Air Quality Facts
Iowa Concentrated Animal Feeding Operations Air Quality Study
February 2002 Iowa State University and the University of Iowa Study Group Final Report
Facts from the Study

Human Health Effects

…With the rise of large industrial CAFOs as the preeminent form of livestock production and their associated higher production of gases, vapors, and fumes, these exposures now have the potential to affect larger numbers of individuals, including members of the neighboring community not involved in agriculture or related industrial livestock production…

…For many reasons, standards for community exposures to the toxic agents released from CAFOs must be stricter than for occupational exposures. Communities may include subgroups of especially susceptible individuals, for example, the elderly, children, and those with preexisting impairments. Secondly, community members may be exposed continuously to released substances rather than for a workshift of less; this is especially true for those who do not work outside the home, and for pre-school children… Ambient exposure levels arising from CAFOs; including ammonia and hydrogen sulfide must be significantly lower than the occupational levels. *(6.3 Human Health Effects)*

Ammonia Emissions

Ammonia is a component of animal waste and released in the waste treatment process and a well recognized human toxin. EPA has reported that animal agriculture operations are responsible for almost 3/4 of ammonia air pollution in the United States… EPA has recommended as a reference concentration for chronic inhalation of ammonia of 1.4 ppm. ATSDR has recommended long term MRL of 300 ppb for community exposures.

Ammonia is water soluble and rapidly absorbed into the upper airways, with the result of damaging upper airway epithelia. Moderate concentrations (50-150ppm) can lead to severe cough and mucous production; higher concentrations can cause scarring of the upper and lower airways… At higher concentrations, sufficient ammonia may bypass the upper airways to cause lower lung inflammation and pulmonary edema…

…Exposure of ammonia can lead to irritation to the eyes, sinuses, and skin. Exposure to 100 ppm ammonia for short (30 second) duration leads to nasal irritation and increases nasal airway resistance. When increasing concentrations of ammonia are delivered by spontaneous respiration, severe nasal irritation develops at 134 ppm after 5 minutes; some individuals report symptoms as low as 32 ppm. Clinical sinusitis has been reported following accidental exposure to ammonia…

Although the most serious adverse affects of ammonia inhalation are usually seen with concentrations of ammonia that have been associated with fatal exposures (in the range of 500 ppm) evidence exists that lower concentrations of ammonia can reach the alveoli and may be adsorbed to respirable particulates as may be seen in complex bioaerosols such as those found in the agricultural setting resulting in a research recommended occupational exposure limit of 7ppm. *(6.3.1.1. Ammonia)*

Hydrogen Sulfide Emissions

…Hydrogen sulfide smells like rotten eggs and is recognized as both an irritant and asphyxiant, and is a prominent component of odorants released from CAFOs…
For community exposures, EPA has recommended reference concentration for long term exposure of 7 ppb…One particular hazard is that, although the odor threshold is quite low, (less than 1ppm) at levels over 6 ppm the intensity of smell only modestly increases; above 150ppm, exposure to hydrogen sulfide may actually reduce the sense of smell, hindering the olfactory detection of high concentrations of the gas and making H2S monitoring equipment mandatory in occupational settings…

…Several additional epidemiological studies of community residents exposed to low levels of hydrogen sulfide have been reported. A U.S public health service study of a general population exposed to levels in excess of 0.3 ppm reported adverse health effects including shortness of breath, eye irritation, nausea, and loss of sleep… Chronic low level exposure is associated with asnomia, the loss of ability to detect odors.

…Survivors of hydrogen sulfide poisoning are reported to commonly have neuropsychiatric defects which may be permanent. A recent study by Kilburn of USC has demonstrated that even exposure to low concentrations of hydrogen

sulfide leads to significant neuropsychologic abnormalities, including impaired balance, visual field performance, color discrimination, hearing, memory, mood, and intellectual function… *(6.3.1.2 Hydrogen Sulfide)*

Exposure Risks as Recommended from Federal Agencies and Regional State Regulations

…Several states have adopted emission standards based on the weight of evidence regarding individual chemical exposures. ATSDR and EPA have made recommendations based on hazard assessment evaluations. Also consideration for mixed exposures should lower levels set for individual exposures. The following concentrations could be supported for CAFOs based on the relevant information reviewed above.

H2S:
15 ppb at the residence for a one-hour average measure and 70 ppb at the property line. No more than seven exceedences would be allowed, per calendar year (with notice to the residents and DNR).

NH3:
150ppb at the residence and 500 ppb at the property line for a one-hour average measure. There should be no more than seven exceedences (with notice to residence and DNR) per calendar year .*(8.6 Summary of ambient Exposure Risks as Recommended from Federal Agencies and Regional State Regulations)*

Mixed Exposures of Toxic Emissions-The Community Setting

In the case of CAFOs, ammonia and hydrogen sulfide both have direct effects on the respiratory system. ATSDR notes Hydrogen sulfide is considered a broad spectrum poison which means it can poison several systems in the body. Thus, in addition to possibly additive or synergistic effects on the respiratory system in the presence of ammonia, there may also be additive effects with other components of CAFO emissions. These materials occur together, not only with each other, but also potentially with a variety of other contaminants… *(8.4.2 Mixed Exposures-The Community Setting)* The air in CAFOs is contaminated with high concentrations of particulates, one quarter which is protein about one third of suspended dust is respirable. In addition of direct inflammatory response of inhaled allergens, dust can also convey inflammatory and/or irritating gases or chemicals (such as ammonia, hydrogen sulfide, or endotoxin) deeper in the lungs, thereby enhancing their toxic effects. *(6.33.3. Particulates)*

Conclusion

There is experimental end epidemiological evidence that very low levels of exposures to ammonia, hydrogen sulfide, known to be ambient air toxic gases from CAFOs, may result in adverse health effects among healthy volunteers and community residents…Taken together with other experimental and epidemiological observations of adverse health effects observed with low levels of exposures to chemical components (ammonia, hydrogen sulfide) of CAFO emissions, these findings support a conclusion that CAFO air emissions constitute a public health hazard, deserving of public health precautions as well as larger, well controlled, population based studies to more fully ascertain adverse health outcomes and their impact on community health services. *(Conclusion 6.3.4.)*