

# From Farm to Fridge: Ensuring Authenticity in Dairy Products

**The dairy industry is increasingly vulnerable to adulterated products, jeopardizing both brand reputation and consumer safety. Traditional anti-counterfeiting measures are struggling to keep pace with advanced replication techniques, highlighting the need for more robust solutions. By integrating overt verification with 3D Physical Unclonable Function (PUF) technology, products can be securely authenticated at any stage of the supply chain. This seamless approach not only protects product integrity but also strengthens consumer trust, ensuring a safer and more reliable dairy market. By embracing these technologies, the dairy sector can safeguard its future and maintain its critical role in global nutrition.**

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## Introduction

The dairy industry is a cornerstone of the global economy, providing essential nutrition to millions of people worldwide. With a rich history and strong traditions, the sector continues to evolve, embracing technological advancements to improve efficiency, sustainability, and animal welfare. From farm-to-fridge innovations to eco-friendly practices, dairy farmers are committed to reducing their environmental footprint while producing high-quality milk and dairy products.

In recent years, the growing demand for healthy, organic choices, along with the rise of value-added products like cheese, yogurt, and probiotics, has demonstrated

the dairy sector's adaptability and resilience. By focusing on nutrition, sustainability, and innovation, the industry remains a key player in global food security and economic growth, paving the way for a bright and sustainable future for producers and consumers alike.

However, this vital sector is facing a growing threat from adulterated to outright counterfeit products. Such adulteration not only jeopardizes consumer safety but also inflicts significant economic losses and damages brand reputation. Adulterators are employing increasingly sophisticated techniques, leaving traditional anti-adulteration measures struggling to keep pace. Methods that once effectively safeguarded products are now susceptible to modern replication, underscoring the urgent need for the dairy industry to adopt more advanced solutions to protect its products and uphold consumer trust.

To safeguard both the integrity of dairy brands and the well-being of consumers, while mitigating economic losses and preserving brand reputation, the industry must rethink its approach to product protection and seek innovative solutions that can keep pace with evolving threats.

## Who Really Holds the Key to Prevention?

The burden of identifying adulteration cannot rest solely on the shoulders of end-users. The critical responsibility lies higher up the supply chain—with retailers and distributors. To effectively tackle this issue, the focus should be on the practice of deterrence on those who are selling fakes by providing technology that clearly establishes their accountability, to the extent evidence can stand up in the courts also, should it come to it.

In the quest for higher profit margins, some retailers and distributors or anyone in the supply chain, driven by greed, knowingly introduce adulterated dairy products into the market. These complicit actors, motivated by short-term gains, do so because with the current anti-counterfeiting technologies they have figured out a way to deny their complicity, if caught. This encourages more and more counterfeiters to appear in the marketplace. This not only endangers consumer safety but also damages brand integrity and results in significant economic losses.

The key to preventing such practices lies in creating a robust deterrent against the introduction of adulterated products; deterrence would imply taking away the ability

of fake product seller to deny connivance. This involves implementing advanced technologies and rigorous protocols designed to detect and prevent adulteration at every stage of the supply chain. Regular audits, stringent standards, and real-time monitoring are essential to ensure that every link in the chain upholds the highest levels of authenticity and quality.

Retailers and distributors must be held accountable for the products they handle. Educating these stakeholders about the long-term benefits of maintaining product integrity and the risks associated with adulteration can foster a culture of vigilance and responsibility. By enforcing strict checks and balances, and adopting innovative solutions to verify product authenticity, the industry can create a more transparent and trustworthy market.

By focusing on deterrence and accountability, the dairy industry can significantly reduce the risk of adulterated products reaching consumers. This approach will safeguard consumer safety, protect brand reputation, and maintain economic stability, ensuring a reliable market for high-quality dairy products.

**Overt Technologies: A New Era for Product Protection**

As adulterators use increasingly sophisticated techniques, traditional product protection methods are falling short. The need for innovation is urgent. Overt technologies offer a solution with instant and reliable verification available anytime, anywhere and to anybody; the last is important, that it should be equally available to both the consumer and the seller so that

seller of the fake product cannot deny involvement. This verification is to be done on a security feature attached to the product. So, another requirement is that the security feature be unclonable, which is called the Physically Unclonable Function (PUF) in scientific language. When combined with 3D-PUF technology, these methods provide an impenetrable defense.

