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Characterization and evaluation of some populations of noble laurel (*Laurus nobilis* L) in northern Algeria

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Abstract

As part of the characterization and evaluation of noble laurel in Algeria, we have undertaken surveys and collections of plant material through the wilayas of Tlemcen, Saida, Algiers, and Chlef. A morphometric characterization was carried out on the main morphological characters on trees and leaves, Analysis of variances, PCA, and Pearson's correlation showed some differences between individuals of the four regions through these quantitative and qualitative characters. Soil analysis has shown a certain resemblance in physical and chemical properties. The extraction of essential oils gave us variable yields and the Physico-chemical analysis of these oils showed almost identical results for all the samples.

Keywords: Noble laurel, *Laurus nobilis L*, Valuation, Morphometric characterization, essential oils, Algeria.

الملخص

في إطار تقييم وتوصيف شجرة الغار في الجزائر، لقد اجرينا دراسات استقصائية وجمع المواد النباتية في ولاية تلمسان، سعيدة، الجزائر وشلف .التوصيف الشكلي تم بواسطة المميزات الشكلية الاساسية لأشجار واوراق ورق الغار، تحليلات التباين، ارتباطات ال أسب وبيرسون اثبتوا بعض الاختلافات بين افراد الاربع مناطق عبر الخصائص الكمية والنوعية أظهر تحليل التربة تشابهًا معينًا في الخصائص الفيزيائية والكيميائية. أعطانا استخلاص الزيوت الأساسية إنتاجية متغيرة وأظهر التحليل الفيزيائي الكيميائي لهذه الزيوت نتائج متطابقة تقريبًا لجميع العينات.

الكلمات المفتاحية: غار، تثمين، توصيف شكلي، زيوت عطرية، الجزائر

Introduction

Among the Mediterranean countries, Algeria has a strategic geographical position; which grant it an important phytogenetic diversity heritage in aromatic and medicinal plants, likely to be used in different fields (Bouderhem, 2015).

Noble laurel (*Laurus nobilis* L) is native to the eastern Mediterranean and Asia Minor, where natural stands still provide a considerable share of bay leaf production(Ivan, 2001).

Laurus nobilis L is a shrub of the Lauraceae family, chosen for the benefit of the therapeutic properties attributed to it in traditional medicine, namely: in the industries of flavoring, perfumery, conservation, cosmetics and pharmacology through its various antimicrobial and antioxidant effects (Bouderhem, 2015).

Our study aims to characterize different populations of *Laurus nobilis* L at four stations: Tlemcen, Saida, Algiers and Chlef, by a morphometric studies, soil analysis, physico-chemical analysis of the essential extracted from the leaves of *Laurus nobilis*

Materials and methods

This study was based on the morphometric characterization of different populations of Laurel encountered in northern Algeria in order to estimate the genetic diversity of this species.

Presentation of the study area

The study stations prospected were mostly individual noble laurel trees planted in the gardens of the houses (wilaya of Tlemcen, Chlef, and Saida, Ain Taya (Algiers)), and trees cultivated in the El-Hamma garden at the wilaya of Algiers (Algiers center). (Table 1)

Table 1. Geographic location and bio climate of the studied laurel tree accessions

Localization		Latitude (N)	Longitude (W)	Bioclimatic stage	Altitude (m)
House gardens					
Tlemcen	Tlemcen center	34.882776	-1.31667	Semi-arid	760
	Hennaya	34.948471	-1.371040	Semi-arid	427
	Beni Mester	34.8704500	-1.4231900	Semi-arid	683
	Chetouane	34.9205560	-1.2913890	Semi-arid	578
	Mansourah	34.8783300	-1.3150000	Semi-arid	657
Saida	Saida	34.8412014	0.1484305	Semi-arid	840
Chlef	Tenes	36.50808	1.30781	Semi-arid	194
Algiers	Ain Taya	36.473599	3.171298	Sub-humid	35
Public Gardens					
Algiers	Algiers center (Trial Garden El-Hamma)	36.4508	3.0231	Sub-humid	186

