Leather industry waste used to obtain biostimulant protein gels

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Introduction

Leather industry generates significant amounts of solid and liquid waste representing a great threat to environment. Due to their rich content in valuable nutrients, the animal tissue by-products might be recovered into valuable products such as protein hydrolysates used as plant biostimulants.
The beneficial effect of protein hydrolysates on crop performances was attributed to the high content of amino acids (glycine, alanine, proline) which are involved in stimulating plant growth by supporting chlorophyll synthesis or improving the resilience of plants to abiotic stress.
Good results have been obtained in terms of yield and quality by using biostimulants in tomato crops.
Tomato (*Lycopersicon esculentum* Mill.) is a vegetable with important role in the human diet, representing a source of healthy compounds such as vitamins, minerals, lycopene, β-carotene etc.
The research performed in this study was focused on testing a protein gel based on bovine gelatin and keratin hydrolysate on tomato crop and their effects on the seedlings were assessed.

Figure 1. Experimental variants of tomato seedlings in the greenhouse

Materials & Methods

Bovine hide and sheep wool were supplied by a slaughterhouse and a sheep farmer from the Constanta County, Romania. The gelatine was obtained by acid hydrolysis from bovine delimed hide at high temperature. The keratine hydrolysate was obtained from sheep wool by alkaline hydrolysis. A combination of bovine gelatin with keratin mixed in a 1:1 ratio (labeled GBK) were used for the treatment of the tomato plants by application on the root plants.
Tomato seeds (*Lycopersicon esculentum* Mill.) of the BPK 16021 hybrid supplied by Marcoser SRL (Galati County, Romania) were selected for the research. The experiment consisting of two variants (untreated control and seedlings treated with the protein gel GBK) was installed in the experimental greenhouses from USAMV Bucharest. Three treatments with tested protein gel were applied on the tomato seedlings by watering the soil once every 10 days with diluted solutions of gel (30 g in 150 mL of water). The control group received only equal amount of water.
The seedlings were measured regarding biometric parameters (plant height and number of leaves) and content in total chlorophyll, carotenoids, dry matter and soluble sugars. Methods used for the measurement of these parameters were according to the standards in force or in house methods.

Results & Discussion

Physico-chemical characterization of the tested protein gel (GBK)
Good contents of protein and amino acids are noted (Table 1), which are important for the development of tomato plants, promoting the rapid biosynthesis of different types of proteins.

Dry substance (%)	31.32	Total free amino-acids (mg/g)	1.50
Total ash (%)	9.36	pH	5.59
Total nitrogen (%)	15	Bloom test (g)	130
Protein content (%)	84.26	Viscosity (mPa*s)	2

Table 1. Physico-chemical characterization of the tested protein gel (GBK)

Biochemical analyses indicated higher amounts of assimilatory pigments (3.25 times more chlorophyll and 2.25 times more carotenoids respectively) in the leaves of the treated plants relative to the control plants (Table 2). This increase positively influenced the photosynthetic activity and consequently the achievement of higher content of dry matter and total sugars in the seedlings leaves.

Experimental variants	Total chlorophyll (mg/g)	Carotenoids (mg/g)	Dry matter (%)	Total soluble sugars (mg/100 g)
Control	0.72±0.02	0.028±0.0014	14.58±0.49	26.73±2.84
GBK	2.34±0.09	0.063±0.0054	26.75±1.07	74.12±2.78

Table 2. Variability of some biochemical parameters of the tomato seedlings

Applied biostimulator treatment determined differences regarding on the growth of tomato seedlings (Figure 1).

Biometric measurements of the seedlings showed higher values of the average number of leaves (by 37.5%) and an increase of plants height (by 27.8%) after the last treatment compared to the untreated plants (Figure 2).

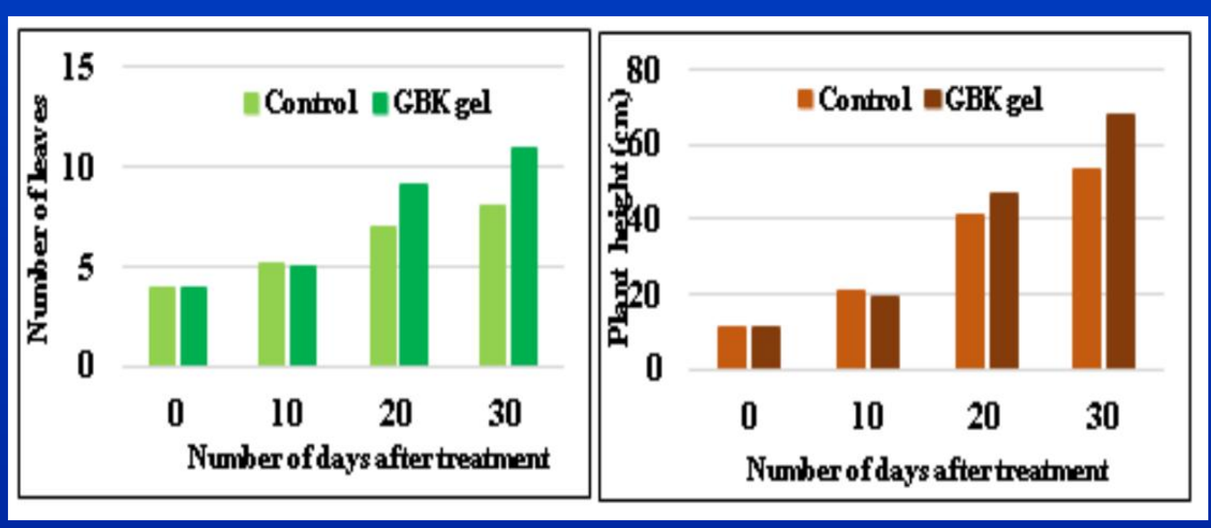

Figure 2. Variability of the biometric parameters of the tomato seedlings

Through these analyzes we can assess that innovative treatment applied induced the development of some vigorous seedlings representing the premise for obtaining superior tomato fruit in terms of production and nutritional qualities.

Conclusions

Leather industry waste can be valorized by obtaining protein hydrolysates. The protein gel tested in this study demonstrated stimulative effects on the tomato crop promoting the reduction of the use of chemical fertilizers and consequently the agricultural sustainability. Moreover, obtaining useful protein hydrolysates from animal tissue by-products represents a solution to the problem of industrial waste disposal.

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