

PT 17 : Sensory quality control by electronic nose in manufacturing plants



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Structure

- ✓ principle of Electronic Nose
- ✓ Set up of QC chart on a tobacco blend of a product named "A"
- ✓ An application which validate The E-Nose's chart

Part I: Principle of Electronic nose

✓ Steps of odour recognition:

✗ Heating the sample ⇒ generates the "smell" (VOC)

✗ Gas phase sampled ⇒ detection device



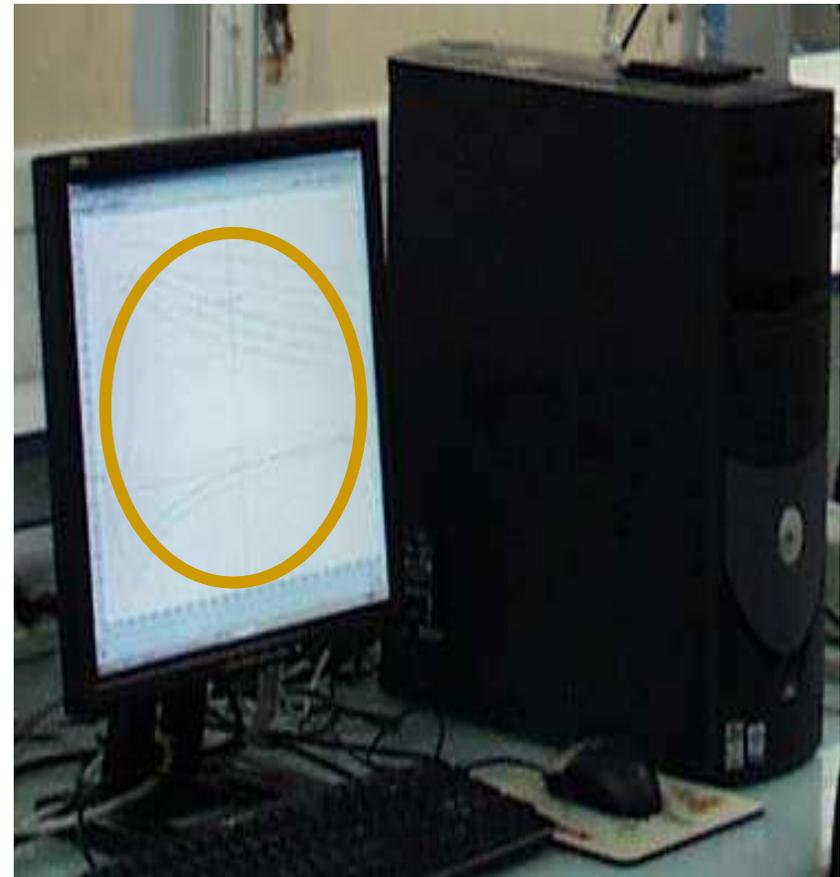
✗ Difference in metallic oxide sensors reactions ⇒



Part I: Principle of Electronic nose

✓ Steps of odour recognition:

- ✗ Heating the sample ⇒ generates the "smell" (VOC)
- ✗ Gas phase sampled ⇒ detection device
- ✗ Difference in metallic oxide sensors reactions ⇒ statistical calculation technics
- ✗ Graphic representation ⇒ PCA



Part II: Manufacturing follow-up by E-Nose: Product "A" batches from 2 manufacturing plants

✓ Materials:

- ✗ Manufactured product (Product A) in french factories
 - ★ 15 samplings pick up (once a week)