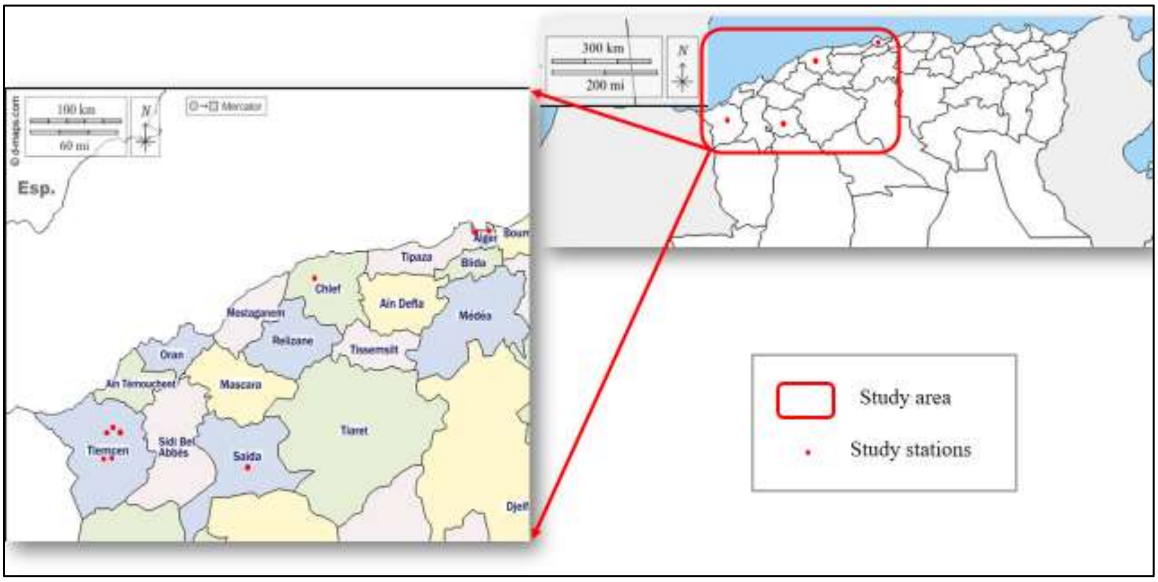

Figure 1. Geographical localization of Laurel study areas

The selection criteria for the experimental stations were based on the importance and availability of the species in the region, the agreement of the owners of the home gardens, and the accessibility of the land and the possibility of assistance from the foresters.

In total, we carried out 14 field trips (prospections): 07 in the wilaya of Tlemcen from February to March 2019 and from October to November 2020, 02 the wilaya of Saida (March 2021), 04 in the wilaya of Algiers (March 2021) and 01 the wilaya of Chlef (March 2021).

Morphometric analysis

We took 82 trees for the population of Tlemcen, 12 for Saida, 8 for Algiers and 4 for Chlef and 30 leaves from each tree / station. A total of one hundred and six trees and one hundred and twenty leaves were used and served for this study.

Laurel populations were assessed using ten traits showing quantitative type variations and two qualitative traits.

Table 2. : Quantitative and qualitative parameters

Quantitative parameters	***Qualitative parameters***
Height of the tree (HT) (m)	
Crown of the tree (CR) (m)	Shape of the leaves
Primary branch length (PBL) (m)	Color of the leaves
Secondary branch length (SBL) (m)	
Trunk circumference (TC) (cm)	
Shank Length (SL) (cm)	
Number of twigs per branch (NTB)	
Number of leaves per branch (NLB)	
Length of leaves (LH). (cm)	
Width leaves (WH). (cm)	

Statistical analysis

The morphometric data were analyzed using SPSS software (Graduate Pack for Windows, version 20). The data collected were subjected to the following statistical analysis: descriptive analysis, ANOVA 1, Pearson correlation, PCA, CAH, chi-square and the Shannon and Weaver index.

Before proceeding to calculate Shannon and Weaver index, the quantitative traits were transformed into classes. This transformation was done using the function (summary) in the R software, which divided these data into the desired number of classes (in our case four). In parallel, we determined the limit of each class. The frequencies of these different phenotypic classes were calculated for each line.

The index of Shannon-Weaver (Shannon and Weaver, 1948) which was described by Jain et al. (1975) was calculated for each line in order to estimate the genetic diversity.

The Shannon-Weaver (H) index formula is:

$$\boxed{\mathbf{H} = -\sum_{i=1}^{n} \mathbf{Pi\ Ln\ Pi}}$$

Pi = Frequency of each phenotypic class i of a given character
n = Number of phenotypic classes of each character.
The index (H) is converted to the relative phenotypic diversity index (H') by dividing it by its maximum value: H max (Ln (n)) to obtain values from 0 to 1.

$$\boxed{\mathbf{H'} = -\sum_{i=1}^{n} \mathbf{Pi\ Ln\ Pi / Ln(n)}}$$

The relative diversity index (H') reaches its minimum value, which is zero for monomorphic characters. In addition, the value of this index increases with the degree of polymorphism and reaches a maximum value (1) when all the phenotypic classes are present at equal frequencies.

Soil analysis
In our work, Physico-chemical analyzes were carried out in order to characterize a sample of soil recovered from the stations.

Table 3. Physic-chemical soil analysis

Physical analysis	Chemical analysis
Texture	Organic matter (OM)
	pH
	Total limestone (TL)
	Electrical conductivity (EC)
	Sulfur (SO4)
	Chlorine (Cl)

*Extraction and physic-chemical analysis of the essential oil (EO***)**

A amount of 11 Kg of leaves of *L. nobilis* was collected from trees The samples were then dried in air at room temperature (25°C) and were protected from the light for ten days.

The extraction of the essential oil from the leaves of the tree was carried out by steaming with a Clevenger type apparatus. The extractions lasted three hours. The essential oil obtained was stored in small opaque bottles and placed in the refrigerator at 4 ° C.
The yield of EO is the weight ratio between the weight of the oil extracted and the weight of the leaves taken for the extraction.

The oil yield is expressed as a percentage and calculated by the following formula:

$$\boxed{R = [PA/ PB] \times 100.}$$

PA = Weight of the oil in g.
PB = Weight of the leafing

All analysis are grouped in the following table 4.

Table 4. Physico-chemical analysis of Laurel EO

Physical analysis	Chemical analysis
Refractive index (RI)	pH
Density (DN)	Acidity index (AI)
	Saponification index (SI)
	Ester index (EI)
	Peroxide index of fatty substances (PI)

Results and discussion

Morphometric Study
a. Trees

After processing the statistical data by ANOVA 1, we concluded that there are not a significant differences between the samples in the four wilayas for all the morphometric (table 6).

