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UV-FACTS
ARTICLE
DECEMBER 2024

# *MEAT-ING* THE STANDARDS

### UV-C IN FOOD SAFETY EU REGULATION 2024/1141.

The adoption of UV technology aligns seamlessly with the objectives of EU Regulation 2024/1141, offering a robust solution for meeting modern food hygiene standards. By integrating UV systems into their operations, food processors can ensure compliance while achieving greater efficiency and safety.

UV technology will undoubtedly remain a cornerstone of innovative and sustainable hygiene practices as the food industry evolves.

## BALANCING TRADITION AND SAFETY: THE EU DIRECTIVE 2024/1141.

The European Union has introduced **Regulation (EU) 2024/1141**, marking a **significant update to hygiene standards for foods of animal origin**.

This directive reflects the EU's commitment to strengthening **food safety**, **quality**, and **animal** welfare across the food chain. The regulation introduces critical measures such as stricter **conditions** for **beef dry aging**, updates to marking animal products, and including sheep and goats under-regulated on-farm slaughter practices.

These changes aim to **align traditional food practices**, like **dry maturation**, with **modern safety requirements** while ensuring flexibility for producers and operators.

The **European Food Safety Authority** (**EFSA**), the EU's independent scientific agency for assessing food-related risks, guides these developments.

EFSA is pivotal in **ensuring public health protection by providing evidence-based insights** that underpin legislative decisions. With this directive, **EFSA's evaluations** of microbial risks, such as those associated with **matured meats**, have been instrumental in establishing the **time**, **temperature**, and **transport** parameters necessary to **safeguard food safety** without compromising traditional techniques.

Together, these efforts reflect the EU's strategic balance between food heritage, consumer protection, and regulatory progress.

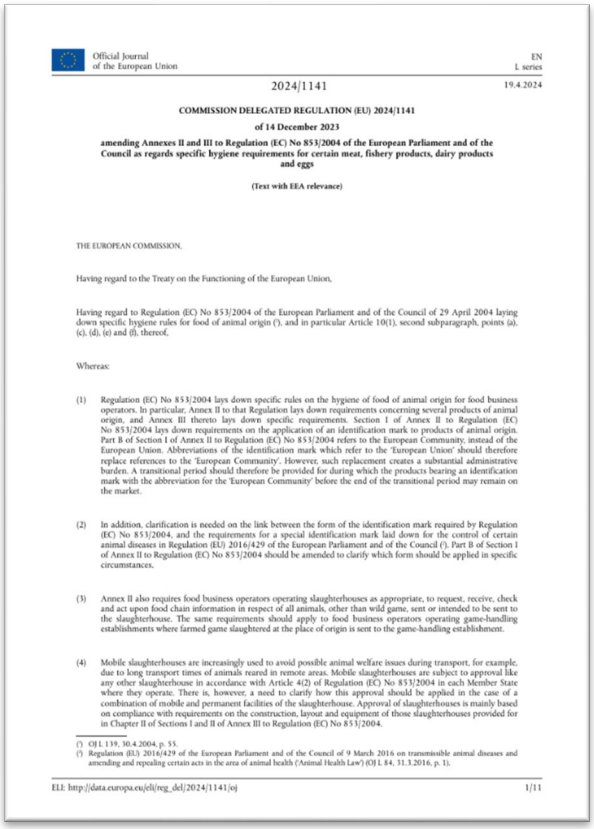
## Regulation 2024/1141: An Overview

The updated regulation introduces **significant changes to the hygiene requirements for animal-origin foods**, including meats, fish, dairy, and eggs. Key highlights include:

☑ **New EU Marking System:** The regulation replaces the existing CE marking with an EU identification mark for products of animal origin, aiming to streamline and standardize product labeling across the EU.

☑ **On-farm and mobile Slaughter:** The regulation expands on-farm slaughter to include sheep and goats under strict hygiene controls and specific conditions to safeguard animal welfare and public health.

