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Research Update: Cell Phone Readable Dendritic Identifiers: Applications for Secure Track and Trace in the Food Supply Chain

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This research update describes an ongoing USDA-NIFA-funded project examining the development and efficacy of cell phone readable Dendritic Identifiers for use in secure track-and-trace systems in the food supply chain. Traceability systems using distributed ledger technologies such as blockchain have been proposed to store and streamline disparate food supply chain information, ultimately aiding in identifying the location and scope of a food safety incident or case of food adulteration. The sophistication and agility of such databases means that each and every food item could be represented in the electronic ledger, coupled with information on its origin and other attributes, and electronically tracked. If this could be achieved with sufficient granularity, it could lead to rapid hyper-targeted recalls, thereby greatly reducing the economic damage and health impacts of tainted or counterfeit product. For each food item to be represented in the electronic ledger, it is necessary to have a *unique and secure physical identifier on each article*—"unique" to allow an unambiguous mapping between the tagged item and the information contained in the database, and "secure" to prevent fraudulent use of the identifier.

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Dendritic Identifiers are intricate branching patterns that cannot be replicated (similar to fingerprints or retinal images) and can serve as a secure identifier. Dendritic Identifiers can be produced inexpensively, can be incorporated with current food labeling technology, and have the potential of being placed on food items directly (without a tag). Furthermore, given Dendritic Identifiers can link to any database and are scannable via cell-phone-based technology, consumers have the opportunity to scan a Dendritic Identifier (similar to a QR code but much more secure) with a cell phone and obtain important food provenance information, such as where and when the item was picked and packed, and sustainability practices of the farm.

The multidisciplinary research team has completed tests of different substrate materials for Dendritic Identifiers that can be used in conjunction with existing food labeling technology, such as PLU stickers, as well as determined the strength of the Dendritic Identifiers to hold up in realistic use settings found in the fresh produce supply chain. The team has also advanced roll-to-roll fabrication processes that aid in potential mass manufacturing. The team is also developing an affordable and easy-to-implement cell phone reader that has the capability of scanning the Dendritic Identifiers and linking production and provenance data with blockchain databases, coupled with image identification software. Focus is also being placed on evaluating the costs and benefits of implementation, an important consideration in determining commercial viability of this technology for food safety applications.

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