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NUTRITIVE VALUE OF SOLUBLE PROTEIN OF SPRING TRITICALE EARS INFESTED BY THE GRAIN APHID (*Sitobion avenae* /F./)

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ABSTRACT

The aim of study was to determine the effect of grain aphid (*Sitobion avenae* /F./) on nutritive value of soluble protein isolated from ears of spring triticale cultivars. Nutritive value of protein was estimated by the limiting amino acid index (CS) calculated in according with to Mitchel and Block (1946), and by the integrated index of essential amino acids (EAA) calculated in with according to Oser (1951). Obtained results showed that feeding of the grain aphid on the ears of tested spring triticale cultivars caused the decrease in the content of essential amino acids. This resulted in the decrease of CS and EAA values and in the reduction of nutritive value of soluble protein.

Key words: nutritive value, essential amino acids, spring triticale, grain aphid, *Sitobion avenae.*

INTRODUCTION

Nutritive value of each protein is determined by its amino acid content, especially the quantity of essential amino acids [13]. Quantitative estimation of these compounds allows us to compare nutritive value of proteins. This evaluation can be done using the limiting amino acid index (CS) and the integrated index of essential amino acids (EAA). Proteins of low nutritive value indicate deficit of one or more essential amino acids.

Such insufficiency may be induced by feeding of insects. An analysis of metabolic processes in phytophagous bodies proved that in their saliva and the alimentary canal there exist proteolitic enzymes which break down

protein and peptides into an assimilable form [16]. Moreover, it has been ascertained that grain aphid feeding may also induce a synthesis of some essential amino acids [6], and thus positively influence the nutritive value of the host plant's protein. Therefore the main aim of study was to examine the influence of feeding of the *S. avenae* on nutritive value of soluble protein of ears of chosen spring triticale cultivars.

MATERIALS AND METHODS

The research was based on three spring triticale cultivars: Gabo, Migo and Wanad. The entomological experiment was embarked upon in the stage of mid-flowering of the tested cultivars (G.S. 65 in Tottman's and Broad's scale (1987)). Twenty wingless females of the grain aphid were placed on each of the ten ears of all the cultivars. Afterwards the ears were isolated with the help of isolators made of blotting-cloth. Simultaneously the same number of non-infested ears was being prepared. The experiment was finished in the stage of mid-milk ripe of the triticale (G.S. 75). Collected ears underwent the process of liophilization. The extraction of soluble protein from liophilizates was conducted according to the procedure suggested by A.O.A.C [1]. In order to determine the content of protein amino acids the acquired extract was evaporated and then put to the process of acid hydrolysis using 6M HCl in temperature of 105-110°C for 20 hours. In the obtained hydrolysate the content of amino acids was indicated using an automatic amino acid analyzer type AAA-339 [4].

Nutritive value of soluble protein of spring triticale ears was determined with the help of CS index, according to Mitchell and Block [11] and the EAA index, assessed according to Oser [12].

All chemical analyses were repeated three times. In order to determine the inter-cultivar differences between CS and EAA indices calculated for control plants (without aphids), acquired results underwent one factor analysis of variance. Significant differences between means were calculated using Duncan multiple range test at $p \leq 0.05$.

RESULTS AND DISCUSSION

Carried out analyses have showed that the limiting amino acid in soluble protein in the Gabo cultivar was leucine, whereas in the Migo and Wanad cultivar- threonine. Moreover, it has been proved that the Gabo variety had the highest value of CS index (with the exception of CS for lysine). The lowest value of this index was recorded for the Wanad cultivar, which was confirmed statistically (Tab. 1.). Similar tendency was also stated in the case of EAA index, where the statistical analysis confirmed that the Gabo variety had the highest and Wanad variety- the lowest value of this index (Tab.1.). On the basis of obtained results it can be ascertained that out of all the examined cultivars the highest nutritive value of soluble protein was recorded in the case of the Gabo variety, and lowest in the case of the Wanad variety.

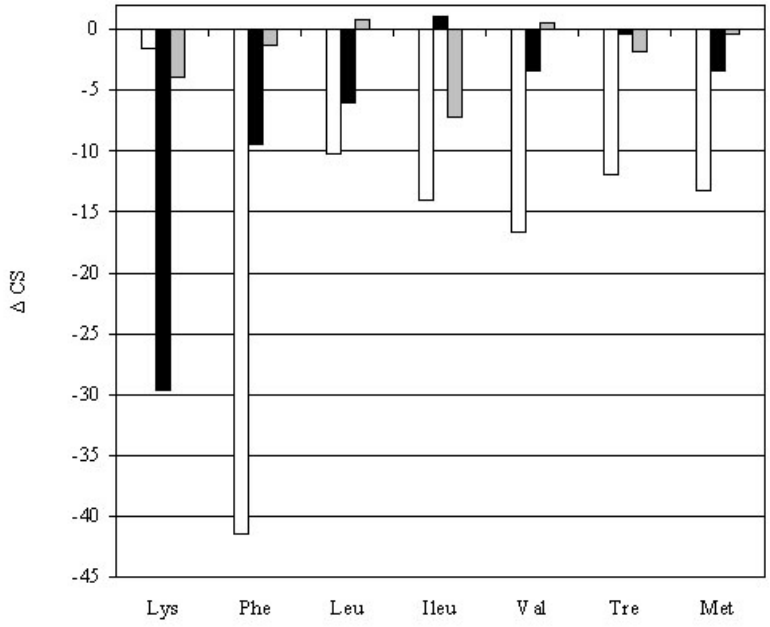
Tabele 1. Values of CS and EAA indices calculated on the basis at the content of essential amino acids in protein of plants without aphids of tested spring triticale cultivars Values in the same columns followed by different letters are significantly different at $p \leq 0.05$ (Duncan's test). Ileu-isoleucine, Leu-leucyne, Lys-lysine, Met-methionine, Phe- phenylalanine, Thr- threonine, Val- valine.

