Sex Conversion in a Male Vitis vinifera L. by a Kinin

Abstract. A synthetic (reputed) kinin. SD 8339. at 1000 parts per million in alcohol solution, applied to flower clusters of a male grapevine about 3 weeks before anthesis, completely converted the flower sex from male to hermaphrodite. Indolebutyric acid, 2,3,5-triiodobenzoic acid, 2-chloroethyltrimethylammonium chloride β -naphthoxyacetic acid, β -indoleacetic acid, α -naphthaleneacetic acid, and gibberellin A_3 failed to modify the sex.

The indigenous forms of the vinifera grape are dioecious, in contrast with practically all cultivated varieties which are hermaphroditic and self-fruitful (1). Seeds were collected from wild vines (Vitis vinifera L.) growing in northern Iran in 1948. Beside the expected male and female vines an unusual type of male flowered vine appeared in one progeny. This male vine produced on rare occasions hermaphroditic flowers and mature fruits, at a frequency of less than $1:10^4$ flowers. Sporadically from season to season since it was first observed in 1951, natural conversion of the flower sex from male to hermaphrodite occurred more frequently on some flower clusters and shoots. This fact aroused our interest as to the underlying cause of sex conversion in this male vine.

It is known that exogenously sup-

plied auxins shift the balance of sex expression from maleness toward femaleness in various flowering plants (2), while gibberellin induces staminate-flower formation on gynoecious cucumber plants (3) and increases the number of staminate flowers in monoecious cucumbers (4). As far as we know there is no report that kinins may modify the sex of flowers. In efforts to induce sex conversion in the male vine we tried several plantgrowth substances, including (reputed) kinin SD 8339 (5) which was very effective in altering flower sex from male to hermaphrodite; it has induced parthenocarpy in the fig (6) and increased fruit set (7) and berry size (8) in the grape.

About 3 weeks before anthesis, flower clusters of the male vine were dipped momentarily in an aqueous so-



Fig. 1. Clusters on a shoot of a male vine 11 weeks after treatment. A. Treated with kinin at 1000 ppm; B and C, controls. Scale, 3 cm.

lution of indolebutyric acid at 500 parts per million, 2,3,5-triiodobenzoic acid at 100 ppm, 2-chloroethyltrimethylammonium chloride (Cycocel) at 1000 ppm, β -naphthoxyacetic acid at 100 ppm, β -indoleacetic acid at 100 ppm, α -naphthaleneacetic acid at 25 ppm, or gibberellic acid at 200 ppm; or in a 5-percent isopropyl alcohol solution of 6-(benzylamino)-9-(2-tetrahydropyranyl)-9H-purine (kinin SD 8339) at 1000 ppm. Tween-20 at 0.1 percent was added to the solutions as a wetting agent. In preliminary experiments, isopropyl alcohol and Tween-20 were applied to young flower clusters separately and in combination at similar concentrations; neither produced morphological changes in the flowers. The growth substances were used at the higher level of concentration, but not so high as to injure the tissues. Fourteen flower clusters, each on a different shoot, were used for each chemical treatment, with adjacent clusters on the same shoots as untreated controls; flower development was compared at anthesis.

Only the kinin treatment changed the sex; all clusters so treated produced typical hermaphroditic flowers instead of the usual male flowers, and normal fruit setting ensued (Fig. 1). Seed development in these fruits was also normal. Pollen stainability and germination studies revealed that development and fertility of the pollen grains were unaffected by the kinin treatment. The control clusters and the clusters treated with the other solutions produced predominantly male flowers which, as usual, dried up a few weeks after anthesis (Fig. 1).

We repeated the kinin treatment on flower clusters that appeared later in the season, with the same results. This kinin-induced sex conversion is thus consistent and complete in that all flowers in treated clusters became typically hermaphroditic. Our observations lead one to suspect that a high level of endogenous kinin in flower buds during development may cause or mediate the natural conversion of sex in this male vine.