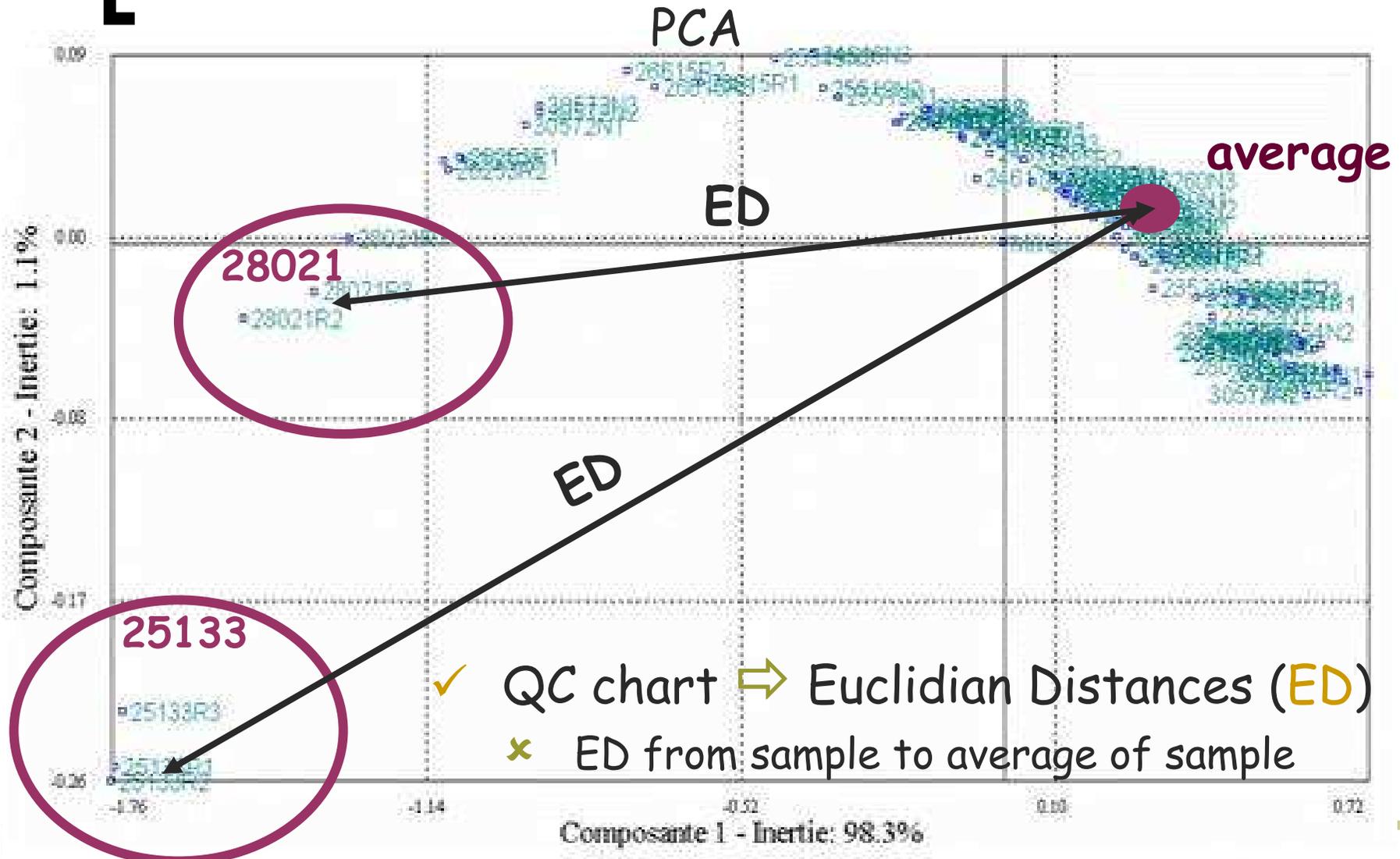
✓ E-Nose Protocol:

- ✗ Generation **Head Space** of cut tobacco
 - ★ Method define by an experimental design
- ✗ E-Nose processing

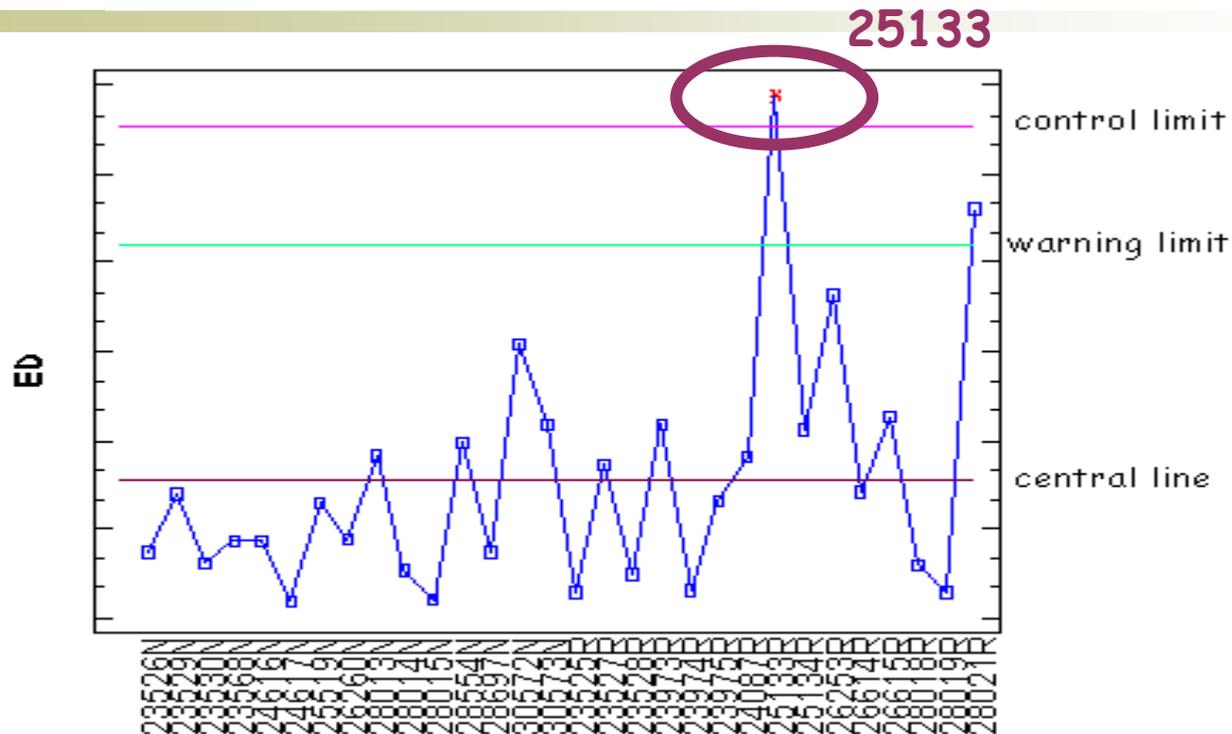


- ✗ Principal Component Analyses (**PCA**)

