Toward A Diet Based on MicroRNA

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Abstract

The purpose of this work is to emphasize the possible benefits of a microRNA-based diet in reducing the negative effects of a number of diseases, such as cancer, diabetes mellitus, obesity, hypertension, chronic respiratory conditions, and others.

Introduction

Smoking, alcohol consumption, sugar-rich foods, and sedentary behavior have all contributed to an increase in noncommunicable diseases (NCDs), such as type 2 diabetes, cancer, cardiovascular disease, and respiratory conditions. These illnesses are a major public health concern, killing 41 million people each year, with 74% being fatal [17].

In addition, we know that nutrition plays an important role in regulating an optimal immune response by providing adequate nutrients to immune cells. The micronutrients (refers to vitamins and minerals), as well as macronutrients - such as amino acids, cholesterol, and fatty acids - have a specific effect on immune activity. For example, vitamin A/ATRA in acute promyelocytic leukemia, vitamin C in tumor cell fighting, calcitriol/vitamin D in COVID vaccination, and cholesterol's role in immune function regulation [16].

For this reason, the use of nutritional products, i.e. products based on natural ingredients and characterized by a high content of nutrients, including isoflavones, vitamins and antioxidants, has increased [18]. Dr. Stephen De Felice coined the name in 1989, combining the words "nutrition" and "pharmaceutical." Additionally, these products contain active ingredients that, in addition to providing basic nutrition, can also improve health [18].

In parallel, the scientific literature began to emphasize the possibility of ingesting small non-coding RNA molecules (microRNA) in food, which are resistant to digestion, enter the bloodstream, and regulate gene expression [8, 14, 26].

Remember that microRNAs (miRNA) are small, non-coding endogenous RNA sequences of 18 to 25 nucleotides that play an important role in regulating post-transcriptional gene expression. They can be secreted from cells and transported to extracellular fluids via a variety of carriers, including lipoprotein complexes, ribonucleoproteins, and extracellular vesicles. Persistent diseases, such as type 2 diabetes [12], heart disease [20], and obesity [2], have been linked to miRNA-mediated interference with proper cell communication.

Two reviews on the use of microRNAs in nutrition and diets are available in the

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scientific literature [6, 9]. For example, consider the work of [2], in which bariatric surgery (a surgical intervention) to combat obesity has been shown to have a significant effect on the expression of several microRNAs (e.g., miR-7-5p, let-7f-5p, let-7i-5p, miR-320c, miR-205-5p, and miR-335-5p). These changes help to regulate adrenal and thyroid hormone release, which limits beige adipocyte function while increasing brown adipose tissue.

Furthermore, aerobic exercise training has been linked to alterations in miRNA expression profiles, with some microRNAs (e.g., miR-1, miR-20a, and miR-21) downregulated and miR-126, miR-214, and miR-29c upregulated, lowering pathogen target expression. These statistics suggest, for example, that bariatric surgery can be used to monitor the intervention's outcomes.

In this sense, [25] discovered that microRNA (i.e., miR-168a) in Chinese serum was acquired through diet consumption and was capable of regulating gene expression. A year later, [7] attempted to replicate this type of experiment but were unable to detect it through food consumption.

[19] conducted human experiments to analyze the transfer of microRNA when they studied the effects on healthy college athletes who fed fruit containing microRNA from plants (i.e., miR-156a, myR-159a, and miR-169a), but they did not detect anything in this case, nor did they study it when they also used bees or mice, and came to the conclusion that it is not a robust or frequent mechanism for maintaining stable microRNA levels in a variety of model animals.

Moreover, [22] conducted experiments on mice fed with microRNA (i.e., miR-2911), and after seven days, they discovered differences in the circulating snow of miR-2911 in the serum of mice fed with this special diet. Therefore, the debate over whether microRNAs were absorbed or not during digestion, it has been demonstrated that microRNAs are used as tools to increase agronomic pest tolerance [5, 24].

On the other hand, [4] emphasize the benefits of long-term breastfeeding, which can prevent cardiometabolic diseases due to the microRNA content in breast milk, but it is unclear what role the microRNA plays in fetal growth, whereas [6] presented studies on healthy adults who are overweight or obese and determined the expression of microRNA in those diets.

Allow me to offer you two brief examples:

Breast milk is the most notable example. Many macronutrients are found in breast milk, including lactose, oligosaccharides, lipids, proteins, and nonprotein nitrogen. Non-protein nitrogen accounts for 25% of the total nitrogen in milk. Breast milk is one of the richest biological fluids in terms of miRNA content, with approximately 1400 different miRNAs identified. This indicates that microRNA is just one new bioactive component in breast milk. Moreover, the composition and expression of miRNAs in human milk can change for a variety of reasons, such as stress, immune dysfunction, and mastitis, all of which have an effect on miRNA expression patterns [3].

The second scenario shows the significance of microRNAs in the epigenetic control of neuropathological signaling pathways, including disruption of the blood-brain barrier, ischemia-reperfusion damage, blood-brain barrier dysfunction, Alzheimer's and Parkinson's disease, and so on [21].

Finally, microRNAs can act as epigenetic modulators by controlling key enzymes involved in epigenetic reactions [23] . Furthermore, epigenetic changes like DNA methylation, RNA modification, and histone modifications can influence microRNAs. The mutual effects of microRNAs and the epigenetic pathway appear to form a microRNA-epigenetic feedback loop with a significant impact on gene expression.

All of this opens the door to the development of foods based on microRNAs that can prevent and control certain diseases due to their ability to modify, alter, or suppress gene expression and regulation. However, more experiments are required to determine whether a food based on microRNA can truly regulate genetic expression and help us combat these diseases [14].

Conclusion

The world's population needs to improve their diet due to their current lifestyle. MicroRNA enrichment in food may be used to modify gene expression and delay or regulate the onset of several non-communicable diseases, according to recent research. However, more research on the topic is required before microRNA is added to foods worldwide.

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