



BIOINDICATION THE AIR POLLUTION BY TOTAL HYDROCARBONS BY USING A LICHENIC SPECIE IN THE AREA OF SKIKDA - ALGERIA

D. Fadel, I. Boughambouz*, A. Laïfa, R. Djamaï

Sciences faculty Department of Biology University of Annaba - 23000 - Algeria

* Corresponding author. E-mail: fadeldjamel@yahoo.fr

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Abstract

The detection and the estimate of the air pollution by total hydrocarbons by using a biological sensor was used for the first time in the area of Skikda located at the Algerian North-East. Capital of petrochemistry, the urban zone of Skikda is to confront with a rather strong hydrocarbon air pollution generated by a diffuse source which includes several hearths of emanations: motor vehicle traffic, domestic hearths and the petrochemical complex. The choice of the bio-indication by the use of a lichenous species epiphyte *Physcia biziana* allowed stage the absence of very expensive physical sensors. It enabled us on the one hand to highlight a strong air pollution of the urban zone of Skikda and its periphery and by the hydrocarbon pollutants and on the other hand to appreciate the accumulating capacity of the biological indicator of vegetable nature of the lichenous species *Physcia biziana*.

Keywords: Air Pollution; Hydrocarbon; Lichen; Bioindication; Skikda; Algeria.

Résumé

La détection et l'estimation de la pollution atmosphérique par les hydrocarbures totaux en utilisant un capteur biologique a été utilisé pour la première fois dans la région de Skikda située au Nord-est algérien. Capitale de la pétrochimie, la zone urbaine de Skikda se trouve confronter à une assez forte pollution atmosphérique hydrocarbonée engendrée par une source diffuse qui englobe plusieurs foyers d'émanations: circulation automobile, foyers domestiques et le complexe pétrochimique. Le choix de la bioindication par l'utilisation d'une espèce lichénique épiphyte *Physcia biziana* a permis de palier à l'absence de capteurs physiques très onéreux. Il nous a permis d'une part de mettre en évidence une forte pollution de l'air de la zone urbaine de Skikda et sa périphérie par les polluants hydrocarbonés et d'autre part d'apprécier le pouvoir accumulateur du bioindicateur de nature végétale de l'espèce lichénique *Physcia biziana*.

Mots clés : Pollution atmosphérique ; Hydrocarbure ; Lichen ; Bioindication ; Skikda ; Algérie.

1. Introduction

The town of Skikda, located at the Algerian North-East constitutes one of the examples most famous of the hydrocarbon air pollution. Indeed, the area of Skikda, equipped with a petrochemical pole of more than 1600 hectares [1,2,3] which includes several polluting units such as the complex of liquefaction, the complex plastics, refining, units of transport by pipelines (gas pipeline and pipeline).

In addition to these polluting units a pollution generated by the motor vehicle traffic and the domestic hearths is added. All this constitutes a diffuse source of air pollution by total hydrocarbons. The establishment of a network of detection and monitoring of this air pollution would require average very expensive physiques such as the sensors. One of the means substitute to these physical sensors resides in the use of a biological indicator in fact of a vegetable species lichenous *Physcia biziana*. The analytical approach of the air pollution by the lichens was

the subject already of many works [4,5,6,7]. It was especially used to proportion heavy metals and fluorine. The pollutants were proportioned in the thallus of the lichens according to specific experimental protocols' such as spectrophotometry for the quantification of lead and of the fluorine [8,9,10,11] We thus estimated for the first time

2. Material and method

*Choices of the sites of sampling and material sampled

The sites of sampling must be representative of the entire zone to study. This representativeness can be to ensure only by one good distribution of the sites. We thus considered six (06) sites of sampling according to their accessibility and the presence of the material to sample in fact of the cortical species epiphyte *Physcia biziana*.

