EVIDENCE OF PANICUM MILIACEUM AS A SAFE FOOD FOR COELIAC PATIENTS

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1 ABSTRACT

In this work toxicological and nutritional analyses provided evidence of the validity of Panicum miliaceum, a cereal species phylogenetically close to maize, as a safe food for coeliac people. A collaboration with some public and private institutions, from both Italy and other countries, has allowed to recover 23 genotypes of Panicum miliaceum, which have been grown in the field and studied for their main agronomic characteristics. Peptic-tryptic (PT) digests of ethanol soluble proteins from Panicum miliaceum have been submitted to agglutination tests on human myelogenous leukemia K562(S) cells, the agglutinating activity of the PT digests being strongly associated with toxicity for the coeliac intestine. The analysis has evidenced absence of agglutination up to 2300 mg/l of PT digests as compared with 70 mg/l of PT digests from the positive check sample Triticum aestivum cultivar S. Pastore. The nutritional characteristics were determined by a test on CaCo-2 cells by the alcohol-soluble proteins of the Panicum miliaceum genotypes analysed here, even at protein concentration as high as 10 g/l.

2 INTRODUCTION

Coeliac disease is a severe permanent alimentary pathology which causes a flattening of intestinal villi in genetically predisposed individuals (in Italy: 1:100-180 inhabitants). The malabsorption resulting from the damage to the small intestine epithelium in coeliac patients causes a wide range of effects as diarrhoea, weight loss, osteoporosis, anaemia, neuropathies, sterility. At the present time the prevention of pathologic symptoms is possible only through the complete exclusion from the diet (for all the rest of the life) of the food containing bread and durum wheat, spelt, Emmer, Einkorn, barley and rye, which contain toxic prolamin; maize and rice, on the contrary, are not toxic—one, and so it’s probable that other cereal species phylogenetically close to maize, including proso millet (Panicum miliaceum), are not toxic for coeliac people. The aim of this study is providing experimental evidences, through toxicological and nutritional analyses, on the validity of this crop as a safe food for coeliac patients.

3 MATERIALS AND METHODS

In order to increase the genetic variability of the material object of this work a collaboration with some public and private institutions, from both Italy and other countries, has been started and has allowed to recover altogether 23 genotypes of Panicum miliaceum. All these varieties and populations have been grown in a field trial, without repetitions, carried out with organic methods in 10 m plots formed by 8 rows 8 metres long and an inter-row 15 centimetres wide. The following parameters were determined in the field: earing date, height from the ground to the last leaf, height from the ground to the base of cob, height of the plant (from the ground to the apex of cob), length of cob. Further parameters were measured on the grain harvest: unit production at 13% of humidity, hectolitric weight, 1000 kernels weight.

The toxicological analysis which has been performed is the agglutination test on human myelogenous leukemia K562(S) cells, in fact the agglutinating activity of prolamin peptides on K562(S) cells is strongly associated with toxicity against the coeliac intestine. Peptides were obtained through PT digestion of alcohol-soluble and acetic-acid-soluble proteins. The nutritional characteristics were determined by a test on CaCo-2 cells in order to verify the possible inhibition effect of in vitro growth by the alcohol-soluble proteins of Panicum miliaceum. In a previous work, in fact, a cytotoxic effect of inhibition of the cell division by prolamin peptides on in vitro cultures of CaCo-2 cell lines has been observed, and the implication of these results for coeliac disease has been described.

4 RESULTS AND DISCUSSION

The agronomic and merchandize characteristics of the 23 Panicum miliaceum genotypes are listed in Table 1. The test on K562(S) cells has evidenced in all the samples absence of agglutination up to 2300 mg/l of PT digests (Table 1) as compared with 70 mg/l of PT digests from the positive check sample Triticum aestivum cultivar S. Pastore. This test, though it is indirect, suggests anyway a total absence of toxicity of Panicum miliaceum for coeliac patients. The nutritional analyses showed the absence of any inhibition effect on the in vitro growth of CaCo-2 cells even at protein concentration as high as 10 g/l (Table 1); so the alcohol-soluble proteins of the Panicum miliaceum genotypes analysed here don’t produce anti-nutritional effects even at very high concentrations. The positive results obtained through the agglutination test and the nutritional test on CaCo-2 cells encourage to continue the studies on this interesting crop, nowadays very little known in the developed countries.

Table 1 Characterization of 23 Panicum miliaceum genotypes

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Country</th>
<th>Theoretical yield (Kg ha⁻¹)</th>
<th>Protein (%)</th>
<th>Protein (g 100g⁻¹)</th>
<th>Lipid (%)</th>
<th>Lipid (g 100g⁻¹)</th>
<th>Phosphorus (g 100g⁻¹)</th>
<th>Phenolic acids (mg/100g⁻¹)</th>
<th>Anthocyanins (mg/100g⁻¹)</th>
<th>Phenol concentration (µg/mg)</th>
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Acknowledgements

The authors thank in particular Dr. Francesca Caporalini for the great support provided for the execution of field trials.

References