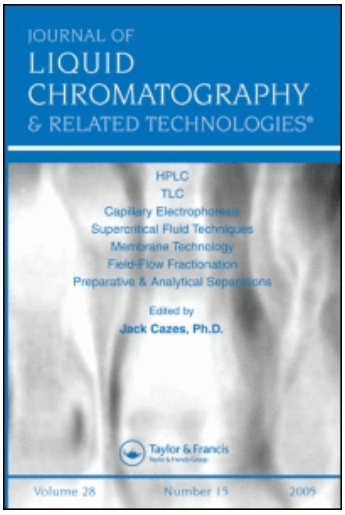

Journal of Liquid Chromatography & Related Technologies
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713597273

Evaluation of Modified Valence Molecular Connectivity Index for Correlations of Chromatographic Parameters

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To cite this Article Bojarski, Jacek and Ekiert, Leszek(1983) 'Evaluation of Modified Valence Molecular Connectivity Index for Correlations of Chromatographic Parameters', Journal of Liquid Chromatography & Related Technologies, 6: 1, 73 — 80
To link to this Article: DOI: 10.1080/01483918308066871
URL: http://dx.doi.org/10.1080/01483918308066871

JOURNAL OF LIQUID CHROMATOGRAPHY, 6(1), 73-80 (1983)

EVALUATION OF MODIFIED VALENCE MOLECULAR CONNECTIVITY INDEX FOR CORRELATIONS OF CHROMATOGRAPHIC PARAMETERS

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ABSTRACT

Twenty five data sets of different chromatographic parameters for barbituric acid derivatives taken from the literature were correlated with the modified valence connectivity index. The results show that more significant correlations are obtained using the standard valence connectivity index for liquid chromatography techniques.

INTRODUCTION

Molecular connectivity indices (1) are widely used in structure-activity relationship analyses in medicinal chemistry (2). There were also numerous attempts to apply these topological parameters for a description of chromatographic behavior of different classes of compounds (3 - 13). It was found, that the topological indices are very useful in describing the interaction between member molecules of one family and the stationary phases (11).

0148-3919/83/0601-0073$3.50/0

We investigated the relationship between first order valence connectivity indices of barbiturates and chromatographic parameters for different chromatographic techniques (14). The best correlations were found for HPLC the worse were those for TLC.

Gas chromatographic retention data for the same group of compounds were correlated with molecular connectivity parameters by Stead et al. (15). They introduced the modified first order valence connectivity index $^{1}\chi^{v}_{N}$ and claimed significantly better correlation than that obtained with the standard valence connectivity values $^{1}\chi^{v}$. The main difference between these parameters lies in the calculations of connectivity term for unsaturated and cyclic substituents, while the calculation rules for saturated chain substituents are identical.

We wanted to study applications of this modified parameter for the correlations of chromatographic data of barbiturates in other techniques of chromatography and to compare the results with those obtained for the original valence connectivity indices.

CALCULATIONS

The values of the modified first order valence connectivity index $^{1}\chi^{v}_{N}$ were calculated according to the original indications (15) and are listed in Table 1.

TABLE 1

Modified connectivity indices of barbiturates

	Barbituric acid	$^1\chi^v_N$
1.	5-allyl-5-ethyl	4.5130
2.	5,5-diallyl	4.7903
3.	5-allyl-5-isopropyl	4.8958
4.	5-ethyl-5-crotyl	5.2340
5.	5-allyl-5-isobutyl	5.3679
6.	5-allyl-5-/1-methylpropyl/	5.4338
7.	5-vinyl-5-/1-methylbutyl/	5.4606
8.	5-allyl-5-n-butyl	5.5130
9.	5-allyl-5-/2,2-dimethylpropyl/	5.6595
10.	5-allyl-5-/1-methylbutyl/	5.9328
11.	5-ethyl-5-/1-methylbuten-1-yl/	5.9401
12.	5-allyl-5-/cyclopenten-1-yl/	6.3050
13.	5-methyl-5-phenyl	6.5269
14.	1,5-dimethyl-5-/cyclohexen-1-yl/	6.6992
15.	5-ethyl-5-/cyclohexen-1-yl/	6.8655
16.	5-ethyl-5-phenyl	7.0866
17.	5-ethyl-5-/cyclohepten-1-yl/	7.3655
18.	5-allyl-5-phenyl	7.3659
19.	1-methyl-5-ethyl-5-phenyl	7.4810
20.	1-phenyl-5,5-diethyl	8.0423

Standard first order valence connectivity indices $^1\chi^v$ were calculated as described previously (14).

