Nutritional and bioactive properties of hulled and naked genotypes of oat intended for cultivation in Poland

Danuta Boros and Damian Gołębiewski

Laboratory of Quality Evaluation of Plant Materials

Institute of Plant Breeding and Acclimatization – National Research Institute, Radzików, Poland

OUTLINE

- ✓ Introduction
  - importance of oat in Polish agriculture
  - end-uses of oat
  - oat breeding program in Poland
  - benefits of eating oat products
- ✓ Objective
- ✓ Material and methods
- ✓ Results
- ✓ Conclusions

Importance of oat in Polish agriculture

- The area under oat cultivation is steadily shrinking over the last few decades in Poland
- In 2014 oat was grown on nearly 0.460 Mha, constituting 6% of the area applied for all cereals
- With the production of 1.460 Mt. Poland is still one of the world's biggest producers of oat

End-uses of oat

- Nearly 80% of oat is used for feed, 5% for human consumption and the rest for sowing in Poland
- Each of the end-uses of oat requires grains of specific quality parameters
- Excellent cultivars for feeding purposes should characterise with a large grain, low content of hull and high content of protein and fat. High hull content of oat is the main determinant of its use in feed ration for monogastrics (Svihus and Gullord, 2002)
- Genotypes suitable for human consumption should stand out additionally in high content of β-glucan, main component of dietary fibre, and other bioactive components (Wood, 2007; 2011)

Utilization of oat in food sector per capita in Poland

(Central Statistical Office of Poland, 2014/2015)

Total production	1.460 Mt	1897 g/year 5.2 g/day 3.74 g of groat/day
Uses for food	73 Kt	
Total population	38.48 Mln	

Oat breeding program in Poland

- Selection towards high end-use quality has been adopted as a priority direction in the oat breeding program in Poland
- Grain weight, grain density and adjustment, content of hull, protein, fat and β-glucan are taking as a goal in this program: (Nita, 2003; Prażak and Romanowicz, 2014)
- Oat breeding program is resulting in 31 cultivars of Polish origin currently admitted to the Polish National List of Agricultural Plant Varieties, representing 27 hulled genotypes and 5 naked genotypes. Only one hulled cultivar from abroad is on this list

Benefits of eating oat products

- Regular eating of foods produced from oat, cereal having the greatest content of soluble β-glucan, which is considered to increase the viscosity of the gastrointestinal ingesta, leads to slower gastric emptying, enhanced gut fill and slower absorption of nutrients, reduction of the blood cholesterol level and post-prandial glycaemic responses (Wood, 2007; Granfeldt et al., 2008; Whitehead et al., 2014)

- Knowledge regarding variability of the chemical composition is therefore of significant importance and help in proper and full utilization of established and newly developing varieties of oat

Objective

The objective of this study was to determine the suitability of advanced breeding materials and varieties of oat currently approved for cultivation in Poland, either as sources of high nutritional, bioactive and pro-healthy properties in human food or as valuable feed components for monogastrics.

This objective was accomplished through the parallel examination of intact grain and its dehulled counterpart.

Materials

Material for the study comprised of 30 genotypes of hulled and 6 genotypes of naked types of oat, including 17 breeding lines and 19 cultivars registered in Poland, grown in one location in 2014.

Analyses and Methods

The following physico-chemical parameters were determined:

1000 kernel weight, density, content of gross energy, protein, ash, lipids, starch, free sugars

