

RAPESEED MICROFLORA AND ITS CHANGES DURING STORAGE*

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A b s t r a c t. The rapeseeds of the Bolko variety with various damage levels (0, 5, 10, 15 and 20 %) and moisture contents (6, 10, 14 and 18 %) were examined for their microbiological changes during storage. The samples were stored in closed containers at 18 ± 2 °C and at relative humidity of air 70 % for a period from 10 days to 12 weeks. The examined seeds were characterised by a low level of microbiological contamination, i.e., 10^1 - 10^3 colony forming units (CFU) per gram. Moisture was the main factor affecting microbiological changes in the seeds during storage. Both growth rate and number of microorganisms directly correlated with water content. Six percent moisture allowed preservation of microbiological quality of the seeds during storage. At 10 % moisture content, an increase in the number of microorganisms during the initial period of storage was observed, while growth rate was in straight correlation to the level of damage. Both microorganism multiplying rate and their population numbers were very high in the seeds containing 14 and 18 % of moisture. Damage of seeds at such a high moisture level had no influence on microorganism growth.

K e y w o r d s: microflora of rapeseeds, moisture, level of damage, microbiological changes

INTRODUCTION

Microbiological contamination of rapeseeds has a substantial influence on the quality of protein and lipid, if conditions allow for microflora multiplication. The most important conditions are: water activity and substrate availability. These factors determine the development of microflora both in quality and quantity, and consequently alter the quality of the seeds.

The aim of the study was to characterise rapeseed microflora and its changes during storage.

MATERIAL AND METHODS

Rapeseeds of the Bolko variety with different levels of macrodamage: 0, 5, 10, 15, and 20 % and containing moisture of: 6, 10, 14 and 18 % were the materials of study. The seed samples were stored in a closed container at temperature 18 ± 2 °C and relative humidity of air 70 %, for a period of 10 days to 12 weeks. The rapeseeds were obtained from the Institute of Agrophysics, PAS in Lublin.

The microbiological analysis was performed directly after preparing the samples and in the following divisions of time:

- samples containing 6 % moisture - 4, 8, and 12 weeks,
- samples containing 10 % moisture - 1, 2, 3, 4, 6, 8, 10, and 12 weeks;
- samples containing 14 % moisture - 3, 7, 15, 17, 21, and 28 days;
- samples containing 18 % moisture - 3, 7, and 10 days.

The tested seeds were analysed for: mesophilic, aerobic and facultative anaerobic bacteria (total plate count), proteolytic bacteria, lipolytic microorganisms and fungi (yeasts and

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moulds). The population number of microorganisms was examined by the plate method using selective media for each group [3-5,7,8]. The results were presented as log of colony forming units (CFU) number per gram.

RESULTS AND DISCUSSION

Microbiological quality of examined seeds

The examined seeds were characterised as having a low level of microbiological contamination, much lower than the rapeseeds of Bolko and Ceres varieties used in the earlier experiments [1]. The total plate count ranged within 10^2 - 10^3 CFU/g (Table 1). Proteolytic bacteria count was low - not exceeding 10^1 - 10^2 CFU/g. The highest contamination of seeds was with lipolytic microorganisms at a level of 10^2 - 10^3 CFU/g. In the fungi group, the count of yeasts as well as moulds oscillated around 10^2 CFU/g. In the earlier experiments the bacteria population number ranged from 10^3 to 10^6 CFU/g, and fungi from 10^3 to 10^5 CFU/g [1].

Table 1. Microbiological quality of rapeseeds of Bolko variety

Group of microorganisms	Number of cells CFU/g
Total plate count	2.6×10^2 - 2.8×10^3
Proteolytic bacteria	1.0×10^1 - 1.0×10^2
Lipolytic microorganisms	1.0×10^2 - 9.0×10^2
Fungi (yeasts and moulds)	1.6×10^1 - 2.0×10^2

