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The variants of circular ascending thin-layer chromatography

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1. Introduction

Circular TLC is characterized by higher efficiency in comparison with the linear variant [1,2]. However, the wide using of circular TLC in the analytical practice is restricted by insufficient development of the variants of this method. The known variants of circular TLC are characterized, first, by supply of the mobile phase into the central area of the TLC plate, and, second, by that separation is implemented in the horizontal chamber [2,3]. The main drawback of the method of circular TLC is the relative complexity of the apparatus for the experiment conducting on the TLC plate positioned horizontally. So it seemed to be expedient to implement the new variants of ascending circular TLC: corner and lateral TLC using only widespread standard N-chambers for ascending linear TLC. In the given work the new simple variants of circular TLC have been studied (circular, corner and lateral TLC) for the ascending variant of the mobile phase supply to the plate. As well, their comparison with the traditional ascending linear TLC has been carried out.

2. Experimental research and results

To conduct the experiments the standard chromatographic chamber for ascending elution (the N-chamber) for the plates of 10×10 cm was used. The point of mobile phase supply might be located in the corner of the TLC plate – corner TLC, on one side – lateral TLC, and in the centre of the plate at the vertical location – ascending circular TLC. The distance from the lower edge of the plate to the start line is 1.5 cm, and the distance from the start line to the front line is 7 cm. To implement the ascending circular variant of elution there were used TLC plates of 20×20 cm and a chamber for circular TLC, in which the eluent was supplied on the flexible capillary to the centre of the TLC plate [4]. As a mobile phase (MPh) toluene, acetone and ethanol were used.

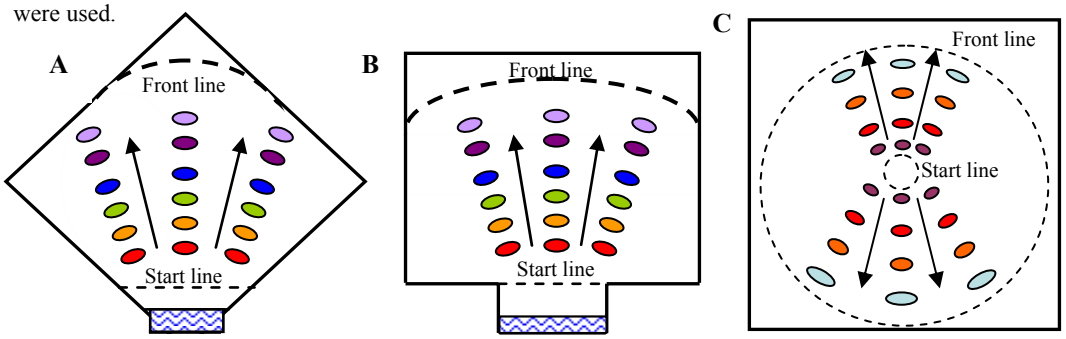

Fig. 1. The schematic of the experiment when implementing circular ascending TLC. A – the corner location of the supply area; B – the lateral location of the supply area, C – circular TLC on the vertically positioned TLC plate.

To evaluate the efficiency of the new variants of circular TLC their comparison with traditional ones has been carried out: with linear ascending and circular TLC on the vertically positioned TLC plate. The velocity of the mobile phase (toluene) front migration increases in the sequence of the following TLC variants: circular (traditional) (74 min) < lateral (50 min) < corner (49 min) < linear (27 min). The duration of the analysis for corner and lateral TLC is longer – to compare to linear elution by 81% and 85%, respectively, but is less than for ascending circular TLC by 51% and 48%, respectively. Thereby, the new variants of circular TLC (lateral and corner) occupy the intermediate place between the traditional circular and linear TLC by the velocity of the mobile phase front migration.

According to the data of the Table 1, it can be concluded that the retardation values (R_f) for the same compounds in circular methods (circular, corner and lateral TLC) are of bigger meanings than in linear TLC, what is typical for circular elution methods. The efficiency of separation (the number of theoretical plates, N) in the corner and lateral TLC exceeds the efficiency of separation within linear TLC by any of the compounds by, at the minimum, 2.0 times. The average efficiency of separation (that is by all the compounds) increases in case of corner TLC by 2.9 times, in case of lateral TLC – by 2.6 times relatively to the linear variant of elution, what occurs because of concentration of the zones of the compounds within the circular gradient of mobile phase migration.

Table 1. The evaluation of the efficiency of the new variants of TLC to compare to the traditional methods (MPh is toluene, R_f is retardation factor, N is the number of theoretical plates).

The compound chromatographed	Ascending circular TLC (the upper part of the chromatogram, fig. 1C)			The ascending supply of the mobile phase							
				Linear TLC		Corner TLC			Lateral TLC		
	R_f	N	N/N_{lin}	R_f	N	R_f	N	N/N_{lin}	R_f	N	N/N_{lin}
Ciba FII	0.09	548	5.2	0.02	101	0.07	428	4.2	0.07	402	4.0
Indophenol	0.22	1360	4.6	0.08	296	0.16	1170	4.0	0.16	956	3.2
Ariabel Red	0.38	1680	2.8	0.15	595	0.29	1510	2.5	0.31	1370	2.3
Sudan Blue	0.45	2230	2.5	0.24	890	0.39	1820	2.0	0.41	1750	2.0
Sudan II	0.59	2480	2.3	0.40	1060	0.56	2090	2.0	0.58	2000	1.9
Dimethylaminoaza benzene	0.75	3760	2.8	0.55	1320	0.69	3090	2.3	0.68	2920	2.2
The average meaning			**3.4**					**2.9**			**2.6**

Where N is the efficiency of separation in the variant of circular TLC, N_{lin} is the efficiency of separation in linear TLC

The regularities described above are also true for other mobile phases (Table 2). The proposed variants of circular TLC allow substantially improving the efficiency of separation – at the minimum, by 2 times (in comparison with linear TLC).

It should be noted that corner and lateral TLC with the ascending elution were used when carrying out the separation of the medication of the trademark "Pentalgin", along with this the increase in efficiency of separation by 2.3-2.7 times was observed [4].

Table 2. The comparison of the new variants of ascending circular TLC with traditional linear TLC.

Mobile phase	Corner TLC (ascending)		Lateral TLC (ascending)	
	Relative increase in the analysis duration, t_{corner}/t_{lin}	Relative increase in the efficiency of separation, N_{corner}/N_{lin}	Relative increase in the analysis duration, $t_{lateral}/t_{lin}$	Relative increase in the efficiency of separation, $N_{lateral}/N_{lin}$
Toluene	1.8	2.9	1.8	2.6
Acetone	1.8	2.0	1.9	1.8
Ethanol	1.8	3.1	1.9	2.9

3. Conclusion

The proposed variants are characterized by higher efficiency of separation (by 2-3 times) to compare to linear TLC, by simplicity of its implementation, but by higher duration of the analysis (by 80%). The new variants of circular TLC are expedient to be used in analytical practice.

References

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