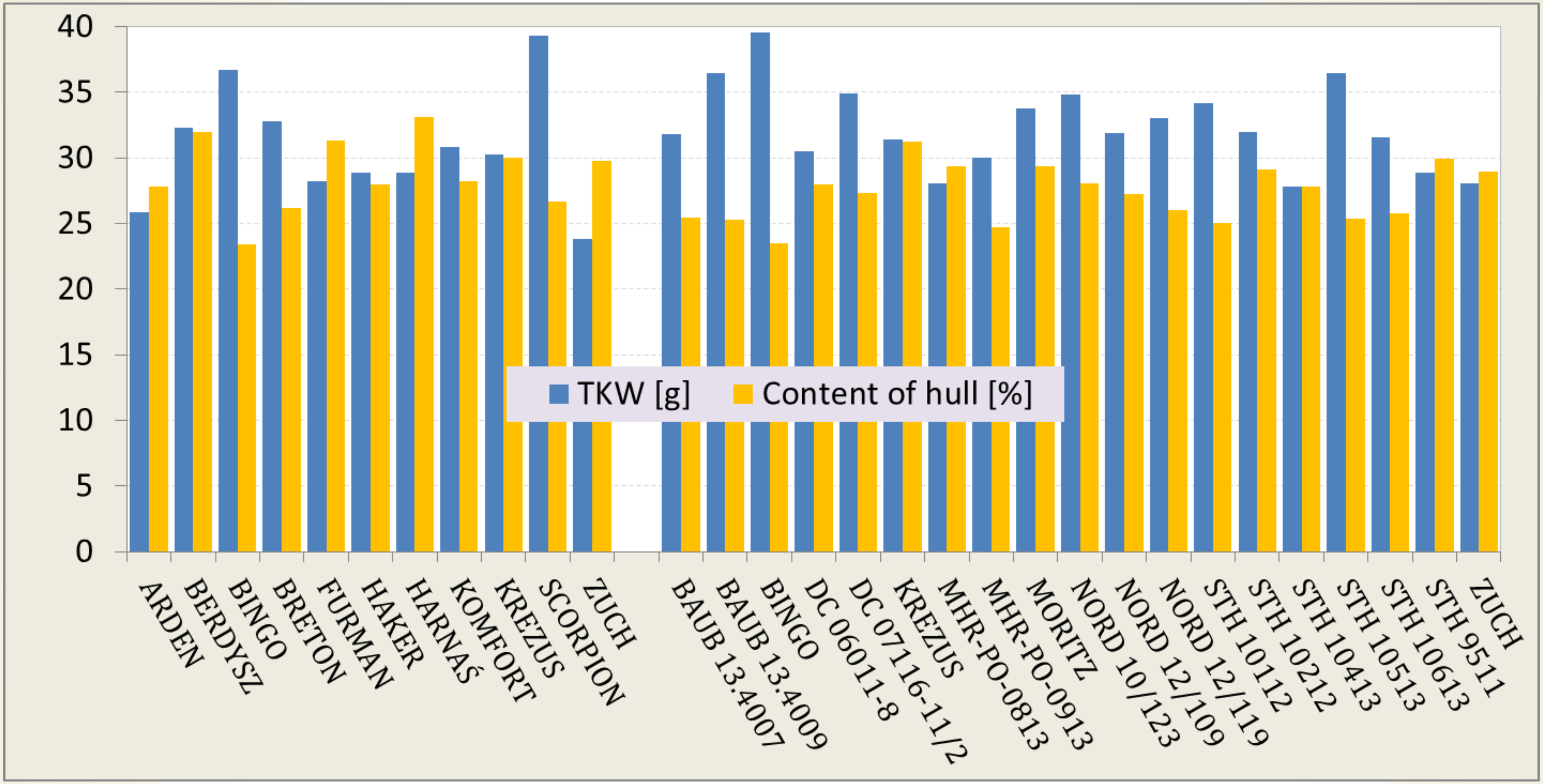
dietary fibre (TDF) - as a sum of water soluble and water insoluble non-starch-polysaccharides (NSP), including β-glucan and Klason lignin

To determine hullability and also for providing material for analyses, 50 g of the grain of each cultivar was dehulled by hand

All analyses were performed in duplicate with standard procedures of AACC, 2011) and the results were expressed in dry matter basis (as % of DM)