☑ **Carcass Transport Regulations, Refrigeration Conditions:** New transport conditions limit carcass delivery to three slaughterhouses or a direct cold storage warehouse, with strict controls on temperature and journey time to maintain product safety; flexibility is introduced for transporting partially refrigerated carcass.



Official Journal of the European Union — EN, L series

2024/1141 — 19.4.2024

**COMMISSION DELEGATED REGULATION (EU) 2024/1141**

**of 14 December 2023**

**amending Annexes II and III to Regulation (EC) No 853/2004 of the European Parliament and of the Council as regards specific hygiene requirements for certain meat, fishery products, dairy products and eggs**

**(Text with EEA relevance)**

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Regulation (EC) No 853/2004 of the European Parliament and of the Council of 29 April 2004 laying down specific hygiene rules for food of animal origin (1), and in particular Article 10(1), second subparagraph, points (a), (c), (d), (e) and (f), thereof,

Whereas:

(1) Regulation (EC) No 853/2004 lays down specific rules on the hygiene of food of animal origin for food business operators. In particular, Annex II to that Regulation lays down requirements concerning several products of animal origin, and Annex III thereto lays down specific requirements. Section I of Annex II to Regulation (EC) No 853/2004 lays down requirements on the application of an identification mark to products of animal origin. Part B of Section I of Annex II to Regulation (EC) No 853/2004 refers to the European Community, instead of the European Union. Abbreviations of the identification mark which refer to the 'European Union' should therefore replace references to the 'European Community'. However, such replacement creates a substantial administrative burden. A transitional period should therefore be provided for during which the products bearing an identification mark with the abbreviation for the 'European Community' before the end of the transitional period may remain on the market.

(2) In addition, clarification is needed on the link between the form of the identification mark required by Regulation (EC) No 853/2004, and the requirements for a special identification mark laid down for the control of certain animal diseases in Regulation (EU) 2016/429 of the European Parliament and of the Council (2). Part B of Section I of Annex II to Regulation (EC) No 853/2004 should be amended to clarify which form should be applied in specific circumstances.

(3) Annex II also requires food business operators operating slaughterhouses as appropriate, to request, receive, check and act upon food chain information in respect of all animals, other than wild game, sent or intended to be sent to the slaughterhouse. The same requirements should apply to food business operators operating game-handling establishments where farmed game slaughtered at the place of origin is sent to the game-handling establishment.

(4) Mobile slaughterhouses are increasingly used to avoid possible animal welfare issues during transport, for example, due to long transport times of animals reared in remote areas. Mobile slaughterhouses are subject to approval like any other slaughterhouse in accordance with Article 4(2) of Regulation (EC) No 853/2004 in each Member State where they operate. There is, however, a need to clarify how this approval should be applied in the case of a combination of mobile and permanent facilities of the slaughterhouse. Approval of slaughterhouses is mainly based on compliance with requirements on the construction, layout and equipment of those slaughterhouses provided for in Chapter II of Sections I and II of Annex III to Regulation (EC) No 853/2004.

(1) OJ L 139, 30.4.2004, p. 55.
(2) Regulation (EU) 2016/429 of the European Parliament and of the Council of 9 March 2016 on transmissible animal diseases and amending and repealing certain acts in the area of animal health ('Animal Health Law') (OJ L 84, 31.3.2016, p. 1).

ELI: http://data.europa.eu/eli/reg_del/2024/1141/oj — 1/11

☑ **Dry Aging of Beef:** Specific rules have been introduced for the dry maturation (aging) of beef. The process is now limited to a maximum of 35 days, under controlled conditions of temperature and humidity to prevent microbiological risks. This aligns with EFSA's recommendations to ensure safety during prolonged aging processes.

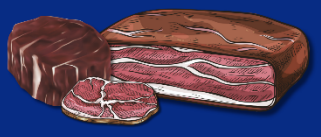
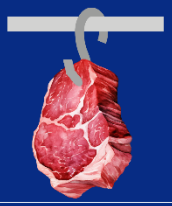
☑ **Transitional Periods:** Operators must comply with rules regarding matured meat (e.g., dry aging) within six months, allowing for adaptation to the new regulations.