Changes of rapeseed microflora during storage

Total plate count of mesophilic, aerobic and facultative anaerobic bacteria

The total bacterial count in rapeseeds containing 6 % moisture, did not change in the 12 weeks of storage, independent of the macrodamage level (Fig. 1). In seeds containing 10 % of moisture the bacteria count rose 2-4 logs, depending on the damage level, while in seeds with a damage level of 5-20 % the microorganism number reached a value of 10^6 - 10^7 CFU/g during the initial 2-3 weeks. However, in seeds not damaged only a slow gradual increase of CFU during 12 weeks was observed. In seeds containing 14 and 18 % moisture, the bacterial count, independent of the initial inoculum,

reached 10^7 - 10^9 CFU/g in the period of 2-3 weeks, in which the rate of growth maintained strict correlation with moisture content and only insignificantly depended on the level of seed damage. In the earlier experiments, a similar rate and level of bacterial multiplication was observed in rapeseeds having a significantly lower quality and moisture to a level of 10-19 % [1]. This suggests the main factor conditioning microbiological changes is moisture.

Proteolytic bacteria

The influence of moisture and damage levels of rapeseeds on the growth kinetics and count of proteolytic bacteria was similar to the total bacterial count (Fig. 2). Relatively low differences, not exceeding 1-2 log increase, in the number of cells in the first month of storage of seeds with 6 % moisture content was observed.

Lipolytic microorganisms

In seeds with 6 % moisture content, there were no changes in the number of lipolytic microorganisms in the period of 12 weeks of storage (Fig. 3). At the other levels of moisture, the growth kinetics was similar to the total and proteolytic bacteria, although the population reached lower numbers, not higher than 10^7 CFU/g of seeds with 18 % moisture and lower than 10^7 CFU/g with 14 % of moisture content. However, in seeds with a moisture content of 10 % the lipolytic microorganism number did not exceed 10^5 CFU/g after 12 weeks of storage. During the first month, similar to the above groups of bacteria, the growth rate of lipolytic microorganisms varied, depending on the level of seed damage. During the next 2 months of storage, equalisation of the population number and its stability followed. Within this group of microorganisms, a low influence of damage on the growth rate was observed in seeds containing 14 and 18 % of moisture. Studying the influence of damage and moisture in rapeseeds on lipolytic activity of enzymatic extracts, Jędrychowski and Grabka [2] determined strong growth in seeds with a high moisture level, and a lack of change in seeds with a water content less than 10 %.