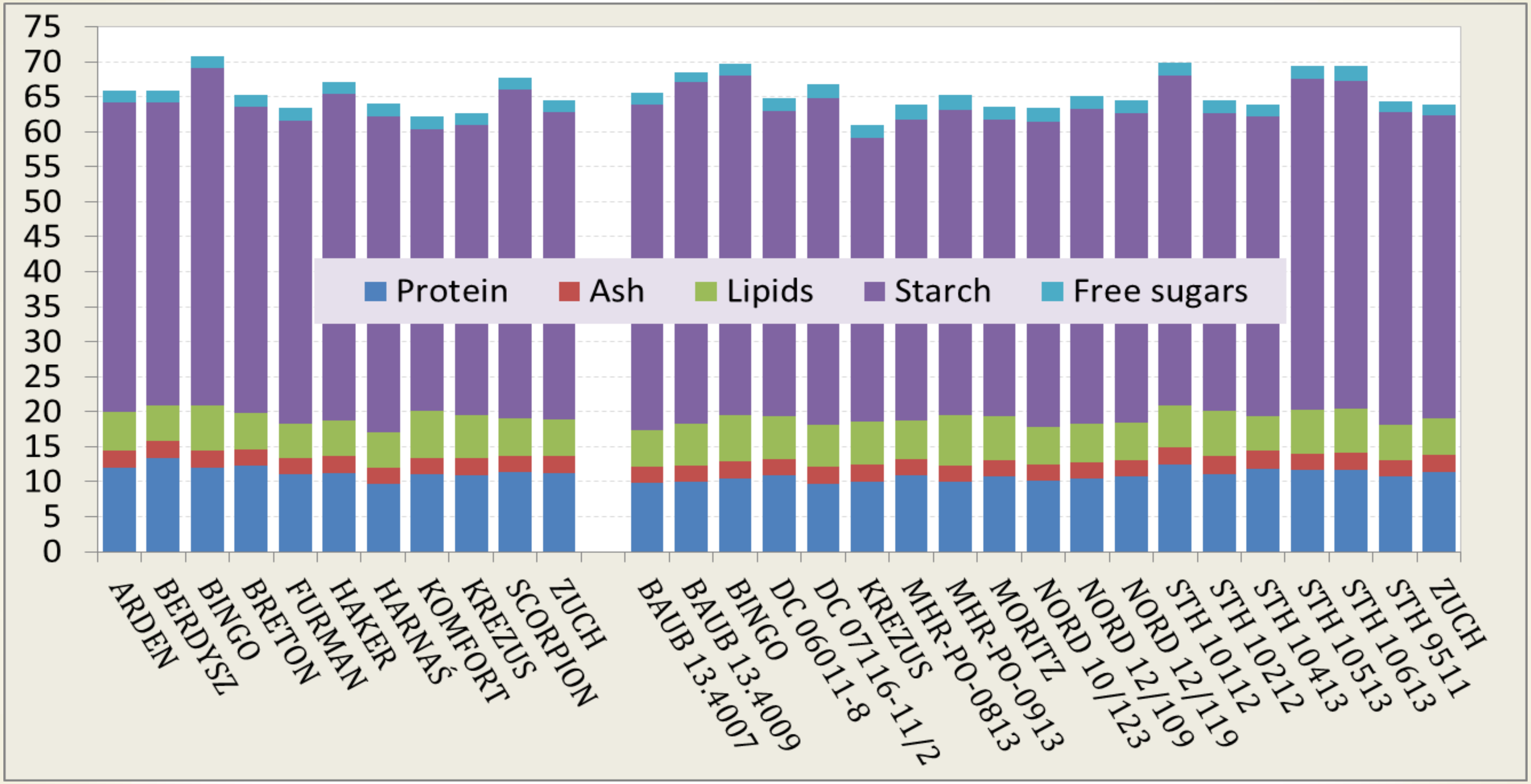
RESULTS OF HULLED OAT

Thousand kernel weight (TKW) and hull content



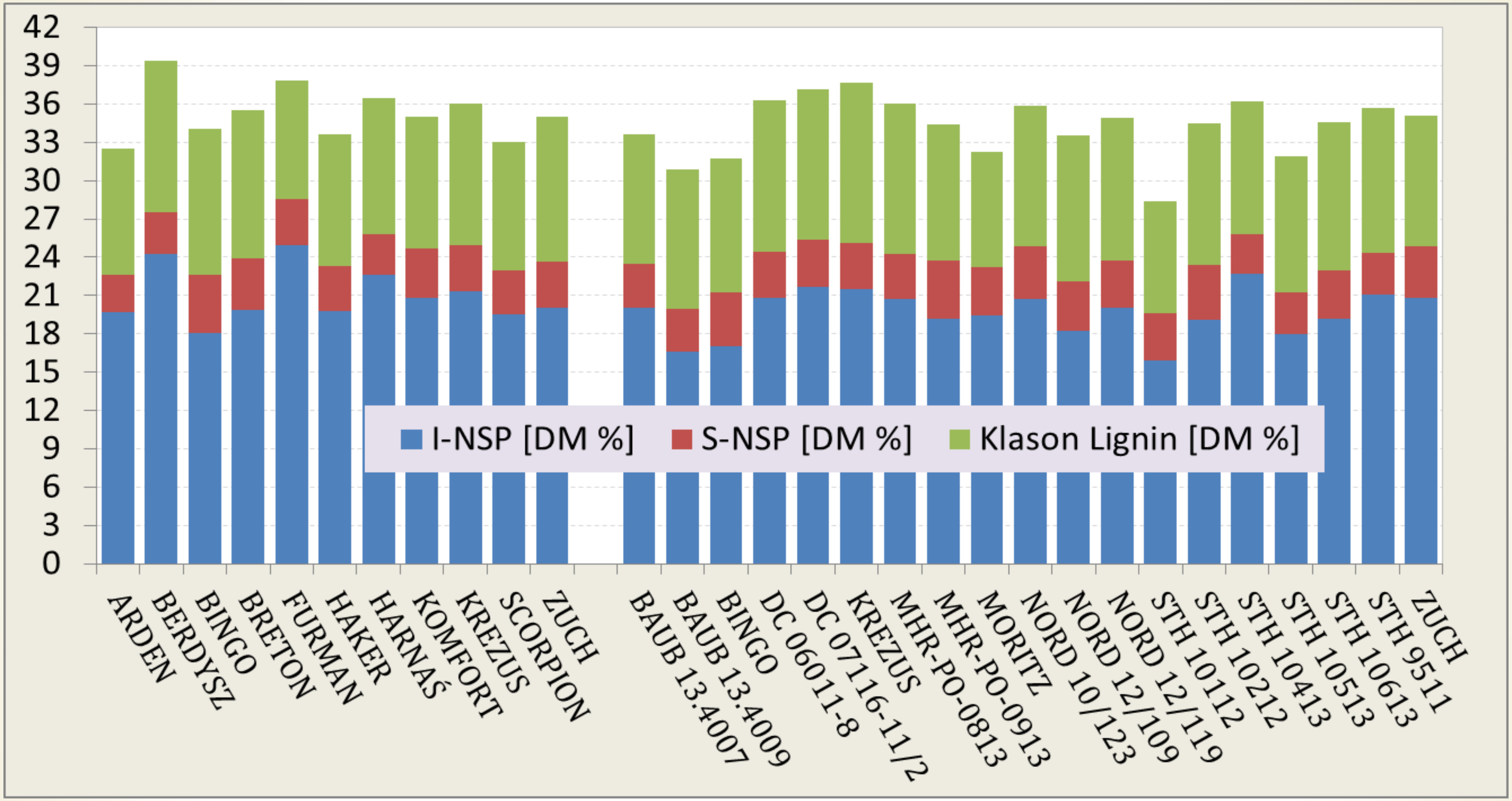
VALUE	*TKW*	*Hull content*
Min.	23,8	23,4 (Bingo)
MEAN	***31,8***	***27,8***
Max.	39,6 (Bingo, Scorpion)	33,1
CV	12	9

