



## CONNECTION BETWEEN THE DEBRANNING TIME AND THE KERNEL HARDNESS OF WHEAT

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### ABSTRACT

Surface cleaning has an important role in the technology of milling of wheat considering food security. Wheat hardness has an effect on the milling process, it determines the properties, qualities and end use of flours. In the last decade new debranning methods have appeared, which are able to better remove the shell of wheat grains applying rubbing surfaces. In my thesis I examined how different levels of debranning affect hardness and content of ash in wheat types with different grain structure. Conclusion is with approximately 4% of shell removed the hardness of grain. Further removing of shell does not result in further changes though. Reduction of hard wheat's general grain size with longer debranning process is larger compared to soft wheat's.

Keywords: PeriTec technology, SATAKE, debranning, wheat kernel hardness

### 1. INTRODUCTION

In the last 25 years, the importance of endosperm classification (soft and hard wheat kernel) has grown bigger. Wheat-hardness is an important parameter of wheat quality, the wheat hardness has an effect on the milling process, it determines the properties, qualities and end use of flours. In recent years the debranning of kernels before milling has moved to the forefront. The kernel hardness has great effect on the baking properties (water absorbent capacity, mixing time, kneading time) of the resulting flour. Flour, which is made from hard wheat generally have a medium to high protein content and stronger gluten than flour, which is made from soft wheat [4]. The friabilin protein complex determines the kernel hardness. Generally, when the amount of the friabilin is high, the kernel hardness is soft and when the amount of the friabilin is low the kernel hardness is hard. Kernel hardness is an important measurable attribute of wheat that has been correlated to it's chemical and genetic make-up. The evaluation of wheat kernel hardness has been used in predictions of flour yield and gives early indication of baking performance [5]. Factors influencing kernel hardness include variety and environment, however the total variation in hardness has yet to be explained. Hardness is suggested to influence the adhesion forces between starch granules and protein matrix whereas vitreousness would rather be related to the endosperm microstructure [2].

Ref. [1] based on a process of peeling, which is traditionally milled grain products (rice, barley, oats) are used during production. Funds that intense influences (peeling, grinding) on the grain surface of the shell is detachable parts, the outer layers of the kernel can be removed.

The bran of wheat kernel branch makes up 14-16%, which is the outer skin layers, including the aleurone layer. The latter is usually removed together with the other layers during milling technology, although botanically the aleurone layer is the outer layer of the endosperm [6]. Bottega et al [1] highlight the fact that the wheat peeling allows the removal of the outer skin layers and keeping the aleurone layer in a controlled manner.

#### 1.1. PeriTec 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. During our experiments we dealt with the laboratory modelling of a new milling surface treatment called PeriTec technology to find out to what extent this method can use to debranning wheat.



The aim of our work was to demonstrate and compare the changes in different parameters of wheat kernels, ash content, percentage of broken kernels, peeled bran content, Hardness Index as the function of debranning times.

## 2. MATERIALS AND METHODS

We have two different kernel hardness Hungarian wheat varieties: sample 'A' was the soft kernel hardness, and sample 'B' was the hard kernel hardness. Sample 'A' and 'B' were air-dried (at 10-11% humidity) and 15% moisture content, they were carried out in the conditioned state experiments. The conditioning was calculated based on the initial moisture content and weight of the amount of wheat, with tap water at 20 °C. After conditioning the samples to a moisture content of 15%, they were subjected to different levels of rubbing applying 0, 10, 20, 30, 40 and 50 s operation times.

To the debranning we used PeriTec 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 modelled the PeriTec technology with a laboratory size, batch-operating, horizontal debranning machine by SATAKE (Figure 1.).



*Figure 1. SATAKE machines*

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 6367/15-84. We used a Perten SKCS 4100-type instrument to measure kernel hardness (Hardness Index).

The Perten SKCS 4100 instrument is one of the well know machines, which examine the kernel hardness. This device measures kernel texture by crushing the kernels one at a time, recording the force required to crush the kernel, and reporting the average force for crushing 300 kernels, in terms of a hardness index (HI) [3].



*Figure 2. Perten SKCS 4100 machine (Perten Inc)*

### 3. RESULTS AND DISCUSSION

Examine the function of the various grinding times (0, 10, 20, 30, 40, 50 seconds), the detached shell, the broken grains rate and ash content, we can be a following conclusion: more grinding time with the SATAKE laboratory peeling equipment, more hulls have been removed.

