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A RATHER SIMPLE METHOD TO CALCULATE Log P VALUES IN QSAR/QSPR STUDIES

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Abstract

We present a rather simple method to deal with structure-property relationships, showing that good enough results are obtained when resorting to a rudimentary form of information theory. Molecular descriptors are the number and sort of atoms and the chemical bonds. We study the Log P values for a wide variety of organic molecules and compare results with others arising from an alternative theoretical method. Some possible further possible extensions are pointed out.

Introduction

The relationship between structure and property is a central focus in the way chemists consider any sort of chemical problem. A fundamental concept in chemistry is that structural characteristics of a molecule are responsible for its properties.[1] The origin of the structure-property relationship can be traced to Boskovic's work, who introduced the idea of representing atoms as points in the space.[2,3] Boskovic's fundamental idea was that substances have different properties because they have different structures and this idea was used, for example, by Davy to rationalize the difference between diamond and graphite.[4]

The mathematical structure-property relationships quantify the connection between the structures and the properties of molecules. The relationships are mathematical models that allow the prediction of properties from structural parameters. These features lead us to look for suitable indices for encoding the structural information.

There are a host of these indices associated with the molecular structure, which within the realm of the ***Q***uantitative ***S***tructure ***A***ctivity ***R***elationships - ***Q***uantitative

Structure ***P***roperty ***R***elationships (QSAR/QSPR) theory can be considered as a set of codes by means of which one can describe a molecule in quantitative terms. It is a model of the form of a given molecule, which produces a series of functions called *properties*. The numerical values of the properties present a mosaic of information about the system. The function or properties of a molecule are dependent on the form or structure.

Then, we deem suitable to consider the ways to encode structure. Testa and Kier[5] and Testa *et al.*[6] have addressed this point showing the existence of several levels of structure and properties, and Randic has pointed out that standard literature registers a huge number of the so called ***molecular descriptors.***[7] An important way to introduce quantitative measures of "order", "complexity", and "information content" into the molecular structure realm is to resort to the concepts of information theory. Thus, it has been possible to derive numerical indices based upon information theoretical formulae to represent the topological structure of atoms and molecules.[8]

The purpose of this paper is to present a very simple method to deal with structure-activity (property) relationships, showing that good enough results are obtained when using a rather rudimentary form of information theory. Molecular descriptors are the number and sort of atoms and the classical chemical bonds. The molecular partition coefficient in 1-octanol/water system is the physical chemistry property chosen to study via the present method a wide variety of organic molecules.

The paper is organized along the following lines: next section deals with some basic definitions and several necessary associated antecedents on this issue. Then, we give the most significant results and we compare them with those obtained through an alternative method, discussing the relative merits of each one of them. Finally, we close the work discussing the values of the results and stating the main conclusions of these findings and pointing out some possible future extensions of the present methodology.

BASIC DEFINITIONS

There are three main methods to derive molecular descriptors: [9]

1) Physicochemical parameters used to describe molecules, which may come from a variety of sources.
2) Parameters which may be calculated solely from consideration of molecular structure.

3) Parameters derived from the Molecular Orbital Theory.

The second category encompasses the largest number of molecular descriptors, which generally can be calculated very readily and they have the advantage that they can be applied to quite diverse sets of structures.[10] There are a wide variety of alternative definitions for molecular descriptors and each one of them have their own merits and limitations.[11] It is totally understandable that each definition presents some sort of intrinsic weakness since a rather complex and subtle characteristic as it is the molecular structure is being represented by a single number: ***the molecular descriptor***.

Naturally, the most primitive and simplest sort of molecular descriptors are the number and kind of atoms and the existing chemical bonds. Surprisingly enough, these primary parameters have not been employed comprehensively, although some studies have shown plainly they are so useful as the most elaborated ones. In fact, we have employed them in several QSAR/QSPR studies on physical chemistry properties and biological activities with quite satisfactory results and we could obtain meaningful quantitative relationships.[12-15]

Therefore, we have deemed suitable to try to extend those studies for other physical chemistry properties and different molecular sets in order to ascertain the real merits of this sort of approximation.

