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QUALITY PARAMETERS OF SWEET CORN GRAIN

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Abstract

During 2012-2014, the sugar, protein and cellulose content in the grain of six of the most popular sweet corn hybrids in Bulgaria was fixed as part of creating Sweet Corn Producing Technology at the Agricultural University. *Challanger* (F_1) and *GSS* keep their sugar content longest, which makes them most suitable for fresh storing. The content of cellulose and protein in the cobs of all tested hybrids was relatively low – less than 6%, which makes them extremely suitable for human food. Protein is at least about 4%, values comparatively low even for cereals, but they are registered in the milky maturity of the crop and considering the high sugar content in the grain the crop is characterized as dietary and healthy food.

Keywords: sweet corn, quality, sugar decomposition.

INTRODUCTION

Sweet corn (Zea mays ssp. Saccharata Körn) is one of the ten subspecies maize (Tomov, 1984). It differs in the structure of the endosperm in its grain consisting of water-soluble carbohydrates.

A characteristic feature of the grain is a high content of water-soluble proteins and fats, which considerably increases its nutritional properties compared to other maize subtypes (Mitev, 1984).

The grain of sweet corn as absolutely dry matter contained 15% protein, 64% carbohydrates of which 32% dextrins, more than 30% starch, and 9% fat. The high sugar content is due to the double recessive allele su su.

Extremely increased consumption of sweet corn all over the world, stimulate the development of a broad genetic and breeding research work that led to the creation of hybrids with exceptional performance and high productivity.

The discovery of high sugar gene sh2 (shrunken 2) from Mains at the University of Michigan, USA in 1948 led to the creation of super sugar lines and hybrids, which contain four times more sugars in the grain than those with su su gene, while their 85% the sugars are the type of sucrose.

Sugar-type lines (su) lose two-thirds of the sugars during the first 48 hours after harvesting, while sh2 – only a fifth part.

Subsequently are discovered genes sh1, bt and du (dull). Thus, in modern practice, the selection is divided into three groups of hybrids containing specific genetic factors (Tosheva, 1997, Larson, 2003).

The first group includes maize with normal sugar (su) normal sugary.

The second group includes maize with increased or enriched sugar sugary enhanced which is determined by the influence of more than one gene for sugar. The third group is hybrids with very high sugar content (sh2 – shrunken 2) called super sweet corns – supersweet.

Hybrids from the latter group retain sugars in harvest maturity up to ten days!

Last selection requirements are hybrids with a low tendency to tillering, yellow corn and high palatability (Sönmez et al., 2013). Now created a super sugar hybrids resistant to firebrand corn borer and cotton moth (Martin, 2005; Guo et al., 2010; Majdancic et al., 2012), which are a major problem in the cultivation of ordinary sweet corn.

By-products in sweet corn production as unusual cobs, stalks, and leaves are an excellent animal feed.

There are various methods of drying and ensiling of crop residues.

The main difference between the silage feed from normal maize (*Zea mays* L.) and that of sweet corn (*Zea maize ssp. saccharatum Körn.)* sugar content of nitrogen-free extract substances and in particular in the second silage has - excessive carbohydrates. As mentioned above, sugar maize contains 4-5 times more soluble carbohydrates from normal.

The chemical analysis of the green stems in mono sweet corn indicates that contain an average of 24% solids, 2.8 to 3% protein and about 15% sugars.

At super sweet hybrids that content is considerably high. In our research, it was found that the total sugars in the stems of super sweet hybrids reach values of 20-22% and a protein content (8-9%) they significantly exceed mono sweet.

MATERIALS AND METHODS

During the 2012-2014 period in the experimental field at the Agricultural University.

The experimental design used was the complete randomized blocks with four replications. Experience in block method in three repetitions with the size of the experimental plot 10 m^2, where are studied basic quality indicators of the 6 most - popular on the Bulgarian market hybrid sweet corn and namely – Challanger F_1, Erica F_1, Vega F_1, Honey Bentam F_1, GSS F_1 and Denitza F_1.

