

An Update on Dairy Products Authenticity - Scientometric Evaluation and Prospects

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Abstract

Dairy products authentication has become an emerging issue for the food industry, consumers and researchers worldwide. A scientometric evaluation that highlights research trends of this evolving field is presented. Publications on dairy products authenticity are on exponential growth. More than 75% of the publications are research articles. South European countries, Italy, France, Spain, India and United States dominate the field. Research on field of dairy products authenticity is highly cited attracting the interest of the scientific community. A big proportion of publications are in journals with high impact factor. The most promising approaches for the determination of geographical & genetic origin, production and processing methods are provided. Specifically, elemental metabolomics, genomics, microbial fingerprinting, proteomics and metabolomics seems to be the future for uncovering possible mislabeling practices.

Keywords: Dairy products, Cheeses, Authentication, Genomics, Proteomics, Metabolomics

1. Introduction

Food market globalization, along with the industrialization of production has led the consumers to an increasing uncertainty concerning food's nutritional value and safety. Recent food scandals such as melamine in baby milk formula, and numerous others, have raised consumer awareness regarding the quality and authenticity of the food they buy and consume. Further, consumers are skeptical about these and address their purchase choices according the geographic or genetic origin, and special attributes such as organic animal husbandry [1]. Food authentication is the process that verifies that a food is in compliance with its label description, including, among else the origin (geographical or genetic), production method (conventional, organic, traditional procedures, free range) [2].

Milk and dairy products are important in a nutritional balanced diet. Their consumption has been associated with

several health benefits due to their high content in proteins, fats and minerals. Milk and dairy products quality is affected by animal nutrition status, processing, and the environment. Cheeses composition is mainly associated with the raw milk source, which, at the same time, is influenced by several factors such as animal species (cow, sheep or goat), their physiological condition, and animal breeding or environmental conditions along with the impact of technology and possible pollution in cheese production.

Dairy products compromise a very important food category. According to the Food and Agricultural Organization (FAO) more than 18 million metric tons of cheeses are produced per year globally. Furthermore, cheeses overcome the annual production of coffee beans, tea leaves, cocoa beans and tobacco leaves together.

2. Scientometric evaluation

A scientometric evaluation that highlights research trends of this evolving field is presented. The search was performed using the Scopus database and [(authentication OR "geographical origin" OR "genetic origin" OR authenticity OR fraud OR adulteration) AND (dairy OR cheese OR cheeses OR "organic cheese" OR yoghurt OR cream OR "sour cream" OR "ice cream" OR "ice-cream" OR "milk fermented" OR kefir OR kumiss OR curd OR whey)] as keywords in the fields TITLE-ABSTRACT-KEYWORDS. Further, we limit our search to years 1976 to 2017, because 2018 is not still completed. The vast majority of articles concerns cheeses, as they are the most "significant" dairy product with high economical value.

Publications on dairy products authentication are mostly research article (663 out of 826) while 53 review articles, 46 conference papers and 45 book chapters (Figure 1). As depicted in Figure 2, publications on dairy products authenticity are on exponential growth. Indeed,

they are almost doubled, from 2010-11 (95) to 2016-17 (172). From 2002-03 publications reached near to the limit of 50 publications per 2 years. There on, publications are, generally, continuously increased. This highlights the importance of the field as it attracts researchers' interest.

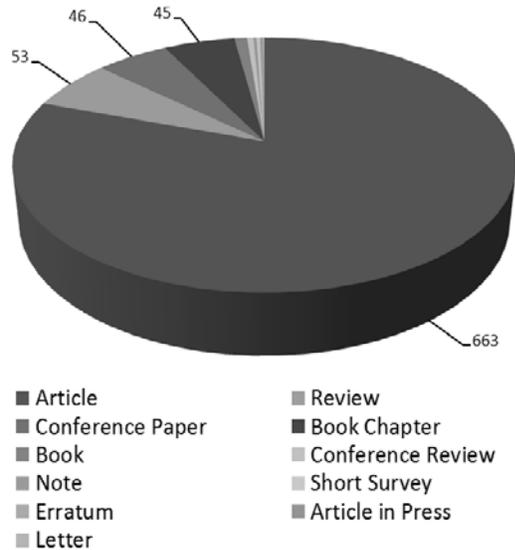


Fig. 1 Research on dairy products authentication.

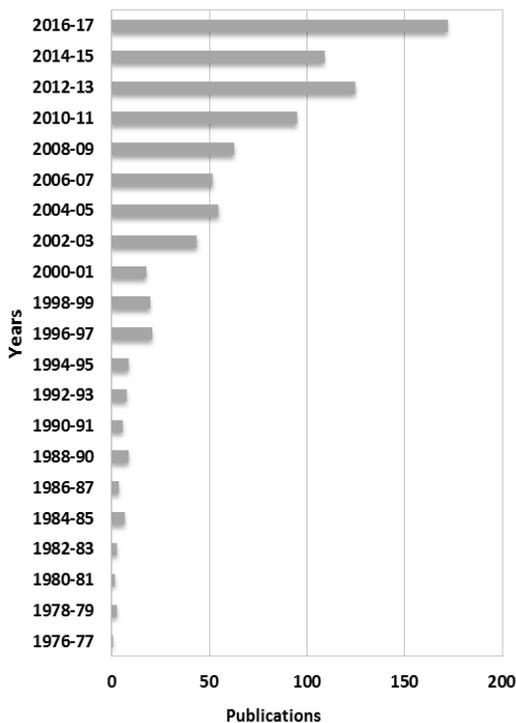


Fig. 2 Publications concerning dairy products authentication per 2 years.