Content of nutrients [% of DM]



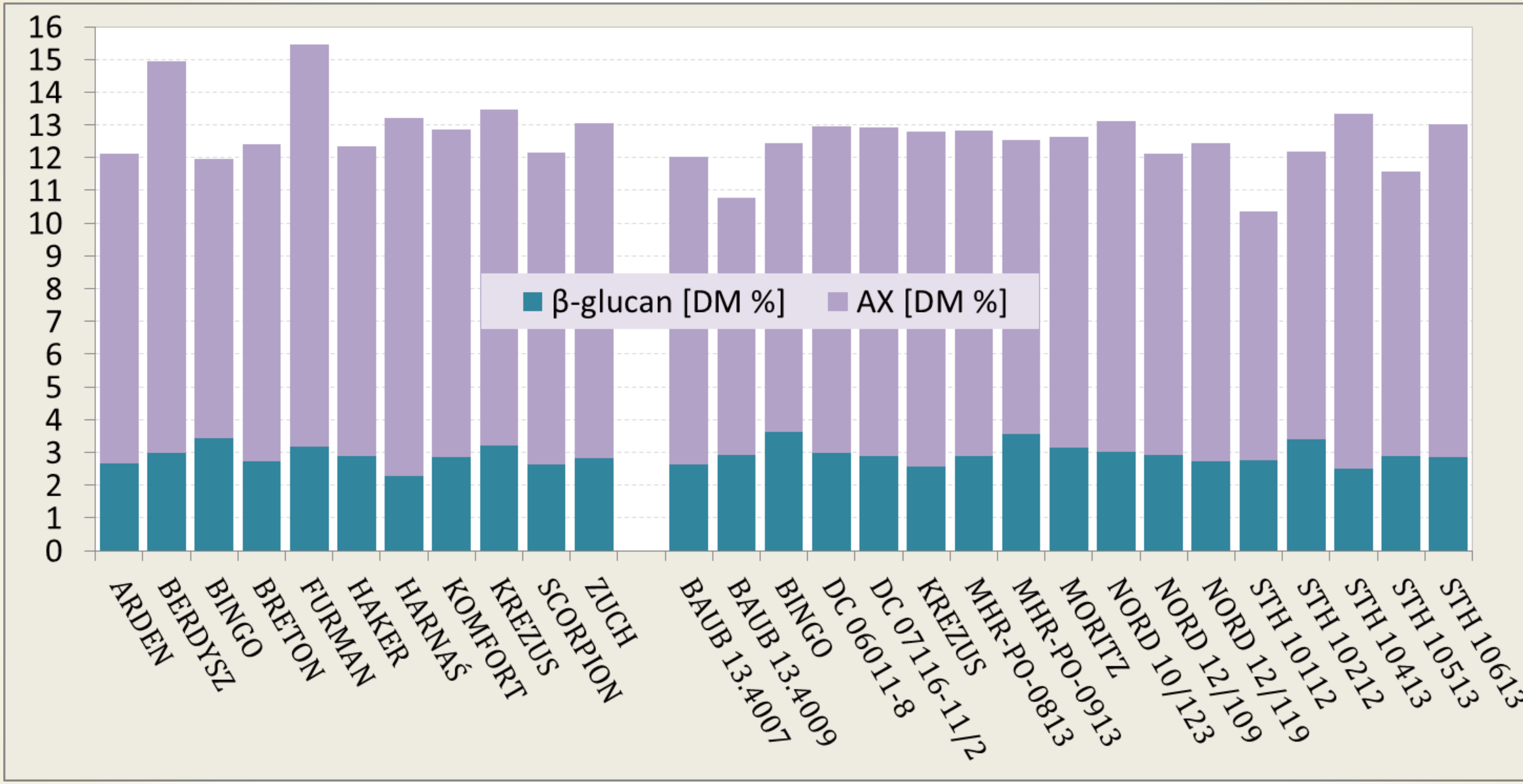
VALUE	*Protein*	*Ash*	*Lipids*	*Starch*	*Free sugars*
Min.	9,7	2,2	4,8	40,2	1,46
MEAN	***11,0***	***2,37***	***5,7***	***44,6***	***1,80***
Max.	13,4	2,5	7,1	48,7	2,15
CV	8	3	11	5	9

Dietary fibre content and composition [% of DM]



VALUE	*I-NSP*	*S-NSP*	*Lignin*	*TDF*	*I-NSP % in TDF*
Min.	15,9	3,0	8,8	28,4	53
MEAN	***20,1***	***3,69***	***10,8***	***34,6***	***58***
Max.	25,0	4,5	12,6	39,4	66
CV	10	11	8	7	5

Content of β-glucan and arabinoxylans



VALUE	*β-glucan*	*Arabinoxylans (AX)*
Min.	2,3	7,6
MEAN	***2,9***	***9,7***
Max.	3,6 (Bingo, MAH-PO-0913)	12,3
CV	11	11

