toute une vie en bonne santé

CHARACTERIZATION OF THE TiO_2 E171 FOOD ADDITIVE

F. Brassinne[1]• S. De Vos[1]• E. Verleysen[1]• P.-J. De Temmerman[1,]• M. Ledecq [1]• J. Mast [1]

1. Service Trace Elements and Nanomaterials, Sciensano, Brussels, Belgium

« Optimized dispersion method for better characterization »

Dispersion is crucial step to characterize the nanofraction as it allows to separate the primary particles.

Fig 1 Examples of food and cosmetic products containing E171.

E171 (Titanium dioxide) is an EC approved food additive (EC 1129/2011), authorized to be used as color in foodstuffs. It is widely used for its refractive properties (shiny coating, UV protection) in the food and pharmaceutical industries (Fig 1). It is intended and assumed to be present in bulk form. A nanofraction may be present.

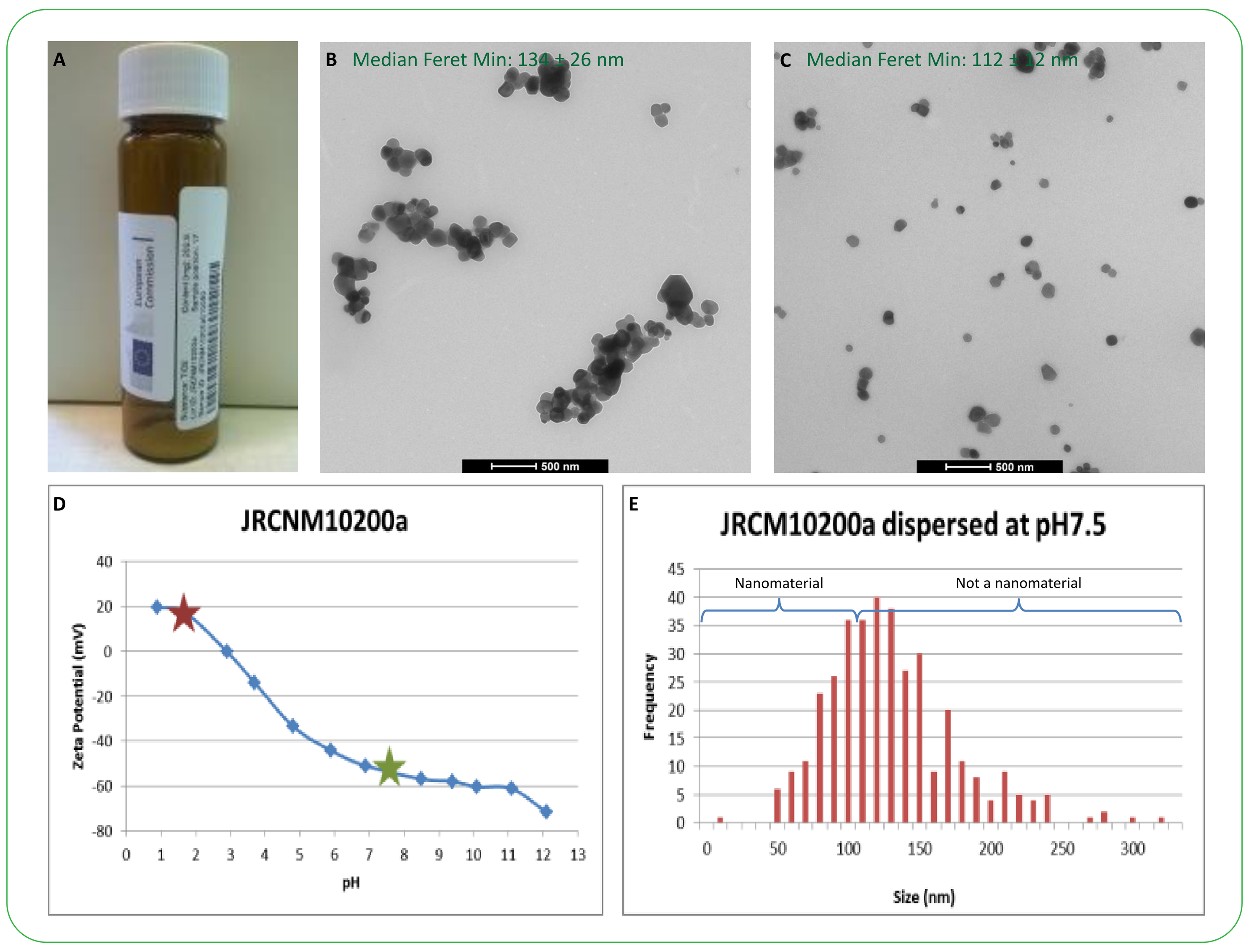

Fig 2 TEM analysis of the representative test material JRCNM10200a. Glass vial containing the TiO2 material as received from JRC (A). Representative images showing the nanomaterial JRCNM10200a dispersed at pH 2 (B) and pH 7.5 (C) and the graph of the zêta potential in function of the pH (D). The red star on the zêta potential graph represents the unstable condition resulting in agglomeration (B). The green star corresponds with the most dispersed condition (C). Image E shows the size distribution of the food additive dispersed at pH 11. Median Feret Min diameters are presented with expanded uncertainties (k=2) (B, C).

