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研究报告

赫氏颗石藻(*Emiliania huxleyi*)响应病毒感染的 microRNA 转录组分析

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摘要: 海洋颗石藻病毒–宿主互作是影响海洋碳、硫生物地化循环及全球气候变化的重要环节。作为大的双链 DNA 病毒，颗石藻病毒进化出一种“病毒细胞代谢”模式，通过重编程宿主代谢途径以满足其代谢需求，但对这一代谢模式的调控机制尚缺乏足够的认识。MicroRNA (miRNA)作为一种基因表达调控的重要因子，能够通过调控代谢过程中的靶基因表达，从而调节相关代谢通路。本研究采用 small RNA 测序技术分析病毒感染颗石藻差异表达的 miRNA 及其靶基因功能，鉴定出 26 条成熟 miRNA (包括 2 条病毒来源的 miRNA)，均来自 23 条新的 miRNA 前体序列，其中 5 条 miRNA 显著差异表达，包括 4 条上调，1 条下调。实时荧光定量 PCR (quantitative real-time PCR, qRT-PCR)验证结果与 miRNA-seq 结果基本一致。功能富集分析显示，5 个差异表达的 miRNA 可能参与调节糖代谢、脂代谢和氨基酸等代谢。此外，差异表达 miRNA 的表达水平与脂质代谢相关靶基因如 *ACC-1*、*SPT*、*ACOX*、*ACAT*、*CERS*、*ACADS* 等的表达水平呈负相关，说明这些 miRNA 可能在病毒感染过程中对宿主的脂质代谢发挥重要的调控作用。

关键词: 赫氏颗石藻；颗石藻病毒；small RNA 测序；microRNA；脂代谢

Analysis of microRNA expression profile in *Emiliania huxleyi* in response to virus infection

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Abstract: The interactions between *Emiliania huxleyi* and *E. huxleyi* virus (EhV) regulate marine carbon and sulfur biogeochemical cycle and play a prominent role in global climate change. As a large DNA virus, EhVs have developed a novel “virocell metabolism” model to meet their higher metabolic needs. However, the regulatory mechanism of this metabolic model is still largely unclear. MicroRNAs (miRNAs) can regulate biological pathways through targeting hub

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genes in the metabolic processes. Here, we performed high-throughput small RNA sequencing to analyse miRNA expression in EhV99B1 infected *E. huxleyi* BOF92. A total of 26 miRNAs (including 2 virus-derived miRNAs) were identified, including four up-regulated and one down-regulated miRNAs. These results were further validated through quantitative real-time PCR. Functional enrichment analysis showed that five differentially-expressed miRNAs might be involved in the regulation of carbohydrate metabolism, lipid metabolism and amino acid metabolism. Moreover, the expression levels of differentially-expressed miRNAs were negatively correlated with that of several lipid metabolism-related genes, such as *ACC-1*, *SPT*, *ACOX*, *ACAT*, *CERS* and *ACADS*, indicating that these miRNAs might play an important regulatory role in virus-mediated lipid metabolism.

Keywords: *Emiliania huxleyi*; *Emiliania huxleyi* virus; small RNA sequencing; microRNA; lipid metabolism

海洋颗石藻(Coccolithophores)是一种全球广泛分布且具有重要生态功能的真核微型浮游植物[1~3]，其中赫氏颗石藻(*Emiliania huxleyi*, Eh)具有形成“球石粒”和高产二甲基硫化物(DMSP)的能力，且几乎每年都在大洋(尤其是高纬度海域)中形成大面积赤潮[4]，该藻赤潮的迅速大规模消亡被证实是特异性病毒(*E. huxleyi* virus, EhV)感染和裂解所致[5,6]。因此，EhV-Eh 的互作过程是影响海洋碳、硫生物地化循环及全球气候变化的重要环节。颗石藻病毒与宿主间侵染和抵抗的博弈形成了一种新的、稳定的协同进化代谢模式，是研究真核浮游植物宿主-病毒互作的理想模式系统[7]。

脂代谢是当今病毒-宿主互作研究的重要问题。作为大的双链 DNA 病毒，EhVs 进化出一种全新的“病毒细胞代谢(virocell metabolism)”模式，通过重编程宿主代谢途径以满足其更高的代谢需求[8,9]。Evans 等[10]2009 年首次报道在 *E. huxleyi* 赤潮消亡过程中，病毒感染诱导宿主细胞脂肪酸的组成由多不饱和向单不饱和转变，导致被病毒感染的宿主细胞减少多不饱和脂肪酸向食物链中更高级营养水平的传递，从而降低海洋生态系统的总生产力。本课题组前期研究发现，病毒感染早期宿主细胞高饱和三酰基甘油(triacylglycerols, TAGs)合成积累、并形成脂滴聚集在病毒颗粒中促进病毒外壳疏水蛋白的存储，满足病毒复制和组装的需求[11]。最新研究发现，病毒感染颗石藻能够以外泌体形式富集并分泌 TAGs，以此加速病毒感染过程[12]。以色列学者 Carmit 团队 2016 年首次发现，EhV 编码的丝氨酸棕榈酰转移酶(viral serine palmitoyltransferase, *vSPT*：鞘脂从头生物合成途径中的第一个关键限速酶)在感染细胞中能够催化合成病毒特有的新型鞘糖脂(viral-specific glycosphingolipids, vGSLs)，该物质被认为是病毒组装的必要条件[9]，这表明病毒能够利用编码的辅助代谢基因(virus-encoded auxiliary metabolic genes, vAMGs)重塑宿主鞘脂代谢途径。同时 vGSLs 还能作为重要的信号分子诱发 ROS(H_2O_2)[13]和 NO[14]的产生，进而启动宿主细胞凋亡程序，最终裂解细胞释放病毒粒子[15~17]。然而，目前对 EhV 感染重塑的脂代谢的 miRNA 调控机制尚缺乏足够的认识。

MicroRNA(miRNA)是一种长度分布在 18~26 nt 的内源性非编码小 RNA。动植物 miRNA 来自基因组位置略有不同，动物 miRNA 通常位于内含子区，而植物 miRNA 更多地来自基因组的基因间区[18]。miRNA 通过结合在靶基因的不同位点抑制或激活靶基因的表达水平，作为丰度极高的基因调控因子参与调控多种生物学过程。最近在高等动植物研究中发现，miRNA 能够通过调节代谢过程中的靶基因，从而调控相关代谢通路，特别是在脂质合成、脂肪酸氧化及脂蛋白分泌等代谢网络中起重要调节作用[19]。相对于高等动植物而言，由于浮游植物种内和种间的差异性特点，且目前只有少数种类基因组信息得到较完整的诠释，因此对 miRNA 在海洋浮游植物生物及非生物胁迫中的重要作用了解较少。目前，主要针对氮、磷、硅及铁等营养胁迫条件下 miRNA 的表达情况进行了初步研究[20~22]。有关浮游植物响应病原菌感染相关 miRNA 的研究国内外尚未报道。

本研究以 Eh-EhV 模式系统为研究对象，在病毒感染早期(6 h)和晚期(45 h)收集藻细胞样品，采用高通量小 RNA 测序技术筛选病毒诱导的差异表达

miRNA，分析 miRNA 在病毒重塑宿主脂代谢过程中可能的调控作用，为从表观遗传学角度深入理解 EhV-Eh 互作的分子机制提供新的理论认识。

1 材料与方法

1.1 赫氏颗石藻的培养及病毒感染

赫氏颗石藻 *E. huxleyi* BOF92 及其特异性裂解病毒株系 EhV99B1 均由挪威卑尔根大学生物系微生物研究所 Gunnar Bratbak 教授馈赠并保存于本实验室，藻株和病毒株均为纯化株系。颗石藻培养采用 70%海水配制的 f/2-si 加富培养基，培养条件为：温度 16℃±2℃，光照强度为 60 μmol quanta m^{-2} s^{-1}，光照周期为 14/10 (光/暗)。在 2 L 指数生长期的藻液中(~10^6 cells/mL)，以 1∶50 (EhV∶Eh)体积比加入浓缩病毒裂解液(病毒初始浓度约为 10^7 viruses/mL)，另外 2 L 添加等量高温灭活的病毒作为对照组。基于本课题组前期 mRNA 转录组和脂质代谢组学分析结果，EhV 感染早期(6 h)和中后期(45 h)，宿主转录组发生了显著差异表达[23]，细胞脂质代谢产物的积累也发生了明显变化[11]，因此本研究选择病毒感染的 6 h 和 45 h 作为采样时间点。分别于病毒感染 6 h 和 45 h 离心收集 500 mL 藻细胞样品(4℃，7000 r/min，5min)，立即置于液氮中速冻，于−80℃保存备用。每个样本设置两个生物学平行，共计 8 个样本：Con_6 h-1、Con_6 h-2、Exp_6 h-1、Exp_6 h-2、Con_45 h-1、Con_45 h-2、Exp_45 h-1、Exp_45 h-2。

1.2 RNA 的提取、small RNA 文库构建及测序

用 mirVana microRNA Isolation Kit (Ambion，美国)试剂盒提取样本总 RNA，NanoPhotometer (IMPLEN，德国)检测总 RNA 的质量和纯度，Agilent 2100 BioAnalyzer 系统和 RNA 6000 Nano chip (Agilent，美国)分析总 RNA 的完整性。利用 Illumina smallRNA-seq 文库构建试剂盒(KAPA Biosystems，美国)制备 small RNA 测序文库，在 Illumina HiSeqTM 2500 平台进行测序(华大基因公司，深圳)。参考基因组为近缘颗石藻株系 *E. huxleyi* CCMP1516 (https://www.ncbi.nlm.nih.gov/genome/2?genome_assembly_id=22489)和近缘病毒株系 EhV86 (https://www.ncbi.nlm.nih.gov/genome/?term=GCA_000865825.1)。

1.3 生物信息学分析

测序获得的原始 raw reads 过滤筛选后得到 clean reads。去除接头序列、长度小于 18 bp 或者大于 30 bp 的 reads、含有 N 碱基的 reads 及低质量的 reads。后续所有分析基于 clean reads。筛选过程基于 Cutadapt 1.7.1[24]和 Fastx toolkit 0.0.14[25]软件。Clean reads 经过比对 Rfam 11.0 数据库，过滤掉 rRNA、scRNA、snoRNA、snRNA 以及 tRNA 等非编码 RNA 序列，过滤后的 small tags 作为预测 miRNA 的候选序列。使用 BLASTN 软件将剩余的 small tags 比对到近缘株系 *E. huxleyi* CCMP1516 和 EhV86 基因组，保留能完全匹配到参考基因组的 tags。使用 miRDeep2[26]软件对能匹配到参考基因组的 tags 进行二级结构预测。miRNA 的表达水平通过 TPM (transcripts per million reads)方法归一化。使用 edgeR 软件[27]对 miRNA 进行差异表达分析，差异条件设置为：$|\log_2(\text{foldchange})| > 1$ 以及 $P<0.05$。

1.4 miRNA 保守性分析

使用序列比对工具 BLAST，将本实验条件下预测的 24 条宿主 miRNAs 序列与 miRBase 数据库收录的 38,589 条 miRNAs、其他微藻的 2650 条(数据库尚未收录的 miRNAs)以及在 *E. huxleyi* CCMP1516 中已鉴定出的 18 条 miRNA[28]进行比对分析。鉴定保守 miRNA 的条件为：miRNA 种子序列(第 2 到第 8 个碱基)不允许有错配，且总错配数≤2。由于颗石藻基因组具有明显的种内变异，为了进一步了解 *E. huxleyi* BOF92 的 miRNAs 及其前体的功能和进化情况，分析了 miRNA 及其前体序列与其他 13 株测序颗石藻株的保守性[29]。其中，*E. huxleyi* 92A、Eh2 和 Van556 为深度测序的分离株，其他 10 株是低覆盖度测序(覆盖度可以达到 91%至 95%)。对病毒来源的 2 条 miRNA 及其前体序列也与其他 13 株测序病毒株进行保守性分析。

1.5 miRNA 靶基因预测及功能富集分析

miRNA 的靶基因通过 miRanda (v3.3a)[30]软件预测，参数设置为：-sc 140 -en -20 -scale 4 -strict。

靶基因的 GO (Gene Ontology)和 KEGG (Kyoto Encyclopedia of Genes and Genomes)富集通过 DAVID[31]在线软件分析，经过超几何分布检验后，$P<0.05$ 的 term 为显著富集。使用 R 语言程序绘制柱状图及气泡图。

1.6　miRNA-脂代谢靶基因互作网络分析

选取差异表达 miRNA 靶基因中与脂代谢相关的基因进行 miRNA-靶基因互作网络分析，包括脂肪酸合成、脂肪酸降解、甘油脂代谢、甘油磷脂代谢以及鞘脂代谢等。使用 Cytoscape (v3.3.0)软件绘制互作网络图。

1.7　qRT-PCR 验证 miRNA 及其靶基因

对 6 条差异表达的 miRNA 进行茎环荧光定量 qRT-PCR 验证。为了进一步分析病毒诱导的 miRNA 是否可能参与调节宿主的脂质代谢，从 miRNA 靶基因中选取了 6 个与脂代谢相关的关键酶基因，即乙酰辅酶 A 羧化酶-1 (acetyl-CoA carboxylase-1, *ACC-1*)、丝氨酸棕榈酰转移酶(serine palmitoyltransferase, *SPT*)、酰基辅酶 A 氧化酶(acyl-CoA oxidase, *ACOX*)、乙酰辅酶 A 酰基转移酶(acetyl-CoA acyltransferase, *ACAT*)、鞘氨脂碱 N-棕榈转移酶(sphingoid base N-stearoyltransferase, *CERS*)以及丁酰辅酶 A 脱氢酶(butyryl-CoA dehydrogenase, *ACADS*)进行常规荧光定量 qRT-PCR 检测，并分析它们与 miRNA 表达水平之间的关系。用 Primer 5 软件设计引物(表 1)，其中通用茎环引物序列为：5′-GTCGTATCCAGTGC-AGGGTCCGAGGTATTCGCACTGGATACG-3′，均由铂尚生物技术(上海)有限公司合成。提取的 RNA 经 DNA 酶消化后反转录为 cDNA，反转录试剂盒为 FastQuant RT Kit with gDNase 试剂盒(TIANGEN，北京)。qRT-PCR 反应体系参照 Power SYBR® Green PCR Master Mix (Thermo Fisher)荧光定量检测试剂盒说明书。miRNA 以 U6 为内参，靶基因以细胞周期蛋白激酶 CDKA 为内参[32]。qRT-PCR 实验在 QuantStudio 7 Flex Real Time PCR system (Thermo Fisher)上进行，每组实验设置 3 个生物学重复和 3 个技术重复(所用样本均为测序同批次藻样)，并采用 $2^{-\Delta\Delta Ct}$ 法进行相对定量[33]。

表 1　miRNA 及其靶基因的引物序列

Table 1　Primer sequences of miRNAs and their target genes

引物名称	序列(5′→3′)	长度(nt)
U6-F	CTCGCTTCGGCAGCACA	17
U6-R	AACGCTTCACGAATTTGCGT	20
ehx-miR1-5p-F	ATTCCGACCCGTCCCTGA	18
ehx-miR2-5p-F	GTACTCGCCTGTCGTCCG	18
ehx-miR3-3p-F	GCGAGGTTGGCGCGGGC	17
ehv-miR1-3p-F	CTAAGTTCGATCCTCGCC	18
ehv-miR2-5p-F	CCCTCGTAGCTCAGTGGA	18
miRNA universal reverse primer	GTGCAGGGTCCGAGGT	16
CDKA-F	TACGCCGACGAGGACTAC	18
CDKA-R	GCGATATGCTTGGGCAGG	18
ACC-1-F	GAACCGGGTGGATGCAGT	18
ACC-1-R	GAAGGAACATGGCCTTGT	18
SPT-F	TCTCGGACACGCTCAACC	18
SPT-R	CCCTCGACGATGATGATG	18
ACOX-F	GTCCGCTTCACCGTCCAG	18
ACOX-R	CGACGATCAGTCCAGACA	18
ACAT-F	GTCAACAAGGTCTGCTCG	18
ACAT-R	AGGTAGTACGGCACGTTG	18
CERS-F	GAGGAGCGGCACAAGGA	17
CERS-R	CCGATGCGGACAAAGTTG	18
ACADS-F	GAGCACGGGCAACCTCAT	18
ACADS-R	ATGTCGGCGAGCAGGAAC	18

1.8　统计学分析

采用 SPSS 17.0 软件进行统计分析。qRT-PCR 的实验数据以平均值±标准差表示，显著性差异采用 *t* 检验，$P<0.05$ 表示差异显著，$P<0.01$ 表示差异极显著。

2　结果与分析

2.1　赫氏颗石藻 miRNA 的基本特征

经 Illumina HiSeqTM 2500 平台高通量测序后，每个 small RNA 文库至少获得了两千万个原始 reads，其中高质量的 reads 占比>97%，经过筛选后每个样本中符合条件的 clean tags 均在 70%左右，满

足后续分析的需要。原始数据已上传至NCBI的SRA数据库(SRP108676)。

通过对 small RNA 进行过滤、质控、分类以及与参考基因组比对后，共鉴定出 26 条成熟 miRNA (其中包括两条病毒来源的 miRNA)，23 个前体 miRNA，且病毒的 2 条 miRNA 来自同一个前体 miRNA。66.7%的 miRNA 来自基因间区，29.2%的 miRNA 来自外显子区，只有 1 条 miRNA 来自内含子区。miRNA 的长度在 18~30 nt 之间，峰值为 21 nt (图 1)。这些 miRNA 的拷贝数从 8 到 765,680 不等，表明在病毒感染条件下 miRNA 表达水平差异较大。此外，赫氏颗石藻 miRNA 的首位碱基对 C 有着较强的偏好性(54.17%)。成熟 miRNA 的序列、测序丰度以及在基因组的定位见附表 1，前体 miRNA 序列见附表 2。

2.2 赫氏颗石藻 miRNA 的保守性分析

用序列比对工具将预测的 26 条 miRNA 序列与 miRBase 数据库收录的 miRNA 以及未被录入 miRBase 数据库的微藻 miRNA 进行比对分析，结果见附表 3。虽然本文中的一些 miRNA 能够和其他 miRNA 的部分碱基配对(包括来源于 *E. huxleyi* CCMP1516 的 18 条 miRNA)，但都不满足鉴定为保守 miRNA 的条件。赫氏颗石藻 BOF92 来源的前体 miRNA 及成熟 miRNA 与其他 13 株赫氏颗石藻基因组的比对结果显示(附表 4、5)，10 条 miRNA (深灰色标记)与其他所有 13 株藻株基因组完全匹配，另外 14 条的前体序列或成熟体序列的匹配较短或无法匹配，表明这 10 条来源于赫氏颗石藻 BOF92 的 miRNA 及其前体比其他 miRNAs 更为保守。对于病毒的 2 条 miRNA，它们都不能同时比对到其他 13 株赫氏颗石藻病毒的基因组上，表明 EhV99B1 编码的 miRNA 在株系间的变异更为明显，但 ehv-miR1-3p 比 ehv-miR2-5p 相对保守(附表 6)。

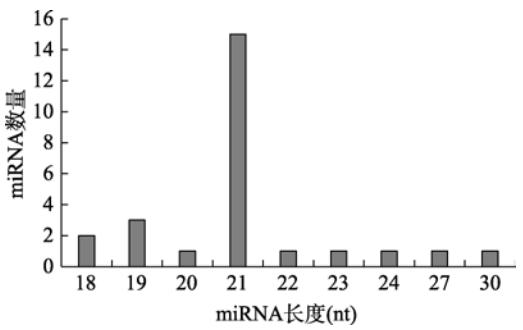

图 1 miRNA 的长度分布

Fig. 1 The length distribution of miRNAs

2.3 miRNA 差异表达分析

对 26 条 miRNA 的测序丰度进行差异分析，结果显示共有 3 条宿主 miRNA 和 2 条病毒 miRNA 在本实验条件下发生了差异表达(表 2)。这 5 条 miRNA 茎环荧光定量 qRT-PCR 结果与测序结果基本一致。5 条差异 miRNA 的二级结构如图 2 所示，其中 3 条 miRNA 位于前体二级结构的 5′端臂，2 条位于 3′端臂，且病毒的 2 条 miRNA (ehv-miR1-5p 和 ehv-miR2-3p)来自同一个前体二级结构。

2.4 差异表达 miRNA 靶基因的预测及 GO 富集分析

以同批次样品转录组测序结果中的 32,909 条宿主 mRNA 作为靶基因预测的数据库(NCBI 登录号为 SRP189555)[29]，26 条 miRNA 共获得了 26,380 个靶

表 2 差异表达 miRNA 的测序差异倍数对数值及 qRT-PCR 的–ΔΔCt 结果

Table 2 DE miRNAs in terms of log_2 (fold change) from sRNA-seq and –ΔΔCt results from qRT-PCR

实验组别	miRNA	log_2 (fold change)	–ΔΔCt
Exp_6h vs Con_6h	ehx-miR1-5p	–1.271**	–1.44±0.31*
Exp_6h vs Con_6h	ehx-miR2-5p	1.082*	2.15±0.68**
Exp_6h vs Con_6h	ehx-miR3-3p	1.545**	1.88±0.59**
Exp_45h vs Con_45h	ehv-miR1-5p	8.484[a], **	24.24±1.12[b], **
Exp_45h vs Con_45h	ehv-miR2-3p	11.60[a], **	30.12±2.08[b], **

*表示 $P<0.05$；**表示 $P<0.01$；[a] 表示 Con_45 h 样本测序结果中未检测到丰度值，TPM 值以 0.01 代替；[b] 表示 Con_45 h 样本 qRT-PCR 结果中 *Ct* 值达到最大阈值 50。

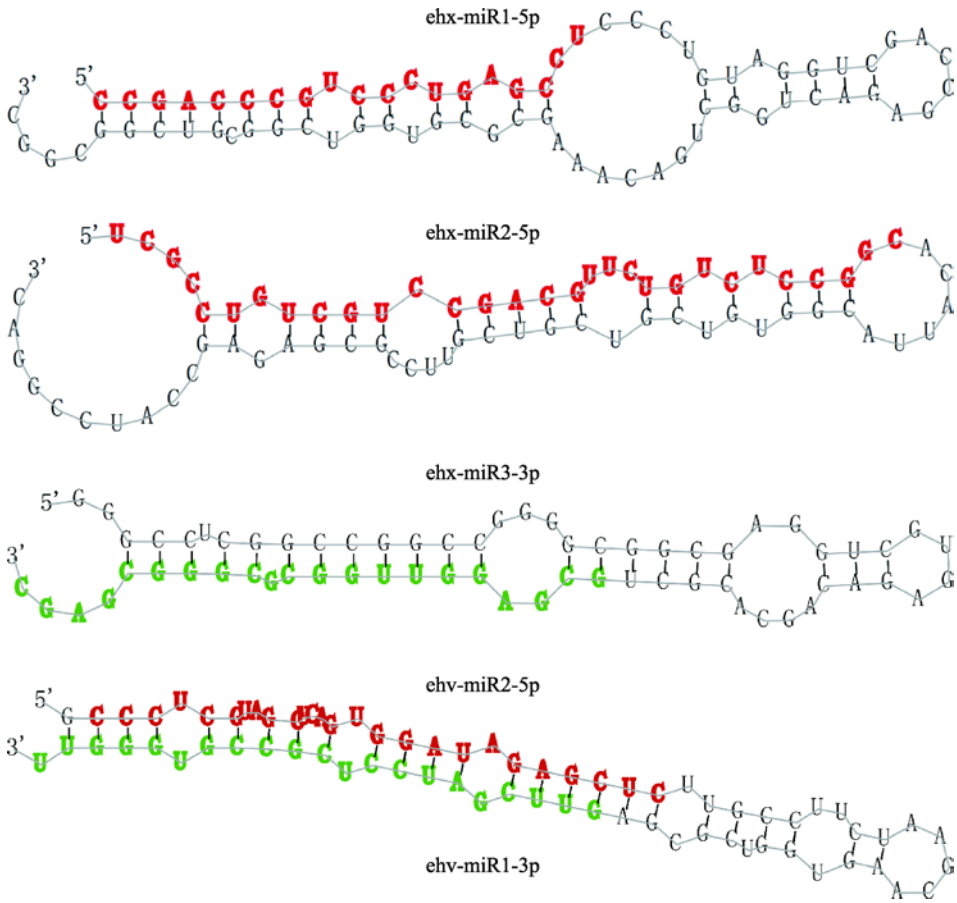

图 2　5 条差异差异表达 miRNA 的前体二级结构

Fig. 2　Precursor structures of five differentially expressed (DE) miRNAs

在每个发夹结构中，红色表示位于 5′臂(5p)的成熟 miRNA，绿色表示位于 3′臂(3p)的成熟 miRNAs。

基因。5 条差异表达的 miRNA 靶向了 11,408 个靶基因，其中 3986 个靶基因发生了差异表达(在感染早期和晚期分别为 1246 和 3043 个，交集为 303 个基因)。差异表达的靶基因 GO 富集结果主要分为 3 个类别(图 3)：生物过程(biological process)、细胞组分(cellular component)和分子功能(molecular function)。生物过程中富集到基因数目最多的是代谢过程(metabolic process)，还包括刺激应答(response to stimulus)、信号通路(signaling)等；细胞组分中膜(membrane)、膜组分(membrane part)以及细胞(cell)等富集最显著；分子功能中，更多的靶基因与催化活性(catalytic activity)、结合(binding)以及转运活性(transporter activity)相关，此外还包括信号转导活性(signal transducer activity)和抗氧化活性(antioxidant activity)。GO 富集结果表明 miRNA 对颗石藻各种功能基因的调控范围十分广泛。

