



Respiratory Disease and Coffee Processing: Precautionary Guidance for Employees and Employers

SUMMARY

Emerging evidence suggests employees exposed to a chemical called diacetyl in coffee processing facilities may develop a rare, serious and disabling respiratory illness called bronchiolitis obliterans. The recognized bronchiolitis obliterans cases have all occurred in workers who worked in both flavored and unflavored coffee processing areas at a single workplace in Texas.

Diacetyl is a food flavoring first linked to bronchiolitis obliterans in exposed microwave popcorn production workers. Diacetyl and 2,3-pentanedione, a similar food flavoring agent used as a substitute for diacetyl, can be man-made or develop naturally during coffee roasting. Flavorings added to flavored coffee often contain diacetyl and 2,3-pentanedione. Diacetyl and 2,3-pentanedione are both released during a number of food manufacturing processes including coffee roasting, grinding and packaging.

Bronchiolitis obliterans is difficult to diagnose, and has been mistaken for asthma, chronic obstructive pulmonary disease (such as chronic bronchitis and emphysema), pneumonia, and reactive airways disease.

To prevent disease in exposed workers, the National Institute of Occupational Safety and Health (NIOSH) has developed best practices for exposure reduction that include air monitoring for diacetyl and 2,3-pentanedione, ventilation to reduce employee exposures, the use of respirators when ventilation is insufficient, and medical surveillance for early detection of lung changes.

Workers with unexplained shortness of breath which worsens with exertion and dry cough should see their doctor as soon as is feasible. Information for clinicians is available at the UW Field Research and Consultation Group web page at <http://deohs.washington.edu/FRCG/EmpClinicianResources>.

What is Bronchiolitis obliterans?

Bronchiolitis obliterans, also known as constrictive bronchiolitis, and sometimes as obliterative bronchiolitis, is characterized by narrowing or blockage of the very smallest airways in the lung. Common symptoms are cough, wheeze and shortness of breath which worsens with exertion. Symptoms can develop rapidly or slowly over months to years. These symptoms persist even when workers are away from the job (i.e. evenings, weekends or vacations). Medical treatment options are limited. Bronchiolitis obliterans is a rare, mostly permanent and disabling condition, and is often misdiagnosed, as noted above.

Can a doctor or other health care provider help me understand if I'm affected by diacetyl and/or 2,3-pentanedione?

Exposed or former workers with unexplainable shortness of breath with exertion and dry cough should see a physician as soon as feasible for a medical evaluation. These symptoms may be early indicators of lung function changes in industrial coffee workers. A health care provider may take a detailed work history and perform a medical exam. Depending upon the history and exam findings, the clinician will determine if any additional tests are needed or if referral to a medical specialist is warranted.

Information for clinicians is available at the University of Washington Field Research and Consultation Group web page <http://deohs.washington.edu/FRCG/EmpClinicianResources>.

Are there other respiratory illnesses that occur in coffee processing workers?

Yes. Coffee processing can lead to new occupational asthma or aggravate pre-existing asthma. Asthma in the coffee industry is linked to exposure to green and roasted coffee bean dusts. Asthma symptoms are episodic cough, wheeze, and shortness of breath.

What are Diacetyl and 2,3-Pentanedione?

Diacetyl is a food flavoring added to some coffee, microwave popcorn and other foods, and it is also created naturally during coffee roasting. 2,3-Pentanedione is chemically similar to diacetyl, has been used as a flavoring substitute for diacetyl, and also forms naturally during coffee roasting. 2,3-pentanedione has been linked to lung damage in animal studies.

Diacetyl and 2,3-pentanedione are readily released when heated, and concentrations exceeding government guidelines (see below) have been measured in both flavored and unflavored industrial coffee roasting and grinding areas, and at other locations in coffee processing facilities. Five coffee processing workers who worked in both flavored and unflavored coffee processing areas developed bronchiolitis obliterans.

Does NIOSH recommend air testing for diacetyl and 2,3-pentanedione?