Part II: Manufacturing follow-up in factory
PCA obtained by E-Nose : 30 batches

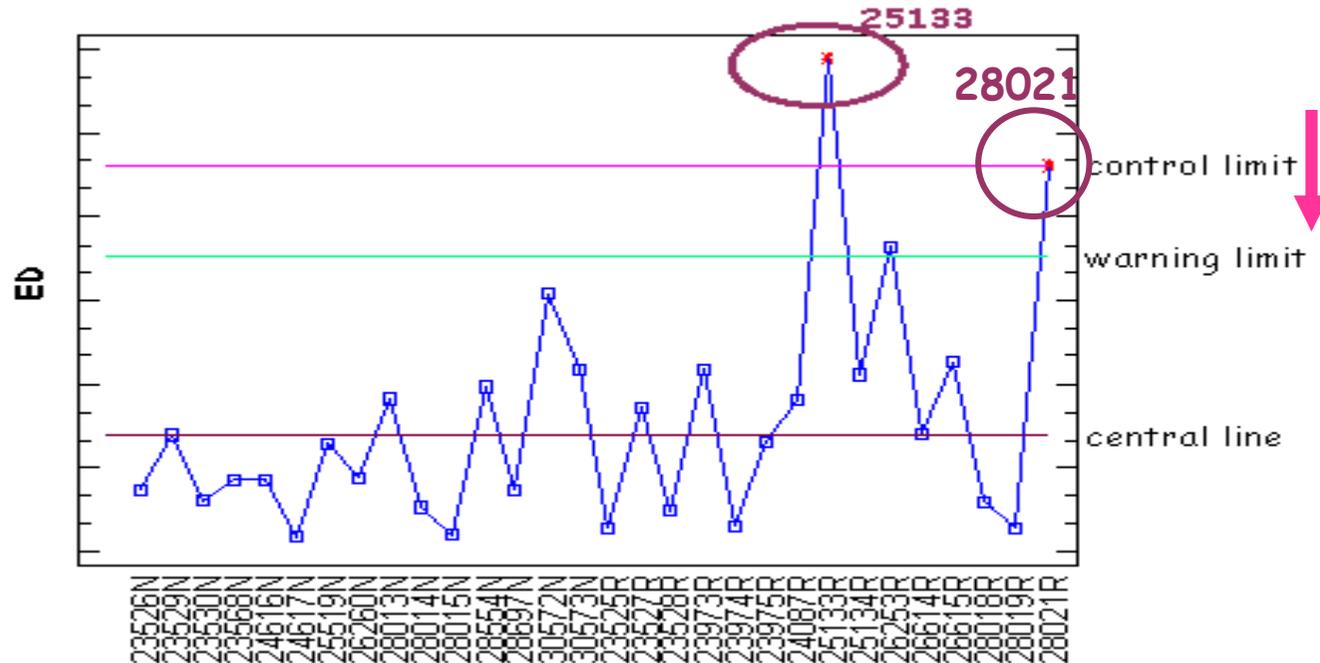


Part II: Quality Control chart on Euclidian Distances by E-Nose (30 batches)



