IngeniaTouch
protecting life through nature

# PHOTOCATALYTICS FOR BUSINESS PROCESS EFFICIENCY, SAFETY & SUSTAINABILITY

**with**

Hygienia Touch©

**Protection**

**Eradication of Bad Odors and Offensive Gases**:
*These coatings can eliminate offensive gases such as methane and ammonia, along with other noxious volatile organic compounds (VOCs).*

**Effective Pathogen Eradication**:
*They effectively eradicate pathogens, bacteria, viruses, and moulds.*

**Self-Cleaning Properties**:
*Additionally, these coatings possess self-cleaning qualities, making hygiene maintenance more environmentally friendly and cost-effective*

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## Photocatalytics for Business Process Efficiency, Safety & Sustainability

In an era defined by rapid technological advancements and growing environmental concerns, the integration of innovative solutions becomes paramount to address challenges across various sectors. Titanium dioxide ($TiO_2$) photocatalysis, in conjunction with light, emerges as a groundbreaking technology with the potential to revolutionise business practices worldwide, particularly in farming, healthcare, workplace health, safety and sustainability.

Harnessing the power of $TiO_2$ and light, represents a paradigm shift in how businesses approach environmental stewardship and operational efficiency. $TiO_2$, a versatile and abundant compound, exhibits remarkable photocatalytic properties when exposed to light, catalysing a range of beneficial chemical reactions that hold immense promise for diverse applications.

In the agricultural sector, $TiO_2$ photocatalysis presents a transformative opportunity to enhance farming practices and mitigate environmental impacts. By harnessing sunlight, $TiO_2$-based solutions offer novel avenues for pest management, soil remediation, and crop protection while reducing reliance on conventional pesticides and fertilizers. Furthermore, the application of $TiO_2$ technology in farming holds the potential to foster sustainable agricultural practices, promoting soil and animal health, biodiversity, and resource conservation.

Similarly, in the realm of workplace health, safety, and sustainability, $TiO_2$ photocatalysis emerges as a game-changer. The ability of $TiO_2$ to actively degrade harmful pollutants, pathogens, and volatile organic compounds (VOCs) in air and on surfaces opens new vistas for creating safer and healthier work environments. By harnessing the natural power of sunlight, $TiO_2$-based solutions offer continuous disinfection and air purification, mitigating the spread of infectious diseases, enhancing indoor air quality, and promoting employee well-being.

As we delve deeper into the potential of $TiO_2$ and light, it becomes evident that this innovative technology holds the key to unlocking a sustainable future for businesses worldwide. By harnessing the synergy between $TiO_2$ and light, businesses can not only enhance operational efficiency and productivity but also embrace their responsibility towards environmental stewardship and social well-being.

In this white paper, we delve into the myriad benefits of $TiO_2$ photocatalysis in farming and workplace environments, exploring its potential to drive positive change and foster sustainable practices across industries. Through insightful analysis and real-world case studies, we aim to illuminate the transformative power of $TiO_2$ and light and inspire businesses to embrace this cutting-edge technology for a brighter, more sustainable future.

## What is Photocatalytics?

Photocatalysis is a chemical reaction that occurs when a catalyst, typically a semiconductor material like titanium dioxide ($TiO_2$), interacts with light, usually ultraviolet (UVA) light. In this process, the catalyst absorbs photons from the light and uses the absorbed energy to facilitate chemical reactions, such as the degradation of organic pollutants or the oxidation of harmful substances. One of the most well-known applications of photocatalysis is in air and water purification, where photocatalytic materials are used to break down pollutants and contaminants into harmless byproducts. Additionally, photocatalysis has found applications in various fields including environmental remediation, self-cleaning surfaces, and solar energy conversion.