Effect of hull content on physico-chemical properties of oat

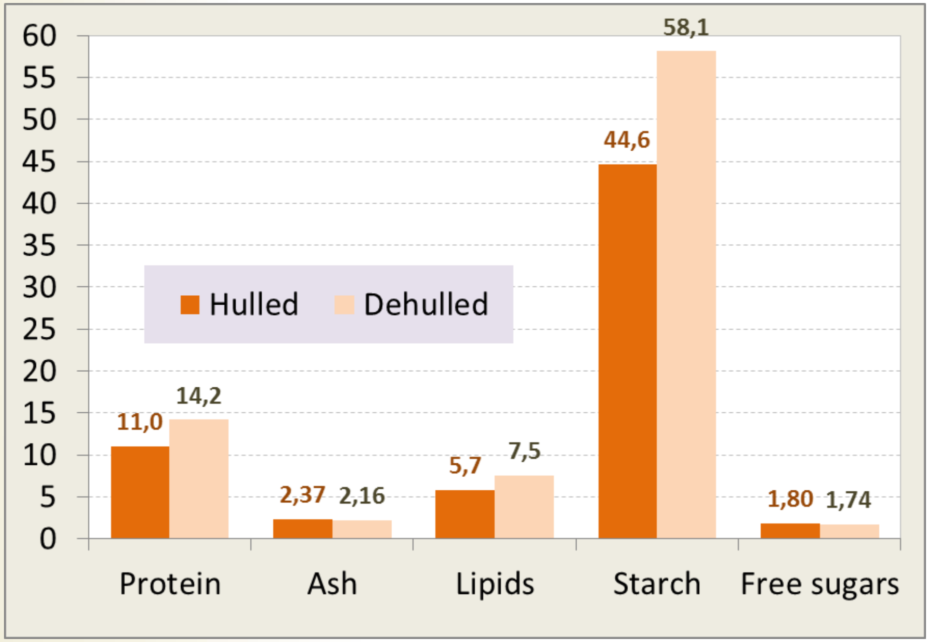
MTZ	-0,547
MHL	-0,499
Lipids	-0,456
Starch	-0,651