Table 5. Descriptive Analysis of Morphometric Measurements of Trees

Trait	Mean (m, cm)	Standard deviation	Variance	Min	Max
HT	6.01	3.70	13.73	1.4	20
CR	3.72	9.12	83.31	0.5	9.5
PBL	1.76	1.37	1.88	0.4	9
SBL	1.92	5.82	33.89	0.2	5.4
TC	35.99	29.96	897.83	1.2	135
SL	61.71	41.79	1746.53	15	220
NTB	17.84	9.03	81.64	4	55
NLB	28.82	13.30	176.98	10	70

Table 6. ANOVA 1 results for quantitative traits

Trait	F value	P value	Decision
HT (m)	2.68	0.051	NS
CR (m)	0.039	0.99	NS
PBL (m)	1.7	0.175	NS
SBL (m)	0.16	0.923	NS
TC (cm)	1.08	0.358	NS
SL (cm)	1.41	0.242	NS
NTB	1.11	0.348	NS
NLB	2.45	0.067	NS

After processing the statistical data with a Pearson correlation test (table 7), we noticed that there are mainly strong links between the parameters, HT, PBL, TC, SL, NTB, and NLB. These results were confirmed by the multivariate analysis in figure 2.

Table 7. PEARSON correlation between Laurie's quantitative traits

	HT	CR	PBL	SBL	TC	SL	NTB
HP	NS						
PBL	**+S*** 0.69**	NS					
SBL	NS	NS	NS				
TC	**+ S*** 0.84**	NS	**+S*** 0.73**	NS			
SL	**+S*** 0.8**	NS	**+S*** 0.81**	NS	**+S*** 0.77**		
NTB	**+ S*** 0.59**	NS	**+ S*** 0.67**	NS	**+S*** 0.60**	**+S*** 0.64**	
NLB	**+S*** 0.68**	NS	**+ S*** 0.59**	NS	**+S*** 0.59**	**+S*** 0.70**	+ S*** 0.73

The results of the principal component analysis (PCA) showed that the studied variables presented 69.27% of the total inertia on the two axes, so the variability explained by this design is significant.

Axis 1 (56.33%) is represented by the following quantitative variables: height, length of the primary branch, trunk circumference, length of the stem, number of twigs per branch and number of leaves per twig and the number of twigs.

Axis 2 (12.93%): is represented by the following variables: crown and length of secondary branch.

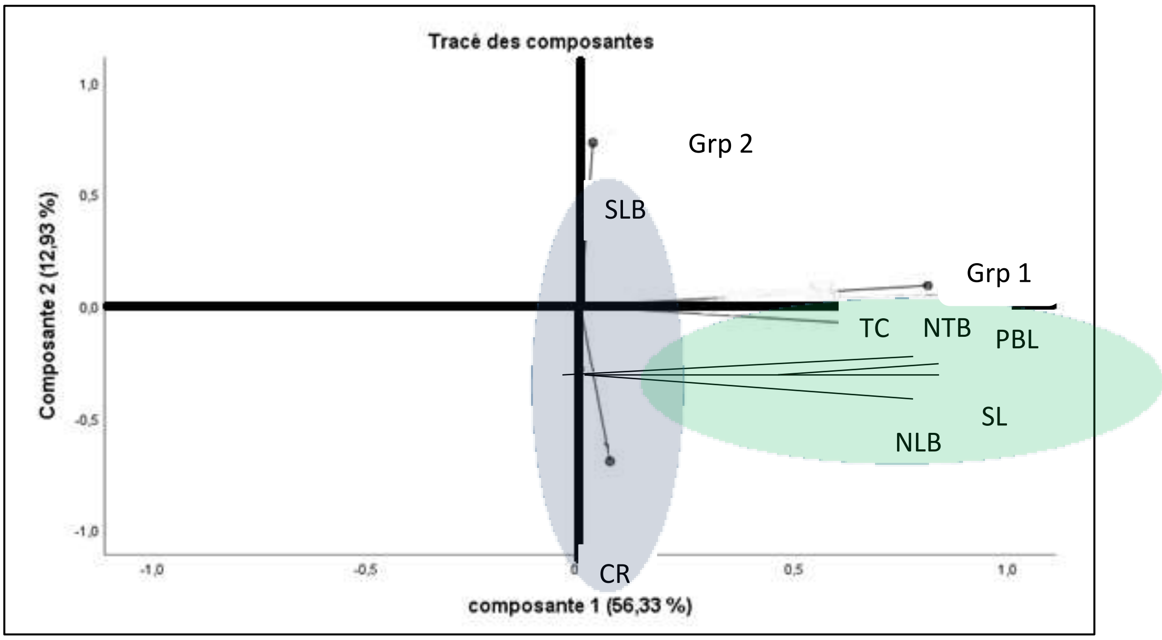

Figure 2. Presentation of dendrometric measurements of laurel trees by the PCA

The component analysis PCA (Figure 2) made it possible to determine two classes

• The first group (Grp1): containing positively correlated variables; these are TC, NTB, PBL, SL, and NLB. Therefore, we can say that the environment influences them in the same way

• A group of two variables (Grp 2) comprising negatively correlated variables; these are the CR and SBL.

Class 1: trees in this class (13 trees) are taller than trees in class 2 such as the height (13.3 ± 3.4 m), have a primary branch length (4.1 ± 1.9 m) , a length of secondary branch (3 ± 1.1m), a large circumference of the trunk (95.4 ± 28.3 cm), long stems (148 ± 47 cm), a large number of branches per branch (32 ± 9), and a number of leaves by twigs (9 ± 32).

Class 2: the 93 trees of this class constitute the majority of the studied population; they have a smaller size than the trees of the first class (Table 8).

