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EFFECT OF SOME NATURAL PREPARATIONS ON CONTENTS OF PROTEIN AND DRY MATTER IN SWEET PEPPER (*CAPSICUM ANNUUM* L.)

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ABSTRACT

The aim of study conducted in 2010–2012 was to evaluate the influence of some natural preparations on the protein and dry matter content in the sweet pepper fruits. Fruits of sweet pepper (cv. Roberta F_1) were the object of research. The natural preparations from garlic extract (Bioczos Plynny), grapefruit extract (Biosept 33 SL), sea algae (Bio-algeen S90 Plus) and blastospores of *Aureobasidium pullulans* (Boni Protect Forte) were used for protection of pepper plants**.** Determination of protein and dry matter in pepper fruits was made during the middle of the harvest period.

The presented results indicated small differences in protein and dry matter content between the fruits from control combinations and those protected with natural preparations. It belongs to ascertain, that none of the applied natural preparations had a significant effect on the content of protein and dry matter in pepper fruits. Therefore, it should be stated that the application of tested preparations cannot decrease the quality of produced pepper and that the application of natural products does not result in the reduce the nutritional value of pepper, regarding proteins and dry matter, therefore they can be used in the practice.

Key words: *Capsicum annuum*, biological control, garlic extract, grapefruit extract, sea algae, *Aureobasidium pullulans*, protein, dry matter.

INTRODUCTION

Recently, the consumers are more conscious of quality and safety of food. The management of pepper diseases relies in a high degree on using the fungicides. However, the chemical control results in the residues of fungicides not only in treated plants but also in the soil what causes the disturbance of biological balance. Additionally, the fungicides, regarded earlier as relatively safe, proved to be more dangerous to people's health than insecticides and herbicides together. Their residues in food might be carcinogenic [32]. Their resistance of pathogens to fungicides also is a problem.

From 1 January 2014 the crop production in all member countries of European Union has to be based on the rules of integrated plant protection according to the Council Directive 2009/128/CE on the sustainable use of pesticides and the later regulations of the European Parliament and the Council [6, 28].

The yield of crops depends on many factors, among them one of the most important is the health status of plants. Recent activities focus on developing natural products that can be effective, long lasting and safe to human beings and the environment. Biological and biotechnical products show antifungal and antibacterial activity against many pathogens [7, 14, 15, 21, 33, 34] and are accepted by the consumers as environmentally friendly.

There are many reports on the efficacy of natural products in plant protection but there is no full information on the effect of

these preparations on the content of chemical compounds and nutrients in pepper fruits. The aim of the study was the answer to the question: is nutritional value of pepper fruits treated with natural preparations higher or lower than of those cultivated traditionally?

In the presented study we compared the contents of protein and dry matter in sweet pepper fruits treated with the natural products to those protected with the fungicide.

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MATERIAL AND METHODS

Field experiment

The experiment was carried out in 2010–2012 in the horticultural farm in Zezulin in Lublin province (N51˚20', E22˚49'). The objects of research were the plants of sweet pepper (*Capsicum annuum* L.) cv. 'Roberta F_1'.

Pepper seedlings were planted in the field in the second decade of May in the spacing of 0.67 × 0.35 m. Twenty seedlings were planted in each plot of 4.69 m^2. In each year of investigations the experiment was set up in randomized blocks in 4 replications. The investigated factors were the natural preparations which types, application methods and concentrations are described in Table 1. There were two control combinations: absolute (with plants without any treatment) and relative (with plants treated with the fungicide Amistar 250 SC). Around experiment plots one row of pepper plants was planted. Those plants were not used in the experiment.

Table 1. Combinations of field experiment in 2010–2012

Experimental combination	Concentration of preparation [%]	Number of treatments
C – control, plant without treatments	lack	lack
A – control, plants protected with azoxystrobin (Amistar 250 SC)	0.1	2
BCZ – plants protected with garlic pulp extract (biotechnical preparation Bioczos Plynny)	2.0	6
BS – plants protected with grapefruit extract (biotechnical preparation Biosept 33SL)	0.2	6
BA – plants protected with sea algae *Ascophyllum nodosum* (biotechnical preparation Bio-algeen S90 Plus)	0.3	6
BP – plants protected with blastospores fungi *Aureobasidium pullulans* strains (biopreparation Boni Protect Forte)	0.1	6

Analysis of protein and dry matter content

The evaluation of protein content in pepper fruits was conducted with Kjeldahl's method, while the estimation of dry matter content was done with dryer method. Standard uncertainty (±U) for the determination of protein content was 9.08%, for dry matter standard uncertainty was 1.64%. These uncertainties were estimated taking into account the coverage factor k = 2, which provides a level of confidence of approximately 95%.