SUSHIL S. NEGI

HAROLD P. OLMO

Department of Viticulture and Enology, University of California, Davis

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Nonthrombogenic Plastic Surfaces

Abstract. Heparin has been chemically combined with a number of plastic surfaces rendering them nonthrombogenic as judged by Lee-White coagulation tests in vitro with human blood. Addition of quaternary ammonium groups to the plastic permitted formation of insoluble complexes with heparin. These heparinized surfaces were essentially nonthrombogenic and adsorb blood proteins to a significantly smaller degree from dilute solution than do the unmodified plastic surfaces. The affinity of the formed blood elements for these modified surfaces is much less than for the unmodified surfaces.

The thrombogenicity of plastics is the major drawback to their use in artificial organs in contact with blood. Although plastics are used in heart-lung machines. kidney machines, and artificial heart valves and patches, the tendency of these materials to cause coagulation necessitates the use of anticoagulants such as heparin. A few plastics such as polytetrafluoroethylene and the silicone rubbers are more compatible with blood

than most plastics, yet they still show thrombogenic characteristics.

The GBH (graphite-benzalkoniumchloride-heparin) surfaces prepared by Gott represented the first real advance in preparation of nonthrombogenic surfaces. These surfaces on plastics, prepared by treating a graphited surface first with Zephiran and then with heparin, have been shown to be nonthrombogenic in dogs over periods of more than 2 years. These surfaces, however, can be applied only to rigid plastics, and the need continues for both flexible and elastomeric plastics that can be used in artificial organs.

Because of the success of this physical coating system, we undertook to bond heparin chemically to plastic surfaces, on the grounds that chemically bonded heparin would, by analogy with the Gott surface, produce blood compatibility. Such a surface, too, would be more like that of the natural vascular system, which is known to contain heparin and other sulfated polysaccharides that have heparin-like activity (1).

The initial step in chemical heparinization of a number of plastics has been the formation of quaternary ammonium sites on the plastic surface by several methods including (i) chloromethylation followed by quaternization with dimethyl aniline, (ii) radiation grafting vinyl pyridine to the base plastic followed by quaternization as with methyl iodide or benzyl chloride, and (iii) incorporation of a quaternizable monomer such as vinyl pyridine into a copolymer. After the surfaces were quaternized, heparinization was accomplished by simple contact with a heparin solution. Coagulation times with several treated and untreated plastics are shown in Table 1.



Fig. 1. Adsorption of fibrinogen on polystyrene and heparinized polystyrene. The concentration of fibrinogen in Ringer solution was one-thousandth that usually found in blood.

Table 1. Coagulation times with treated and untreated plastics.

Base polymer	Untreated (min)	Treated (hr)	
Polystyrene	9–11	>20	
Polyethylene	9-12	>20	
Silicone rubber	15-20	>20	
Polyvinyl chloride	12-16	>1	
Nylon 610	8-14	>20	
Gott surface		>20	

Table 2. Change of ¿-potential during treatment.

	ζ-potential (mv)			
Time of test	Polyethy- lene	Polysty- rene		
Initial	-15.2	-16.8		
After irradiation	-14.7	-12.6		
After graft with 4-vinylpy	-			
ridine	-19.8	-18.8		
After methyl iodide	+11.5	+15.3		
After heparinization	-8.4	-14.1		

Table 3. D	ecay of	ζ-po	otential	of	heparinized
polystyrene	surfaces	in	Ringer	sol	lution.

Hours in	Ringer	ζ-potential	(mv)
I	vinyl pyridine	–methyl iodide	
24	1	-14.9	
48	3	-11.8	
192	2	-10.9	
746	5	-3.3	
1394	ł	-3.3	
Chlo	promethylation	n–dimethyl aniline	,
24	L.	-11.5	
48	3	-7.3	
696	5	-6.8	
1344		-5.7	

The quaternization and heparinization treatments were followed by measurements of the ζ -potential of the surface in contact with Ringer solution. Most plastics show a negative ¿-potential. After quaternization the ζ -potential generally swings to a positive value because of the positive ammonium groups, and after heparinization the ζ potential again becomes negative. The magnitude of the changes is an indication of the extent of the reaction (Table 2). Permanence of the heparinization is necessary if these surfaces are to be used for long-term implants. An indication of these stabilities was gained by following the ζ -potential of heparinized surfaces in contact with Ringer solution over relatively long periods. If the heparin is lost, the ζ -potential would be expected to become positive. Table 3 shows the decay of ζ potentials of some heparinized surfaces. There is some indication from work by Gott (2)