Table 8. Classification of laurel trees by PCA

	Class 01	**Class 02**
Effective	13	93
HT (m)	13.3±3.4	5±2.4
CR (m)	4.9±1.9	6.3±9.7
PBL (m)	4.1±1.9	1.4±0.9
SBL (m)	3±1.1	1.8±6.2
TC (cm)	95.4±28.3	27.7±18.8
SL (cm)	148±47	50±23
NTB (cm)	32±9	16±7
NLB (cm)	9±32	7±16

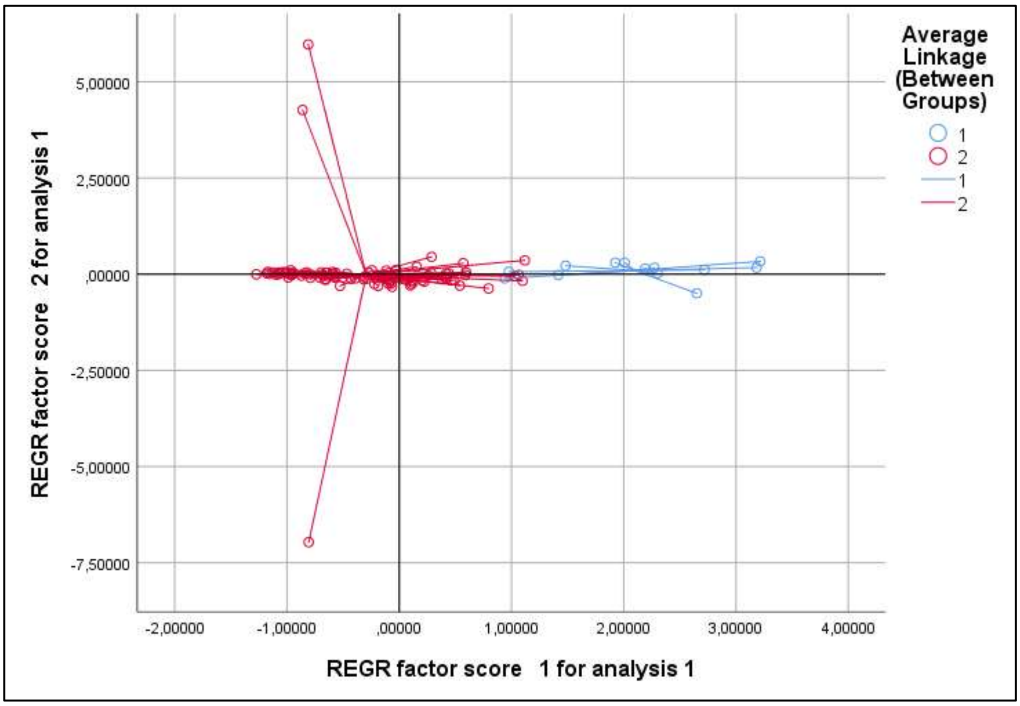

Figure 3. Presentation of the sizes of laurel trees by the ACP

b. Leaves

From the graphic, we noticed that the most dominant leaf shape is the lanceolate with a size of 81 for the four stations (figure 5). Also the simple shape of 28 leaves for the four stations, and the shape having the smallest number is the oval of 11 leaves for the four stations.

Remarkably, the average length of leaves is 8.29 cm, and the average of their widths is 2.92 cm.

Table 9. Descriptive analysis of laurel noble leaves

Trait	Mean (cm)	Standard Deviation	Standard error	Variance	Min	Max
Length (LH)	8.299	2.24	0.2045	5.017	4.3	13.5
Width (WH)	2.929	0.8783	0.8002	0.771	1	5

