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DEVELOPMENT OF CARBON PASTE ELECTRODE FOR THE POTENTIOMETRIC DETERMINATION OF ACEBUTOLOL

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Aim of this work:
development of sensor based on carbon paste for potentiometric determination of acebutolol, cardiovascular drug from the family of beta blockers

Methods:
A series of carbon paste electrodes (CPE) of different components but with approximately same binder ratios were prepared. Dibutyl phthalate (DBP), dioctyl phthalate (DOP), tris(2-ethylhexyl) phosphate (TEPh) and 2-nitrophenyl octyl ether (NPOE) were used as binders. Acebutolol tetraphenylborate (AC-TPB), acebutolol phosphotungstate (AC-PT), acebutolol phosphomolybdate (AC-PM) and acebutolol reineckate (AC-R) were used as ion-associated complexes whereas tetrabutylammonium tetraphenylborate (TBATPB) and sodium tetraphenylborate (NaTPB) were used as ionic additives.
Response characteristics of all prepared electrodes were tested in 0.015 M acetate buffer solution (pH = 4.5) at room conditions.

Results:

Table 1. Carbon paste electrode composition for direct potentiometric determination of acebutolol

CPE (no.)	Ingredient				Linear Range (mol L^{-1})	Detection Limit (mol L^{-1})	Slope (mV/dec) ± SD	R^2
	Gr (%)	Binder	IAC	Ionic additive				
1	55.4	44.3% (DOP)	0.3% (AC-PT)	-	3.2×10^{-6} – 3.2×10^{-3}	2.9×10^{-6}	−34.9 ± 3.5	0.9915
2	53.9	45.2% (DOP)	0.9% (AC-PT)	-	3.2×10^{-6} – 3.2×10^{-3}	3.0×10^{-6}	−33.6 ± 3.2	0.9909
3	53.6	44.9% (DOP)	1.5% (AC-PT)	-	1.3×10^{-5} – 3.2×10^{-3}	1.2×10^{-5}	−32.0 ± 3.2	0.9960
4	53.0	43.8% (DOP)	3.2% (AC-PT)	-	1.3×10^{-5} – 3.2×10^{-3}	1.2×10^{-5}	−40.0 ± 2.4	0.9890
5	48.8	45.8% (DOP)	5.4% (AC-PT)	-	1.3×10^{-5} – 3.2×10^{-3}	1.1×10^{-5}	−40.7 ± 1.9	0.9931
6	55.2	41.9% (DOP)	2.8% (AC-PT)	0.1% (TBATPB)	1.3×10^{-5} – 3.2×10^{-3}	1.3×10^{-5}	−37.7 ± 2.1	0.9970
7	53.2	43.5% (DOP)	3.3% (AC-PT)	0.1% (NaTPB)	1.3×10^{-5} – 3.2×10^{-3}	1.2×10^{-5}	−33.5 ± 2.7	0.9659
8	53.0	43.7% (DOP)	3.1% (AC-PT)	0.1% (NaTPB)	1.3×10^{-5} – 3.2×10^{-3}	9.8×10^{-6}	−40.7 ± 1.6	0.9790
9	53.6	46.0% (DBP)	0.4% (AC-PM)	-	1.3×10^{-5} – 3.2×10^{-3}	1.3×10^{-5}	−29.3 ± 1.1	0.9986
10	53.8	45.3% (DBP)	0.9% (AC-PM)	-	-	-	−25.5 ± 2.2	0.9428
11	54.4	44.2% (DBP)	1.4% (AC-PM)	-	-	-	−22.5 ± 2.7	0.9072
12	53.0	43.6% (DBP)	3.4% (AC-PM)	-	-	-	−22.0 ± 1.8	0.9028
13	55.1	44.3% (DBP)	0.4% (AC-PM)	0.2% (NaTPB)	5.0×10^{-5} – 3.2×10^{-3}	3.6×10^{-5}	−56.3 ± 0.9	0.9990
14	53.9	45.1% (DBP)	0.9% (AC-PM)	0.1% (NaTPB)	5.0×10^{-5} – 3.2×10^{-3}	3.5×10^{-5}	−55.3 ± 1.2	0.9969
15	54.7	44.8% (TEPh)	0.5% (AC-TPB)	-	5.0×10^{-5} – 3.2×10^{-3}	4.6×10^{-5}	−46.3 ± 2.5	0.9972
16	54.1	44.6% (TEPh)	1.3% (AC-TPB)	-	5.0×10^{-5} – 3.2×10^{-3}	4.7×10^{-5}	−47.8 ± 2.0	0.9994
17	53.8	43.3% (TEPh)	2.9% (AC-TPB)	-	1.3×10^{-5} – 3.2×10^{-3}	1.0×10^{-5}	−46.5 ± 0.9	0.9867
18	52.4	42.9% (TEPh)	4.8% (AC-TPB)	-	1.3×10^{-5} – 3.2×10^{-3}	9.2×10^{-6}	−44.8 ± 1.6	0.9928
19	53.2	43.6% (TEPh)	2.9% (AC-TPB)	0.3% (NaTPB)	-	-	−53.2 ± 4.9	0.9246
20	53.2	43.6% (TEPh)	2.9% (AC-TPB)	0.3% (TBATPB)	-	-	−23.7 ± 3.1	0.9015
21	53.4	43.7% (TEPh)	2.9% (AC-R)	-	-	-	-	-
22	53.4	43.4% (TEPh)	2.9% (AC-R)	0.3% (NaTPB)	-	-	−20.2 ± 3.0	0.8395
23	54.9	44.8% (NPOE)	0.3% (AC-PM)	-	3.2×10^{-6} – 5.0×10^{-5}	3.1×10^{-6}	−44.3 ± 1.2	0.9994
24	54.6	44.5% (NPOE)	0.9% (AC-PM)	-	-	-	−24.2 ± 5.4	0.8329
25	54.2	44.3% (NPOE)	1.5% (AC-PM)	-	-	-	−22.0 ± 4.3	0.8486
26	54.8	44.8% (NPOE)	0.3% (AC-PM)	0.1% (NaTPB)	-	-	-	-

