

Supplementary Information

Genome-wide expression analysis and Metabolite Profiling Elucidate Transcriptional Regulation of Flavonoid Biosynthesis and Modulation under Abiotic Stresses in Banana

Ashutosh Pandey^{1,2,*}, Anshu Alok², Deepika Lakhwani¹, Jagdeep Singh², Mehar H. Asif¹ & Prabodh K. Trivedi^{1,*}

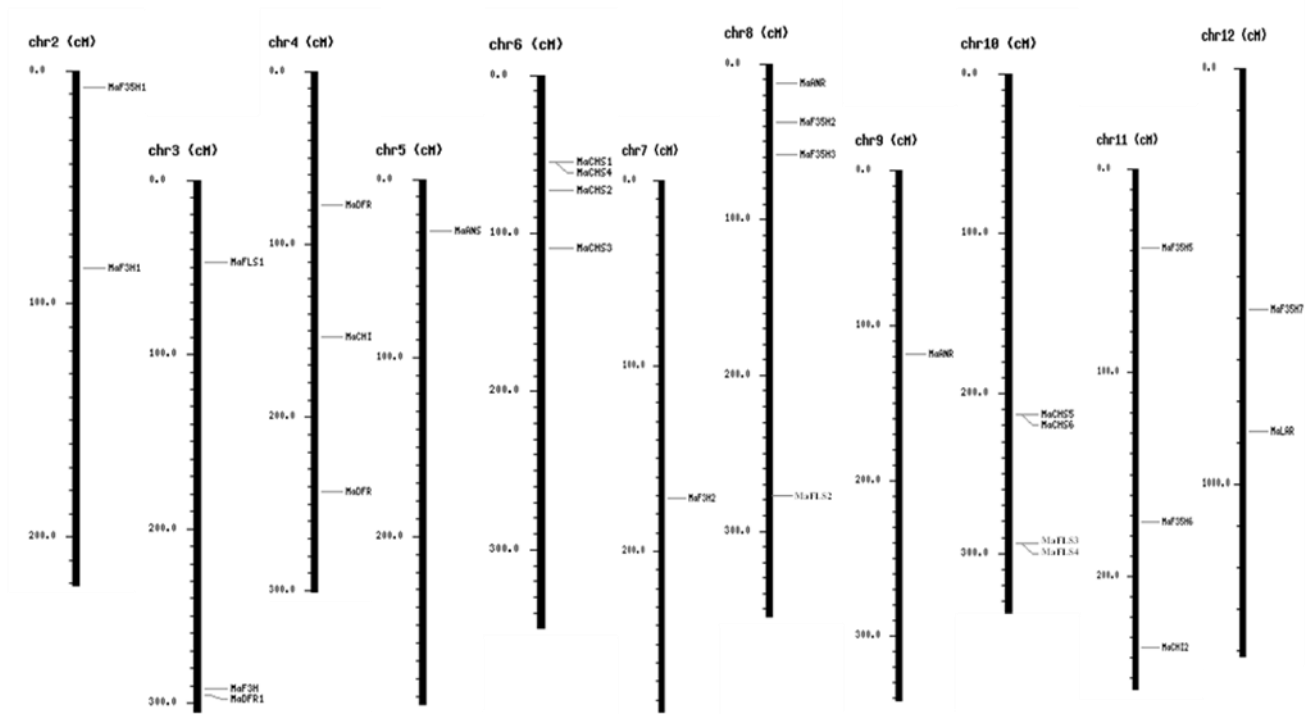
¹CSIR-National Botanical Research Institute, Council of Scientific and Industrial Research (CSIR-NBRI), Rana Pratap Marg, Lucknow-226001, INDIA

²National Agri-Food Biotechnology Institute (NABI), (Department of Biotechnology, Government of India), C-127, Industrial Area, Phase VIII, S.A.S. Nagar, Mohali 160071, India