## History of the Technology

The history of photocatalysis spans several decades, with significant developments occurring since the 1950s in Japan up to the present day:

- 1950s - Discovery of Photocatalysis: The concept of photocatalysis emerged in the 1950s when researchers at the University of Tokyo discovered the photocatalytic properties of titanium dioxide ($TiO_2$). They observed that $TiO_2$ could split water molecules into hydrogen and oxygen when exposed to ultraviolet (UVA) light.
- 1970s - Growth of Research: Throughout the 1970s, research on photocatalysis expanded, particularly in Japan. Scientists explored various applications of photocatalytic materials, including environmental remediation and air purification.
- 1980s - Development of $TiO_2$ Photocatalysis: In the 1980s, Japanese researchers further developed $TiO_2$ photocatalysis for practical applications. They demonstrated its effectiveness in decomposing organic pollutants, disinfecting water, and creating self-cleaning surfaces.
- 1990s - Commercialization and Applications: During the 1990s, photocatalytic technology began to be commercialized in Japan. $TiO_2$-coated products, such as self-cleaning glass and air purification systems, became available in the market.
- 2000s - Global Recognition and Research: In the early 2000s, the potential of photocatalysis gained global recognition, leading to increased research efforts and applications worldwide. Researchers explored novel photocatalytic materials and advanced techniques to improve efficiency and expand applications.
- 2010s - Diversification of Applications: In the 2010s, photocatalysis continued to diversify its applications. Beyond environmental remediation and air purification, photocatalytic materials were used in areas such as energy production, biomedical applications, and food safety.
- Present Day - Ongoing Research and Innovation: Today, photocatalysis remains an active area of research and innovation. Scientists are exploring new photocatalytic materials, optimizing photocatalytic processes, and expanding the range of applications to address emerging environmental and societal challenges.

Overall, from its discovery in the 1950s to the present day, photocatalysis has evolved from a scientific curiosity to a practical technology with diverse applications, with significant contributions and advancements originating from Japan and extending globally.

## What is the mode of Action?

The chemical mode of action of titanium dioxide ($TiO_2$) and UVA light involves a photocatalytic process that generates reactive oxygen species (ROS), including hydroxyl radicals (•OH) and hydrogen peroxide ($H_2O_2$). Here's how it works:

Semiconductor Behaviour of $TiO_2$: When $TiO_2$ is exposed to UVA light, it absorbs photons and undergoes a photoexcitation process. This causes electrons in the valence band of $TiO_2$ to jump to the conduction band, creating electron-hole pairs.

Generation of Electron-Hole Pairs: The excited electrons (e-) and holes (h+) in the conduction and valence bands of $TiO_2$, respectively, are highly reactive species. They can initiate redox reactions with adsorbed molecules on the $TiO_2$ surface or in the surrounding environment.

Hydroxyl Radicals (•OH) Formation: One of the key reactions facilitated by TiO2 photocatalysis is the generation of hydroxyl radicals (•OH). This occurs when hydroxyl ions (OH-) in the aqueous solution react with the holes (h+) in the $TiO_2$ valence band. The holes oxidize water molecules ($H_2O$) to form hydroxyl radicals:

- $TiO_2$ (h+) + $H_2O$ → •OH + H+ + e-

Hydrogen Peroxide ($H_2O_2$) Formation: Additionally, the combination of hydroxyl radicals (•OH) and electrons (e-) generated during $TiO_2$ photocatalysis can lead to the formation of hydrogen peroxide ($H_2O_2$). Hydroxyl radicals can react with water molecules, generating hydrogen peroxide through a series of reactions:

- OH + •OH + $H_2O$ → $H_2O_2$ + $H_2O$

Antimicrobial and Oxidative Properties: Both hydroxyl radicals and hydrogen peroxide are highly reactive oxidizing agents. They can oxidize organic compounds, including bacteria, viruses, and pollutants, leading to their inactivation or degradation. This oxidative process contributes to the antimicrobial and disinfecting properties of $TiO_2$ photocatalysis.

In summary, the interaction between $TiO_2$ and UVA light triggers a series of photochemical reactions that generate reactive oxygen species, including hydroxyl radicals and hydrogen peroxide. These species exhibit strong oxidative properties, which play a crucial role in the antimicrobial and disinfecting capabilities of $TiO_2$ photocatalysis.

