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A Study of Economically Feasible Technologies to Remove Dioxin and Dioxin-Like Toxicants from Animal Co-Products

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Several in-depth national and international studies have been conducted to measure the concentration and TEQs for dioxin and dioxin-like contaminants in a variety of food categories, including meat, poultry, milk, eggs, fats and oils, fish, and fruits and vegetables; and animal feedstuffs. Parts per trillion TEQs seldom exceeded 2, a limit currently adopted in the European community for fats and oils. This limit may be reduced in 2006/7. Depending on limits promulgated in the United States, there may be the potential for some concern. As noted in the October Progress Report several more articles were published in the European community further detailing the dietary intake of dioxin and dioxin-like toxicants from a variety of five food groups (fish, meat, dairy products, eggs, and fats/oils). Reported contaminant levels continue to be below the TEQ of 2 parts per trillion. Some toxicants namely DDTs, p,p'-DDE and Chlordane were reported above the EC limit. I*n addition, several publications have appeared in the 2006 open literature addressing the presence of these toxicants in human serum, milk, salmon, cheese, laying chickens, sport fish, and in a variety of foods collected from European markets. A preliminary review of these reports continue to indicate that current levels found in these matrices do not pose a significant concern for elevated levels of the toxicants in animal co products.*

If the current EC limit is significantly reduced during the 2006/7 year, it will be pragmatic to investigate plausible technologies to further reduce the levels of these toxicants in fats and oils.

As previously reported, numerous investigations have shown that bacteria and fungi are capable of degrading dioxin and dioxin-like toxicants by various enzymatic pathways. Our previous report noted that Terrabacter sp. strain DBF63 and Pseudomonas sp. strain CA10 possess the ability to use their angular dioxygenases to degrade dibenzo-p-dioxins and dibenzofurans. Our most recent preliminary review of the literature since the 2005 report indicates that several intracellular enzymes are capable of hydroxylating aromatic rings. In addition, dibenzofuran 4,4a-dioxygenase and carbazole 1,9a-dioxygenase also degrade these types of toxicants. A more thorough investigation during the coming months may uncover several more enzymatic systems that may be plausible systems to degrade these toxicants in fats and oils.

At present an effective process to remove dioxin-like contaminants from animal co-products (fats and oils) without degrading the product is unknown. However, a potentially plausible remediation technique centers on the ability of microorganisms to degrade the contaminants. If microorganisms are capable of degrading the contaminants, they must first synthesize the enzymes to catalyze the degradation. Since it is not practical to treat the fats and oils with microorganisms, it is plausible to isolate the cellular enzymes and subsequently add the enzymes to the fats and oils to achieve enzymatic catalysis. To remove the enzymes from the fats and oils before further processing to edible or inedible products, system temperatures could be elevated to denature the then unwanted enzymes.

A review of the most recent literature (2005-2006) has not provided insight regarding the conceptualization of a treatment scheme utilizing in situ enzymatic degradation of dioxin and dioxin-like toxicants from fats and oils. Still, this remains a viable research area should the requirement to further reduce toxicant levels in these matrices.