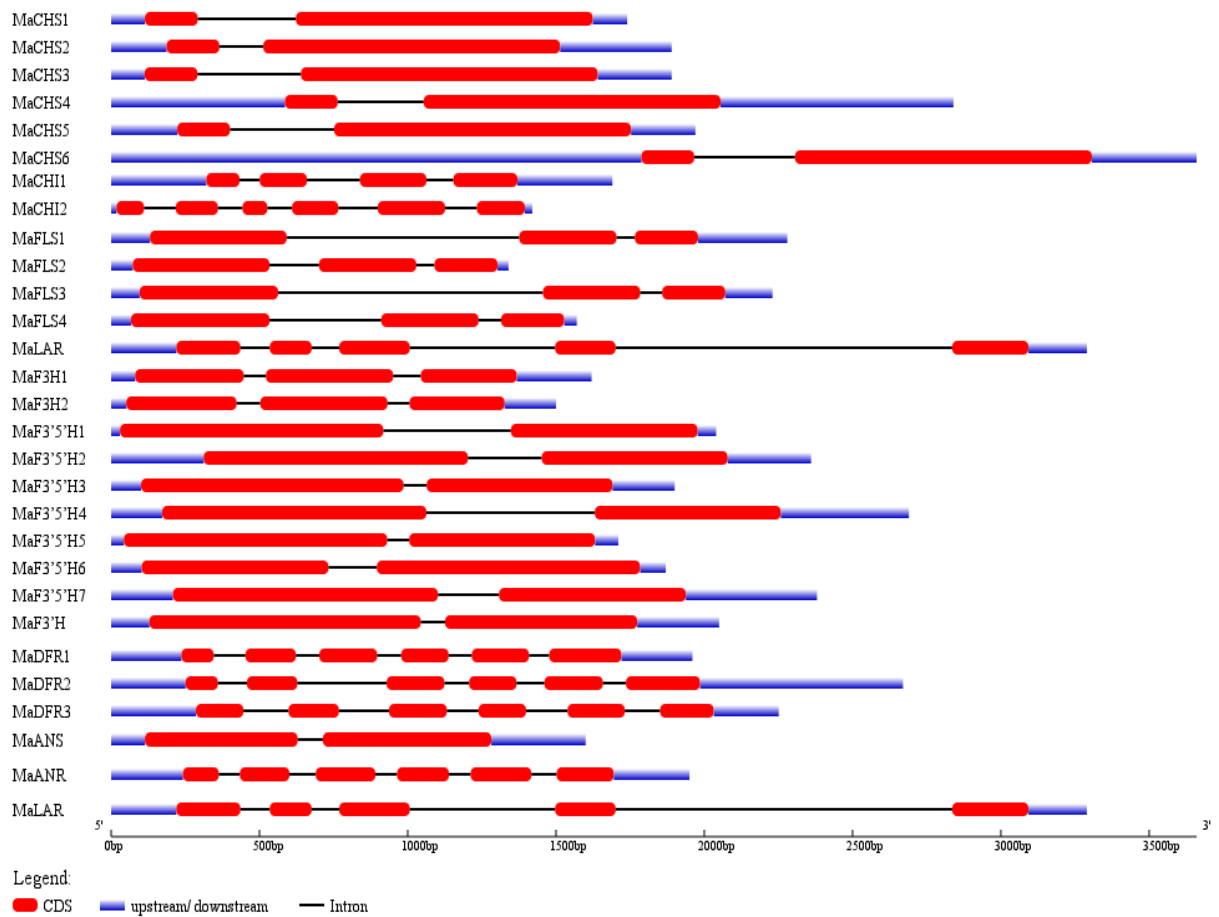
* Authors for correspondence:

PKT: prabodht@nbri.res.in; prabodht@hotmail.com

AP: ashutosh_biotech@yahoo.co.in



Supplementary Figure S1. Chromosomal localization of different biosynthetic genes in *Musa* genome. The black lines on the chromosomes (vertical) indicate the positions of the respective genes. Numbers represent nucleotide base pair positions.



Supplementary Figure S2. Schematic representation of intron- exon composition of flavonoid biosynthetic genes of banana. Genes showing exons (in red boxes) and introns (in black lines).

Table S1. List of the primers used in the present study.

