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Redox Potential Gradients in the Flower

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Abstract. Distinct redox gradients were found in flowers and stalks of some plants. The ovary was found to be the most negative part in the whole pistil and more negative than the coloured perigon or corona leaves. These redox differences are in accordance with biopotential differences obtained in flowers by other authors.

One of the problems in the pollen tube growth is how the pollen tube finds its way into the stylar canal and to the ovules in the ovary. ZEILEMAKER (1956) has shown that there were potential differences between the top of the ovary and the corona of *Narcissus pseudonarcissus* (average 33 mV) and between the ovary and the stigma (120 mV). The ovary proved to be negative both with regard to the corona and the stigma and style. Furthermore, this author has shown that the pollen tube has grown to the cathode.

According to LUND (1928), the bioelectric potential originates in redox potential and, therefore, the redox potentials were measured in the flowers of some plants.

Methods

Oxidation reduction potential (RP) was measured according to the method described in another paper (BENADA 1966). The experimental material was grown under field conditions. RP is given as the difference in mV from the potential of the saturated calomel electrode: E_c being 0·244 V at 20° C.

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Results

1. RPs were measured in the flowers of *Papaver somniferum*. The results are shown in Table 1. The ovary has very distinctly lower RP compared with petals.

Table 1
Redox potentials in the flowers of *Papaver somniferum* (in mV)

Petala	+253	+264	+267	+289	+264	+273	+260	+251	+261	+250
Ovary	+195	+194	+169	+194	+148	+210	+127	+145	+180	+138
Difference	58	70	98	95	116	63	133	106	81	112
Mean difference	93·2 mV									

2. The redox gradients in the flowers and the stalks of three varieties of tulip are shown in Table 2. The gradients are expressive. The lower part of the stalk, as well as the tepala, have relatively high RPs. Redox gradients were found in the pistil, too. The ovary has the lowest RP. The average difference between the tepala and the ovary was 93 mV.

Table 2
Redox gradients in the flowers of tulip (in mV)

Colour of flowers: yellow										
1 Stalk middle part	+ 8	−10	+14	+ 7	+16	+27	+12	+25	+ 5	+20
2 Stalk under the flower	0	−16	− 3	− 5	−15	+ 3	+20	+ 2	− 5	− 5
3 Tepala	+ 7	+28	+10	−16	−14	+ 4	+10	+28	− 4	+26
4 Stigma	−68	−42	−51	−42	−71	−66	−61	−41	−74	−76
5 Ovary	−88	−100	−94	−97	−87	−71	−94	−95	−96	−91
Colour of flowers: yellow with red margin										
1 Stalk middle part	+62	+51	+44	+34	+35	+53	+46	+36	+34	+49
2 Stalk under the flower	+60	+39	+33	+22	+35	+34	+30	+16	+19	+26
3 Tepala	+53	+35	+47	+28	+36	+52	+25	+36	+36	+47
4 Stigma	− 5	−44	−55	−23	−31	−53	−41	−49	−51	−31
5 Ovary	−67	−58	−69	−75	−83	−79	−72	−69	−64	−83

3. The RPs were measured in the flowers of *Gladiolus gandavensis*. The results are shown in Table 3. The ovary had clearly much lower RP than

Table 3
Redox potentials in the flowers of *Glâdiolus gandavensis* cv. Klenot (in mV)

	Lower old flower	Just opened flower	Young upper flower
Corolla:	+20	− 2	−40
Ovary:	−70	−78	−50

the tepala. In the partly developed flower the potential difference was only small.

Discussion

The shown redox gradients are in accordance with the potential differences obtained by Zeilemaker (1956), but there is a discrepancy with the results of Britikov (1954) who found high RPs in the stigma and low RPs in the pollen grains using redox dyes. The present measurements, as well as those earlier ones (Benada 1966), give a basis for the opinion that the redox dyes are not suitable for RP measurement in the living tissues.

From experiment No. 3 it is concluded that a potential difference appears during the flower development. In this connection the meaning of the anthocyans in the flower is very impressive as the RP is kept higher in the corona and probably also in the pollen grains than in the pistil.

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Ve květech a stoncích vybraných druhů rostlin byly nalezeny význačné gradienty redoxních potenciálů. Redoxní potenciál semeníku byl nejvíce negativní ve srovnání s ostatními částmi pestíku a byl negativnější než okvětní nebo korunní lístky. Gradienty redoxních potenciálů byly naměřeny i ve květní stopce tulipánů. Zjištěné rozdíly v redoxních potenciálech květů souhlasí s rozdíly biopotenciálů, naměřenými jinými autory.

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В цветках и стеблях исследованных растений найдены значительные градиенты редокс потенциалов. Потенциал завязи оказался наиболее отрицательным по сравнению с остальными частями пестика и был более отрицателен, чем потенциал лепестков цветка. Градиенты редокс потенциалов получены и из цветоножки тюльпанов. Измеренные различия редокс потенциалов цветка сходны с данными различиями биопотенциалов других авторов.