I-NSP	0,771
S-NSP	-0,420
T-NSP	0,727
β-glucan	-0,359
T-AX	0,746
TDF	0,661

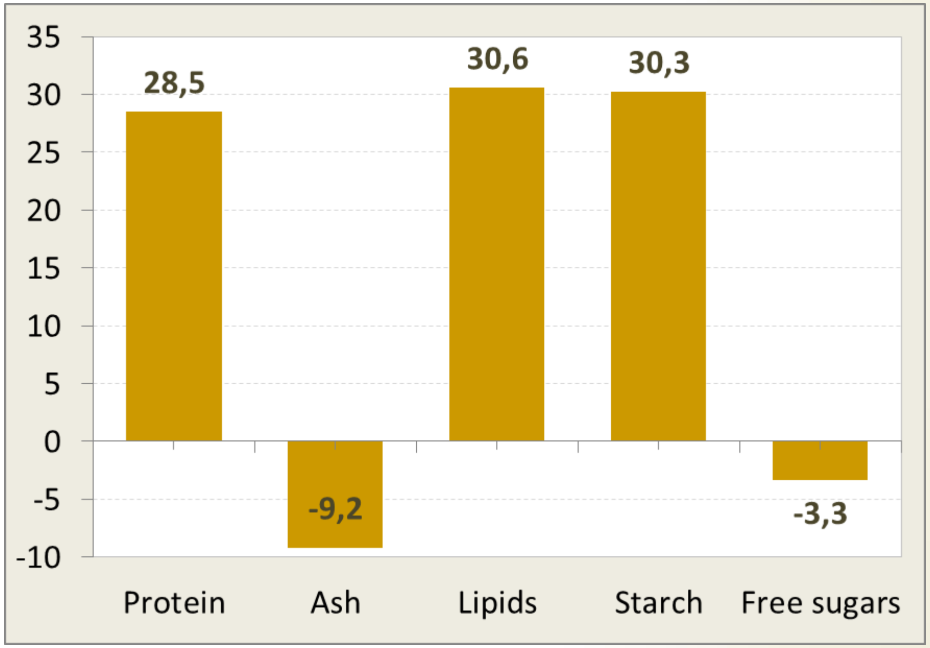
EFFECT OF DEHULLING

Impact of dehulling on content of nutrients

Comparison between hulled and dehulled values

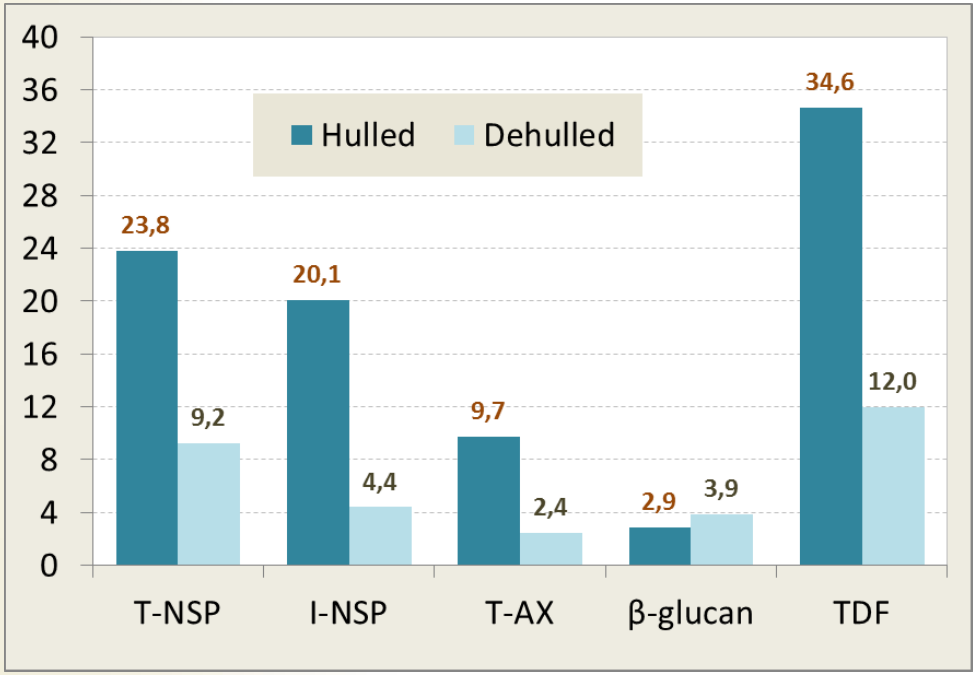


Differences as compared to hulled values [in %]

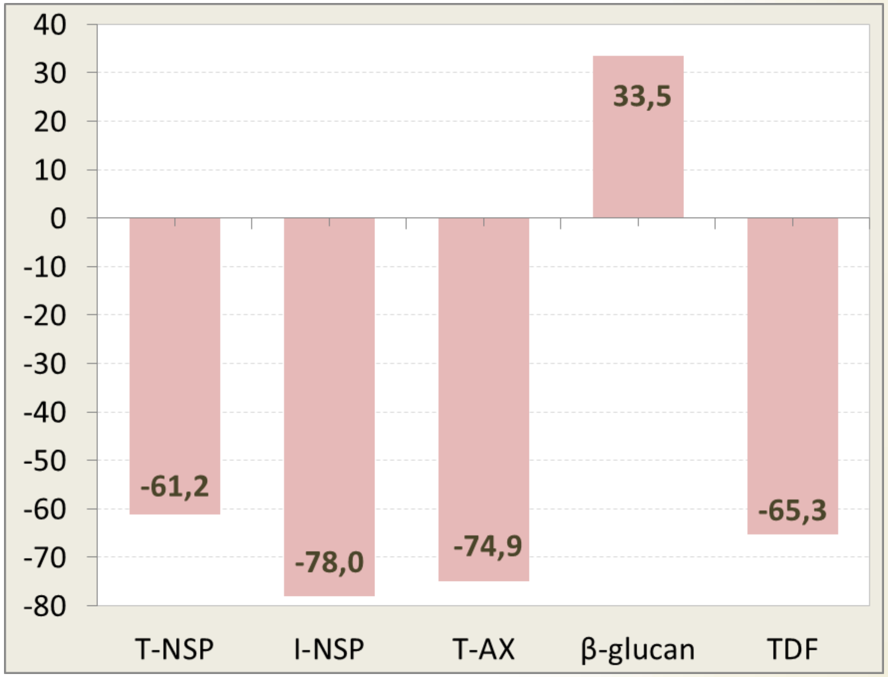


Impact of dehulling on dietary fibre content and composition

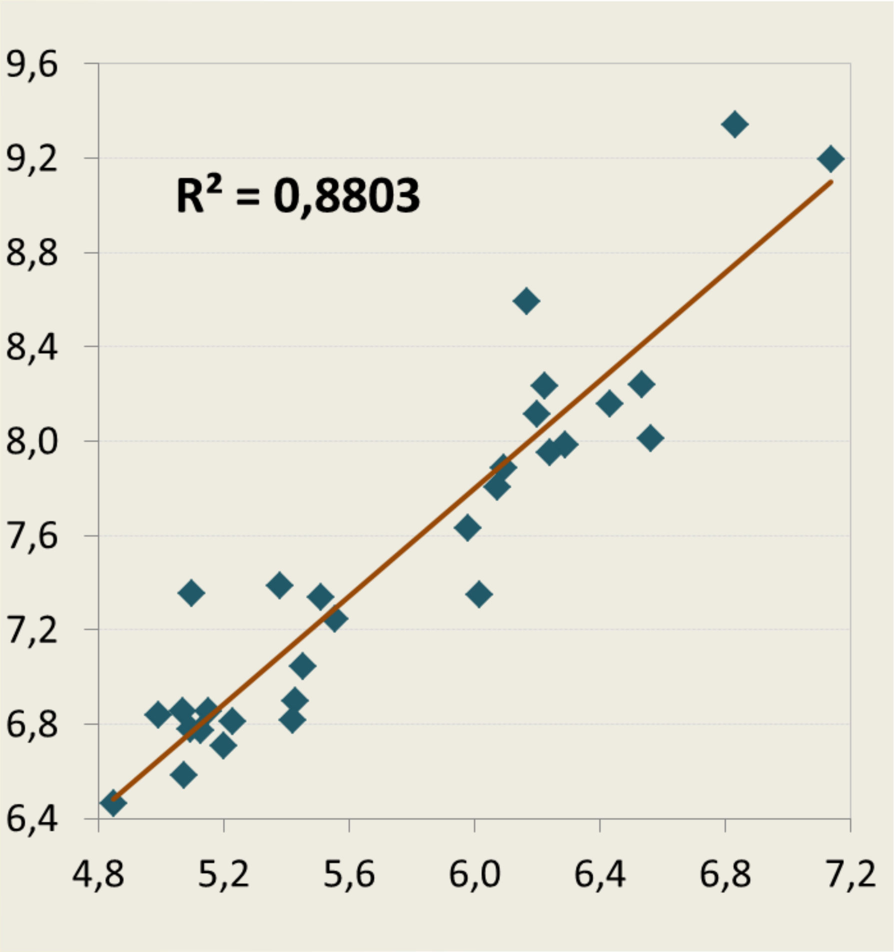
Comparison between hulled and dehulled values