These six sites are located near the sources of emissions: motor vehicle traffic, petrochemical pole and domestic hearths of the urban zone of Skikda. The site of the site of sampling remains

difficult to realize. The sites thus selected, are localised with the periphery of the petrochemical complex, the major roads of the trunk road 44 and 44 AB and the zones north-eastern out of town and south-east of the town of Skikda under the privileged direction of the dominant winds of the North-West (Fig.1) sampling proceeded over one 07 months period going of the 25/11/04 to the

22/06/05. The pilot site, represented by a citrus fruits orchard is located at a score of kilometers far from the sources of emission of hydrocarbons by the gravimetric method the hydrocarbon pollutants collected by the thallus of the corticolous species epiphytic *Physcia biziana*.

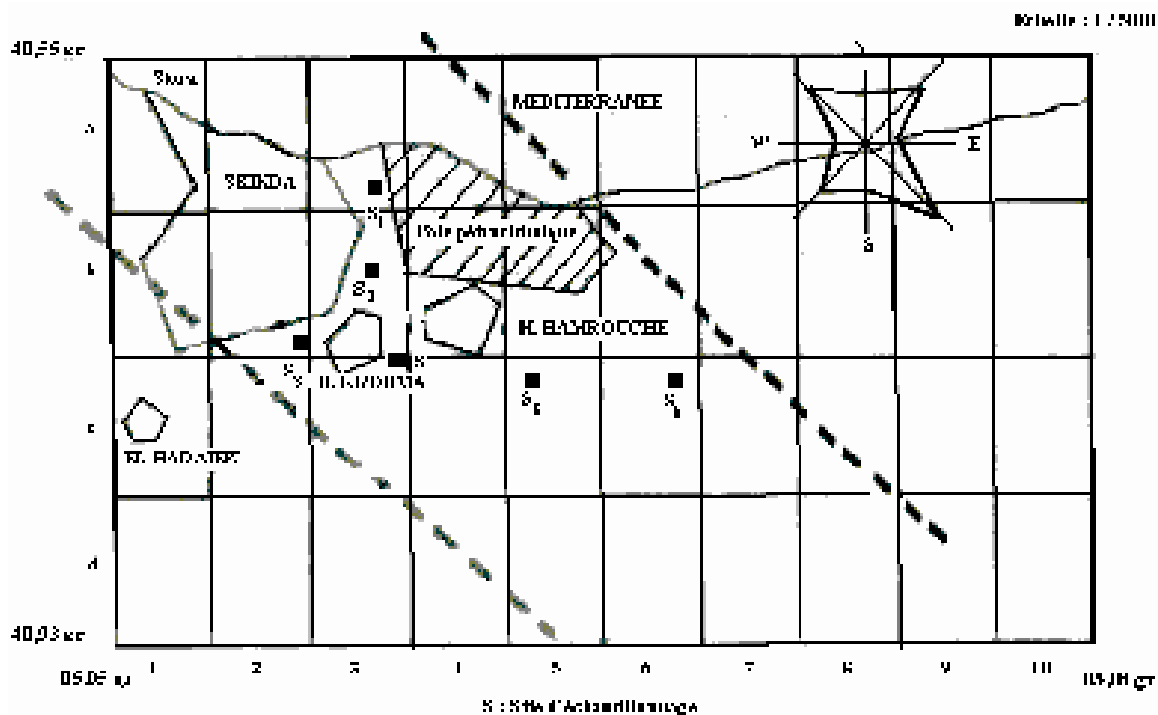


Figure 1: Sites of sampling.

Method of analysis and experimental procedure the analytical approach of total hydrocarbons accumulated by the lichenous species *Physcia biziana* required as a preliminary their extraction thanks to a solvent normal Hexane. After evaporation of solvent, the total hydrocarbons are proportioned by the gravimetric method thanks to an experimental device of extraction "Soxhlet" (Fig.2). The total hydrocarbon concentrations are given thus in an indirect way according to specific calculations'.