As the mass ratio and the detached shell material grew, it reduced the ash content of wheat. The grinding time is increased by the shell content of endosperm has also been discarded parts. The increasing grinding time, the sample had a greater amount of mechanical stress, which resulted in a growing proportion of broken grains.

*Table 1. The results of removed parts and ash content*

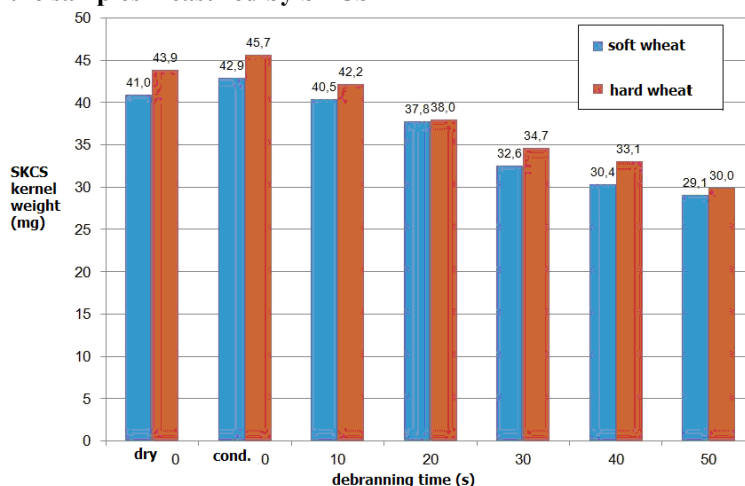
Wheat sample	Debranning time (s)	Removed parts (%)	Ash content(%)
'A' sample	0	0.00	1.69
'A' sample	10	4.30	1.62
'A' sample	20	10.05	1.47
'A' sample	30	18.75	1.32
'A' sample	40	27.78	1.26
'A' sample	50	34.33	1.20
'B' sample	0	0.00	1.78
'B' sample	10	3.90	1.76
'B' sample	20	8.85	1.62
'B' sample	30	13.88	1.42
'B' sample	40	18.53	1.32
'B' sample	50	22.00	1.26



The removed part of the soft wheat sample ('A' sample) was higher than the hard wheat sample ('B' sample), because more endosperm part of the wheat was removed (it is go away with coat of the kernel). When the debranning time is more the removed parts will be more. The polishing time is increased by the shell content of endosperm has also been discarded parts. As the mass ratio and the detached shell material grew, it reduced the ash content of wheat.

### 3.1. Result of SKCS

#### Kernel weight of the samples measured by SKCS



*Figure 3. Results of Perten SKCS kernel weight of wheat samples*

The graph clearly reveals that a weight of the wheat in the air-dry condition is slightly lower than the conditioned wheat samples. During the debranning of wheat to lose weight, it is mean the outer coat losing. At the beginning the weight of hard wheat ('B' sample) is greater than the weight of the soft wheat ('A' sample). The debranning degree is increase and it is reduce the mass proportion of the kernel, the reduction can be made between 3-15 mg.



### Kernel size of the samples measured by SKCS

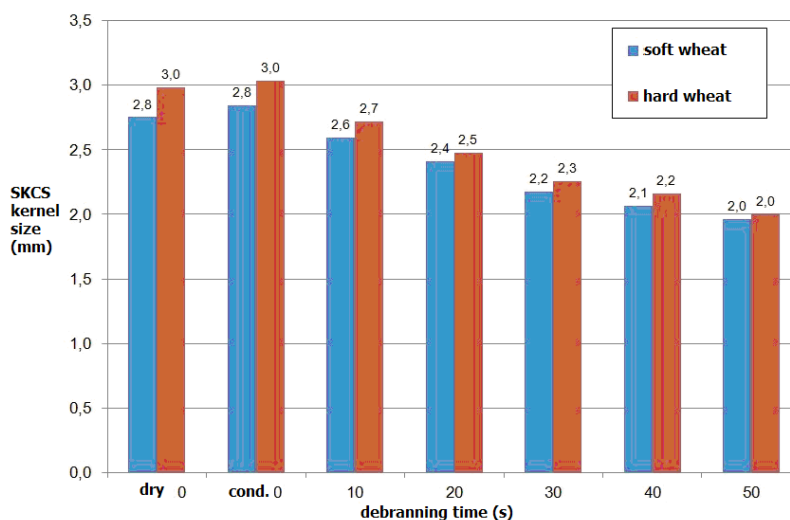


Figure 4. Results of Perten SKCS kernel size of wheat samples

There is no difference between the air-dry wheat size and the conditioned wheat size. After the debranning the size of kernel decreased steadily, the longer debranning of a sample, the reduction of the kernel size was greater.

