Scharf, S., Schlögl, N., Philipp, C., & Gök, R. (2026). Investigation of carotenoids and C_{13}-norisoprenoids during ripening in grapes of the variety *Vitis vinifera* cv. Blaufränkisch. *OENO One, 60*(3).
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SUPPLEMENTARY DATA

The figures show the average temperatures measured during ripening.

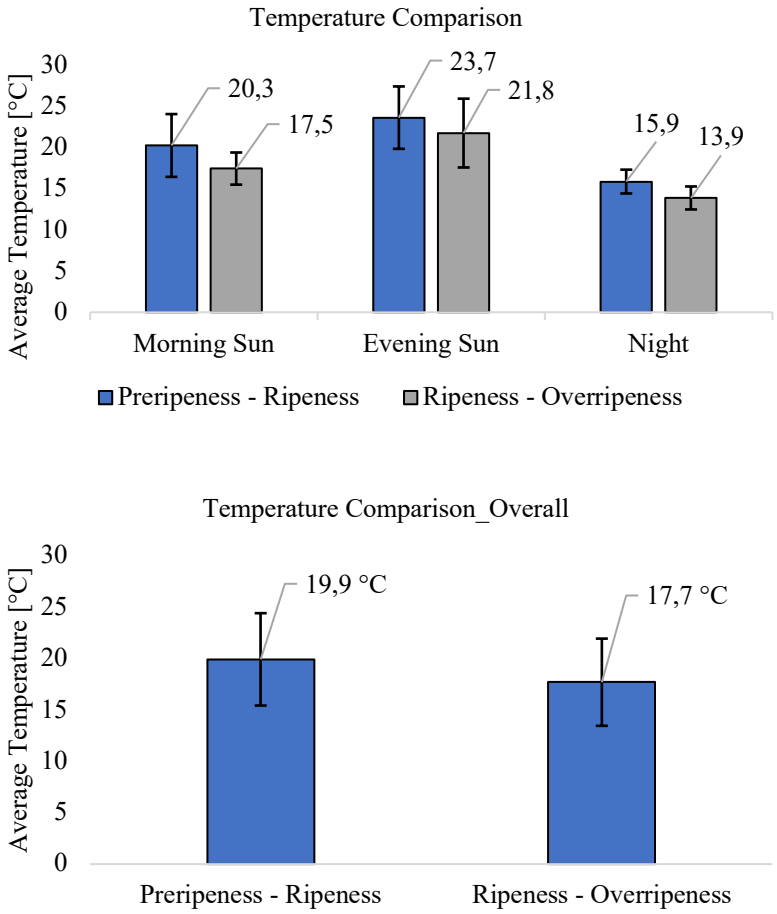


Figure S1. Comparison of average temperatures between the morning- and afternoon sun side.

SUPPLEMENTARY DATA
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Table S1. Concentrations of carotenoids (µg/kg FW) in Blaufränkisch grapes during ripening at different canopy sides (morning sun, MS; afternoon sun, AS).