此外，本研究也对病毒的基因进行了靶向预测分析。结果显示，赫氏颗石藻 BOF92 来源的成熟 miRNA 靶向 8 个有明确功能的病毒基因(附表 7)，分别是病毒衣壳蛋白(major capsid protein)、DNA 拓扑异构酶(DNA topoisomerase)、核酸内切酶(endonuclease)、核糖核酸酶(ribonuclease)、核糖核苷酸还原酶蛋白(ribonucleoside-diphosphate reductase protein)、DNA 依赖的 RNA 聚合酶 II 亚基(DNA-dependent RNA polymerase II largest subunit)、DNA 指导的 RNA 聚合酶 II 亚基(DNA-directed RNA polymerase II subunit)以及丝氨酸蛋白酶(serine protease)。其中，宿主编码的上调 ehx-miR2-5p 和 ehx-miR3-3p 靶向病毒衣壳蛋白基因的得分均较高，提示 ehx-miR2-5p 和 ehx-miR3-3p 可能在宿主抗病毒防御过程中具有一定的作用。衣壳蛋白的作用是包裹病毒的遗传物质，能够协助病毒感染，且具有免疫原性。而宿主

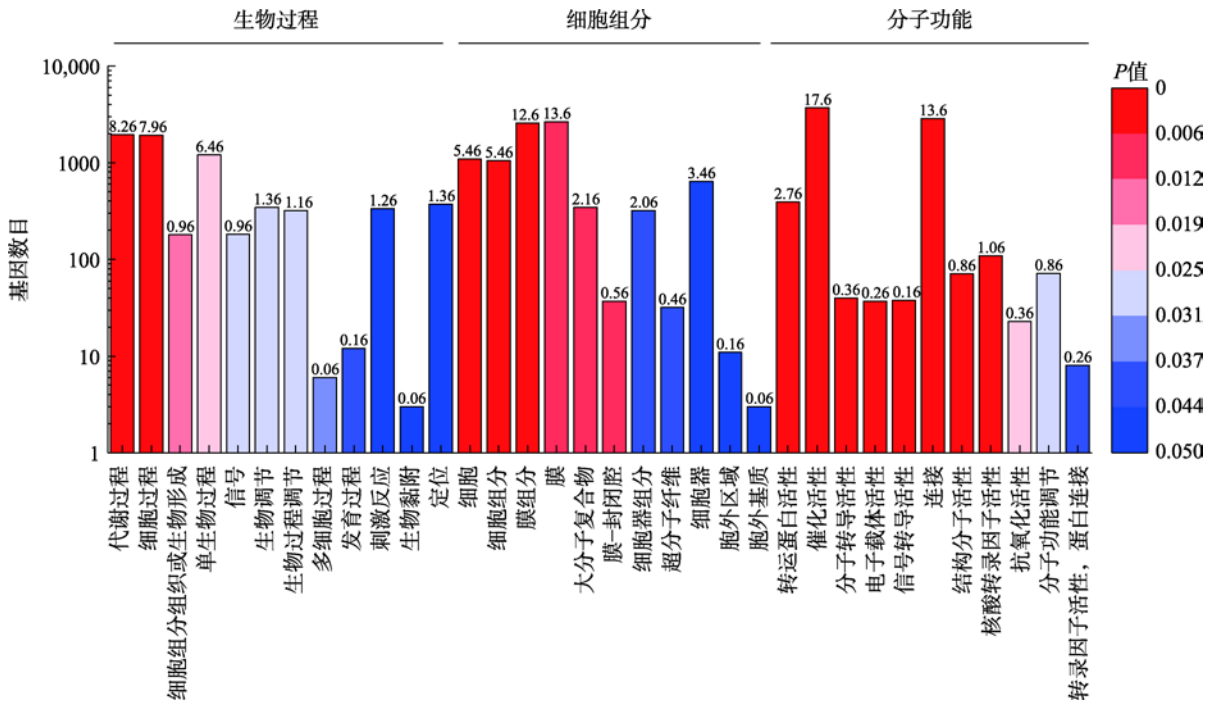

图 3　miRNA 靶基因的 GO 富集分析

Fig. 3　GO enrichment analysis of DE miRNA target genes

横坐标表示不同类别的 GO term，纵坐标表示每个 GO term 中基因的数量，每个柱子上面的数字代表 miRNA 靶基因占该通路中总基因数的百分比(%)；不同的颜色对应不同的显著性 *P* 值。

编码的 miRNA 可能通过靶向病毒衣壳蛋白基因以抑制其翻译，进而影响病毒的装配过程。表明 ehx-miR2-5p 和 ehx-miR3-3p 的上调表达可能是宿主的抗病毒策略。由于转录组测序数据中没有检测到病毒的转录本，因此有关宿主 miRNA 如何影响病毒的生理过程本文将不做进一步分析。

2.5　差异表达 miRNA 靶基因的 KEGG 富集分析

差异表达 miRNA 的靶基因 KEGG 富集结果见图 4。在病毒感染早期，富集最显著的两个通路分别是戊糖葡糖醛酸相互转化(pentose and glucuronate interconversions)和氨酰 tRNA 合成(aminoacyl-tRNA biosynthesis)此外，还包括脂代谢过程，特别是甘油脂代谢(glycerolipid metabolism)和脂肪酸代谢(fatty acid metabolism)。甘氨酸，丝氨酸和苏氨酸代谢(glycine, serine and threonine metabolism)也富集显著，丝氨酸可作为神经酰胺合成的原料参与鞘脂代谢。在病毒感染晚期，富集最显著的代谢通路包括 ABC 转运蛋白(ABC transporters)和氨酰 tRNA 合成(aminoacyl-tRNA biosynthesis)，鞘脂代谢(sphingolipid metabolism)、脂肪酸降解(fatty degradation)以及糖酵解/糖异生(glycolysis/gluconeogenesis)等。特别是感染早期和晚期，差异表达 miRNA 的靶基因均能够显著富集到宿主脂代谢过程，暗示病毒感染重构的脂代谢过程可能存在转录后水平调控。

2.6　miRNA 与脂代谢靶基因的互作网络

miRNA-脂代谢靶基因的互作网络图能够帮助人们更好地了解 miRNA 与脂代谢相关基因之间的调控关系。从图 5 中可以看出，ehx-miR3-3p 和 ehv-miR1-5p 靶基因数量最多，并且这两个 miRNA 的靶基因在 5 个脂代谢相关通路中都有分布，表明这两个 miRNA 可能在脂代谢调控中起到核心作用。同时，部分基因也能被多个 miRNA 靶向，比如 *ACSL4* (长链酰基辅酶 A 合成酶 4)能够同时被 ehv-miR2-3p 和 ehx-miR3-3p 靶向。此外，病毒 miRNA 和宿主 miRNA 也能同时靶向某一代谢途径，表明病毒可能会利用宿主 miRNA 来共同调节脂代谢过程。

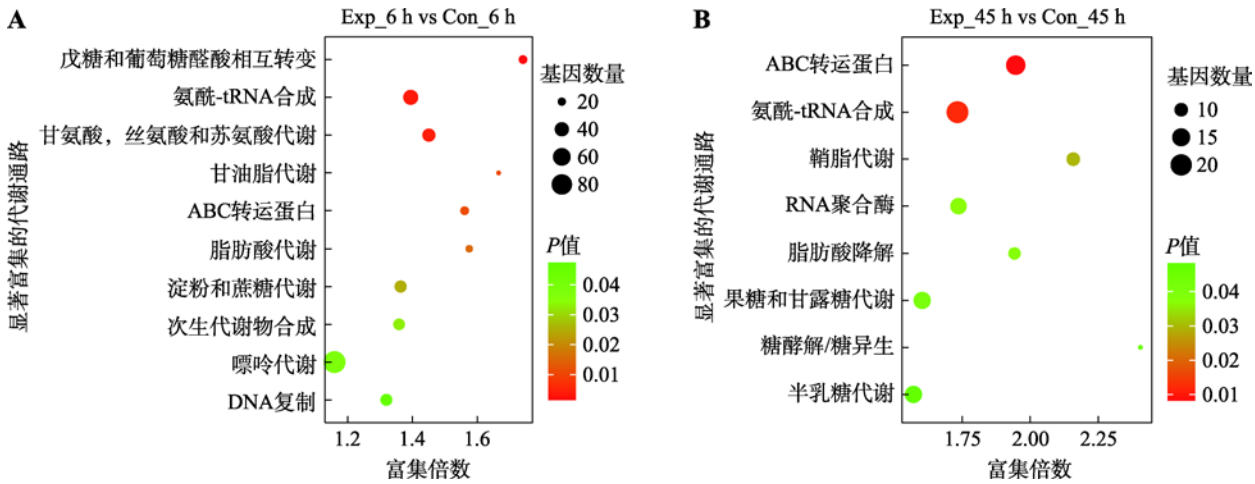

图 4　病毒感染 6 h (A)和 45 h (B)差异 miRNA 靶基因的 KEGG 富集分析

Fig. 4　KEGG enrichment analysis of DE miRNA target genes at 6 (A) and 45 (B) hours post infection

富集倍数为：(某通路中差异基因数目/有注释的差异基因总数)/(某通路中的有注释的基因总数/背景基因中有注释的基因总数)；气泡的大小对应该通路中基因数量的多少，颜色表示富集的显著性 *P* 值。

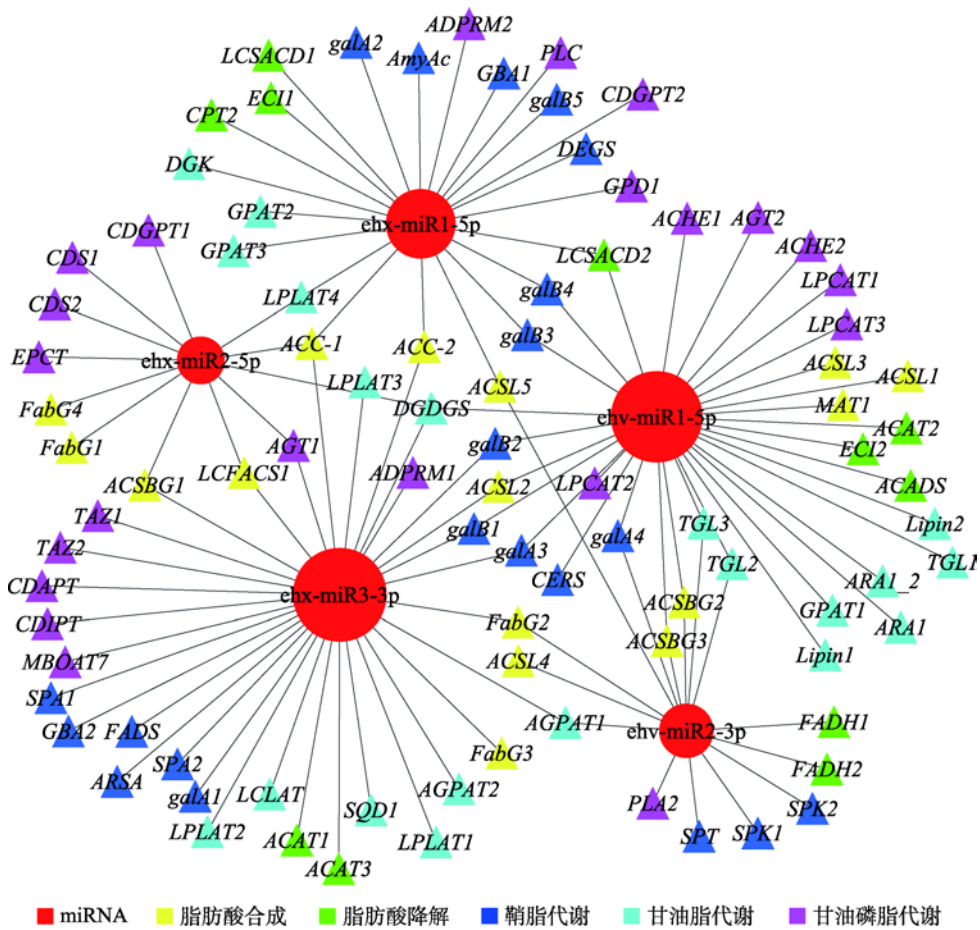

图 5　miRNA-脂代谢靶基因互作网络图

Fig. 5　The correlation network between miRNA and lipid metabolism-related target genes

图中红色圆形表示 miRNA，三角形表示脂代谢相关靶基因，不同颜色对应不同脂代谢过程。

2.7 miRNA 靶基因 qRT-PCR 验证

为了进一步了解 miRNA 与脂代谢相关靶基因的靶向关系，采用 qRT-PCR 方法验证了 miRNA 靶基因的表达水平，并分析 miRNA 与其靶基因表达之间的相关性。选取 6 个脂代谢关键靶基因(附表 8)，包括参与脂肪酸合成的 *ACC-1*，参与鞘脂代谢过程的 *SPT* 和 *CERS*，以及参与脂肪酸降解过程的 *ACOX*, *ACAT* 和 *ACADS* 酶基因。荧光定量结果显示，除了 *ACC-1* 基因在病毒感染早期表达水平显著升高外，其他几个脂代谢相关酶基因的表达水平在病毒感染早期(6 h)和晚期(45 h)均不同程度下调(附图 1)；而且这些酶基因的表达水平与 miRNA 的 qRT-PCR 结果均为负相关关系，符合一般的 miRNA 对靶基因的调控规律，表明这些靶基因的表达水平很可能受到 miRNA 的调控。

3 讨论

miRNA 是近年来 RNA 生物学领域中的重大发现，其通过结合在靶基因的不同位点抑制或激活靶基因的表达水平，作为丰度极高的基因调控因子参与调控多种生物学过程。特别是新近研究发现 miRNA 与它作用的靶基因是响应生物及非生物环境胁迫的主要调控因子[34]。例如，miRNA 作为关键因子在复杂的病毒–宿主互作网络中调控病毒的复制、免疫逃逸及宿主抗病毒等过程，并可能成为病毒感染诊断及治疗的新手段[35]。miRNA 的另一个新功能是通过控制代谢过程中的靶基因，从而调控相关代谢通路，特别是在脂质代谢网络中起重要调节作用[19,36]。越来越多的研究表明，病毒感染赫氏颗石藻能够显著重塑宿主脂肪酸代谢、鞘脂代谢及甘油脂等脂代谢过程，且这些相关脂代谢与病毒的侵染、复制、组装及病毒颗粒的释放等过程密切相关[9~11]。miRNA 是否参与颗石藻病毒感染重塑的脂代谢过程尚不清楚。本研究通过对 EhV99B1 感染的赫氏颗石藻 BOF92 细胞样品进行小 RNA 测序，鉴定出 26 条新的 miRNA，分析其基本特征和保守性，并结合 miRNA 差异表达谱特征、靶基因功能富集以及 qRT-PCR 实验等，初步分析了病毒感染诱导的差异表达 miRNA 在宿主脂代谢过程中可能发挥的作用。

3.1 赫氏颗石藻 miRNA 的基本特征

本研究经测序分析共鉴定出了 24 条颗石藻 miRNA，长度主要集中于 18~21 nt，峰值为 21 nt，符合一般植物 miRNA 的特征。*E. huxleyi* BOF92 的 miRNA 首位碱基对 C 有着较强的偏好，这一点与营养胁迫条件下 *E. huxleyi* CCMP1516 中的 miRNA 相似[28]。然而，在大部分生物体中，包括其他一些浮游植物，其 miRNA 的 5′端首位碱基通常为 U[37~41]。这可能与参与 RISC (RNA 诱导的沉默复合体)形成过程中的 2 个重要蛋白即 Dicer-like protein (DCL)和 Argonaute (AGO)有关。DCL 能够切割初始 miRNA 进而形成前体 miRNA，该蛋白通常包含以下几个特征结构域：DEAD、Hleicase-C、dsRBD 及 RNA 酶Ⅲ结构域[42,43]。*E. huxleyi* CCMP1516 能够编码四种 DCL，但是它们都缺少一个或多个特征结构域，有三种包含了 DEAD，Helicase-C 和 DSRM 结构域，但不含有 RNA 酶Ⅲ结构域，该结构与对于 RNA 的绑定和切割十分重要；另外一种 DCL 含有 DRSM 和 RNA 酶Ⅲ结构域，但不含 DEAD 和 Helicase-C 结构域[25]，颗石藻 DCL 结构上的这些差异可能会影响其切割位点的选择，进而影响 miRNA 首位碱基的偏好性。AGO 蛋白位于 RISC 的中心，其最主要的功能结构域为 PAZ 和 PIWI 结构域。*E. huxleyi* CCMP1516 基因组中有 2 种 AGO 同源物，虽然它们都含有 PAZ 和 PIWI 结构域，但与其他微藻以及部分模式物种的 AGO 系统发育树的分析结果显示[28]，包括颗石藻在内的各种微藻的 AGO 蛋白都各自聚集成一类，表明这些微藻的 AGO 蛋白在进化上同源性较低。因此颗石藻可能也存在特殊的 RNA 沉默机制，使得 miRNA 的首位碱基不偏好于 U。

在病毒诱导的 *E. huxleyi* BOF92 miRNA 中，66.7%来自基因间区，29.2%来自外显子区，只有 1 条 miRNA 来自内含子区(附表 1)。这与近缘株系 *E. huxleyi* CCMP1516 的 miRNA 来源分布较为相似，*E. huxleyi* CCMP1516 的 miRNA 约 77%来自基因间区，23%来自内含子区[28]。三角褐指藻(*Phaeodactylum tricornutum*)和团藻(*Volvox carteri*)的 miRNA 也都主要来源于基因间区，只有少部分 miRNA 比对到了外显子区[38,44]，这些微藻的 miRNA 的来源更类似于陆生高等植物[18]。莱茵衣藻(*Chlamydomonas reinhardtii*)和长囊水云(*Ectocarpus siliculosus*)的 miRNA 来源类

似, 即大部分位于内含子区, 少数位于基因间区[40,39]。综上所述，不同浮游植物 miRNA 的来源具有多样性, 表明 miRNA 在浮游植物的转录后水平可能具有广泛的调控功能。

3.2　miRNA 保守性特点

针对本研究中鉴定的 24 条宿主 miRNA 同源性较低的问题，推测可能有以下几个原因。首先，不同微藻之间的 miRNA 可能是独立进化的。Zhao 等[40]首先对莱茵衣藻的 miRNA 进行了表征, 作者将鉴定出来的莱茵衣藻 miRNA 与 miRBase 数据库比对后未发现同源 miRNA。随后多位学者对不同种的微藻，如假微型海链藻(*T. pseudonana*)[21]，三角褐指藻(*P. tricornutum*)[44]及赫氏颗石藻 CCMP1516[28]等在不同生长条件或环境胁迫条件下的 miRNA 进行了研究，也均未能在 miRBase 数据库找到同源的序列。这暗示 miRNA 可能在浮游植物、动植物中分别有着独立的进化机制。其次，病毒感染诱导产生特异性 miRNA 的表达。miRNA 的表达是动态的，具有时空特异性，不同胁迫条件如营养胁迫、氧化应激、病毒感染等都会影响 miRNA 的表达，某些特异的 miRNA 可能表达水平很低，仅在特殊的生理生态条件下表达量才增加[28]。因此，病毒感染可能使赫氏颗石藻 BOF92 产生了特异性 miRNA。另外，赫氏颗石藻 miRNA 株系间的变异较为明显。根据本文 24 条宿主 miRNA 与其他 13 株赫氏颗石藻基因组的比对结果看，能够全部比对上其他赫氏颗石藻株系的 miRNA 仅有 10 条，占 miRNA 总数的 42%左右。赫氏颗石藻作为一种单细胞浮游植物，基因组的种内变异更有利于其适应动态变化的海洋环境以及在与病毒的“arms race”中获得优势。本研究中鉴定的 24 条宿主 miRNA 保守性较低可能是这些因素共同作用的结果。此外，本研究也没有找到 EhV99B1 miRNA 的同源序列。一方面, 已鉴定的病毒 miRNA 非常有限；另一方面，与真核生物相比，病毒基因组有着更高的变异率，这意味着病毒拥有能快速适应宿主和环境条件的进化优势。

3.3　miRNA 靶向宿主脂代谢途径

miRNA 靶基因功能富集结果显示，病毒感染早期(6 h)和晚期(45 h)，差异表达的 miRNA 均能靶向宿主脂肪酸和鞘脂代谢通路(图 6)。就脂肪酸代谢而言，感染早期，宿主编码的 ehx-miR1-5p 下调，其对脂肪酸合成过程的限速酶 *ACC-1* 靶基因的抑制作用减弱，与此同时宿主编码的 ehx-miR4-3p 上调，其对脂肪酸降解过程中的关键酶 *ACOX* 和 *ACAT* 靶基因的抑制作用增强，从而导致脂肪酸含量的积累(图 6A)。感染晚期, 则是病毒编码的 ehv-miR2-5p 上调，并靶向抑制脂肪酸降解过程的相关酶基因 *ACADS* (图 6B)。因此，推测感染过程中，宿主和病毒编码的 miRNA 协同作用导致宿主细胞中脂肪酸含量的不断积累。脂肪酸在病毒感染过程有着十分重要的作用, 一方面大型双链 DNA 病毒的复制和装配有更高的代谢需求，另一方面脂肪酸可作为甘油脂和鞘脂的合成原料[7]。另外，病毒感染过程中，宿主鞘脂从头合成过程中的两个关键酶基因 *SPT* 和 *CERS* 的表达分别受到早期宿主上调的 ehx-miR3-5p (图 6A)和晚期病毒上调的 ehv-miR2-5p (图 6B)的靶向抑制，因而宿主鞘脂从头合成途径在整个病毒感染过程中被显著抑制, 并导致鞘脂类物质含量减少。上述结果可能在一定程度上补充解释了本课题组之前的脂质组学数据，即 EhV99B1 感染早期(6 h)和晚期(45 h)，宿主赫氏颗石藻 BOF92 细胞中大部分脂肪酸代谢物显著积累, 而几乎所有检测到的 16 种鞘脂类物质的含量均显著降低[11]。众所周知，鞘脂是细胞膜上“脂筏”结构域的关键功能成分，也是病毒包膜结构的主要成分之一，对病毒的侵染、装配及释放过程十分重要，且作为信号分子，在感染晚期能够诱导宿主程序性细胞死亡。对赫氏颗石藻 CCMP1516 及其特异性裂解病毒 EhV86 的全基因测序注释结果显示，通过基因水平转移，病毒基因组“截获”了一套鞘脂从头合成途径中的关键酶基因，并通过调节相关基因的表达在一定程度上掌控了宿主的鞘脂代谢过程[45]。在 EhV201 感染赫氏颗石藻 CCMP374 过程中发现，随着感染时间的延长(感染 0~36 h)，宿主基因组编码的 *hSPT* 基因表达显著降低，而病毒基因组编码的 *vSPT* 在 mRNA 和蛋白水平的表达均明显上升，从而大量合成并积累病毒性鞘糖脂[9]，并最终诱导宿主程序性细胞死亡[15,17]。综上所述, 病毒和宿主的 miRNA 均可能参与宿主脂代谢的重塑过程, 其中病毒的 miRNA 主要在感染晚期通过对脂肪酸降解过程和鞘脂合成过程中的部分