The so-called "Log P" (*i.e.* the molecular partition coefficient in 1-octanol/water system) is a very simple measure of the hydrophobic/lyophilic character of a given substance. Topological geometry of molecules should condition either the weak polar-

polar interactions or the geometric requirements for substrate-receptor complex formation in which the whole molecule takes part. The first type of interactions, however, condition such primary effects as substrate partitioning between phases of different polarity (*i.e.* Log $P_{octanol/water}$). These primary effects and/or geometric demands for fitting to receptor cavity next can determine secondary effects, such as acute toxicity, carcinogenicity, etc.

This parameter can be available from experimental determinations for extensive series of molecules, but there are cases where such values are still unknown as, for example, when molecules are completely new or/and when the experimental determination is rather difficult or subject to large uncertainties. Consequently, several theoretical evaluation methods have been proposed. A somewhat complete and updated review on the measurement and calculation methods of the hydrophobic parameter has been given by Hansch and Leo.[16] Among the host of alternative methodologies to compute log P, that one based on the idea of hydrophobic atomic contributions given by Ghose and Crippen[17] is closely related to our proposed technique. These authors classified the atoms H, C, O, N, S, and halogens into 90 different types and then calculated their hydrophobic atomic contributions to log P. However, this approach has received some criticism. In fact, Hansch and Leo[18] have found... "the most disturbing aspect of any atomic contribution approach is the difficulty in accounting for interactions at a distance". More recently, Moriguchi *et al.*[19] published a method that combines atom-type descriptors with factors for proximity effects, unsaturation, intramolecular hydrogen bonds, ring structures, and amphoteric properties. Besides, specific descriptors for certain arbitrarily chosen structures were required. This approach demands a 14-parameter regression equation and furthermore those correction factors for different effects are chosen in a rather arbitrary way, which on his turn, does not yield a clear enough manner to ascertain their relative influence on Log P. A quite interesting way of calculating Log P is the fragment method, introduced by Rekker and coworkers.[20,21] In this case, Log P values are constructed from hydrophobic fragment constants.

Here, we resort to the more simple and direct method to compute Log P on the basis of atom-types and chemical bonding-classes. The approach has been applied to the same molecular set selected by Amat *et al.*[22] to a broad series of 58 molecules, including various structural types, such as hydrocarbons, alcohols, amines, carboxylic acids, halides, esters, ketones, amides, amino-acids and chlorohydrines.

RESULTS AND DISCUSSION

Having introduced the basic definitions related to the present approach, we give the results of the practical application of the aforementioned method. We have resorted to the same test molecular set as taken by Amat *et al.*[22] and the various structural types include simple monofunctional derivatives like hydrocarbons R-H, alcohols R-OH, halides R-Cl, amines R-NH_2, carboxylic acids R-COOH, esters R-$COOCH_3$, amides H-CONHR, R-$CONH_2$, and ketones R-CO-R', as well as some representatives of somewhat complex molecules with polyfunctional groups such as chlorohydrines Cl-$(CH_2)_n$-OH and amino acids R-CH(NH_2)-COOH.

The general form of the multilinear regression equations employed for each molecular set is

$$\text{Log P} = \sum_{i}^{\text{atoms}} a_i A_i + \sum_{i\text{-}j}^{\text{bonds}} b_{i\text{-}j} B_{i\text{-}j} + D \qquad (1)$$

where a_i is the i-th class of atom (*i.e.* C, H, O, etc.), $b_{i\text{-}j}$ is the i-j sort of bond (*i.e.* C-H, C=H, O-H, etc.), and A_i, $B_{i\text{-}j}$, and D are statistical fitting coefficients.

The calculated regression coefficients of linear relationships (1) for the series of molecules are given in Table 1, together with Amat's similar data. The listing of the complete set of coefficients A_i and $B_{i\text{-}j}$ and D for the molecular families are displayed in

Table 2. A direct comparison of the numerical data shows the better quality of the present results with respect to the previous ones.

TABLE 1. Calculated statistical parameters of linear relationships between molecular descriptors and Log P values for the series described in Table I of Ref. 20.