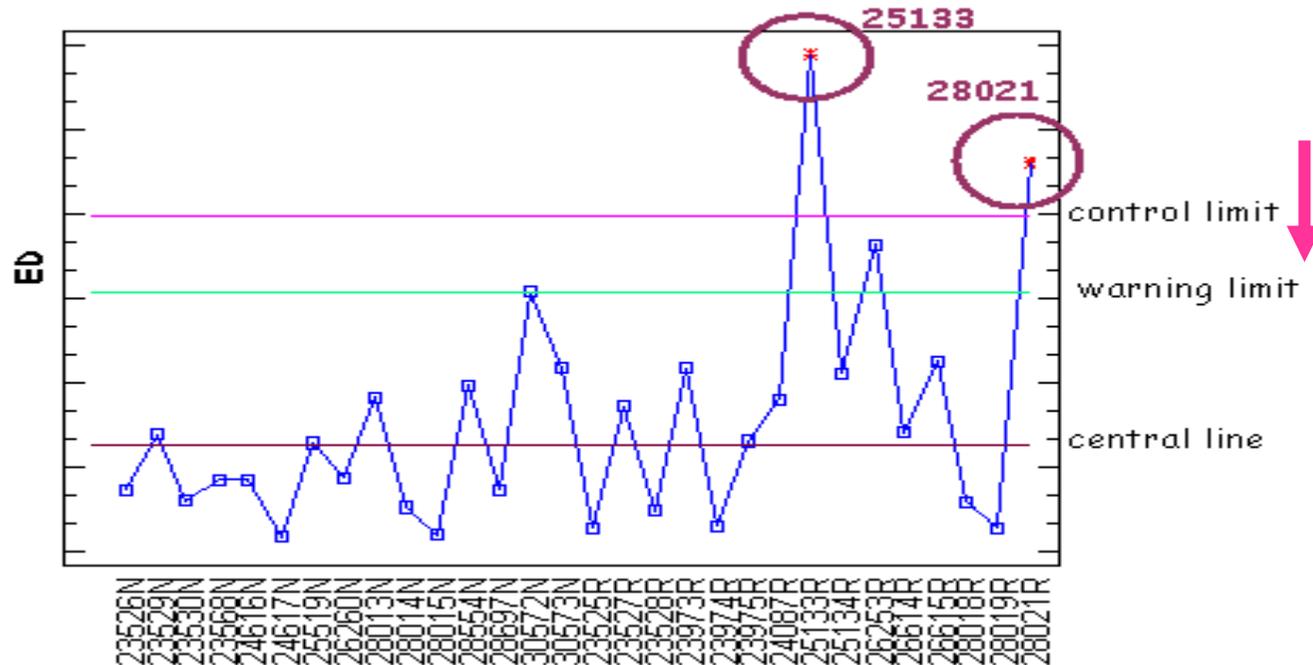
- ✓ **Control chart method:**
 - ✗ Study of individual variables ⇒ Average and gap for 30 batches
 - ★ 25133 is over the limits
- ✓ New study with the other 29 batches

Part II: Quality Control chart on Euclidian Distances by E-Nose (29 batches)



- ✓ Study of individual variables ⇒ Average and gap for 29 batches
- ✗ 28021 is over the limits too
- ✓ Study on individual variables with the other 28 batches

Part II: Quality Control chart on Euclidian Distances by E-Nose (28 batches)



- ✓ 28 batches under control limit
- ✓ What about batches 25133 & 28021? Is it
 - ✗ a structural difference
 - ✗ or an aromatic one?

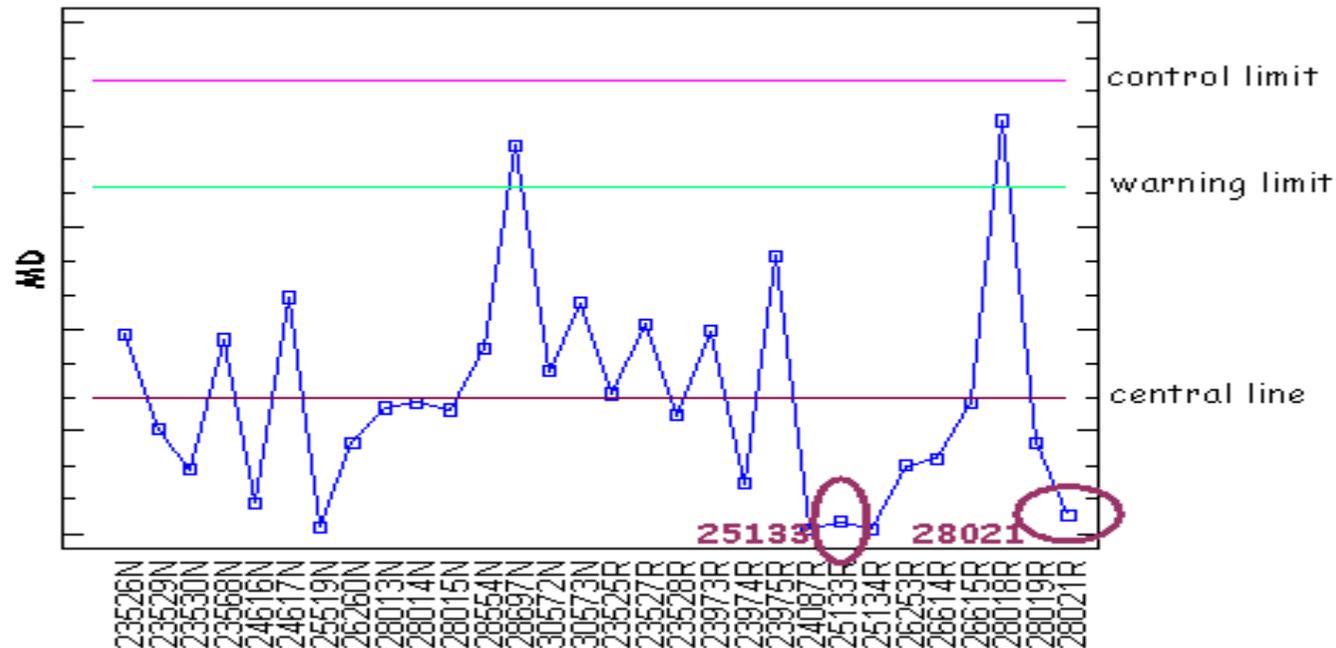
Part II: Manufacturing follow-up by NIRS: Product "A" batches from 2 manufacturing plants