## Why Photocatalytics in the Agri sector?

Think Climate Change, Methane and Pathogens.

The integration of $TiO_2$ coatings and UVA light technology in the poultry sector offers a comprehensive approach to addressing environmental, health, and welfare concerns. With climate change amplifying the risk of viral and pathogenic attacks like bird flu, swine flu, and Newcastle disease, creating healthier environments both inside and outside poultry facilities becomes essential. $TiO_2$ coatings and UVA light technology play a crucial role in mitigating these risks by reducing pathogen transmission, minimizing methane and ammonia emissions, and enhancing bio-protection measures in live animal logistics. By tackling issues such as environmental pollution, pathogen control, antibiotic usage, and animal welfare, these innovative solutions pave the way for a more sustainable, resilient, and humane poultry industry.

1. **Reducing Methane and Ammonia Emissions**: $TiO_2$ coatings, when activated by UVA light, catalyse the breakdown of methane and ammonia gases emitted from poultry sheds. By mitigating these harmful gases, $TiO_2$ technology helps minimize environmental pollution and improves air quality both inside and outside the sheds.
2. **Pathogen Reduction**: The antimicrobial properties of TiO2 coatings contribute to reducing pathogens, including bacteria, viruses, and fungi, within poultry facilities. This reduction in microbial contamination helps create a healthier environment for both animals and humans, lowering the risk of disease transmission and improving overall hygiene standards.
3. **Decreasing Antibiotic Usage**: By minimizing the presence of pathogens and creating cleaner living conditions for poultry, $TiO_2$ coatings and UVA light technology can potentially reduce the need for antibiotics in the poultry sector. This reduction in antibiotic usage aligns with efforts to combat antibiotic resistance and promote more sustainable farming practices.
4. **Enhancing Animal Welfare**: Cleaner and healthier living environments created through the use of TiO2 coatings and UVA light technology contribute to enhancing animal welfare in the poultry sector. By reducing stressors such as pathogens and noxious gases, animals experience improved comfort, health, and overall well-being, fostering a culture of compassion in farming practices.

In summary, the integration of $TiO_2$ coatings and UVA light technology in the poultry sector offers a comprehensive approach to addressing environmental, health, and welfare concerns. By tackling issues such as methane and ammonia emissions, pathogen control, antibiotic usage, and animal welfare, these innovative solutions pave the way for a more sustainable and humane poultry industry.

## List of Video Applications on Photocatalytics

- Long lasting Infection Free Farms - animation
- Taking methane out of the food chain
- Preparing Lights for Livestock Methane Reduction
- Removing methane and pathogens from livestock buildings

## Revolutionizing Kitchen Safety and Health

Executive Summary: In the fast-paced realm of commercial kitchens, innovation is not merely beneficial - it's imperative. As a culinary leader, you wield the influence to elevate your offerings, ensuring they not only meet but exceed expectations in value, health, and sustainability. Enter Titanium Dioxide ($TiO_2$) coatings, a groundbreaking solution poised to redefine kitchen and food safety standards.

Introduction: The culinary industry is witnessing a paradigm shift towards health-centric, sustainable practices. $TiO_2$ coatings emerge as a beacon of this transformation, promising a suite of benefits that cater to the hygiene and well-being of chefs and staff while simultaneously addressing environmental concerns.