Series	**N**	**r ^{2}**	**r ^{2} /*20*/**
R-H	6	1.000	0.996
R-NH_2	4	0.998	0.996
R-OH	6	0.998	0.996
R_1-CH(OH)-R_2	6	0.998	0.996
R-OH and R_1-CH(OH)-R_2	12	0.996	0.972
R_1COR_2	6	1.000	0.993
CH_3COOR	5	0.999	0.996
RCOOH	5	1.000	0.998
HCONHR	5	0.999	0.999
CH_3COOR, RCOOH, HCONHR and RCONH2	19	0.999	0.996
$RCONH_2$	5	0.991	0.999
R-Cl	4	0.994	0.998
Cl-$(CH_2)_n$-OH	3	0.998	0.981
R-CH(NH_2)COOH	4	1.000	0.986

The experimental[23] and calculated Log P values for the different series of molecules are presented in Table 3, where one can verify the good agreement between both sorts of results. In not any case there is "pathological" behavior and maximum deviations between theoretical and experimental results are around 10%.

TABLE 2. Regression equations for the molecular families.

Molecular set	**Linear regression equation ***

Hydrocarbons	$\text{Log P} = 0.4577\ n(C_{prim}) + 0.6983\ n(C_{sec}) - 0.4494\ n(H) + 0.7214 n(C\text{-}C) + 2.8875$
Amines	$\text{Log P} = 1.4457\ n(C_{sec)}) - 0.4613\ n(H) + 1.7097$
Primary alcohols	$\text{Log P} = 1.3799\ n(Csec) - 0.4008\ n(H) + 0.7643$
Secondary alcohols	$\text{Log P} = 0.8472\ n(C_{sec}) - 0.4748\ n(H) + 0.6553\ n(C\text{-}C) + 2.5524$
Ketones	$\text{Log P} = 0.9904\ n(C_{sec}) - 0.5070\ n(H) + 0.5821\ n(C\text{-}C) + 1.6504$
Esters	$\text{Log P} = 0.2632\ n(C_{sec}) + 0.1780\ n(H) - 0.0882\ n(C\text{-}C) - 0.7938$
Carboxylic acids	$\text{Log P} = 1.3459\ n(C_{sec}) - 0.4044\ n(H) + 1.4453$
Amides (HCONHR)	$\text{Log P} = 1.1982\ n(C_{sec}) - 0.3291\ n(H) + 1.1982\ n(C\text{-}N) - 1.7209$
Amides ($RCONH_2$)	$\text{Log P} = 0.9525\ n(C_{sec}) - 0.5347\ n(H) + 0.6419\ n(C\text{-}C) + 0.7957$
Chlorides	$\text{Log P} = 1.3545\ n(C_{sec}) - 0.3873\ n(H) + 2.0468$
Alcohols, chlorides	$\text{Log P} = 0.4416\ n(C_{sec}) - 0/5360\ n(H) + 1.0853\ n(C\text{-}C) + 1.7716$
Amino acids	$\text{Log P} = -\ 0.5144\ n(H) + 1.4019\ n(C\text{-}C) - 2.0917$
Primary and secondary alcohols	$\text{Log P} = -0.1314\ n(C_{prim}) + 0.7597\ n(C_{sec}) + 1.3608\ n(C_{tert}) - 0.4903\ n(H) + 0.7920\ n(C\text{-}C) + 1.2712$
Esters, acids and amides	$\text{Log P} = 0.0121\ n(C_{prim}) + 0.7653\ n(C_{sec}) - 0.3873\ n(C_{tert}) + 0.1055\ n(C_{quat}) - 0.4742\ n(H) - 1.7819\ n(N_{prim}) + 0.0773\ n(N_{sec}) - 2.9141\ n(\text{-}O\text{-}) + 0.7112\ n(C\text{-}C) - 0.3651\ n(C\text{-}N) + 1.3309\ n(C\text{-}O\text{-}) + 2.4469$

*$n(C_{prim})$ denotes number of primary carbon atoms, n(H) means number of hydrogen atoms, n(C-C) stands for number of single C-C bonds, etc.

TABLE 3. Experimental and calculated Log P values for the different series of molecules.