## LESS MEAT, BETTER MEAT: EUROPE'S DRY-AGED REVOLUTION IN QUALITY AND SUSTAINABILITY

Europe accounts for approximately **30% of the global dry-aged beef market**, second after North America. This growth is primarily driven by Europe's **strong culinary heritage**, particularly in countries like **France**, **Italy**, **Spain**, and the **UK**, where dry-aged beef is highly appreciated in upscale dining.

However, challenges persist, such as **high production costs** due to specialized facilities, **extended maturation times**, and moisture loss, alongside **limited shelf life** and stricter regulatory compliance, as seen with the new Commission Delegated Regulation (EU) 2024/1141, which caps dry-aging at 35 days.

Reflecting broader trends, European consumers are embracing the philosophy of "less meat, but better meat," prioritizing quality over quantity due to health, sustainability, and ethical considerations. This shift is evident in a growing preference for **premium products** like, organic meats, and artisanal offerings emphasizing craftsmanship and traceability. Consumers increasingly associate **high-quality meat** with **superior taste**, **nutritional value**, and **lower environmental impact**, underscoring a cultural shift toward mindful, high-value meat consumption.

| | DRY AGING | MATURATION |
|---|---|---|
| |  |  |
| **PROCESS** | MEAT IS EXPOSED TO AIR, LEADING TO SURFACE DEHYDRATATION AND THE FORMATION OF AN OUTER CRUST, WHICH IS TRIMMED AWAY BEFORE SERVICING. MEANWHILE, THE INTERIOR BECOMES EXCEPTIONALLY TENDER AND FLAVORFUL. | MEAT IS STORED AT 0-4°C IN COLD STORAGE TO ENSURE PROPER TENDERIZATION WHILE MNIMIZING CONTAMINATION RISKS. |
| **TIME** | 2-8 WEEKS OR LONGER | USUALLY 7-21 DAYS |
| **MOISTURE LOSS** | SIGNIFICANT MOISTURE LOSS (UP TP 30% OF WEIGHT) | MINIMAL MOISTURE LOSS |
| **FLAVOR DEVELOPENT** | RICH, CONCENTRATED, UMAMI FLAVORS | MILD, TENDER FLAVOUR, LESS INTENSITY |
| **TEXTURE CHANGES** | FIRMER TEXTURE, ENHANCED TENDERNESS | TENDERIZED THROUGH NATURAL ENZYMATIC ACTIVITY |
| **APPERANCES** | DARK FROM THE OUTSIDE | RETAINS ORIGINAL COLOR, NO EXTERNAL CRUST |
| **COST** | HIGH COST, LONG PROCESS, TRIMMING WASTE | LOWER COST, SHORTER TIME |
| **COMMON USE** | PREMIUM | GENERAL |

## BALANCING FLAVOR, SAFETY, AND CONTROL IN DRY AGING.

The **microbial risks** in dry aging primarily stem from the **surface exposure of meat to air over extended periods** under controlled temperature and humidity conditions.

**While the process enhances flavor and tenderness, it also creates an environment where microorganisms can grow.**

### 1. Pathogenic Bacteria

- **Listeria monocytogenes:** A significant concern as it can grow at low temperatures commonly used in dry-aging (0-4°C)
- **Escherichia coli** (E. coli): Shiga toxin-producing strains, such as E. coli O157:H7, can contaminate meat surfaces during slaughter and persist if conditions allow.
- **Salmonella:** If hygiene practices are compromised, Salmonella can survive on meat surfaces, posing a risk of foodborne illness.

### 2. Spoilage Microorganisms

- **Pseudomonas spp.:** These bacteria thrive on meat surfaces exposed to air, leading to slime formation and off-odors.
- **Molds and Mycotoxins**: While some mold growth on dry-aged beef is natural and contributes to flavor, molds like Penicillium and Aspergillus can produce harmful mycotoxins if humidity and airflow are not adequately controlled.