Figure 3, shows the top 15 countries in number of publications concerning dairy products authentication. As depicted Italy is by far the first. This is explained by the high number (53) of registered cheeses as Protected Designation of Origin (PDO) and Protected Geographical Indication (PGI) obtained by Italy. India and United States have also noticeable contribution to the field. Moreover, Spain and France, are in the first 5 countries because also of the high number of registered cheeses as PDO and PGI. Brazil, China, Germany, Switzerland and United Kingdom are following while other 5 European countries, namely Portugal, Netherlands, Austria, Poland and Ireland are closing the top 15. Concluding, dairy products authenticity attracts the interest of researchers all over the world from Asia and Europe to America.

Top 15 Countries

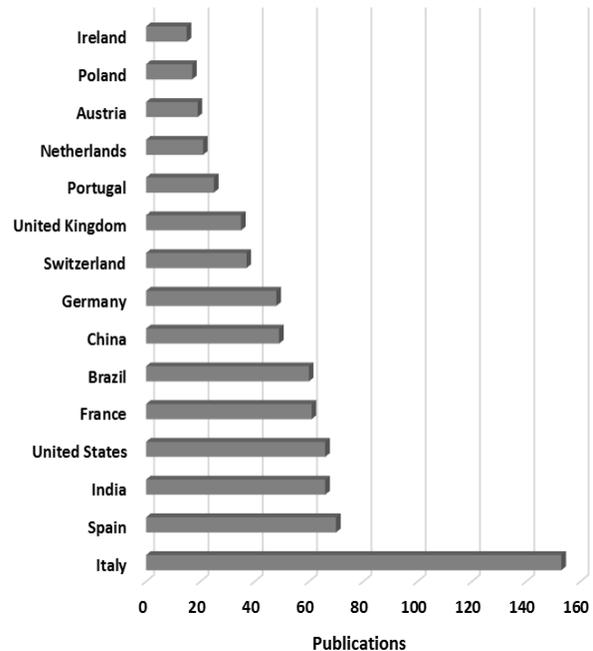


Fig. 3 Top 15 countries on publications concerning dairy products authentication.

Journals which are mostly chosen are “Journal of Dairy Science”, “Food Chemistry” and “Journal of Agricultural & Food Chemistry” (Table 1). “Food Control”, “European Food Research and Technology”, “International Dairy Journal” and “International Journal of Dairy Technology” are following. Almost all the journals in the top 15 selected journals, acquire an impact factor

around or higher than 2. Thus, research regarding dairy products authenticity is highly cited attracting the interest of the scientific community. It should be also noticed the presence of some “pure” analytical chemistry journals such as “Journal of Chromatography A”, “Rapid Communications in Mass Spectrometry” and “Analytical and Bioanalytical Chemistry”. This could be justified by the demand of new reliable analytical methods for dairy products authenticity. It should be highlighted also the presence of one of the most highly cited journal for review articles concerning food science, “Critical Reviews in Food Science and Nutrition”.

Table 1: Publications per journal and impact factor.

Journal	Publications	Impact factor 2017
Journal of Dairy Science	63	2.749
Food Chemistry	48	4.946
Journal of Agricultural and Food Chemistry	36	3.412
Food Control	23	3.667
European Food Research and Technology	21	1.919
International Dairy Journal	19	2.201
International Journal of Dairy Technology	18	1.225
Journal of Chromatography A	11	3.716
Food Research International	10	3.520
Journal of Dairy Research	9	1.170
Rapid Communications in Mass Spectrometry	9	1.970
Critical Reviews in Food Science And Nutrition	8	6.202
Dairy Science and Technology	8	1.435
Journal of AOAC International	8	1.087
Analytical and Bioanalytical Chemistry	7	3.307

3. Prospects

The most significant new research trends on dairy products authentication are genomics [3], proteomics [4, 5], metabolomics [6-8] and elemental metabolomics [9]. Genomics and proteomics are mostly chosen in genetic origin studies for species identification while elemental techniques mostly for geographical origin determination. Some indicators are fractions of α_1 -, α_2 -, β - and κ -

caseins, peptides [10-13] and TAGs [14, 15], VOCs [16] and ω -cyclohexyl fatty acids [17]. Specie-specific gene locations have been distinguished allowing us to identify genetic origin, not only within species, but also variations among the intra-species [18-21]. Furthermore, microbial fingerprint is an evolving approach for geographical origin determination [22-24]. Advances on HRMS techniques offer outstanding capabilities for metabolomics and proteomics. Non-targeted analysis provides plethora of determined compounds making them an exceptional choice for food authentication studies [25]. Elemental metabolomics is another emerging methodology, where the total elemental fingerprint, is utilized [9]. Indeed, elemental fingerprint has been proved promising authenticity indicators especially for geographical origin determination [26, 27]. Moreover, isotopic fingerprint can be used for the authenticity assessment of dairy products [27-29]. Finally, Enzyme-linked Immunosorbent Assay (ELISA) is also another option for the detection of possible adulterations [30, 31].

4. Conclusions

To sum up, dairy products authenticity is of major interest and attracting the attention of all the involved parties, from producers to consumers, even to policymakers globally. Moreover, it is on the spotlight of analytical chemists and food scientists interest. The continuous development of new analytical methods and identification of new indicators empower reliable authenticity controls of dairy products.

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