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THE EFFECT OF ADEQUATE TECHNICAL CONDITIONS ON LEVEL OF DON TOXIN IN MILLING PROCESS

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Abstract: Both the cereals and the processed cereals might contain DON-toxin of Fusarium. In the grain of wheat this toxin can bedetected more often according to science literature. In Hungary lately the concentration of this toxin was often higher in wheat, than the maximum limit in law. It effects quantity of grain crops and in the course of processing like milling as well as feeding it cause problem in food safety. I analised the effect of application of specific machinery on reduction of quantity of toxin in milling process.
Keywords: food chain, food safety regulation, chemical and microbiological requirements, toxin, milling process

1. INITATION

Across the whole food chain – from the production of raw material to processing and sale of final product - the adequate technical background is important factor to fulfil the food safety criterias determined by laws and market requirements. These regulations and standards must be well-known by the organizations which are connected directly or indirectly to the foodchain.

It follows from the foregoing that my research work has two main objectives. On the one hand I analized the optional and obligatory elements of the food safety regulation in order to make that clear for the organisations which don't have close connection with the food chain, like suppliers. I hope it help them understand the system and purport of regulations. But it is important that the suppliers can deliver machinery and equipments which must correspond to the food safety requirements and these conditions can be guaranted for a long time. On the other hand I prove by means of experiment: Adequate technical conditions increase food safety. It help food business operators and their suppliers to be able to ensure that all stage of production, processing and distribution of food satisfy the relevant higiene, chemical and microbiological requirements laid down in the regulations.

The objective of present study is to evaluate and to prove, the adequte technical conditions decrease the mycotoxin content of breadmaking wheat in the process of milling industry. In consequence of this the maximum allowable limit values determined by law can be kept safely.

2. THE BASIS, SUBJECT AND METHOD OF RESEARCH

The objective of my research work to investigate: Is there any, justifiable way to decrease the level of micotoxin - within this deoxinivalenol (DON) content - of breadmaking wheat during the milling process.

The mycotoxins in food are secondary metabolic products of moulds, which have strong toxic effect. These can cause heavy complications in human and animal organisations, can result illness shorter or longer time, and can cause lasting damage. The species belong to Fusarium family produce significant quantity of toxin, which contain several fuzariotoxin. The Fusarium species are parasites on several cultivated plants. In most cases they infect the cereals. So they might cause significant damage both in plant cultivation and animal husbandry as well as there might be considerable human-health consequences. (Mesterházy, 2007; Szabó-Hevér Ágnes, 2013). Deoxinivalenol, otherwise vomitoxin, became known as DON-toxin, is frequent representative of fusariotoxins. This toxin can be found in wheat very often according to Mesterházy (2007). This toxin might be present both in cereals and in processed cereal products, so it is important from the point of food safety. Big quantity of DON getting in human organism for one occasion can result digestive system problems. This is a very stabil chemical substance, it stands out heat effects and does'nt decompose in the manufacturing, storage and handling procedures (Ambrus et al., 2010). This is the reason why highest level of this toxin content in different products is strictly regulated in the European Union. Regulation 1881/2006/EC of the

European Parliament and of Council determines the highest acceptable level of contamination. DON toxin limit in unprocessed bread wheat is 1,25 ppm, and in unprocessed durum wheat is 1,75 ppm. It is compulsory to comply with this regulation, which is not problem for farmers and food business operators in average year. But in rainy years the toxin content of cereals might increase notably.

According to professional literature almost the prevention is considered as an exclusive method to keep below safe level the content of DON-toxin. That is different agritechnical and plant protection methods, best cultivation practices were suggested for farmers to cultivation. In addition must pay attention to timing of harvesting and to drying of grain of cereals within short time, as well as to assurance of good hygienic and temperature parameters of storing (Szabó-Hevér, 2013; Szeitzné, 2009; Commission Recommendation 2006/583/EC).

Weather factors play important role in emergence of fusarium infection and development of toxin content of cereals.This risk factor is out of range of effects of farmers (Commission Recommendation 2006/583/EC; Mesterházy, 1995). Potential prevention might be against these factors usage of resistant varieties in the cultivation. But it is well-known, in this respect the variety-structure haven't been changed in the last years. This means we have to face with fusarium infects during the next periods also, especially in years when the early summer is rainy.

