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REDUCTION OF TOXIN CONTENT OF *TRITICUM DURUM* IN THE MILLING PROCESS

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ABSTRACT
The DON toxin in terms of human and animal health is a serious food safety risk factor. Thanks to the favorable impact of vintage effect occurring in recent years the Fusarium contamination of wheat and consequently a high DON toxin concentration often cause problem. Therefore, it is important that there be methods during of wheat milling process, which reduces the level of toxin. Experience has shown that *Triticum durum* wheat species is more sensitive to *Fusarium* infection than *Triticum aestivum* species. According to professional literature, almost the prevention is considered to be the exclusive method to keep the content of DON-toxin below safe level. It is very difficult, sometimes impossible to correct those food safety risks, which polluted the products in the process of cropping. My objective was to investigate, if it possible to decrease DON-toxin content of durum wheat and to minimize the food safety risk by application of milling technology with good production practice and technological conditions. According to results of measurements, Sortex Z color sorting decreased DON-toxin content of wheat.

Keywords: DON-toxin, food safety, food chain, *Fusarium*, cereals

INTRODUCTION

Nowadays, the majority of food production happens in large-scale industrial circumstances thanks to structural transformation and change of lifestyle. The development of food processing technology made possible to produce sufficient quantity of food for several thousand people in one locality. The food processing technology has changed according to the change of the lifestyle and demand of consumers. It was necessary to increase the efficiency by mechanization of processing and ensure suitable technical background. Due to the changes of techniques and processes new food safety risks turn up with its necessary management (VASS, 2007). The large-scale food processing might carry that food safety problem affects wide range of customers and might cause extended food safety incidence in time and space. From this point of view there is an extremely high risk at the basic foods which are consumed relatively regularly and in large quantities.
Products made of cereals, such as flour, bread and bakery products are classifiable as basic foods, but we consume lot of pasta and cake, too. Large-scale consumption of basic foods is a feature of adult and children population equally. At these products, the fundamental importance to use primary materials which are free from biological and chemical pollutants is unambiguous.
Recent years the *Fusarium* infection caused serious problems in cereals, especially in durum wheat, depending on climatic factors of the given year. The *Fusarium spp.* moulds produce micotoxins during their life activities. These secondary metabolites generate harmful processes in the human body.
DON toxin can be found more frequently among the fusarium toxins in durum wheat. If this secondary metabolite produced by moulds gets into the human body it causes nausea, vomit, sometimes diarrhea, abdominal pain, headache, dizziness. Big quantity might cause immune system and hematopoietic organs problems. It is proved by experiments that even small quantity has unfavourable effect on immune system (SZEITZNÉ, 2009). DON toxin

resists to heat, so the heat treatment doesn't decrease its concentration in the course of processing. Therefore, we have to make efforts to ensure the freedom from toxin of primary products used for processing and milling which is primarily feasible with appropriate cultivation, storage technology and by reasonable choice of varieties (KECSKÉSNÉ, 2015). According to the literature, the efficiency of this possibility is considered to be low.
During our research work we looked for answer, whether DON-toxin content can be decreased below the allowable, safe level determined by law with adequate technical conditions and modern machinery in the milling process.

MATERIAL AND METHOD

We investigated the DON-toxin content of durum wheat before and after the cleaning process in the course of milling.

Figure 1. Ear of 'Elsadur' durum wheat variety

Durum wheat which was the subject of our investigation is cultivated among the wheat species on the second largest territory in the world *(Figure 1)*. It is particularly popular in the mediterranean region. The flour made from hard, glassy wheat grains (*Figure 2*) is used primarily by pasta industry but Sicilians bake bread from that also. Its nutritional value is better than that of *T. aestivum*, which is widely grown in our area. Its consumption is advantageous because of its beta-carotene content, amino acid and protein composition, slowly resorbable carbohydrate content. Owing to its beta-carotene and protein content, pasta can be produced from durum wheat without eggs. But growing experiences indicate that durum wheat is more sensitive to Fusarium infection than other wheat species.
Cleaning of durum wheat means color sorting in the preceding phase of milling. This work operation was implemented by Sortex Z+ color sorter. In the first step of technology process metal contaminations are selected and the lot of wheat is sorted by size and specific gravity. Latter sorting removes rough dirts, foreign substances (foreign seeds, other contaminations, etc.), broken and frivolous grain of wheat. This cleaning process may increase the efficiency of color sorting among others.