## The Case for $TiO_2$ Coatings:

- **Self-Cleaning Surfaces**: $TiO_2$ coatings harness photocatalytic properties to decompose organic pollutants upon contact, ensuring surfaces remain pristine with minimal effort.
- **Air Quality Enhancement**: Acting as a natural air purifier, $TiO_2$ coatings diminish the presence of VOCs and allergens, significantly improving air quality and offering relief to those affected by hay fever or migraines.
- **Pathogen Reduction**: The antimicrobial prowess of $TiO_2$ coatings is formidable, effectively neutralizing a broad spectrum of pathogens, thus fortifying kitchens against microbial threats.
- **Mildew and Spore Mitigation**: Photocatalytic reactions facilitated by $TiO_2$ coatings prevent the proliferation of mildew and spores, safeguarding walls and surfaces from fungal infestations.
- **Odor Neutralization:** $TiO_2$ coatings play a pivotal role in maintaining a fresh atmosphere by eliminating odors and pathogens, enhancing the culinary experience.
- **Disinfection Efficiency:** With a disinfection rate of up to 70,000 instances per second, $TiO_2$ coatings deliver continuous sanitation, instilling confidence and peace of mind.
- **Sustainability Advancement**: The application of $TiO_2$ coatings leads to a marked decrease in water consumption, chemical use, and labor, contributing to a more sustainable kitchen environment.
- **Maintenance Simplification:** The reduction of cooking toxins and ease of cleaning afforded by $TiO_2$ coatings translate to significant time and labor savings.

## Conclusion:

Incorporating $TiO_2$ coatings into your kitchen design is a commitment to a healthier, safer, and more sustainable culinary practice. We extend an invitation to explore the transformative potential of $TiO_2$ coatings and to consider their integration into your operations.

This white paper review encapsulates the essence of $TiO_2$ coatings and their applicability in commercial kitchens. It is designed to inform and inspire chefs and kitchen managers to adopt this technology for a safer, healthier, and more efficient cooking environment.

## INTRODUCTION

The **HygieniaTouch** System implemented in farming endeavours to minimise the risk of introducing or spreading diseases on a farm while positively reinforcing overall animal welfare. By applying this system to the farm's surfaces, we achieve permanent disinfection of materials, thereby reducing the potentially harmful microorganisms that may proliferate there. Moreover, The **HygieniaTouch** System has the capability to neutralize a significant portion of the ammonia and other gases emitted by intensive farms, thereby enhancing the quality of life for both animals and staff. This prevents, among other benefits, irritation of the upper respiratory tract, hindering the entry of pathogens into the body and bolstering immunity.

The high concentration of pollutants in farms poses a major health concern for workers who are near the animals. Various infections, whether bacterial, viral, or fungal, that affect animals also carry the risk of transmission to humans.

Furthermore, elevated levels of ammonia and other noxious gases contribute to animal discomfort, aggression, and restlessness, which in turn diminishes productivity and increases casualties. Consequently, farms become pollution hotspots, adversely impacting their immediate environment. The **HygieniaTouch** System facilitates a significant reduction in total pollutant concentration, with reductions of up to 90% achievable in standard farming operations.

Thanks to The **HygieniaTouch** System, farm surfaces act as large converters, effectively neutralizing pollutants before they can cause health and environmental problems.

## The HygieniaTouch System

SUPERFACES TO BE TREATED:


The surfaces to be treated are those that may be in contact with the animals and their manure. As a rule, it includes:

- Pavement, including corridors and areas where there is a potential transfer of pathogens.
- Separators.
- Equipment that is in contact with the animals. (feeders, troughs…)
- Walls up to a reasonable height. On poultry farms, this height will be around 1 mtr., on swine farms, it is recommended to apply up to the level of 1.5 mtr .
- Locker rooms.
- Animal Transport Trucks and related equipment.