Primer name	Forward Sequence (5' to 3')	Reverse Sequence (5' to 3')
<i>MaCHS1</i>	CAGCCCTTCCATTAACCGGTTACAG	GAGCTCGGAACAGACCACGAGC
<i>MaCHS2</i>	CCACAGTCACCTTCCGCGGG	ACGAGCTGAAAGAGGGGTCGCTC
<i>MaCHS3</i>	CCTGTTCCAGATCGTCTCCGCC	CGCCTCCACCAGGCTCTTCTCTAT
<i>MaCHS4</i>	GACGCGGCAGGTGCTGAGCG	TACCGTCTCCACCGTCAGCCC
<i>MaCHS5</i>	CCCGACCCCGCCACAGAGAA	CCTCCGCCAGGCTCCGCTC
<i>MaCHS5</i>	GCCTCCTCATCTCCGGACCG	GACGTTGACAGGGGTGGCGGT
<i>MaCHI1</i>	CTGCTGAAGCCACTGACCGGG	AGGTCTCGGCCCTGAAAGCCT
<i>MaCHI2</i>	CCAAGTCCCATTTCGCTCCTGAGA	TGCCCTTCCAATCCGCTAAATGC
<i>MaF3'H</i>	CGGTGAAGGCGATGGCGGAA	GAGCTCCCGCTGGGCTTGC
<i>MaF3'5'H1</i>	ATGGGGTGTCGCTTTCTGATGT	TTCCCGATTACTTGGTCCATCTC
<i>MaF3'5'H2</i>	CGTCAACGTCAAGGCTATCATC	GTAGTCGATCTCGGATTGCAG
<i>MaF3'5'H3</i>	AAAGCGTCGGGACGTAAGCG	GATGTTACCTGCCCCGCCAAA
<i>MaF3'5'H4</i>	TCAGTACCTGTTGGGCATGCTA	GCGGGCGCAGAAAACTTTGA
<i>MaF3'5'H5</i>	ATGCATCGGGGCGGAAGGGA	GTTCCACCACCATGTCCTTGAA
<i>MaF3'5'H6</i>	CGCCATCCTCTCCGAGTTCGT	AGCGACGAACATGTGGAAGATG
<i>MaF3'5'H7</i>	CTGCTCATGGTACAGTACGTGC	ATCGCCTTAAGGGACACCTTC
<i>MaF3H1</i>	CAAACCTACAGCAGGCTCTCC	CTTAGTCTTCTCCAGTAGCTCC
<i>MaF3H2</i>	GATCGTGTATCCCCTGGCGA	TGGCATTCTCCGGCAACTCCA
<i>MaFLS1</i>	CGCCGGGGAGCCTCCAGG	TGGATTCTCCGGCCATGCGC
<i>MaFLS2</i>	GGATCCTCGTTCCGGGAGC	CCTCCCTATACGAAGAAGGCTG
<i>MaFLS3</i>	AATTCAAACCGGGGAGCTCGG	CGTTTGCTTTCCTGTAATCAGAA
<i>MaFLS4</i>	CCGGATCGGGGAGCTTGAA	TGCTCGTTTACTTGCCTATAATC
<i>MaANS</i>	GAGGGGAAGCTGGACAGGGAAC	GTTGTGGAGGATGAAGGAGAGC
<i>MaDFR1</i>	TCGAACGGGTGCACTTCTCCTCC	CCTCACTGCACTGTCCTCTGCTG
<i>MaDFR2</i>	AGACATCTTAAGGGTGCCTTCTCC	CACAGGTTTCTTCTTCACCATCTCG
<i>MaDFR3</i>	GGTACCCTGAGTATGACATCCCCA	TGCACGACTCTATTGCTCCGTCG
<i>MaANR</i>	CCGGTTCCATCTCGTTCACCCAC	CCGAGGGTATCGTTCTGAGAGGA
<i>MaLAR</i>	GCATTCTGGATCAGCTCTGCTTGC	CTCGCCGAACCCTTCTCTTTCTG
<i>MaActin</i>	ATGACATGGAGAAGATCTGGCATCA	AGCCTGGATGGCAACATACATAGC

Table S2. Quantification of different group of flavonoids (mean value $\pm$ standard deviation $\mu\text{g}/100\text{g DW}$) in various tissues of banana