The concentration total hydrocarbons expressed in dry matter g/kg of the sample to analyze (lichen) or in p.p.m. is obtained according to the formula :

$$PHCt = \frac{P_{cp} - P_{cv}}{Pe} \cdot 10^6$$

- PHCt: total hydrocarbon weight
- Pcp: weight of the crucible full
- Pcv: weight of the crucible empties
- Pe: weight of the sample with analyser

3. Results and discussions

*Bio-accumulation of total hydrocarbons at *Physcia biziana*.

The results consigned in table 1 represent the space-time accumulation of total hydrocarbons by the lichenous species *Physcia biziana* of all the sites of study.

The given analytical which are reproduced on this table show a variation of the total hydrocarbon concentrations in all the sites at the studied lichenous species. This variation is more significant in the six sites which are localised near the sources of emissions of hydrocarbon pollutants. The variation of the concentrations of total hydrocarbons at *Physcia biziana* of the pilot site is relatively not very significant. It should nevertheless be announced that the total hydrocarbons accumulated by the lichenous species of the pilot site would be of nature biogene.

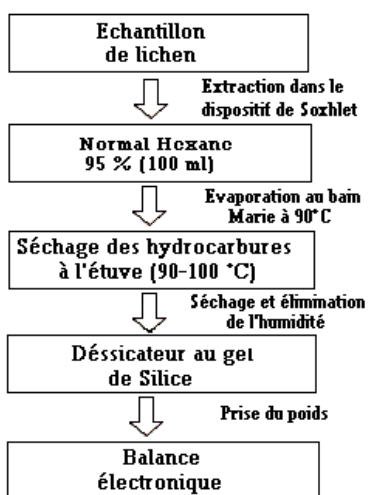


Figure 2: Experimental procedure.

Date of sampling	Spatio-temporal bio-accumulation of total hydrocarbons (p.p.m)						
	Site1	Site 2	Site 3	Site 4	Site 5	Site 6	Pilot
25/12/04	9562,40	10626,30	11445,15	12430,25	10204,10	10128,95	285,30
20/01/05	9481,75	10045,95	10885,70	11180,40	8410,15	8105,80	168,20
14/02/05	8725,55	9740,55	10213,45	10525,35	7277,95	6991,60	142,15
12/03/05	7886,80	8758,70	9045,60	9175,10	5995,60	5780,25	110,85
06/04/05	9490,45	9968,85	11112,25	12123,80	9875,55	8895,20	145,20
02/05/05	11512,60	12795,20	13985,95	14295,05	11812,45	11128,55	160,85
28/05/05	16324,95	18845,35	19455,80	19845,15	16565,40	15956,90	195,55
22/06/05	17990,25	19895,60	21322,10	22402,95	18938,95	17894,15	328,35

Table 1: Spatio-temporal accumulation of the total hydrocarbons at *Physcia biziana*.

They are synthesized by the living organisms at the time of some metabolisms [12]. This variation of the space-time accumulation of total hydrocarbons at this species highlights the concept of bio-accumulation which is defined as the sum of absorptions of a pollutant per direct or food way by the animal and vegetable species watery or terrestrial [13].

The curves of the figure3 representing the space-time accumulation of total hydrocarbons by *Physcia biziana* on all the sites of study have a great similarity. They present a regressive accumulation during three months (25/12/04 to the 12/03/05) then a significant and progressive accumulation for all the remaining length of time of sampling (06/04/05 to the 22/06/05).