### 3. Environmental Contamination

**Dry aging relies heavily on the conditions of the aging chamber**, including temperature, humidity, and airflow. **Any lapse in cleaning** or sanitation of the chamber can result in bacterial or fungal **contamination**.

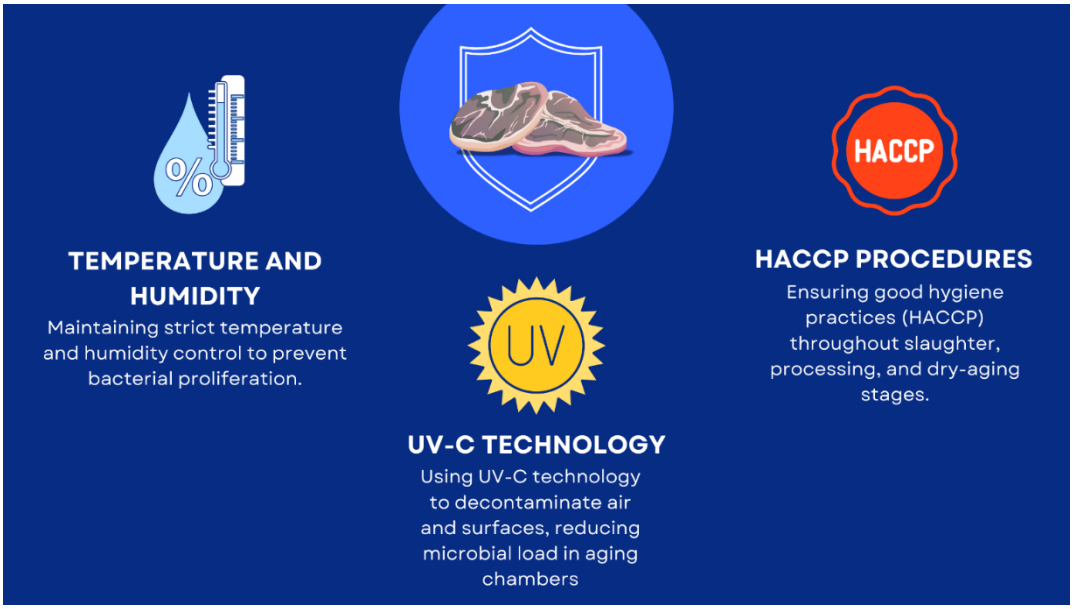
**Poor air circulation** can lead to uneven drying, creating **microbial hotspots**

### 4. Cross-Contamination

Improper handling during processing, aging, or cutting can **transfer microorganisms to the meat surface**. If hygiene protocols are not followed, pathogens like Listeria or E. coli may spread from **tools**, **surfaces**, or **personnel**.

## MITIGATION STRATEGIES

While microbial risks are inherent in dry aging, carefully managing environmental conditions and hygiene practices ensures safety without compromising dry-aged beef's quality and unique characteristics.



## Role of UV Technology in Food Safety

UV technology is a non-invasive, chemical-free method that inactivates pathogens by disrupting their DNA.

**Integrating UV-C light into dry-aging processes helps maintain microbial stability while improving meat quality, aligning with the directive's focus on safe handling practices.**

In the dairy and egg industries, UV treatment can serve as an alternative or complement to thermal pasteurization, adhering to HACCP principles required by the regulation. Similarly, fresh and thawed fish products benefit from UV treatment during processing, ensuring compliance with temperature and hygiene standards emphasized in the updated regulatory framework.

In light of **Regulation 2024/1141**, UV systems can address several requirements:

- **Air Disinfection**: UV-C devices can be installed in HVAC or, locally, inside the refrigeration units to mitigate microbial contamination.

- **Surface Decontamination**: UV devices effectively disinfect surfaces such as cutting boards, tools, and packaging materials, enhancing cleanliness in compliance with EU standards.