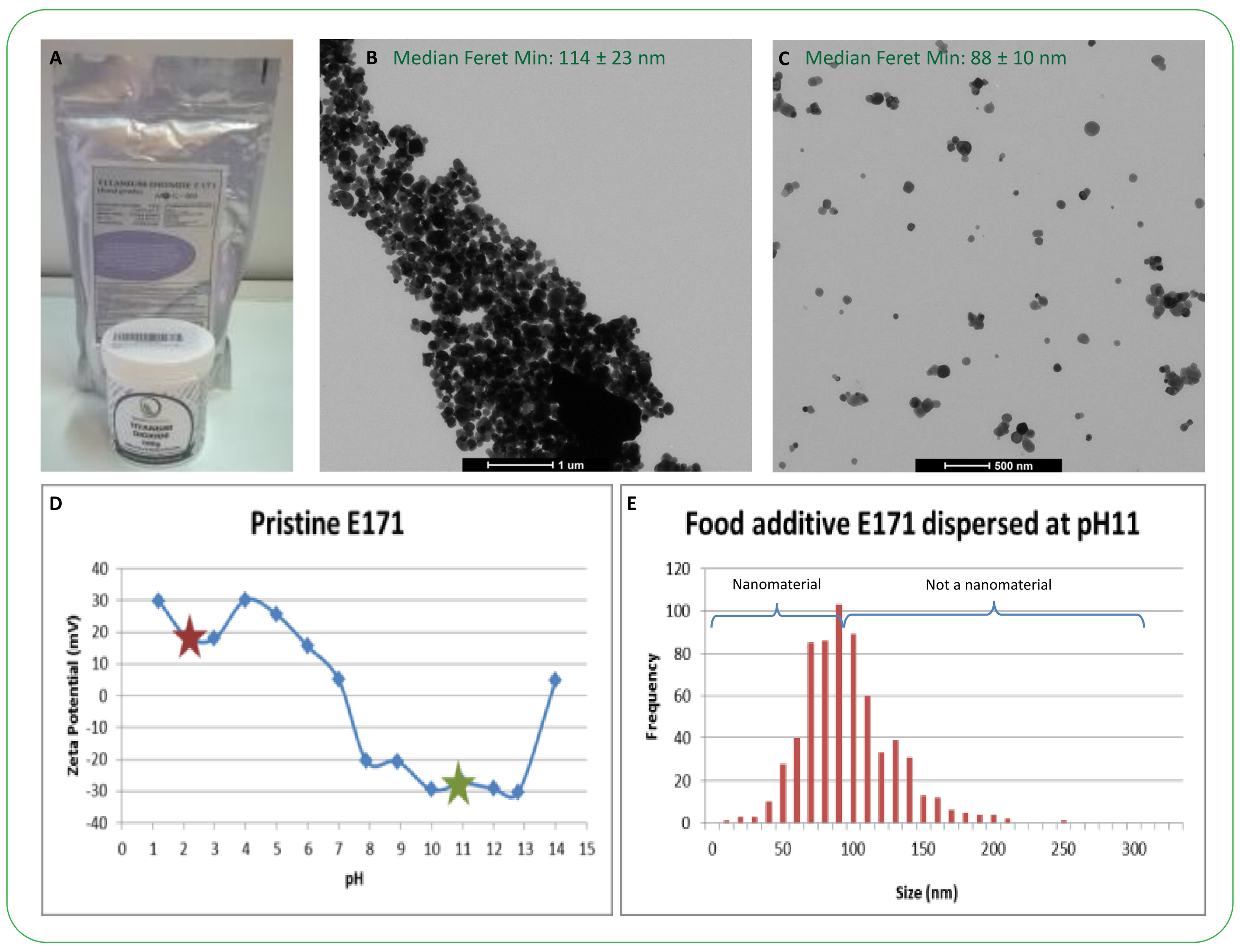

Fig 3 TEM analysis of a pristine food additive E171. Package as received from supplier (A). Representative images showing the food additive E171 dispersed at pH 2 (B) and pH 11 (C) and the graph of the zêta potential in function of the pH (D). The red star on the zêta potential graph represents the unstable condition resulting in agglomeration (B). The green star corresponds with the most dispersed condition (C). Image E shows the size distribution of the food additive dispersed at pH 11. Median Feret Min diameters are presented with expanded uncertainties (k=2) (B, C).

Methods

- The developed dispersion methodology is based on the Guiot & Spalla approach. It electrosterically stabilizes the (nano)materials, dispersed by sonication, using BSA at a pH determined by zeta potential measurement.
- Using a combination of TEM imaging and image analysis, the distribution of the particle properties (size, shape, surface structure) are assessed quantitatively.

Results

For both the pristine TiO_2 food additive E171 and the JRC TiO_2 representative test material :

- Zeta-potential measurement allowed to identify the conditions (pH) where a stable dispersion with a minimal level of agglomeration was observed.
- The stability of the dispersion was confirmed by descriptive TEM (compare Fig 2B and Fig 2C and Fig 3B and Fig 3C, respectively).
- Combining EM imaging and image analysis, the minimal external dimension of the primary particles could be measured precisely and accurately, such that the materials could be classified according to the EC definition of a nanomaterial.

Conclusion

Preparing dispersions of TiO_2 through a pH adjustment provides a stable dispersion of single primary particles and small aggregates and agglomerates. Using the optimized dispersion conditions improves the accuaracy and precision of the measurements.

REFERENCES

- Guiot, C. and Spalla, O. (2013) Environnemental Science & Technology 1057-1064.
- http://ec.europa.eu/environment/chemicals/nanotech/faq/definition_en.htm.

ACKNOWLEDGEMENTS

The representative test material JRCNM10200a was obtained from the JRC repository for nanomaterials (JRC, Ispra, Italie). This research was funded by the To²DeNano Brain (BELSPO), the Nanofood@ (RTXXX), the NanoAg@ (DG4, FPSS) and the EFSA projects.