PERITEC TECHNOLOGY TO REDUCE FUSARIUM TOXIN CONTAMINATION IN THE MILLING TECHNOLOGY

Antal Veha, Balazs P. Szabó, Ernő Gyimes
Institute of Food Engineering, Faculty of Engineering
University of Szeged, H-6725, Szeged, Moszkvai krt. 5-7., Hungary
e-mail: szpb@mk.u-szeged.hu

ABSTRACT

The fungi causing the infection and mycotoxins production are concentrated in the bran of the grain, thus the intensive surface cleaning, the so-called debranning operation could allow the reduction of contamination in the milling technology. The essence of the PeriTec technology - originally developed by SATAKE, a Japanese company, to clean rice - is that it gradually removes the bran layers of the grain by mechanical means before further processing.
We carried out our experiments using a naturally contaminated wheat lot. We modelled the PeriTec technology with a laboratory size, batch-operating, horizontal debranning machine by SATAKE. Applying different treatment times we varied the rate of debranning.
As for DON (deoxinivalenol) toxin contamination, a continuous decrease can be found by increasing the rate of debranning. The total flour obtained during grinding the unpolished wheat contains 0.25 mg/kg toxin on average, which decreases to 0.11 mg/kg if we apply the highest, 40 sec polishing.
Figure 4 shows the DON toxin content of all the obtained fractions. The toxin contamination of the wheat grains and the grinding fractions gradually decreased as a result of debranning. Very high toxin content of the removed parts of the husk indicates that toxin is concentrated in the outer husk layers. Although the DON content of the original wheat sample was relatively law (0.74 mg/kg), the DON content of the removed materials was about 4 mg/kg, which exceeds all statutory limits.
During our work we focused mainly on the toxin contamination of the grains and their milling products, as well as on other characteristics that are important with regard to milling processing.
As a result of debranning, the toxin content of the grinding fractions decreased, which justifies that that PeriTec method is suitable for the reduction of toxin contamination.
On the basis of the experimental results, the optimum peeling was the peeling which resulted in a weight loss of about 6%, the toxin content significantly decreased (from 1,59 mg/kg to 0,94 mg/kg).

1. INTRODUCTION

Nowadays, more and more attention is paid to mycotoxin contamination in the food safety considerations of wheat, as an essential nutrient raw material, in particular to the toxins produced by fusaria (Szeitzné, 2009; Téren et al., 1990). During our experiments we dealt with the laboratory modelling of a new milling surface treatment called PeriTec technology (Figure 1.) to find out to what extent this method can reduce toxin contamination (Gold, 2005).

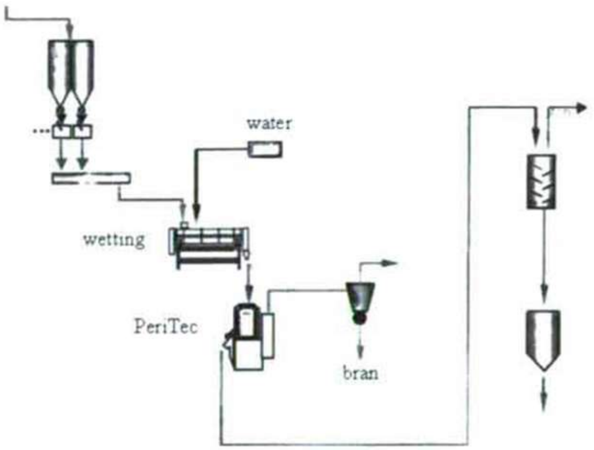

Figure 1. Flowsheet of the PeriTec technology

The fungi causing the infection and mycotoxin production are concentrated in the bran of the grain, thus the intensive surface cleaning, the so-called debranning operation could allow the reduction of contamination in the milling technology. The essence of the PeriTec technology - originally developed by SATAKE, a Japanese company, to clean rice - is that it gradually removes the bran layers of the grain by mechanical means before further processing.
We carried out our experiments using a naturally contaminated wheat lot. We modelled the PeriTec technology with a laboratory size, batch-operating, horizontal debranning machine made by SATAKE. Applying different treatment times we varied the rate of debranning.
We studied how the physical parameters of wheat grain developed (kernel size, kernel hardness, ash content) as well as the rate of grain fracture. After peeling we ground the wheat samples in laboratory mills. We determined DON toxin content of all the resulting fractions with competitive ELISA method.