## Key References to UV-C Technology in the EU Directive:

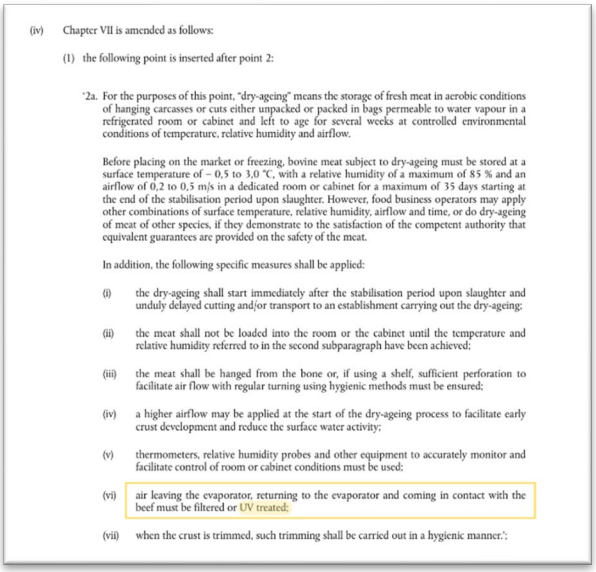
Dry aging demands strict conditions, including stable temperature, humidity, and consistent airflow. **Air reuse in the dry-aging process is essential for maintaining precise environmental control and achieving energy efficiency, but it requires continuous cleaning to eliminate microbial contaminants.**

**Recirculating air** through specialized HVAC systems ensures these parameters are maintained, promoting uniform drying of meat surfaces and preventing "hot spots" or excessive moisture that could foster microbial growth or uneven aging.

Reusing conditioned air significantly reduces the need for constant cooling and humidification, **minimizing energy consumption** and operational costs while upholding hygiene standards.

To ensure safety, **the recirculated air must be treated with advanced air filtration and disinfection technologies**, such as HEPA filters or UV-C light.

The updated Annex III of the EU Directive 2024/1141 highlights the importance of maintaining hygienic conditions during processing, storage, and transport, with UV-C light explicitly recognized as a reliable method for air decontamination.



(iv) Chapter VII is amended as follows:

(1) the following point is inserted after point 2:

'2a. For the purposes of this point, "dry-ageing" means the storage of fresh meat in aerobic conditions of hanging carcasses or cuts either unpacked or packed in bags permeable to water vapour in a refrigerated room or cabinet and left to age for several weeks at controlled environmental conditions of temperature, relative humidity and airflow.

Before placing on the market or freezing, bovine meat subject to dry-ageing must be stored at a surface temperature of − 0,5 to 3,0 °C, with a relative humidity of a maximum of 85 % and an airflow of 0,2 to 0,5 m/s in a dedicated room or cabinet for a maximum of 35 days starting at the end of the stabilisation period upon slaughter. However, food business operators may apply other combinations of surface temperature, relative humidity, airflow and time, or do dry-ageing of meat of other species, if they demonstrate to the satisfaction of the competent authority that equivalent guarantees are provided on the safety of the meat.

In addition, the following specific measures shall be applied:

(i) the dry-ageing shall start immediately after the stabilisation period upon slaughter and unduly delayed cutting and/or transport to an establishment carrying out the dry-ageing;

(ii) the meat shall not be loaded into the room or the cabinet until the temperature and relative humidity referred to in the second subparagraph have been achieved;

(iii) the meat shall be hanged from the bone or, if using a shelf, sufficient perforation to facilitate air flow with regular turning using hygienic methods must be ensured;

(iv) a higher airflow may be applied at the start of the dry-ageing process to facilitate early crust development and reduce the surface water activity;

(v) thermometers, relative humidity probes and other equipment to accurately monitor and facilitate control of room or cabinet conditions must be used;

(vi) air leaving the evaporator, returning to the evaporator and coming in contact with the beef must be filtered or UV treated;

(vii) when the crust is trimmed, such trimming shall be carried out in a hygienic manner.';