Statistical analysis

The data were analyzed by the analysis of variance (Tukey's test) at 5% significance level using the SAS statistical system (SAS Version 9.1, SAS Inst., Cary, N.C., USA).

RESULTS AND DISCUSSION

The biological value and chemical composition of pepper fruits depend on many factors, like the cultivar, cultivation method, variable environment conditions, harvest time and the type of agrichemicals [3–5, 9, 12, 13, 16, 17, 19, 22, 23]. The content of nutrients in the fruits changes depending on their ripening stage [18, 20, 23].

The fruits of sweet pepper are the source of many vitamins and minerals (magnesium, calcium, potassium, phosphorus, iron) that have a great importance in the diet of each human being [2, 3, 10, 12, 13, 17, 20, 24–27]. They contain also many antioxidants (vitamins C and E, beta-carotene) that play an important role in human nourishments [27, 32]. The epidemiologic researches indicate that these compounds increase the immunity system protecting the human organisms against the diseases of civilization [11, 25]. The fruits of sweet pepper are not an important source of proteins but the content of these compounds have a great biological importance [31, 32]. Schuphan [29] presented the studies on protein content in pepper where the amount of raw protein varied between 1.2% and 1.5% in fresh fruits. Somos [31] describes several studies undertaken in Hungary on this group of chemical compounds. The results of those researches showed that the amount of protein in pepper pericarp was 16–17% of dry matter. According to the results of investigations conducted by Simonovska et al. [30], the protein content in the pericarp of pepper cultivated in Macedonia amounted to 14.13% of total dry matter.

The analysis of obtained results indicates that the content of protein in the fresh fruits of sweet pepper was rather low: from

0.633% (in 2010) for the fruits protected with Biosept to 1.15% (in 2012) for the combination with Boni Protect (Tab. 2) and was similar to the results obtained by some researchers [29–31].

Table 2. Content of protein [%] in fresh sweet pepper fruits protected with natural preparations in 2010–2012

Experimental combination	Protein (±U)		
	2010	2011	2012
Control	0.915 A* ±0.083	0.940 BC* ±0.085	1.140 B* ±0.103
Amistar 250 SC	0.876 AB ± 0.0794	0.889 C ±0.08	1.460 A ±0.132
Bioczos Płynny	0.795 AB ±0.072	1.017 AB ±0.092	1.140 B ±0.103
Biosept 33 SL	0.633 C ±0.057	1.071 A ±0.097	0.990 B ±0.089
Bio-algeen S90 Plus	0,893 A ±0.081	0.990 ABC ±0.089	1.110 B ±0.101
Boni Protect Forte	0.807 AB ±0.073	0.980 ABC ±0.088	1.150 B ±0.104
LSD 0.05	0.1021	0.1083	0.2807

*Values followed by the same letters within a column are not significantly different at the 0.05 level probability according to the Tukey test.

The highest content of protein was found in 2012 and the lowest one in 2010. The content of nutrients, as well as proteins, depends on genetic factors and agricultural practices (e.g. pesticides applications) [1]. The investigations on the effect of biological and biotechnical preparations on the contents of mineral and biologically active compounds in pepper fruits were conducted by only few researchers [8, 10, 15]. Among others, Jamiołkowska [15] stated that the application of garlic pulp (Bioczos Plynny), grapefruit extract (Biosept 33 SL), sea algae extract (Bio-algeen Plus) and Boni Protect Forte (*Aureobasidium pullulans*) did not have a significant effect on the content of vitamin C in fresh fruits. The presented results indicated small differences in protein content between the fruits from control combinations and those protected with natural preparations (Tab. 2). The mean values show the lack of significant differences in the content of protein between the combinations of the experiment (Fig. 1).