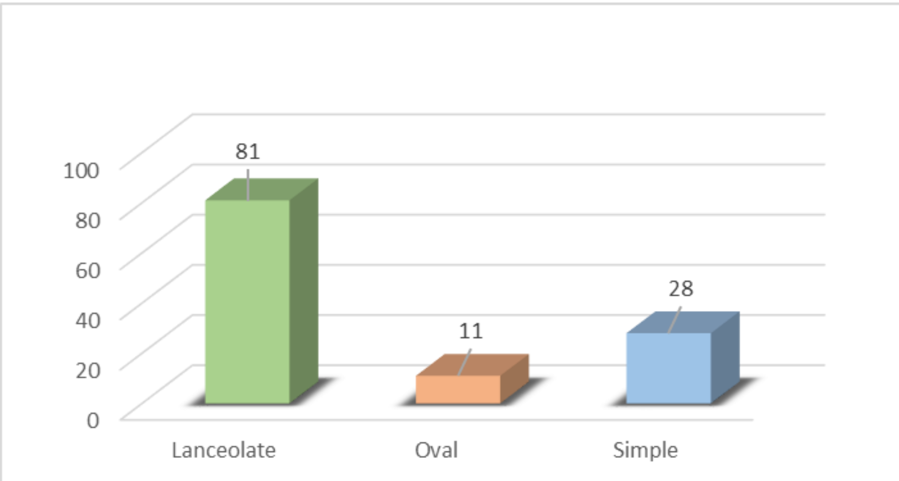

Figure 4. Representation of different type of laurel noble leaves

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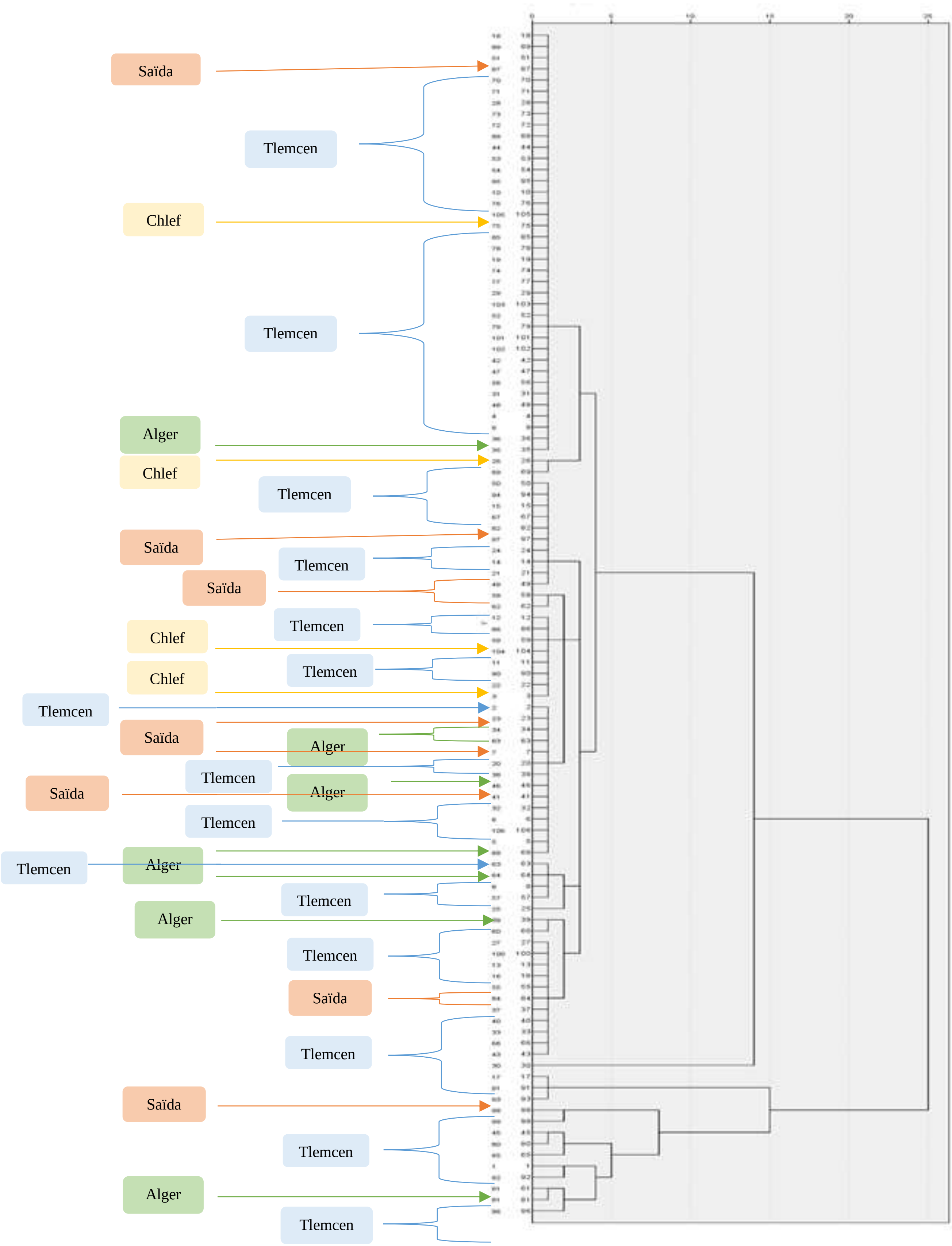

Figure 5. Noble Laurel Dendrometric Tree

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Table 10.ANOVA 1 of quantitative leaves traits

Trait	F value	P value	Decision
Length	5.91	0.04	S*
Width	10.12	0.000	S***

ANOVA 1 investigated quantitative traits relative to region

After processing the data with ANOVA 1 we obtained a very highly significant P value <α (0.000 <0.05), however there is at least one significant difference between the samples.

These quantitative characteristics concerning the shape of the leaves were also treated with ANOVA 1 (Table 11)

Table 11. ANOVA1 of quantitative leaves characteristics / shape

Trait	F value	P Value	Decision
Length (LH)	21.056	0.000	S***
Width (WH)	31.323	0.000	S***

After the analysis by ANOVA 1 of the data we obtained a P value <α, for the length of the sheet it is highly significant and for the width it is very highly significant, so we can say that there is a minus significant difference between samples.

- **Chi-Square**

Leaf shape/ Region

From the results, we notice that the only form of noble laurel leaves in the wilaya of Algiers is the lanceolate form, the same thing for the other wilayas the lanceolate form is the most common compared to other forms.