The variation of accumulation could be mainly explained by the influence of the factors of a climatic nature (pluviometry, wind) and by certain physiological factors related to the studied species more particularly the exsorption of hydrocarbons by *Physcia biziana*. Indeed, the first three months of sampling coincided with the winter season. This period is characterized by a significant pluviometry and rather strong winds. Pluviometry

would have been on the one hand at the origin of the scrubbing of hydrocarbons of the atmosphere towards the other ecosystems and on the other hand, the exsorption by washing of the thallus of the lichen supported. The winds played the role of diffusion of the hydrocarbon pollutants far from the sources of emission. What would explain the fall of the concentrations of total hydrocarbons accumulated by the lichenous species during sampling in winter period of the 25/12/04 to the 12/03/05. On the other hand the total hydrocarbon concentrations bio-accumulated during the season of spring were significant for various reasons. An intense traffic of the motor vehicle traffic to which is added a strong activity activity of the petrochemical pole. Pluviometry and the winds were relatively weak and not very frequent during the sampling of spring thus supporting the stagnation and consequently a saturation of the air by total hydrocarbons.

*Accumulation of total hydrocarbons according to the distance to the road axes

We have here the results of the average total hydrocarbon concentrations accumulated by

Physcia biziana in the localised sites of study close to the road axes serving the agglomeration of Skikda and its periphery table 2.

On generally notes a regular fall of the accumulation of total hydrocarbons at Physcia biziana in the most distant sites compared to the road axes and this some is the date of taking away

of the lichen. To each time one moves away from the polluting source represented by the road axes, one observes a reduction in the hydrocarbon concentration at the lichen. That suggests a variation according to an equation of the form $y = a + bx$ (Fig.4).

Sites of sampling	Outdistances compared to the road axis (m)	Average concentration of hydrocarbons accumulated (p.p.m)
1	80	11371,84
2	60	12584,56
3	50	13433,25
4	30	13997,26
5	100	11135,02
6	200	10610,17
Witness	500	183,30

Table 2: Accumulation of total hydrocarbons by Physcia biziana compared to the road axes.

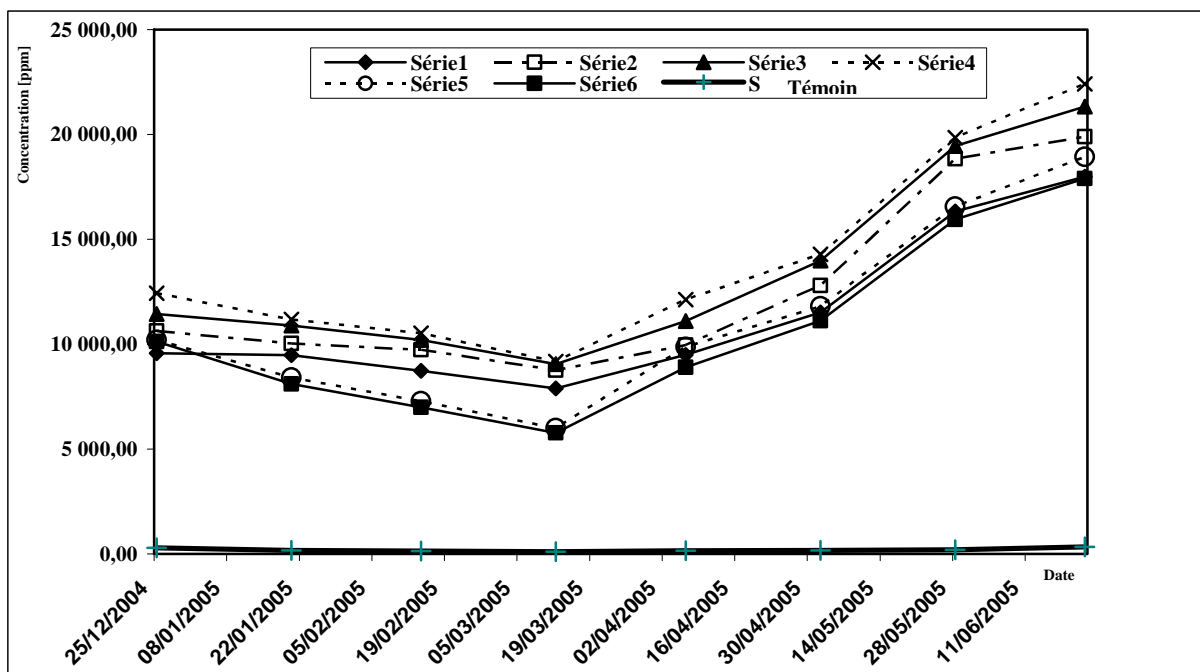


Figure 3: Spatio- temporal accumulation of total hydrocarbons by Physcia biziana.