Molecule	**Formula**	**Log P (exp.)**[16,23]	**Log P (theor.)**

Hydrocarbons(R-H)			
1. Methane	CH_4	1.09	1.09
2. Ethane	CH_3CH_3	1.81	1.83
3. Propane	CH3CH2CH3	2.36	2.35
4. Butane	$CH_3CH_2CH_2CH_3$	2.89	2.87
5. Pentane	$CH_3CH_2CH_2CH_2CH_3$	3.39	3.39
6. Hexane	$CH_3CH_2CH_2CH_2CH_2CH_3$	3.90	3.91
Amines (R-NH2)			
7. Methylamine	CH_3NH_2	-0.57	-0.60
8. Ethylamine	$CH_3CH_2NH_2$	-0.13	-0.07
9. Propylamine	$CH_3CH_2CH_2NH_2$	0.48	0.45
10. Butylamine	$CH_3CH_2CH_2CH_2NH_2$	0.97	0.97
Primary alcohols (R-OH)			
11. Methanol	CH_3OH	-0.77	-0.84
12. Ethanol	CH_3CH_2OH	-0.31	-0.26
13. Propanol	$CH_3CH_2CH_2OH$	0.25	0.31
14. Butanol	$CH_3CH_2CH_2CH_2OH$	0.88	0.89
15. Pentanol	$CH_3CH_2CH_2CH_2CH_2OH$	1.56	1.47
16. Hexanol	$CH_3CH_2CH_2CH_2CH_2CH_2OH$	2.03	2.05
Secondary alcohols (R_1-CH(OH)-R_2)			
17. 2-Propanol	$(CH_3)_2CHOH$	0.06	0.06
18. 2-Butanol	$CH_3CH_2CH(OH)CH_3$	0.61	0.62
19. 2-Pentanol	$CH_3CH_2CH_2CH(OH)CH_3$	1.19	1.17
20. 3-Pentanol	$CH_3CH_2CH(OH)CH_2CH_3$	1.21	1.17
21. 2-Hexanol	$CH_3CH_2CH_2CH_2CH(OH)CH_3$	1.76	1.72
22. 3-Hexanol	$CH_3CH_2CH_2CH(OH)CH_2CH_3$	1.65	1.72
Ketones (R_1-CO-R_2)			
23. Acetone	CH_3COCH_3	-0.24	-0.22
24. 2-Butanone	$CH_3COCH_2CH_3$	0.29	0.33
25. 2-Pentanone	$CH_3COCH_2CH_2CH3$	0.91	0.89
26. 3-Pentanone	$CH_3CH_2COCH_2CH_3$	0.99	0.89
27. 2-Hexanone	$CH_3COCH_2CH_2CH_2CH_3$	1.38	1.45
28. 3-Hexanone	$CH_3CH_2COCH_2CH_2CH_3$	1.45	1.45
Esters (CH_3COOR)			
29. Acetic acid	CH_3COOH	-0.17	-0.17
30. Methylacetate	CH_3COOCH_3	0.18	0.19
31. Ethylacetate	$CH_3COOCH_2CH_3$	0.73	0.72

TABLE 3 Continued. Experimental and calculated Log P values for the different series of molecules.

Molecule	**Formula**	**Log P (exp.) */16,23/***	**Log P (theor.)**

32. Propylacetate	$CH_3COOCH_2CH_2CH_3$	1.24	1.25
33. Butylacetate	$CH_3COOCH_2CH_2CH_2CH_3$	1.78	1.78
Carboxylic acids (RCOOH)			
29. Acetic acid	CH_3COOH	-0.17	-0.17
34. Propionic acid	CH_3CH_2COOH	0.33	0.30
35. Butyric acid	$CH_3CH_2CH_2COOH$	0.79	0.84
36. Valeric acid	$CH_3CH_2CH_2CH_2COOH$	1.39	1.38
37.Hexanoic acid	$CH_3CH_2CH_2CH_2CH_2COOH$	1.92	1.91
Amides (HCONHR)			
38. Formamide	$HCONH_2$	-1.51	-1.51
39. N-methylformamide	$HCONHCH_3$	-0.97	-0.97
40. N-ethylformamide	$HCONHCH_2CH_3$	-0.43	-0.43
41. N-propylformamide	$HCONHCH_2CH_2CH_3$	0.11	0.11
42. N-butylformamide	$HCONHCH_2CH_2CH_2CH_3$	0.65	0.65
Amides ($RCONH_2$)			
43. Acetamide	CH_3CONH_2	-1.26	-1.24
44. Propionamide	$CH_3CH_2CONH_2$	-0.66	-0.71
45. Butyramide	$CH_3CH_2CH_2CONH_2$	-0.21	-0/19
46. Valeramide	$CH_3CH_2CH_2CH_2CONH_2$	0.33	0.34
47. Caproamide	$CH_3CH_2CH_2CH_2CH_2CONH_2$	0.87	0.86
Chlorides (R-Cl)			
48. Methylchloride	CH_3Cl	0.91	0.89
49. Ethylchloride	CH_3CH_2Cl	1.43	1.47
50. 1-Chloropropane	$CH_3CH_2CH_2Cl$	2.04	2.05
51. 1-Chlorobutane	$CH_3CH_2CH_2CH_2Cl$	2.64	2.63
Alcohols, chlorides Cl-($(CH_2)_n$-OH)			
52. 2-Chloroethanol	CH_2OHCH_2Cl	-0.06	-0.03
53. 3-Chloro-1-propanol	$CH_2OHCH_2CH_2Cl$	0.50	0.43
54. 4-Chloro-1-butanol	$CH_2OHCH_2CH_2CH_2Cl$	0.85	0.89
Amino acids (R-CH(NH_2)COOH)			
55. Glycine	CH_3NH_2COOH	-3.21	-3.26
56. Alanine	CH_3CHNH_2COOH	-2.96	-2.89
57. α-Aminobutyric	$CH_3CH_2CHNH_2COOH$	-2.53	-2.52
58. α-Aminovaleric	$CH_3CH_2CH_2CHNH_2COOH$	-2.11	-2.14