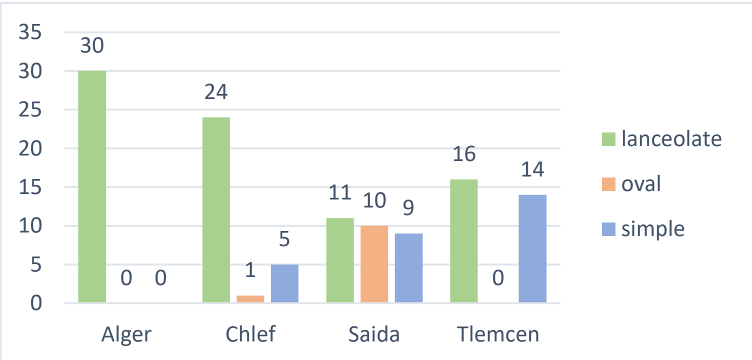

Figure 6. Representation of the different shapes of noble laurel leaves in the four Wilayas

Table 12. Chi-Square Test

	Value	ddl	P value	Decision
Pearson chi-square	51,376[a]	6	0.000	S***
Like lihood ratio	55,137	6	0.000	S***
Linear by linear association	23,638	1	0.000	S***
No. of observations	120			

For this table, the level of significance is less than 0.05 (p = 0.000), therefore these two variables affirm a correlation between them, it is that one exerts an influence on the other (in this case the region with the form leaves)

Table 13. Symmetric measurements by the chi-square test

		Value	P value	Decision
Nominal by nominal	Phi	0.654	0.000	S***
	Cramer's V	0.463	0.000	S***
N Of valid observations		120		

Using Carmer's V coefficient which is 0.463 (46.3%) <70% we can say that the relationship strength between the two parameters (region x shape) is significant.

Table 14. Shannon and Weaver H 'diversity index for each trait studied.

Trait	**H'**
HT	0,91
CR	0,94
PBL	0,95
SBL	0,91
TC	0,96
SL	0,95
NTB	0.9
NLB	0.9
Mean	0.93

Following the calculation of the Shannon and Weaver H 'diversity index, we obtained a rate equal to 0.93 for the population studied (Table 15). This index is relatively high which a reflection of significant genetic diversity is probably.

Soil analysis

Granulometry

Knowledge of the texture allows the deduction of the properties of the concerning plants, from its water content to its biological activity, including its ability to root, etc.

The results obtained were characterized using the texture triangle to define the texture of each sample.

Table 15. Textures analysis soils

	Tlemcen	**Saida**	**Chlef**	**Alger**
Granulometric composition	Sandy Loam	Silty sand	Silty sand	Silty sand
Texture	*Balanced texture*	*silty texture*	*Silty texture*	*Silty texture*

The granulometric composition analysis performed showed that the samples have different textures;

The soil sample from the wilaya of Tlemcen has a balanced texture (sandy loam); while the other samples have a silky texture.

Biological analysis

Organic matter (OM): According to the results obtained, our soils have an organic matter rate varying between high and very high, a very important parameter that accurately conditions the state of the plant in its environment which is remarkably adequate for soil fertility for the tree and which will result in fairly high productivity.
In conclusion, we can say that organic matter is the basis of fertility, soil conservation and the quality of crop production.

Table 16. % OM in the soils of the four samples

Sample	OM (٪)
Tlemcen	6.248
Saida	14.134
Alger	17.33
Chlef	2.652

Chemical characteristics

pH: our samples have a basic soil pH ranging from 7.6 up to 8.4. According to (*Teuscher et al; 2005)*, the laurel tree can adapt to any type of soil. The typical soil should be rich in nutrients, humus and with a pH close to neutrality, but cannot tolerate too acidic soils.

Total Limestone (CaCo3): We notice that there is a disturbance in the percentages of limestone for the four samples because the soil of Tlemcen is strongly calcareous, and that of Saida is weakly calcareous, Algiers has a non-calcareous soil, and Chlef a moderately calcareous soil.

Table 17. pH of soils samples

Sample	**pH**	**Decision**
Tlemcen	7.8	Basic Soil
Saida	7.7	Basic Soil
Alger	7.6	Basic Soil
Chlef	8.4	Basic Soil

Table 18. % CaCo3 of the four samples

Sample	Ca Co3 (٪)	Decision
Tlemcen	43.2	Heavily calcareous soil
Saida	10.4	Weakly calcareous soil
Alger	4.4	Non-calcareous soil
Chlef	13	Moderately calcareous soil

Electrical conductivity (salinity)**:** From the results; we can distinguish that the soil of the wilaya of Tlemcen is moderately salty, the soil of Saida is highly salty, that of Algiers is moderately salty, and that of Chlef is unsalted, we notice that there is a differentiation of the salinity between the four soil samples but in the field we observe that the development and the growth of the trees are normal which means that the noble laurel has a certain resistance to salinity.

According to the obtained values of conductivity, we cannot make such a decision because it is a small amount of salt that all species can withstand, water that contains such quantity is considered potable

Table 19. The conductivity rate for each sample

Sample	Conductivity (μs/cm)	Decision
Tlemcen	395	Medium salty
Saida	757	Very salty
Alger	435	Medium salty
Chlef	240	Unsalted soil

Sulfur (SO4): According to our result, we can deduce that our soil samples do not contain sulfur so treess will not suffer from a limitation of nitrogen absorption.

Table 20. % SO4 of the four samples

Sample	So4 (%)
Tlemcen	Null
Saida	Null
Alger	Null
Chlef	Null

Chlorine (Cl): It can be noted that the percentage of chlorine for the four samples is low which means that there is no impediment to the absorption of nutrients for the growth of the tree, and by inference no change in the pH of the soil.

Table 21. Cl levels in the soils of the samples

Sample	Cl	Decision
Tlemcen	0.213	Low
Saida	0.231	Low
Alger	0.195	Low
Chlef	0.213	Low

Physic-chemical analysis of the essential oil

Oil yield

The oil yield in our was 25ml of essential oil for 11Kg of Tlemcen Laurel dry matter, 9.2ml for 11Kg of Saida, 17ml for 11Kg of Algiers, and 25ml for 11Kg of Chlef olant material (figure 8).

