Study of the cadmium distribution into durum wheat grain tissues and processing fractions: comparison with deoxynivalenol as a mycotoxin contaminant

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Cadmium (Cd) and mycotoxins are contaminants that both threaten the safety of food products derived from cereal grains. Durum wheat, in particular, is the most sensitive for Cd and deoxynivalenol (DON) accumulation in grains.

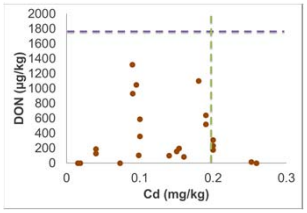
The possible occurrence of both contaminants in cereal products is puzzling for human health and is under study in a 4 years project called CaDON. Cd is a trace element naturally occurring or added to soils by natural and industrial atmospheric deposition, or through agricultural inputs. It is readily absorbed by wheat roots and translocated to grains. Cereal contaminations with DON, in Europe, are mainly caused by the toxigenic filamentous fungus *Fusarium graminearum* that develops on growing crops. In Europe, legislation fixed the respective limit of concentration of Cd and DON in commercialized wheat grains for human consumption to 0.2 mg/kg and 1750 µg/Kg.

This study evaluate the potential of Cd spreading in the different wheat mill streams through processing from distinct durum wheat grain samples in comparison with those of DON.

Materials and Methods

Sample set

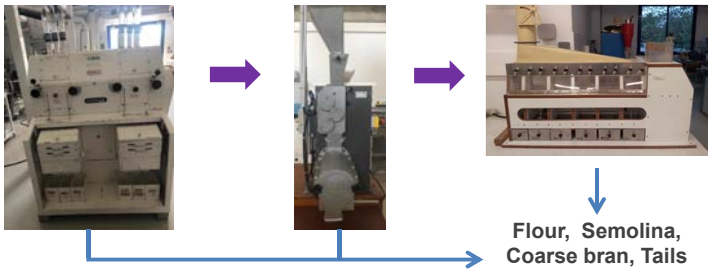
7 distinct cultivars grown in different environnemental conditions, all but one accumulating Cd



Cd and DON amounts in grains. (dashed lines indicate legislative upper limits)

Milling process

1. Grinding & sieving
2. Sizing reduction
3. Sizing purifier



Flour, Semolina, Coarse bran, Tails

Debranning process

Removed fractions (2-30 %) according to time

Recovered debranned grains

Biochemical analysis

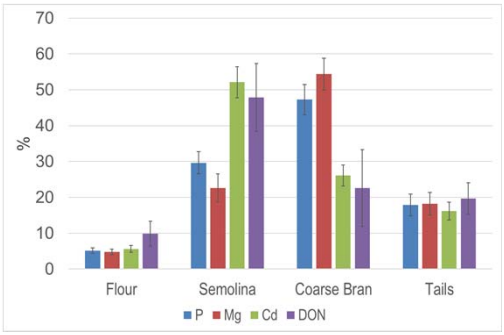
- ✓ **DON** quantification was as described in Rios et al. (2009) *Food Additives and Contaminants 26 (4), 487–495.*
- ✓ After acid digestion **Cd** was quantified by ICPMS with RSD of 8 % and compared to **Mg** and **P** (known to be mainly located in the peripheral aleurone layer) which was quantified by ICPAES with respective RSD of 8 and 6 % *(Universidad del Pais Vasco Leioa, Spain).*

Results

Durum wheat milling process

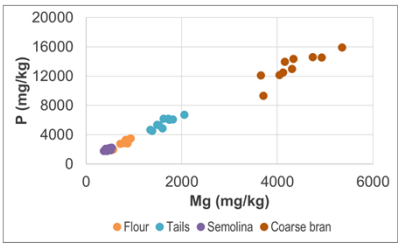
Mill streams	Yield (%)
Flour	7.8 ± 1.1
Semolina	62.9 ± 2.1
Coarse bran	15.9 ± 0.9
Tails	13.3 ± 1.6

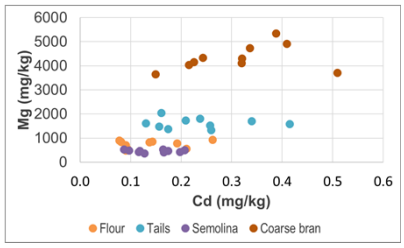
Mean values calculated from all the samples.



Distribution of P, Mg, DON and Cd in mill streams

Comparison of mean values between Cd, P, Mg and DON distribution pointed out high proportion of Cd and DON in semolina whereas P and Mg appear to accumulate in coarse bran as known from their location in the grain outer layers.

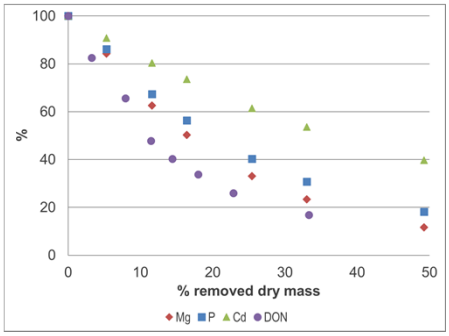




Mg concentration according to P or Cd amount in the different mill streams

Interestingly, Mg and P, which are similarly located in grains, displayed related concentrations mill streams whereas those of Cd do not appear related to either Mg or P.

Debranning process



Relative decrease of Mg, P, Cd and DON during debranning

Comparison of mean values of Cd, P, Mg and DON loss along debranning pointed out a higher loss of P, Mg and DON (>80 %) which are found mainly located in the outer layers whereas Cd loss appeared moderate (only 60 % with a half dry grain mass removal)

Conclusion - Perspectives

If debranning is an efficient way to remove DON and the corresponding producing fungi, as previously shown (Rios et al, 2009, *J Cereal Sci 49 387–392*), Cd contamination remains at a high level in grains after debranning suggesting that it is more equally distributed in grains.

Strategy to select Cd non-cumulating cultivars therefore appears the most appropriate.

Acknowledgments

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http://cadon.inra.fr

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