

Jasmina Ranilović<sup>1</sup>, Tanja Cvetković<sup>1</sup>, Ante Jukić<sup>2</sup>, Kristina Sušac<sup>2</sup>, Elvira Vidović<sup>2</sup>

<sup>1</sup> Podravka Inc, Ante Starčevića 32, 48000 Koprivnica, Croatia

<sup>2</sup> Faculty of Chemical Engineering and Technology, University of Zagreb, Trg Marka Marulića 19, 10000 Zagreb, Croatia  
jasmina.ranilovic@podravka.hr

## BACKGROUND

By-products of the fruits and vegetables (seeds, peels and pulp) processing are mainly discarded as waste. Pepper seeds (2-3% of the fruit) from red sweet peppers (*Capsicum annuum* L.) varieties Podravka and Slavonka are nutritionally valuable organic material for production of oil, rich in bioactive components and therefore suitable for food, cosmetic and the pharmaceutical purposes.

However, after pepper seed cold pressing for oil production, a new by-product remains - pepper seed cake (Fig 1), which is high in fiber (54%), proteins (21%), carbohydrates (4%) and residual oil (up to 9%). However, due to its highly bitter taste, incorporating pepper seed cake into food products is not organoleptically acceptable. A preliminary research was undertaken here while looking for a novel opportunity to utilize pepper seed cake as a possible compound in the production of biodegradable packaging materials for food products.



**Figure 1** Pepper seed cake (by-product after cold pressing of pepper seeds)

## RESULTS

Since packaging materials obtained by pressing only the pepper seed cake did not have satisfactory properties, composites of pepper seed cake with polyamide (PA) or polylactide (PLA) were prepared. Ratio of pepper seed cake in PA composites was 50 wt.%, while in PLA it was 5, 10 or 25 wt.%.

Composites with PLA were prepared in a twin-screw semi-industrial extruder (Fig 2), after which samples were prepared in the form of tiles using a press (Fig 3).