2. MATERIALS AND METHODS

We carried out our experiments using a wheat lot from Cereal Researc, Szeged, naturally contaminated with fusaria.
We modelled the PeriTec technology with a laboratory size, batch-operating horizontal debranning machine by SATAKE (Figure 2.).
The main part of the equipment is a cylindrical working space delimited by a perforated plate. In this working space/area there is a horizontal-spindle, corundum-covered grinding wheel rotating. The operation of the machine is batch-type; 200g of wheat can be treated at a time. We inject the samples into the treatment area through the inlet. The rate of polishing can be altered by changing the treatment time applied. After the debranning operation we open the latch put/located at the bottom of the working space and the kernels fall into the central container, while the removed parts of the hull get into the two lateral chambers.
After conditioning to a moisture content of 15%, the samples were subjected to different levels of rubbing applying 10, 20 and 40 sec operation times.
We studied the development of the physical parameters of the wheat grains, as well as the rate of grain breakage. We determined the ash content of the samples according based on MSZ (Hungarian Standard) 6367/15-84. We used a Perten SKCS 4100-type instrument to measure kernel hardness.

Kernel length, width and thickness were determined with a digital calliper using 100 kernels per sample. We measured the rate of broken kernels using a 50g sample manually sorted and separated.
After polishing the wheat samples were ground using a Quadrumat Senior type laboratory mill made by Brabender. During milling there were four fractions: 1. flour, 2. flour, fine bran and coarse bran.
We determined the DON toxin content of the base material and of all the fractions obtained during polishing and grinding with R-Biopharm RIDASCREEN FAST DON competitive ELISA test.

Figure 2. SATAKE machine

3. RESULTS AND DISCUSSION

The development of the physical parameters of wheat as a result of peeling can be seen from Table 1.

Table 1. Development of the measured characteristics of wheat as a result of debranning

	width (mm)	length (mm)	thickness (mm)	kernel hardness HI	broken grains (%)
unpolished wheat grains	3,25	6,64	2,86	70,49	2,32
10s polished wheat grains	3,22	6,53	2,72	71,77	4,01
20s polished wheat grains	3,24	6,53	2,69	69,59	5,12
40s polished wheat grains	3,13	6,38	2,55	70,85	9,28

From the specific grain dimensions thickness decreased to the highest degree as a result of rubbing. This thickness decrease may mean that the ventral furrow becomes shallow and thus the quantity of the contamination stuck in it also decreases. The kernel hardness index did not change significantly, however, the rate of broken grains in the lot increased significantly as a result of the strong mechanical impact applied during the operation.

Figure 3 shows the quantitative ratio of the fractions obtained during debranning and the subsequent grinding.

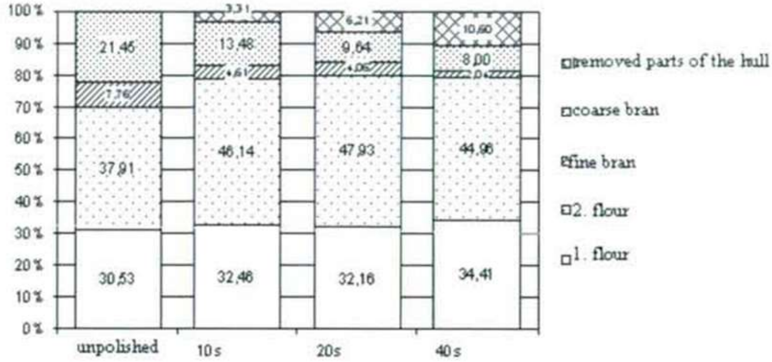

Figure 3. Quantitative ratio of the obtained fractions

The flour yield increased significantly with the application of the peeling operation, and the higher and higher rate of debranning resulted in the reduction of by-product (brans) rates obtained through grinding.

Figure 4 shows the total flour characteristics obtained during milling.

