The Food-Borne Micro RNA and its Controversy on Human Health

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Editorial

A micro-RNA (mi-RNA) is a small non-coding RNA molecule containing about 21-25 nucleotides. Micro-RNAs are partially complementary to one or more messenger RNA (mRNA) molecules, and their main function is to down regulate the gene expression in a variety of manners, including translational repression, mRNA cleavage, and deadenylation. This mechanism relies on the seed region of nucleotide sequence of mi-RNAs that bind to target mRNA [1]. Imperfect pairing of sequences in the seed region in mi-RNA to mRNA impairs gene down-regulation at the protein or RNA level [2]. The mRNA degradation occurs if the mi-RNA nucleotide sequence has a high degree of complementarities to the mRNA sequence [3,4]. Most of the circulating mi-RNAs exist in packaged exosomes [5,6]. Exosomes are the extracellular vesicles containing variety of compounds, lipids, proteins including mRNAs, micro-RNAs (mi-RNAs), and other non-coding RNAs (ncRNAs) [7,8]. Exosomes are not only play essential roles in cell-to-cell communication but also in the role of protection against enzymatic and non-enzymatic degradation of cargos.

In the past, endogenous-mi-RNA has been considered as a regulator of the expression of genes within the host. Evidence suggests that the endogenous synthesis of mi-RNAs can be altered by the dietary bioactive components. Polyphenolic compounds from food sources like fruits and beverages such as tea, coffee, and wine can modulate the expression of mi-RNAs that regulate mRNA which are involved in various biological functions, such as apoptosis, inflammation, lipid metabolism, and cell migration [9].

Interestingly, mature exogenous mi-RNAs may also be obtained from dietary sources [10]. Recently it has been claimed that the mi-RNA from the food-borne especially plants and animals-origin mi-RNAs molecules can be absorbed by the intestinal absorption. Polyphenolic compounds from food sources like fruits and beverages such as tea, coffee, and wine can modulate the expression of mi-RNAs that regulate mRNA which are involved in various biological functions, such as apoptosis, inflammation, lipid metabolism, and cell migration [9].

In their plant-origin mi-RNAs study, they did not detect the Brassica-specific mi-RNAs in a broccoli sprout-feeding study. There are some evidences that mi-RNAs (endogenous as well as exogenous) are contained in exosomes, providing protection against degradation from acidic environment of intestine and adequately stable to pass through the gastrointestinal (GI) tract and enter into circulation without losing its functionality. This intestinal uptake of micro-RNAs contained exosomes is mediated by endocytosis where the protein/protein recognition plays an important role in the intestinal uptake in humans and rats [17]. The glycosylated proteins are important to the endocytosis of food-borne exosomes. The more compatibility of glycoprotein's with the receptors on the apical surface of mammalian cells the more bioavailability of mi-RNAs. When compared to animal-origin mi-RNAs, bioavailability
of plant-origin mi-RNAs is quite low, that could be due to the poor compatibility of plant vesicles [17].

To explore more on the exogenous mi-RNAs and its effect on peripheral gene expression on human, one should understand the information of mi-RNA molecules through the computational analytical approaches; more experiments in characterization of intestinal mi-RNA transport mechanisms and alter the gene expression through binding to mRNA in hosts; and molecular interaction of the glycoprotein’s involved in the endocytosis of dietary micro-RNAs.

References
1. Lewis BP, Burge CB, Bartel DP (2005) Conserved seed pairing, often flanked by adenosines, indicates that thousands of human genes are microRNA targets. Cell 120(1): 15-20.
2. Wang X (2014) Composition of seed sequence is a major determinant of microRNA targeting patterns. Bioinformatics 30(10): 1377-1383.
3. Ameres SL, Zamore PD (2013) Diversifying microRNA sequence and function. Nat Rev Mol Cell Biol 14(8): 475-488.
4. Rana TM (2007) Illuminating the silence: understanding the structure and function of small RNAs. Nat Rev Mol Cell Biol 10(1): 23-36.
5. Simpson RJ, Lim JW, Mortiz RL, Mathivanan S (2009) Exosomes: Proteomic insights and diagnostic potential. Expert Rev Proteomics 6(3): 267-283.
6. Kosaka N, Iguchi H, Ochiya T (2010) Circulating microRNA in body fluid: A new potential biomarker for cancer diagnosis and prognosis. Cancer Sci 101(10): 2087-2092.
7. Satô Kuwabara Y, Melo SA, Soares FA, Calin GA (2015) The fusion of two worlds: non-coding RNAs and extracellular vesicles - diagnostic and therapeutic implications (Review). Int J Onco 46(1): 17-27.
8. Zempleni J, Aguilar Lozano A, Sadri M, Sukreet S, Manca S, et al. (2017) Biological activities of extracellular vesicles and their cargos from bovine and human milk in humans and implications for infants. J Nutr 147(1): 3-10.
9. Milenkovic D, Jude B, Morand C (2013) miRNA as molecular target of poly-phenols underlying their biological effects. Free Radic Biol Med 64: 40-51.
10. Baier SR, Nguyen C, Xie F, Wood JR, Zempleni J (2014) MicroRNAs are absorbed in biologically meaningful amounts from nutritionally relevant doses of cow’s milk and affect gene expression in peripheral blood mononuclear cells. HEK-293 kidney cell cultures, and mouse livers. J Nutr 144(10): 1495-1500.
11. Zhang L, Hou D, Chen X, Li D, Zhu LX, et al. (2012) Exogenous plant MIR168a specifically targets mammalian LDLRAP1: evidence of cross-kingdom regulation by microRNA. Cell Res 22: 107-126.
12. Lukasik A, Zidenkiewicz P (2014) In silico identification of plant miRNAs in mammalian breast milk exosomes-A small step forward? PLoS ONE 9: e99963.
13. Snow JW, Hale AE, Isaacs SK, Baggish AL, Chan SY (2013) Ineffective delivery of diet-derived microRNAs to recipient animal organisms. RNA Biol 10(7): 1107-1116.
14. Dickinson B, Zhang Y, Petrick JS, Heck G, Ishii S, et al. (2013) Lack of detectable oral bioavailability of plant microRNAs after feeding in mice. Nat Biotechnol 31(11): 965-967.
15. Zempleni J, Baier SR, Howard KM, Cui J (2015) Gene regulation by dietary microRNAs. Can J Physiol Pharmacol 93(12): 1097-1102.
16. Baier SR, Nguyen C, Xie F, Wood JR, Zempleni J (2014) MicroRNAs are absorbed in biologically meaningful amounts from nutritionally relevant doses of cow’s milk and affect gene expression in peripheral blood mononuclear cells. HEK-293 kidney cell cultures, and mouse livers. J Nutr 144(10): 1495-1500.
17. Wolf T, Baier SR, Zempleni J (2015) The intestinal transport of bovine milk exosomes is mediated by endocytosis in human colon carcinoma caco-2 cells and rat small intestinal IEC-6 cells. J Nutr 145(10): 2201-2206.