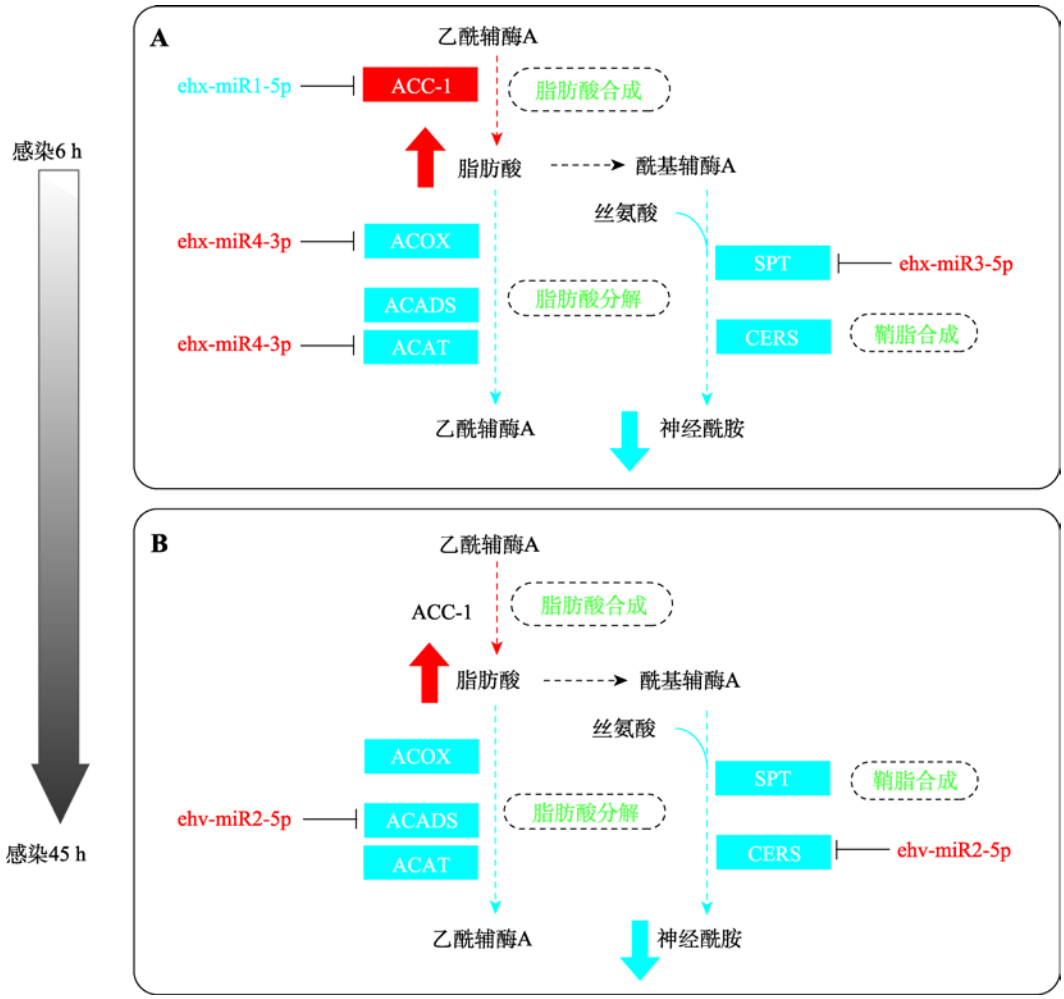

图 6　miRNA 靶向的脂肪酸及鞘脂代谢通路

Fig. 6　Fatty acid and sphingolipid metabolism pathways targeted by miRNAs

A 和 B 分别表示病毒感染 6 h 和 45 h 差异 miRNA 对宿主脂肪酸和鞘脂代谢的靶向调控图。红色字体代表 miRNA 及靶基因高表达，蓝色填充表示 miRNA 及靶基因低表达；红色箭头代表脂代谢物积累，蓝色箭头表示脂代谢物减少。虚线框中的绿色字体表示不同的代谢通路

基因进行靶向抑制，进而促进宿主脂肪酸的积累和鞘脂水平的降低。

附录：

附加材料详见文章电子版 www.chinagene.cn。

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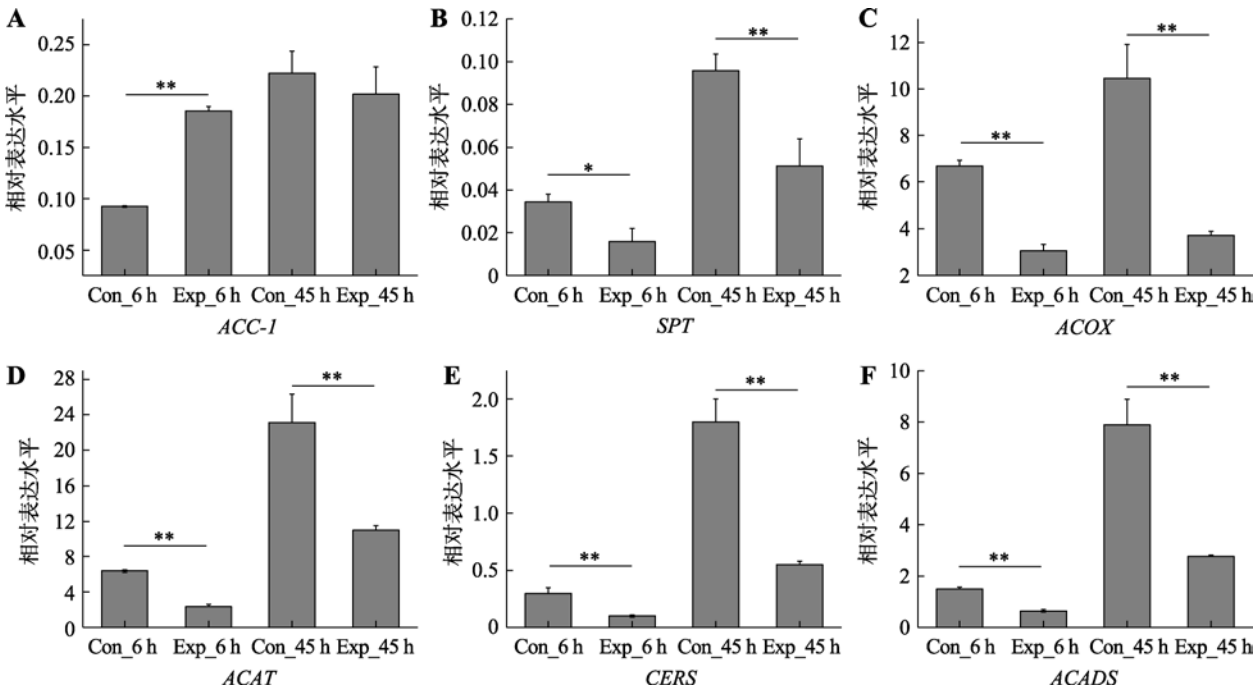

附图 1　6 个靶基因的荧光定量 qRT-PCR 结果

Supplementary Fig. 1　The qRT-PCR results of six target genes

“*”表示 $P<0.05$；“**”表示 $P<0.01$。

附表 1　成熟 miRNA 的基本信息

Supplementary Table 1　The basic information of mature miRNAs

miRNA ID	miRNA 序列	长度 (nt)	表达丰度(FPKM)				基因组位置
			Con_6h	Exp_6h	Con_45h	Exp_45h	
NW_005195085.1_38173-5p	cgucggcgcaugugguuagag	21	24.23	20.52	17.56	12.32	Intergenic
NW_005195085.1_38180-3p	cuagucguaguaaguguuuga	21	5.51	2.53	7.48	2.66	Intergenic
NW_005196191.1_35170-3p	cagguguauuugugaggccaa	21	2.45	1.11	3.23	2.23	Intergenic
NW_005196603.1_34298-5p (ehx-miR1-5p)	ccgacccgucccugagccu	19	206.33	71.57	145.54	86.69	intron
NW_005196755.1_34052-3p	cgaggagccgccaccagagcu	21	3.42	1.57	3.56	4.59	Intergenic
NW_005196755.1_34028-5p	cgagaugguacugaagagauc	21	240.47	205..45	266.69	116.88	Intergenic
NW_005196755.1_34019-3p	cuuguccgcgucgccucauga	21	1.45	2.46	1.78	2.56	Intergenic
NW_005197715.1_30571-5p	gagguuggcgcgggcgagc	19	2.47	4.76	7.58	3.45	Exon
NW_005198391.1_27186-5p	cgacaccugcuggcuggcgcc	21	3.12	1.63	1.45	1.73	Exon
NW_005198966.1_24265-3p	aacccucgcucggagccgcgc	21	3.32	1.86	1.73	1.43	Intergenic
NW_005198966.1_24265-5p	uugguucugacgauuugu	18	88106.45	105030.78	101495.53	88208.43	Exon
NW_005199363.1_22042-5p	cguucagggcgccgggcacg	20	5.45	1.78	3.51	1.81	Intergenic
NW_005199378.1_21978-3p	gggcuaugcccgcgcgaguuc	21	1.12	0.79	1.96	1.13	Intergenic
NW_005199378.1_21978-5p	guugacguggccgagugguuaag	23	3124.46	1430.13	1710.79	761.41	Intergenic
NW_005199975.1_17848-3p	cagagccacccuccuggacgc	21	2.73	1.23	1.72	0.00	Intergenic
NW_005200282.1_15947-3p	auguugucgccccaguccg	19	24.56	11.22	17.86	19.76	Exon
NW_005200461.1_14543-5p	gccggcuacgccgccgccgggc	22	3.45	1.37	2.56	1.39	Intergenic

续表

miRNA ID	miRNA 序列	长度(nt)	表达丰度(FPKM)				基因组位置
			Con_6h	Exp_6h	Con_45h	Exp_45h	
NW_005200496.1_14318-5p (ehx-miR2-5p)	ucgccugucguccgacguucugucuccggc	30	25.64	52.78	14.67	7.35	Exon
NW_005200517.1_13952-3p	cggagaagcgucagacucggc	21	17.56	18.67	13.47	13.43	Intergenic
NW_005200535.1_13863-3p	cagucguguguuuggcguccu	21	1.97	3.45	0.99	1.89	Intergenic
NW_005200600.1_13330-3p (ehx-miR3-3p)	gcgagguuggcgcgggcgagc	21	7.36	17.41	18.22	12.56	Intergenic
NW_005200881.1_10661-3p	cgaacuugucggcgcccgcga	21	4.25	1.47	3.34	1.67	Exon
NW_005201234.1_6668-5p	acuccauggccagggccu	18	5.63	1.29	2.42	1.37	Intergenic
NW_005202428.1_1248-3p	gccacggccgcgccgccgcccgcc	24	2.56	2.79	4.34	5.34	Exon
gi|73852470|ref|NC_007346.1|_540-3p (ehv-miR1-3p)	guucgauccucgccgugggguu	21	0.01	0.01	0.01	61.35	Exon
gi|73852470|ref|NC_007346.1|_540-5p (ehv-miR2-5p)	cccucguagcucaguggauagagcuc	26	0.01	0.01	0.01	7.64	Exon

附表 2　前体 miRNA 的完整序列

Supplementary Table 2　The full sequences of pre-miRNAs

前体 miRNR ID	长度(nt)	前体 miRNA 序列
NW_005195085.1_38173	74	cgucggcgcauguggguuagagauacaucuagagauacuucugcauuuuucucuuuccgcacgcaccccgaauuc
NW_005195085.1_38180	60	agauguuacgauaacuagcacauuuagaucauucaugugcuagucguaguaaguguuuga
NW_005196191.1_35170	46	gggguuggggaaacaucugucaaaugcagguguauuugugaggccaa
NW_005196603.1_34298	70	ccgacccgucccugagccucccuguaggucgaccgagacuggcugacaaagcgcguggucggcgucggcg
NW_005196755.1_34019	52	aagaggaagggaugugcgagaaagcaaccugcuuguccgcgucgccucauga
NW_005196755.1_34028	72	cgagaugguacugaagagauccguuacgcaaaagcaugcgcgacuugcacucuuucgugccacucgcucgcc
NW_005196755.1_34052	58	auaacgugugucgggcacucgggcugcuuguacggcucgaggagccgccaccagagcu
NW_005197715.1_30571	47	gagguuggcgcgggcgagcuucgacaucuucucgcggcagcggucga
NW_005198391.1_27186	78	cgacaccugcuggcuggcgccggccgucgccucugccgcgcgcgcgaggcccacgucggcgagguagccguugccgcg
NW_005198966.1_24265	53	uugguucugacgauuuguugcgcgcgcgcaacaacccucgcucggagccgcgc
NW_005199363.1_22042	52	cguucagggcgccgggcacgccuuaggggggcgugcgccgugaugcucgggc
NW_005199378.1_21978	65	guugacguggccgaguggguuaaggcgagggacugcuaaucccuugggcuaugcccgcgcgaguuc
NW_005199975.1_17848	86	cuccggcgaggugaggaccucugcacuugugaggaccucugcuuccagcccacaucuuccaggugcagagccacccuccuggacgc
NW_005200282.1_15947	39	agcuggggcagcagcgcagcauguugucgccccaguccg
NW_005200461.1_14543	56	gccggcuacgccgccgccgggccagcccgccucgccgccucaugcguugccgccgc
NW_005200496.1_14318	71	ucgccugucguccgacguucugucuccggcacauuacggugucgucgucguuccgcgagagccauccggac
NW_005200517.1_13952	57	gaggucaacauguuucucguagaacacggugacgugcggagaagcgucagacucggc
NW_005200535.1_13863	70	gggccgggggggcggcgggcgcggggugcggggugcggugcggugcgugcagucguguguuuggcguccu
NW_005200600.1_13330	65	gggccucggccggccggggcggcgaggucgugagacagcacgcugcgagguuggcgcgggcgagc
NW_005200881.1_10661	55	accucgcgcggcaggcggcagacgaagauguugccgaacuugucggcgcccgcga
NW_005201234.1_6668	56	acuccauggccagggccuaucgucuucaagaggagaagccuaccgccgaggaggac
NW_005202428.1_1248	53	cgcagcugcgcgcggccgcggcuaccucggccacggccgcgccgccgcccgcc
gi|73852470|ref|NC_007346.1|_540	72	cccucguagcucaguggauagagcucuugccuucuaagcaaguggucgcgaguucgauccucgccgugggguu

附表 3　26 条成熟 miRNA 与已鉴定 miRNA 的比对结果

Supplementary Table 3　The results of 26 mature miRNAs mapping against the identified miRNAs

比对到 miRbase 数据库中已知 miRNA 的结果

Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005196603.1_34298-5p	pal-miR-9987-3p	93.75	16	1	0	2	17	20	5	25	19.6
NW_005196603.1_34298-5p	hsa-miR-6743-5p	83.333	18	3	0	2	19	19	2	80	18
NW_005198966.1_24265-3p	hsa-miR-3183	83.333	18	3	0	4	21	2	19	89	18
NW_005199363.1_22042-5p	aof-miR160a	83.333	18	3	0	1	18	18	1	84	18
NW_005199363.1_22042-5p	vca-miR160-5p	83.333	18	3	0	1	18	18	1	84	18
NW_005199363.1_22042-5p	cpa-miR160d	83.333	18	3	0	1	18	18	1	84	18
NW_005199363.1_22042-5p	mes-miR160f	83.333	18	3	0	1	18	18	1	84	18
NW_005199363.1_22042-5p	mes-miR160e	83.333	18	3	0	1	18	18	1	84	18
NW_005199363.1_22042-5p	cme-miR160d	83.333	18	3	0	1	18	18	1	84	18
NW_005199363.1_22042-5p	bdi-miR160e-5p	83.333	18	3	0	1	18	18	1	84	18
NW_005199363.1_22042-5p	tcc-miR160a	83.333	18	3	0	1	18	18	1	84	18
NW_005199363.1_22042-5p	ahy-miR160-5p	83.333	18	3	0	1	18	18	1	84	18
NW_005199363.1_22042-5p	rco-miR160c	83.333	18	3	0	1	18	18	1	84	18
NW_005199363.1_22042-5p	sbi-miR160f	83.333	18	3	0	1	18	18	1	84	18
NW_005199363.1_22042-5p	vvi-miR160b	83.333	18	3	0	1	18	18	1	84	18
NW_005199363.1_22042-5p	vvi-miR160a	83.333	18	3	0	1	18	18	1	84	18
NW_005199363.1_22042-5p	mtr-miR160c	83.333	18	3	0	1	18	18	1	84	18
NW_005199363.1_22042-5p	ptc-miR160f	83.333	18	3	0	1	18	18	1	84	18
NW_005199363.1_22042-5p	ptc-miR160e-5p	83.333	18	3	0	1	18	18	1	84	18
NW_005199363.1_22042-5p	osa-miR160f-5p	83.333	18	3	0	1	18	18	1	84	18
NW_005199378.1_21978-5p	cel-miR-8189-5p	88.889	18	2	0	6	23	21	4	26	19.8
NW_005200461.1_14543-5p	mdo-miR-12392-3p	88.235	17	2	0	6	22	23	7	52	18.8
NW_005200461.1_14543-5p	bta-miR-11976	88.235	17	2	0	2	18	17	1	52	18.8
NW_005200461.1_14543-5p	bta-miR-11975	88.235	17	2	0	2	18	17	1	52	18.8
NW_005200461.1_14543-5p	hsa-miR-3960	88.235	17	2	0	2	18	17	1	52	18.8
NW_005200461.1_14543-5p	mmu-miR-3960	88.235	17	2	0	2	18	17	1	52	18.8
NW_005200461.1_14543-5p	ssc-miR-4332	100	13	0	0	10	22	5	17	69	18.4
NW_005200535.1_13863-3p	mle-miR-10a-3p	80	20	4	0	2	21	3	22	77	18.2
NW_005202428.1_1248-3p	bta-miR-11976	85	20	3	0	1	20	20	1	24	20.1
NW_005202428.1_1248-3p	bta-miR-11975	85	20	3	0	1	20	20	1	24	20.1
NW_005202428.1_1248-3p	hsa-miR-9899	88.235	17	2	0	7	23	6	22	56	18.8
NW_005202428.1_1248-3p	cja-miR-638	100	13	0	0	12	24	22	10	76	18.4
NW_005202428.1_1248-3p	mmu-miR-5126	77.273	22	5	0	2	23	22	1	76	18.4
NW_005202428.1_1248-3p	mml-miR-638	100	13	0	0	12	24	23	11	76	18.4
NW_005202428.1_1248-3p	mdo-miR-7346-3p	80	20	4	0	5	24	20	1	87	18.2

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005195085.1_38173-5p	Vca_miR80	85.714	14	2	0	6	19	4	17	17	15.6
NW_005195085.1_38173-5p	Vca_miR116	90.909	11	1	0	4	14	9	19	41	14.4
NW_005195085.1_38173-5p	Thalassiosira	75	20	4	1	1	19	24	5	47	14.2
NW_005195085.1_38173-5p	miR90_0453	78.571	14	3	0	3	16	6	19	63	13.7
NW_005195085.1_38173-5p	miR90_0414	78.571	14	3	0	3	16	5	18	63	13.7
NW_005195085.1_38173-5p	miR90_0041	78.571	14	3	0	3	16	2	15	63	13.7
NW_005195085.1_38173-5p	miR90_0631	83.333	12	2	0	2	13	7	18	73	13.5
NW_005195085.1_38173-5p	miR90_0284	83.333	12	2	0	2	13	13	2	73	13.5
NW_005195085.1_38173-5p	miR95_0193	83.333	12	2	0	2	13	7	18	73	13.5
NW_005195085.1_38173-5p	miR90_0169	91.667	12	0	1	1	12	11	1	85	13.3
NW_005195085.1_38173-5p	miR95_0076	90	10	1	0	1	10	8	17	85	13.3
NW_005195085.1_38173-5p	CCMP1516-miR8	90	10	1	0	1	10	12	21	85	13.3
NW_005195085.1_38173-5p	miR90_0835	100	8	0	0	1	8	10	17	98	13.1
NW_005195085.1_38173-5p	miR90_0689	100	8	0	0	1	8	12	5	98	13.1
NW_005195085.1_38173-5p	miR90_0682	100	8	0	0	1	8	8	1	98	13.1
NW_005195085.1_38173-5p	miR90_0351	100	8	0	0	1	8	3	10	98	13.1
NW_005195085.1_38173-5p	miR90_0271	100	8	0	0	1	8	2	9	98	13.1
NW_005195085.1_38173-5p	miR90_0220	100	8	0	0	1	8	4	11	98	13.1
NW_005195085.1_38180-3p	ccr-miR5	85.714	14	2	0	5	18	6	19	17	15.6
NW_005195085.1_38180-3p	miR90_0317	84.615	13	2	0	5	17	13	25	35	14.6
NW_005195085.1_38180-3p	miR90_0157	78.571	14	3	0	4	17	1	14	63	13.7
NW_005195085.1_38180-3p	ppu-miR21-5p	83.333	12	2	0	1	12	2	13	73	13.5
NW_005195085.1_38180-3p	miR95_0487	68.421	19	6	0	2	20	19	1	85	13.3
NW_005195085.1_38180-3p	Vca_miR107*	68.421	19	6	0	3	21	19	1	85	13.3
NW_005195085.1_38180-3p	Vca_miR19	90	10	1	0	2	11	1	10	85	13.3
NW_005195085.1_38180-3p	SjapMIR84	90	10	1	0	7	16	4	13	85	13.3
NW_005195085.1_38180-3p	miR90_0817	70.588	17	5	0	4	20	17	1	98	13.1
NW_005195085.1_38180-3p	miR95_0559	70.588	17	5	0	2	18	18	2	98	13.1
NW_005196191.1_35170-3p	miR90_0395	78.571	14	3	0	7	20	18	5	63	13.7
NW_005196191.1_35170-3p	miR90_0538	100	8	0	0	3	10	18	11	98	13.1
NW_005196191.1_35170-3p	miR90_0527	70.588	17	5	0	2	18	23	7	98	13.1
NW_005196191.1_35170-3p	miR90_0448	70.588	17	5	0	2	18	3	19	98	13.1
NW_005196191.1_35170-3p	miR90_0421	100	8	0	0	6	13	1	8	98	13.1
NW_005196191.1_35170-3p	miR95_0114	70.588	17	5	0	2	18	20	4	98	13.1
NW_005196603.1_34298-5p	miR90_0660	87.5	16	2	0	3	18	4	19	3.6	17.7
NW_005196603.1_34298-5p	miR95_0377	100	10	0	0	2	11	14	5	21	15.2
NW_005196603.1_34298-5p	miR95_0344	100	10	0	0	2	11	14	5	21	15.2
NW_005196603.1_34298-5p	miR95_0338	100	10	0	0	2	11	11	2	21	15.2

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005196603.1_34298-5p	miR95_0320	100	10	0	0	2	11	10	1	21	15.2
NW_005196603.1_34298-5p	miR90_0701	76.471	17	4	0	2	18	17	1	24	15
NW_005196603.1_34298-5p	Vca_miR13*	76.471	17	4	0	2	18	18	2	24	15
NW_005196603.1_34298-5p	SjapMIR5	80	15	3	0	5	19	19	5	28	14.8
NW_005196603.1_34298-5p	miR90_0905	90.909	11	1	0	7	17	1	11	37	14.4
NW_005196603.1_34298-5p	ppu-miR35-5p	100	9	0	0	11	19	16	8	43	14.2
NW_005196603.1_34298-5p	miR90_0203	75	16	4	0	3	18	4	19	50	13.9
NW_005196603.1_34298-5p	Vca_miR38	77.778	18	3	1	1	17	19	2	50	13.9
NW_005196603.1_34298-5p	miR90_0679	78.571	14	3	0	6	19	2	15	57	13.7
NW_005196603.1_34298-5p	miR90_0274	78.571	14	3	0	1	14	2	15	57	13.7
NW_005196603.1_34298-5p	miR90_0185	78.571	14	3	0	6	19	16	3	57	13.7
NW_005196603.1_34298-5p	SjapMIR6	78.571	14	3	0	6	19	2	15	57	13.7
NW_005196603.1_34298-5p	ppu-miR7-5p	83.333	12	2	0	6	17	18	7	66	13.5
NW_005196603.1_34298-5p	miR95_0036	83.333	12	2	0	3	14	7	18	66	13.5
NW_005196603.1_34298-5p	miR90_0147	90	10	1	0	6	15	10	19	77	13.3
NW_005196603.1_34298-5p	Vca_miR67	90	10	1	0	6	15	10	1	77	13.3
NW_005196603.1_34298-5p	ccr-miR9	68.421	19	6	0	1	19	20	2	77	13.3
NW_005196603.1_34298-5p	SjapMIR26_2	90	10	1	0	7	16	15	6	77	13.3
NW_005196603.1_34298-5p	SjapMIR26_1	90	10	1	0	7	16	15	6	77	13.3
NW_005196603.1_34298-5p	miR90_0579	100	8	0	0	4	11	8	1	89	13.1
NW_005196603.1_34298-5p	miR95_0515	100	8	0	0	10	17	9	2	89	13.1
NW_005196755.1_34052-3p	miR95_0442	82.353	17	3	0	4	20	3	19	7.1	16.9
NW_005196755.1_34052-3p	miR90_0873	92.308	13	1	0	4	16	14	2	9.5	16.5
NW_005196755.1_34052-3p	miR90_0824	92.308	13	1	0	4	16	20	8	9.5	16.5
NW_005196755.1_34052-3p	miR90_0824	90	10	1	0	7	16	14	5	85	13.3
NW_005196755.1_34052-3p	miR90_0764	92.308	13	1	0	4	16	19	7	9.5	16.5
NW_005196755.1_34052-3p	miR90_0764	90	10	1	0	7	16	13	4	85	13.3
NW_005196755.1_34052-3p	miR90_0529	100	10	0	0	7	16	11	2	23	15.2
NW_005196755.1_34052-3p	miR95_0450	80	15	3	0	6	20	18	4	31	14.8
NW_005196755.1_34052-3p	Vca_miR44c	80	15	3	0	7	21	5	19	31	14.8
NW_005196755.1_34052-3p	Vca_miR44b	80	15	3	0	7	21	5	19	31	14.8
NW_005196755.1_34052-3p	Vca_miR44a	80	15	3	0	7	21	5	19	31	14.8
NW_005196755.1_34052-3p	miR90_0922	84.615	13	2	0	1	13	18	6	35	14.6
NW_005196755.1_34052-3p	miR90_0898	84.615	13	2	0	7	19	14	2	35	14.6
NW_005196755.1_34052-3p	miR90_0897	84.615	13	2	0	3	15	17	5	35	14.6
NW_005196755.1_34052-3p	miR90_0866	84.615	13	2	0	1	13	21	9	35	14.6
NW_005196755.1_34052-3p	miR90_0771	84.615	13	2	0	3	15	16	4	35	14.6
NW_005196755.1_34052-3p	miR90_0722	84.615	13	2	0	9	21	17	5	35	14.6