When choosing a hybrid must be considered vegetation period and the parameters of the cobs – they should be large, well looked toward the top - cobs with good presentation.

It is essential that also the type of endosperm (normal or super sugar), especially in the realization of the culture as cobs for fresh consumption.

Experience is displayed as part of a major study aimed at creating technology for cultivation.

Qualitative indicators are reported in plants grown under optimal herbicide combination Merlin Flex - 42 g/da + Laudis OD - 200 ml/ da, (Sevov et al., 2014), providing well-garnished crop and weed areas.

The aim of the investigation was to evaluate the chemical composition parameters as sugar, protein and cellulose content in grain of six from the most popular hybrids in Bulgaria - Challanger F_1, Erica F_1, Vega F_1, Honey Bentam F_1, GSS F_1 и Denitza F_1.

RESULTS AND DISCUSSION

Years of the experiment are similar in climatic conditions with those for a long period. And in the three years of this study, the temperatures during pollination and development of the ears are suitable for the processes.

Aspect in the selection of modern sweet corn hybrid is the creation of hybrids with a delayed decomposition of sugars.

This allows to storage the cobs fresh from harvest to their realization in the market. It is known that relatively quickly after harvesting sugar in the grain converted into amylose and amylopectin and it loses its sweet taste, while monosaccharides corns this process occurs within hours to 1 day, with losses up to 50%.

Figure 1 presents data on sugar content in the ears of the studied hybrids on the first, third and fifth day after the harvest. It is different in each one of them but also reduces differently.

The highest sugar content on the day of harvest we find at GSS (F_1) - 13,2%. It decreases only 0.3% on the third day after harvest to 12.9% and 0.9% after two days (Fig. 1).

Second place by sugars content on the day of harvest ranks Vega (F_1) with 12.45%, decreasing by steady step by about 2% every two days and reached a value of 8.7% after 5 days.

Thirdly ranks Honey Bentam (F_1) with 10.05% sugars, such as the 5th day they were 8.36%. Follows Denitza (F_1) with 9,75% and after 5 days they decreased by 1.28% to 8.47%.

The longest preserving sugar content in Challanger (F_1), for five days it decreased by 0.45% from 8.55 to 8.1%.

Lastly, Erica (F_1) with 7.47%, but in this hybrid is observed and a typical monosaccharide hybrids sharp decrease in sugar content during storage by the third day, it is 2% lower (Fig. 1).

Based on the results we can determine the most suitable for storage in fresh hybrids Challanger (F_1) and GSS (F_1), in which sugars are broken down slowest and storing corn cobs not lose its taste qualities.

This makes them particularly suitable for marketing as fresh cobs.

The cellulose content in the ears of all tested hybrids moves at relatively low values - less than 6%, which makes them extremely suitable for feeding to humans and livestock, (Fig. 2).

Given that the technological maturity of the sweet corn is milk to milk-wax ripeness and then the stems are still completely green, and the high number of unconventional cobs that remain on the plants, it can be recommended as a profitable crop for small farms under which aims closed production cycle. In the six studied hybrids, values are relatively close, but the three Honey Bentam F_1, GSS F_1, and Denitza F_1 stand out with a higher protein content (more than 4%) and comparable to the fact that about half of the cobs of the plants (in direction for the implementation of fresh produce) remain on the stems, we can recommend them for growing in mixed farms as an excellent food for farm animals.

