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Effects of cAMP on the composition of berry juice in Muscat Bailey A

by

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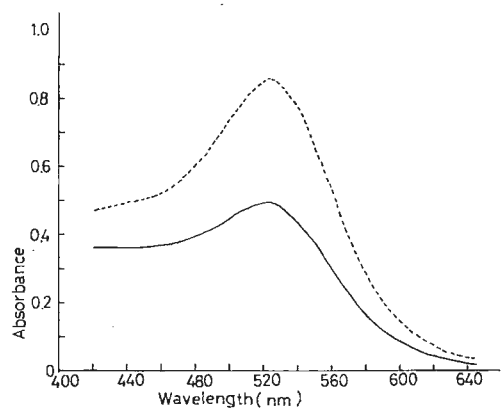
Der Einfluß von cyclischem Adenosin-3′,5′-monophosphat auf die Zusammensetzung des Beerensaftes bei Muscat Bailey A

Zusammenfassung. — Wurden die Infloreszenzen der Rebsorte Muscat Bailey A (*Vitis labrusca* L. × *V. vinifera* L.) vor der Blüte mit cAMP behandelt, so war 3 Wochen vor der vollen Reife ein Anstieg des Säuregehaltes und ebenso der Glucose- und Fructosekonzentration zu verzeichnen; gegen Ende der Reifephase waren die Unterschiede im Glucose- und Fructosegehalt behandelter und unbehandelter Beeren allerdings ziemlich verwischt.

In a previous paper (MOTOMURA *et al.* 1979), we reported that, in Delaware grapevine, the prebloom application of adenosine-3′,5′-monophosphate (cAMP) to the inflorescences enhanced appreciably the titratable acid value as well as the organic acid content in the matured berries. In Muscat Bailey A, we could also recognize a similar effect. In order to obtain more detailed understanding of such an increase, we examined the effects of various concentrations of cAMP, applied to inflorescences in prebloom, on the composition of grape juice at different stages of maturity.



Absorption curves of cleared juices of Muscat Bailey A. The clusters were given a prebloom application of cAMP at 250 µg/ml and sampled on Aug. 26,3 weeks before harvest time in 1978. Juices were diluted twice with water before measurements. - - - - = control, —— = cAMP application.

Absorptionskurven des geklärten Beerensaftes der Sorte Muscat Bailey A. Die Infloreszenzen wurden vor der Anthese in 250 µg cAMP/ml getaucht und die Trauben am 26. Aug. 1978, 3 Wochen vor der Lese, geerntet. Der Beerensaft wurde vor der Messung zweifach verdünnt. - - - - = Kontrolle, —— = cAMP-Behandlung.

Experiments were carried out over three seasons from 1977 to 1979 using two vines of Muscat Bailey A (*Vitis labrusca* L. × *V. vinifera* L.) growing in the vineyard of the Saitama Horticultural Experiment Station in Kuki-shi. In the first year of experiments the vines were 10 years old. Inflorescences were thinned out except one per shoot before cAMP application. All other experimental methods were similar to those described in the previous paper, except for procedures specially indicated in tables or figure.

In Muscat Bailey A, as well as previously reported in Delaware, the increase in the titratable acid values of berries following 500 µg/ml of cAMP application to prebloom inflorescences was established with statistical significance over the seasons from 1977 to 1979, though these data are not shown here because of their close resemblance to those of Delaware. This was true only for treatment before, but not after full bloom. There was found no consistent trend in the reducing sugar values.

Tables 1 and 2 show the results of the 1978 experiment in which different concentrations of cAMP were used and fruit clusters were sampled at different stages of maturity in order to clarify whether or not the increase in the content of organic acids of berries resulted from a delay of maturation caused by cAMP application.

Table 1

Effects of prebloom cAMP application at different concentrations on pH, contents of titratable acid, soluble solids and reducing sugars and absorbance at 520 nm (10 mm) due to anthocyanine pigments of berries at different maturity (1978)

Einfluß der Behandlung mit unterschiedlichen cAMP-Konzentrationen vor der Blüte auf pH, titrierbare Säure, Mostgewicht, reduzierende Zucker und Anthocyane (Extinktion bei 520 nm, 10 mm) im Verlaufe der Beerenreife (1978)