Sándor et al (2010) and Frank (2010) carried out technological research, in which they investigated the effects of cleaning methods and machinery on decreasing of DON toxin content in the course of milling process. They started on the understanding that majority of the toxin is concentrated in the embryo and in the grain-coat. The results proved that application of certain surface cleaning methods can decrease the toxin content of relevant lot of wheat. On the other hand we should take into consideration that the extent and the characteristic of fusarium infection depends on phenological phase of wheat when the fungus inoculate the plant. This determines wether the grain-coat infected only or its inner part also. According to scientific investigation of Veres (2007) there is no close corrrelation between internal and external infection of grain. Beyond this, his results pointed out that the extent of total infection is not in direct ratio to toxic content of wheat. The above results leed to conclusion cleaning of the grain-surface don't provide sufficient certanty to decrease DON-toxin content.

I carried my experiment out under mill industry circumstances in January 2014. I looked for answers to two questions. On the one hand I investigated whether the above mentioned conclusion can be justifiable. The other question: is there other technical, mechanical method to decrease toxin content of wheat in the course of milling technology?

The place of my investigation was at the Júlia Malom Ltd, where I studied how is it possible to decrease toxin content of durum wheat, and what extent by application of Sortex Z optical sorter. The theoretical base of investigation are organileptic properties of grain of wheat. There are pink or whitish mould spots on the grains which are infected by Fusarium sp. and in consequence of infection they become white and their consistency sustain an injury.

There is an optical system in Sortex Z optical sorter. The wheat flows through the system and two cameras take photo of grains at a certain point. The photos are evaluated by the processors of the machine which operate the pneumatic ejector. So the selection of grains by color happen. This machine has wide range of capacity. The adjustment determines the quality of selection and influence the productivity. It is of importance to operate the machine with optimal adjustment. At Júlia Malom Ltd 6 t/h selection speed proved to be satisfactory. This speed was applied during the experiment also.

2.2. Description of experiment

The experiment was built in the milling technology process of Júlia Malom Ltd, consequently it wasn't a modell research. My objective was to investigate, if it possible to decrease DON-toxin content of bread-making wheat and to minimize the food safety risk by application milling technology with good production practice and technological conditions.

Wheat samples were taken directly before and after color-sorting in the cause of exact tracing of toxin content of relevant sample. We investigated DON-toxin content of 25 samples during the experiment. It was important for us that the initial samples must have different toxin content. This was realized by changing of mixing proportion of lots with different parameters. We made every effort to use starter samples with DON content close to the critical level determined by law, because reduction of toxin content is principal thing in this range from the point of food safety. (Figure 1) The samples taken before sorting by Sortex Z indicate the initial toxin content of investigated wheat. After sorting we can evaluate mikotoxin decreasing efficiency of the process by means of analytical results of relevant samples.

Toxin analysis was carried out in own laboratory of Júlia Malom Ltd with AgraQuant Deoxinyvalenol test kit which is a quantitative enzyme-linked immunosorbent assay (ELISA) for the analysis of DON in cereals developed by Romer Labs. The test isn't accredited, but its precision is verified regularly by control tests in other laboratories.

3. RESULTS

As it appears from results of tests after sorting by color the DON toxin content of lots of wheat is lower compared to initial datas. (Figure 1.) Consequently it is possible to decrease toxin content by application Sortex Z machine in technological process.