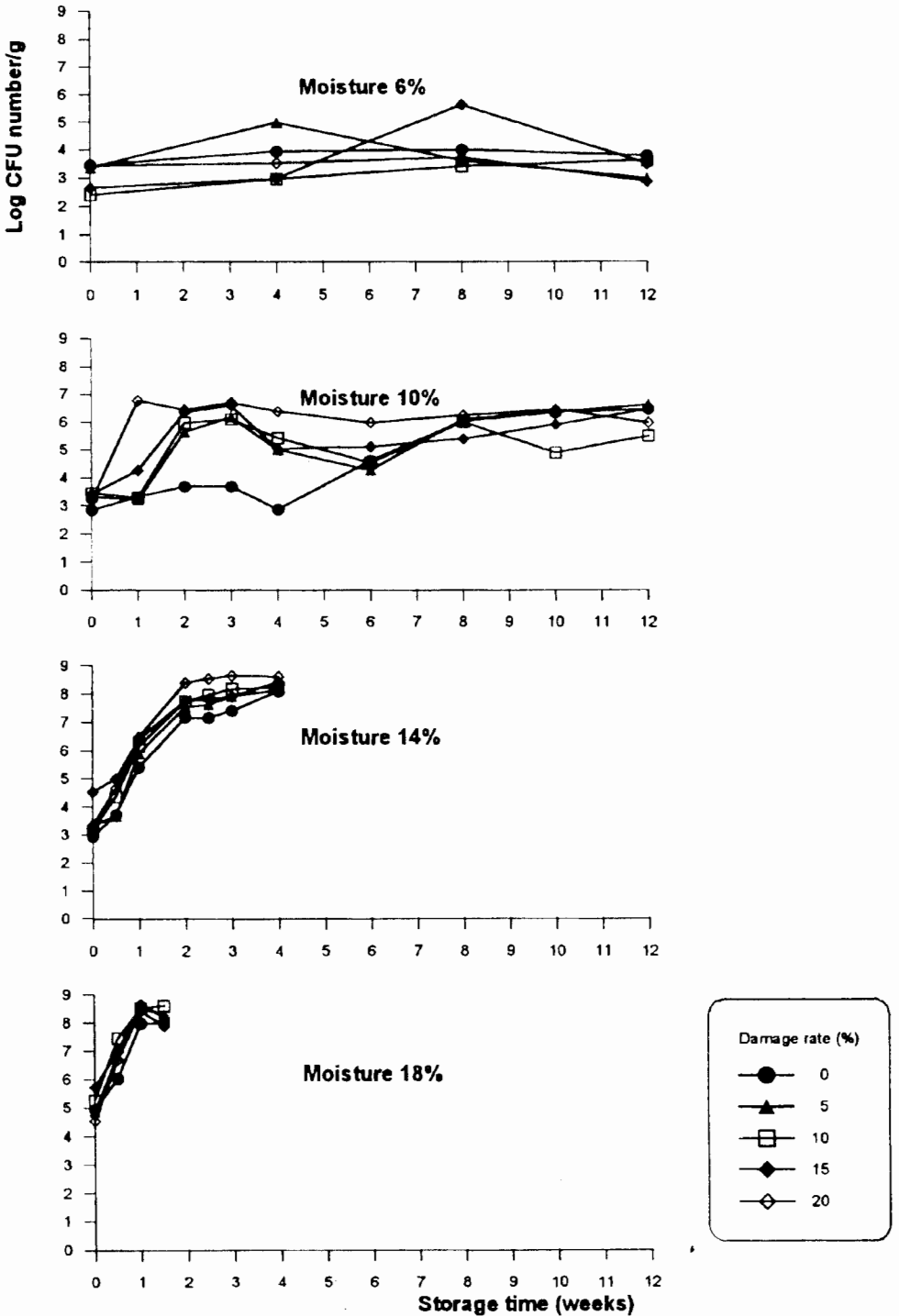


Fig. 1. Total plate count.