- ✓ NIRS measurements requested ⇒ to have structural (physical or chemical) information

- ✓ NIRS protocol:
 - ✗ Cut tobacco sample scanned by NIRS
 - ✗ Principal Component Analyses (PCA)
 - ✗ Calculation of Mahalanobis Distance (MD)

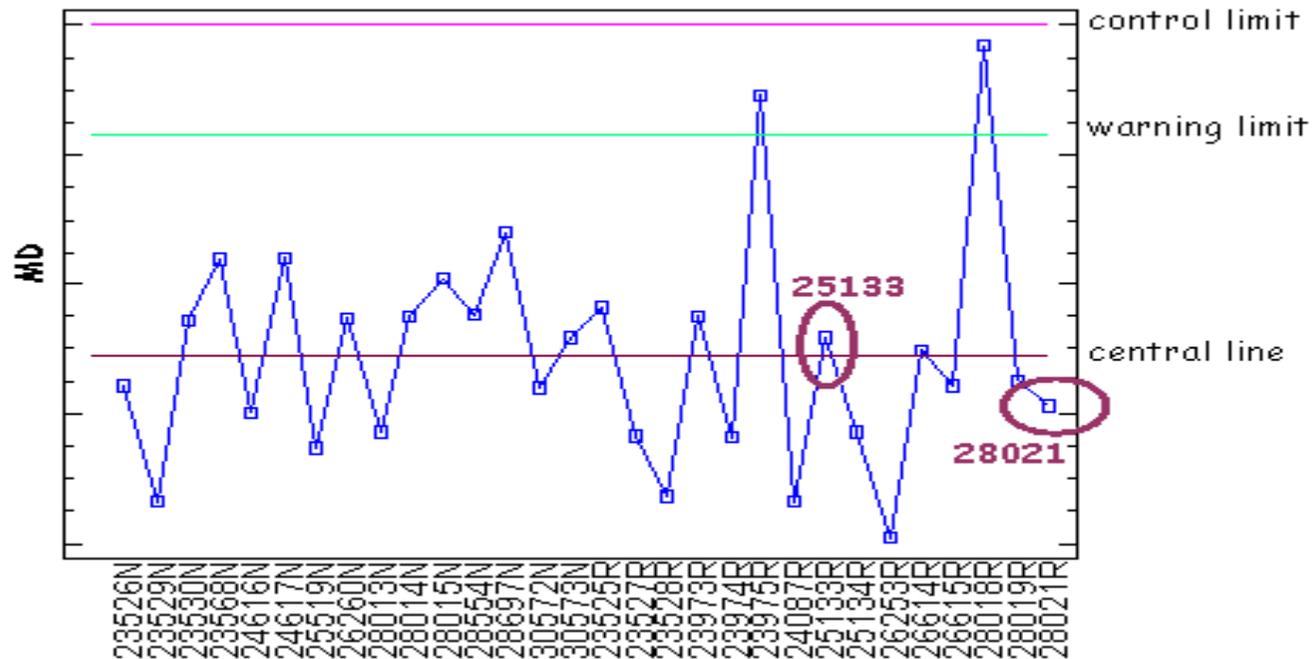
- ✓ Raw spectra ⇒ physical properties

Part II: Manufacturing follow-up in factory NIRS : control cards on Mahalanobis Distances Raw spectra (physical properties)



- ✓ No outlier ⇒ all batches under the control limit
- ✗ 25133 & 28021 ⇒ No physical difference
- ✓ Pre-treated NIRS spectra ⇒ chemical properties

Part II: Manufacturing follow-up in factory NIRS : control cards on Mahalanobis Distances Pre-treated spectra (chemical properties)



- ✓ No outlier ⇒ all batches under the control limit
- ✗ 25133 & 28021 ⇒ No chemical difference
- ✓ Confirmed by classical chemicals analyses

Part II: What about batches 25133 & 28021?