Sampling date	cAMP applied (µg/ml)	pH	Acidity (ml)	Soluble solids (°B)	Reducing sugar (%)	Absorbance ($E_{520\,nm}$)
Aug. 26	0	3.05	2.88	16.03	15.25	1.736
	250	2.90 *(—)	3.13 **	15.30 **(—)	14.16 *(—)	1.027 **(—)
	500	3.00 NS	2.98 *	15.80 NS	14.81 NS	1.427 *(—)
	1 000	3.15 NS	2.75 NS	16.30 **	15.62 NS	2.305 NS
Sept. 1	0	3.30	2.16	17.40	16.78	2.062
	250	3.15 *(—)	2.35 **	17.30 NS	16.50 NS	1.527 **(—)
	500	3.15 NS	2.25 *	17.60 NS	16.94 NS	1.942 NS
	1 000	3.25 NS	2.05 NS	17.50 NS	16.86 NS	1.732 NS
Sept. 8	0	3.55	1.75	17.40	17.99	1.890
	250	3.65 NS	1.90 **	18.00 *	18.30 NS	1.570 *(—)
	500	3.60 NS	1.85 *	18.30 **	18.32 NS	1.764 NS
	1 000	3.60 NS	1.83 NS	18.30 **	18.33 NS	2.045 NS
Sept. 16	0	3.50	1.55	19.40	18.45	2.250
	250	3.45 NS	1.65 *	19.30 NS	18.60 NS	1.668 **(—)
	500	3.50 NS	1.63 *	19.90 NS	18.64 NS	1.828 NS
	1 000	3.55 NS	1.58 NS	19.90 NS	18.45 NS	1.954 NS

**, *, NS = Means differ significantly at P = 0.01, P = 0.05, or not significantly, respectively.
(—) = Means differ negatively as compared with control.

Table 2

Effects of prebloom cAMP application at different concentrations on the contents of tartaric and malic acid, glucose and fructose of berries during maturity (1978)

Einfluß der Behandlung mit unterschiedlichen cAMP-Konzentrationen vor der Blüte auf den Gehalt an Wein- und Äpfelsäure sowie Glucose und Fructose im Verlaufe der Beerenreife (1978)

Sampling date	cAMP applied (µg/ml)	Tartaric acid (g/l)	Malic acid (g/l)	Glucose[1]) (g/l)	Fructose[1]) (g/l)
Aug. 26	0	5.54	6.81	64.24	60.60
	250	5.93 **	7.81 **	72.11 **	65.45 *
	500	5.78 *	7.47 **	76.77 **	70.94 **
	1 000	5.64 NS	7.10 *	75.05 **	75.85 **
Sept. 1	0	5.15	5.63	83.67	74.82
	250	5.70 **	6.86 **	89.78 *	79.83 *
	500	5.58 **	6.56 **	89.96 *	81.28 **
	1 000	5.39 *	5.73 NS	97.16 **	81.64 **
Sept. 8	0	4.64	4.64	96.84	89.04
	250	5.12 **	5.11 **	98.29 *	90.50 NS
	500	5.08 **	5.08 **	99.89 **	92.11 *
	1 000	4.96 *	4.68 NS	100.53 **	93.57 **
Sept. 16	0	4.40	4.12	94.75	93.57
	250	4.78 *	4.39 *	100.69 **	94.05
	500	4.74 *	4.32 *	100.15 **	95.02 NS
	1 000	4.56 NS	4.10 NS	102.14 **	96.11 *

[1]) Glucose and fructose were determined by enzymic methods (F-kit Glucose/Fructose; Boehringer, Mannheim, W. Germany) using hexokinase, glucose-6-phophate dehydrogenase and phosphoglucose isomerase.

**, *, NS = Means differ significantly at P = 0.01, P = 0.05, or not significantly, respectively.

The organic acid contents at 250 or 500 µg/ml of cAMP showed statistically significant increase of means at every sampling date in comparison with the control, being largest at 250 µg/ml of cAMP and diminishing towards 1000 µg/ml (Table 1). At first sampling (Aug. 26), 3 weeks before final harvest, soluble solid content and reducing sugar were lowered by prebloom application of 250 or 500 µg/ml of cAMP (Table 1), but the contents of glucose and fructose of berries were higher with each concentration of cAMP than in the control, and, in addition, increased with increasing cAMP concentration (Table 2). The difference between sugar contents of treated and of non-treated berries diminished with maturity and finally could hardly be detected. The discrepancies between the behaviour of soluble solid content and reducing sugars and the tendencies of glucose and fructose contents could not clearly be understood. The ratio of tartaric to malic acid increased with maturity and was little affected by concentration of cAMP, whereas the glucose to fructose ratio varied little with both maturity and cAMP concentration.

The effects of cAMP on amino acids were similar to those described in Delaware (MOTOMURA *et al.* 1979), except that postbloom application did not reduce the content of tyrosine.

The maximum absorbance of berry juice was found at 520 nm (Fig.), regardless of cAMP concentration and maturity, and absorbance at 520 nm decreased significantly

with the prebloom application of lower concentrations of cAMP, while the values at 1000 µg/ml sometimes were higher than in control, though there were no significant differences (Table 1).

Consequently, it seems that the higher acid content following prebloom cAMP application was not necessarily due to the delay of maturity, and the change in acid and sugar contents with maturity might be controlled by different mechanism as far as the above observation are concerned.

Summary

In Muscat Bailey A, the increases of organic acids due to cAMP prebloom application 3 weeks before final harvest were accompanied by increases of glucose and fructose, though these increments compared with control diminished toward full maturity.

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Literature

MOTOMURA, Y., HORI, Y. and ISHIYAMA, J., 1979: Increase of the acid contents in grape berries by treatment with cAMP. Vitis **18**, 301—306.

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