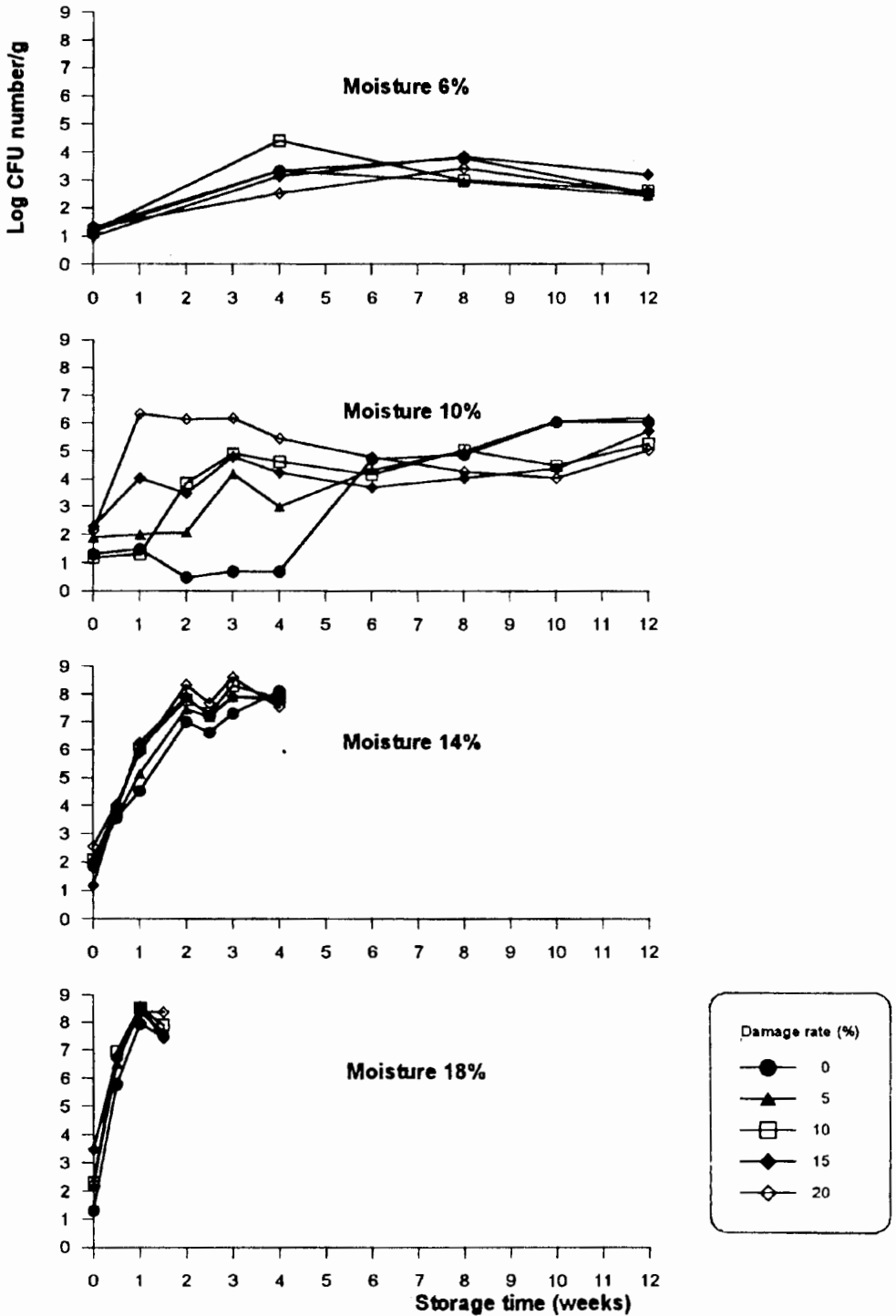


Fig. 2. Proteolytic bacteria.