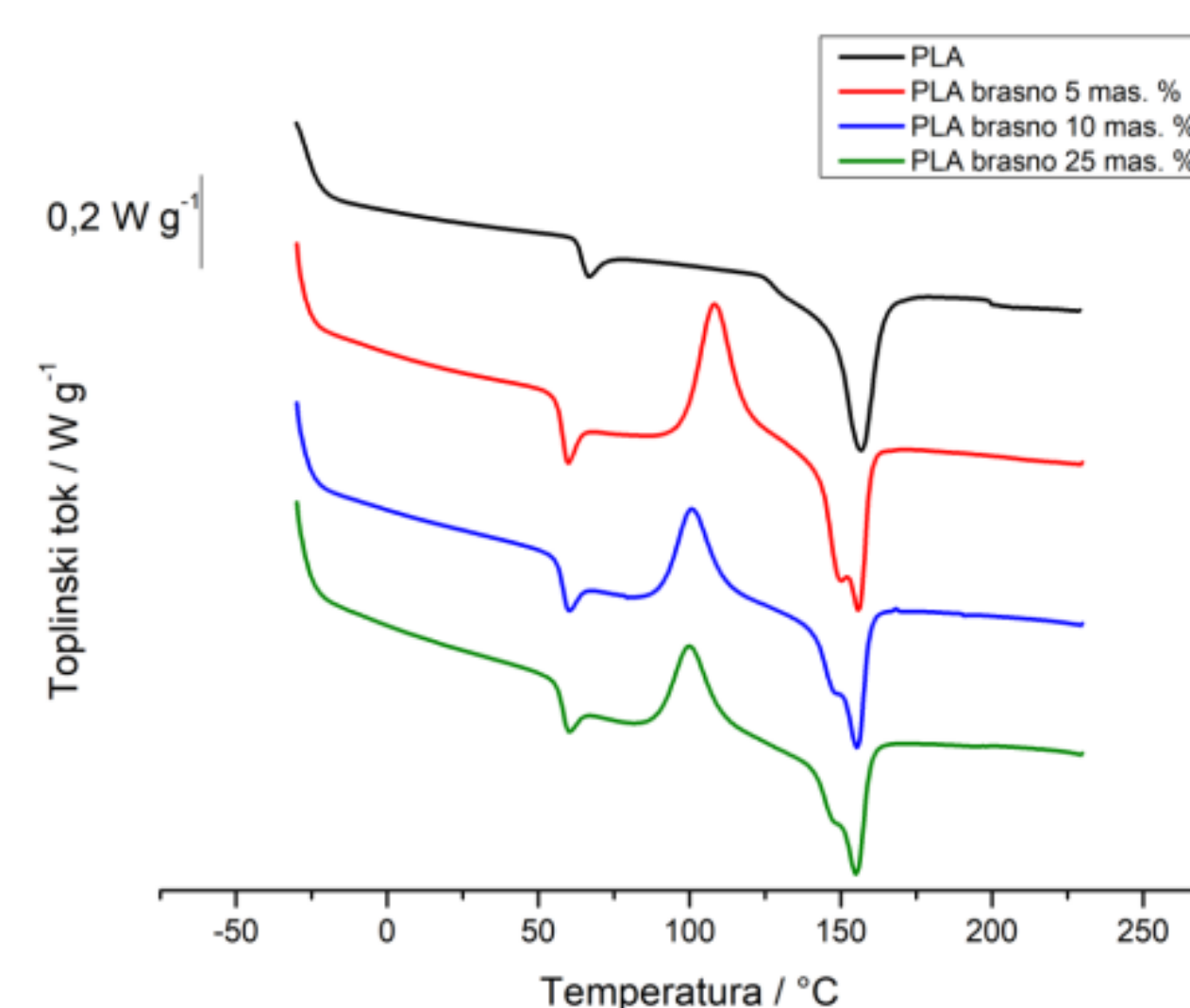


**Figure 2.** PLA composite with 25 wt.% pepper seed cakes

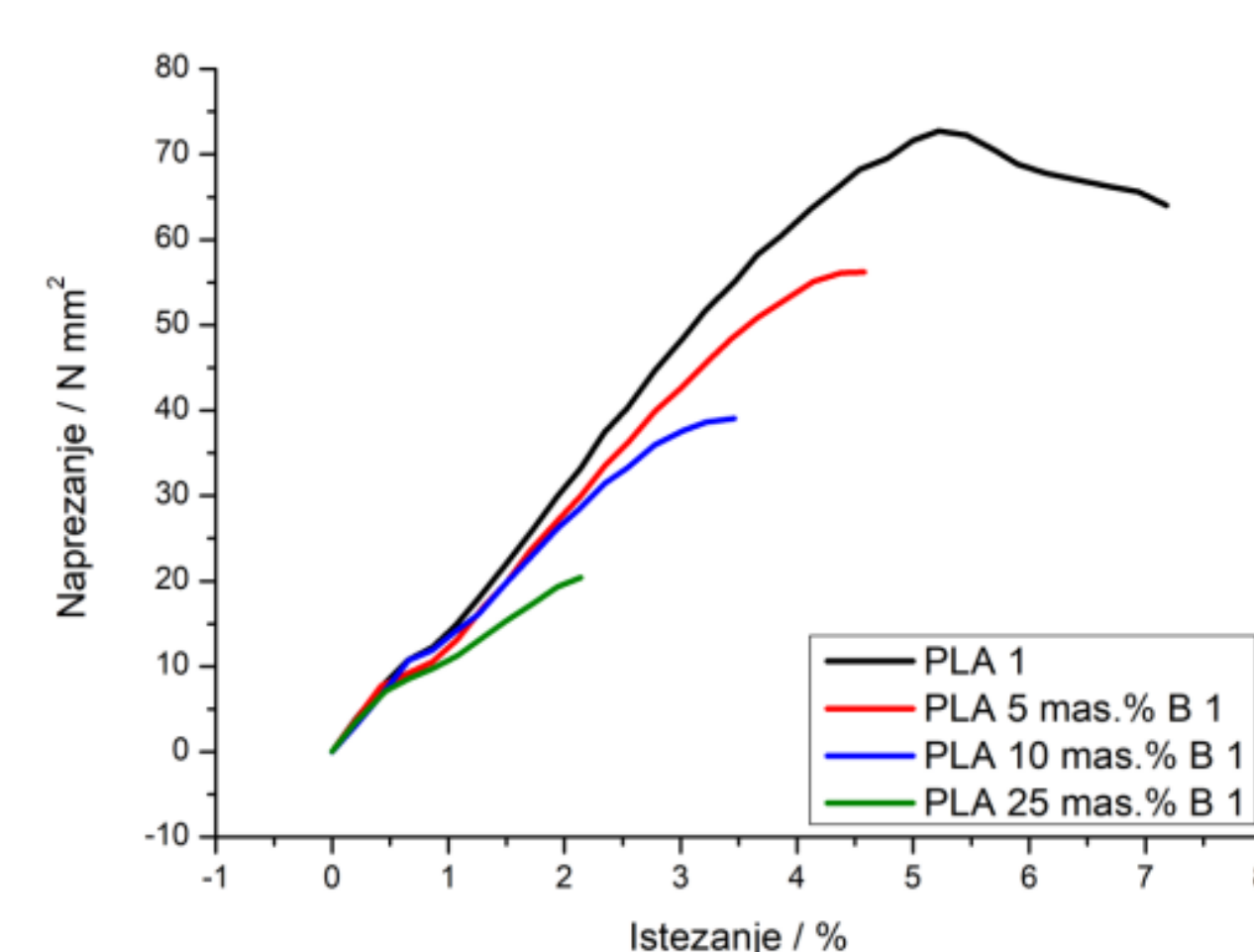


**Figure 3.** Tiles after pressing of PLA composites with 25 wt.% pepper seed cakes

Differential scanning calorimetry (DSC) analysis of reveals that composites display similar thermal behavior (glass transition temperature and melting temperature) like PLA but an additional cold crystallization peak appeared (Fig 4). Mechanical tests showed that addition of 5 wt.% of cake slightly decreased toughness of the PLA while higher content of cake significantly decreased mechanical properties of materials (Fig 5). Apart from the poorer mechanical properties of cake its uneven dispersion in matrix probably contributes additionally to the deterioration of mechanical strength of materials.



**Figure 4.** DSC analysis of PLA and its composite with cake



**Figure 5.** Mechanical properties of pure PLA and composites prepared on a twin-screw extruder

## CONCLUSION

After preliminary research, it can be concluded that pepper seed cake can be used for preparation of composites for polymer packaging materials, where chosen polymer matrices were polyamide and biodegradable PLA. Additional research should be undertaken in order to meet the required application properties and to avoid significant degradation of the cake or polymer matrix.