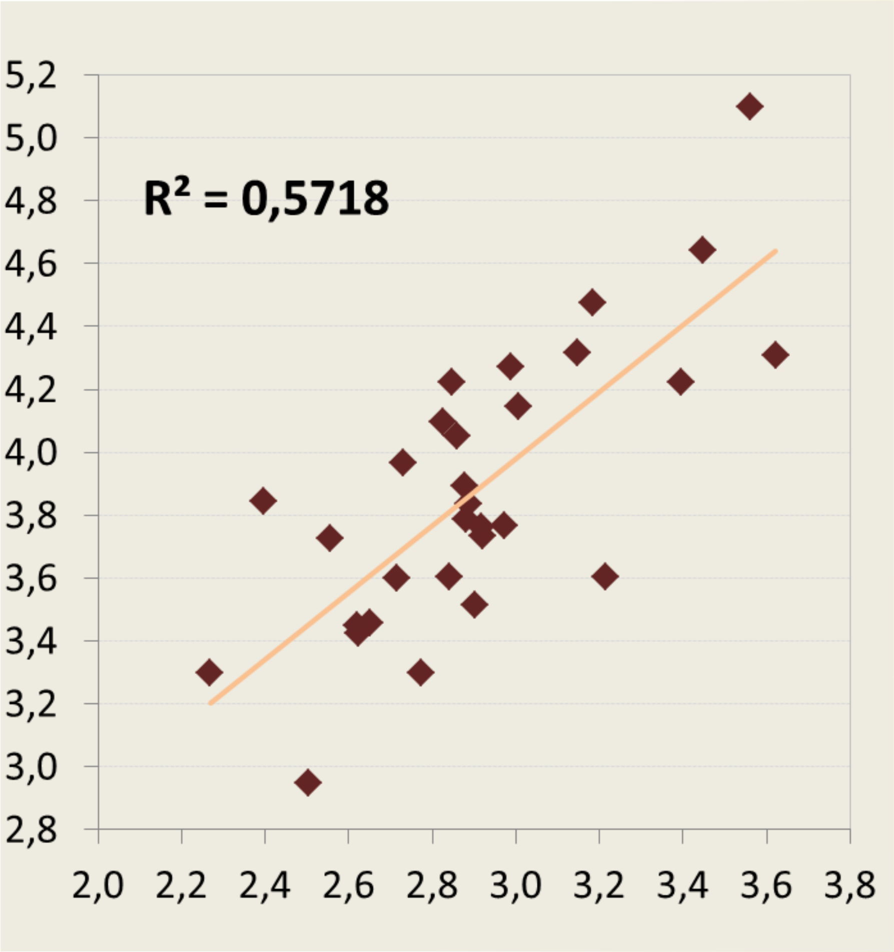
Differences as compared to hulled values [in %]



Correlation between contents of lipids and β-glucan in hulled and dehulled grains