Tissues	Isoquercetin	Quercetin	Kaempferol	Quercetin 3- O - galactoside	Rutin	Naringenin	Catechin	Epicatechin
YL	221.708 $\pm$ 1.87	244.77 $\pm$ 2.64	360.53 $\pm$ 1.98	213.73 $\pm$ 2.12	2700.02 $\pm$ 12.75	50.62 $\pm$ 0.86	7085.93 $\pm$ 763	ND
BRT	486 $\pm$ 5.86	840.5 $\pm$ 12.85	53.98 $\pm$ 0.87	140.85 $\pm$ 1.87	117.3 $\pm$ 0.86	10.21 $\pm$ 0.15	860.71 $\pm$ 56	ND
P.STEM	50.6 $\pm$ 0.75	200.13 $\pm$ 1.97	5.27 $\pm$ 0.02	88.43 $\pm$ 0.97	990.71 $\pm$ 8.76	2.24 $\pm$ 0.01	2325.07 $\pm$ 653	ND
ROOT	10.28 $\pm$ 0.14	70.5 $\pm$ 0.75	ND	ND	351.75 $\pm$ 6.86	ND	2799.83 $\pm$ 563	ND
UR_PL	246.85 $\pm$ 12.12	1811.77 $\pm$ 47.83	595.61 $\pm$ 17.55	321.69 $\pm$ 15.89	14310.37 $\pm$ 513.07	58.63 $\pm$ 5.44	12742.37 $\pm$ 418.34	7816.92 $\pm$ 141.82
UR_PP	ND	11.15 $\pm$ 1.28	130.86 $\pm$ 7.81	2.09 $\pm$ 0.23	248.49 $\pm$ 21.1	3.91 $\pm$ 0.39	167.33 $\pm$ 23.83	106.72 $\pm$ 15.48
R_PL	211.06 $\pm$ 12.96	1696.43 $\pm$ 47.89	319.97 $\pm$ 28.55	298.58 $\pm$ 10.26	9145.01 $\pm$ 588.3	49.96 $\pm$ 5.32	5655.28 $\pm$ 414.61	3769.56 $\pm$ 606.87
R_PP	ND	11.08 $\pm$ 1.52	111.65 $\pm$ 9.59	5.45 $\pm$ 0.71	141.82 $\pm$ 10.82	5.86 $\pm$ 0.7	94.66 $\pm$ 18.62	51.4 $\pm$ 7.01

Three biological and three technical replicates were used for analysis.

Table S3. Quantification of different group of flavonoids flavonoids (mean value $\pm$ standard deviation $\mu\text{g}/100\text{g}$ DW) in different developmental stages of fruit pulp of banana

	Isoquercetin	Quercetin	Kaempferol	Quercetin 3- O - galactoside	Rutin	Naringenin	Catechin	Epicatechin
6W-Pulp	ND	28.72 $\pm$ 1.59	119.49 $\pm$ 8.98	7.26 $\pm$ 0.58	519.89 $\pm$ 13.91	0.61 $\pm$ 0.03	406.07 $\pm$ 17.16	253.31 $\pm$ 20.41
9W-Pulp	ND	33.06 $\pm$ 1.85	115.72 $\pm$ 6.05	3.3 $\pm$ 0.42	151.49 $\pm$ 12.71	5.47 $\pm$ 0.49	236.55 $\pm$ 11.49	179.32 $\pm$ 12.44
12W-Pulp	ND	11.26 $\pm$ 0.38	275.25 $\pm$ 14.94	4.38 $\pm$ 0.65	143.1 $\pm$ 7.42	9.31 $\pm$ 0.66	262.54 $\pm$ 23.67	196.17 $\pm$ 15.69
15W-Pulp	ND	8.71 $\pm$ 0.77	110.7 $\pm$ 4.99	4.19 $\pm$ 0.36	111.21 $\pm$ 4.94	5.91 $\pm$ 0.31	138.02 $\pm$ 23.57	168.26 $\pm$ 14.94
18W-Pulp	ND	11.15 $\pm$ 1.28	130.86 $\pm$ 7.81	2.09 $\pm$ 0.23	248.49 $\pm$ 21.1	3.91 $\pm$ 0.39	167.33 $\pm$ 23.83	106.72 $\pm$ 15.48
21W-Pulp	ND	8.6 $\pm$ 0.48	242.53 $\pm$ 8.68	3.05 $\pm$ 0.48	278.19 $\pm$ 31.32	2.82 $\pm$ 0.28	274.03 $\pm$ 20.17	142.22 $\pm$ 21.32
24W-Pulp	ND	15.52 $\pm$ 1.1	215.06 $\pm$ 19.11	6.58 $\pm$ 0.83	120.79 $\pm$ 5.84	4.4 $\pm$ 0.13	125.91 $\pm$ 16.75	82.05 $\pm$ 11.59
Ripe-Pulp	ND	11.08 $\pm$ 1.52	111.65 $\pm$ 9.59	5.45 $\pm$ 0.71	141.82 $\pm$ 10.82	5.86 $\pm$ 0.7	94.66 $\pm$ 18.62	51.4 $\pm$ 7.01