While **filters** and **UV-C technology** are both effective in air treatment, **UV-C often proves superior for applications like dry aging** and microbial control in food processing environments due to its unique advantages:

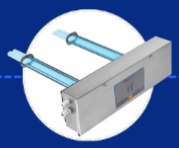
| Criteria | FILTERS | UV-C TECHNOLOGY |
|---|---|---|
| | Traps airborne particles, but **pathogens remain viable**. | **Inactivates microorganisms** ensuring the air is disinfected. |
| | Require **regular replacement** and cleaning, which **increases operational costs** and downtime. Improper maintenance can turn filters into breeding grounds for microorganisms. | Requires **minimal maintenance**, typically limited to lamp replacement, and operates continuously with **no downtime**. |
| | High-performance filters create **airflow resistance**, reducing ventilation efficiency and **increasing energy consumption**. | Has **no impact on airflow** and introduces no obstruction, enabling smooth, **energy-efficient ventilation**. |
| | **Do not prevent mold** or microbial growth on filters, ducts, or AHUs, particularly in humid environments. | Effectively **prevent mold and biofilm growth** within HVAC components. |
| | Operate **passively**, it is sized on the air volume, cannot address an increasing microbial load. | Provides **active**, **real-time disinfection** and systems can be sized to treat the microbial load precisely, at all times. |

IN ADDITION TO ITS MICROBIAL CONTROL BENEFITS, **UV-C TECHNOLOGY SIGNIFICANTLY EXTENDS THE SHELF LIFE OF DRY-AGED MEAT** BY REDUCING SURFACE CONTAMINATION AND MAINTAINING A CLEANER AGING ENVIRONMENT.

## APPLICATION FOR A SUCCESSFUL IMPLEMENTATION OF UV-C.

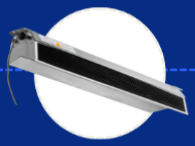
**HVAC - COIL**

Evaporator coils, essential for cooling and dehumidifying, often fall prey to mold and microbial contamination.
The cold, damp environment encourages the growth of mold spores, leading to biofilm formation. This biofilm reduces efficiency by up to 20% and poses contamination risks.
Enter UV-FCU Coil Clean Lamps—a solution that prevents mold, restores efficiency, and ensures cleaner indoor air.



**HVAC - AIR FLOW**

Install high-intensity UV-C lamps like the one in UV-DUCT-FL in the return or supply ducts of your Heating, Ventilation, and Air Conditioning (HVAC) system.
As the air is heated or cooled, these lamps effectively disinfect microorganisms and spores. This method provides 99% disinfection at each passage and is both economical and chemical-free—a powerful ongoing prevention strategy.



**DRYING ROOM**

With the use of UV-REFLEX-SCB directly inside the drying room, the treatment takes place by exploiting the constant forced air circulation, (due to the flow generated by the fan of the ventilation system), which is decontaminated from microbes, before they enter into contact with the products inside the cold rooms.
The device does not affect the normal aging of the product, as it avoid only the growth of unwanted microorganisms.

## HOW TO APPLY UV-C IN CENTRALIZED HVAC SYSTEM: COIL and AIRFLOW

*Light Progress installation in a food industry ductwork.*

Advanced **Air Handling Units (AHUs)** equipped with **UV-C devices** and sensors are designed to regulate temperature, airflow, and humidity, creating the precise environmental conditions required for processes like **dry aging** and **cold storage.**

When installed inside **air ducts** or at the final section of AHUs, UV-C devices form an effective **UV-C barrier** that inhibits the proliferation of harmful microorganisms by deactivating bacteria, mold, and viruses in the airflow.

A critical challenge in UV-C system design is accurately simulating the **Real Dose** of UV-C light delivered to the air, factoring in the **dwell time**—the duration air spends passing through the UV-C section of the AHU or duct system.

Light Progress addresses this challenge using specialized **simulation software** that tailors UV-C applications to specific conditions with high precision and confidence.