Compound	Canopy side[a]	Jul 23	Jul 30	Aug 06	Aug 13	Aug 25	Sep 09	Sep 15	Sep 29	Oct 13
neochrome a	MS***[b]	384 ± 46^{a}	355 ± 45^{a}	355 ± 13^{a}	383 ± 11^{a}	233 ± 7^{b}	267 ± 35^{b}	267 ± 29^{b}	240 ± 15^{b}	209 ± 21^{b}
	AS***	406 ± 4^{a}	372 ± 20^{ab}	392 ± 19^{ab}	349 ± 25^{b}	202 ± 12^{c}	198 ± 4^{c}	209 ± 22^{c}	200 ± 6^{c}	231 ± 12^{c}
(all-*E*)-neoxanthin	MS***	896 ± 163^{a}	574 ± 9^{bc}	553 ± 45^{bc}	596 ± 28^{bc}	693 ± 112^{ab}	885 ± 142^{a}	644 ± 98^{abc}	651 ± 109^{ab}	370 ± 55^{c}
	AS***	770 ± 23^{a}	734 ± 84^{a}	585 ± 20^{b}	600 ± 27^{b}	415 ± 47^{c}	506 ± 63^{bc}	393 ± 19^{c}	433 ± 12^{c}	450 ± 21^{c}
neochrome b	MS***	295 ± 25^{ab}	306 ± 38^{a}	269 ± 11^{ab}	256 ± 8^{b}	158 ± 4^{c}	153 ± 13^{c}	178 ± 12^{c}	n. d.^{d}	n. d.^{d}
	AS***	274 ± 24^{ab}	296 ± 14^{ab}	303 ± 22^{a}	261 ± 16^{b}	n. d.^{d}	n. d.^{d}	163 ± 3^{c}	n. d.^{d}	n. d.^{d}
luteoxanthin	MS$^{n.s.}$	210 ± 37^{a}	180 ± 10^{a}	179 ± 8^{a}	169 ± 3^{a}	250 ± 29^{a}	169 ± 148^{a}	218 ± 24^{a}	228 ± 14^{a}	216 ± 13^{a}
	AS***	197 ± 4^{abc}	203 ± 26^{ab}	169 ± 3^{c}	172 ± 7^{bc}	214 ± 13^{a}	205 ± 10^{a}	194 ± 10^{abc}	206 ± 2^{a}	186 ± 3^{abc}
lutein-5,6-epoxide	MS**	214 ± 34^{ab}	171 ± 5^{b}	173 ± 2^{b}	165 ± 3^{b}	213 ± 19^{ab}	266 ± 44^{a}	208 ± 38^{ab}	220 ± 28^{ab}	186 ± 12^{b}
	AS***	174 ± 3^{bc}	165 ± 3^{c}	169 ± 1^{c}	164 ± 1^{c}	173 ± 10^{bc}	213 ± 21^{a}	177 ± 8^{bc}	196 ± 4^{ab}	177 ± 2^{bc}
flavoxanthin	MS***	394 ± 18^{a}	366 ± 26^{ab}	339 ± 13^{abc}	362 ± 20^{ab}	306 ± 10^{bc}	328 ± 43^{abc}	322 ± 25^{abc}	295 ± 27^{bc}	270 ± 29^{c}
	AS***	423 ± 10^{a}	356 ± 11^{b}	347 ± 3^{b}	329 ± 19^{b}	208 ± 4^{d}	254 ± 3^{c}	250 ± 22^{c}	252 ± 5^{c}	331 ± 11^{b}
(all-*E*)-lutein	MS***	4918 ± 377^{a}	3720 ± 615^{abc}	3310 ± 207^{bc}	3760 ± 171^{abc}	3157 ± 258^{c}	4531 ± 487^{ab}	3474 ± 375^{bc}	3254 ± 690^{c}	1625 ± 387^{d}
	AS***	3917 ± 129^{ab}	4333 ± 134^{a}	3687 ± 119^{b}	3571 ± 249^{b}	1878 ± 123^{c}	2257 ± 178^{c}	1821 ± 274^{c}	1887 ± 105^{c}	1837 ± 140^{c}
(all-*E*)-zeaxanthin	MS***	1418 ± 87^{a}	332 ± 35^{d}	313 ± 10^{d}	676 ± 30^{b}	301 ± 17de	528 ± 54^{c}	479 ± 37^{c}	341 ± 35^{d}	193 ± 15^{e}
	AS***	838 ± 28^{a}	523 ± 16^{b}	360 ± 104^{cd}	469 ± 24^{bc}	267 ± 18de	290 ± 10de	286 ± 22de	237 ± 7^{e}	194 ± 5^{e}
(all-*E*)-β-carotene	MS***	2765 ± 137^{a}	1928 ± 432^{bc}	1530 ± 128^{bcd}	2034 ± 68^{b}	1133 ± 104de	2020 ± 230^{b}	1503 ± 136^{bcd}	1400 ± 247^{cd}	760 ± 156^{e}
	AS***	2357 ± 121^{a}	1984 ± 139^{b}	2043 ± 71^{b}	1903 ± 121^{b}	861 ± 76^{c}	1086 ± 75^{c}	888 ± 120^{c}	839 ± 49^{c}	870 ± 45^{c}

Values are given as mean ± standard deviation (n = 3). n.d. = not detected [a] MS = morning sun; AS = afternoon sun. [b] Significant differences were evaluated by ANOVA (*p = 0.05; ** p = 0.01; *** p = 0.001) followed by Tukey´s post hoc test; different letters indicate significant differences.

SUPPLEMENTARY DATA
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Table S2. Concentrations of C_{13}-norisoprenoids in Blaufränkisch grapes (µg/kg FW) during ripening at different canopy sides (morning sun, MS; afternoon sun, AS).