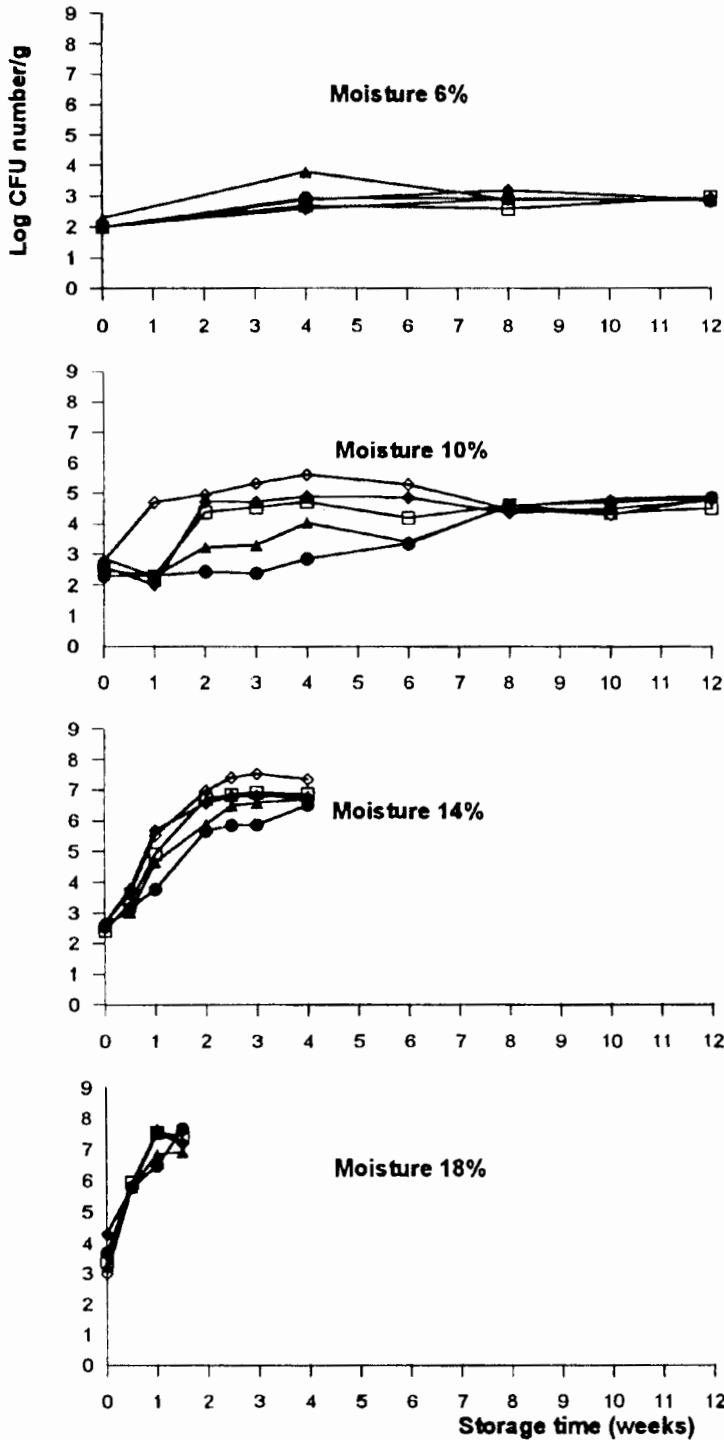


Fig. 3. Lipolytic microorganisms.