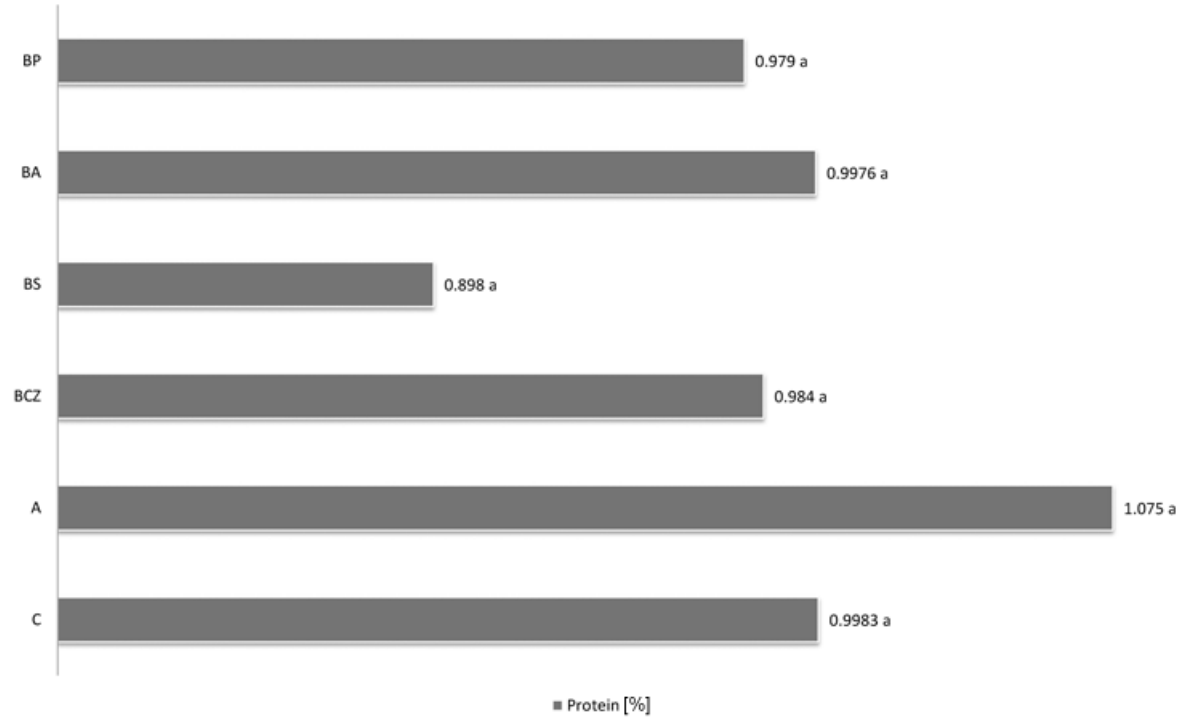

Fig. 1. Mean content of protein [%] in fruits of sweet pepper protected with natural preparations in 2010–2012 (abbreviations as in Tab. 1), *values followed by the same letters within a column are not significantly different at the 0.05 level probability according to the Tukey test, LSD 0.05 = 0.5606

The content of dry matter in pepper fruits depends mainly on the cultivar and the conditions of cultivation [4]. In this study the lowest content of dry matter was observed in 2011 in the combination with Biosept and the highest one in 2012 in the combination with the fungicide (Tab. 3). The mean content of dry matter in investigated fruits ranged from 8.98% (Biosept) to 9.946% (Boni Protect Forte) but did not differ significantly (Fig. 2).

Table 3. Content of dry matter [%] in fresh fruits of sweet pepper protected with natural preparations in 2010–2012

Experimental combination	Dry matter (±U)		
	2010	2011	2012
Control	9.230 B* ±0.151	8.900 BC* ±0.146	9.360 D* ±0.153
Amistar 250 SC	9.230 B ±0.151	8.590 BC ±0.141	11.470 A ±0.188
Bioczos Płynny	8.970 D ±0.146	9.320 AB ±0.153	9.810 C ±0.161
Biosept 33 SL	8.950 D ±0.146	8.780 BC ±0.144	9.210 D ±0.151
Bio-algeen S90 Plus	9.090 C ±0.149	8.720 C ±0.143	10.810 B ±0.177
Boni Protect Forte	9.880 A ±0.162	9.880 A ±0.162	10.080 C ±0.165
LSD 0.05	0.0800	0.7875	0.4213
Note as Table 2			

