ANN in pharmacognosy identification in the Setif region - Algeria

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Abstract: *As ethno-pharmacognosy databases grow rapidly, the automated identification of medicinal plants based on digital data becomes of great interest to accelerate the evaluation, research and monitoring of their biodiversity. The vegetal biogeography of the Setif region in Algeria offers a great ecological and floristic diversity; seen its geography and its remarkable climate of high plains. In this study, we established a census of the main species of medicinal plants in region according to a pre-established protocol. Species are classified according to several factors (their taxonomy, their geographical locations and their uses in traditional medication). In order to identify them, a database is established from the morphological characters (leaf shape, stem, flower, and root) and their natural environments. It is very difficult to analyze all these factors using conventional mathematical tools. An artificial neural network system is proposed in the analysis of these data. As this tool is distinguished by its ability to deal with such complexities of data, its application in this case is adequate. Once the system is established, it will allow the identification of the plant species and thus its administration in the treatment of diseases already used by the indigenous population with the least risk.*

Key Words: *Pharmacognosy, ethnobotany, medicinal plant, artificial neural networks.*

1. INTRODUCTION:

The plant biogeographically situation of the Setif region offers a great ecological and floristic diversity. This comes down to its remarkable geographical and climatic position (1). It is necessary to understand the effect of the factors that influence the spatial distribution of medicinal flora in the region. This is an essential step in developing a pharmacopoeia specific to the medicinal plants that populate the region. The purpose of this study comes in this context. An identification of the spatial distribution of this flora in the region is established according to the geomorphological forms encountered. In the identification of plants and their differentiation of medicinal plants which often have similar characteristics, it is necessary to begin by classifying them by their distinctive characteristics. The first criterion of identification is based on what is visible, namely the physical or morphological characters. Regarding identification, often the most common element used is flora. That's because it's the most visible part and also because it's where we have the most data available in the collections. Despite this, much remains to be done in this area.

We are witnessing lately the creation of database of images. The automated identification of species is nowadays based on digital data. This is needed to accelerate biodiversity research, monitoring and evaluation (2). Our work is part of this idea. A collection of local medicinal plants is gathered. Geo morphological characters are established. For the purpose of their identification, and with reference to already existing databases, we have proposed an identification system with artificial neural networks. Artificial neural networks are highly interconnected networks that make it possible to match two inputs and outputs spaces. By his learning skills, its application in the analysis of complex data is adequate in this area (3).

The established system allows the identification of the medicinal plants of the region from the shape of the leaves, the flowers, the stems as well as the geographical area which is characterized by the conditions of the soil and the climate. These factors are the input variables to the system. The identification of the plant expresses the output variable and therefore its use in traditional medicine with the least risk.

2. LITERATURE REVIEW:

Everywhere, they are the medicinal plants. Their lives are related to human societies. But many of these plants are threatened with extinction, hence the need to establish a database for the purpose of their protection (4-7). For this, it is important to take steps to preserve the knowledge of our ancestors in the use of medicinal plants (8). The United Nations Environment Program is part of this vision. This program aims to promote this potential in medicine (9). Traditional plant medicine dates back to ancient Egypt, Mesopotamia and the industrial valley (10-12). Nowadays, this medication comes back in strength. This is due to studies based on analytical and experimental techniques (13).
The medical world relies on it in its prescriptions. From there appears the interest of traditional phyto therapy and ethno botany (14). Currently, the identification of medicinal plants uses different techniques because of its importance. Plant identification is an interesting and challenging topic research because of the variety of plant species. Among the different parts of the plant, the leaf is widely used for plant identification because it is usually the most abundant type of data available in botanical reference collections and the easiest to obtain in studies of age. A number of works have

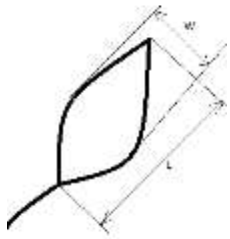
been done for the identification of plant leaves. Identification uses several techniques. Often, it is a question of comparing certain characteristics by using taxonomic keys. In this context, several studies are done to identify the plants (15-21). However, this topic is still an open research topic. So, in front of the situation where the urgency is that many the plants are threatened with extinction. It is therefore very necessary to set up a database for the protection of plants. Several bioinformatics studies are used in research on medicinal plants (22).
Among the used techniques, we can quote:

- A technique based on the identification from the geometric characteristics of the leaves. Algorithms have been incorporated into the implementation, segmentation and classification of sheets. Recovery algorithms are demonstrated using geometric characteristics of the leaves (23).
- Other plant identification studies are based on the combination of characters received from the user (24).
- Tools based on the principle of fuzzy inference are also used. This is to compare the circular sampling with the center of the image (25).
- Artificial probabilistic neural network systems are also proposed (PNN). This is to do the recognition of images of leaves for the classification of plants (26).
- Classification algorithms based on generalized Gaussian density model. There, the color angle is used in different spaces. This is combined with probabilistic neural networks with machine-vector support (SVM). (27).