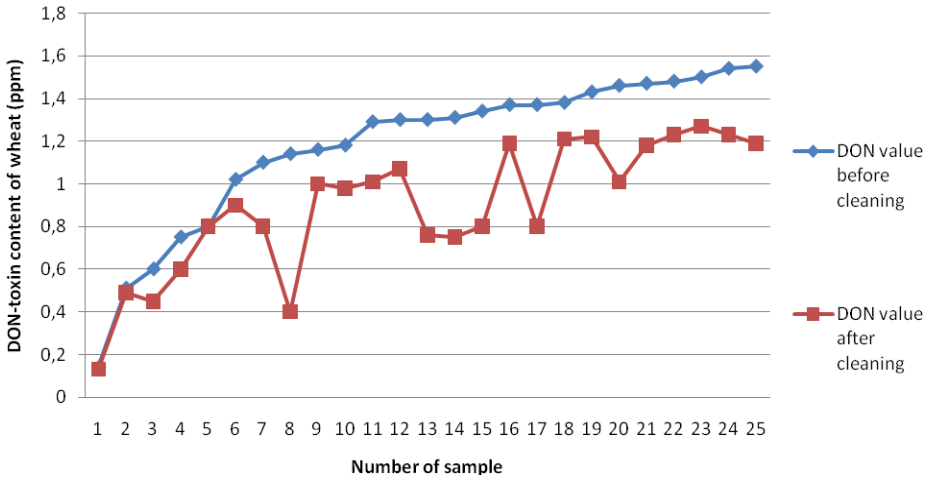

Figure 1. Change of DON-toxin content of wheat after color sorting

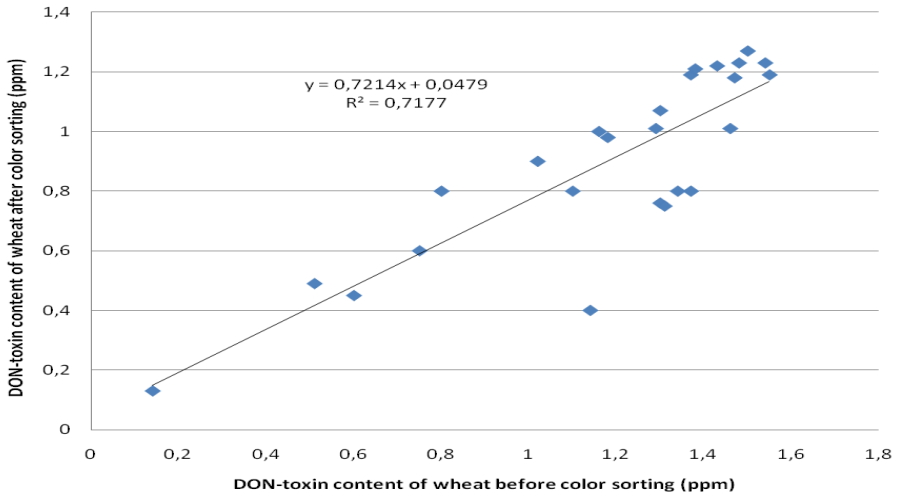

Figure 2. Correlation analysis of DON-toxin content of wheat before and after color sorting

Fort he sake of lucidity I sorted the values of DON of wheat-lots in growing order. So the figure shows if toxin infection of initial sample is lower, than the efficieny of cleaning is lower also, while the operation of sorter is more efficient at harder infected wheats. This is advantageous process in respect of food safety.

Figure 1. well demonstrates that decreasing of toxin isn't linear, or to be more exact there is a big fluctuation. We can draw a conclusion from this that Sortex Z color sorter is not able to select and to remove from the system each infected seed. It is worthy to make further examination about correlation between initial toxin content of wheat and micotoxin content after cleaning. Correlation between datas can be analyzed by regression function. Figure 2. shows the values before cleaning and after cleaning are not independed of each other. From the value of determination coefficient can be calculated the absolute value of correlation index. (r=0,8471). Linear correlation index indicates there is strong connection between values before cleaning and after cleaning. So decreasing of toxin owing to cleaning process can be evaluated as a good and effective method.

If we analyse the coefficient of determination, namely its value in percent, we can see 72 % of decreasing of toxin was owing to cleaning method and 28 % was resulted by other factors.

4. CONCLUSIONS, SUGGESTIONS

During my reserchs work I looked for answer: Is there any opportunity in the milling technology to decrease DON-toxin content of wheat below the food safety limit value to an acceptable level. The results of tests proved the DON fuzariotoxin content of breadmaking wheat expressly decreased by the application of Sortex Z color sorter in given research circumstances. But the degree of decreasing alternates and can not be well-defined in advance. The reason of this, the color sorter machine is not able to select infected grains with absolute certainty. If high toxin content don't goes together with change of grain color, it will not be selected by machine and it continue on milling process and final-product. If this level is kept below food safety limit the consumption of these products don't cause illness.

Results of present tests showed the effect of color selection on decreasing of toxin content is 72%, and the effect of other factors 28%. In my opinion this is not satisfactory security from the point of food safety. But it is encouraging result, the decrease of toxin content was balanced at 1/5 part of tested samples with higher level of infection. Further investigations are required to undoubtable verification.

Summing up what has been written above it is possible to decrease DON-toxin content of wheat, but further investigations are required to prove its efficiency and reliability. The influence of different kind of fusarium infection on efficiency of Sortex Z must be investigated. Influence of different years and different geographical areas deserve attention also. Moreover it is necessary to analise efficiency of other cleaning methods separately and in combined application.

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