Cultivar	Limiting amino acids index CS							Integrated index of essential amino acid EAA
	Ileu	Leu	Lys	Met	Phe	Thr	Val	
Gabo	25.37 a	22.79 a	30.71b	24.84a	68.93 a	28.30 a	30.30a	30.76a
Migo	14.44 b	16.05 b	44.29 a	14.84b	31.43b	7.87 b	16.21 b	17.99 b
Wanad	14.26 c	11.63 c	19.29 c	15.48 b	24.64c	6.17 c	12.42 c	13.76 c

Supplying nutritional needs of aphids is connected not only with protein amino acid quantity but also with their qualitative content. According to Auclair [2] aphids' feeding needs cover about 20 protein amino acids, where an especially significant role is ascribed to essential amino acids. These compounds can stimulate growth and reproduction of these arthopoda [3,5,8,9,14] or hamper their development [10,17]. Therefore the total amino acid content and particularly the quantity of essential amino acids may render the host plant more attractive to this species of insects.

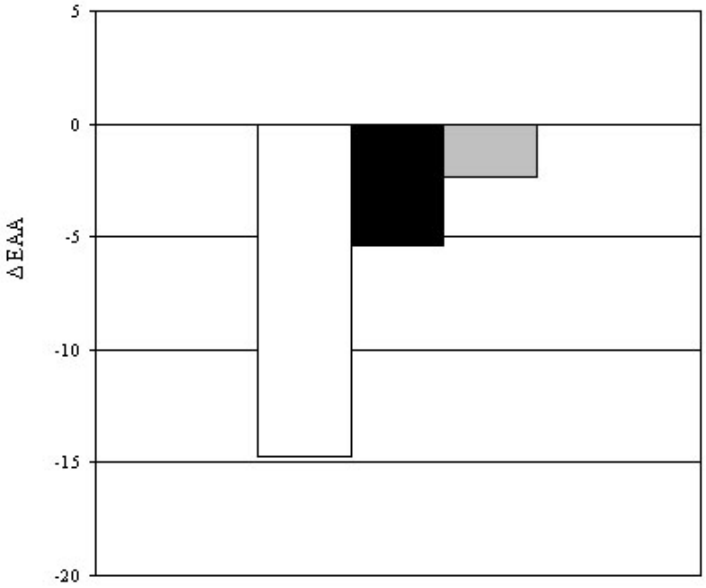
Furthermore, conducted analyses showed that feeding of the grain aphid wingless females on ears of the Gabo cultivar lead to a decrease of CS index value assessed for all studied essential amino acids in comparison with non-infested plants (Fig.1.). The same downward tendency was observable in the case of CS index assessed for the Migo cultivar (with the exception of CS for isoleucine). Feeding of the grain aphid on ears of the Wanad cultivar also caused decrease in CS index value calculated for most studied amino acids (with the exception of CS for leucine and valine, (Fig.1.). Of all examined cultivars of the spring triticale the biggest drop of CS index value induced by feeding of the grain aphid was ascertained in the case of ears of the Gabo cultivar.

Fig.1. Changes in the values of the limiting amino acid index (CS) caused by feeding of wingless females of grain aphid on ears of tested spring triticale cultivars (white-Gabo, black-Migo, grey-Wanad).
Δ CS calculated as the difference between CS index of infested plants and CS index of non-infested plants



Chemical analyses also showed that feeding of the wingless *S. avenae* induces decrease of EAA index value calculated for all examined spring triticale cultivars (Fig.2.) in comparison with non-infested plants. Feeding of the grain aphid has the strongest influence on decrease of EAA index value in the case of the Gabo cultivar. Decreases of amino acid content in plants infested with grain aphid, and thus drop of both CS and EAA indices' value and nutritive value of soluble protein allows us to assume that these insects use this protein as element of diet. Breakdown of these proteins is a result of an excretion of proteolitic enzymes into tissues. Urbańska and Niraz [16], in studies of anatomical and biochemical aspects of cereal aphids feeding, assert that enzymes in saliva of these insects indicate a connection with content of nutrition they consume. According to these authors hydrolytic enzymes of cereal aphids break down peptides and proteins. This supplies them with essential amino acids crucial for growth and development. Moreover, break down of amino acids may also be caused by the host plant's proteases, an activity of which is induced by chemical substances contained in aphids' saliva. According to Dorscher [7] aphids may also change the host plant's metabolism by intensifying syntheses of nutritive substances therein, including essential amino acids. This can be an explanation for increase of CS index value calculated for isoleucine in the Migo cultivar and for leucine and valine in the Wanad cultivar.

Fig.2. Changes in the values of the integrated index of essential amino acids EAA caused by feeding of wingless females of grain aphid on ears of tested spring triticale cultivars (white-Gabo, black-Migo, grey-Wanad).
Δ EAA calculated as the difference between EAA index of infested plants and EAA index of non-infested plants



CONCLUSIONS

Conducted research have proved that feeding of grain aphid on ears of tested spring triticale cultivars (Gabo, Migo, Wanad) induces decrease in content of essential amino acids in soluble protein of these organs, thus strongly influences the decrease of values of CS and EAA, and thus decrease of nutritive value of the analyzed protein.

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