We noticed that the yield on EO of the wilaya of Tlemcen and Chlef is 0.2 % it is an interesting rate compared to the wilaya of Algiers with a rate of 0.15% , and the wilaya of Saida of 0.092% ,

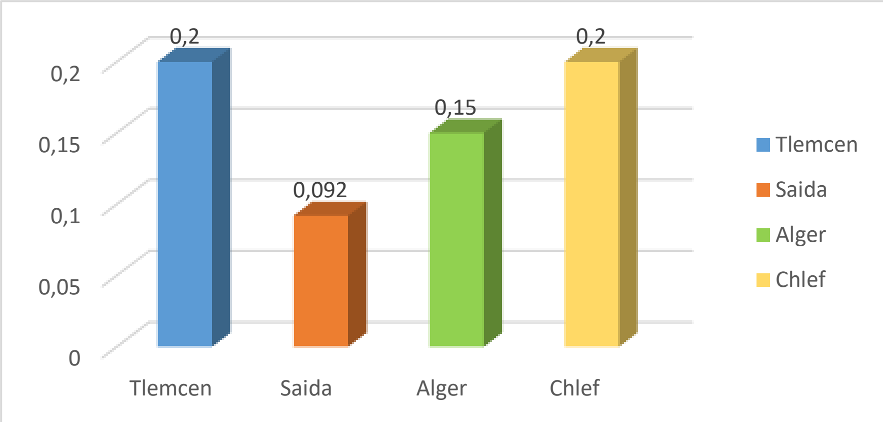

Figure 7. Algerian Noble Laurel Essential Oil yield

Physico-chemical analysis of the EO

Physical analysis

Refractive index (RI): The HE with a high refractive index must be between 1.447 to 1.469 for the noble laurel (Jollois et *al*, 2001; Faucon, 2015), our results with an index between 1.466 and 1.4671 are in the standards; therefore of good quality.

The density (DN): According to the results, we noticed that the density of the EO of the wilaya of Chlef is the highest compared to the other stations (0.914).

EO of Chlef is the least dense and harmful according to the work of (*Faucon, 2015*), the same case is for the other samples.

Table 22. physical analysis the EO

Sample	**RI**	**DN**
Tlemcen	1.467	0.7367
Saida	1.466	0.7026
Alger	1.466	0.8855
Chlef	1.467	0.914

Chemical analyzes

Hydrogen potential (pH): The pH of our samples varies from 4.3 to 5.9 which means that our EOs are all acidic.
*Acidity index***:** According to (1) the index of acidity of noble laurel oil is 2.5 mg KOH / gr.
The acidity index for the two samples EO of Tlemcen and Saida is 2.244 mg KOH / gr, which is almost perfect signifying (our oil is fresh and good quality), while AI for EO from the wilaya of Algiers and Chelef are of 1.683 mg KOH / gr.

Saponification index: The SI simply indicates how many milligrams of the base are required to completely saponify 1 gram of an acid (oil or fat). This number usually indicates how much potassium hydroxide (potash) is needed rather than how much sodium hydroxide (NaOH) is needed. (2)

So we can say that it takes 35.0625g of soda to saponify 1g of noble laurel oil from the wilaya of Tlemcen (because IS = 35.0625), 23 g of soda to saponify 1g of Saida oil (IS = 23), 19.8175g of soda to saponify 1g of Algiers oil (SI = 19.8175), and 19.635g of soda to saponify 1g of Chlef oil (SI = 19.635).

Ester index: Esters are molecules almost devoid of toxicity at normal physiological doses. According to (3) the essential oil of noble laurel contains 17 % of ester, the ester number of the noble laurel EO is 44 (1). In our results, we obtained an ester index rate lower than the standards, 32.8185 of EO from the wilaya of Tlemcen, 20.756 from Saida, 18.1345 from Algiers and 17.952 from Chlef, which means that our EO has a low power of toxicity.

Peroxide index of fatty substances: We obtained a peroxide index of fatty substances of 0.5meg / g in the four EO of the four wilayas it is a very low rate compared to the standard which means that our EO has very low oxidation; so it can be stored for long periods.

Table 23.parameters of chemical analyses

Sample	pH	AI	SI	EI	PI
Tlemcen	5.9	2.244	35.06	32.81	0.5
Saida	5.1	2.244	23	20.75	0.5
Alger	5.3	1.683	19.81	18.13	0.5
Chlef	4.3	1.683	16.63	17.95	0.5

Compiled Character Analyzes

This analysis grouped morphometric parameters related to trees and leaves, and chemical characteristics of Laurel essential oil.

Principal Component Analyses (PCA)

The analysis of the studied parameters shows that the two axes present respectively 38.67% for PC1 and 12.106% for PC2 whose total inertia is 64.77% of the total variance related to the studied parameters (figure 8).

- A group (Grp1): containing positively correlated variables; which are: AI, pH oil, EI, SI, RI, CaCo3 and Y, We can then say that the essential characteristics of the oil are in positive correlation with the CaCo3 of the soil.

According to (J.H Durand, 1955) the soils of Algeria in the semi-arid and steppe zone are differentiated by their nature: soils containing limestone (calcic soils) and soils that do not contain limestone, which are rare, these soils of these areas are typical calcic soils that are favorable to agriculture. (Maurice, 1956).

- A group (Grp 2): containing positively correlated variables; are the CR, SL, TC, SBL, PBL, NLB, NTB, which are the morphometric characters of the tree.
- A group (Grp3): containing positively correlated variables; are OM, DN, and EC; the most parameter of analyses quality of the oil is negatively correlated with OM of the soil,. This astonishing and illogical result must be verified with other tests in future

The Cl cannot be interpreted according to the two components because it is very close to the center.

