Natural Vitamin E Sources Show Better Efficacy and Biopotency than Synthetic Sources

Vitamin E is an essential nutrient for humans and the vast majority of animals. The benefits of supplementing human and animal diets with vitamin E has been widely publicized due to its critical role in many biological functions. Vitamin E provides the first line of defense in protecting the integrity of body organs, tissues, and cell membranes from damage caused by biological oxidation. In this function, vitamin E acts as an internal antioxidant to prevent highly unstable free radicals, referred to as peroxides, from attacking the polyunsaturated fatty acids of cell membranes.

Vitamin E is also crucial for:

- Tissue respiration
- Energy metabolism
- Immune system function
- Hormone synthesis
- Thyroid function
- Synthesis of critical body components
- Extended shelf life of meat

Vitamin E is the generic name for a group of lipid-soluble compounds known as tocopherols and tocotrienols (tocols). Each of these compounds has four different "configurations":

- Alpha
- Beta
- Gamma
- Delta

Each of these "configurations" act as biological vitamin E antioxidants to varying degrees, the most powerful being alpha-tocopherol. The number of methyl groups on the chromanol ring determines the efficiency at which a "configuration" will act as an antioxidant. The relative biopotency of the four "configurations" are alpha 100%, beta 25-40%, gamma 1-11%, and delta 1%.

The vitamin E requirement is dictated largely by the level of biological oxidation the animal or human encounters. Intensive animal production and dramatic improvements in growth rate and metabolic efficiencies have increased the need for higher dietary levels of vitamin E. Environmental and disease stress also contribute to increased oxidation; thus, increasing vitamin E need.

The commonly available source of stable vitamin E used in animal feed is synthetic dl-alpha-tocopheryl acetate, which consists of equal amounts of eight isomers. These eight isomers vary greatly in relative biopotency. An alternative natural form of stable vitamin E is d-alpha-tocopheryl acetate, which is derived from vegetable oils (such as soybean, sunflower, and corn oil) and consists of only the alpha isomer. Natural vitamin E source (d-alpha-tocopheryl acetate) has a relative biopotency of more than 136% compared to dl-alpha-tocopheryl acetate.

Biopotency is used to describe efficacy of vitamin E. Biopotency refers to the amount of a nutrient associated with some measured physiological endpoint, such as growth or prevention of a specific deficiency symptom. Standard biopotency values have been officially assigned to different sources of vitamin E compounds based on the rat fetal gestation-resorption test. The biopotency values are expressed as international unit (IU) per unit of weight (mg). The accepted USP biopotency factor for dl-alpha-tocopheryl acetate (synthetic vitamin E) is 1.00 and 1.36 for d-alpha-tocopheryl acetate – the natural source of vitamin E (United States Pharmacopia, 1980). This official potency factor, however, does not take into account newer findings in vitamin E metabolism research.

Biopotency values for different vitamin E compounds are influenced by many factors such as species, stage of production, degree of tissue depletion before start of the study, dietary concentration, and response variables. The following is a review of recent vitamin E biopotency research in swine.

In a study at Ohio State University (Mahan et al., 2000), sows were fed different sources of vitamin E (synthetic versus natural) for five parities. The alpha-tocopherol concentration in serum, colostrum, and milk was higher in sows fed d-alpha-tocopheryl acetate (natural source) than in sows fed dl-alpha-tocopheryl acetate (synthetic source). Serum and liver d-alpha-tocopherol content was higher in weaned pigs when d-alpha-tocopheryl acetate (natural source of vitamin E) was fed to sows. These findings suggest that more d-alpha-tocopherol was transferred to the dam's milk and ultimately absorbed and retained by the nursing pigs. Based on these data (mostly milk alpha-tocopherol content), the authors concluded that the biopotency factor should be approximately 1.54, not 1.36, for d-alpha-tocopheryl acetate (natural source) in comparison to dl-alpha-tocopheryl acetate (synthetic source).

Research conducted at the University of Florida (Anderson et al., 1995) found that d-alpha-tocopherol content was higher in serum, liver, backfat, leaf fat, and muscle in finishing pigs fed diets containing 62 IU/kg (28 IU/lb) of d-alpha-tocopheryl acetate than in finishing pigs fed

diets containing the same amount of dl-alpha-tocopheryl acetate. Their data suggested a biopotency of 1.74:1.00 (natural versus synthetic source).

In a Danish study (Lauridsen et al., 2002), deuterium-labeled isotope techniques were used to evaluate biopotency of natural versus synthetic sources of vitamin E in sows. The results from this study demonstrated that natural vitamin E has roughly twice the activity of synthetic vitamin E in maintaining blood plasma concentrations. Therefore, this data showed a 2:1 biopotency ratio of natural to synthetic source of vitamin E.

Taken together, recent swine research data demonstrated a higher biopotency factor (1.76, an average of the above three studies) for natural source vitamin E in swine than the currently accepted USP definition of natural:synthetic vitamin E of 1.36:1.00, which was previously established using traditional bioassays with the rat.