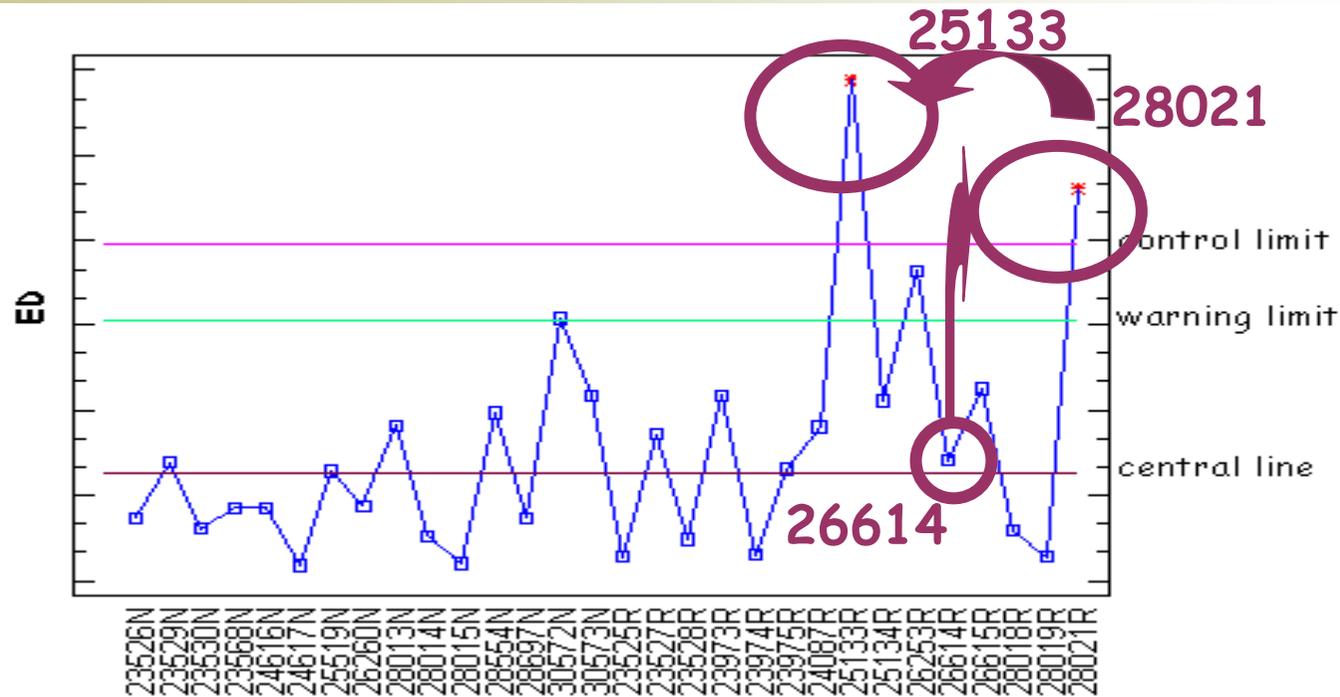
- ✓ E-Nose ⇒ Two outliers
- ✓ NIRS ⇒ No outliers ⇒ No structural difference
- ✓ Tasting session by expert panel requested
 - x aromatic difference?

Part II: Blind tasting session by expert panel

- ✓ Three cigarettes:
 - ✗ Outliers:
 - ★ 25133
 - ★ 28021
 - ✗ Reference:
 - ★ 26614

- ✓ Conclusions of the expert panel:
 - ✗ **Reference** ≠ ≠ **Outliers**
 - ✗ **25133** ≠ **28021**