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005196755.1_34052-3p	miR95_0441	84.615	13	2	0	8	20	25	13	35	14.6
NW_005196755.1_34052-3p	miR95_0439	84.615	13	2	0	3	15	4	16	35	14.6
NW_005196755.1_34052-3p	miR90_0840	90.909	11	1	0	1	11	11	1	41	14.4
NW_005196755.1_34052-3p	miR90_0520	90.909	11	1	0	5	15	17	7	41	14.4
NW_005196755.1_34052-3p	miR90_0515	100	9	0	0	8	16	10	2	47	14.2
NW_005196755.1_34052-3p	Vca_miR30-5p*	72.222	18	5	0	4	21	20	3	47	14.2
NW_005196755.1_34052-3p	miR90_0460	78.571	14	3	0	7	20	2	15	63	13.7
NW_005196755.1_34052-3p	miR95_0509	78.571	14	3	0	6	19	1	14	63	13.7
NW_005196755.1_34052-3p	miR95_0508	78.571	14	3	0	6	19	8	21	63	13.7
NW_005196755.1_34052-3p	Vca_miR16	78.571	14	3	0	8	21	9	22	63	13.7
NW_005196755.1_34052-3p	miR90_0646	83.333	12	2	0	4	15	12	1	73	13.5
NW_005196755.1_34052-3p	Vca_miR98b	83.333	12	2	0	6	17	17	6	73	13.5
NW_005196755.1_34052-3p	Vca_miR98a	83.333	12	2	0	6	17	17	6	73	13.5
NW_005196755.1_34052-3p	miR90_0862	90	10	1	0	1	10	10	1	85	13.3
NW_005196755.1_34052-3p	miR90_0422	90	10	1	0	8	17	8	17	85	13.3
NW_005196755.1_34052-3p	miR95_0300	90	10	1	0	7	16	5	14	85	13.3
NW_005196755.1_34052-3p	miR95_0254	90	10	1	0	7	16	1	10	85	13.3
NW_005196755.1_34052-3p	miR95_0185	90	10	1	0	7	16	9	18	85	13.3
NW_005196755.1_34052-3p	miR95_0164	90	10	1	0	3	12	1	10	85	13.3
NW_005196755.1_34052-3p	miR95_0044	90	10	1	0	7	16	3	12	85	13.3
NW_005196755.1_34052-3p	ppu-miR7-5p	100	8	0	0	11	18	8	1	98	13.1
NW_005196755.1_34052-3p	miR90_0900	100	8	0	0	7	14	3	10	98	13.1
NW_005196755.1_34052-3p	miR90_0891	100	8	0	0	7	14	3	10	98	13.1
NW_005196755.1_34052-3p	miR90_0876	100	8	0	0	1	8	12	19	98	13.1
NW_005196755.1_34052-3p	miR90_0743	100	8	0	0	1	8	11	18	98	13.1
NW_005196755.1_34052-3p	miR90_0624	100	8	0	0	8	15	9	2	98	13.1
NW_005196755.1_34052-3p	miR90_0535	100	8	0	0	8	15	8	1	98	13.1
NW_005196755.1_34052-3p	miR90_0493	100	8	0	0	7	14	8	1	98	13.1
NW_005196755.1_34052-3p	miR90_0229	70.588	17	5	0	4	20	21	5	98	13.1
NW_005196755.1_34052-3p	miR90_0172	100	8	0	0	7	14	12	5	98	13.1
NW_005196755.1_34052-3p	miR90_0165	100	8	0	0	7	14	12	5	98	13.1
NW_005196755.1_34052-3p	miR90_0108	100	8	0	0	7	14	12	5	98	13.1
NW_005196755.1_34052-3p	miR90_0013	100	8	0	0	7	14	10	17	98	13.1
NW_005196755.1_34052-3p	miR95_0416	100	8	0	0	2	9	7	14	98	13.1
NW_005196755.1_34052-3p	miR95_0381	100	8	0	0	8	15	11	18	98	13.1
NW_005196755.1_34052-3p	miR95_0289	100	8	0	0	7	14	12	5	98	13.1
NW_005196755.1_34052-3p	miR95_0288	100	8	0	0	7	14	12	5	98	13.1
NW_005196755.1_34052-3p	miR95_0275	100	8	0	0	8	15	8	1	98	13.1

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005196755.1_34052-3p	miR95_0274	100	8	0	0	8	15	11	18	98	13.1
NW_005196755.1_34052-3p	miR95_0260	100	8	0	0	8	15	5	12	98	13.1
NW_005196755.1_34052-3p	miR95_0248	100	8	0	0	7	14	9	16	98	13.1
NW_005196755.1_34052-3p	miR95_0175	100	8	0	0	8	15	10	17	98	13.1
NW_005196755.1_34052-3p	miR95_0158	100	8	0	0	7	14	7	14	98	13.1
NW_005196755.1_34052-3p	miR95_0102	100	8	0	0	7	14	1	8	98	13.1
NW_005196755.1_34052-3p	miR95_0090	100	8	0	0	7	14	8	1	98	13.1
NW_005196755.1_34052-3p	miR95_0088	100	8	0	0	7	14	8	1	98	13.1
NW_005196755.1_34052-3p	Porphyra	100	8	0	0	6	13	8	1	98	13.1
NW_005196755.1_34052-3p	SjapMIR103	100	8	0	0	8	15	16	9	98	13.1
NW_005196755.1_34028-5p	miR95_0404	88.235	17	0	2	1	17	5	19	35	14.6
NW_005196755.1_34028-5p	miR90_0665	90.909	11	1	0	2	12	7	17	41	14.4
NW_005196755.1_34028-5p	miR90_0317	90.909	11	1	0	4	14	11	21	41	14.4
NW_005196755.1_34028-5p	Vca_miR84	90.909	11	1	0	4	14	14	4	41	14.4
NW_005196755.1_34028-5p	Vca_miR58-5p.1	75	16	4	0	4	19	8	23	55	13.9
NW_005196755.1_34028-5p	Vca_miR19	83.333	12	2	0	6	17	4	15	73	13.5
NW_005196755.1_34028-5p	ppu-miR14-3p	90	10	1	0	12	21	12	21	85	13.3
NW_005196755.1_34028-5p	miR90_0837	90	10	1	0	2	11	5	14	85	13.3
NW_005196755.1_34028-5p	miR90_0676	90	10	1	0	10	19	8	17	85	13.3
NW_005196755.1_34028-5p	miR90_0661	90	10	1	0	2	11	5	14	85	13.3
NW_005196755.1_34028-5p	miR90_0637	90	10	1	0	2	11	11	2	85	13.3
NW_005196755.1_34028-5p	miR90_0634	90	10	1	0	2	11	18	9	85	13.3
NW_005196755.1_34028-5p	miR90_0633	90	10	1	0	2	11	11	2	85	13.3
NW_005196755.1_34028-5p	miR90_0586	90	10	1	0	2	11	14	5	85	13.3
NW_005196755.1_34028-5p	miR90_0578	90	10	1	0	2	11	3	12	85	13.3
NW_005196755.1_34028-5p	miR90_0569	90	10	1	0	4	13	18	9	85	13.3
NW_005196755.1_34028-5p	miR90_0555	90	10	1	0	2	11	20	11	85	13.3
NW_005196755.1_34028-5p	miR90_0537	90	10	1	0	2	11	8	17	85	13.3
NW_005196755.1_34028-5p	miR90_0447	90	10	1	0	2	11	2	11	85	13.3
NW_005196755.1_34028-5p	miR90_0446	90	10	1	0	2	11	2	11	85	13.3
NW_005196755.1_34028-5p	miR90_0413	90	10	1	0	2	11	14	5	85	13.3
NW_005196755.1_34028-5p	miR90_0380	90	10	1	0	2	11	10	19	85	13.3
NW_005196755.1_34028-5p	miR90_0357	90	10	1	0	2	11	11	2	85	13.3
NW_005196755.1_34028-5p	miR90_0347	90	10	1	0	2	11	5	14	85	13.3
NW_005196755.1_34028-5p	miR90_0346	90	10	1	0	2	11	15	6	85	13.3
NW_005196755.1_34028-5p	miR90_0345	90	10	1	0	2	11	4	13	85	13.3
NW_005196755.1_34028-5p	miR90_0343	90	10	1	0	2	11	13	4	85	13.3
NW_005196755.1_34028-5p	miR90_0318	90	10	1	0	2	11	13	4	85	13.3

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005196755.1_34028-5p	miR90_0295	90	10	1	0	2	11	14	5	85	13.3
NW_005196755.1_34028-5p	miR90_0291	90	10	1	0	2	11	16	7	85	13.3
NW_005196755.1_34028-5p	miR90_0290	90	10	1	0	2	11	18	9	85	13.3
NW_005196755.1_34028-5p	miR90_0289	90	10	1	0	2	11	16	7	85	13.3
NW_005196755.1_34028-5p	miR90_0288	90	10	1	0	2	11	16	7	85	13.3
NW_005196755.1_34028-5p	miR90_0287	90	10	1	0	2	11	15	6	85	13.3
NW_005196755.1_34028-5p	miR90_0280	90	10	1	0	2	11	1	10	85	13.3
NW_005196755.1_34028-5p	miR90_0234	90	10	1	0	2	11	4	13	85	13.3
NW_005196755.1_34028-5p	miR90_0131	90	10	1	0	2	11	14	5	85	13.3
NW_005196755.1_34028-5p	miR90_0128	90	10	1	0	2	11	21	12	85	13.3
NW_005196755.1_34028-5p	miR90_0127	90	10	1	0	2	11	25	16	85	13.3
NW_005196755.1_34028-5p	miR90_0124	90	10	1	0	2	11	14	5	85	13.3
NW_005196755.1_34028-5p	miR90_0123	90	10	1	0	2	11	10	1	85	13.3
NW_005196755.1_34028-5p	miR90_0122	90	10	1	0	2	11	14	5	85	13.3
NW_005196755.1_34028-5p	miR90_0121	90	10	1	0	2	11	18	9	85	13.3
NW_005196755.1_34028-5p	miR90_0120	90	10	1	0	2	11	20	11	85	13.3
NW_005196755.1_34028-5p	miR90_0111	90	10	1	0	2	11	15	6	85	13.3
NW_005196755.1_34028-5p	miR90_0093	90	10	1	0	2	11	18	9	85	13.3
NW_005196755.1_34028-5p	miR90_0092	90	10	1	0	2	11	19	10	85	13.3
NW_005196755.1_34028-5p	miR90_0078	90	10	1	0	2	11	4	13	85	13.3
NW_005196755.1_34028-5p	miR90_0063	90	10	1	0	2	11	9	18	85	13.3
NW_005196755.1_34028-5p	miR90_0062	90	10	1	0	2	11	5	14	85	13.3
NW_005196755.1_34028-5p	miR90_0061	90	10	1	0	2	11	4	13	85	13.3
NW_005196755.1_34028-5p	miR90_0060	90	10	1	0	2	11	3	12	85	13.3
NW_005196755.1_34028-5p	miR90_0040	90	10	1	0	2	11	9	18	85	13.3
NW_005196755.1_34028-5p	miR90_0021	90	10	1	0	2	11	15	6	85	13.3
NW_005196755.1_34028-5p	miR95_0565	90	10	1	0	2	11	15	6	85	13.3
NW_005196755.1_34028-5p	miR95_0565	100	8	0	0	13	20	18	11	98	13.1
NW_005196755.1_34028-5p	miR95_0564	90	10	1	0	2	11	20	11	85	13.3
NW_005196755.1_34028-5p	miR95_0564	100	8	0	0	13	20	23	16	98	13.1
NW_005196755.1_34028-5p	miR95_0443	90	10	1	0	2	11	11	20	85	13.3
NW_005196755.1_34028-5p	miR95_0305	90	10	1	0	2	11	11	2	85	13.3
NW_005196755.1_34028-5p	miR95_0305	100	8	0	0	13	20	14	7	98	13.1
NW_005196755.1_34028-5p	miR95_0298	90	10	1	0	2	11	11	20	85	13.3
NW_005196755.1_34028-5p	miR95_0259	90	10	1	0	2	11	12	3	85	13.3
NW_005196755.1_34028-5p	miR95_0053	90	10	1	0	2	11	14	5	85	13.3
NW_005196755.1_34028-5p	miR95_0052	90	10	1	0	2	11	13	4	85	13.3
NW_005196755.1_34028-5p	miR95_0051	90	10	1	0	2	11	16	7	85	13.3

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005196755.1_34028-5p	miR95_0050	90	10	1	0	2	11	12	3	85	13.3
NW_005196755.1_34028-5p	miR95_0049	90	10	1	0	2	11	19	10	85	13.3
NW_005196755.1_34028-5p	miR95_0026	90	10	1	0	2	11	10	19	85	13.3
NW_005196755.1_34028-5p	miR95_0010	90	10	1	0	2	11	11	2	85	13.3
NW_005196755.1_34028-5p	Vca_miR35-3p*	91.667	12	0	1	10	20	22	11	85	13.3
NW_005196755.1_34028-5p	Porphyra	90	10	1	0	1	10	10	1	85	13.3
NW_005196755.1_34028-5p	miR95_0524	100	8	0	0	4	11	15	8	98	13.1
NW_005196755.1_34028-5p	miR95_0500	100	8	0	0	13	20	12	5	98	13.1
NW_005196755.1_34028-5p	miR95_0480	100	8	0	0	1	8	8	1	98	13.1
NW_005196755.1_34028-5p	miR95_0445	100	8	0	0	13	20	12	5	98	13.1
NW_005196755.1_34028-5p	SjapMIR20	100	8	0	0	6	13	1	8	98	13.1
NW_005196755.1_34019-3p	ppu-miR32-5p	80	20	3	1	2	21	19	1	13	16.1
NW_005196755.1_34019-3p	miR90_0172	76.19	21	4	1	1	21	21	2	23	15.2
NW_005196755.1_34019-3p	miR90_0493	76.471	17	4	0	1	17	17	1	26	15
NW_005196755.1_34019-3p	miR95_0289	76.471	17	4	0	1	17	21	5	26	15
NW_005196755.1_34019-3p	miR95_0090	76.471	17	4	0	1	17	17	1	26	15
NW_005196755.1_34019-3p	miR95_0088	76.471	17	4	0	1	17	17	1	26	15
NW_005196755.1_34019-3p	miR95_0468	80	15	3	0	1	15	16	2	31	14.8
NW_005196755.1_34019-3p	SjapMIR60	90.909	11	1	0	5	15	13	3	41	14.4
NW_005196755.1_34019-3p	miR90_0907	75	16	4	0	2	17	2	17	55	13.9
NW_005196755.1_34019-3p	CCMP1516-miR8	77.778	18	3	1	3	20	21	5	55	13.9
NW_005196755.1_34019-3p	miR90_0839	78.571	14	3	0	4	17	1	14	63	13.7
NW_005196755.1_34019-3p	miR90_0765	78.571	14	3	0	4	17	2	15	63	13.7
NW_005196755.1_34019-3p	miR90_0211	78.571	14	3	0	2	15	16	3	63	13.7
NW_005196755.1_34019-3p	ppu-miR15-5p	83.333	12	2	0	1	12	6	17	73	13.5
NW_005196755.1_34019-3p	miR95_0415	83.333	12	2	0	6	17	1	12	73	13.5
NW_005196755.1_34019-3p	miR95_0394	85.714	14	1	1	9	21	17	4	73	13.5
NW_005196755.1_34019-3p	miR95_0194	83.333	12	2	0	6	17	3	14	73	13.5
NW_005196755.1_34019-3p	miR95_0179	83.333	12	2	0	9	20	21	10	73	13.5
NW_005196755.1_34019-3p	miR95_0032	83.333	12	2	0	1	12	13	2	73	13.5
NW_005196755.1_34019-3p	SjapMIR39	83.333	12	2	0	7	18	10	21	73	13.5
NW_005196755.1_34019-3p	miR90_0804	90	10	1	0	1	10	15	24	85	13.3
NW_005196755.1_34019-3p	miR90_0691	90	10	1	0	1	10	15	24	85	13.3
NW_005196755.1_34019-3p	miR90_0658	90	10	1	0	12	21	15	6	85	13.3
NW_005196755.1_34019-3p	miR90_0658	100	8	0	0	14	21	4	11	98	13.1
NW_005196755.1_34019-3p	miR90_0457	90	10	1	0	6	15	6	15	85	13.3
NW_005196755.1_34019-3p	miR90_0278	90	10	1	0	7	16	6	15	85	13.3
NW_005196755.1_34019-3p	miR95_0325	90	10	1	0	8	17	17	8	85	13.3

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005196755.1_34019-3p	miR95_0269	90	10	1	0	8	17	18	9	85	13.3
NW_005196755.1_34019-3p	miR90_0424	100	8	0	0	14	21	1	8	98	13.1
NW_005196755.1_34019-3p	miR95_0444	100	8	0	0	6	13	11	4	98	13.1
NW_005196755.1_34019-3p	Botryococcus	70.588	17	5	0	1	17	17	1	98	13.1
NW_005197715.1_30571-5p	miR90_0709	91.667	12	1	0	8	19	18	7	18	15.4
NW_005197715.1_30571-5p	miR90_0495	100	10	0	0	1	10	18	9	21	15.2
NW_005197715.1_30571-5p	Vca_miR60	73.684	19	5	0	1	19	3	21	21	15.2
NW_005197715.1_30571-5p	miR90_0876	80	15	3	0	4	18	1	15	28	14.8
NW_005197715.1_30571-5p	Vca_miR82	80	15	3	0	4	18	2	16	28	14.8
NW_005197715.1_30571-5p	miR90_0690	84.615	13	2	0	7	19	2	14	32	14.6
NW_005197715.1_30571-5p	miR90_0653	84.615	13	2	0	7	19	1	13	32	14.6
NW_005197715.1_30571-5p	miR90_0211	84.615	13	2	0	5	17	1	13	32	14.6
NW_005197715.1_30571-5p	Vca_miR77	84.615	13	2	0	7	19	15	3	32	14.6
NW_005197715.1_30571-5p	miR90_0487	90.909	11	1	0	9	19	19	9	37	14.4
NW_005197715.1_30571-5p	ppu-miR9-3p	100	9	0	0	2	10	3	11	43	14.2
NW_005197715.1_30571-5p	miR90_0862	100	9	0	0	10	18	15	7	43	14.2
NW_005197715.1_30571-5p	miR90_0840	100	9	0	0	10	18	16	8	43	14.2
NW_005197715.1_30571-5p	miR90_0743	100	9	0	0	10	18	6	14	43	14.2
NW_005197715.1_30571-5p	Porphyra	72.222	18	5	0	1	18	3	20	43	14.2
NW_005197715.1_30571-5p	miR90_0400	75	16	4	0	1	16	16	1	50	13.9
NW_005197715.1_30571-5p	miR90_0016	75	16	4	0	1	16	17	2	50	13.9
NW_005197715.1_30571-5p	miR95_0258	77.778	18	3	1	1	18	19	3	50	13.9
NW_005197715.1_30571-5p	Vca_miR13*	75	16	4	0	4	19	6	21	50	13.9
NW_005197715.1_30571-5p	miR90_0759	78.571	14	3	0	4	17	3	16	57	13.7
NW_005197715.1_30571-5p	SjapMIR60	78.571	14	3	0	6	19	2	15	57	13.7
NW_005197715.1_30571-5p	SjapMIR70	83.333	12	2	0	3	14	2	13	66	13.5
NW_005197715.1_30571-5p	miR90_0809	90	10	1	0	7	16	12	3	77	13.3
NW_005197715.1_30571-5p	miR90_0769	90	10	1	0	7	16	11	2	77	13.3
NW_005197715.1_30571-5p	miR90_0754	90	10	1	0	7	16	9	18	77	13.3
NW_005197715.1_30571-5p	miR95_0143	90	10	1	0	1	10	8	17	77	13.3
NW_005197715.1_30571-5p	SjapMIR102	90	10	1	0	1	10	18	9	77	13.3
NW_005197715.1_30571-5p	ppu-miR4-5p	100	8	0	0	12	19	11	18	89	13.1
NW_005197715.1_30571-5p	miR90_0866	100	8	0	0	11	18	25	18	89	13.1
NW_005197715.1_30571-5p	miR90_0706	100	8	0	0	12	19	18	11	89	13.1
NW_005197715.1_30571-5p	miR90_0610	70.588	17	5	0	3	19	1	17	89	13.1
NW_005197715.1_30571-5p	miR90_0560	100	8	0	0	1	8	13	6	89	13.1
NW_005197715.1_30571-5p	miR90_0314	100	8	0	0	1	8	14	7	89	13.1
NW_005197715.1_30571-5p	miR90_0217	100	8	0	0	1	8	17	24	89	13.1

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005197715.1_30571-5p	miR95_0499	70.588	17	5	0	1	17	2	18	89	13.1
NW_005197715.1_30571-5p	miR95_0488	70.588	17	5	0	1	17	1	17	89	13.1
NW_005197715.1_30571-5p	miR95_0401	70.588	17	5	0	1	17	18	2	89	13.1
NW_005198391.1_27186-5p	miR90_0599	73.684	19	5	0	2	20	25	7	23	15.2
NW_005198391.1_27186-5p	miR90_0404	73.684	19	5	0	2	20	3	21	23	15.2
NW_005198391.1_27186-5p	miR95_0479	100	10	0	0	12	21	19	10	23	15.2
NW_005198391.1_27186-5p	miR95_0433	100	10	0	0	12	21	18	9	23	15.2
NW_005198391.1_27186-5p	miR95_0337	73.684	19	5	0	2	20	22	4	23	15.2
NW_005198391.1_27186-5p	miR95_0199	73.684	19	5	0	2	20	6	24	23	15.2
NW_005198391.1_27186-5p	miR95_0197	73.684	19	5	0	2	20	7	25	23	15.2
NW_005198391.1_27186-5p	miR95_0082	73.684	19	5	0	2	20	19	1	23	15.2
NW_005198391.1_27186-5p	miR95_0023	73.684	19	5	0	2	20	25	7	23	15.2
NW_005198391.1_27186-5p	miR95_0019	73.684	19	5	0	2	20	19	1	23	15.2
NW_005198391.1_27186-5p	SjapMIR71	76.471	17	4	0	4	20	20	4	26	15
NW_005198391.1_27186-5p	Vca_miR112	86.667	15	1	1	5	18	16	2	35	14.6
NW_005198391.1_27186-5p	miR90_0778	90.909	11	1	0	3	13	2	12	41	14.4
NW_005198391.1_27186-5p	Vca_miR1d	90.909	11	1	0	3	13	3	13	41	14.4
NW_005198391.1_27186-5p	Vca_miR1c	90.909	11	1	0	3	13	3	13	41	14.4
NW_005198391.1_27186-5p	Vca_miR1b	90.909	11	1	0	3	13	3	13	41	14.4
NW_005198391.1_27186-5p	Vca_miR1a	90.909	11	1	0	3	13	3	13	41	14.4
NW_005198391.1_27186-5p	miR95_0563	100	9	0	0	12	20	3	11	47	14.2
NW_005198391.1_27186-5p	miR95_0522	100	9	0	0	12	20	1	9	47	14.2
NW_005198391.1_27186-5p	miR95_0481	72.222	18	5	0	4	21	1	18	47	14.2
NW_005198391.1_27186-5p	miR95_0335	72.222	18	5	0	3	20	1	18	47	14.2
NW_005198391.1_27186-5p	miR90_0616	75	16	4	0	1	16	2	17	55	13.9
NW_005198391.1_27186-5p	miR95_0537	75	16	4	0	2	17	16	1	55	13.9
NW_005198391.1_27186-5p	miR90_0800	78.571	14	3	0	2	15	4	17	63	13.7
NW_005198391.1_27186-5p	miR90_0753	81.25	16	2	1	4	19	18	4	63	13.7
NW_005198391.1_27186-5p	miR90_0285	78.571	14	3	0	2	15	2	15	63	13.7
NW_005198391.1_27186-5p	miR95_0486	78.571	14	3	0	8	21	1	14	63	13.7
NW_005198391.1_27186-5p	miR95_0263	78.571	14	3	0	1	14	3	16	63	13.7
NW_005198391.1_27186-5p	miR95_0116	78.571	14	3	0	1	14	21	8	63	13.7
NW_005198391.1_27186-5p	miR95_0059	78.571	14	3	0	1	14	20	7	63	13.7
NW_005198391.1_27186-5p	Porphyra	78.571	14	3	0	8	21	1	14	63	13.7
NW_005198391.1_27186-5p	ppu-miR8-5p	83.333	12	2	0	10	21	9	20	73	13.5
NW_005198391.1_27186-5p	miR90_0913	83.333	12	2	0	6	17	2	13	73	13.5
NW_005198391.1_27186-5p	miR90_0730	83.333	12	2	0	7	18	14	3	73	13.5
NW_005198391.1_27186-5p	miR90_0680	83.333	12	2	0	2	13	7	18	73	13.5