Yes. NIOSH recommends air sampling to identify high exposure tasks such as roasting, pouring, and grinding/packaging coffee, and opening storage bins of, and adding flavorings to, coffee. Excessive exposures are also possible in other areas and characterization of peak exposures is recommended.



Does OSHA or WA DOSH have workplace exposure limits for diacetyl and 2,3-pentanedione?

No. Neither the WA DOSH (Washington Division of Occupational Safety and Health) nor OSHA (U.S. Occupational Safety and Health Administration) have exposure standards for these substances.

NIOSH has proposed voluntary recommended exposure limits (RELs) for diacetyl and 2,3-pentanedione in air (Table 1), but these RELs have not been finalized. If workplace exposures exceed these RELs, NIOSH recommends controls to protect workers from developing respiratory disease.

The American Conference of Governmental Industrial Hygienists (ACGIH), a professional, not-for-profit, scientific association, has also issued diacetyl best practices exposure guidelines (Table 1).

When setting the RELs, NIOSH did not differentiate between the natural and synthetic forms of diacetyl and 2,3-pentanedione.

Table 1
Occupational Exposure Best Practice Levels
Proposed NIOSH RELs¹ and ACGIH TLVs²

	Diacetyl		2,3-Pentanedione	
	8-hour (ppb)	15-min (ppb)	8-hour (ppb)	15-min (ppb)
NIOSH RELs	5	25	9.3	31
ACGIH TLVs	10	20	n/a	n/a

¹Recommended exposure limit (REL)

²Threshold limit value (TLV)

Can improved ventilation decrease diacetyl and 2,3-pentanedione concentrations?

The most effective way to reduce exposure is to eliminate the use of food flavorings that contain these substances or choose less toxic flavorings. Alternatively, isolation of the areas where flavorings are added and use of negative pressure to contain and reduce employee exposures are also effective. Since diacetyl and 2,3-pentanedione are also naturally released during coffee roasting, grinding and other processes, the use of local exhaust ventilation to capture emissions is also recommended. To further reduce employee exposures, employers can also increase the amount of outside air that enters problematic areas.

When is a respirator recommended?

If ventilation is insufficient to control exposures to acceptable levels (Table 1), NIOSH recommends the use of respiratory protection. To capture diacetyl and 2,3-pentanedione, use of P100 particulate filters combined with organic vapor cartridges is recommended. Since the RELs for diacetyl and 2,3-pentanedione are very low, a full-face respirator or powered air-purifying respirator (PAPR) may be needed to sufficiently reduce exposures. Employers must ensure workers only use NIOSH-certified equipment and that workers are fit-tested and medically cleared to use respiratory protection.



Should employees receive specific training on the potential health effects from exposure to diacetyl and 2,3-pentanedione in coffee processing?

Yes. NIOSH urges employers to train workers on the emerging evidence regarding this serious hazard as part of the workplace hazard communication program.

Are medical tests recommended for all workers?

In order to detect early symptoms of respiratory disease and prevent serious illness, NIOSH recommends medical evaluation when workplace diacetyl and 2,3-pentanedione exposures exceed the NIOSH RELs (Table 1). The medical evaluation includes such things as a health questionnaire and a breathing test known as spirometry.

Who are we and why are we involved?

To promote worker health and safety, the University of Washington Field Research and Consultation Group provides consultation services to employers throughout the State of Washington. The Field Group provides information, on-site evaluation of health and safety issues in the workplace, and consultation on strategies to reduce workplace hazards – all at no cost. The Field Group also provides learning experiences and research opportunities to UW Department of Environmental and Occupational Health Sciences students. The Field Group has no regulatory authority.

Resources

NIOSH. 2015 Best Practices. Engineering Controls, Work Practices, and Exposure Monitoring for Occupational Exposures to Diacetyl and 2,3-Pentanedione. <http://www.cdc.gov/niosh/docs/2015-197/pdfs/2015-197.pdf> Date accessed February 26, 2016.

NIOSH. 2015. Flavoring-Related Lung Disease Coffee Processing Facilities. <http://www.cdc.gov/niosh/topics/flavorings/processing.html> Date accessed February 25, 2016

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