

ODOURS: Fish Drying and Fishy Smells

Dry fish has been one of the most common preserved food used by peoples of all cultures. Drying species of fish in the open air usually gives fish water content of 17-18% (w/w), this process came into being because of both the need to prevent spoilage and to provide a food reserve.

However, fish processing may cause environmental contamination, not only by the odors generated, but the wastes generated are a potential source of environmental pollution (water, soil) that may affect public health. This memo is focused on the odors. Please let us know if you need additional information.

1. SOURCES OF ODORS IN THE DRYING FISH PROCESS

Odors are produced mainly by bacterial decomposition, volatilization, and chemical reactions during the fish drying process. The process to dry fish generally involves gutting, washing, soaking the fish in brine or a salt solution and letting it dry. Liquid and solid wastes are generated during the separation of the fish from the by-products (skin, bones and other parts). Odors can occur from microbial decomposition at several steps of the fish drying process, and depend on several factors such as the quality and freshness the fish to be processed, solid and liquid waste disposal, temperature, and storage conditions.

Bacteria may transform chemicals in the fish meat to a mixture of other chemicals that have pungent odors. Bacterial decomposition of fish and its by-products produces several pungent chemicals such as trimethylamine, ammonia, amines, sulphides, mercaptans, and volatile fatty acids (acetic, propionic, butanoic and pentanoic). They can have detrimental effects on aesthetics, property value, and the quality of life in communities subjected to them. Studies on dry fish found anaerobic/facultative anaerobic bacterial flora in the fish flesh, such as *Moraxella* and *Acinetobacter*-like species of bacteria. Valdimarsson G. (1984) "The microbiology of stockfish during the drying process". *J. Appl. Bacteriol.* Dec.57(3).

2. THE HEALTH EFFECTS OF EXPOSURE TO ODORS FROM DRYING OF FISH

Exposure to odors result in physiological stresses that may result in a variety of symptoms including headache, nausea, loss of appetite and emotional disturbance. In extreme cases, offensive odors can lead to deterioration of personal and community well-being, interfere with human relations, deter population growth and lower its socio-economic status. Shukla N, (1991) "Air Pollution by Odor-Sources. Identification and Control" *Reviews on Environmental Health*, Vol 9. 94.

Continued exposure to noxious odors can also cause 'odor-related stress-induced illness.' In this disease, continued exposure to noxious odor can cause physiological stress, including increased blood pressure (which results in an increased risk of heart attacks and strokes) ulcers, and headaches. There is a scientific article that documents the health effects of exposure to noxious chemicals. Shusterman, D., (1992) "Critical review: the health significance of environmental odor pollution" *Archives of Environmental Health*, Vol. 47, No. 1, 76-87.

Subjects who have been exposed to malodors reported that they thought the odors had a negative effect on human task performance, mood and perceived health. Knasko, S. (1993) "Performance, mood, and health during exposure to intermittent odors." Archives Environmental Health, Sept-Oct, 48 (5).

The most commonly reported compounds on odorous chemicals are irritants of the respiratory tract, skin or eyes. The extent to which people regard mal-odor as a threat to their health is a relatively strong predictor of annoyance. Moreover, the effects of long-term low exposure are similar to the effects of temporary high exposure. Cavalini PM. (1994) "Industrial odorants: the relationship between modeled exposure concentrations and annoyance." Arch Environ Health. Sep-Oct;49(5). Allergic reactions to inhalation of raw fish aeroallergens have also been documented. In Madrid, patients with fish allergy have exhibited respiratory symptoms after being exposed to fish aeroallergens. Taylor AV (2000) "Detection and quantitation of raw fish aeroallergens from an open-air fish market". Journal of Allergy Clinical Immunology. Jan; 105.

3. LEGAL BASIS TO ABATE NOXIOUS ODORS FROM A SOURCE

Air pollution control authorities dealing with odorous emissions from industrial, municipal and agricultural activities are often faced with many complaints from the public. In Germany, the Directive on Odour in ambient air provides a regulating system for the abatement of odour annoyance. Ambient air quality standards have been established based on investigations of the relationship between ambient odour load and community annoyance reaction. The following paper describes a tool for the assessment of annoyance reactions, whereby degree of annoyance is correlated with ambient odour load. Sucker K et al. (2001) "Adverse effects of environmental odours: reviewing studies on annoyance responses and symptom reporting" Water Science Technology 44(9):43-51.

<http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=pubmed&opt=Abstract&list_uids=11762482>

According to article 3 of the German Federal Protection Act all odours caused by manufacture or industrial plants are defined as an annoyance. In the Directive on Odour in Ambient Air a complete system is designed, beginning with measurement methods and concluding with ambient air quality requirements. The paper written by Both R. (2001) "Directive on odour in ambient air: an established system of odour measurement and odour regulation in Germany" Water Sci Technol. 44(9):119-26. describes some main aspects of more than five years of practical experience and a perspective on some future investigations and developments about this issue. As a conclusion it is pointed out that in practice, the Directive on Odours has been successful. Both methods, field measurements with panels and dispersion modelling, are generally qualified for the determination of odour loads. The restriction of odour loads by limit values expressed as odour frequency per year for certain areas has been established in a lot of cases.

In the U.S., the legal basis to abate noxious odors is nuisance law. A nuisance occurs when one person interferes with enjoyment of another's

property. In several states, there are nuisance statutes which enable a state official OR a private party to seek abatement of an odor source.

One example of a nuisance statute is from the State of California. This statute states:

" . . . no person shall discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance, or annoyance to any considerable number of persons or to the public, or which endanger the comfort, repose, health, or safety of any such persons or the public, or which cause, or have a natural tendency to cause, injury or damage to business or property." California Health and Safety Code, Section 41700.

California has interpreted an "annoyance" under this statute to mean that which would be irritating to a reasonable person. California has also interpreted "considerable number of persons" under this statute to mean at least five confirmed complaints within a 24-hour period.

One jurisdiction in California has adopted a regulation specifically for the abatement of odor nuisances. Bay Area Air Quality Control District, Regulation 7, Odorous Substances. The regulation prohibits the discharge of "any odorous substance which causes the ambient air at or beyond the property line of such person to be odorous and to remain odorous after dilution with four parts of odor-free air."

In practice, a person violates the regulation if the person is emitting an odorous chemical AND air on adjacent or near-by property contains the odorous chemical such that two of three people who have a normal sense of smell can detect the odor in a sample of air from the property that has been diluted four-fold with clean air. Section 7-404.

The regulation also places emission limits on the amount of certain odorous chemicals a source can emit, regardless of whether it causes annoyance. For example, the regulation prohibits any source from emitting more than 0.02 parts per million (ppm) of trimethylamine, or 5000 ppm of ammonia. Section 7-303.