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Mini Review

Opportunities of Artificial Intelligence in the Development of Predictive Methods Applied to Food Composition Databases

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Abstract

Increased data on the type and amount of nutrients and bioactives present in food are growing. Its compilation in food databases allows the management of useful information for different professionals as nutritionist, agronomists, economics, etc. This essay presents the possibilities offered by artificial intelligence techniques in the generation of information and new knowledge about the type and quantity of compounds present in food, pattern recognition, etc. Nutritional decisions and therapeutic diets can be seen especially favoured in the future, as well as the impulse of new research in this field.

Keywords: Artificial Intelligence; Nutrition; Dietetics; Food Databases; Bioactive

Abbreviations

FCDB: Food Composition Databases; USDA: U.S. Department of Agriculture; AI Artificial Intelligence

Introduction

Recent studies in human nutrition show a correlation between patterns of high consumption of fruits and vegetables and a lower incidence of cardiovascular diseases [1]. This is attributed to the presence of dietary fiber, minerals and, natural antioxidants such as some vitamins and phytochemicals (such as polyphenols) [3]. The benefit of bioactive antioxidant compounds has been studied intensively in recent years. Particular attention has been paid to the treatment of strokes and neurodegenerative diseases. Its search and characterization is currently a topic of great interest, since through this activity, it is possible to reverse the damage caused by reactive oxygen species (ROS), under conditions of oxidative stress [3]. Although it should be noted that the results found are in some cases inconclusive and contradictory [6].

Data management on the composition of foods is present within the theoretical tools that a nutritionist has. These tools may be compiled in food composition databases (FCDB). This type of data is continuously increasing. Other compounds (eg, antioxidant bioactives) are emerging or quantified, beyond the typical macro and micronutrients. For example, the content of flavonoids in food has been published by the USDA (U.S. Department of Agriculture) [7,13]. What information do such data provide when studying the intake levels of an individual or population groups? How to link this information with the rest of the nutrients provided by a food, within specific nutrition methodologies and even dietetics? These are some of the questions that can contribute the development of new dietary procedures, the design of new foods, the proper and personalized management of diet therapy, the development of new

epidemiological studies aimed at the area of nutrition, diet intake studies, etc.

Development

Facing these challenges, the proper use of computational tools and methods becomes very important. Within these methods, artificial intelligence (AI) should be valued, for the advantages it offers in the paradigm that has been proposed for human nutrition, where it is fundamental to optimize health and to eliminate the symptoms of specific diseases. This advanced concept sets the stage for the evolution of complex models within the framework of personalized nutrition [8]. The use of complex classification and regression models has increased in the biomedical sciences, so the food science should take this into account [2].

In a general sense, when trying to process by AI techniques, the data of these FCDB-polyphenols, the set of characteristics intrinsic must be taken into account: a) the uncertainty in the quantities of these bioactive, influenced by the development of the methods of extraction and quantification, b) the wide structural variability of polyphenols (eg, numerous sub-classes of flavonoids have been identified in food), c) the limitations inherent in the creation and improvement of FCDB (some contain regional information). Faced with such conditions and uncertainty in the data, the techniques of machine learning could be beneficial. These techniques allow the analysis of data, through a process of knowledge induction. Algorithms are created in this way, from information provided in the form of real cases, until generalized behaviors are obtained that will help in the decision-making process.

The management of the data contained in these FCDB are poorly explored to develop AI techniques, therefore the information and knowledge that can be generated could constitute a topic of interest to the Food Science [5]. Decision-making, based on information that is yet to be known, can also be very useful for economists, agronomists, as well as food industries [4]. The processing of this information allows, for example, the design of diets or diet-therapy schemes, adjusted to the needs of patients with different pathologies [12], in addition to the development of intake studies [10], even those that respond to the areas of nutritional genomics, epigenetics [11], can benefit the improvement of personalized dietary guidelines and recommendations, as well as being able to develop treatments with potential health benefits (functional foods) [9].

Previous studies on the prediction of the antioxidant capacity of food matrices, with the use of AI techniques [5], are based on the existence of high numbers of foods whose content of the type and amount of food is already known. Polyphenols are a well-known example (Figure 1). Some of the AI techniques explored in this field of food are: Artificial Neural Networks, Nearest k-Neighbor Algorithm, Vector Support Machine Algorithm8. All of them belong to machine learning, which, as explained, develops techniques and algorithms capable of extracting knowledge from complex data sets [14], such as food matrices [6].

Figure 1: Possible exemplification on the obtaining, processing of data on food database until the generation of new knowledge by AI techniques.

Conclusion

Based on these evidence and challenges, for the resolution of global problems associated with the binomial diet-health, it is worth paying special attention to the collection of data on food composition and processing. It is appropriate to consider the use of AI, as a useful tool in the modeling of complex systems, such as the phenomena studied by the nutrition sciences and their emerging disciplines.

Conflict of Interest

We have no conflicts of interest.

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Volume 3 Issue 9 September 2019