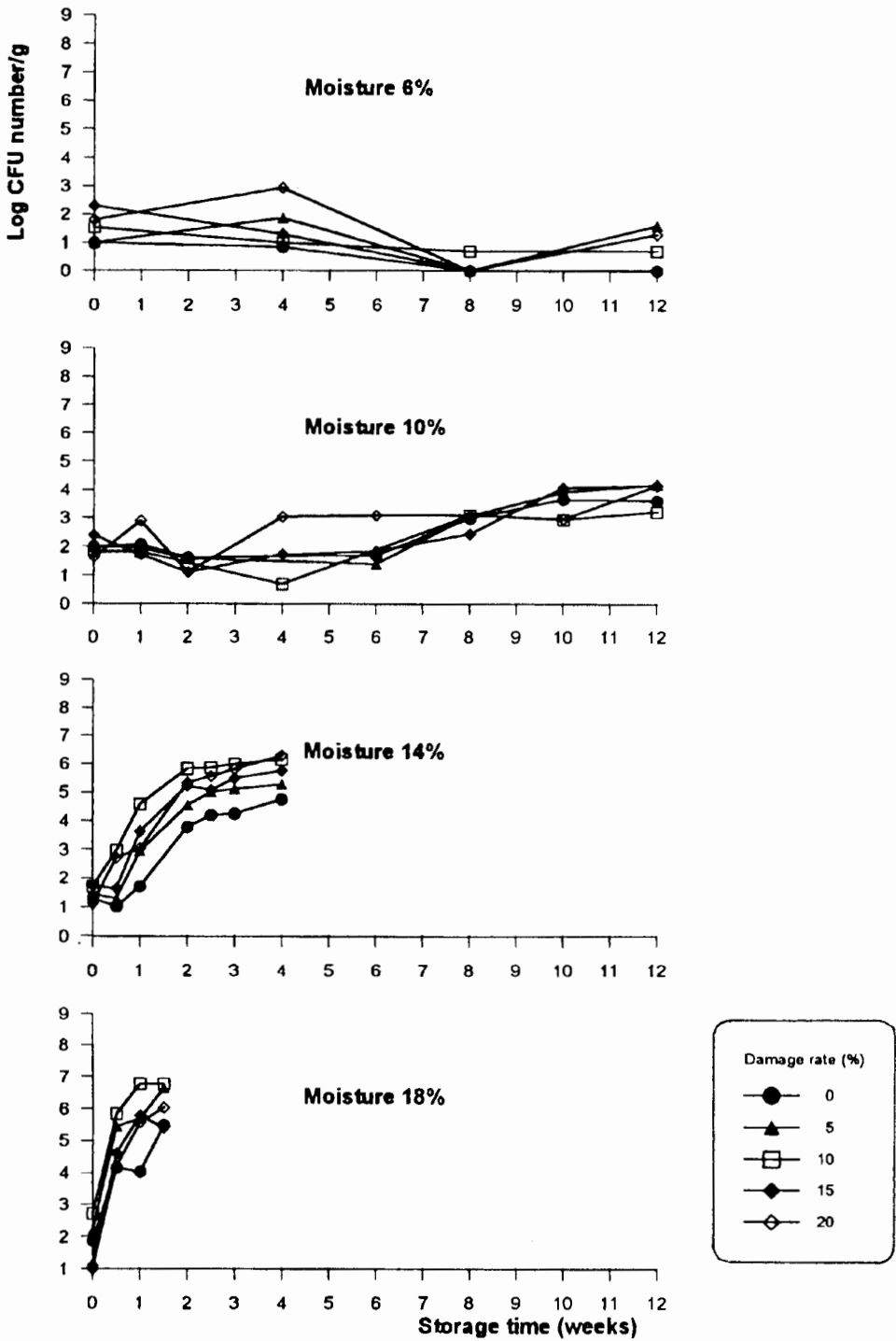


Fig. 4. Yeasts.