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005198391.1_27186-5p	miR90_0400	85.714	14	1	1	7	20	18	6	73	13.5
NW_005198391.1_27186-5p	miR90_0258	83.333	12	2	0	6	17	16	5	73	13.5
NW_005198391.1_27186-5p	miR95_0247	83.333	12	2	0	3	14	1	12	73	13.5
NW_005198391.1_27186-5p	CCMP1516-miR5	85.714	14	1	1	7	19	1	14	73	13.5
NW_005198391.1_27186-5p	miR90_0615	90	10	1	0	7	16	1	10	85	13.3
NW_005198391.1_27186-5p	miR90_0548	91.667	12	0	1	5	16	11	1	85	13.3
NW_005198391.1_27186-5p	Vca_miR98b*	90	10	1	0	10	19	14	5	85	13.3
NW_005198391.1_27186-5p	Vca_miR98a*	90	10	1	0	10	19	14	5	85	13.3
NW_005198391.1_27186-5p	SjapMIR39	90	10	1	0	1	10	16	7	85	13.3
NW_005198391.1_27186-5p	miR90_0708	100	8	0	0	10	17	10	17	98	13.1
NW_005198391.1_27186-5p	miR90_0016	100	8	0	0	13	20	14	7	98	13.1
NW_005198391.1_27186-5p	miR95_0485	100	8	0	0	14	21	1	8	98	13.1
NW_005198391.1_27186-5p	PC-5p-179621_3	70.588	17	5	0	2	18	4	20	98	13.1
NW_005198391.1_27186-5p	SjapMIR88	100	8	0	0	8	15	5	12	98	13.1
NW_005198966.1_24265-3p	miR95_0490	85.714	14	2	0	3	16	3	16	17	15.6
NW_005198966.1_24265-3p	miR90_0306	76.471	17	4	0	3	19	25	9	26	15
NW_005198966.1_24265-3p	miR90_0223	84.615	13	2	0	7	19	17	5	35	14.6
NW_005198966.1_24265-3p	miR95_0063	84.615	13	2	0	4	16	7	19	35	14.6
NW_005198966.1_24265-3p	miR90_0916	90.909	11	1	0	4	14	12	2	41	14.4
NW_005198966.1_24265-3p	miR90_0188	70	20	6	0	2	21	22	3	41	14.4
NW_005198966.1_24265-3p	miR90_0640	100	9	0	0	9	17	24	16	47	14.2
NW_005198966.1_24265-3p	miR90_0298	100	9	0	0	9	17	22	14	47	14.2
NW_005198966.1_24265-3p	miR95_0303	72.222	18	5	0	1	18	18	1	47	14.2
NW_005198966.1_24265-3p	miR95_0172	72.222	18	5	0	1	18	18	1	47	14.2
NW_005198966.1_24265-3p	miR95_0117	75	16	4	0	4	19	2	17	55	13.9
NW_005198966.1_24265-3p	Porphyra	75	16	4	0	5	20	20	5	55	13.9
NW_005198966.1_24265-3p	miR90_0017	78.571	14	3	0	5	18	14	1	63	13.7
NW_005198966.1_24265-3p	Vca_miR77	78.571	14	3	0	5	18	4	17	63	13.7
NW_005198966.1_24265-3p	miR95_0292	83.333	12	2	0	7	18	12	1	73	13.5
NW_005198966.1_24265-3p	CCMP1516-miR9	83.333	12	2	0	3	14	5	16	73	13.5
NW_005198966.1_24265-3p	miR90_0477	90	10	1	0	9	18	17	8	85	13.3
NW_005198966.1_24265-3p	miR90_0439	68.421	19	6	0	3	21	24	6	85	13.3
NW_005198966.1_24265-3p	miR90_0186	71.429	21	5	1	1	21	3	22	85	13.3
NW_005198966.1_24265-3p	miR90_0182	90	10	1	0	11	20	2	11	85	13.3
NW_005198966.1_24265-3p	miR95_0165	68.421	19	6	0	3	21	19	1	85	13.3
NW_005198966.1_24265-3p	Vca_miR64	90	10	1	0	12	21	12	21	85	13.3
NW_005198966.1_24265-3p	SjapMIR10	90	10	1	0	12	21	9	18	85	13.3
NW_005198966.1_24265-3p	miR90_0013	70.588	17	5	0	4	20	2	18	98	13.1

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005198966.1_24265-3p	miR95_0359	70.588	17	5	0	4	20	2	18	98	13.1
NW_005198966.1_24265-3p	miR95_0326	70.588	17	5	0	4	20	2	18	98	13.1
NW_005198966.1_24265-3p	SjapMIR16	70.588	17	5	0	3	19	17	1	98	13.1
NW_005198966.1_24265-5p	SjapMIR63_2	84.615	13	2	0	2	14	4	16	30	14.6
NW_005198966.1_24265-5p	SjapMIR63_1	84.615	13	2	0	2	14	4	16	30	14.6
NW_005198966.1_24265-5p	miR95_0357	90.909	11	1	0	1	11	14	4	35	14.4
NW_005198966.1_24265-5p	miR95_0012	90.909	11	1	0	8	18	25	15	35	14.4
NW_005198966.1_24265-5p	Vca_miR53b	90.909	11	1	0	2	12	1	11	35	14.4
NW_005198966.1_24265-5p	Vca_miR53a	90.909	11	1	0	2	12	1	11	35	14.4
NW_005198966.1_24265-5p	miR95_0462	75	16	4	0	1	16	19	4	47	13.9
NW_005198966.1_24265-5p	miR90_0669	78.571	14	3	0	2	15	14	1	54	13.7
NW_005198966.1_24265-5p	miR90_0445	78.571	14	3	0	3	16	10	23	54	13.7
NW_005198966.1_24265-5p	miR90_0226	78.571	14	3	0	3	16	14	1	54	13.7
NW_005198966.1_24265-5p	miR95_0136	78.571	14	3	0	3	16	15	2	54	13.7
NW_005198966.1_24265-5p	Vca_miR94b	78.571	14	3	0	4	17	2	15	54	13.7
NW_005198966.1_24265-5p	Vca_miR94a	78.571	14	3	0	4	17	2	15	54	13.7
NW_005198966.1_24265-5p	miR90_0577	83.333	12	2	0	1	12	19	8	63	13.5
NW_005198966.1_24265-5p	miR90_0360	83.333	12	2	0	1	12	7	18	63	13.5
NW_005198966.1_24265-5p	miR90_0160	83.333	12	2	0	1	12	6	17	63	13.5
NW_005198966.1_24265-5p	miR90_0058	83.333	12	2	0	1	12	19	8	63	13.5
NW_005198966.1_24265-5p	miR90_0057	83.333	12	2	0	1	12	13	2	63	13.5
NW_005198966.1_24265-5p	miR90_0056	83.333	12	2	0	1	12	17	6	63	13.5
NW_005198966.1_24265-5p	miR95_0460	83.333	12	2	0	6	17	23	12	63	13.5
NW_005198966.1_24265-5p	miR95_0424	83.333	12	2	0	1	12	1	12	63	13.5
NW_005198966.1_24265-5p	miR95_0423	83.333	12	2	0	1	12	3	14	63	13.5
NW_005198966.1_24265-5p	miR95_0362	83.333	12	2	0	1	12	6	17	63	13.5
NW_005198966.1_24265-5p	miR95_0331	83.333	12	2	0	1	12	25	14	63	13.5
NW_005198966.1_24265-5p	miR95_0318	83.333	12	2	0	1	12	15	4	63	13.5
NW_005198966.1_24265-5p	miR95_0208	83.333	12	2	0	1	12	4	15	63	13.5
NW_005198966.1_24265-5p	miR95_0207	83.333	12	2	0	1	12	2	13	63	13.5
NW_005198966.1_24265-5p	miR95_0206	83.333	12	2	0	1	12	11	22	63	13.5
NW_005198966.1_24265-5p	miR95_0204	83.333	12	2	0	1	12	12	23	63	13.5
NW_005198966.1_24265-5p	miR95_0201	83.333	12	2	0	1	12	9	20	63	13.5
NW_005198966.1_24265-5p	miR95_0200	83.333	12	2	0	1	12	13	24	63	13.5
NW_005198966.1_24265-5p	miR95_0078	83.333	12	2	0	1	12	2	13	63	13.5
NW_005198966.1_24265-5p	miR95_0077	83.333	12	2	0	1	12	6	17	63	13.5
NW_005198966.1_24265-5p	miR95_0071	83.333	12	2	0	1	12	16	5	63	13.5
NW_005198966.1_24265-5p	miR95_0024	83.333	12	2	0	1	12	18	7	63	13.5

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005198966.1_24265-5p	miR95_0022	83.333	12	2	0	1	12	12	1	63	13.5
NW_005198966.1_24265-5p	miR95_0018	83.333	12	2	0	1	12	12	1	63	13.5
NW_005198966.1_24265-5p	miR95_0017	83.333	12	2	0	1	12	19	8	63	13.5
NW_005198966.1_24265-5p	Vca_miR84	83.333	12	2	0	2	13	12	1	63	13.5
NW_005198966.1_24265-5p	miR90_0142	90	10	1	0	9	18	20	11	73	13.3
NW_005198966.1_24265-5p	SjapMIR64	90	10	1	0	2	11	4	13	73	13.3
NW_005198966.1_24265-5p	miR95_0383	100	8	0	0	4	11	2	9	84	13.1
NW_005198966.1_24265-5p	Vca_miR88b	73.333	15	4	0	2	16	9	23	97	12.9
NW_005198966.1_24265-5p	Vca_miR88a	73.333	15	4	0	2	16	9	23	97	12.9
NW_005198966.1_24265-5p	Vca_miR68*	73.333	15	4	0	2	16	4	18	97	12.9
NW_005199363.1_22042-5p	miR90_0108	83.333	18	2	1	4	20	2	19	14	15.8
NW_005199363.1_22042-5p	miR90_0013	73.684	19	5	0	2	20	21	3	22	15.2
NW_005199363.1_22042-5p	miR90_0172	82.353	17	2	1	4	19	2	18	29	14.8
NW_005199363.1_22042-5p	miR90_0165	82.353	17	2	1	4	19	2	18	29	14.8
NW_005199363.1_22042-5p	miR95_0448	80	15	3	0	3	17	2	16	29	14.8
NW_005199363.1_22042-5p	miR95_0248	82.353	17	2	1	5	20	18	2	29	14.8
NW_005199363.1_22042-5p	miR95_0158	82.353	17	2	1	4	19	17	1	29	14.8
NW_005199363.1_22042-5p	ppu-miR3-5p	84.615	13	2	0	3	15	1	13	34	14.6
NW_005199363.1_22042-5p	miR90_0457	90.909	11	1	0	6	16	17	7	39	14.4
NW_005199363.1_22042-5p	Vca_miR38	90.909	11	1	0	2	12	2	12	39	14.4
NW_005199363.1_22042-5p	miR90_0428	100	9	0	0	12	20	24	16	45	14.2
NW_005199363.1_22042-5p	miR95_0522	100	9	0	0	3	11	10	18	45	14.2
NW_005199363.1_22042-5p	miR95_0289	72.222	18	5	0	2	19	1	18	45	14.2
NW_005199363.1_22042-5p	miR95_0288	72.222	18	5	0	2	19	1	18	45	14.2
NW_005199363.1_22042-5p	miR95_0541	78.571	14	3	0	5	18	15	2	60	13.7
NW_005199363.1_22042-5p	miR95_0515	78.571	14	3	0	1	14	1	14	60	13.7
NW_005199363.1_22042-5p	miR95_0419	78.571	14	3	0	2	15	16	3	60	13.7
NW_005199363.1_22042-5p	miR95_0415	78.571	14	3	0	1	14	17	4	60	13.7
NW_005199363.1_22042-5p	miR95_0325	78.571	14	3	0	1	14	3	16	60	13.7
NW_005199363.1_22042-5p	miR95_0269	78.571	14	3	0	1	14	4	17	60	13.7
NW_005199363.1_22042-5p	miR95_0246	78.571	14	3	0	1	14	14	1	60	13.7
NW_005199363.1_22042-5p	miR95_0118	78.571	14	3	0	7	20	4	17	60	13.7
NW_005199363.1_22042-5p	miR90_0493	83.333	12	2	0	8	19	3	14	70	13.5
NW_005199363.1_22042-5p	miR95_0468	83.333	12	2	0	8	19	2	13	70	13.5
NW_005199363.1_22042-5p	miR95_0179	83.333	12	2	0	1	12	6	17	70	13.5
NW_005199363.1_22042-5p	miR95_0179	68.421	19	6	0	2	20	24	6	81	13.3
NW_005199363.1_22042-5p	miR95_0090	83.333	12	2	0	8	19	3	14	70	13.5
NW_005199363.1_22042-5p	miR95_0088	83.333	12	2	0	8	19	3	14	70	13.5

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005199363.1_22042-5p	SjapMIR56	83.333	12	2	0	1	12	13	2	70	13.5
NW_005199363.1_22042-5p	miR90_0169	90	10	1	0	6	15	9	18	81	13.3
NW_005199363.1_22042-5p	miR95_0188	90	10	1	0	7	16	1	10	81	13.3
NW_005199363.1_22042-5p	SjapMIR61	90	10	1	0	9	18	12	3	81	13.3
NW_005199363.1_22042-5p	miR90_0876	70.588	17	5	0	2	18	1	17	94	13.1
NW_005199363.1_22042-5p	miR90_0726	100	8	0	0	1	8	4	11	94	13.1
NW_005199363.1_22042-5p	miR90_0629	100	8	0	0	1	8	8	15	94	13.1
NW_005199363.1_22042-5p	miR95_0563	100	8	0	0	3	10	12	19	94	13.1
NW_005199363.1_22042-5p	miR95_0388	100	8	0	0	1	8	7	14	94	13.1
NW_005199363.1_22042-5p	miR95_0387	100	8	0	0	1	8	14	21	94	13.1
NW_005199363.1_22042-5p	miR95_0354	100	8	0	0	1	8	3	10	94	13.1
NW_005199363.1_22042-5p	miR95_0133	100	8	0	0	1	8	10	17	94	13.1
NW_005199363.1_22042-5p	miR95_0111	100	8	0	0	1	8	6	13	94	13.1
NW_005199363.1_22042-5p	miR95_0087	100	8	0	0	1	8	15	22	94	13.1
NW_005199363.1_22042-5p	miR95_0083	100	8	0	0	1	8	8	15	94	13.1
NW_005199363.1_22042-5p	miR95_0080	100	8	0	0	1	8	9	16	94	13.1
NW_005199378.1_21978-3p	ppu-miR5-3p	73.684	19	5	0	3	21	20	2	23	15.2
NW_005199378.1_21978-3p	Vca_miR22	84.615	13	2	0	1	13	13	1	35	14.6
NW_005199378.1_21978-3p	SjapMIR95	90.909	11	1	0	3	13	16	6	41	14.4
NW_005199378.1_21978-3p	Vca_miR88b*	100	9	0	0	3	11	17	9	47	14.2
NW_005199378.1_21978-3p	Vca_miR88a*	100	9	0	0	3	11	17	9	47	14.2
NW_005199378.1_21978-3p	miR90_0844	75	16	4	0	1	16	9	24	55	13.9
NW_005199378.1_21978-3p	miR95_0514	75	16	4	0	1	16	9	24	55	13.9
NW_005199378.1_21978-3p	miR95_0390	75	16	4	0	1	16	4	19	55	13.9
NW_005199378.1_21978-3p	miR95_0346	75	16	4	0	1	16	3	18	55	13.9
NW_005199378.1_21978-3p	miR95_0324	75	16	4	0	1	16	5	20	55	13.9
NW_005199378.1_21978-3p	miR90_0701	78.571	14	3	0	1	14	1	14	63	13.7
NW_005199378.1_21978-3p	miR95_0369	78.571	14	3	0	6	19	19	6	63	13.7
NW_005199378.1_21978-3p	PC-3p-33398_31	83.333	12	2	0	2	13	12	1	73	13.5
NW_005199378.1_21978-3p	miR90_0567	90	10	1	0	6	15	16	7	85	13.3
NW_005199378.1_21978-3p	miR90_0513	90	10	1	0	6	15	11	2	85	13.3
NW_005199378.1_21978-3p	miR90_0012	90	10	1	0	6	15	10	1	85	13.3
NW_005199378.1_21978-3p	miR95_0558	100	8	0	0	1	8	9	16	98	13.1
NW_005199378.1_21978-5p(ehx-miR2-5p)	PC-3p-33398_31	92.857	14	1	0	6	19	6	19	5	17.5
NW_005199378.1_21978-5p(ehx-miR2-5p)	PC-3p-11444_150	92.308	13	1	0	7	19	7	19	10	16.5
NW_005199378.1_21978-5p(ehx-miR2-5p)	CCMP1516-miR18	80	20	3	1	1	19	2	21	14	16.1
NW_005199378.1_21978-5p(ehx-miR2-5p)	miR90_0571	80	15	3	0	3	17	16	2	33	14.8
NW_005199378.1_21978-5p(ehx-miR2-5p)	Vca_miR60	80	15	3	0	1	15	6	20	33	14.8

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005199378.1_21978-5p(ehx-miR2-5p)	Vca_miR32*	80	15	3	0	1	15	7	21	33	14.8
NW_005199378.1_21978-5p(ehx-miR2-5p)	miR90_0599	90.909	11	1	0	10	20	11	1	45	14.4
NW_005199378.1_21978-5p(ehx-miR2-5p)	miR90_0378	90.909	11	1	0	5	15	17	7	45	14.4
NW_005199378.1_21978-5p(ehx-miR2-5p)	ppu-miR15-5p	75	16	4	0	4	19	17	2	60	13.9
NW_005199378.1_21978-5p(ehx-miR2-5p)	miR90_0701	75	16	4	0	4	19	3	18	60	13.9
NW_005199378.1_21978-5p(ehx-miR2-5p)	miR90_0663	75	16	4	0	5	20	18	3	60	13.9
NW_005199378.1_21978-5p(ehx-miR2-5p)	ppu-miR38-3p	78.571	14	3	0	7	20	2	15	69	13.7
NW_005199378.1_21978-5p(ehx-miR2-5p)	miR90_0535	78.571	14	3	0	1	14	2	15	69	13.7
NW_005199378.1_21978-5p(ehx-miR2-5p)	miR90_0515	78.571	14	3	0	1	14	4	17	69	13.7
NW_005199378.1_21978-5p(ehx-miR2-5p)	miR95_0279	78.571	14	3	0	1	14	16	3	69	13.7
NW_005199378.1_21978-5p(ehx-miR2-5p)	miR95_0167	78.571	14	3	0	1	14	18	5	69	13.7
NW_005199378.1_21978-5p(ehx-miR2-5p)	miR90_0651	83.333	12	2	0	1	12	2	13	80	13.5
NW_005199378.1_21978-5p(ehx-miR2-5p)	SjapMIR2	66.667	21	7	0	1	21	1	21	80	13.5
NW_005199378.1_21978-5p(ehx-miR2-5p)	miR90_0342	90	10	1	0	6	15	19	10	93	13.3
NW_005199378.1_21978-5p(ehx-miR2-5p)	miR95_0507	90	10	1	0	3	12	15	24	93	13.3
NW_005199378.1_21978-5p(ehx-miR2-5p)	miR95_0451	90	10	1	0	3	12	8	17	93	13.3
NW_005199378.1_21978-5p(ehx-miR2-5p)	miR95_0210	90	10	1	0	3	12	9	18	93	13.3
NW_005199975.1_17848-3p	miR90_0607	88.235	17	1	1	5	20	18	2	8.2	16.7
NW_005199975.1_17848-3p	miR90_0778	92.857	14	0	1	7	19	1	14	20	15.4
NW_005199975.1_17848-3p	miR95_0547	91.667	12	1	0	6	17	3	14	20	15.4
NW_005199975.1_17848-3p	miR95_0545	91.667	12	1	0	6	17	3	14	20	15.4
NW_005199975.1_17848-3p	miR90_0411	80	15	3	0	1	15	2	16	31	14.8
NW_005199975.1_17848-3p	miR90_0352	86.667	15	1	1	3	17	4	17	35	14.6
NW_005199975.1_17848-3p	miR90_0293	86.667	15	1	1	6	19	18	4	35	14.6
NW_005199975.1_17848-3p	miR90_0258	84.615	13	2	0	6	18	20	8	35	14.6
NW_005199975.1_17848-3p	miR90_0011	86.667	15	1	1	6	19	17	3	35	14.6
NW_005199975.1_17848-3p	miR90_0884	92.308	13	0	1	7	19	3	14	41	14.4
NW_005199975.1_17848-3p	miR90_0704	92.308	13	0	1	7	19	4	15	41	14.4
NW_005199975.1_17848-3p	miR90_0583	92.308	13	0	1	7	19	10	21	41	14.4
NW_005199975.1_17848-3p	miR90_0545	92.308	13	0	1	7	19	13	24	41	14.4
NW_005199975.1_17848-3p	miR90_0509	92.308	13	0	1	7	19	7	18	41	14.4
NW_005199975.1_17848-3p	miR90_0431	92.308	13	0	1	7	19	7	18	41	14.4
NW_005199975.1_17848-3p	miR90_0427	92.308	13	0	1	7	19	13	2	41	14.4
NW_005199975.1_17848-3p	miR90_0415	92.308	13	0	1	7	19	13	24	41	14.4
NW_005199975.1_17848-3p	miR90_0292	92.308	13	0	1	7	19	9	20	41	14.4
NW_005199975.1_17848-3p	miR90_0277	92.308	13	0	1	7	19	5	16	41	14.4
NW_005199975.1_17848-3p	miR90_0276	92.308	13	0	1	7	19	6	17	41	14.4
NW_005199975.1_17848-3p	miR90_0139	92.308	13	0	1	7	19	16	5	41	14.4