Figure 2. Grains of durum wheat

The color of the grain of wheat infected by Fusarium mould species is mostly different from healthy grains. Depending on the phenophase when the infection happened and its degree, the wheat grains may get light or pink discoloration may appear on them. But, unfortunately, there are grains on which can not be seen unambiguous signs of infection with naked eye. So, it is important to investigate and to prove experimentally what extent of toxin reduction can be achieved by color sorting of wheat. The experimental samples were taken in line with the steps of the technological process. In the phase before Sortex Z+, we took samples which were cleaned from rough dirt and foreign materials. This can be considered as primary input material of processing. The speed of grains in the production process can be calculated depending on machine performance. So, the sampling time can be settled exactly after color sorting. Consequently, we took samples from the same lot of wheat before and after color sorting. In this phase of the experiment we processed and evaluated data of 25 sample-pairs by statistical methods.

RESULTS

Analysis of DON values of durum wheat before and after cleaning aimed to define the correlation intervals and their relative errors at 95 % confidence level of the given samples. This case 95% confidence level, that is 5% significance level means: 2.5% is the probability, that values of samples less than the mean of samples, and 2.5% is the probability they are above the mean. Examined the confidence intervals before and after treatments it is determinable, whether two intervals have common part, and the common part what proportion represents compared to the union of two intervals. On the other hand conclusion can be drawn about strength of standard deviation from the relative errors of confidence-intervals.

The relative error of the confidence bands is 10-20% in both sampling, that is why standard deviation is moderate compared to means.

Figures 3-4 demonstrate measured data, their mean and confidence bands calculated around mean.

Only one-third (32%) of data measured before treatment (*Figure 3*) are in the confidence-band, while two-third (68 %) are outside. According to the values of data, 6 are below (24%) and 11 are above (44%) the confidence-band.

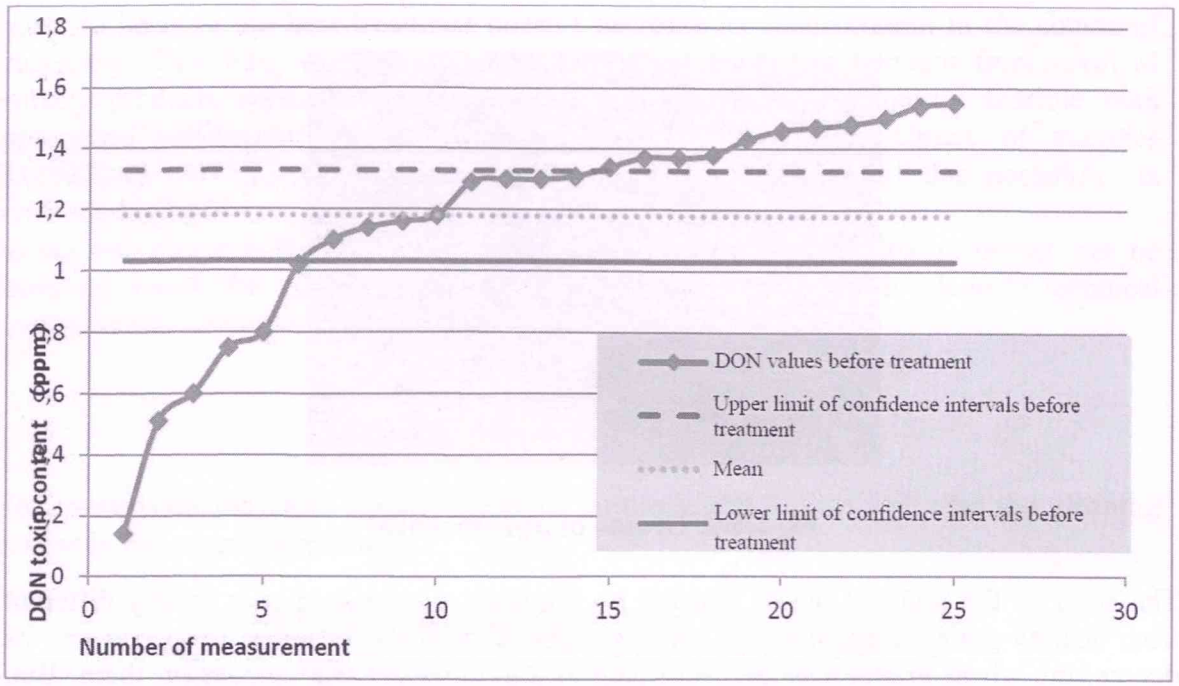

Figure 3. Evaluation of DON toxin content of durum wheat before color sorting by interval estimation

There are more data in the confidence interval from the sampling after treatment, but the majority of data are outside, too (below 28%, above 36%).