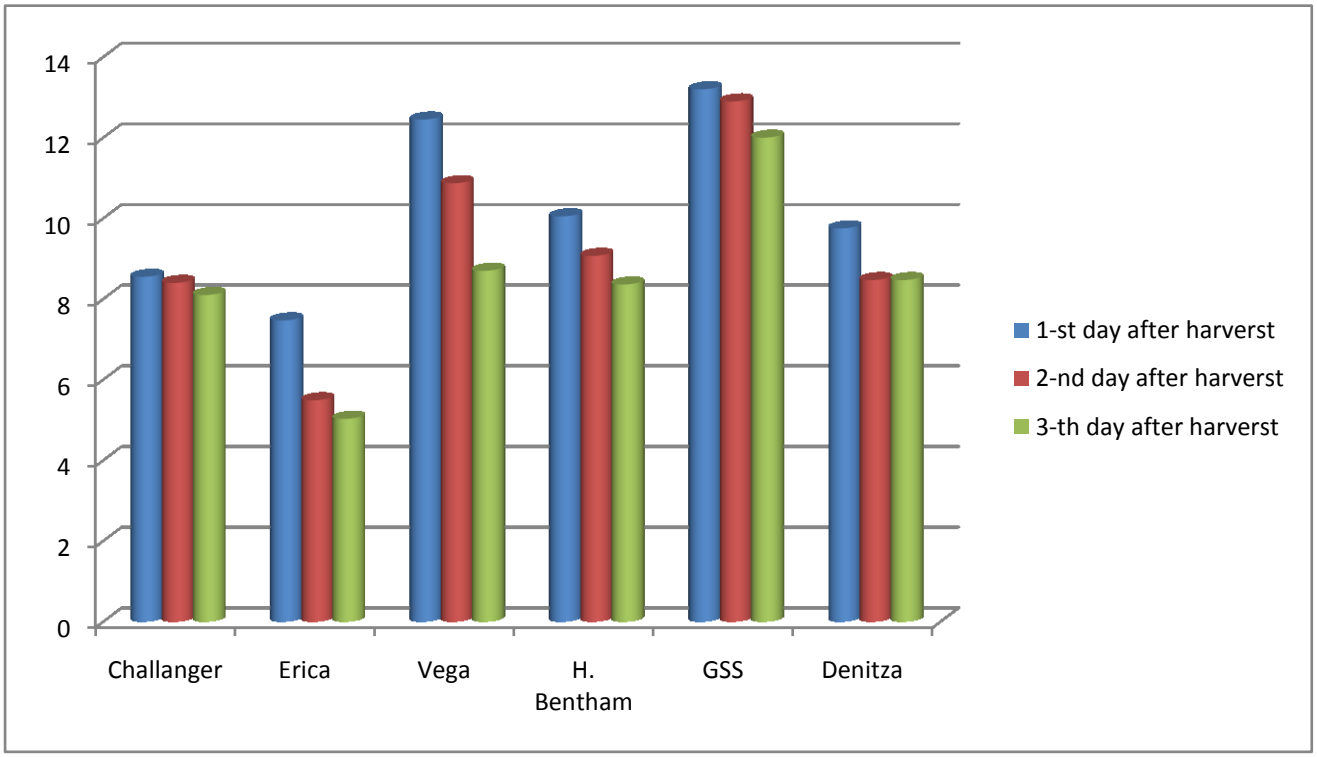

Fig. 1. *Total sugars content of in the stalks of the first, third and fifth day of harvest, average for the period of study*