In our case, we propose an artificial neural network system where the shape of the leaves, the flowers, the stems as well as the geographical area which is characterized by the conditions of the soil and the climate are system inputs. The species of the plant represents the output of the system.

3. MATERIALS AND METHOD:

In the collection, we made ethnobotanical surveys on the basis of questionnaire cards. This makes it possible to list the species used in traditional local medicine and to identify the part of the plant used as well as its mode of use. In species determination, we used the New Flora of Algeria and Southern Desert Regions and the Flora of North Africa (28-29). Different species are determined where we can cite as an example: (*Peganum harmala, Ormenis africana, Globularia alypum, Artemisia herba-alba, Argyrolobium saharae, Tapsia garganica, Pallenis spinosa,…*).
The next step is to take the size and shape of the sheets as an identification parameter (Figure 1). In this we are inspired by the work of (Stephen Gang Wu et al., 2007) (30).



W: Physiological width
L: Physiological length

Figure 1. Physiological Length and Physiological Width

It is then necessary to determine the leaf perimeter. Subsequently we have determined the nature of the flower, the characters of the stem. A second step consists in linking these plants to the places of recollection (geographical data such as the nature of the soil, the altitude and the exposure to the wind and the sunshine) as well as to the climatic data (rainfall, temperature, winds).

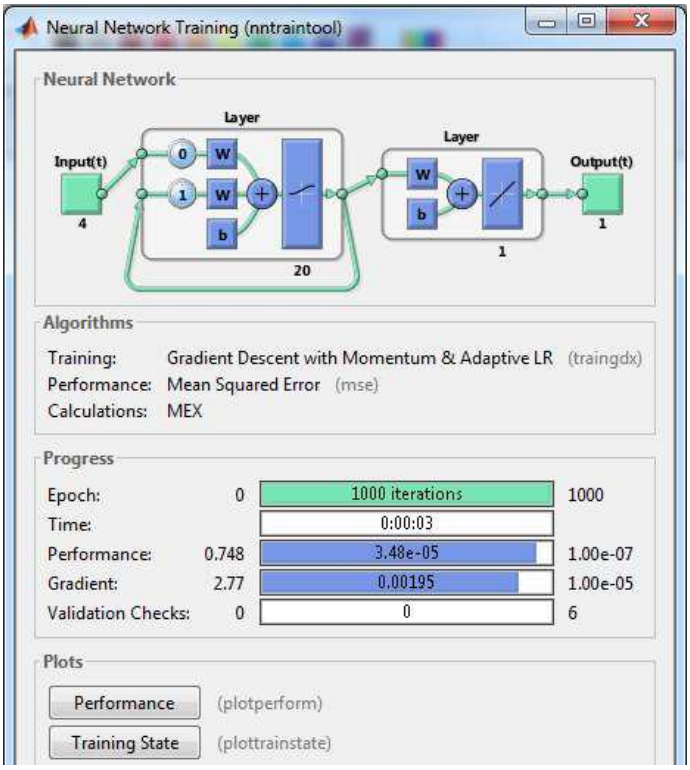
3.1. Artificial neural networks.

Artificial neural networks are an imitation of the natural neural network. Mathematicians have reproduced the functioning of the mathematical network by taking inspiration from the natural network. By building a computer model with these functions, it will be possible to infer the learning function. Neural networks are currently finding applications in different areas of science and technology (31). These networks have the ability to read experimental data and solve complex systems of natural processes. These networks make it possible to match the two inputs and output spaces. During the learning phase of the network, a transfer function is established. When changing reading parameters, the network operates by variations of the mathematical coefficients in order to adjust the function. In other words, it is not necessary to change the network itself, but just to act on mathematical coefficients. When the final function is adjusted from the real data, it will be possible to enter the data at the input to automatically read the result at the output. In our case, it will be enough to introduce the parameters related to the leaf, the stem, the geography and the climate to instantly read the species of the corresponding plant and therefore its use by the local traditional medicine.