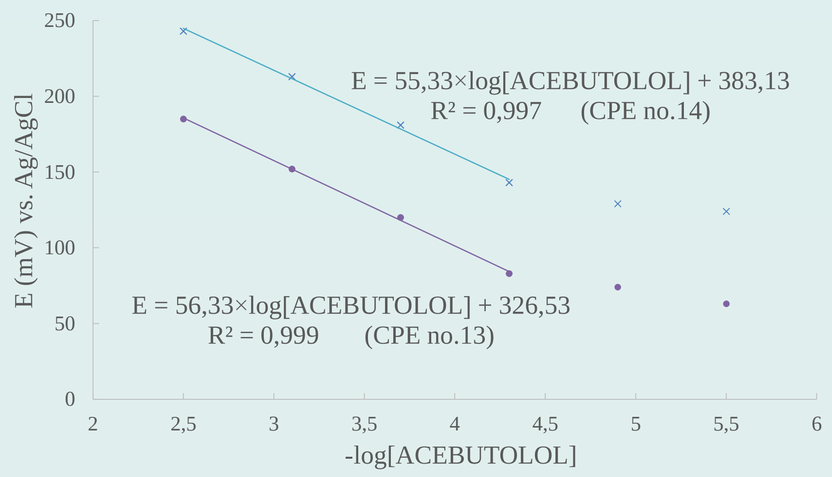

Figure1. Potentiomteric responses of two prepared CPEs (no.13 and no.14) for acebutolol determination

Conclusions:

All prepared CPEs showed worse preliminary response characteristics than CPE for acebutolol determination previously published.
However, two of all prepared membranes gave the promising response characteristics, but linear range for the change in potential spanned only 2 concentration decades.
Significant improvement in response characteristics was observed with the addition of ionic additives in membranes no.13 and no.14.
It is still necessary to continue working on this problem in order to develop a suitable sensor. In further researches emphasis is going to be placed on the incorporation of different nanomaterials into the paste, especially those made of carbon materials.

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