Compound	Canopy side[a]	Jul 23	Jul 30	Aug 06	Aug 13	Aug 25	Sep 09	Sep 15	Sep 29	Oct 13
Vitispiranes	MS*** [b]	6.70 ± 0.60^{e}	8.94 ± 0.28^{e}	15.12 ± 1.05^{d}	19.07 ± 1.74^{bc}	22.30 ± 0.60^{a}	22.15 ± 0.06^{ab}	20.34 ± 0.05^{abc}	20.98 ± 2.27^{abc}	18.79 ± 0.32^{c}
	AS***	10.60 ± 0.57^{d}	12.52 ± 1.35^{cd}	13.84 ± 0.35^{cd}	12.88 ± 0.92^{cd}	19.32 ± 0.97^{b}	15.42 ± 1.69^{bc}	16.02 ± 1.70^{bc}	18.93 ± 0.28^{b}	28.99 ± 2.78^{a}
Riesling acetal	MS***	0.01 ± 0.01^{c}	0.06 ± 0.01^{b}	0.09 ± 0.01^{b}	0.09 ± 0.01^{b}	0.15 ± 0.01^{a}	0.10 ± 0.02^{b}	0.08 ± 0.02^{b}	0.10 ± 0.02^{b}	0.08 ± 0.02^{b}
	AS***	0.03 ± 0.00^{c}	0.07 ± 0.03^{bc}	0.07 ± 0.03^{bc}	0.07 ± 0.00^{bc}	0.12 ± 0.04^{ab}	0.07 ± 0.02^{bc}	0.05 ± 0.03^{c}	0.08 ± 0.01^{bc}	0.15 ± 0.01^{a}
TDN	MS***	5.92 ± 0.39^{e}	7.40 ± 0.25^{e}	10.65 ± 0.15^{d}	13.05 ± 1.20^{c}	15.68 ± 0.39^{b}	18.41 ± 0.86^{a}	14.06 ± 0.71^{bc}	14.13 ± 0.56^{bc}	14.48 ± 0.16^{bc}
	AS***	9.75 ± 0.56^{de}	11.78 ± 0.53^{bcd}	12.72 ± 0.83^{bc}	7.87 ± 0.66^{e}	13.85 ± 0.31^{b}	12.08 ± 0.30^{bcd}	11.11 ± 0.37^{cd}	12.65 ± 0.51^{bc}	20.55 ± 2.01^{a}
β-damascenone	MS***	8.12 ± 1.04^{e}	8.39 ± 0.13^{de}	10.20 ± 0.27^{cd}	10.47 ± 0.45^{c}	15.34 ± 0.46^{a}	11.75 ± 1.27^{bc}	11.15 ± 0.47^{c}	12.05 ± 0.40^{bc}	13.39 ± 0.49^{b}
	AS***	7.18 ± 0.18^{f}	9.31 ± 0.45^{de}	8.41 ± 0.44^{ef}	11.45 ± 0.60^{bc}	13.02 ± 0.76^{a}	11.49 ± 0.44^{bc}	12.72 ± 0.06^{ab}	11.25 ± 0.62^{bc}	10.77 ± 0.65^{cd}
TPB	MS***	0.27 ± 0.01^{c}	0.32 ± 0.01^{c}	0.41 ± 0.08^{c}	0.43 ± 0.04^{c}	0.73 ± 0.04^{b}	1.07 ± 0.14^{a}	0.83 ± 0.10^{ab}	0.77 ± 0.08^{b}	1.10 ± 0.21^{a}
	AS***	0.30 ± 0.02^{d}	0.43 ± 0.08^{d}	0.43 ± 0.04^{d}	0.38 ± 0.01^{d}	0.6 ± 0.03^{c}	0.85 ± 0.02^{b}	0.87 ± 0.07^{ab}	0.74 ± 0.04^{bc}	1.01 ± 0.09^{a}
β-ionone	MS*	2.92 ± 1.84^{a}	1.39 ± 0.05^{ab}	1.18 ± 0.09^{ab}	1.40 ± 0.11^{ab}	1.43 ± 0.07^{ab}	0.85 ± 0.11^{b}	1.05 ± 0.11^{b}	0.72 ± 0.08^{b}	0.57 ± 0.05^{b}
	AS***	2.30 ± 0.19^{a}	1.09 ± 0.03^{cd}	0.90 ± 0.04^{def}	1.26 ± 0.04^{bc}	1.41 ± 0.05^{b}	0.70 ± 0.02^{f}	0.97 ± 0.01^{de}	0.81 ± 0.07^{ef}	1.09 ± 0.09^{cd}
actinidols	MS***	0.00 ± 0.00^{c}	0.02 ± 0.00^{bc}	0.05 ± 0.00^{bc}	0.05 ± 0.01^{bc}	0.22 ± 0.02^{a}	0.21 ± 0.06^{a}	0.08 ± 0.01^{bc}	0.09 ± 0.01^{b}	0.21 ± 0.06^{a}