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005199975.1_17848-3p	miR90_0125	90.909	11	1	0	1	11	5	15	41	14.4
NW_005199975.1_17848-3p	miR90_0113	92.308	13	0	1	7	19	20	9	41	14.4
NW_005199975.1_17848-3p	miR90_0081	92.308	13	0	1	7	19	5	16	41	14.4
NW_005199975.1_17848-3p	miR90_0071	92.308	13	0	1	7	19	2	13	41	14.4
NW_005199975.1_17848-3p	miR90_0070	92.308	13	0	1	7	19	3	14	41	14.4
NW_005199975.1_17848-3p	miR90_0069	92.308	13	0	1	7	19	3	14	41	14.4
NW_005199975.1_17848-3p	miR90_0046	92.308	13	0	1	7	19	18	7	41	14.4
NW_005199975.1_17848-3p	miR90_0026	92.308	13	0	1	7	19	3	14	41	14.4
NW_005199975.1_17848-3p	miR90_0022	92.308	13	0	1	7	19	17	6	41	14.4
NW_005199975.1_17848-3p	miR90_0002	92.308	13	0	1	7	19	1	12	41	14.4
NW_005199975.1_17848-3p	miR90_0001	92.308	13	0	1	7	19	1	12	41	14.4
NW_005199975.1_17848-3p	miR90_0847	72.222	18	5	0	3	20	19	2	47	14.2
NW_005199975.1_17848-3p	miR90_0441	72.222	18	5	0	1	18	4	21	47	14.2
NW_005199975.1_17848-3p	Vca_miR52	100	9	0	0	9	17	18	10	47	14.2
NW_005199975.1_17848-3p	SjapMIR103	72.222	18	5	0	1	18	18	1	47	14.2
NW_005199975.1_17848-3p	miR90_0846	78.571	14	3	0	1	14	6	19	63	13.7
NW_005199975.1_17848-3p	miR95_0513	78.571	14	3	0	1	14	1	14	63	13.7
NW_005199975.1_17848-3p	miR95_0502	78.571	14	3	0	7	20	19	6	63	13.7
NW_005199975.1_17848-3p	SjapMIR11	78.571	14	3	0	4	17	14	1	63	13.7
NW_005199975.1_17848-3p	miR95_0537	83.333	12	2	0	3	14	18	7	73	13.5
NW_005199975.1_17848-3p	miR95_0512	83.333	12	2	0	3	14	1	12	73	13.5
NW_005199975.1_17848-3p	miR95_0179	83.333	12	2	0	10	21	16	5	73	13.5
NW_005199975.1_17848-3p	miR90_0795	90	10	1	0	10	19	2	11	85	13.3
NW_005199975.1_17848-3p	miR90_0698	90	10	1	0	3	12	13	4	85	13.3
NW_005199975.1_17848-3p	miR90_0685	90	10	1	0	3	12	13	4	85	13.3
NW_005199975.1_17848-3p	miR90_0660	90	10	1	0	11	20	17	8	85	13.3
NW_005199975.1_17848-3p	miR90_0268	90	10	1	0	10	19	1	10	85	13.3
NW_005199975.1_17848-3p	miR90_0267	90	10	1	0	10	19	2	11	85	13.3
NW_005199975.1_17848-3p	miR90_0082	90	10	1	0	10	19	1	10	85	13.3
NW_005199975.1_17848-3p	miR95_0543	90	10	1	0	2	11	15	6	85	13.3
NW_005199975.1_17848-3p	miR95_0120	90	10	1	0	9	18	5	14	85	13.3
NW_005199975.1_17848-3p	miR95_0100	90	10	1	0	9	18	8	17	85	13.3
NW_005199975.1_17848-3p	miR90_0316	70.588	17	5	0	3	19	2	18	98	13.1
NW_005199975.1_17848-3p	Vca_miR68*	100	8	0	0	1	8	11	4	98	13.1
NW_005200282.1_15947-3p	Vca_miR32	77.778	18	4	0	1	18	19	2	12	16.1
NW_005200282.1_15947-3p	miR95_0534	91.667	12	1	0	2	13	4	15	18	15.4
NW_005200282.1_15947-3p	miR95_0532	91.667	12	1	0	2	13	3	14	18	15.4
NW_005200282.1_15947-3p	miR95_0538	100	10	0	0	2	11	9	18	21	15.2

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005200282.1_15947-3p	miR95_0479	76.471	17	4	0	3	19	18	2	24	15
NW_005200282.1_15947-3p	miR95_0433	76.471	17	4	0	3	19	17	1	24	15
NW_005200282.1_15947-3p	miR90_0584	80	15	3	0	3	17	15	1	28	14.8
NW_005200282.1_15947-3p	miR95_0485	80	15	3	0	5	19	2	16	28	14.8
NW_005200282.1_15947-3p	SjapMIR11	90.909	11	1	0	9	19	13	3	37	14.4
NW_005200282.1_15947-3p	Vca_miR1d	100	9	0	0	7	15	18	10	43	14.2
NW_005200282.1_15947-3p	Vca_miR1c	100	9	0	0	7	15	18	10	43	14.2
NW_005200282.1_15947-3p	Vca_miR1b	100	9	0	0	7	15	18	10	43	14.2
NW_005200282.1_15947-3p	Vca_miR1a	100	9	0	0	7	15	18	10	43	14.2
NW_005200282.1_15947-3p	miR90_0568	78.571	14	3	0	3	16	14	1	57	13.7
NW_005200282.1_15947-3p	miR90_0412	78.571	14	3	0	3	16	2	15	57	13.7
NW_005200282.1_15947-3p	miR90_0018	78.571	14	3	0	2	15	14	1	57	13.7
NW_005200282.1_15947-3p	ppu-miR4-5p	83.333	12	2	0	7	18	16	5	66	13.5
NW_005200282.1_15947-3p	miR90_0576	83.333	12	2	0	8	19	18	7	66	13.5
NW_005200282.1_15947-3p	miR90_0529	83.333	12	2	0	2	13	15	4	66	13.5
NW_005200282.1_15947-3p	miR95_0415	85.714	14	1	1	6	19	5	17	66	13.5
NW_005200282.1_15947-3p	miR95_0325	85.714	14	1	1	6	19	15	3	66	13.5
NW_005200282.1_15947-3p	miR95_0269	85.714	14	1	1	6	19	16	4	66	13.5
NW_005200282.1_15947-3p	miR95_0254	83.333	12	2	0	1	12	10	21	66	13.5
NW_005200282.1_15947-3p	miR95_0246	85.714	14	1	1	6	19	2	14	66	13.5
NW_005200282.1_15947-3p	miR95_0149	83.333	12	2	0	1	12	5	16	66	13.5
NW_005200282.1_15947-3p	miR95_0179	90	10	1	0	4	13	22	13	77	13.3
NW_005200282.1_15947-3p	Vca_miR88b*	90	10	1	0	9	18	12	3	77	13.3
NW_005200282.1_15947-3p	Vca_miR88a*	90	10	1	0	9	18	12	3	77	13.3
NW_005200282.1_15947-3p	Vca_miR45	90	10	1	0	3	12	21	12	77	13.3
NW_005200282.1_15947-3p	SjapMIR39	90	10	1	0	5	14	12	21	77	13.3
NW_005200282.1_15947-3p	miR90_0445	70.588	17	5	0	3	19	18	2	89	13.1
NW_005200282.1_15947-3p	miR90_0402	70.588	17	5	0	3	19	25	9	89	13.1
NW_005200282.1_15947-3p	miR90_0239	100	8	0	0	4	11	6	13	89	13.1
NW_005200282.1_15947-3p	miR95_0527	100	8	0	0	2	9	9	16	89	13.1
NW_005200282.1_15947-3p	miR95_0497	100	8	0	0	2	9	10	17	89	13.1
NW_005200282.1_15947-3p	miR95_0484	70.588	17	5	0	2	18	18	2	89	13.1
NW_005200282.1_15947-3p	miR95_0251	100	8	0	0	8	15	23	16	89	13.1
NW_005200282.1_15947-3p	miR95_0194	100	8	0	0	6	13	7	14	89	13.1
NW_005200282.1_15947-3p	miR95_0002	100	8	0	0	2	9	11	18	89	13.1
NW_005200461.1_14543-5p	miR90_0642	80	20	4	0	1	20	1	20	3.1	18.2
NW_005200461.1_14543-5p	miR90_0642	90.909	11	1	0	9	19	3	13	43	14.4
NW_005200461.1_14543-5p	miR90_0642	90	10	1	0	10	19	1	10	89	13.3

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005200461.1_14543-5p	miR90_0592	80	20	4	0	1	20	1	20	3.1	18.2
NW_005200461.1_14543-5p	miR90_0592	90.909	11	1	0	9	19	3	13	43	14.4
NW_005200461.1_14543-5p	miR90_0592	90	10	1	0	10	19	1	10	89	13.3
NW_005200461.1_14543-5p	miR90_0220	87.5	16	2	0	5	20	18	3	4.1	17.7
NW_005200461.1_14543-5p	miR90_0657	92.857	14	1	0	6	19	1	14	4.8	17.5
NW_005200461.1_14543-5p	miR90_0657	77.778	18	4	0	3	20	1	18	13	16.1
NW_005200461.1_14543-5p	miR90_0641	92.857	14	1	0	6	19	1	14	4.8	17.5
NW_005200461.1_14543-5p	miR90_0641	77.778	18	4	0	3	20	1	18	13	16.1
NW_005200461.1_14543-5p	miR90_0621	92.857	14	1	0	6	19	1	14	4.8	17.5
NW_005200461.1_14543-5p	miR90_0621	77.778	18	4	0	3	20	1	18	13	16.1
NW_005200461.1_14543-5p	miR90_0727	100	12	0	0	8	19	1	12	5.5	17.3
NW_005200461.1_14543-5p	miR90_0727	91.667	12	1	0	9	20	5	16	21	15.4
NW_005200461.1_14543-5p	miR90_0580	100	12	0	0	8	19	2	13	5.5	17.3
NW_005200461.1_14543-5p	miR90_0580	91.667	12	1	0	9	20	6	17	21	15.4
NW_005200461.1_14543-5p	miR90_0580	90	10	1	0	10	19	1	10	89	13.3
NW_005200461.1_14543-5p	miR90_0434	78.947	19	4	0	1	19	19	1	6.4	17.1
NW_005200461.1_14543-5p	miR90_0557	82.353	17	3	0	6	22	18	2	7.4	16.9
NW_005200461.1_14543-5p	miR95_0455	82.353	17	3	0	3	19	17	1	7.4	16.9
NW_005200461.1_14543-5p	miR90_0466	86.667	15	2	0	6	20	4	18	8.6	16.7
NW_005200461.1_14543-5p	miR90_0356	86.667	15	2	0	6	20	4	18	8.6	16.7
NW_005200461.1_14543-5p	miR90_0442	77.778	18	4	0	1	18	18	1	13	16.1
NW_005200461.1_14543-5p	miR90_0536	81.25	16	3	0	1	16	18	3	15	15.8
NW_005200461.1_14543-5p	miR90_0536	100	9	0	0	12	20	10	2	50	14.2
NW_005200461.1_14543-5p	miR90_0141	81.25	16	3	0	1	16	19	4	15	15.8
NW_005200461.1_14543-5p	miR90_0141	100	9	0	0	12	20	11	3	50	14.2
NW_005200461.1_14543-5p	miR95_0004	81.25	16	3	0	1	16	19	4	15	15.8
NW_005200461.1_14543-5p	miR95_0004	100	9	0	0	12	20	11	3	50	14.2
NW_005200461.1_14543-5p	miR90_0777	85.714	14	2	0	1	14	5	18	18	15.6
NW_005200461.1_14543-5p	miR90_0777	83.333	12	2	0	8	19	3	14	77	13.5
NW_005200461.1_14543-5p	miR90_0271	85.714	14	2	0	6	19	18	5	18	15.6
NW_005200461.1_14543-5p	miR90_0271	72.222	18	5	0	3	20	18	1	50	14.2
NW_005200461.1_14543-5p	miR90_0271	75	16	4	0	1	16	3	18	57	13.9
NW_005200461.1_14543-5p	miR90_0189	85.714	14	2	0	6	19	6	19	18	15.6
NW_005200461.1_14543-5p	miR90_0104	85.714	14	2	0	6	19	21	8	18	15.6
NW_005200461.1_14543-5p	miR90_0104	73.684	19	5	0	3	21	21	3	24	15.2
NW_005200461.1_14543-5p	miR90_0104	78.571	14	3	0	3	16	8	21	66	13.7
NW_005200461.1_14543-5p	miR95_0185	85.714	14	2	0	5	18	4	17	18	15.6
NW_005200461.1_14543-5p	miR95_0185	90.909	11	1	0	9	19	5	15	43	14.4

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005200461.1_14543-5p	miR95_0076	85.714	14	2	0	6	19	2	15	18	15.6
NW_005200461.1_14543-5p	miR95_0076	84.615	13	2	0	8	20	1	13	37	14.6
NW_005200461.1_14543-5p	miR95_0076	78.571	14	3	0	6	19	18	5	66	13.7
NW_005200461.1_14543-5p	miR90_0689	91.667	12	1	0	9	20	5	16	21	15.4
NW_005200461.1_14543-5p	miR90_0689	83.333	12	2	0	2	13	4	15	77	13.5
NW_005200461.1_14543-5p	miR90_0407	91.667	12	1	0	9	20	2	13	21	15.4
NW_005200461.1_14543-5p	miR90_0351	91.667	12	1	0	8	19	17	6	21	15.4
NW_005200461.1_14543-5p	miR90_0351	83.333	12	2	0	9	20	13	2	77	13.5
NW_005200461.1_14543-5p	miR90_0215	91.667	12	1	0	9	20	1	12	21	15.4
NW_005200461.1_14543-5p	miR90_0898	100	10	0	0	9	18	15	6	24	15.2
NW_005200461.1_14543-5p	miR90_0898	90.909	11	1	0	9	19	18	8	43	14.4
NW_005200461.1_14543-5p	miR90_0477	100	10	0	0	11	20	1	10	24	15.2
NW_005200461.1_14543-5p	miR90_0477	90	10	1	0	9	18	2	11	89	13.3
NW_005200461.1_14543-5p	miR95_0444	100	10	0	0	8	17	17	8	24	15.2
NW_005200461.1_14543-5p	miR95_0444	83.333	12	2	0	10	21	18	7	77	13.5
NW_005200461.1_14543-5p	miR95_0439	100	10	0	0	10	19	8	17	24	15.2
NW_005200461.1_14543-5p	miR95_0439	100	9	0	0	9	17	10	18	50	14.2
NW_005200461.1_14543-5p	miR95_0439	90	10	1	0	10	19	5	14	89	13.3
NW_005200461.1_14543-5p	miR95_0300	100	10	0	0	9	18	4	13	24	15.2
NW_005200461.1_14543-5p	miR95_0300	90.909	11	1	0	9	19	1	11	43	14.4
NW_005200461.1_14543-5p	miR95_0176	100	10	0	0	10	19	20	11	24	15.2
NW_005200461.1_14543-5p	miR95_0044	100	10	0	0	9	18	2	11	24	15.2
NW_005200461.1_14543-5p	miR95_0044	100	9	0	0	11	19	1	9	50	14.2
NW_005200461.1_14543-5p	miR95_0006	100	10	0	0	10	19	1	10	24	15.2
NW_005200461.1_14543-5p	Vca_miR44c	73.684	19	5	0	2	20	21	3	24	15.2
NW_005200461.1_14543-5p	Vca_miR44c	78.571	14	3	0	9	22	17	4	66	13.7
NW_005200461.1_14543-5p	Vca_miR44b	73.684	19	5	0	2	20	21	3	24	15.2
NW_005200461.1_14543-5p	Vca_miR44b	78.571	14	3	0	9	22	17	4	66	13.7
NW_005200461.1_14543-5p	Vca_miR44a	73.684	19	5	0	2	20	21	3	24	15.2
NW_005200461.1_14543-5p	Vca_miR44a	78.571	14	3	0	9	22	17	4	66	13.7
NW_005200461.1_14543-5p	miR90_0182	76.471	17	4	0	1	17	17	1	28	15
NW_005200461.1_14543-5p	miR90_0208	82.353	17	2	1	4	19	1	17	32	14.8
NW_005200461.1_14543-5p	miR90_0208	90	10	1	0	9	18	10	19	89	13.3
NW_005200461.1_14543-5p	miR90_0809	84.615	13	2	0	7	19	1	13	37	14.6
NW_005200461.1_14543-5p	miR90_0809	83.333	12	2	0	9	20	6	17	77	13.5
NW_005200461.1_14543-5p	miR90_0564	84.615	13	2	0	6	18	6	18	37	14.6
NW_005200461.1_14543-5p	miR90_0254	84.615	13	2	0	7	19	17	5	37	14.6
NW_005200461.1_14543-5p	miR90_0223	84.615	13	2	0	6	18	13	1	37	14.6

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005200461.1_14543-5p	miR90_0200	84.615	13	2	0	7	19	17	5	37	14.6
NW_005200461.1_14543-5p	miR95_0340	84.615	13	2	0	7	19	19	7	37	14.6
NW_005200461.1_14543-5p	Vca_miR77	84.615	13	2	0	8	20	9	21	37	14.6
NW_005200461.1_14543-5p	miR90_0850	90.909	11	1	0	11	21	5	15	43	14.4
NW_005200461.1_14543-5p	miR90_0769	90.909	11	1	0	9	19	2	12	43	14.4
NW_005200461.1_14543-5p	miR90_0769	83.333	12	2	0	9	20	5	16	77	13.5
NW_005200461.1_14543-5p	miR90_0754	90.909	11	1	0	9	19	18	8	43	14.4
NW_005200461.1_14543-5p	miR90_0754	83.333	12	2	0	9	20	15	4	77	13.5
NW_005200461.1_14543-5p	miR90_0644	90.909	11	1	0	9	19	8	18	43	14.4
NW_005200461.1_14543-5p	miR90_0507	90.909	11	1	0	10	20	12	2	43	14.4
NW_005200461.1_14543-5p	miR90_0507	75	16	4	0	1	16	18	3	57	13.9
NW_005200461.1_14543-5p	miR90_0241	90.909	11	1	0	10	20	1	11	43	14.4
NW_005200461.1_14543-5p	miR90_0199	90.909	11	1	0	9	19	1	11	43	14.4
NW_005200461.1_14543-5p	miR90_0199	83.333	12	2	0	10	21	8	19	77	13.5
NW_005200461.1_14543-5p	miR95_0194	90.909	11	1	0	4	14	12	2	43	14.4
NW_005200461.1_14543-5p	miR90_0722	100	9	0	0	12	20	17	9	50	14.2
NW_005200461.1_14543-5p	miR90_0294	72.222	18	5	0	3	20	18	1	50	14.2
NW_005200461.1_14543-5p	miR95_0254	100	9	0	0	10	18	1	9	50	14.2
NW_005200461.1_14543-5p	miR95_0140	100	9	0	0	11	19	1	9	50	14.2
NW_005200461.1_14543-5p	miR95_0001	72.222	18	5	0	1	18	1	18	50	14.2
NW_005200461.1_14543-5p	miR90_0747	75	16	4	0	5	20	1	16	57	13.9
NW_005200461.1_14543-5p	miR90_0169	75	16	4	0	3	18	4	19	57	13.9
NW_005200461.1_14543-5p	miR90_0169	75	16	4	0	1	16	19	4	57	13.9
NW_005200461.1_14543-5p	miR90_0169	83.333	12	2	0	9	20	17	6	77	13.5
NW_005200461.1_14543-5p	miR90_0169	83.333	12	2	0	9	20	7	18	77	13.5
NW_005200461.1_14543-5p	miR90_0169	90	10	1	0	10	19	19	10	89	13.3
NW_005200461.1_14543-5p	miR90_0157	75	16	4	0	4	19	18	3	57	13.9
NW_005200461.1_14543-5p	miR90_0013	80	20	2	2	1	19	1	19	57	13.9
NW_005200461.1_14543-5p	miR95_0421	75	16	4	0	6	21	3	18	57	13.9
NW_005200461.1_14543-5p	miR95_0326	80	20	2	2	1	19	1	19	57	13.9
NW_005200461.1_14543-5p	miR95_0260	75	16	4	0	4	19	1	16	57	13.9
NW_005200461.1_14543-5p	miR95_0260	68.421	19	6	0	1	19	1	19	89	13.3
NW_005200461.1_14543-5p	miR90_0756	78.571	14	3	0	1	14	5	18	66	13.7
NW_005200461.1_14543-5p	miR90_0756	90	10	1	0	9	18	4	13	89	13.3
NW_005200461.1_14543-5p	miR90_0576	78.571	14	3	0	9	22	18	5	66	13.7
NW_005200461.1_14543-5p	miR95_0190	78.571	14	3	0	4	17	17	4	66	13.7
NW_005200461.1_14543-5p	miR90_0908	83.333	12	2	0	9	20	1	12	77	13.5
NW_005200461.1_14543-5p	miR90_0887	83.333	12	2	0	9	20	2	13	77	13.5

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005200461.1_14543-5p	miR90_0678	83.333	12	2	0	2	13	7	18	77	13.5
NW_005200461.1_14543-5p	miR90_0655	83.333	12	2	0	2	13	3	14	77	13.5
NW_005200461.1_14543-5p	miR90_0520	83.333	12	2	0	7	18	18	7	77	13.5
NW_005200461.1_14543-5p	miR90_0219	83.333	12	2	0	10	21	4	15	77	13.5
NW_005200461.1_14543-5p	miR95_0411	83.333	12	2	0	7	18	8	19	77	13.5
NW_005200461.1_14543-5p	miR95_0373	83.333	12	2	0	7	18	7	18	77	13.5
NW_005200461.1_14543-5p	PC-5p-179621_3	83.333	12	2	0	11	22	9	20	77	13.5
NW_005200461.1_14543-5p	SjapMIR50	83.333	12	2	0	4	15	10	21	77	13.5
NW_005200461.1_14543-5p	miR90_0899	90	10	1	0	10	19	9	18	89	13.3
NW_005200461.1_14543-5p	miR90_0897	90	10	1	0	10	19	10	1	89	13.3
NW_005200461.1_14543-5p	miR90_0897	90	10	1	0	10	19	13	4	89	13.3
NW_005200461.1_14543-5p	miR90_0848	90	10	1	0	10	19	4	13	89	13.3
NW_005200461.1_14543-5p	miR90_0814	90	10	1	0	10	19	8	17	89	13.3
NW_005200461.1_14543-5p	miR90_0771	90	10	1	0	10	19	12	3	89	13.3
NW_005200461.1_14543-5p	miR90_0750	90	10	1	0	10	19	8	17	89	13.3
NW_005200461.1_14543-5p	miR90_0741	90	10	1	0	10	19	3	12	89	13.3
NW_005200461.1_14543-5p	miR90_0656	90	10	1	0	6	15	17	8	89	13.3
NW_005200461.1_14543-5p	miR90_0624	68.421	19	6	0	1	19	19	1	89	13.3
NW_005200461.1_14543-5p	miR90_0613	90	10	1	0	6	15	17	8	89	13.3
NW_005200461.1_14543-5p	miR90_0588	90	10	1	0	6	15	12	3	89	13.3
NW_005200461.1_14543-5p	miR90_0584	68.421	19	6	0	1	19	21	3	89	13.3
NW_005200461.1_14543-5p	miR90_0336	90	10	1	0	6	15	14	5	89	13.3
NW_005200461.1_14543-5p	miR90_0331	68.421	19	6	0	1	19	1	19	89	13.3
NW_005200461.1_14543-5p	miR90_0274	90	10	1	0	10	19	6	15	89	13.3
NW_005200461.1_14543-5p	miR90_0236	90	10	1	0	9	18	17	8	89	13.3
NW_005200461.1_14543-5p	miR90_0211	90	10	1	0	9	18	12	3	89	13.3
NW_005200461.1_14543-5p	miR90_0006	90	10	1	0	10	19	1	10	89	13.3
NW_005200461.1_14543-5p	miR95_0525	68.421	19	6	0	1	19	19	1	89	13.3
NW_005200461.1_14543-5p	miR95_0415	90	10	1	0	4	13	10	1	89	13.3
NW_005200461.1_14543-5p	miR95_0327	90	10	1	0	9	18	7	16	89	13.3
NW_005200461.1_14543-5p	miR95_0220	90	10	1	0	10	19	1	10	89	13.3
NW_005200461.1_14543-5p	miR95_0064	90	10	1	0	10	19	8	17	89	13.3
NW_005200496.1_14318-5p	miR90_0521	86.667	15	2	0	1	15	1	15	11	16.7
NW_005200496.1_14318-5p	Thalassiosira	86.667	15	2	0	13	27	2	16	11	16.7
NW_005200496.1_14318-5p	miR90_0808	77.778	18	4	0	7	24	2	19	17	16.1
NW_005200496.1_14318-5p	miR90_0808	83.333	12	2	0	6	17	12	1	96	13.5
NW_005200496.1_14318-5p	miR90_0496	85.714	14	2	0	17	30	2	15	22	15.6
NW_005200496.1_14318-5p	miR90_0379	85.714	14	2	0	17	30	2	15	22	15.6