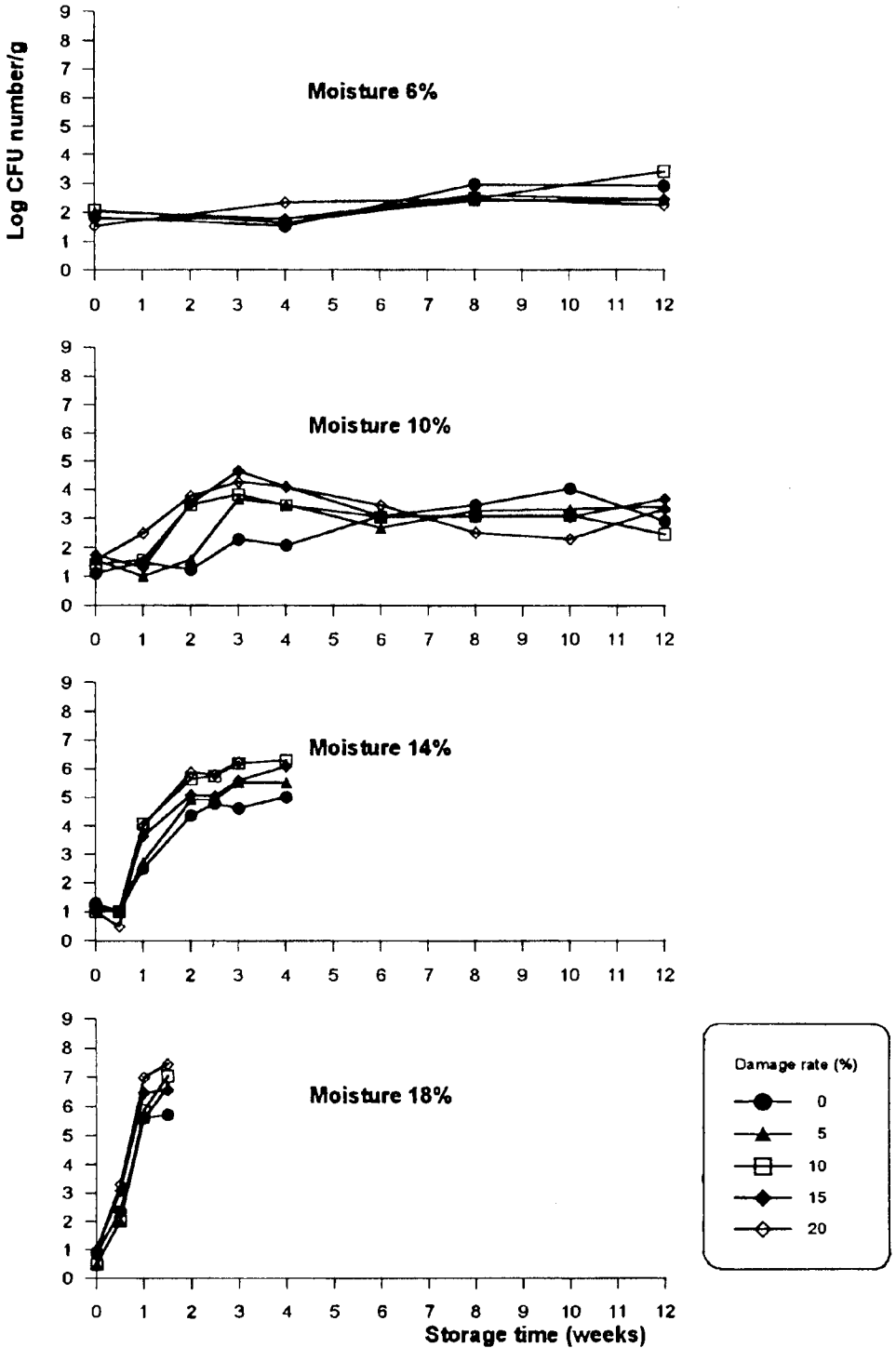


Fig. 5. Moulds.

Fungi (yeasts and moulds)

The population number of yeasts as well as moulds remained unchanged in the period of 12-week storage of seeds with moisture content of 6 % (Figs 4 and 5). In seeds containing 10 % of moisture, the cell count increase was not higher than 2 logs, and the growth rate varied, depending on the level of seed damage. A similar rate of mould development in rapeseeds containing 7-12 % moisture was determined by Mills and Sinha [6]. With an increase of moisture content the rate of fungi development and population number increased. In seeds containing 14 % of moisture the cell count of yeasts rose 3-5 logs, reaching a level of 10^5 - 10^5 CFU/g, and moulds 4-6 logs to a level of 10^5 - 10^6 CFU/g during 2-4 weeks depending on the level of seed damage. Fungi growth was very fast during the initial 2 weeks of storage, after which a gradual decrease followed. It had the fastest growth, and reached the most abundant population of 10^7 - 10^8 CFU/g, in seeds containing 18 % of moisture. The damage level of seeds with such a high level of moisture only insignificantly influenced the growth rate of fungi and population number.

CONCLUSIONS

The main factor determining the microbiological changes in rapeseed during storage was found to be moisture content. The size and rate of microorganism growth were in direct correlation with water content.

The level of rapeseed damage had a significant influence on the rate of development of microorganisms, especially in the initial period of storage, however, influencing insignificantly the population number.

The moisture content of 6 % in rapeseeds secured the microbiological quality during storage. The moisture content of 10 % allowed microflora development, however, the population did not reach the maximum number. The growth rate was maintained in straight correlation to the level of seed damage.

In rapeseeds with 14 and 18 % water content, a fast and strong development of microorganisms followed. The level of seed damage did not, in this case, significantly influence the rate of growth.

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MIKROFLORA NASION RZEPAKU I JEJ ZMIANY PODCZAS PRZECHOWYWANIA

Zbadano mikroflorę nasion rzepaku odmiany Bolko oraz jej zmiany podczas przechowywania ziarna o różnym stopniu makrouszkodzeń (0, 5, 10, 15 i 20 %) i o różnej zawartości wody (6, 10, 14 i 18 %). Próbki nasion przechowywano w zamkniętych pojemnikach w temp. $18 \pm 2^\circ\text{C}$ i wilgotności względnej powietrza 70 % przez okres od 10 dni do 12 tygodni. Badane ziarno charakteryzowało się niskim stopniem zanieczyszczeń mikrobiologicznych. Liczebność populacji poszczególnych grup drobnoustrojów wahała się w granicach 10^1 - 10^3 jednostek tworzących kolonie. Głównym czynnikiem warunkującym zmiany mikrobiologiczne w nasionach podczas przechowywania była wilgotność. Zarówno szybkość wzrostu jak i stopień namnożenia mikroorganizmów pozostawały w prostej korelacji z zawartością wody. Wilgotność nasion 6 % zapewniała zachowanie początkowego stanu mikrobiologicznego przez okres 12 tygodni, natomiast przy wilgotności 10 % obserwowano niewielki przyrost mikroflory, przy czym jego tempo pozostawało w prostej korelacji do stopnia uszkodzeń nasion. W nasionach zawierających 14 i 18 % wody następował szybki i silny rozwój drobnoustrojów, a stopień uszkodzeń nasion miał tylko nieznaczny wpływ na szybkość wzrostu.

S ł o w a k l u c z o w e: mikroflora nasion rzepaku, wilgotność, stopień uszkodzeń, zmiany mikrobiologiczne.