### Kernel moisture content of the samples measured by SKCS

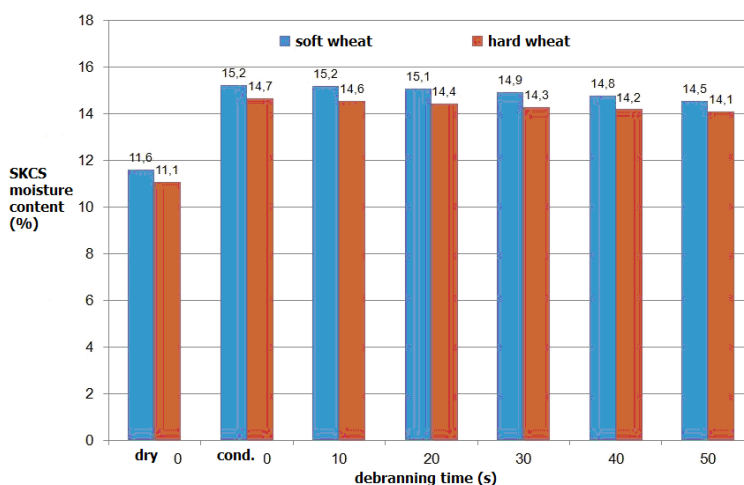
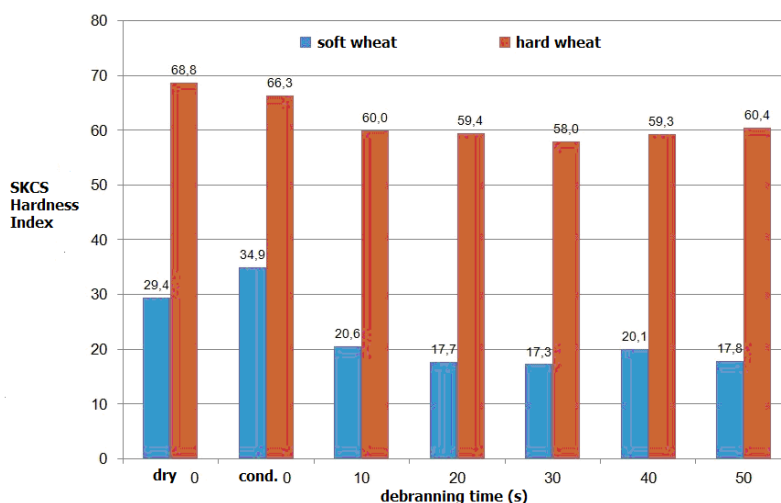


Figure 5. Results of Perten SKCS moisture content of wheat samples

The moisture content of the air-dry wheat is 11-12%, the conditioned wheat moisture content is between 14-15%. After the different debranning time the moisture content is reduced somewhat, which could happen due to the material dries.



### Kernel hardness of the samples measured by SKCS



*Figure 6. Results of Perten SKCS Hardness Index of wheat samples*

The Hardness Index of the hard wheat ('B' sample) was between 60-70, and the soft wheat ('A' sample) is between 17-35. After 10 s debranning time the Hardness Index decreased both samples. There was no significant difference between the 10-second and 50-second debranning time.

### 4. CONCLUSION

Same debranning time causes higher debranning losses in the soft wheat ('A' sample), than the hard wheat ('B' samples). The reason is the soft wheat kernel was broken easily and more removed parts were generated. As a result of debranning, the 40 s treatment reduced ash content of wheat, over this, it has not changed significantly. The 10 s debranning effect is approx. 4 % decrease of the wheat part, the hardness index decreased in both samples.

The associations found in this study will help to better understanding the wheat kernel hardness and wheat debranning technological aspects as well as provide useful information to breeders to develop new, high quality hard a soft wheat varieties.

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