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005200496.1_14318-5p	miR90_0826	91.667	12	1	0	7	18	4	15	26	15.4
NW_005200496.1_14318-5p	miR90_0826	83.333	12	2	0	6	17	14	3	96	13.5
NW_005200496.1_14318-5p	ppu-miR36-3p	73.684	19	5	0	1	19	2	20	30	15.2
NW_005200496.1_14318-5p	SjapMIR6	73.684	19	5	0	9	27	3	21	30	15.2
NW_005200496.1_14318-5p	miR95_0193	76.471	17	4	0	4	20	4	20	35	15
NW_005200496.1_14318-5p	miR95_0193	72.222	18	5	0	7	24	19	2	62	14.2
NW_005200496.1_14318-5p	miR90_0576	86.667	15	1	1	2	16	18	5	46	14.6
NW_005200496.1_14318-5p	miR90_0663	90.909	11	1	0	4	14	11	1	54	14.4
NW_005200496.1_14318-5p	miR95_0358	70	20	6	0	7	26	6	25	54	14.4
NW_005200496.1_14318-5p	SjapMIR23	72.222	18	5	0	1	18	4	21	62	14.2
NW_005200496.1_14318-5p	miR90_0566	75	16	4	0	7	22	5	20	72	13.9
NW_005200496.1_14318-5p	miR90_0012	75	16	4	0	7	22	6	21	72	13.9
NW_005200496.1_14318-5p	SjapMIR17	75	16	4	0	15	30	6	21	72	13.9
NW_005200496.1_14318-5p	miR90_0628	78.571	14	3	0	10	23	16	3	83	13.7
NW_005200496.1_14318-5p	miR90_0441	65.217	23	8	0	7	29	25	3	83	13.7
NW_005200496.1_14318-5p	miR95_0421	78.571	14	3	0	4	17	18	5	83	13.7
NW_005200496.1_14318-5p	miR95_0294	78.571	14	3	0	17	30	4	17	83	13.7
NW_005200496.1_14318-5p	miR95_0275	78.571	14	3	0	17	30	17	4	83	13.7
NW_005200496.1_14318-5p	miR95_0274	78.571	14	3	0	17	30	2	15	83	13.7
NW_005200496.1_14318-5p	miR95_0175	78.571	14	3	0	17	30	1	14	83	13.7
NW_005200496.1_14318-5p	Vca_miR44c	78.571	14	3	0	17	30	18	5	83	13.7
NW_005200496.1_14318-5p	Vca_miR44b	78.571	14	3	0	17	30	18	5	83	13.7
NW_005200496.1_14318-5p	Vca_miR44a	78.571	14	3	0	17	30	18	5	83	13.7
NW_005200496.1_14318-5p	SjapMIR59	78.571	14	3	0	17	30	21	8	83	13.7
NW_005200496.1_14318-5p	miR90_0793	83.333	12	2	0	2	13	1	12	96	13.5
NW_005200496.1_14318-5p	miR90_0048	83.333	12	2	0	7	18	15	4	96	13.5
NW_005200496.1_14318-5p	miR95_0460	66.667	21	7	0	10	30	24	4	96	13.5
NW_005200496.1_14318-5p	miR95_0283	83.333	12	2	0	7	18	13	2	96	13.5
NW_005200496.1_14318-5p	PC-5p-179621_3	83.333	12	2	0	19	30	1	12	96	13.5
NW_005200496.1_14318-5p	SjapMIR57	66.667	21	7	0	5	25	21	1	96	13.5
NW_005200517.1_13952-3p	SjapMIR15_2	100	9	0	0	3	11	14	6	47	14.2
NW_005200517.1_13952-3p	SjapMIR15_1	100	9	0	0	3	11	14	6	47	14.2
NW_005200517.1_13952-3p	Vca_miR113b	75	16	4	0	1	16	18	3	55	13.9
NW_005200517.1_13952-3p	Vca_miR113a	75	16	4	0	1	16	18	3	55	13.9
NW_005200517.1_13952-3p	miR90_0679	78.571	14	3	0	7	20	15	2	63	13.7
NW_005200517.1_13952-3p	miR90_0123	78.571	14	3	0	7	20	25	12	63	13.7
NW_005200517.1_13952-3p	miR95_0563	78.571	14	3	0	5	18	14	1	63	13.7
NW_005200517.1_13952-3p	miR95_0436	78.571	14	3	0	7	20	3	16	63	13.7

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005200517.1_13952-3p	miR95_0407	78.571	14	3	0	7	20	3	16	63	13.7
NW_005200517.1_13952-3p	miR95_0379	78.571	14	3	0	7	20	2	15	63	13.7
NW_005200517.1_13952-3p	miR95_0370	78.571	14	3	0	7	20	3	16	63	13.7
NW_005200517.1_13952-3p	miR95_0314	78.571	14	3	0	7	20	2	15	63	13.7
NW_005200517.1_13952-3p	miR95_0094	78.571	14	3	0	7	20	23	10	63	13.7
NW_005200517.1_13952-3p	miR95_0091	78.571	14	3	0	7	20	23	10	63	13.7
NW_005200517.1_13952-3p	miR95_0007	78.571	14	3	0	7	20	2	15	63	13.7
NW_005200517.1_13952-3p	SjapMIR97	78.571	14	3	0	6	19	14	1	63	13.7
NW_005200517.1_13952-3p	miR95_0522	83.333	12	2	0	5	16	12	1	73	13.5
NW_005200517.1_13952-3p	miR95_0460	83.333	12	2	0	6	17	14	25	73	13.5
NW_005200517.1_13952-3p	miR95_0093	83.333	12	2	0	9	20	21	10	73	13.5
NW_005200517.1_13952-3p	miR95_0054	83.333	12	2	0	9	20	20	9	73	13.5
NW_005200517.1_13952-3p	miR95_0050	83.333	12	2	0	9	20	25	14	73	13.5
NW_005200517.1_13952-3p	SjapMIR75	90	10	1	0	2	11	1	10	85	13.3
NW_005200517.1_13952-3p	miR90_0591	100	8	0	0	7	14	12	5	98	13.1
NW_005200517.1_13952-3p	Vca_miR39	100	8	0	0	2	9	13	20	98	13.1
NW_005200535.1_13863-3p	Vca_miR104	84.615	13	2	0	3	15	9	21	35	14.6
NW_005200535.1_13863-3p	miR90_0459	78.571	14	3	0	6	19	18	5	63	13.7
NW_005200535.1_13863-3p	SjapMIR102	78.571	14	3	0	8	21	18	5	63	13.7
NW_005200535.1_13863-3p	miR90_0440	83.333	12	2	0	7	18	7	18	73	13.5
NW_005200535.1_13863-3p	miR90_0286	83.333	12	2	0	7	18	25	14	73	13.5
NW_005200535.1_13863-3p	miR95_0304	83.333	12	2	0	3	14	4	15	73	13.5
NW_005200535.1_13863-3p	miR95_0256	83.333	12	2	0	7	18	10	21	73	13.5
NW_005200535.1_13863-3p	Vca_miR58-3p*	83.333	12	2	0	10	21	15	4	73	13.5
NW_005200535.1_13863-3p	SjapMIR53	83.333	12	2	0	5	16	17	6	73	13.5
NW_005200535.1_13863-3p	SjapMIR37_2	83.333	12	2	0	7	18	1	12	73	13.5
NW_005200535.1_13863-3p	SjapMIR37_1	83.333	12	2	0	7	18	1	12	73	13.5
NW_005200535.1_13863-3p	miR95_0392	90	10	1	0	1	10	7	16	85	13.3
NW_005200535.1_13863-3p	Vca_miR111	90	10	1	0	7	16	1	10	85	13.3
NW_005200535.1_13863-3p	miR95_0143	70.588	17	5	0	1	17	1	17	98	13.1
NW_005200535.1_13863-3p	SjapMIR8	100	8	0	0	13	20	7	14	98	13.1
NW_005200600.1_13330-3p	miR90_0709	91.667	12	1	0	10	21	18	7	20	15.4
NW_005200600.1_13330-3p	miR90_0495	100	10	0	0	3	12	18	9	23	15.2
NW_005200600.1_13330-3p	Vca_miR60	73.684	19	5	0	3	21	3	21	23	15.2
NW_005200600.1_13330-3p	miR90_0876	80	15	3	0	6	20	1	15	31	14.8
NW_005200600.1_13330-3p	Vca_miR82	80	15	3	0	6	20	2	16	31	14.8
NW_005200600.1_13330-3p	miR90_0690	84.615	13	2	0	9	21	2	14	35	14.6
NW_005200600.1_13330-3p	miR90_0653	84.615	13	2	0	9	21	1	13	35	14.6

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005200600.1_13330-3p	miR90_0211	84.615	13	2	0	7	19	1	13	35	14.6
NW_005200600.1_13330-3p	Vca_miR77	84.615	13	2	0	9	21	15	3	35	14.6
NW_005200600.1_13330-3p	miR90_0487	90.909	11	1	0	11	21	19	9	41	14.4
NW_005200600.1_13330-3p	ppu-miR9-3p	100	9	0	0	4	12	3	11	47	14.2
NW_005200600.1_13330-3p	miR90_0862	100	9	0	0	12	20	15	7	47	14.2
NW_005200600.1_13330-3p	miR90_0840	100	9	0	0	12	20	16	8	47	14.2
NW_005200600.1_13330-3p	miR90_0743	100	9	0	0	12	20	6	14	47	14.2
NW_005200600.1_13330-3p	miR95_0499	72.222	18	5	0	2	19	1	18	47	14.2
NW_005200600.1_13330-3p	miR95_0258	75	20	4	1	1	20	21	3	47	14.2
NW_005200600.1_13330-3p	Porphyra	72.222	18	5	0	3	20	3	20	47	14.2
NW_005200600.1_13330-3p	miR90_0827	75	16	4	0	1	16	3	18	55	13.9
NW_005200600.1_13330-3p	miR90_0559	75	16	4	0	1	16	2	17	55	13.9
NW_005200600.1_13330-3p	miR90_0400	75	16	4	0	3	18	16	1	55	13.9
NW_005200600.1_13330-3p	miR90_0016	75	16	4	0	3	18	17	2	55	13.9
NW_005200600.1_13330-3p	Vca_miR13*	75	16	4	0	6	21	6	21	55	13.9
NW_005200600.1_13330-3p	miR90_0759	78.571	14	3	0	6	19	3	16	63	13.7
NW_005200600.1_13330-3p	miR90_0457	78.571	14	3	0	2	15	19	6	63	13.7
NW_005200600.1_13330-3p	miR95_0417	78.571	14	3	0	1	14	18	5	63	13.7
NW_005200600.1_13330-3p	SjapMIR60	78.571	14	3	0	8	21	2	15	63	13.7
NW_005200600.1_13330-3p	miR90_0777	83.333	12	2	0	1	12	18	7	73	13.5
NW_005200600.1_13330-3p	miR90_0363	83.333	12	2	0	2	13	6	17	73	13.5
NW_005200600.1_13330-3p	SjapMIR70	83.333	12	2	0	5	16	2	13	73	13.5
NW_005200600.1_13330-3p	miR90_0809	90	10	1	0	9	18	12	3	85	13.3
NW_005200600.1_13330-3p	miR90_0769	90	10	1	0	9	18	11	2	85	13.3
NW_005200600.1_13330-3p	miR90_0754	90	10	1	0	9	18	9	18	85	13.3
NW_005200600.1_13330-3p	miR90_0314	90	10	1	0	1	10	16	7	85	13.3
NW_005200600.1_13330-3p	miR90_0217	90	10	1	0	1	10	15	24	85	13.3
NW_005200600.1_13330-3p	miR95_0549	90	10	1	0	1	10	8	17	85	13.3
NW_005200600.1_13330-3p	miR95_0143	90	10	1	0	3	12	8	17	85	13.3
NW_005200600.1_13330-3p	SjapMIR102	90	10	1	0	3	12	18	9	85	13.3
NW_005200600.1_13330-3p	SjapMIR29	68.421	19	6	0	1	19	3	21	85	13.3
NW_005200600.1_13330-3p	ppu-miR4-5p	100	8	0	0	14	21	11	18	98	13.1
NW_005200600.1_13330-3p	miR90_0866	100	8	0	0	13	20	25	18	98	13.1
NW_005200600.1_13330-3p	miR90_0706	100	8	0	0	14	21	18	11	98	13.1
NW_005200600.1_13330-3p	miR90_0610	70.588	17	5	0	5	21	1	17	98	13.1
NW_005200600.1_13330-3p	miR90_0560	100	8	0	0	3	10	13	6	98	13.1
NW_005200600.1_13330-3p	miR95_0488	70.588	17	5	0	3	19	1	17	98	13.1
NW_005200600.1_13330-3p	miR95_0401	70.588	17	5	0	3	19	18	2	98	13.1

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005200600.1_13330-3p	miR95_0260	70.588	17	5	0	1	17	17	1	98	13.1
NW_005200600.1_13330-3p	SjapMIR98	70.588	17	5	0	1	17	2	18	98	13.1
NW_005200881.1_10661-3p	Vca_miR32	75	20	5	0	2	21	23	4	11	16.3
NW_005200881.1_10661-3p	miR95_0499	85.714	14	2	0	8	21	5	18	17	15.6
NW_005200881.1_10661-3p	miR95_0488	85.714	14	2	0	8	21	4	17	17	15.6
NW_005200881.1_10661-3p	miR95_0193	76.471	17	4	0	2	18	1	17	26	15
NW_005200881.1_10661-3p	miR95_0534	82.353	17	2	1	5	21	2	17	31	14.8
NW_005200881.1_10661-3p	miR95_0532	82.353	17	2	1	5	21	1	16	31	14.8
NW_005200881.1_10661-3p	miR90_0351	84.615	13	2	0	8	20	4	16	35	14.6
NW_005200881.1_10661-3p	miR90_0271	84.615	13	2	0	8	20	3	15	35	14.6
NW_005200881.1_10661-3p	miR90_0457	90.909	11	1	0	10	20	9	19	41	14.4
NW_005200881.1_10661-3p	miR95_0386	70	20	6	0	2	21	25	6	41	14.4
NW_005200881.1_10661-3p	Vca_miR43d	90.909	11	1	0	4	14	21	11	41	14.4
NW_005200881.1_10661-3p	Vca_miR43c	90.909	11	1	0	4	14	21	11	41	14.4
NW_005200881.1_10661-3p	Vca_miR43b	90.909	11	1	0	4	14	21	11	41	14.4
NW_005200881.1_10661-3p	Vca_miR43a	90.909	11	1	0	4	14	21	11	41	14.4
NW_005200881.1_10661-3p	miR90_0487	100	9	0	0	12	20	11	19	47	14.2
NW_005200881.1_10661-3p	ppu-miR15-5p	75	16	4	0	4	19	5	20	55	13.9
NW_005200881.1_10661-3p	miR90_0691	78.571	14	3	0	2	15	12	25	63	13.7
NW_005200881.1_10661-3p	miR95_0538	78.571	14	3	0	3	16	5	18	63	13.7
NW_005200881.1_10661-3p	miR90_0507	83.333	12	2	0	7	18	13	2	73	13.5
NW_005200881.1_10661-3p	miR90_0477	83.333	12	2	0	9	20	16	5	73	13.5
NW_005200881.1_10661-3p	miR90_0400	83.333	12	2	0	8	19	2	13	73	13.5
NW_005200881.1_10661-3p	miR90_0298	83.333	12	2	0	5	16	25	14	73	13.5
NW_005200881.1_10661-3p	miR90_0169	83.333	12	2	0	8	19	8	19	73	13.5
NW_005200881.1_10661-3p	miR90_0016	83.333	12	2	0	8	19	3	14	73	13.5
NW_005200881.1_10661-3p	miR95_0525	83.333	12	2	0	10	21	1	12	73	13.5
NW_005200881.1_10661-3p	miR95_0076	83.333	12	2	0	9	20	4	15	73	13.5
NW_005200881.1_10661-3p	SjapMIR102	83.333	12	2	0	2	13	18	7	73	13.5
NW_005200881.1_10661-3p	miR90_0497	90	10	1	0	6	15	2	11	85	13.3
NW_005200881.1_10661-3p	miR90_0315	90	10	1	0	1	10	17	8	85	13.3
NW_005200881.1_10661-3p	miR90_0084	90	10	1	0	1	10	20	11	85	13.3
NW_005200881.1_10661-3p	miR95_0380	90	10	1	0	3	12	11	2	85	13.3
NW_005200881.1_10661-3p	miR95_0118	90	10	1	0	10	19	11	2	85	13.3
NW_005200881.1_10661-3p	miR95_0087	68.421	19	6	0	2	20	19	1	85	13.3
NW_005200881.1_10661-3p	miR90_0378	70.588	17	5	0	4	20	17	1	98	13.1
NW_005200881.1_10661-3p	miR95_0292	100	8	0	0	9	16	9	2	98	13.1
NW_005201234.1_6668-5p	miR90_0701	80	15	3	0	4	18	4	18	26	14.8

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005201234.1_6668-5p	miR90_0701	90	10	1	0	8	17	11	2	73	13.3
NW_005201234.1_6668-5p	miR90_0701	90	10	1	0	8	17	2	11	73	13.3
NW_005201234.1_6668-5p	miR90_0701	100	8	0	0	4	11	9	2	84	13.1
NW_005201234.1_6668-5p	miR95_0282	84.615	13	2	0	3	15	15	3	30	14.6
NW_005201234.1_6668-5p	miR95_0282	78.571	14	3	0	2	15	1	14	54	13.7
NW_005201234.1_6668-5p	miR90_0787	90.909	11	1	0	6	16	1	11	35	14.4
NW_005201234.1_6668-5p	miR90_0167	90.909	11	1	0	5	15	24	14	35	14.4
NW_005201234.1_6668-5p	miR90_0144	90.909	11	1	0	5	15	9	19	35	14.4
NW_005201234.1_6668-5p	miR90_0829	100	9	0	0	1	9	7	15	41	14.2
NW_005201234.1_6668-5p	miR90_0829	100	8	0	0	1	8	17	24	84	13.1
NW_005201234.1_6668-5p	miR90_0463	100	9	0	0	1	9	9	1	41	14.2
NW_005201234.1_6668-5p	miR90_0245	100	9	0	0	1	9	9	1	41	14.2
NW_005201234.1_6668-5p	miR90_0245	100	9	0	0	1	9	19	11	41	14.2
NW_005201234.1_6668-5p	miR90_0244	100	9	0	0	1	9	9	1	41	14.2
NW_005201234.1_6668-5p	miR90_0244	100	8	0	0	2	9	18	11	84	13.1
NW_005201234.1_6668-5p	miR90_0193	100	9	0	0	1	9	7	15	41	14.2
NW_005201234.1_6668-5p	miR95_0047	75	16	4	0	3	18	17	2	47	13.9
NW_005201234.1_6668-5p	miR90_0489	78.571	14	3	0	4	17	4	17	54	13.7
NW_005201234.1_6668-5p	miR90_0489	78.571	14	3	0	4	17	21	8	54	13.7
NW_005201234.1_6668-5p	miR90_0390	78.571	14	3	0	4	17	2	15	54	13.7
NW_005201234.1_6668-5p	miR90_0390	78.571	14	3	0	4	17	19	6	54	13.7
NW_005201234.1_6668-5p	miR90_0328	78.571	14	3	0	4	17	2	15	54	13.7
NW_005201234.1_6668-5p	Vca_miR90.2	78.571	14	3	0	3	16	18	5	54	13.7
NW_005201234.1_6668-5p	miR95_0409	83.333	12	2	0	7	18	3	14	63	13.5
NW_005201234.1_6668-5p	Vca_miR82	83.333	12	2	0	7	18	4	15	63	13.5
NW_005201234.1_6668-5p	ppu-miR7-5p	90	10	1	0	3	12	15	6	73	13.3
NW_005201234.1_6668-5p	miR90_0663	90	10	1	0	9	18	6	15	73	13.3
NW_005201234.1_6668-5p	miR90_0366	90	10	1	0	5	14	10	1	73	13.3
NW_005201234.1_6668-5p	miR95_0482	90	10	1	0	4	13	11	20	73	13.3
NW_005201234.1_6668-5p	Vca_miR117	90	10	1	0	3	12	16	7	73	13.3
NW_005201234.1_6668-5p	CCMP1516-miR16	90	10	1	0	9	18	14	5	73	13.3
NW_005201234.1_6668-5p	SjapMIR58	90	10	1	0	1	10	5	14	73	13.3
NW_005201234.1_6668-5p	miR90_0845	100	8	0	0	9	16	1	8	84	13.1
NW_005201234.1_6668-5p	miR90_0742	70.588	17	5	0	2	18	2	18	84	13.1
NW_005201234.1_6668-5p	miR90_0606	100	8	0	0	7	14	8	1	84	13.1
NW_005201234.1_6668-5p	miR90_0251	100	8	0	0	2	9	7	14	84	13.1
NW_005201234.1_6668-5p	miR90_0112	100	8	0	0	2	9	14	21	84	13.1
NW_005201234.1_6668-5p	miR90_0306	73.333	15	4	0	4	18	25	11	97	12.9

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005201234.1_6668-5p	miR95_0303	73.333	15	4	0	4	18	16	2	97	12.9
NW_005201234.1_6668-5p	miR95_0172	73.333	15	4	0	4	18	16	2	97	12.9
NW_005202428.1_1248-3p	miR95_0185	92.857	14	1	0	7	20	4	17	5.2	17.5
NW_005202428.1_1248-3p	miR95_0185	87.5	16	1	1	9	24	3	17	19	15.6
NW_005202428.1_1248-3p	miR90_0642	93.333	15	0	1	7	20	1	15	11	16.5
NW_005202428.1_1248-3p	miR90_0642	73.684	19	5	0	2	20	19	1	26	15.2
NW_005202428.1_1248-3p	miR90_0642	72.222	18	5	0	5	22	3	20	54	14.2
NW_005202428.1_1248-3p	miR90_0592	93.333	15	0	1	7	20	1	15	11	16.5
NW_005202428.1_1248-3p	miR90_0592	73.684	19	5	0	2	20	19	1	26	15.2
NW_005202428.1_1248-3p	miR90_0592	72.222	18	5	0	5	22	3	20	54	14.2
NW_005202428.1_1248-3p	miR95_0300	92.308	13	1	0	8	20	1	13	11	16.5
NW_005202428.1_1248-3p	miR90_0219	77.778	18	4	0	5	22	19	2	15	16.1
NW_005202428.1_1248-3p	miR90_0219	83.333	18	2	1	4	20	1	18	17	15.8
NW_005202428.1_1248-3p	miR95_0455	81.25	16	3	0	5	20	17	2	17	15.8
NW_005202428.1_1248-3p	miR95_0455	84.615	13	2	0	7	19	18	6	40	14.6
NW_005202428.1_1248-3p	miR95_0455	75	16	4	0	5	20	1	16	63	13.9
NW_005202428.1_1248-3p	miR95_0455	75	16	4	0	1	16	3	18	63	13.9
NW_005202428.1_1248-3p	miR95_0001	81.25	16	3	0	5	20	3	18	17	15.8
NW_005202428.1_1248-3p	miR90_0576	85.714	14	2	0	11	24	18	5	19	15.6
NW_005202428.1_1248-3p	miR90_0557	85.714	14	2	0	11	24	15	2	19	15.6
NW_005202428.1_1248-3p	miR90_0274	85.714	14	2	0	7	20	1	14	19	15.6
NW_005202428.1_1248-3p	miR90_0274	85.714	14	1	1	7	19	6	19	84	13.5
NW_005202428.1_1248-3p	miR90_0274	68.421	19	6	0	1	19	19	1	97	13.3
NW_005202428.1_1248-3p	Vca_miR89*	85.714	14	2	0	10	23	20	7	19	15.6
NW_005202428.1_1248-3p	miR90_0636	91.667	12	1	0	2	13	8	19	23	15.4
NW_005202428.1_1248-3p	miR90_0636	75	16	4	0	8	23	2	17	63	13.9
NW_005202428.1_1248-3p	Vca_miR44c	91.667	12	1	0	12	23	13	2	23	15.4
NW_005202428.1_1248-3p	Vca_miR44c	76.471	17	4	0	8	24	20	4	30	15
NW_005202428.1_1248-3p	Vca_miR44b	91.667	12	1	0	12	23	13	2	23	15.4
NW_005202428.1_1248-3p	Vca_miR44b	76.471	17	4	0	8	24	20	4	30	15
NW_005202428.1_1248-3p	Vca_miR44a	91.667	12	1	0	12	23	13	2	23	15.4
NW_005202428.1_1248-3p	Vca_miR44a	76.471	17	4	0	8	24	20	4	30	15
NW_005202428.1_1248-3p	miR90_0898	100	10	0	0	11	20	15	6	26	15.2
NW_005202428.1_1248-3p	miR90_0898	85.714	14	1	1	11	24	18	6	84	13.5
NW_005202428.1_1248-3p	miR90_0727	100	10	0	0	11	20	2	11	26	15.2
NW_005202428.1_1248-3p	miR90_0727	78.571	14	3	0	2	15	15	2	72	13.7
NW_005202428.1_1248-3p	miR90_0727	83.333	12	2	0	11	22	5	16	84	13.5
NW_005202428.1_1248-3p	miR90_0657	100	10	0	0	11	20	4	13	26	15.2