Three biological and three technical replicates were used for analysis.

Table S4. Quantification of different group of flavonoids (mean value $\pm$ standard deviation $\mu\text{g}/100\text{g DW}$) in different developmental stages of fruit peel of banana

	Isoquercetin	Quercetin	Kaempferol	Quercetin 3- O - galactoside	Rutin	Naringenin	Catechin	Epicatechin
6W-Peel	564.88 $\pm$ 44.49	416.1 $\pm$ 40.59	397.4 $\pm$ 25.53	612.62 $\pm$ 20.73	15194.79 $\pm$ 540.66	266.12 $\pm$ 12.79	14363.32 $\pm$ 800.77	6009.32 $\pm$ 517.33
9W-Peel	189.83 $\pm$ 18.34	461.32 $\pm$ 53.85	310.95 $\pm$ 27.92	205.05 $\pm$ 15.01	12161.33 $\pm$ 494.03	47.1 $\pm$ 9.98	13253.52 $\pm$ 559.01	9821.33 $\pm$ 384.44
12W-Peel	419.79 $\pm$ 38.84	2025.07 $\pm$ 86.85	400.64 $\pm$ 26.17	352.28 $\pm$ 13.94	14282.38 $\pm$ 570.34	46.38 $\pm$ 5.77	6342.71 $\pm$ 434.2	4248.26 $\pm$ 271.39
15W-Peel	272.71 $\pm$ 14.16	1778.25 $\pm$ 95.55	427.49 $\pm$ 42.89	315.02 $\pm$ 20.44	14667.13 $\pm$ 534.55	39.24 $\pm$ 5.52	2410.01 $\pm$ 201.89	1590.81 $\pm$ 163.94
18W-Peel	246.85 $\pm$ 11.41	1811.77 $\pm$ 47.83	595.61 $\pm$ 17.55	321.69 $\pm$ 15.89	14310.37 $\pm$ 513.07	58.63 $\pm$ 5.44	12742.73 $\pm$ 418.34	7816.92 $\pm$ 141.82
21W-Peel	227.03 $\pm$ 14.68	1655.2 $\pm$ 70.11	179.77 $\pm$ 13.28	270.19 $\pm$ 12.38	15183.33 $\pm$ 507.11	28.14 $\pm$ 3.12	4941.73 $\pm$ 527.22	3253.21 $\pm$ 309.06
24W-Peel	244.11 $\pm$ 14.25	1794.24 $\pm$ 95.05	116.73 $\pm$ 11.8	284 $\pm$ 10.73	13496.52 $\pm$ 556.97	29.29 $\pm$ 1.99	8526.26 $\pm$ 221.87	6006.4 $\pm$ 245.13
Ripe-Peel	211.06 $\pm$ 23.1	1696.43 $\pm$ 47.89	319.98 $\pm$ 28.55	298.58 $\pm$ 10.26	9145.01 $\pm$ 588.3	49.97 $\pm$ 5.32	5655.28 $\pm$ 414.61	3769.56 $\pm$ 606.87