To target or not to target? Definitions and nomenclature for targeted versus non-targeted analytical food authentication (#30)

Nicolai Zederkopff Ballin[1], Kristian H. Laursen[2]

[1] Danish Veterinary and Food Administration, Ringsted, Denmark; [2] University of Copenhagen, Faculty of Science, Department of Plant and Environmental Sciences, Plants and Soil Science Section & Copenhagen Science Centre, Copenhagen, Denmark

Introduction:
Analytical methods that can offer fast, cost-effective, and reliable food authenticity testing at several points in the food production and retail chain are urgently requested. Consequently, the number of authentication studies has increased by more than 300% from year 2007-2016 (Figure 1). Targeted methods have much to offer but it is increasingly acknowledged that food is a complex matrix and should thus be treated and analyzed by techniques that can embrace this complexity. This is reflected in the increase in non-targeted studies from 34% to 42% during the same period (Figure 1). However, this increase in non-targeted authentication studies is not mirrored in its use in regulatory food control. One explanation for the limited implementation is the absence of standardized validation procedures for non-targeted methods, common nomenclature, and definitions. The increasing use of non-targeted analyses across several scientific disciplines has brought together a mixture of analytical traditions and terminologies, and terms such as profiling, signature, fingerprinting, analytical marker, etc. are inconsistently used. At the conference, novel definitions and nomenclature of targeted and non-targeted authentication methods will be presented as a step towards harmonization.

Methods:
Nomenclature in analytical food authentication was reviewed in various scientific disciplines. Terms and concepts were gathered and compared to propose common nomenclature and definitions.

Results:
Biological and chemical examples of targeted and non-targeted approaches will be presented while discussing the associated possibilities and limitations for analytical food authentication. Definitions are proposed for targeted and non-targeted methods, fingerprints, profiles, and signatures. Furthermore, we will introduce the terms primary and secondary markers, to direct focus towards the cases where the analytical results are different from the reported results (Figure 2). To further understand these differences, consider the methods for Sudan dyes in spices where the analytical result (Sudan dye) and the reported result (Sudan dye) is the same, and on the contrary, methods for protein determination where the analytical result (nitrogen) is different from the reported result (protein). The discrepancy between the analytical result and the reported result turned out to dominate most analytical food authentications. It is therefore pertinent to explicitly address this difference, and the terms direct and indirect authentication will be introduced through examples with meat fraud. The implications and consequences of the reporting of indirect authentication will also be discussed.

Conclusion:
Defining terms and concepts in analytical food authentication is a prerequisite for standardizing validation protocols for non-targeted authentication methods. Hopefully, these proposed definitions, terms, and concepts in analytical food authentication will initiate further work on harmonization and standardization of non-targeted validation procedures. Standardized validation procedure for non-targeted methods will strongly support implementation of non-targeted authentication methods in regulatory control.

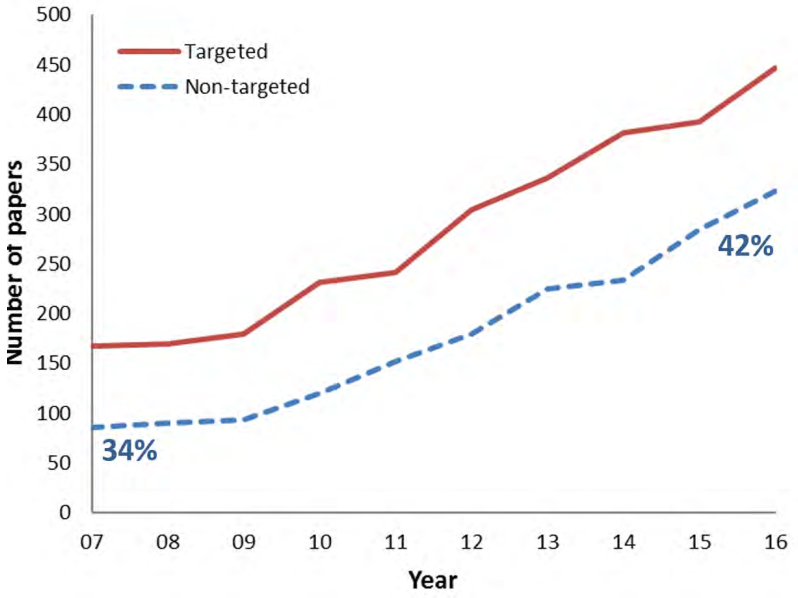

Figure 1 The development in numbers of food authentication studies based on targeted versus non-targeted analytical methods from 2007 to 2016. (Ballin and Laursen. Trends in Food Science & Technology. 2019; 86, 537-543).*Ballin, Nicolai Zederkopff*

Notes

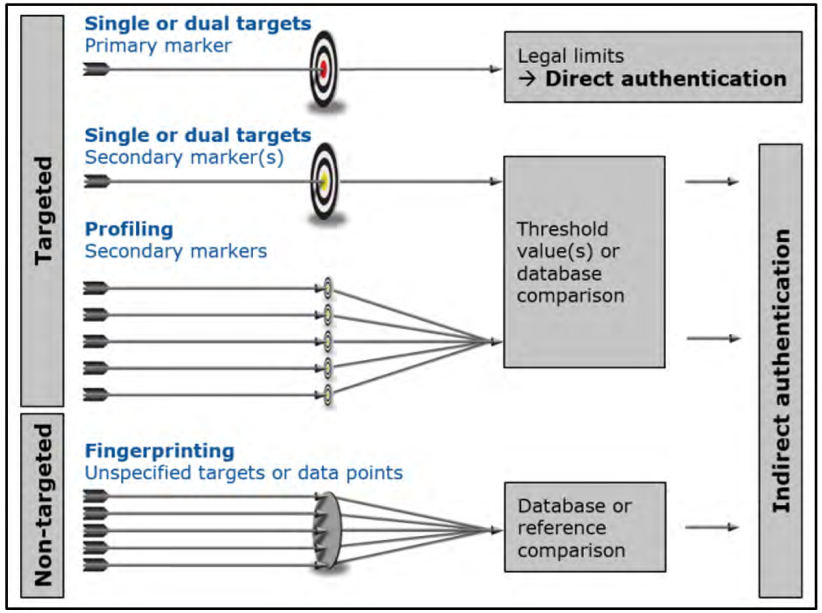

Figure 2
The principles of targeted versus non-targeted analytical food authentication.

The first horizontal arrows (from the left) illustrate if single/ dual targets, several targets, unspecified targets or data points are measured. Red bullseye represents a primary marker, yellow bullseye represents a secondary marker, and a grey dartboard illustrates that no specified targets are addressed but that the measured targets/ data points are still within a closed entity, e.g. proteomics, metabolomics, etc. The arrows after the dartboards illustrate the fate of the analytical result – either a direct authentication result, or an indirect authentication result following a comparison to a legal limit, a threshold value/database, or a database/reference.

(Ballin and Laursen. Trends in Food Science & Technology. 2019; 86, 537-543).

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