

Changes of cellular structure of potato tuber parenchyma tissues during storage

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Abstract: The presented work is continuation of researches on cellular structure of potato tuber parenchyma tissue. It concerns changes of the potato tuber cellular structure parameters during storage. Tubers of two varieties: Andromeda and Pasat were tested, 5 tubers for each variety and storage period. Cylindrical samples 10 mm in diameter and 1 mm thick were taken out of two types of tissues – potato pith and internal parenchyma from each tuber. Images of the tissues in natural state were taken with optical confocal microscope. Technique elaborated earlier by the author was used to obtain images containing number of cells sufficient for statistical analysis. As the result of analysis performed following mean values parameters of cell size and shape were used: surface area of plane section of the cell A (μm^2) and cell elongation E. The results show differences between cell size for potato pith and internal parenchyma Andromeda variety and storage period. For this smaller values of the area of cell were obtained just after harvest. No differences of area of cell were observed for Pasat variety, and no differences in elongation of cell were observed for all varieties.

Keywords: parameters of cell structure; parenchyma tissue of potato tuber; optical confocal microscope; image analysis

The current stage of material science development is characterised by the search for the quantitative relation between chemical composition, technological parameters, structure and material properties. In any studies aimed at the determination of such relations, objectivism and accuracy in structure evaluation is of fundamental importance (HAMAN & KONSTANKIEWICZ 2002).

Microscopic methods are used to obtain structural images, and their analysis can be carried out by means of modern computer methods (CWAJNA *et al.* 1994; PETRAN *et al.* 1995; CZACHOR *et al.* 2000; POSPIECH *et al.* 2000; KONSTANKIEWICZ 2002). The fact that there are no universal computer methods and procedures which could be used for various types of materials makes this type of research very difficult.

Materials and products of plant origin are used in studies on material structure to a large extent. The research showing that micro-structure exerts an influence on the mechanical resistance of plant tissue (PITT & CHEN 1983; ZDUNEK & KONSTANKIEWICZ 2004). Structural composition of plant tissue influences both its mechanical properties and the quality of the final product (PAWLAK & KRÓL 1999; KONSTANKIEWICZ *et al.* 2002). Limitation of losses and improvement of the quality of the raw materials

and the quality of agricultural products are subjects of research work which has been carried out for many years now (HAMAN & KONSTANKIEWICZ 1999; BOHDZIEWICZ 2001; ZDUNEK & KONSTANKIEWICZ 2004). The microscope image of good quality and sufficient number of structural elements for the quantitative analysis parameter of structure are required. The plant tissues are characterized by the heterogeneous structure and on many occasions is only few cells on the single microscope image. Therefore it is necessary to use the method to obtain the composition images (CWAJNA *et al.* 1994; GANCARZ *et al.* 2003).

The microstructure changes of plant tissue maybe cause changes of its mechanical properties. Therefore knowledge about influence of storage on the microstructure of potato tissue is very important.

The present work reviews changes of the potato tuber cellular structure parameters during storage carried out on for two potato varieties: Andromeda and Pasat.

MATERIALS AND METHODS

Two potato varieties were used for the present experiment, i.e.: Andromeda and Pasat harvested in

