incubation in LB and BPW — but not in minimal salts medium and universal pre-enrichment — the pH of the broth was shown to drop to 3.9 and 4.1, respectively. These very acidic pH values have been shown to injure and kill salmonella. Therefore, in addition to the heating and dryness stresses, the cells of the target organism are also subjected to acid stress when LB or BPW is used.

It has been shown that exposure of salmonella to sequential stressors results in faster reductions than the exposure to single or double stresses applied simultaneously (Tiganitas et al., 2009). In an attempt to detect the presence of salmonella in feed samples, we may be killing or sublethally injuring the increasing organism in the first step of the laboratory procedure. The sublethally injured salmonella may lose their ability to produce expected biochemical reactions such as hydrogen sulfide production and lysine decarboxylase (Blankenship, 1981). These traits are necessary to recognize and identify salmonella on plating and screening media. Therefore, even though salmonella are not killed, the extent of the acid injury could certainly result in the organism going undetected on routinely used media.

When one considers the various fermentable substrates found in feed and feed ingredients and couples that with the large number of bacteria, particularly *Enterobacteriaceae*, found in commercial feed (Cox et al., 1983), it is very easy to understand how an assortment of acids are produced in a relatively short period of time in a medium with very little buffering capacity, such as LB or BPW.

Since feed and feed ingredients are well-known sources of salmonella contamination in poultry, sensitive methods that minimize false-negative observations should be used.

Regulatory agencies that recommend either LB or BPW for analysis of feed and feed ingredients in their standard procedures should, perhaps, reconsider and re-evaluate these official methods for salmonella.

References

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