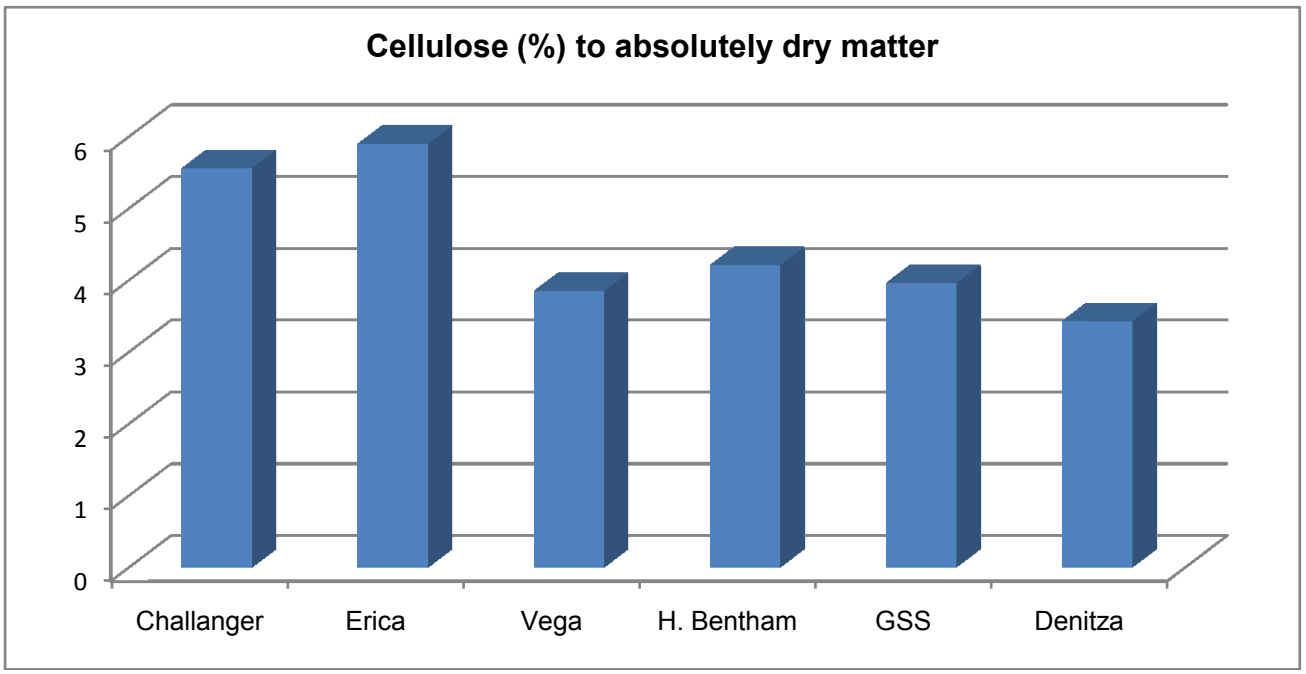

Fig. 2. *Cellulose content in sweet corn ears average of the period of study*

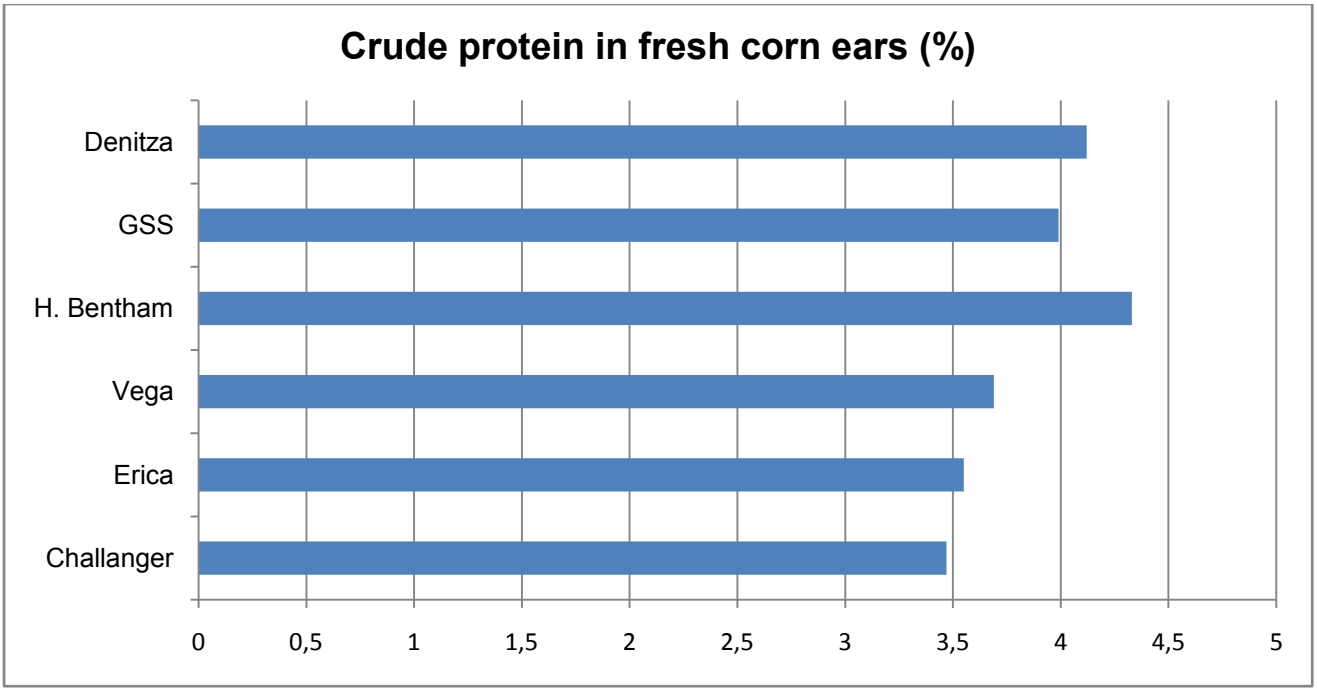

Fig. 3. *Crude protein content in fresh sweet corn ears average for the period of study*

The crude protein content in the ears at all tested hybrids is within the range of about 4% (Fig. 3).

The values are relatively low even for cereals, but bear in mind that they are registered in the milky maturity of culture and considering the high sugar content in the grain we can recommend culture as dietary and healthy food and based once again on it's forage qualities recommend the culture as a good alternative, especially in closed production cycle.

Being particularly suitable for this purpose stand Vega F_1, Honey Bentam F_1, GSS F_1 and Denitza F_1, in which the content of cellulose in the grain is less than 4%.

At the same time they sugar content and protein are - high. This shows in these hybrids chemical composition of the grain is the best balanced.

Over all studied hybrids stands GSS F_1.

Given that the same the sugars decomposition is longest and ahead of other hybrids and productivity gives us reason to recommend it particularly suitable for production.

An exception is the early production of sweet corn, which is looking hybrids with a short growing season.

The data contained in the table 1 shows that the raw protein in the dry mass is 10.35% on average, which is higher than the one cited by Tomov (1984), as probably the authors of the cited source meant either the quantity of nitrogen in the dry mass or the quantity of raw protein in the native fodder.