QR codes and holograms, while useful, have their vulnerabilities. QR codes can be copied, and holograms, despite their visual deterrence, can be tampered with or even an approximate hologram on the fake product allows seller to deny involvement as he could not have verified, or so would he claim.

3D PUF technology introduces a new level of security. Each product is marked with a unique, physically unforgeable pattern, creating a "phygital" fingerprint that integrates physical and digital elements. This ensures that even the most advanced adulterators cannot replicate it.

For the dairy industry, combining 3D PUFs with overt technologies like QR codes can transform product protection. This integration verifies the authenticity of every product, from milk to cheese, from farm to fridge. Consumers gain confidence, and retailers and distributors benefit from improved transparency and accountability.

By adopting these advanced solutions, the dairy sector can effectively combat adulteration and maintain high standards of quality and safety. Leveraging the strengths of both overt technologies and 3D PUFs, the industry can stay ahead of evolving threats and secure a trustworthy market.



## App-Based Authentication vs Website-Based Methods

While the 3D PUF can provide the necessary digitization lever, it is only as safe as the weakest link in the chain- the authentication interface to the retail consumer. In the evolving landscape, two primary channels exist, app-based authentication and website-based.

Traditional website-based methods are vulnerable to replication and phishing attacks with counterfeiters using many innovative strategies to dupe even the most careful consumers. For example, a minor change in web-address can take the validation process to a counterfeiter's site. App based authentication methods on the other hand offer a more secure and reliable solution. Apps downloaded from trusted sources like the Play Store or App Store benefit from stringent security measures implemented by the platforms themselves. These platforms invest heavily in maintaining a secure environment, ensuring that apps are regularly updated and free from vulnerabilities.

In contrast, website-based methods are increasingly susceptible to phishing attacks and fraudulent websites, which can undermine their reliability. The ease with which counterfeiters can create convincing fake web portals presents a significant challenge to ensuring product authenticity.

The strength of app-based authentication lies in its combination of security and reliability. By leveraging the advanced security infrastructure of app stores, this method offers a dependable way to verify products and combat adulteration effectively.

A question may be raised that rarely anyone downloads an App. This question may be due to indiscriminate attention to consumer-ease over reliability. Note that, whether an App or App-less solution, consumers rarely scan a tag. Thus, it is not a question of App versus non-App based technology. The relevant question is what will threaten a seller of fake product. Just as a camera with a warning that "you are under camera surveillance" prevents thefts, irrespective of the fact that the video feed from camera may not even be watched, the App serves the purpose of that camera, whether or not it is downloaded or used.

The threat from availability of a reliable authentication to the consumer (and everyone alike) is sufficient, it is

not important how many times an App is downloaded.

In short, for discouraging sellers of fake products, select a technology that has a unclonable physical identifier attached to the product and a reliable authentication method equally available to both the buyer and the seller.



For brands, adopting app-based solutions means delivering a seamless and trustworthy experience for consumers, reinforcing product integrity, and enhancing overall security.

## Embracing Innovation for a Secure Dairy Future

As the dairy industry grapples with the escalating threat of adulteration, the urgency for innovative solutions has never been clearer. Traditional safeguards fall short in the face of advanced adulteration tactics, but by integrating breakthrough technologies like 3D Physical Unclonable Function (PUF) with app-based authentication, the industry can turn the tide. These advanced tools not only build an impenetrable defense against tampering but also empower consumers with real-time product verification, turning trust into a measurable asset.

The future of dairy rests on this powerful synergy between authenticity and technology. Each carton of milk, each block of cheese, will embody the highest standards of safety, transparency, and quality. By reinforcing the supply chain with these cutting-edge protections, the dairy sector can safeguard its pivotal role in global nutrition, ensuring consumers receive only the purest, most authentic products from farm to fridge. With innovation driving the way forward, the industry can redefine consumer trust and establish a new benchmark for food safety in the modern world.

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