

Liquid Nitrogen in Molecular Cooking

Molecular and cryogenic cooking

Molecular cooking is a method used by both food scientists and researchers to help study the physical and chemical processes that occur while cooking and by food professionals to prepare food at cryogenic temperatures, usually using liquid nitrogen (-196°C). This is often referred to as cryogenic cooking.

There is a growing list of food preparation techniques that use liquid nitrogen, including:

- Preparation of nitro-meringues.
- Making powdered ice using a spray gun.
- Coating soft products with thin layers of jelly by repeated quick freezing with nitrogen.
- Creating ice-cream pearls from a fruit coulis.
- Preparing fresh ice sorbet.

Although cooking with liquid nitrogen looks simple, there are many hazards to be considered. The Safety Advisory Council of EIGA is aware of incidents as a result of cooking with liquid nitrogen, which have resulted in severe injuries to chefs, trainees and consumers.

This Safety Information is intended to raise awareness of hazards and safety measures necessary when liquid nitrogen is used in gastronomy.



A serious accident involving cryogenic nitrogen and molecular cooking

A trainee chef was unaware of liquid nitrogen hazards when filling a closed container without appropriate authorisation. When the trainee chef tried to open the container at his home, it ruptured. The trainee chef lost one of his hands and suffered severe injuries to the second one.

The container used by the injured person was not designed for storing liquid nitrogen. It had been closed using an unvented screwed cap and the liquid nitrogen was trapped. Due to the heat transfer into the liquid nitrogen, it warmed up and raised the pressure inside the container. As the container had no safety device to relieve pressure it ruptured when the cook tried to open it.

How to prevent accidents?

Be familiar with the risks associated with liquid nitrogen properties

Risks of burns

- Cryogenic nitrogen is an extremely cold liquid: -196 °C. In contact with the skin or eyes, it will cause severe cold burns.

Risk of cold embrittlement

- Equipment materials can become brittle when very cold. Embrittlement can result in failure of the vessel containing the liquid nitrogen and spillage.

Risk of equipment rupturing

- If liquid nitrogen is in a closed container, the pressure will rise as the liquid warms up and turns to gas until the container is liable to rupture. Rupture of the container causes an extremely violent release of energy, projectiles and spillage of liquid nitrogen.



Risk of asphyxiation

- Be aware of the large volume of gas which will be generated by evaporating liquid, 1 litre of liquid nitrogen will evaporate to approximately 700 litres of gas which can result in an asphyxiant atmosphere due to oxygen deficiency.

Safety recommendations to liquid nitrogen suppliers

Suppliers of liquid nitrogen for cryogenic cooking shall provide information and advice to customers on appropriate equipment to handle liquid nitrogen safely and make them aware of the potential hazards when using liquid nitrogen in cryogenic cooking. This should include information on:

- Containers for storage of liquid nitrogen;
- Open topped containers for handling of liquid nitrogen and temperature control;
- Face, eye and hand protection;
- Safe operating practices (e.g. oxygen monitoring, safety distances for spectators, etc.).

Safety recommendations to liquid nitrogen users when cryogenic cooking

Never use liquid oxygen for cryogenic cooking!

Literature for cryogenic cooking often emphasises that they are very basic recipes that do not require special education or skills to prepare. This is definitely not true for safe handling of liquid nitrogen, when the following measures shall be in place:

- Ensure adequate ventilation to avoid oxygen deficiency, when decanting liquid nitrogen into containers at ambient temperature and when dipping warm food or cookware into the liquid nitrogen.
- Keep spectators at a reasonable distance determined as part of the risk assessment.
- Use a gas detector to measure oxygen levels to warn staff and spectators against asphyxiation through oxygen deficiency.



When handling liquid nitrogen, minimum precautions should be followed:

- Read carefully and respect all safety information written in the safety data sheet
- In case of doubt or questions contact the gas company which delivered the cryogenic nitrogen.

When practising cryogenic cooking, carry out a hazard assessment of the workplace and the immediate surroundings:

- Is the cooking place free of tripping hazards where liquid nitrogen vessels are being carried?
- Is the liquid nitrogen container secured against falling?
- Is the appropriate personal protective equipment being worn?
 - Eye protection to prevent liquid nitrogen splashing into the eyes as this can cause temporarily or permanent blindness;
 - Skin protection (long sleeves, long trousers);
 - Be careful that liquid nitrogen does not spill into shoes.
- Is the safety distance to the spectators sufficient?
- Are first aid requirements considered?
- Are the emergency procedures known?

When moving transport container (Dewar) or cooking bowl with liquid nitrogen or when decanting liquid nitrogen from transport container into cooking bowl always:

- Wear safety glasses and face shield to protect your face and eyes.
- Wear gloves suitable to handle liquid nitrogen;
- Wear adequate clothes and shoes

When you finished the cooking, leave any surplus liquid nitrogen to evaporate in a secure ventilated space.

NOTE: This publication does not refer to transportation, see the following EIGA publications for guidance on Safe Transport of Gases or Dry Ice in Non-Dedicated Vehicles:

- SL 08/17 Safe Transport of Gases, and
- SL 09/17 Safe Transport of Dry Ice

Further information:

EIGA Doc. 136 *Selection of Personal Protective Equipment*. www.eiga.eu

EIGA Safety Leaflet SL 01 *Dangers of Asphyxiation*. www.eiga.eu

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