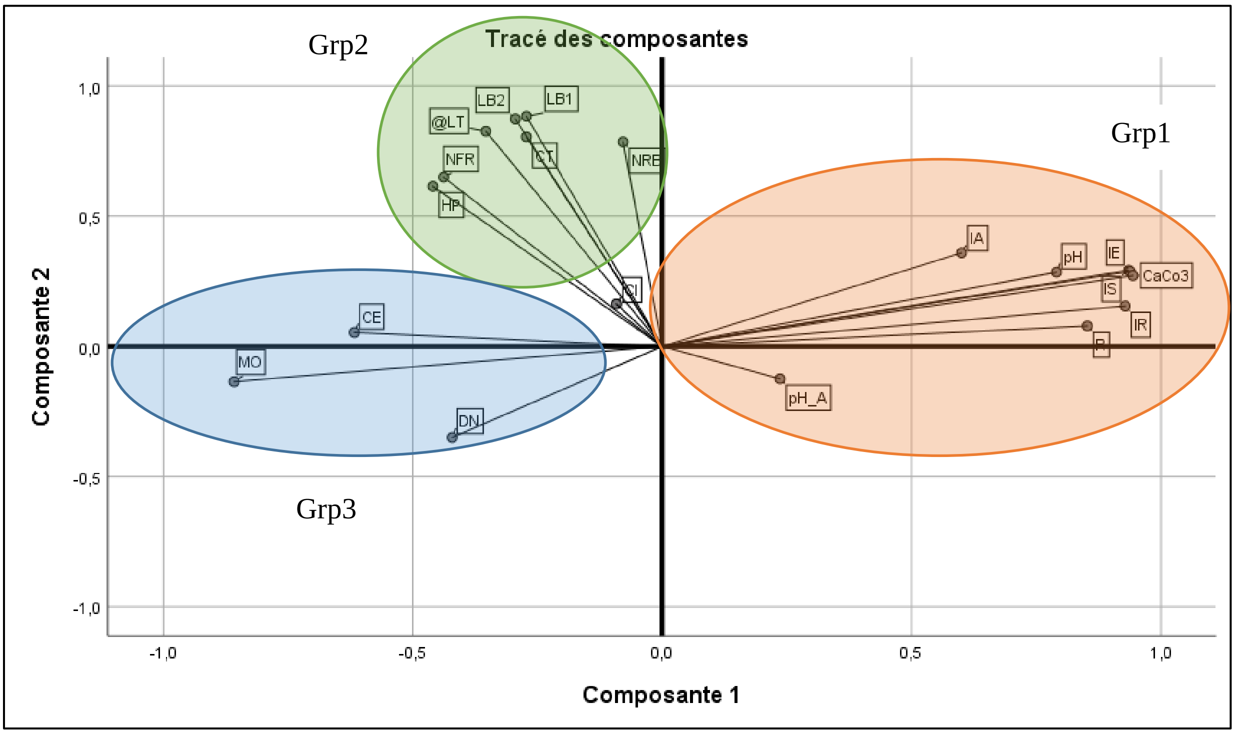

Figure 8. PCA of noble laurel characters

(CR) Crown, (PBL)Primary branch length, (SBL) Secondary branch length, (TC) Trunk circumference, (SL) Shank Length, (NTB) Number of twigs per branch, (NLB) Number of leaves per branch, (Y) Yield, (RI) Refractive index, (DN) Density, (pH) potential hydrogen, (AI) Acidity index, (SI) Saponification index, (EI) Ester index, (PI) Peroxide index of fatty substances, (OM) Organic matter, (CaCo3) Total limestone, (EC) Electrical conductivity, (Cl) Chlorine

Conclusion

To deepen the knowledge and the valorization of the noble laurel in Algeria, our present work made it possible to carry out prospecting and a study of the morphological characteristics, the analyses of the grounds, the extraction of essential oils and their physicochemical analysis of state your species in four wilayas: Tlemcen, Saïda, Alger and Chlef.

The prospection at the level of the four regions indicates the existence of noble laurel in Algeria, which is not identified in the Algerian catalog of plants. The survey carried out with the people of these regions confirms that this shrub is known for a long time; a thing which we noted by the presence of centenarians trees.

Descriptive analysis showed that there was not significant differences between the phenotypic profiles of the trees but the leaves are different depending to the region.

The results of the soil analyses showed that the types of soils of the four stations were different from each other, so we can say that *laurus nobilis* has a wide range of adaptation.

The Physico-chemical analysis of the laurel essential oils gave us reliable and interesting results. We concluded that the different oils had a very high quality allowing it to be stored for a long period.

The nature of soil in the study areas is a typical calcareous soil, hence, the noble laurel adapts to it. However, even though the quality of laurel essential oil was not influenced by the tree morphology, it was influenced by the rate of OM of the soil, which decreases their quality.

From the results obtained, we can conclude that the noble laurel (*Laurus nobilis*) is a robust species, resistant and can adapt to extreme conditions.

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Author contributions

M.I designed the study, carried out the field and laboratory work and wrote the manuscript; B.A contributed to the writing of the manuscript, interpreted the results, revised, edited and supervised the work; M.L participated in the statistical analysis; L.B. carried out the field, laboratory work and contributed to the interpretation of results.

Disclosure statement

No potential conflict of interest was reported by the authors.

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