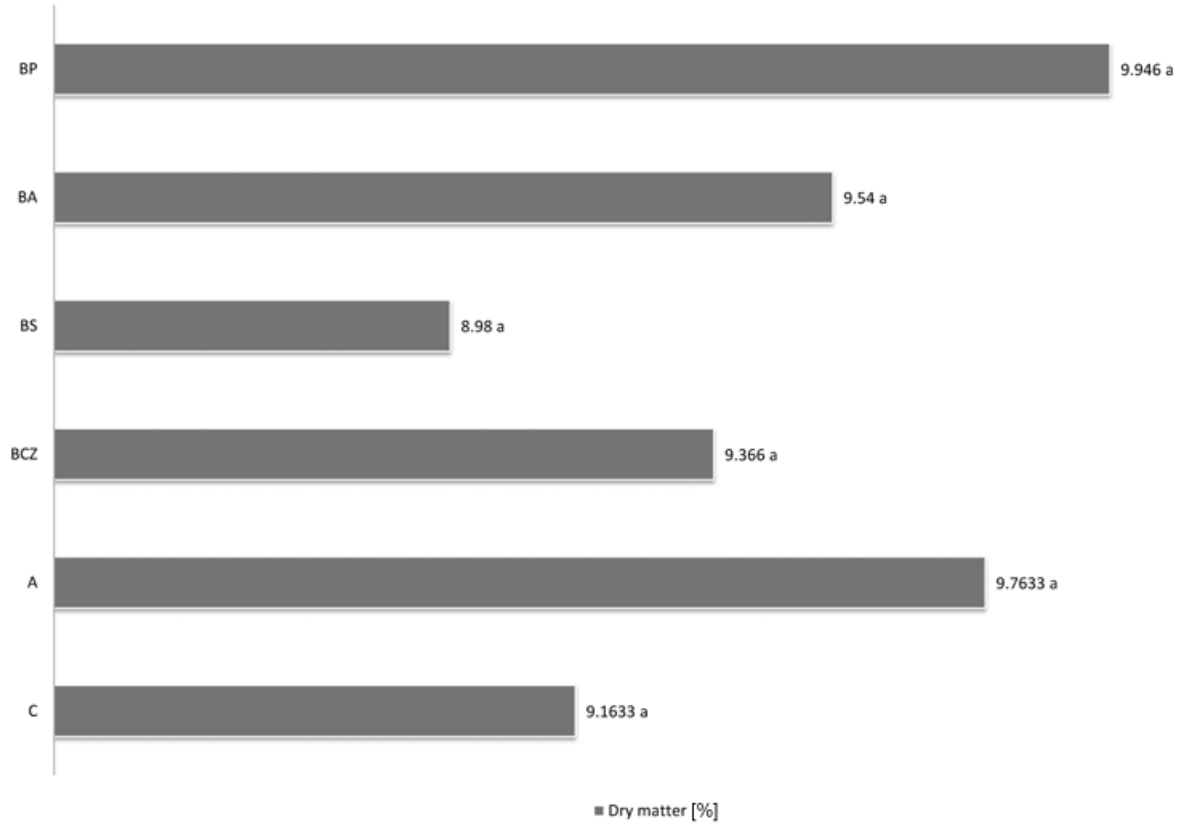

Fig. 2. Mean content of dry matter [%] in fresh fruits of sweet pepper protected with natural preparations in 2010–2012 (abbreviations as in Tab. 1), *values followed by the same letters within a column are not significantly different at the 0.05 level probability according to the Tukey test, LSD 0.05 = 2.4021

Buczkowska and Michałojć [4] report that the content of dry matter in the fruits of Red Knight F_1 cultivated in the field was significantly lower than in the fruits of this cultivar cultivated in the greenhouse. In the investigations presented by Gajc-Wolska et al. [10] the application of Göteo Goemar and BM 86 (extract of sea algae) caused the increase of dry matter, vitamin C, potassium and calcium contents in treated pepper in comparison to the control plants. Also Dobromilska and Gubarewicz [8] showed a beneficial effect of Bioalgeen on the content of dry matter and vitamin C in the fruits of cherry tomatoes. The number of treatments had also a significant effect on the content of dry matter in tomato fruits.

In the presented study none of the applied natural preparations had a significant effect on the content of dry matter in pepper fruits (Fig. 2).

CONCLUSIONS

1. The application of natural preparations (Biosept 33 SL, Bioczos Płynny, Bio-algeen S Plus, Boni Protect Forte) in the cultivation of sweet pepper does not have a significant effect on the content of protein in fresh fruits.
2. The preparations of natural origin (Biosept 33 SL, Bioczos Płynny, Bio-algeen S Plus, Boni Protect Forte) used in the

cultivation of sweet pepper does not have a significant effect on the content of dry matter in fresh fruits.

3. The tested natural preparations does not have a negative effect on the nutritional value of pepper fruits, therefore they can be used in plant protection.

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