In order to perform a somewhat demanding test, we have also calculated equations for two "compound" sets of closely related molecules (*i.e.* primary and secondary alcohols (12 molecules), and carboxylic acids, amides and esters (19 molecules)). The numerical data given in Table 4 show that the resulting predictions are quite satisfactory.

TABLE 4. Comparison between calculated and observed Log P values for two composite sets.

Molecule	**Log P (exp.)**	**Log P (theor.)**	**Deviation** (*)
Methanol	-0.77	-0.82	0.05
Ethanol	-0.31	-0.25	-0.06
Propanol	0.25	0.32	-0.07
Butanol	0.88	0.89	-0.01
Pentanol	1.56	1.46	0.10
Hexanol	2.03	2.03	0.00
2-Propanol	0.05	0.03	0.02
2-Butanol	0.61	0.60	0.01
2-Pentanol	1.19	1.17	0.02
3-Pentanol	1.21	1.17	0.04
2-Hexanol	1.76	1.74	0.02
3-Hexanol	1.65	1.74	-0.09
Average absolute deviation	-	-	0.04
Acetic acid	-0.17	-0.20	0.03
Methylacetate	0.18	0.19	-0.01
Ethylacetate	0.73	0.72	0.01
Propylacetate	1.24	1.25	-0.01
Butylacetate	1.77	1.78	-0.01
Propionic acid	0.33	0.32	0.01
Butyric acid	0.79	0.85	-0.06
Valeric acid	1.39	1.38	0.01
Hexanoic acid	1.92	1.91	0.01
Formamide	-1.51	-1.51	0.00
N-methylformamide	-0.97	-0.95	-0.02
N-ethylformamide	-0.43	-0.42	-0.01
N-propylformamide	0.11	0.10	0.01
N-butylformamide	0.65	0.63	0.02
Acetamide	-1.26	-1.24	-0.02
Propionamide	-0.66	-0.71	0.05
Butyramide	-0.21	-1.19	-0.02
Valeramide	0.33	0.34	-0.01
Caproamide	0.87	0.87	0.00
Average absolute deviation	-	-	0.02

(*) Deviation = Log P (experimental) - Log P (theoretical).

In order to judge the relative merits of this approximation scheme it must be taken into account that independent variables are the simplest kind of molecular descriptor one can imagine: atoms and classical chemical bonds. When comparing with the most current molecular descriptors employed for this sort of calculations[10] we realize the importance of them as suitable quantifiers of molecular topology (*e.g.* topological indices).

The basic concept which determines the topological conditioning of the reactivity is the principle of ***Molecular Structure***, according to which, molecules are considered as isolated objects, possessing a relatively rigid and permanent location of nuclei (atoms), joined each other by electronic forces (chemical bonds) which are highly specific and strongly localized. Hence, molecules are assumed to have a structure which conditions their physical and chemical properties. Therefore, as a consequence of this principle, it is hardly surprising that the sort of "natural" topological descriptors we have employed renders such satisfactory results.

CONCLUSIONS

We have presented several results to predict Log P values in QSAR/QSPR studies on the basis of employing linear fitting relationships where independent variables are atoms and bonds. The quite valuable results for the various sets of different molecules makes it evident the suitability degree of these rather simple topological descriptors. Although current molecular indices can be computed in a nearly simple way, they are arbitrarily chosen and cannot be associated in a so direct manner with chemical structure as atoms and bonds do.