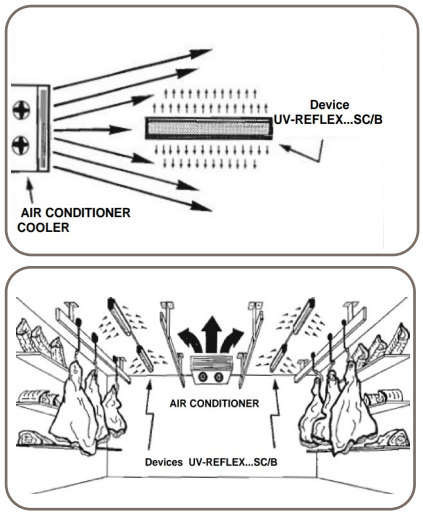

The software can quickly generate reliable outcomes by inputting key parameters, such as duct size and airflow rate, ensuring the system delivers optimal performance. These tools allow for accurate commissioning and validation of UV-C installations, ensuring effective microbial control while maintaining energy-efficient operations.

## IN-ROOM UV-C APPLICATION: PRODUCTS SPECIFICALLY DESIGNED FOR DRY AGING ROOMS

Light Progress has been installing UV-C-specific devices for in-room air disinfection, such as UV-REFLEX-SCB or UV-FLOW, **since the 1990s**, offering decades of expertise in UV-C solutions for food hygiene.

These systems effectively reduce the **airborne microbial load** by leveraging **forced air circulation** within drying or cold rooms. By progressively eliminating bacteria, molds, and spores **before they come into contact** with food surfaces, they help maintain a clean and controlled environment. The result is improved **product freshness, taste, and appearance**, while minimizing common issues like **weight loss and dehydration** during processes such as dry aging.

For optimal performance, the system must be designed to treat as much indoor air as possible, with devices **uniformly distributed** throughout the space to avoid untreated areas, such as corners. Installation can be performed on **ceilings or walls**, ensuring comprehensive coverage and continuous air disinfection.




*Light Progress installation in drying rooms*

## EU AND NORTH AMERICAN UV TECHNOLOGY TREND FOR MEAT PRODUCTS

While the EU Directive 2024/1141 explicitly highlights UV-C technology as a key tool for microbial control in processes like dry aging, the United States is also increasingly adopting UV-C solutions to enhance food safety.

Under FDA and USDA guidelines, advanced disinfection methods, including UV-C systems, are recognized for effectively reducing airborne and surface contamination, particularly in meat processing facilities. Although the regulatory approach in the US is less prescriptive compared to the EU's precautionary framework, the growing focus on HACCP compliance and technological innovation creates opportunities for **UV-C to play a more prominent role in improving air quality, extending product shelf life, and supporting microbial safety standards across the food industry**.

**This trend highlights UV-C as a valuable, globally accepted solution for modern food safety challenges**.

References:

***Commission Delegated Regulation (EU) 2024/1141**: Official document outlining updated hygiene standards for foods of animal origin, including specific guidelines for dry aging and microbial safety. (https://eurlex.europa.eu/legalcontent/EN/TXT/?uri=CELEX%3A32024R1141).*

***European Food Safety Authority (EFSA)**: Scientific opinions and risk assessments related to microbial control, surface hygiene, and food safety measures in processing environments.[EFSA Publications](https://www.efsa.europa.eu).*

***Air Handling Units and UV-C Technology**: Insights into the role of UV-C disinfection in HVAC systems, ensuring clean air circulation and microbial control for food processing facilities. [Eurovent Analysis on IAQ](https://www.eurovent.eu).*

***Microbial Risks and UV-C Benefits in Dry Aging**: Industry reports and studies highlighting UV-C's role in reducing microbial load, extending shelf life, and improving product quality. (https://www.markwideresearch.com).*

***Dry Aging Market Trends**: Reports analyzing European market growth, consumer trends favoring premium meat, and innovations in microbial safety technologies. [DataHorizzon Research Dry Aging Report](https://www.datahorizzonresearch.com)..*