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005202428.1_1248-3p	miR90_0657	76.471	17	4	0	2	18	17	1	30	15
NW_005202428.1_1248-3p	miR90_0657	72.222	18	5	0	5	22	1	18	54	14.2
NW_005202428.1_1248-3p	miR90_0657	85.714	14	1	1	11	24	1	13	84	13.5
NW_005202428.1_1248-3p	miR90_0641	100	10	0	0	11	20	4	13	26	15.2
NW_005202428.1_1248-3p	miR90_0641	76.471	17	4	0	2	18	17	1	30	15
NW_005202428.1_1248-3p	miR90_0641	72.222	18	5	0	5	22	1	18	54	14.2
NW_005202428.1_1248-3p	miR90_0641	85.714	14	1	1	11	24	1	13	84	13.5
NW_005202428.1_1248-3p	miR90_0621	100	10	0	0	11	20	4	13	26	15.2
NW_005202428.1_1248-3p	miR90_0621	76.471	17	4	0	2	18	17	1	30	15
NW_005202428.1_1248-3p	miR90_0621	72.222	18	5	0	5	22	1	18	54	14.2
NW_005202428.1_1248-3p	miR90_0621	85.714	14	1	1	11	24	1	13	84	13.5
NW_005202428.1_1248-3p	miR90_0580	100	10	0	0	11	20	3	12	26	15.2
NW_005202428.1_1248-3p	miR90_0580	75	16	4	0	2	17	16	1	63	13.9
NW_005202428.1_1248-3p	miR90_0580	83.333	12	2	0	11	22	6	17	84	13.5
NW_005202428.1_1248-3p	miR95_0044	100	10	0	0	11	20	2	11	26	15.2
NW_005202428.1_1248-3p	miR90_0220	76.471	17	4	0	7	23	18	2	30	15
NW_005202428.1_1248-3p	miR95_0036	76.471	17	4	0	2	18	19	3	30	15
NW_005202428.1_1248-3p	miR90_0701	80	15	3	0	1	15	3	17	35	14.8
NW_005202428.1_1248-3p	miR90_0701	68.421	19	6	0	3	21	19	1	97	13.3
NW_005202428.1_1248-3p	miR90_0451	80	15	3	0	4	18	16	2	35	14.8
NW_005202428.1_1248-3p	CCMP1516-miR5	80	15	3	0	8	22	15	1	35	14.8
NW_005202428.1_1248-3p	miR90_0908	84.615	13	2	0	11	23	1	13	40	14.6
NW_005202428.1_1248-3p	miR90_0887	84.615	13	2	0	11	23	2	14	40	14.6
NW_005202428.1_1248-3p	miR90_0756	84.615	13	2	0	11	23	4	16	40	14.6
NW_005202428.1_1248-3p	miR90_0747	84.615	13	2	0	11	23	5	17	40	14.6
NW_005202428.1_1248-3p	miR90_0706	86.667	15	1	1	11	24	3	17	40	14.6
NW_005202428.1_1248-3p	miR90_0696	84.615	13	2	0	11	23	17	5	40	14.6
NW_005202428.1_1248-3p	miR90_0203	84.615	13	2	0	2	14	16	4	40	14.6
NW_005202428.1_1248-3p	miR90_0182	84.615	13	2	0	1	13	13	1	40	14.6
NW_005202428.1_1248-3p	miR95_0327	84.615	13	2	0	9	21	5	17	40	14.6
NW_005202428.1_1248-3p	miR95_0327	83.333	12	2	0	13	24	6	17	84	13.5
NW_005202428.1_1248-3p	miR90_0831	90.909	11	1	0	14	24	8	18	47	14.4
NW_005202428.1_1248-3p	miR90_0520	90.909	11	1	0	10	20	17	7	47	14.4
NW_005202428.1_1248-3p	miR90_0477	90.909	11	1	0	13	23	1	11	47	14.4
NW_005202428.1_1248-3p	miR90_0477	90	10	1	0	11	20	2	11	97	13.3
NW_005202428.1_1248-3p	miR90_0466	90.909	11	1	0	12	22	8	18	47	14.4
NW_005202428.1_1248-3p	miR90_0356	90.909	11	1	0	12	22	8	18	47	14.4
NW_005202428.1_1248-3p	miR90_0208	90.909	11	1	0	1	11	8	18	47	14.4

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005202428.1_1248-3p	miR90_0208	77.778	18	3	1	1	17	2	19	63	13.9
NW_005202428.1_1248-3p	Vca_miR77	90.909	11	1	0	13	23	21	11	47	14.4
NW_005202428.1_1248-3p	miR90_0722	100	9	0	0	10	18	18	10	54	14.2
NW_005202428.1_1248-3p	miR90_0564	100	9	0	0	12	20	10	18	54	14.2
NW_005202428.1_1248-3p	miR90_0457	72.222	18	5	0	1	18	2	19	54	14.2
NW_005202428.1_1248-3p	miR90_0189	100	9	0	0	12	20	10	18	54	14.2
NW_005202428.1_1248-3p	miR95_0444	100	9	0	0	11	19	16	8	54	14.2
NW_005202428.1_1248-3p	miR95_0439	100	9	0	0	12	20	8	16	54	14.2
NW_005202428.1_1248-3p	miR95_0439	100	9	0	0	11	19	10	18	54	14.2
NW_005202428.1_1248-3p	miR95_0254	100	9	0	0	12	20	1	9	54	14.2
NW_005202428.1_1248-3p	miR95_0254	66.667	21	7	0	1	21	1	21	84	13.5
NW_005202428.1_1248-3p	miR95_0176	100	9	0	0	12	20	20	12	54	14.2
NW_005202428.1_1248-3p	miR95_0118	72.222	18	5	0	7	24	18	1	54	14.2
NW_005202428.1_1248-3p	miR95_0006	100	9	0	0	12	20	1	9	54	14.2
NW_005202428.1_1248-3p	CCMP1516-miR16	100	9	0	0	1	9	14	6	54	14.2
NW_005202428.1_1248-3p	SjapMIR71	72.222	18	5	0	2	19	21	4	54	14.2
NW_005202428.1_1248-3p	miR90_0644	75	16	4	0	5	20	2	17	63	13.9
NW_005202428.1_1248-3p	miR90_0644	90	10	1	0	2	11	7	16	97	13.3
NW_005202428.1_1248-3p	miR90_0442	75	16	4	0	5	20	16	1	63	13.9
NW_005202428.1_1248-3p	miR90_0434	75	16	4	0	5	20	17	2	63	13.9
NW_005202428.1_1248-3p	miR90_0434	68.421	19	6	0	5	23	1	19	97	13.3
NW_005202428.1_1248-3p	miR90_0223	77.778	18	3	1	4	20	18	1	63	13.9
NW_005202428.1_1248-3p	miR95_0489	75	16	4	0	2	17	6	21	63	13.9
NW_005202428.1_1248-3p	miR95_0415	75	16	4	0	5	20	17	2	63	13.9
NW_005202428.1_1248-3p	miR95_0325	75	16	4	0	5	20	3	18	63	13.9
NW_005202428.1_1248-3p	miR95_0269	75	16	4	0	5	20	4	19	63	13.9
NW_005202428.1_1248-3p	Porphyra	75	16	4	0	9	24	20	5	63	13.9
NW_005202428.1_1248-3p	Porphyra	78.571	14	3	0	11	24	15	2	72	13.7
NW_005202428.1_1248-3p	Porphyra	75	16	4	0	6	21	2	17	63	13.9
NW_005202428.1_1248-3p	Porphyra	78.571	14	3	0	7	20	15	2	72	13.7
NW_005202428.1_1248-3p	miR90_0809	78.571	14	3	0	5	18	3	16	72	13.7
NW_005202428.1_1248-3p	miR90_0809	90	10	1	0	11	20	3	12	97	13.3
NW_005202428.1_1248-3p	miR90_0769	78.571	14	3	0	5	18	2	15	72	13.7
NW_005202428.1_1248-3p	miR90_0769	90	10	1	0	11	20	2	11	97	13.3
NW_005202428.1_1248-3p	miR90_0754	78.571	14	3	0	5	18	18	5	72	13.7
NW_005202428.1_1248-3p	miR90_0754	90	10	1	0	11	20	18	9	97	13.3
NW_005202428.1_1248-3p	miR90_0536	78.571	14	3	0	5	18	16	3	72	13.7
NW_005202428.1_1248-3p	miR90_0426	78.571	14	3	0	1	14	10	23	72	13.7

续表

比对其他微藻 miRNA 的结果											
Query ID (本研究中鉴定的 miRNA)	Subject ID (其他已知 miRNA)	Identities (%)	Length (nt)	Mis-match	Gap	Query start	Query end	Subject Start	Subject end	E value	Bit score
NW_005202428.1_1248-3p	miR90_0141	78.571	14	3	0	5	18	17	4	72	13.7
NW_005202428.1_1248-3p	miR90_0104	78.571	14	3	0	5	18	8	21	72	13.7
NW_005202428.1_1248-3p	miR90_0104	90	10	1	0	11	20	18	9	97	13.3
NW_005202428.1_1248-3p	miR95_0340	78.571	14	3	0	8	21	17	4	72	13.7
NW_005202428.1_1248-3p	miR95_0292	78.571	14	3	0	11	24	1	14	72	13.7
NW_005202428.1_1248-3p	miR95_0230	78.571	14	3	0	6	19	1	14	72	13.7
NW_005202428.1_1248-3p	miR95_0230	77.778	18	2	1	6	21	18	1	84	13.5
NW_005202428.1_1248-3p	miR95_0004	78.571	14	3	0	5	18	17	4	72	13.7
NW_005202428.1_1248-3p	miR90_0794	83.333	12	2	0	6	17	15	4	84	13.5
NW_005202428.1_1248-3p	miR90_0689	83.333	12	2	0	11	22	5	16	84	13.5
NW_005202428.1_1248-3p	miR90_0407	83.333	12	2	0	11	22	2	13	84	13.5
NW_005202428.1_1248-3p	miR90_0215	83.333	12	2	0	11	22	1	12	84	13.5
NW_005202428.1_1248-3p	miR95_0541	83.333	12	2	0	4	15	4	15	84	13.5
NW_005202428.1_1248-3p	miR95_0409	83.333	12	2	0	12	23	12	1	84	13.5
NW_005202428.1_1248-3p	miR95_0194	83.333	12	2	0	10	21	2	13	84	13.5
NW_005202428.1_1248-3p	miR95_0194	90	10	1	0	10	19	11	2	97	13.3
NW_005202428.1_1248-3p	Vca_miR75	83.333	12	2	0	10	21	12	23	84	13.5
NW_005202428.1_1248-3p	SjapMIR29	83.333	12	2	0	3	14	13	2	84	13.5
NW_005202428.1_1248-3p	miR90_0522	90	10	1	0	5	14	6	15	97	13.3
NW_005202428.1_1248-3p	miR90_0504	90	10	1	0	5	14	8	17	97	13.3
NW_005202428.1_1248-3p	miR90_0497	90	10	1	0	6	15	15	6	97	13.3
NW_005202428.1_1248-3p	miR90_0379	90	10	1	0	5	14	12	21	97	13.3
NW_005202428.1_1248-3p	miR90_0351	90	10	1	0	11	20	16	7	97	13.3
NW_005202428.1_1248-3p	miR90_0306	90	10	1	0	5	14	7	16	97	13.3
NW_005202428.1_1248-3p	miR90_0271	90	10	1	0	11	20	15	6	97	13.3
NW_005202428.1_1248-3p	miR90_0236	90	10	1	0	11	20	17	8	97	13.3
NW_005202428.1_1248-3p	miR90_0211	90	10	1	0	11	20	12	3	97	13.3
NW_005202428.1_1248-3p	miR90_0199	90	10	1	0	11	20	1	10	97	13.3
NW_005202428.1_1248-3p	miR95_0549	90	10	1	0	9	18	10	1	97	13.3
NW_005202428.1_1248-3p	miR95_0359	90	10	1	0	3	12	9	18	97	13.3
NW_005202428.1_1248-3p	miR95_0326	90	10	1	0	3	12	9	18	97	13.3
NW_005202428.1_1248-3p	miR95_0258	68.421	19	6	0	3	21	3	21	97	13.3
NW_005202428.1_1248-3p	miR95_0076	90	10	1	0	11	20	5	14	97	13.3
NW_005202428.1_1248-3p	miR95_0076	90	10	1	0	14	23	5	14	97	13.3
NW_005202428.1_1248-3p	CCMP1516-miR13	90	10	1	0	1	10	18	9	97	13.3

附表 4 *E. huxleyi* BOF92 来源的前体 miRNA 与其他 13 株颗石藻株基因组比对结果

Supplementary Table 4 The alignments of *E. huxleyi* BOF92-derived pre-miRNAs in the genomes of thirteen other *E. huxleyi* strains

前体 miRNA ID	92A (SRX 112489)	EH2 (SRX 112493)	Van556 (SRX 112498)	M217 (SRX 112497)	B39 (SRX 112496)	B11 (SRX 112495)	M219 (SRX 112494)	12-1 (SRX 112492)	L (SRX 112491)	NZEH (SRX 112490)	92F (SRX 112499)	92E (SRX 112488)	92D (SRX 112487)
NW_005195085.1_38173	1.98e-11	–	–	2.90e-31	1.28e-29	1.30e-29	–	–	2.41e-25	–	–	–	–
NW_005195085.1_38180	–	–	–	1.76e-23	–	–	–	9.67e-24	–	–	–	–	–
NW_005196191.1_35170	–	–	–	1.07e-15	–	–	–	–	–	–	–	–	–
NW_005196603.1_34298 (ehx-MIR1)	9.02e-25	5.95e-23	6.58e-28	4.86e-29	5.96e-28	6.04e-28	3.7e-20	3.45e-28	1.86e-26	2.42e-20	2.29e-27	9.43e-20	3.26e-24
NW_005196755.1_34019	–	–	–	4.93e-19	–	7.93e-17	–	2.71e-19	5.25e-17	–	–	5.68e-17	4.24e-18
NW_005196755.1_34028	1.16e-28	9.96e-21	3.08e-21	3.76e-30	6.00e-23	7.87e-22	6.14e-23	4.50e-22	6.74e-21	4.02e-23	8.29e-22	2.03e-21	5.45e-22
NW_005196755.1_34052	7.02e-21	–	2.38e-22	2.28e-22	2.16e-22	1.02e-20	2.21e-22	1.25e-22	1.45e-22	6.73e-21	1.07e-20	2.04e-16	1.96e-21
NW_005197715.1_30571	1.97e-16	2.79e-16	1.44e-14	2.97e-16	2.81e-16	2.85e-16	2.88e-16	1.63e-16	1.89e-16	1.88e-16	3.00e-16	2.04e-16	1.97e-16
NW_005198391.1_27186	3.22e-29	3.53e-30	8.45e-32	8.08e-32	7.66e-32	7.76e-32	7.84e-32	7.42e-30	3.09e-29	3.09e-29	1.37e-29	2.58e-30	3.24e-29
NW_005198966.1_24265	9.08e-20	1.29e-19	1.43e-19	1.37e-19	1.3e-19	1.32e-19	1.33e-19	7.53e-20	8.72e-20	8.70e-20	1.39e-19	9.43e-20	9.12e-20
NW_005199363.1_22042	3.27e-19	4.64e-19	1.86e-18	4.93e-19	4.67e-19	4.74e-19	4.78e-19	2.71e-19	3.14e-19	3.13e-19	6.45e-18	3.39e-19	3.28e-19
NW_005199378.1_21978	1.94e-26	2.75e-26	3.06e-26	2.93e-26	2.77e-26	2.81e-26	2.84e-26	1.61e-26	1.86e-26	1.86e-26	2.96e-26	2.01e-26	9.06e-25
NW_005199975.1_17848	2.49e-30	1.00e-15	3.02e-36	6.20e-38	5.88e-38	5.96e-38	2.80e-36	1.26e-17	1.44e-27	1.43e-32	1.05e-35	1.54e-32	1.49e-32
NW_005200282.1_15947	5.51e-12	3.63e-10	8.69e-12	8.31e-12	7.87e-12	7.98e-12	8.06e-12	4.56e-12	5.28e-12	5.27e-12	8.41e-12	5.72e-12	5.53e-12
NW_005200461.1_14543	–	–	–	–	–	–	–	–	–	–	–	–	–
NW_005200496.1_14318 (ehx-MIR2)	4.20e-23	1.27e-29	6.58e-28	1.35e-29	2.77e-26	2.81e-26	6.14e-23	4.47e-27	1.86e-26	4.02e-23	1.37e-29	4.36e-23	3.24e-29
NW_005200517.1_13952	–	7.76e-17	1.86e-18	8.19e-22	7.82e-17	-	8.00e-17	4.53e-17	2.44e-15	5.24e-17	1.79e-18	–	1.18e-18
NW_005200535.1_13863	–	–	–	–	–	–	–	–	–	–	–	–	–
NW_005200600.1_13330 (ehx-MIR3)	–	6.00e-18	3.06e-26	1.37e-19	2.77e-26	1.02e-20	–	1.61e-26	–	–	–	5.68e-17	–
NW_005200881.1_10661	7.02e-21	9.96e-21	1.11e-20	1.06e-20	1.00e-20	1.02e-20	1.03e-20	5.82e-21	6.74e-21	6.73e-21	1.07e-20	7.29e-21	7.05e-21
NW_005201234.1_6668	1.95e-21	–	1.43e-19	2.95e-21	2.79e-21	2.83e-21	2.86e-21	1.62e-21	1.87e-21	1.87e-21	2.98e-21	2.03e-21	1.96e-21
NW_005202428.1_1248	–	–	–	–	7.87e-12	–	–	–	–	–	–	–	–

Blast 比对的阈值为 E < 1e-9；不同株系的球石藻基因组序列从 NCBI 的 SRA 数据库获得。

附表 5　*E. huxleyi* BOF92 来源的成熟 miRNA 与其他 13 株颗石藻基因组的比对结果

Supplementary Table 5　The alignments of *E. huxleyi* BOF92-derived mature miRNAs in the genomes of thirteen other *E. huxleyi* strains

成熟 miRNA ID	92A (SRX 112489)	EH2 (SRX 112493)	Van556 (SRX 112498)	M217 (SRX 112497)	B39 (SRX 112496)	B11 (SRX 112495)	M219 (SRX 112494)	12-1 (SRX 112492)	L (SRX 112491)	NZEH (SRX 112490)	92F (SRX 112499)	92E (SRX 112488)	92D (SRX 112487)
NW_005195085.1_38173-5p	71.4%	81.0%	76.2%	100.00%	100.0%	100.0%	81.0%	71.4%	100.0%	71.4%	71.4%	66.7%	66.7%
NW_005195085.1_38180-3p	61.9%	71.4%	76.2%	100.00%	71.4%	71.4%	71.4%	100.0%	66.7%	66.7%	66.7%	66.7%	61.9%
NW_005196191.1_35170-3p	71.4%	76.2%	71.4%	100.00%	71.4%	81.0%	76.2%	66.7%	71.4%	71.4%	71.4%	71.4%	71.4%
NW_005196603.1_34298-5p (ehx-miR1-5p)	89.5%	89.5%	94.7%	100.00%	94.7%	89.5%	94.7%	89.5%	89.5%	89.5%	89.5%	89.5%	89.5%
NW_005196755.1_34052-3p	100.0%	81.0%	100.0%	100.00%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
NW_005196755.1_34028-5p	95.2%	71.4%	66.7%	100.00%	100.0%	66.7%	76.2%	76.2%	66.7%	66.7%	71.4%	66.7%	66.7%
NW_005196755.1_34019-3p	76.2%	76.2%	76.2%	100.00%	76.2%	100.0%	76.2%	100.0%	100.0%	76.2%	71.4%	100.0%	90.5%
NW_005197715.1_30571-5p	100.0%	100.0%	100.0%	100.00%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
NW_005198391.1_27186-5p	100.0%	100.0%	100.0%	100.00%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
NW_005198966.1_24265-3p	100.0%	100.0%	100.0%	100.00%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
NW_005198966.1_24265-5p	100.0%	100.0%	100.0%	100.00%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
NW_005199363.1_22042-5p	100.0%	100.0%	95.0%	100.00%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	90.0%	100.0%	100.0%
NW_005199378.1_21978-3p	100.0%	100.0%	100.0%	100.00%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
NW_005199378.1_21978-5p	100.0%	100.0%	100.0%	100.00%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
NW_005199975.1_17848-3p	100.0%	81.0%	100.0%	100.00%	100.0%	100.0%	100.0%	81.0%	100.0%	100.0%	100.0%	100.0%	100.0%
NW_005200282.1_15947-3p	100.0%	100.0%	100.0%	100.00%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
NW_005200461.1_14543-5p	100.0%	81.8%	100.0%	100.00%	100.0%	100.0%	100.0%	86.4%	100.0%	100.0%	86.4%	100.0%	86.4%
NW_005200496.1_14318-5p (ehx-miR2-5p)	100.0%	100.0%	100.0%	100.00%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
NW_005200517.1_13952-3p	100.0%	100.0%	100.0%	100.00%	100.0%	90.5%	100.0%	100.0%	100.0%	100.0%	100.0%	81.0%	100.0%
NW_005200535.1_13863-3p	100.0%	100.0%	100.0%	100.00%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
NW_005200600.1_13330-3p (ehx-miR3-3p)	95.2%	100.0%	100.0%	100.00%	100.0%	100.0%	95.2%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
NW_005200881.1_10661-3p	100.0%	100.0%	100.0%	100.00%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
NW_005201234.1_6668-5p	100.0%	100.0%	100.0%	100.00%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
NW_005202428.1_1248-3p	100.0%	100.0%	100.0%	100.00%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	83.3%

该表中的百分比表示 miRNA 成熟序列比对到其他球石藻株系基因组的程度，100%表示能够完全匹配。

附表 6 EhV99B1 来源的成熟 miRNA 及前体 miRNA 与其他 13 株颗石藻病毒基因组的比对结果

Supplementary Table 6 The alignments of EhV99B1-derived pre-miRNA and mature miRNAs in the genomes of thirteen other EhV strains

前体或成熟 miRNA ID	EhV86 (NC_007346)	EhV18 (KF481685)	EhV84 (SRX042587)	EhV88 (SRX042704)	EhV145 (KF481686)	EhV156 (KF481687)	EhV164 (KF481688)	EhV201 (SRX042500)	EhV202 (SRX042425)	EhV203 (SRX042594)	EhV207 (SRX042529)	EhV208 (SRX042474)	EhVPS401 (SRX042696)
gi|73852470|ref|C_007346.1|_540	1.00e-32	1.00e-17	2.00e-32	2.00e-31	9.00e-32	1.00e-17	9.00e-32	2.00e-31	1.00e-16	2.00e-31	9.00e-32	2.00e-31	–
ehv-miR1-5p	96.3%	92.6%	100.0%	100.0%	96.3%	92.6%	96.3%	100.0%	92.6%	100.0%	100.0%	100.0%	85.2%
ehv-miR2-3p	100.0%	47.6%	100.0%	100.0%	100.0%	47.6%	100.0%	100.0%	52.4%	100.0%	100.0%	100.0%	61.9%

附表 7 宿主或病毒编码的 miRNAs 及其潜在的病毒靶基因

Supplementary Table 7 Host or virus encoded miRNAs and their potential viral target genes

病毒靶基因 ID	NCBI 登录号	靶基因功能	miRNA ID	Score	Energy/kCal/Mol
EhV018	CAZ69357	endonuclease	ehx-miR2-5p	149	–27.41
EhV022	CAZ69361	phosphoglycerate mutase family protein	ehv-miR1-3p	140	–23.04
EhV030	CAZ69369	DNA polymerase delta catalytic subunit	ehv-miR1-3p	142	–26.74
EhV050	CAZ69386	serine palmitoyltransferase (vSPT)	ehv-miR1-3p	146	–20.96
EhV064	CAZ69400	DNA-dependent RNA polymerase II largest subunit	ehx-miR2-5p	144	–32.91
EhV085	CAZ69419	major capsid protein (mcp)	ehx-miR2-5p	171	–37.70
			ehx-miR3-3p	164	–28.73
EhV361	CAZ69689	serine protease	ehx-miR2-5p	140	–21.53
EhV401	CAZ69732	ribonuclease	ehx-miR3-3p	148	–29.82
EhV428	CAZ69758	ribonucleoside-diphosphate reductase protein	ehx-miR2-5p	143	–27.78
EhV434	CAZ69764	DNA-directed RNA polymerase II subunit	ehx-miR2-5p	141	–25.66
EhV444	CAZ69774	DNA topoisomerase	ehx-miR2-5p	150	–30.10

附表 8 6 个靶基因的基本信息

Supplementary Table 8 The basic information of the six selected target genes

基因名称	基因 ID	差异 miRNA 名称	miRNA 靶基因所属代谢通路
ACC-1	17277436	ehx-miR1-5p	Fatty acid biosynthesis
SPT	17255778	ehx-miR2-5p	Sphingolipid metabolism
ACOX	17261797	ehx-miR3-3p	Fatty acid degradation
ACAT	17283066	ehx-miR3-3p	Fatty acid degradation
CERS	17255735	ehv-miR2-5p	Sphingolipid metabolism
ACADS	17256377	ehv-miR2-5p	Fatty acid degradation