## The 2-STEPS HygieniaTouch System

**STEP 1: Lighting**

- The **HygieniaTouch** System is the result of combining surface treatment and HT-Light. This lighting system has specific light emissions, that activates the surfaces and continuously produces on it radicals that eliminate bacteria, viruses and fungi.
- The **HygieniaTouch** System is a complete system/package underpinned by numerous scientific study and trials globally.
- Our HT-Light lamps don't emit any harmful light, it is completely safe for humans and animals.
- Cleaning, Surface Treatment, and Lighting are integral components of The **HygieniaTouch** System, essential for unlocking its remarkable benefits. HT-Light, a key element of the system, continuously and safely activates surfaces, generating active radicals that effectively eliminate microorganisms and harmful gases, particularly ammonia.
- The **HygieniaTouch** System maintains surfaces in an active state 24 hours a day, thwarting the development of viruses or bacterial colonies that could endanger animal health. HT-Light lamps should be installed at a height not exceeding 4 meters, strategically oriented to illuminate both floors and the corresponding sections of walls.
- Presently, HT-Light lamps are arranged in rows approximately 3 meters from the walls, with a separation of about 5 meters between each row. Each row features lamps positioned 5 meters apart, effectively illuminating the entirety of treated surfaces, averaging one HT-Light lamp per 40 m² of surface area.
- Upon the emptying of the farm, thorough surface cleaning is imperative. Subsequently, all products, including insecticides, must be applied in accordance with the manufacturer's specifications. It is crucial to note that **HygieniaTouch** must be applied atop any other treatments; no product can be administered over it.

**Step 2: Application**

- Entails the application of **HygieniaTouch**. Once applied, no other product may be administered to the treated surfaces, and only essential elements prior to the animals' entry (such as absorbents and feed) should be introduced. **HygieniaTouch** may be applied to dry or slightly damp surfaces but not to surfaces experiencing ponding or excessive moisture leading to dripping.

## Dosage of the coating

**The initial application:** Always employ a minimum of 100 grams of **HygieniaTouch** per square meter (10 $m^2$ per litre). This shock treatment ensures the complete eradication of infection sources, even those deeply ingrained in the surfaces, throughout the animals' growth period.

After the animal-entry process, upon the completion of the transition/fattening phase, the farm undergoes emptying, manure removal, and cleaning, constituting Step 2. Once again, **HygieniaTouch** application concludes the superficial treatment sequence.

**Maintenance coating**: Depending on the farm's cleaning regimen and conditions, a rejuvenating of 50 grams per square meter (20 $m^2$ per litre) is tailored to each farm's specific circumstances, adjusting quantities based on the achieved results.

During cleanup operations, a substantial portion of the applied material is removed, necessitating replenishment through the rejuvenating applications. A significant reduction in rejuvenating doses may diminish disinfectant efficacy. In such instances, it is advisable to revert to the initial treatment of 100 grams per square meter (10 $m^2$ per litre) of **HygieniaTouch** before readjusting dosages in subsequent operations.

**Summary:**

| Protocol | Product | Dosage | Where |
|---|---|---|---|
| Cleaning and Preparation | Farm Protocol | See step 2 | Walls & Floors |
| Surface Treatment | HygieniaTouch | 100gr/m2 Initial crash application | All surfaces |
| | | 30 to 50gr/m2 in follow-up applications | It will be applied as the last |
| | | depending on farm conditions, see step 3 | treatment prior to animal |
| | | | entrance |
| **Lighting** | PureLight | 1 lamp / 40m2, see step 1 | |

## What trials and tests have we done?

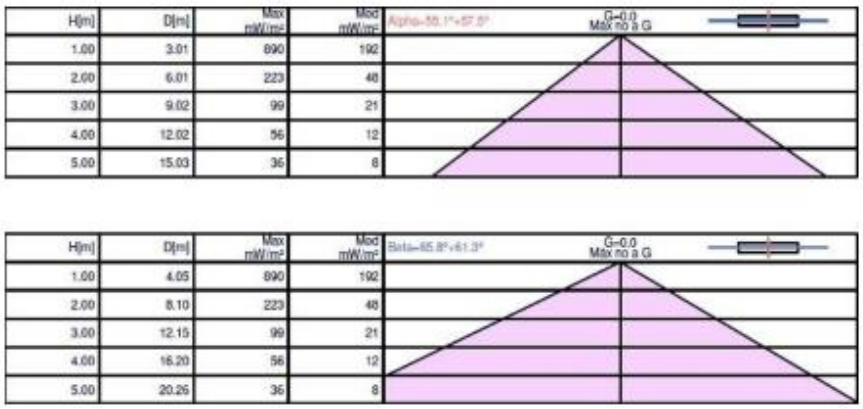
There have been thousands of trials and tests carried out by academics to confirm the efficacy and safety of $Tio_2$ coatings.