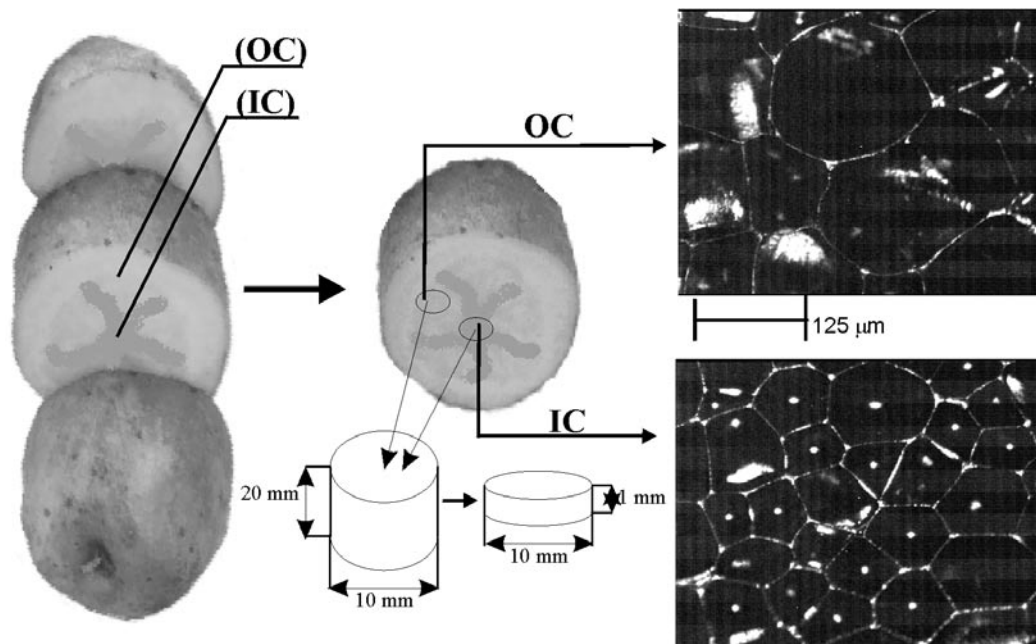


Figure 1. The two areas of potato tuber tissue; IC – potato pith, OC – internal parenchyma sampling sites and example cell images

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Cell sizes within the same tuber differ considerably in relation to the sample collection site. Two areas were distinguished in the potato tuber: the pith and internal parenchyma; samples for analyses were taken from both (Figure 1). It executes research two periods: after harvest and after 6 month of storage.

Ten samples were taken from each core in each variety studied (Figure 1). The samples were cylindrical in shape with a height of 1 mm and diameter of 10 mm. The sample size allowed uniform material to be taken which is especially difficult in the case of the internal parenchyma as its volume is relatively small when compared to the whole tuber.

An optic confocal microscope "CONFOCAL 2002" equipped with 20/0.4 lens and continuous object shift in plane X-Y was used for taking microscopic images of the potato tuber. The confocal microscope makes plant tissue examination possible in the natural state without any prior sample preparation. Technique elaborated earlier by the author was used to obtain images containing number of cells sufficient for statistical analysis (GANCARZ *et al.* 2003; KONSTANKIEWICZ *et al.* 2003). The following parameters of the cell structure were determined for the potato pith and internal parenchyma of the varieties studied: area of cross section and elongation (KONSTANKIEWICZ *et al.* 2001).

To the image analysis was used aPhelion software and to the statistical analysis – Excel.

RESULTS AND DISCUSSION

In the present experiment, ten images were taken for each variety (5 images for each core). Each image consisted of 25 individual photographs containing a few whole cells (Figure 2). Analysis was carried out further to the methodology elaborated earlier (KONSTANKIEWICZ *et al.* 2001; GANCARZ *et al.* 2003).

Combined images consisted of 25 single images (Figure 2) were subjected to contour drawing. Only wholly completely visible cells were contoured. A skeleton of visible cells was obtained as a product

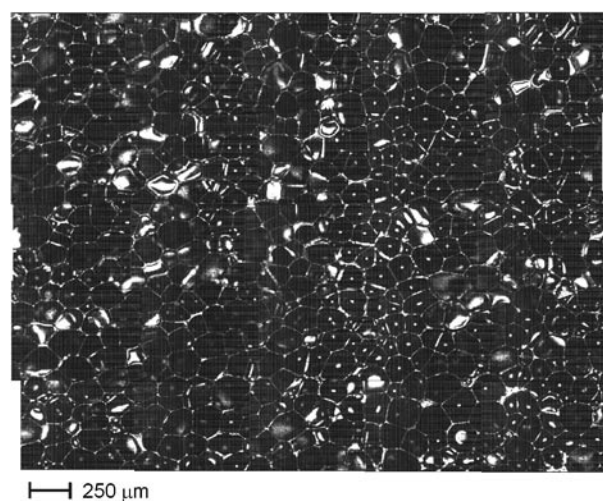


Figure 2. Sample composition of 25 microscopic images of potato tuber tissue

Table 1. Mean values parameters with coefficient intervals for Andromeda and Pasat varieties, type of tissue and storage period; A – surface area of the cell, E – elongation of cell, IC - potato pith and OC –internal parenchyma