3.2 Learning the neural network

By setting the values to the input corresponding to the species identified as the output value of the system, the network establishes a mapping function between the inputs and the output. After introducing all the variables at our disposal and each time we connect the inputs to the output, the network readjusts the matching function by changing the weights. These weights are in the form of mathematical coefficients that vary. The created function must respond to all possible combinations.

The proposed system includes an input layer, an output layer and a hidden layer (Figure 2).



4. RESULT AND DISCUSSION:

Depending on the function created, we affect all the data in Excel spreadsheet format including all the registered cases. During the learning phase of the network, it is assigned line by line for reading. The intermediate lines are left to the test. We fixed 1000 loop iterations for him to adjust the function to its optimum.

The following results are shown (Figure 3):

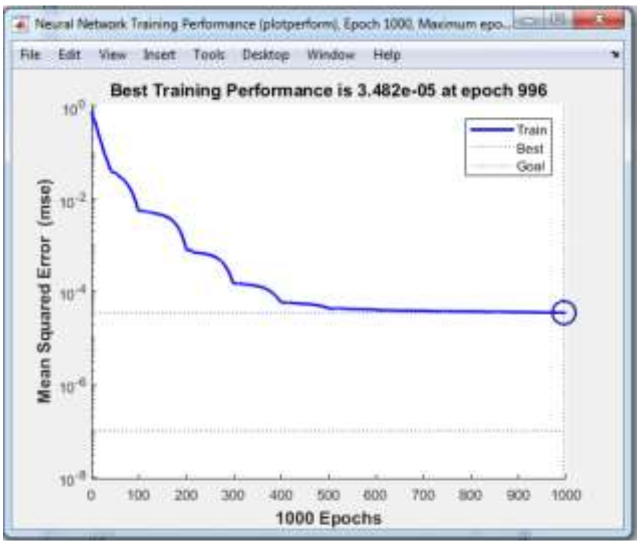


Figure 3. Optimum at 996 epocs

The optimum is practically reached at 500 pieces, but to go up to 996 pieces, the error is 3.482.10-5. By injecting the data that relate the inputs (plant-specific variables and their geographical and climatic conditions and that are not taken into consideration for learning as a test, we find that the two curves coincide perfectly.) This proves the validity of the learning function (Figure 4).

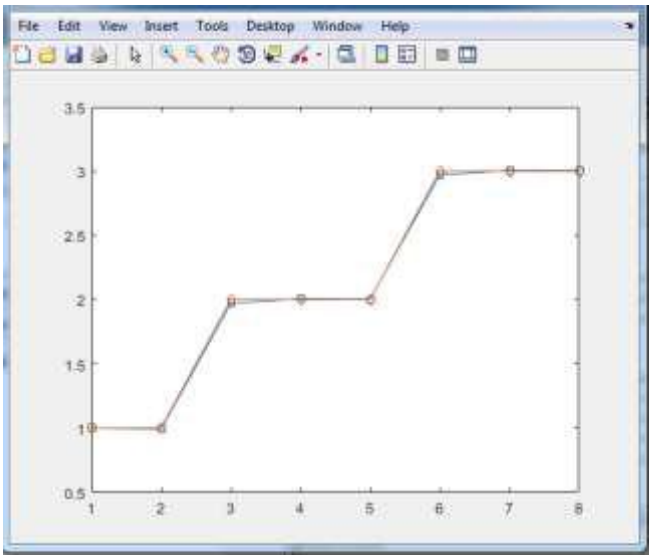


Figure 4. Training results

5. CONCLUSION:

The identification of medicinal plants is more than a necessity these days. These plants are widely used in our region of study. These plants have varied and complex characteristics. The proliferation of these plants is a function of several factors including geomorphological and climatic factors. Also, the ethnobotany of the region is very rich and varied. Attempting to establish a database gathering them by identifying them with their species and their use in traditional medicine is no small thing. By developing an artificial neural network in the identification of these species, we put an effective and precise tool. In this study, after collecting the majority of medicinal plants in the region, we identified those using conventional methods. We obtained a rich and varied database. Each plant is classified with its morphological characters (leaf, flower, and stem) and also its geographical environment (nature of the soil, altitude) as well as the climatic conditions in which it has proliferated. Our proposed system allows introducing these data to mathematically connect the inputs to the output that expresses the species. The proposed artificial neural network has made it possible to establish a correspondence function between the inputs and the output during its learning phase with a minimum error. The test values prove it. By this, we have at our disposal a reliable identification tool that remains extensible to species not considered in this study. We then have the possibility to introduce the characters of a collected plant to instantly read its species and its use in local traditional medicine.

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