Part II: Expert's sensory ranking on E-Nose's Quality Control chart

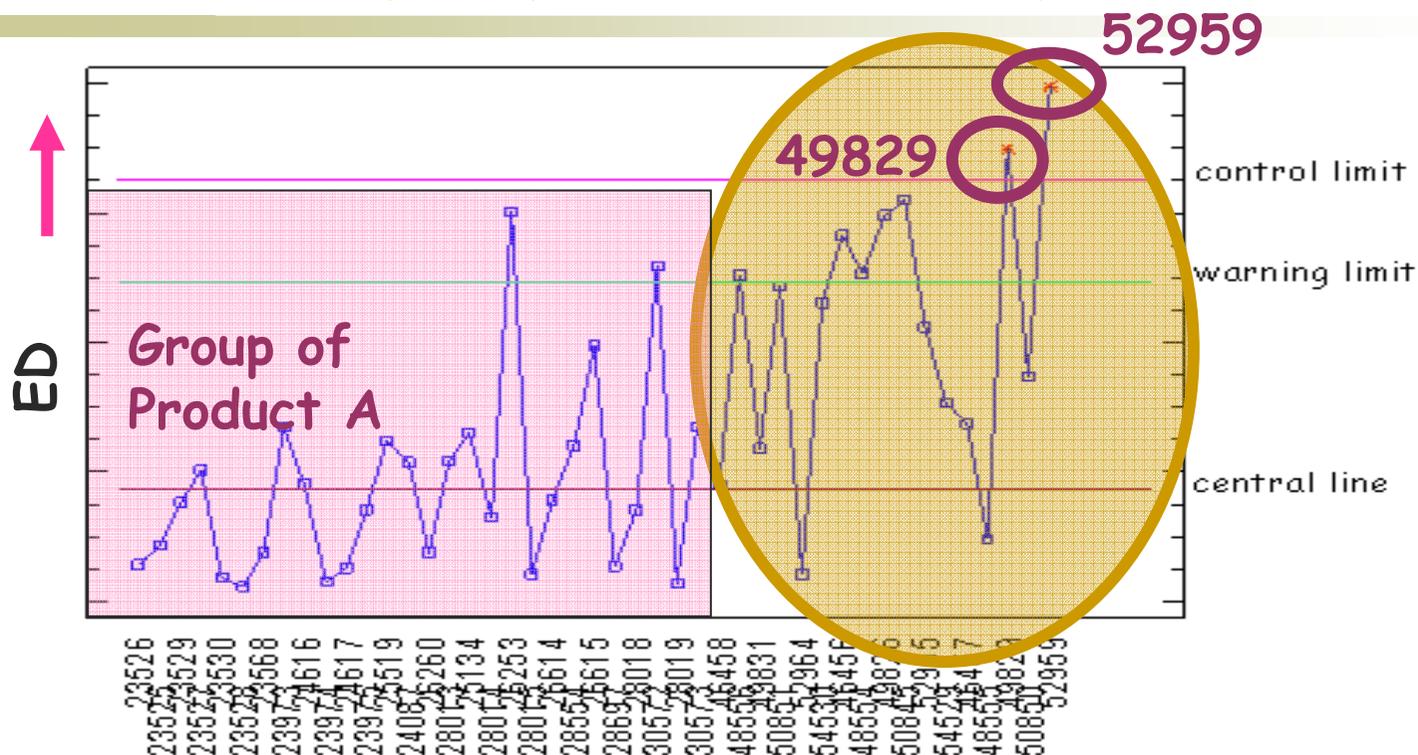


✓ Sensory differences ~ ED

Part II: Conclusion about Set up of E-Nose's QC chart on a tobacco blend

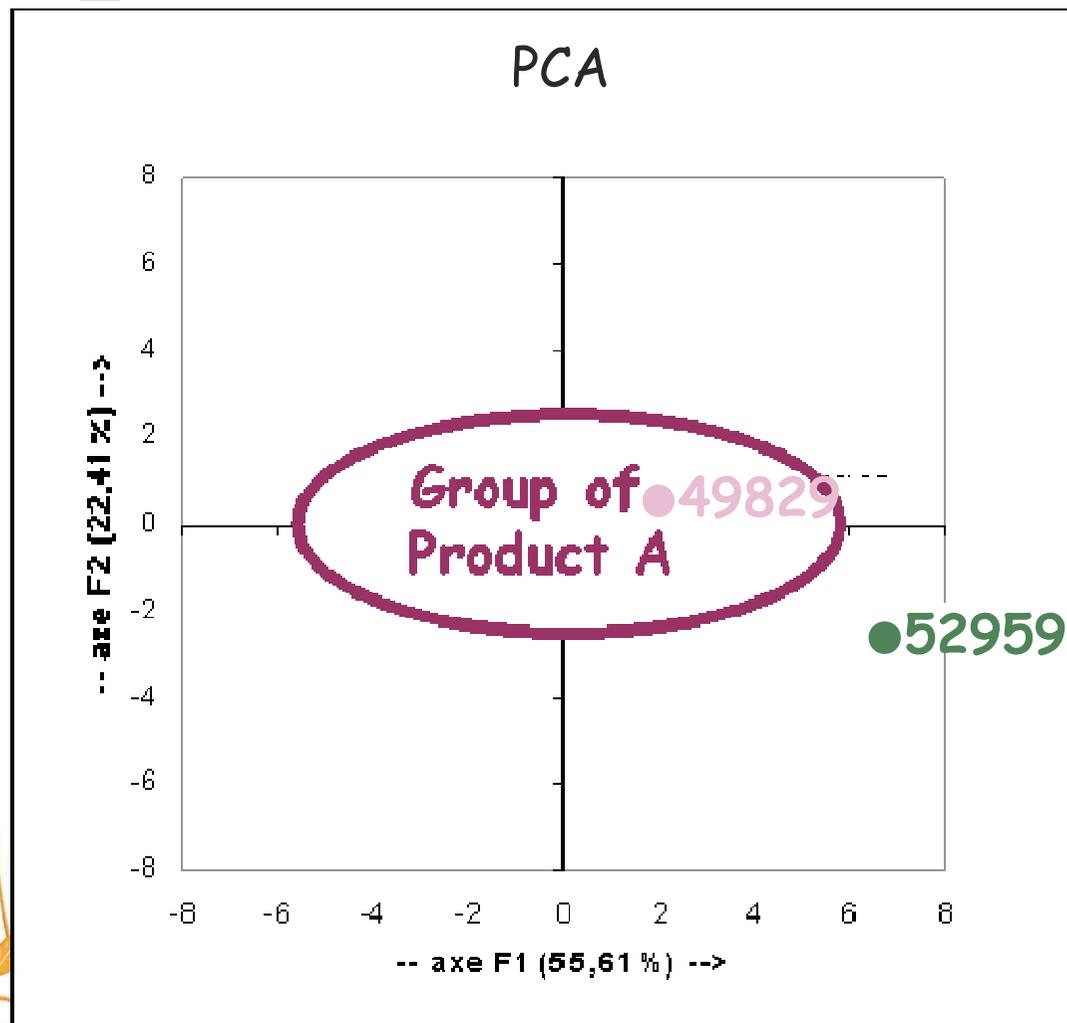
- ✓ Two outliers
 - ✗ Detected by E-Nose & expert panel
 - ✗ Not detected by consumers
- ✓ E-Nose ⇒ Very sensitive tool
- ✓ E-Nose's QC chart representative of consumers perceptions? ⇒ increasing upper control limit ↑