We have carried out tests ourselves in pork and poultry farms in Spain over 4 years. Every farm, using our **HygieniaTouch** $TiO_2$ technology, does not require antibiotics after three months.

## The Installation of the HT-Light LED-lamps

**Installation**

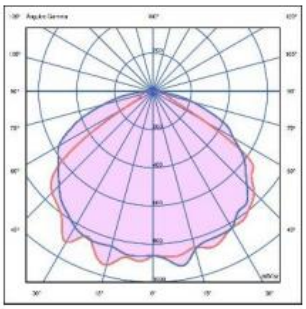
- The installation of System 48.1 must be carried out by a professional electrician.
- The System 48.1 lights work at 24V DC, and have a unit consumption of 26 Watt.
- The appropriate transformers, connectors and wiring must be installed, in accordance with local legislation, and considering the environmental conditions of the farm.
- The distribution of The System 48.1 must be carried out in accordance with the instructions indicated in the Protocol for Farms. In general, regular distribution of The System 48.1 lighting will be sought at a height between 2 and 3 meters above the floor, spaced 5 meters from one to the other, and between 2 and 3 meters from the walls. The objective is to achieve regular lighting, with minimal shadows, and that it reaches all points of the farm that may be in contact with the animals, that is, susceptible to containing or spreading infections.
- The System 48.1 lighting must be installed in such a way that it is not susceptible to receiving direct water jets during maintenance and cleaning of the farm.



| H[m] | D[m] | Max mW/m² | Med mW/m² |
|---|---|---|---|
| 1.00 | 3.01 | 890 | 192 |
| 2.00 | 6.01 | 223 | 48 |
| 3.00 | 9.02 | 99 | 21 |
| 4.00 | 12.02 | 56 | 12 |
| 5.00 | 15.03 | 36 | 8 |

| H[m] | D[m] | Max mW/m² | Med mW/m² |
|---|---|---|---|
| 1.00 | 4.05 | 890 | 192 |
| 2.00 | 8.10 | 223 | 48 |
| 3.00 | 12.15 | 99 | 21 |
| 4.00 | 16.20 | 56 | 12 |
| 5.00 | 20.26 | 36 | 8 |

Power received as a function of distance to System 48.1



Light emission distribution of System 48.1

**Warning**

- Risk of electric shock.
- Disconnect the electrical network before its installation.
- Do not disassemble or tamper with the interior of the luminaire.
- 24V DC power supply. Respect polarity.
- The surface could be hot. Caution.

## Technical information HT-Lights

The System 48.1 Rigid linear composition of LED diodes that emit in the range of high energy visible light (violet), and UVA-I, with the following characteristics.

- Length: 490 mm
- Rigid aluminium frame
- Protection IP 66 • Number of diodes: 6
- Two connection cables at one end, for installation in parallel
- Working voltage: 24 V DC, Intensity: 1,2 A
- Direct Current (DC)
- Consumption: 26 Watts
- Maximum working temperature: 85º Celsius
- Emission 5 Watt
- Angle of emission 120º
- Average life of LEDs: 50,000 hours (5½-6 years)
- Recommended effective life for use in the System: 30,000 hours (3-3½ years)

## Note

The recommended effective life should not be exceeded, even if the System 48.1 lighting continues to work since the intensity of light emissions in LED technology decreases over time, so lighting with more than 30,000 hours of operation would not be able to correctly activate the System.

## Presentation

The System 48.1 is presented in boxes containing 27 units.

## Disclaimer

All data provided in our technical information is based on our experience, technical knowledge and practice under certain working and testing conditions. The client must check consumption and the adaptation of the products under their working conditions, carrying out their own tests. NanoLandGlobal and their partners can provide technical advice if required. We guarantee the quality of the products in case of manufacturing defect, excluding subsequent claims. Our guarantee is limited to the value of the products purchased. The warranty will not apply in case of misuse, incorrect power, poor installation, handling, or repairs carried out by unauthorized or unqualified persons. This data sheet is valid until the issuance of a new version.