	A ($\times 10^3 \mu\text{m}^2$)				E			
	after harvest		after 6 month of storage		after harvest		after 6 month of storage	
	IC	OC	IC	OC	IC	OC	IC	OC
Andromeda	18.7 \pm 0.6	20.4 \pm 0.6	20.0 \pm 0.5	23.4 \pm 0.7	0.30 \pm 0.01	0.32 \pm 0.01	0.31 \pm 0.01	0.31 \pm 0.01
Pasat	16.5 \pm 0.3	18.4 \pm 0.5	16.0 \pm 0.4	18.3 \pm 0.7	0.31 \pm 0.01	0.33 \pm 0.01	0.33 \pm 0.01	0.33 \pm 0.01

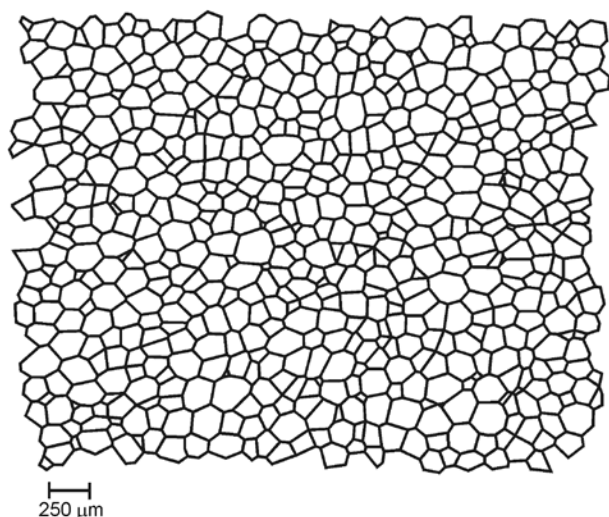


Figure 3. Cellular skeleton obtained after composition of 25 microscopic images

of contouring (Figure 3). Results of analysis are presented in Table 1.

Table 1 presents the mean values of the structural parameters of potato tubers for the varieties studied, type of tissue and storage period.

The Pasat variety was characterized by smallest cells size than Andromeda variety. The internal parenchyma cells in all cases are bigger than potato pith cells. The shapes of cell are similar for the both varieties type of tissue and storage period. The cells of the Pasat variety were not changed during storage, but the Andromeda variety cells size after 6 month of storage were bigger than after harvest.

CONCLUSIONS

– The results show differences between cell size for potato pith and internal parenchyma of Andromeda variety and storage period. Smaller cells were obtained just after harvest. No changes in cell size were observed for Pasat variety during storage.

– No differences in elongation of cell were observed for all varieties during storage.

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Abstrakt

GANCARZ M., KONSTANKIEWICZ K. (2007): **Změny buněčné struktury parenchymatické tkáně bramborové hlízy během skladování.** *Res. Agr. Eng.*, **53**: 75–78.

Předkládaná práce je pokračováním výzkumu buněčné struktury parenchymatické tkáně bramborové hlízy. Zabývá se změnami parametrů buněčné tkáně brambor během skladování. Výzkum se zabýval hlízami dvou odrůd, Andromeda a Pasat, a to v počtu po pěti hlízách od každé odrůdy a pro dva úseky skladování. Ze dvou typů tkáně – dužiny a vnitřního parenchymu – byly u obou odrůd odebrány vzorky válcového tvaru o průměru 10 mm a o tloušťce 1 mm. Obě tkáně byly snímkovány optickým kofokálním mikroskopem. Pro získání obrazu obsahujícího počet buněk dostačující pro statistickou analýzu byla použita technika již dříve autorem vypracovaná. Analýzou byly získány směrodatné odchylky pro tyto parametry velikosti a tvaru buněk: povrch rovinného řezu buňkou A (μm^2) a protažení buňky E. Výsledky ukázaly rozdíly mezi rozměrem buňky u dužiny a u vnitřního parenchymu u odrůdy Andromeda a to pro období skladování. Nižší hodnoty u plochy buněk byly zjištěny pro období těsně po sklizni. U odrůdy Pasat nebyly u plochy buněk rozdíly zjištěny. U obou odrůd nebyly zjištěny rozdíly v prodloužení tvaru buněk.

Klíčová slova: parametry struktury buněk; parenchymatická tkáň hlízy bramboru; optický kofokální mikroskop; analýza obrazu

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