Another thing to be noticed is the high content of nitrogen-free extract substances – 57.10% on average and the lower content of raw fibre – 22,55% despite the fact that the main mass consists of leaves and stems.

The variations in the chemical composition (consequently in the nutritional value) in the different kinds is insignificant. It shows once again that the sweet corn green mass is an excellent food for farm animals.

Table 1. The chemical composition of leaves and stem of the tested hybrids

Chemical composition of stem In absolutely dry mass (%)					
	Raw protein	Nitrogen-free extract substances	Raw fibre	Raw ash	Total sugar content
Challanger F_1	10,36	58,17	23,95	4,36	18,5
Erica F_1	9,99	58,36	23,96	4,50	15,1
Vega F_1	11,56	52,57	23,84	4,57	18,2
Honey Bentam F_1	10,60	57,70	22,55	4,30	18,3
GSS F_1	8,96	56,00	22,87	4,72	19,7
Denitza F_1	10,67	59,80	23,04	4,40	17.9
Average	10,35	57,10	23,37	4,47	17.95

CONCLUSIONS

1. As most suitable for storage in fresh appear hybrids Challanger (F_1) and GSS (F_1), in which the sugars decomposition is most slowly and during storage maize cobs not lose their taste qualities.

2. Based on the low cellulose content (below 6% in all studied hybrids), and the fact that the harvest maturity of culture is milk - milk wax maturity makes it very suitable as food for humans and livestock.

3. Despite the relatively low protein content (around 4%), taking into account balanced composition of grain we recommend culture as dietary and healthy food.

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