The chromatographic data for barbituric acid derivatives were taken from the literature (16 - 23). The following parameters were used for the correlations: R_F and R_M for paper chromatography (PC) and thin-layer chromatography (TLC), retention indices (I) and retention times (t_R and log t_R) for gas chromatography (GC) and capacity factors (k' and log k') for high performance liquid chromatography (HPLC).

The correlations were carried out by the least squares method and the significance of correlation coefficients was evaluated by Student's test.

RESULTS

Table 2 reports statistical data: correlation coefficients (r), significance levels (α) and number of compounds in data sets (n). The results of comparisons between correlations using $^1\chi^v_N$ and $^1\chi^v$ values are presented in Table 3.

CONCLUSION

From the results presented in Tables 2 and 3 it is clear that the modified valence connectivity parameter $^1\chi^v_N$ yields better correlations of chromatographic data only for the gas chromatography techni-

TABLE 2

Results of linear regression analysis

Technique	Data set	Reference	n	y	$^1\chi^v$ r	$^1\chi^v$ ∝	$^1\chi^v_N$ r	$^1\chi^v_N$ ∝
PC	1	16	12	R_F	0.6356	0.05	0.2024	0.6
				R_M	0.6259	0.05	0.1890	0.6
	2		16	R_F	0.6297	0.01	0.1832	0.5
				R_M	0.6186	0.02	0.1742	0.6
	3		14	R_F	0.7535	0.01	0.4880	0.1
				R_M	0.7386	0.01	0.4609	0.1
TLC	4	9	15	R_F	0.7394	0.01	0.6480	0.01
				R_M	0.8411	0.001	0.7857	0.001
	5	16	30	R_F	0.3671	0.05	0.1123	0.6
				R_M	0.3721	0.05	0.0908	0.7
	6	17	14	R_F	0.6058	0.05	0.5086	0.1
				R_M	0.6158	0.02	0.4922	0.1
	7	18	18	R_F	0.4107	0.1	0.3573	0.2
				R_M	0.4148	0.1	0.1715	0.5
GC	8	19	16	t_R	0.6333	0.01	0.6880	0.01
				lg t_R	0.7051	0.01	0.9453	0.001
	9	20	17	t_R	0.7120	0.01	0.8899	0.001
				lg t_R	0.8470	0.001	0.9458	0.001
	10	21	19	I	0.7176	0.001	0.9479	0.001
HPLC	11	22	14	k′	0.6513	0.01	0.1529	0.6
				lg k′	0.7426	0.01	0.1864	0.6
	12		14	k′	0.6800	0.01	0.1749	0.6
				lg k′	0.7372	0.01	0.2297	0.5
	13	23	15	k′	0.7801	0.01	0.5886	0.05
				lg k′	0.8722	0.001	0.7638	0.01

TABLE 3

Evaluation of $^1\chi_N^v$ vs $^1\chi^v$ values

	Number of correlations			
	PC	TLC	GC	HPLC
$^1\chi_N^v$ better than $^1\chi^v$	-	-	5	-
$^1\chi_N^v$ worse than $^1\chi^v$	6	8	-	6

que and its application for liquid chromatography data of barbituric acid derivatives cannot be justified.

The advantage of $^1\chi_N^v$ over $^1\chi^v$ values for the correlations of GC data may reflect some specific features of separation processes, different for gas and liquid phases, although their exact nature and general application of $^1\chi_N^v$ values for other classes of compounds remain to be clarified.

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