	AS***	0.00 ± 0.00^{c}	0.02 ± 0.00^{bc}	0.03 ± 0.01^{bc}	0.03 ± 0.00^{bc}	0.17 ± 0.01^{a}	0.16 ± 0.09^{a}	0.11 ± 0.03^{ab}	0.08 ± 0.02^{ab}	0.08 ± 0.02^{abc}
edulan	MS***	0.01 ± 0.00^{cd}	0.01 ± 0.01^{bcd}	0.00 ± 0.01^{d}	0.02 ± 0.02^{abcd}	0.04 ± 0.00^{a}	0.02 ± 0.02^{abcd}	0.04 ± 0.00^{ab}	0.04 ± 0.01^{abc}	0.03 ± 0.00^{abc}
	AS***	0.02 ± 0.00^{bc}	0.01 ± 0.01^{bc}	0.01 ± 0.01^{bc}	0.00 ± 0.01^{c}	0.02 ± 0.02^{bc}	0.02 ± 0.00^{bc}	0.03 ± 0.01^{bc}	0.03 ± 0.00^{ab}	0.06 ± 0.01^{a}
3,4-didehydro-β-ionone	MS***	0.11 ± 0.03^{g}	0.16 ± 0.01^{fg}	0.19 ± 0.03^{fg}	0.39 ± 0.03^{de}	0.78 ± 0.04^{a}	0.60 ± 0.05^{bc}	0.50 ± 0.02^{cd}	0.26 ± 0.04^{ef}	0.73 ± 0.12^{ab}
	AS*	0.10 ± 0.02^{e}	0.15 ± 0.03^{de}	0.31 ± 0.02^{cd}	0.30 ± 0.03^{d}	0.55 ± 0.08^{b}	0.49 ± 0.05^{b}	0.46 ± 0.12^{bc}	0.22 ± 0.04^{de}	0.74 ± 0.04^{a}
unknown_3 MW_172	MS***	0.06 ± 0.02^{e}	0.09 ± 0.00^{de}	0.15 ± 0.02^{cd}	0.19 ± 0.02^{abc}	0.18 ± 0.01^{abc}	0.21 ± 0.03^{a}	0.13 ± 0.03^{cd}	0.15 ± 0.02^{bc}	0.21 ± 0.02^{ab}
	AS***	0.08 ± 0.01^{c}	0.17 ± 0.06^{ab}	0.22 ± 0.01^{a}	0.16 ± 0.01^{abc}	0.11 ± 0.01^{bc}	0.17 ± 0.02^{ab}	0.14 ± 0.02^{abc}	0.12 ± 0.02^{bc}	0.17 ± 0.01^{ab}
4-(2,3,6-Trimethylphenyl)-butane-2-one	MS***	0.05 ± 0.03^{d}	0.18 ± 0.02^{d}	0.35 ± 0.01^{c}	0.36 ± 0.01^{c}	0.62 ± 0.02^{ab}	0.74 ± 0.06^{a}	0.53 ± 0.04^{b}	0.52 ± 0.05^{b}	0.74 ± 0.10^{a}
	AS***	0.18 ± 0.03^{f}	0.37 ± 0.03^{cd}	0.33 ± 0.02^{de}	0.24 ± 0.03^{ef}	0.56 ± 0.03^{b}	0.46 ± 0.06^{bc}	0.52 ± 0.02^{b}	0.53 ± 0.08^{b}	0.70 ± 0.04^{a}
unknown_4 MW_172	MS*	0.00 ± 0.00^{a}	0.04 ± 0.00^{a}	0.07 ± 0.01^{a}	0.07 ± 0.03^{a}	0.17 ± 0.02^{a}	0.21 ± 0.07^{a}	0.08 ± 0.04^{a}	0.07 ± 0.01^{a}	0.22 ± 0.09^{a}
	AS***	0.00 ± 0.00^{d}	0.05 ± 0.00^{cd}	0.05 ± 0.02^{cd}	0.06 ± 0.01^{bcd}	0.15 ± 0.02^{a}	0.13 ± 0.02^{ab}	0.10 ± 0.03^{abc}	0.08 ± 0.02^{abc}	0.13 ± 0.05^{ab}

Values are given as mean ± standard deviation (n = 3) [a] MS = morning sun; AS = afternoon sun. [b] Significant differences were evaluated by ANOVA (* p = 0.05; ** p = 0.01; *** p = 0.001) followed by Tukey´s post hoc test; different letters indicate significant differences.