Context & Objective

Cognac matures solely many years in an oak wood barrel. Cognac has an alcohol content of about 70% volume when it comes directly out of the pot still. As it ages, the aromas concentrate and the color darkens to a warm shade of amber.

During the first few years (0 to 5 years), the bouquet mellows and becomes less aggressive. The spirits turn into a shade of yellow that darkens even more. The aroma of the oak wood develops new aromas in the product as the Cognac continues to age. The alcoholic strength decreases slowly. For sale, the alcoholic strength is set to 40% volume.

All these steps are necessary to produce the unique characteristics of Cognac. In parallel, some products are available on the market that mimics Cognac.
The need to verify the adulteration of the Cognac, to maintain the quality control and protect the consumer is a high priority.

In this application note, the objective was to detect adulterated Cognac on the market place using an electronic tongue.

ASTREE electronic tongue

The ASTREE Electronic Tongue (fig. 1) is based on liquid sensor array allowing a measurement of potential difference between each sensor and a reference electrode. Each sensor has a specific organic membrane, which interacts with chemicals present in the liquid sample in a specific manner. Recorded data are processed by the software as a global taste fingerprint.

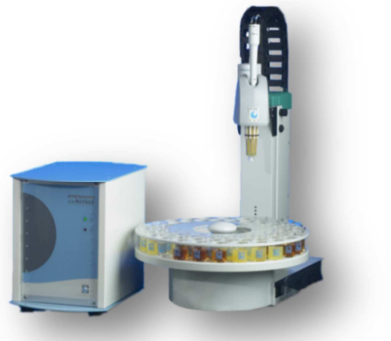

Fig.1: ASTREE Electronic Tongue (Alpha MOS, France)

Analytical Method

Samples

15 cognacs were collected. The reference name and quality of each of them are listed in the following table. All the cognacs are from different producers.

Reference	Sample	Quality
C1	Cognac	VSOP*
C2	Cognac	VSOP
C3	Cognac	VSOP
C4	Cognac	VSOP
C5	Cognac	XO**
C6	Cognac	VSOP
C7	Cognac	VSOP
C8	Cognac	VSOP
C9	Cognac	XO**
C10	Cognac	VSOP
F1	Artificial sample 1	F1
F2	Artificial sample 2	F2
F3	Artificial sample 3	F3
F4	Artificial sample 4	F4
F5	Artificial sample 5	F5

* V.S.O.P Very Superior Old Pales

** XO X Old

Analytical conditions

Sample volume used	100 mL
Temperature	ambient
Time between analyses	180 sec
Acquisition time	120 sec

Off specification detection

Following the sample analysis, several data treatments are available to detect the differences in product quality. To compare the samples a PCA Calculation is performed:

- ✓ An easy to see discrimination is obtained with the Astree system. (Figure 2).
- ✓ All of the “Good” Cognac samples are grouped on the left part of the graph (red plots). All off specification samples are grouped on the right part of the graph (blue plots).

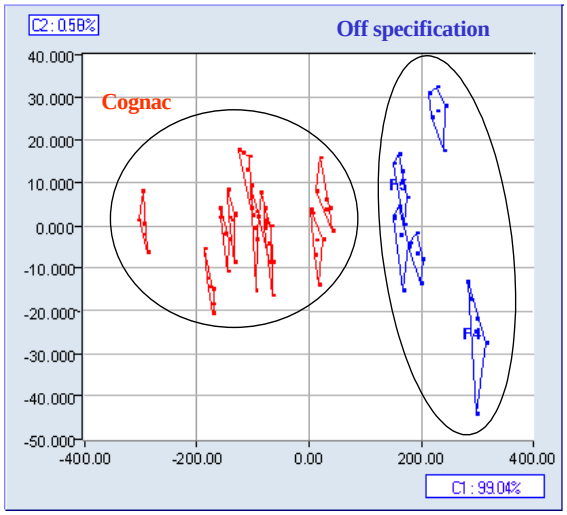

Figure 2: PCA with all the samples

Unknown sample identification

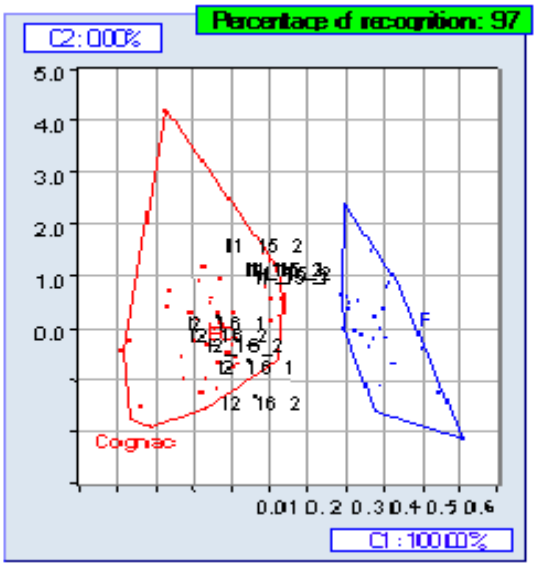

Figure 2: DFA with the unknown projection

The application has been further validated by calibrating the Astree using the same samples and by projecting unknown samples.

The unknown samples are correctly recognized.
The identification of the unknown samples are presented in the following table:

Unknown samples	Identified by the E tongue as:	Theoretical results
I1	Cognac	Cognac
I2	Cognac	Cognac

Conclusion

The results obtained using ASTREE accurately predict the Cognac's authenticity. Representing the data by PCA and prediction using a DFA model provides an objective measurement. The results in this experiment were quickly and easily obtained. The speed of the analysis provides the option of testing a large number of samples.