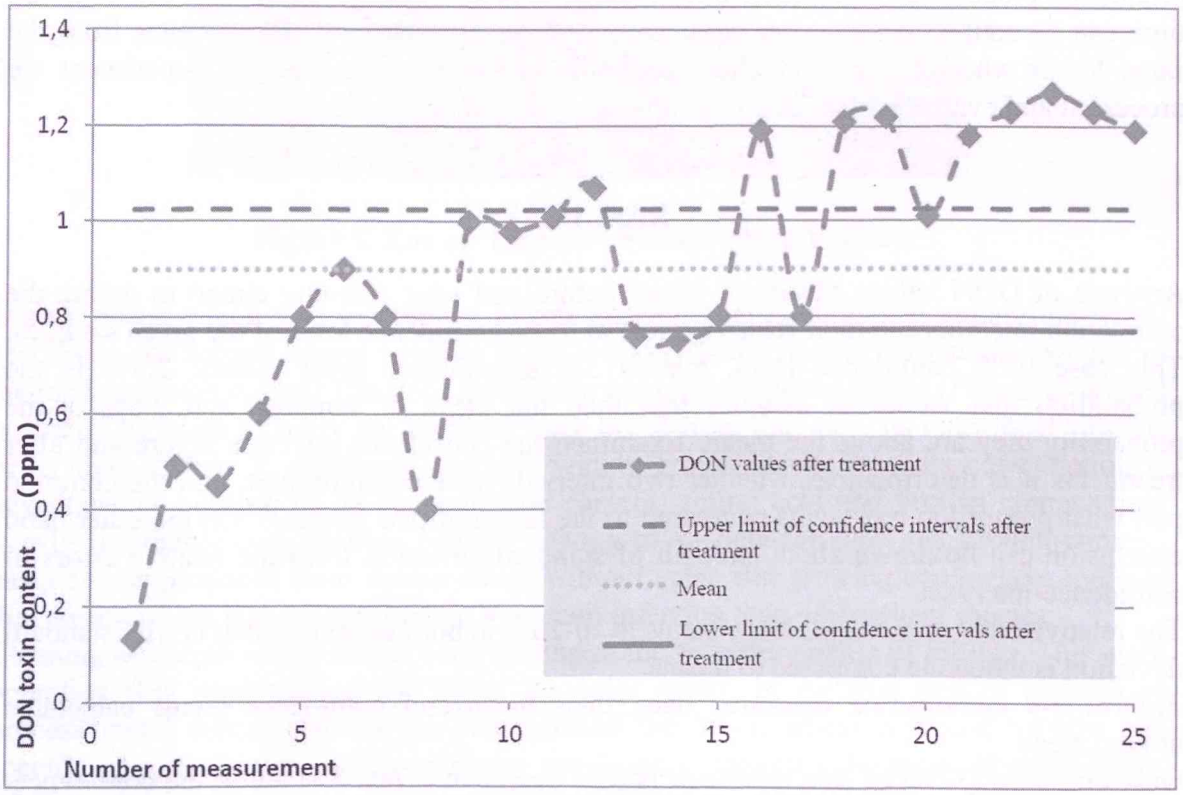

Figure 4. Evaluation of DON toxin content of durum wheat after color sorting by interval estimation

Figure 5 illustrates the values together. The chart shows, that confidence intervals don't have common section. The conclusion from this is that DON-toxin values of samples before and after treatment are significantly different from each other.