## Links to Pathogen Eradication lists

- List of Viruses shown to be inhibited or destroyed by photocatalysts
- Examples of E. coli strains shown to be killed
- Gram-positive bacteria shown to be killed
- Other Gram-negative bacteria shown to be killed
- Protozoa and algae shown to be killed
- All 5 lists in one (1.5MB)

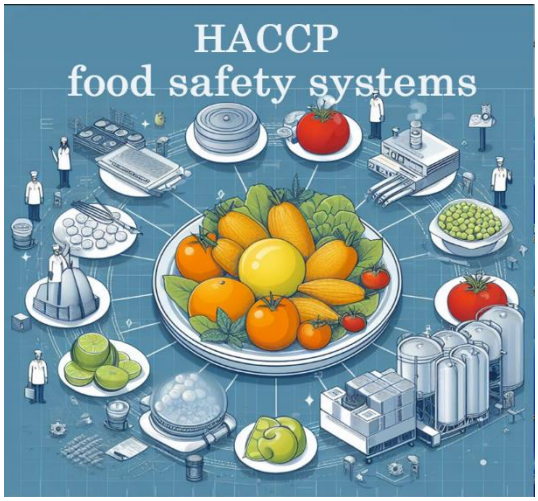
**HygieniaTouch** offers a proactive approach to inhibiting the propagation of bacteria, viruses, and pathogens, distinct from reactive methods like disinfectants that act after biofilm and viruses have spread. By leveraging TiO2 photocatalysis, surfaces treated with **HygieniaTouch** continuously work to neutralise and break down organic contaminants upon exposure to light, preventing the formation and proliferation of biofilms and pathogens before they establish a foothold. This proactive inhibition not only reduces the risk of contamination but also offers sustained protection, making it a versatile and efficient solution for maintaining clean and hygienic environments with minimal intervention and costs.

## Confirmation of antiviral and antibacterial test below

- Long lasting Infection Free Farms - animation
- Taking methane out of the food chain
- Preparing Lights for Livestock Methane Reduction
- Removing methane and pathogens from livestock buildings

## HygieniaTouch: Enhancing the food sector

**HygieniaTouch** photocatalysis combined with light holds immense potential to revolutionise and fortify our food systems, bolster biosecurity, diminish reliance on animal antibiotics, boost profitability for farmers and food manufacturers, promote animal welfare, mitigate the risk of pathogens, viruses, and bacteria, and provide an exceptional sustainability solution rooted in solar power.




**HygieniaTouch** photocatalysis, when exposed to light, triggers a process that eradicates harmful microorganisms and pollutants, thus enhancing the safety and quality of our food supply. By harnessing the power of this technology, biosecurity measures can be significantly strengthened, preventing the spread of diseases and contaminants within agricultural settings.

Moreover, the implementation of **HygieniaTouch** photocatalysis offers the potential to reduce the need for antibiotics in animal husbandry, addressing concerns related to antibiotic resistance and promoting healthier livestock practices.

From an economic standpoint, the adoption of **HygieniaTouch** can lead to increased profitability for farmers and food manufacturers through improved productivity, reduced losses due to disease outbreaks, and enhanced product quality.

Furthermore, by prioritising animal welfare and health, **HygieniaTouch** contributes to a more ethical and sustainable approach to food production.

In terms of sustainability, **HygieniaTouch** represents a remarkable tool, as it relies on solar power to drive its processes. By harnessing renewable energy sources, this technology minimises environmental impact and offers a pathway towards more sustainable agricultural practices.

In summary, **HygieniaTouch** coupled with light presents a multifaceted solution that addresses critical issues in food production and biosecurity, promotes sustainability, and fosters a safer and more resilient food system for the future.

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