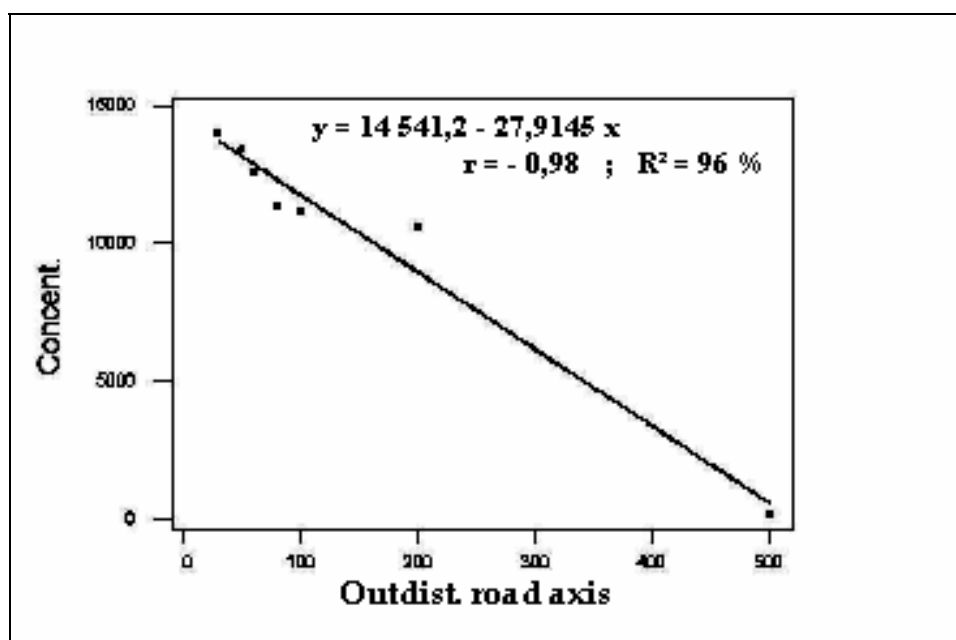


Figure 4: Curve of regression (correlation enters accumulation of hydrocarbons/with the distance from the road axes.

The coefficient of correlation between the hydrocarbon concentrations accumulated and outdistances it road axes has a negative value ($R = -0,98$). There is thus a correlation very highly significant. It is also noticed that the principal source of the air pollution by hydrocarbons of the town of Skikda is dependent a ceaseless motor vehicle traffic as the value of the coefficient of determination ($R^2 = 96\%$) attests it. The other polluting sources in fact the great petrochemical zone and the domestic hearths represent that 4% of the hydrocarbon air pollution of the urban zone of Skikda and its periphery.

4. Conclusion

The analytical data that we recorded on pollution by total hydrocarbons of the town of Skikda and its periphery, enabled us to highlight: - a rather strong air pollution by total hydrocarbons of the town of Skikda due mainly to the motor vehicle traffic, the emissions of the units of the petrochemical complex and the domestic hearths of the town of Skikda; - a space-time bio-accumulation of the hydrocarbon pollutants by *Physcia biziana* in all the sites of study, thus highlighting its role of bio indicator. The results of work which we completed enabled us to emit a methodological remark of order. Indeed, we note that the use of a biological material of vegetable nature, can, in any zone deprived of physical analyzers of the atmosphere: - to measure and chart the area subjected to pollution while emphasizing the zones of iso pollution, to

identify or specify the nature of the pollutant, to chart and classify the road axes compared to the traffic of the circulation and by the nature of the pollution generated like that of hydrocarbon pollution.

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