Part III: Further investigations : 2006 organoleptic Follow up of product'A Blend by E-Nose



- ✓ Monthly follow up by E-Nose:
 - ✗ 49829 over control limite
 - ✗ 52959 also over control limite
- ⇒ Organoleptic view requested: in-house trained consumers

Part III: Organoleptic confirmation by in-house trained consumers of capability of our control chart



✓ Sensory gap on 52959

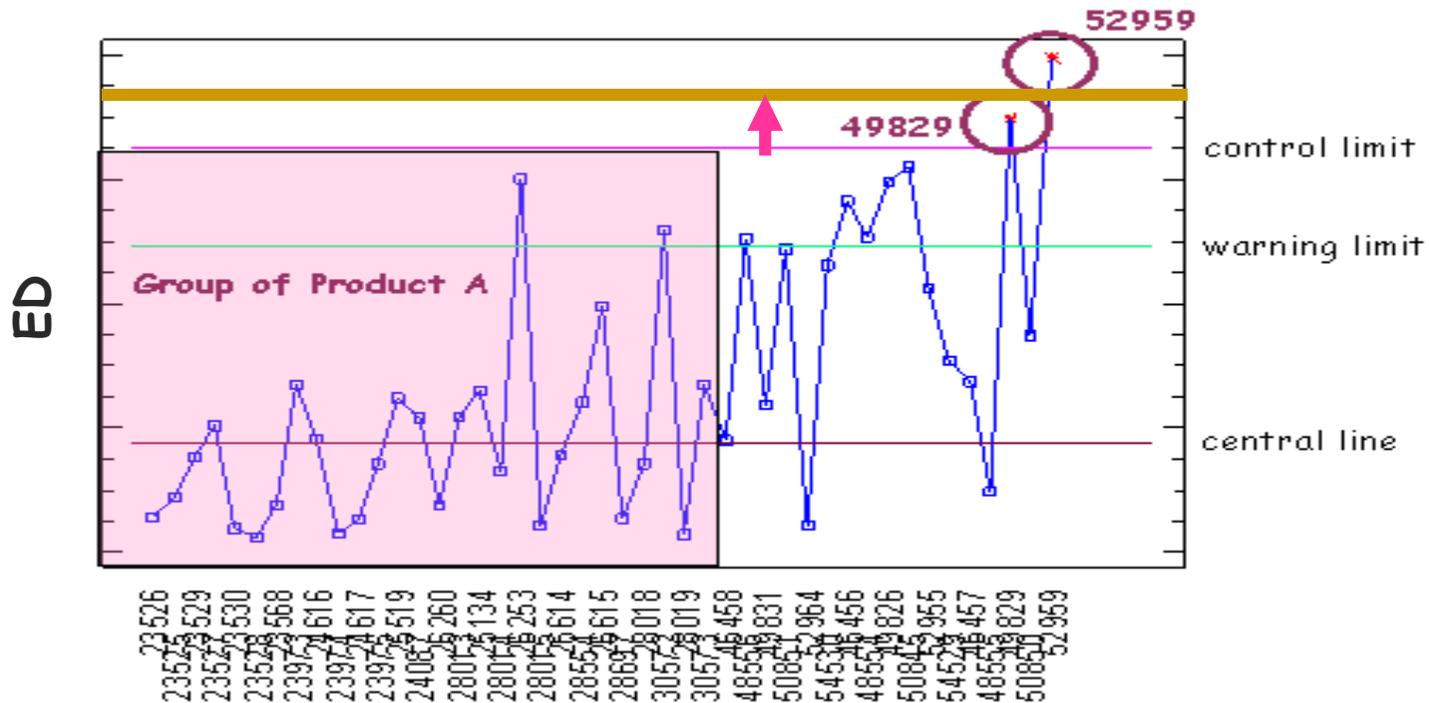
✓ No difference for:

✗ NIRS

✗ Classical chemistry

⇒ capability of our control chart

Part III: Increase of upper control limit \Rightarrow more representative of consumers perceptions



consumers' threshold limit

Conclusion

- ✓ Sensory evaluation = F(ED(E-Nose))
- ✓ E-Nose \Rightarrow Sensory quality prediction
- ✓ E-Nose \Rightarrow Easy and quick technic
- ✓ Control can be made at different steps of the process

Acknowledgments

- ✓ Quality team
- ✓ NIRS team
- ✓ Sensory team
- ✓ E-Nose Team