Some previous results have allowed us to derive similar conclusions,[12-15] so that present ones are in line with them. However, we deem that before to state more definitive conclusions, it is necessary to make additional research in order to study other physical chemical properties and biological activities for quite different sets of molecules. Work on this field is presently being made in our laboratory and results will be given elsewhere in the forthcoming future.

References and Notes

1 R. B. King, Ed., Chemical Applications of Topology and Graph Theory; Studies in Physical and Theoretical Chemistry, Vol.28, Elsevier, Amsterdam, 1983.
2 Z. Dadiç, "Rugier Boskovic", Skolske knjiga, Zagreb, 1987.
3 R. J. Bóskovic, "The Theory of Natural Philosophy", MIT, Cambridge, M|A, 1966.
4 H. Davy, "Elements of Chemical Philosophy", London, 1812.
5 B. Testa and L. B. Kier, *Med. Res. Rev.* **1991**, *11*, 35.
6 B. Testa, N. El Tayar, C. Altomare, P. -A. Carrutpt, R. S. Tsai, and A. Carotti, in "*Trends in Chemical Research*", P. Angeli, U. Gulini, and W. Quaglia, Eds., Elsevier, Amsterdam, 1993, p.61.
7 M. Randic, *J. Math. Chem.* **1991**, *7* , 155.
8 D. Bonchev, "*Information Theoretic Indices for Characterization of Chemical Structures*", UMI Books on Demand, Ann Arbor, Michigan, 1998.
9 D. Livingstone, "*Data Analysis for Chemists*", Oxford Science Publications, Oxford, 1995.
10 O. Mekenyan and S. C. Basak, *Topological Indices and Chemical Reactivity*, in "*Graph Theoretical Approaches to Chemical Reactivity*", D. Bonchev and O. Mekenyan, Eds., Kluwer, Netherlands, 1994, pp.221-239.
11 A. T,. Balaban, Ed., "*Chemical Appications of Graph Theory*", Academic Press, London, 1976.
12 P. Duchowicz and E. A. Castro, *J. Kor. Chem. Soc.***1999**, *43*(6), 621.
13 L. Gavernet, M. Firpo and E. A. Castro, *Rev. Roum. Chim.* **1998**, *43*(11), 1079.
14 E. A. Castro, *Comp. & Chem.* **1997**, *21*(5), 305.
15 G. P. Romanelli, L. F. R. Cafferata and E. A. Castro, *J. Mol. Struct. THEOCHEM* **2000**, *504* 261.
16 C. Hansch and A. Leo, "*Exploring QSAR. Fundamentals and Applications in Chemistry and Biology*", ACS Professional Reference Book, American Chemical Society, Washington, DC, 1995, Chapters 4 and 5.
17 A. K. Ghose and G. M. Crippen, *J. Comp. Chem.* **1986**, *7* , 565.
18 Ref. 16, p.113.
19 I. Moriguchi, S. Hirono, Q. Liu, I. Nakagome, and Y. Matsuchita, *Chem. Pharm. Bull.* **1992**, *40* 127.
20 R. F. Rekker, "*The Hydrophobic Fragment Constants. Its Derivation and Applications. A Means of Characterizing Membrane Systems*", Elsevier, New York, 1977.
21 R. F. Rekker and H. M. Kort, *Eur. J. Med. Chem.* **1979**, *14*, 479.
22 L. Amat, R. Carbó-Dorca, and R. Ponec, *J. Comp. Chem.* **1998**, *19*(14), 13.
23 C. Hansch, D. Kim, A. J. Leo, E. Novellino, C. Silipo, and A. Vittoria, *CRC Crit. Rev. Toxicol.* **1989**, *19*, 185.

Povzetek

Predstavljamo enostavno metodo za obravnavo odnosa struktura-lastnosti, ki potrjuje, da lahko dobimo zadovoljive rezultate z uporabo enostavne oblike informacijske teorije. Molekularni deskriptorji so število in vrsta atomov ter kemijske vezi. Predstavljamo metodo za izračun Log P vrednost i in rezultate primerjamo z rezultati, dobljenimi z ostalimi teoretskimi metodami.