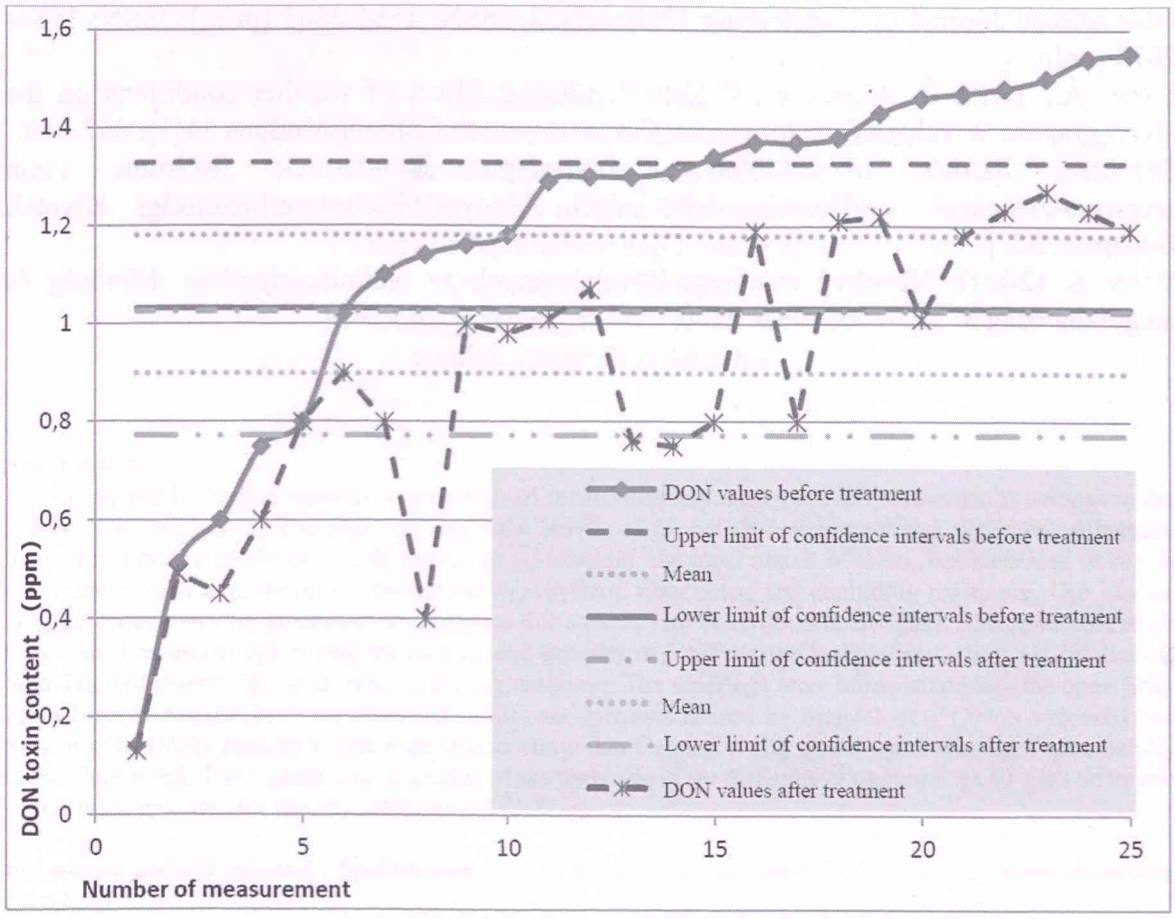

Figure 5. Evaluation of DON toxin content of durum wheat before and after color sorting by interval estimation

CONCLUSIONS

We come to the conclusion from the examination of results, that color sorting of wheat has statistically verifiable effect on the reduction of toxin content. *Figure 3* clearly shows that the confidence-intervals of samples taken before and after treatment are disjoint, that is the effect of cleaning is provable on 95% probability level. Since this is a food safety question, it is important to clarify the results to what extent can be considered stable and repeatable. We didn't get unambiguous answer to this.

Further investigations are required to determine the extent of correlation between different initial micotoxin content of wheat before sorting and efficiency of cleaning. This can give answers whether we can meet food safety regulations consequently and on appropriate level with the application of Sortex Z+ color sorter. The question is whether the method of color sorting is enough to make usable the lot of wheat with higher DON-toxin content for production of flour.

REFERENCES

KECSKÉSNÉ NAGY, E., SEMBERY, P. (2015): The effect of adequate technical conditions on level of don toxin in milling process. ANNALS of Faculty Engineering Hunedoara – International Journal of Engineering 13(1): 49-52. ISSN: 1584-2665 [print]; ISSN: 1584-2673 [online]

SIPOS, Á., TÓTH, É., MARS, Z., GYŐRI, Z. (2006): Effect of weather conditions on the alveo-graphic W value of winter wheat. Cereal Research Communications 34(1): 657-660.

SZEITZNÉ SZABÓ, M. (2009): Gabonaalapú élelmiszerek fuzárium toxin szennyezettségének csökkentési lehetőségei. Magyar Élelmiszerbiztonsági Hivatal, Budapest, 35. p.

VASS, S. (2007): Növekvő minőségi követelmények az élelmiszeriparban. Minőség és megbízhatóság 5: 257-259. ISSN 0580-1185