Selenate from the remaining seven dry premixes, including molasses and molasses plus phosphoric acid, at all times tested (at preparation of the samples and after incubation of one and three weeks) with an average recovery of 88.5%, with no result lower than 74.1%.

Sodium selenite and “protected” selenite degraded almost totally and immediately in water extracts of two premixes (4011 and 1202), both containing ferrous sulphate. The unprotected sodium selenite degraded more slowly in one premix (1358) that contained ferric ammonium citrate (as oxidizing compound) in addition to ferrous sulphate, whereas the “protected” selenite in this premix appeared stable over time (Table 1).

Recovery from premix 1598 for unprotected sodium selenite was 87.2% at preparation of the samples, 68.4% after one week incubation and 44.2% after three weeks. Recovery of “protected” sodium selenite was 68.5% at preparation of the samples, 88.2% after one week and 85.3% after three weeks, indicating analytical error in the testing procedure. Total recoveries of sodium selenite, “protected” selenite and selenate in the remaining seven premixes are shown in Table 3.

In these premixes, the selenate appeared stable in premixes that contained protected selenite and the “protected” selenite lost more than 20% during storage and then seemingly achieved stability. In the molasses and molasses-plus-phosphoric-acid premixes, significant percentages of selenite and “protected” selenite degraded to the selenate form. The incubated samples apparently lost a substantial portion of the selenite and the recoveries of the samples were below the detection limit of the chemical analysis. The Figure shows the recoveries of the bioavailable selenium (selenite plus selenate) from the samples after two weeks incubation. Recovery of the selenate from the wet samples was 76.3% from the dry premix and 51.2% from the premix with added selenate. Reduction of selenite to hydrogen selenide requires the presence of very strong reducing agents and, therefore, loss of selenium to hydrogen selenide in premixes is less likely than loss to selenium dioxide.

During manufacturing, in a trial with a simulated corn/soybean meal-based poultry diet manufactured at the Oceanic Institute in Hawaii, 1,000 ppm selenium was added to two batches of feed, one batch as sodium selenite and a second batch as sodium selenate (Table 2). Four samples were taken from each batch at each of three locations, mash, after conditioning and after pelleting.

The recovery of selenium from water extracts of the mash was 99.5%, of the conditioned feed was 74.5% and of the pelleted feed was 69.5% based on analyses of all samples by Micro- Tracers using the Norris-Fay titration method. Results from the samples with added selenite were meaningless due to false high results from the method. In a trial with a corn/soybean meal-based poultry mash feed, Micro- Tracers added 1,000 ppm selenium as either sodium selenite or as sodium selenate, incubated them for two weeks at 40 °C, made water extracts from them and sent the extracts and the residual wet premixes to the University of California-Davis for specified selenium analysis by LC-ICPMS. The recovery of selenite from the water extract was 76.3% from the recovery of the selenate was 99.6%. The addition of a recovery of total selenium from analysis of the wet premix formulated with sodium selenite was 20.3% and from the wet premix formulated with sodium selenate 4.3%. The sodium from the wet premix analyses was probably elemental selenium.

Selenium selenate appeared stable in the corn/soybean meal poultry mash feed whereas sodium selenite degraded by 25.5% in the first trial and by 23.7% in the second trial. It appears likely the sodium selenite degrades when fed is conditioned and pelleted or merely incubated.

During digestion
Dr. PD Whanger of Oregon State University (2002) reported that cattle rumen microbes reduce selenium to insoluble forms. Whanger reported that the uptake and retention by sucking rat pups was most rapid for selenomethionine (TM), followed by selenite (51%) and least for selenium (25%). He also reported that the transfer of selenium as selenomethionine and selenite to vascular effluents was respectively 2.4 fold and 1.5 fold greater than the transfer of selenium-based selenite. These data suggest that selenomethionine (and therefore, selenium yeast) is preferable to sodium selenite and that selenium selenate is preferable to sodium selenite as a feed additive.

Bioavailability
The summary data reported in “Bioavailability of Nutrients for Animals,” published by Ammerman et al. (1995) revealed that sodium selenate, selenium yeast and selenomethionine are more bioavailable than other selenium supplements (Table 4).

In that book, the term bioavailability is defined as “the degree to which an ingested nutrient can be absorbed by the body.” The definition is used to describe absorption of a nutrient by the animal. For some nutrients, measurement is extremely difficult. One can reasonably conclude that selenium selenate is stable in premixes during storage, stable in feeds during manufacture, and more bioavailable to most species than sodium selenite. It is probably less bioavailable for some species than selenium yeast containing selenomethionine, but it costs far less and should be seriously considered as a feed additive.

One may reasonably conclude that sodium selenite may be particu- larly unstable in premixes containing ferrous sulphate, but it may be available to other compounds, and it may also degrade during the pelleting of formula feeds and during digestion in the rumen of cattle.

References