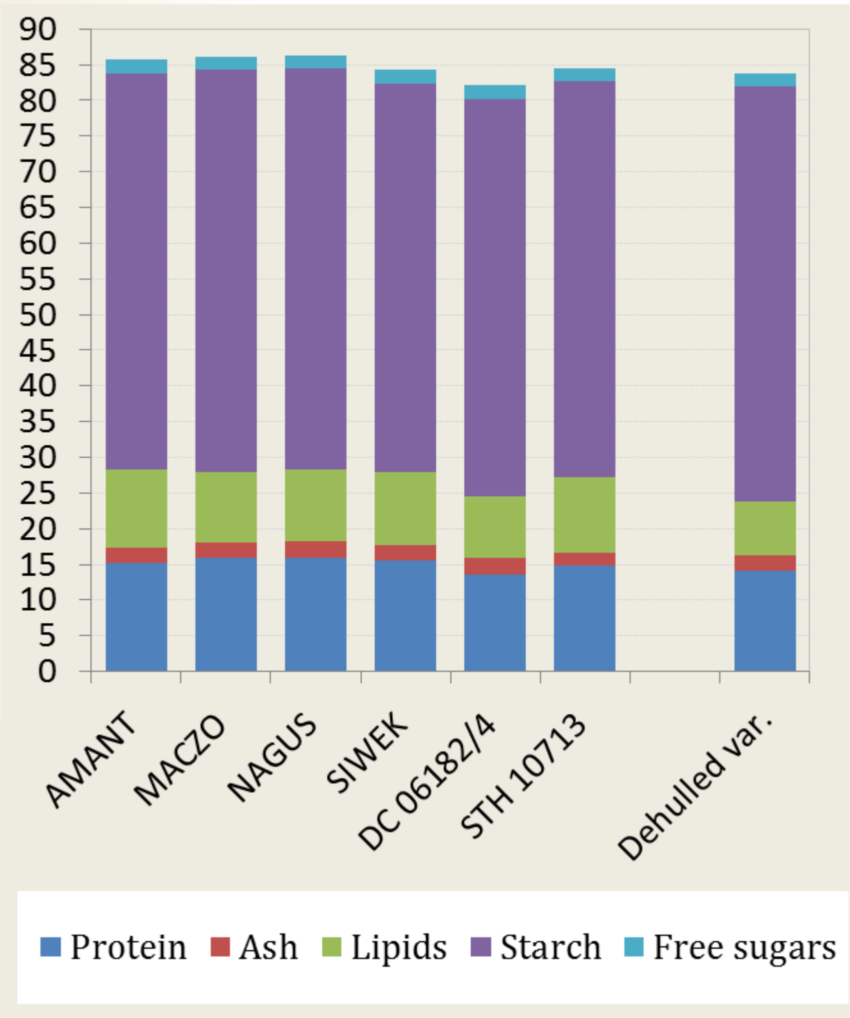


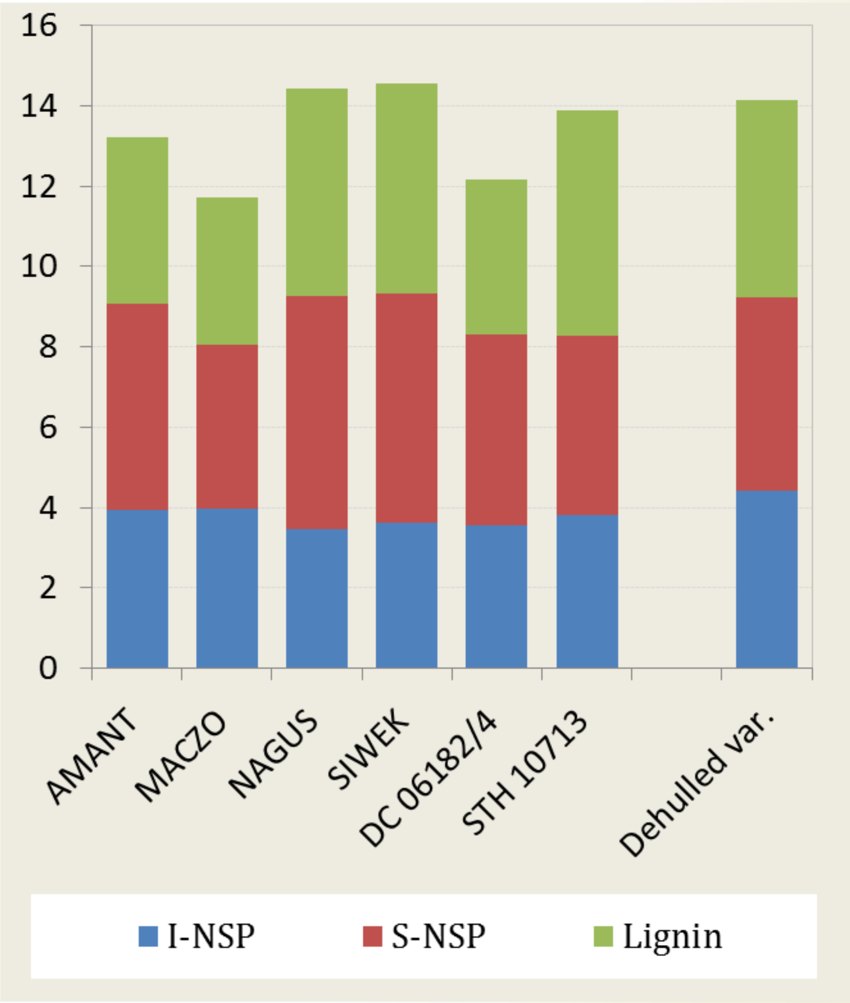
Lipids



β-glucan

Comparison of chemical characteristics of dehulled and naked varieties of oat [% of DM]





Conclusion

- ✓ Further decrease the content of hull in oat breeding will improve quality traits for two main ways of its end-uses
- ✓ Variability in contents of nutrients and bioactive components within cultivars and superior breeding lines indicates the possibility to select the proper genotypes for desired end-uses
- ✓ Removing hulls from oat increased content of these ingredients, which are located in endosperm and germ of the kernel

Thank you for your attention

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