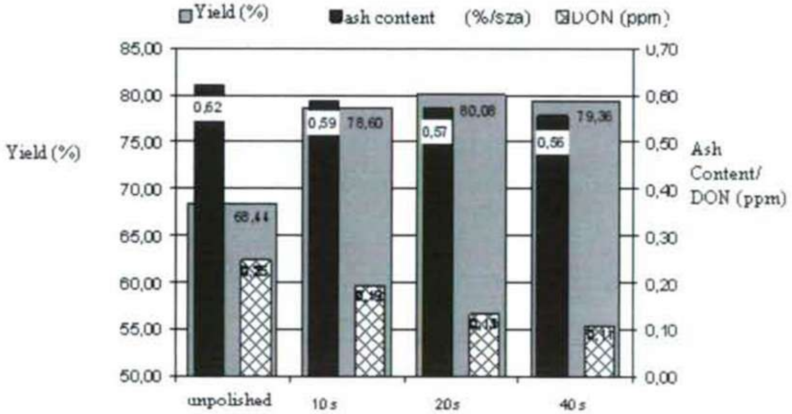

Figure 4. Rate of yield, ash content and toxin contamination of total flour

The flour yield increased, the value of the ash content – used to characterize the hull content of flour – decreased, which means a better flour quality in milling industry, and also the increase of the rate of white flour obtainable as a result of this technology. The 20 sec polishing operation resulted in the best flour yield.
As for DON toxin contamination, a continuous decrease can be found by increasing the rate of debranning. The total flour obtained during grinding the unpolished wheat contains 0.25 mg/kg toxin on average, which decreases to 0.11 mg/kg if we apply the highest, 40 sec polishing.
Figure 5 shows the DON toxin content of all the obtained fractions. The toxin contamination of the wheat grains and the grinding fractions gradually decreased as a result of debranning. Very high toxin content of the removed parts of the husk indicates that toxins are concentrated in the outer husk layers. Although the DON content of the original wheat sample was relatively law (0.74 mg/kg), the DON content of the removed materials was about 4 mg/kg, which exceeds all the hygienic limits.

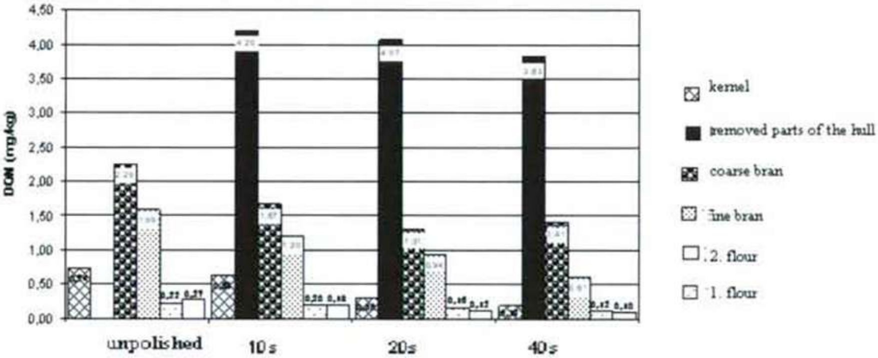

Figure 5. DON toxin content of the debranning and grinding fractions

During our work we focused mainly on the toxin contamination of the grains and their milling products, as well as on other characteristics that are important with regard to milling processing.

4. CONCLUSIONS

As a result of debranning, the toxin content of the grinding fractions decreased, which justifies that PeriTec method is suitable for the reduction of toxin contamination.
On the basis of the experimental results, the optimum peeling was the peeling which resulted in a weight loss of about 6%:

- the toxin content significantly decreased (from1,59 mg/kg to 0,94 mg/kg),
- the flour yield increased (from 70 % to 80 %),
- the rate of grain fracture remained within an acceptable level.

Despite the fact that the toxin content of the experimental wheat sample was rather low, 0,74 mg/kg, we got quite high values of toxin contamination, about 4 mg/kg, in the removed bran, which significantly exceeds the allowed rate. This result draws special attention to the importance of the surface cleaning of crops before milling and the significance of the debranning technology studied.

REFERENCES

1. Gold M. (2005): Gabonaelőkészítés PeriTec eljárással, Molnárok lapja 110. évf. 2005. 1-2 sz.
2. Szeitzné Szabó M., (2009): Gabonaalapú élelmiszerek fuzáriumtoxin szennyezettségének csökkentési lehetôségei, Magyar Élelmiszer-biztonsági Hivatal tájékoztatója
3. Téren J.; Draskovics I.; Novák E. K. (1990): Mikotoxinok, toxinogén gombák, mikotoxikózisok. Magyar Élelmezéstudományi Egyesület Bp.