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PASTA PACKAGING WITH BIO-BASED BARRIER TO PREVENT INSECT INFESTATION

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Introduction

Recently, many researches have demonstrated that biodegradable plastic mixtures could be produced with certain limitations [1-3]. Furthermore, post-consumer management and recyclability must be carefully managed. Biobased polyethylene (bio- PE) is presented as a suitable substitute due to its superior barrier properties (reduced permeability to O2, CO2 and water) and its higher heat resistance than polyethylene (PE) [3-5]. Therefore, bio- PE has been frequently investigated in recent years [1, 6, 7]. The production of bio- PE is mainly based on sugar cane, which is produced by chemical synthesis from renewable, biologically derived monomers [8, 9]. A major disadvantage of the existing packaging material is that insects infest the packaged food by penetrating it. Insect infestation depends on the pest species, exposure time, food, packaging material and prevailing environmental conditions. The solution to prevent infestation could be to use resistant laminated packaging that is both environmentally friendly and recyclable. Several insect species can infest pasta factories, which can have negative economic and commercial consequences. Infestation may occur during the storage process in production facilities, warehouses, general stores and retail outlets already colonised by insects derived from other products. Pasta in particular can be infested by the corn weevil, S. zeamais, during transport in trucks, railway waggons and ships, and during storage at retail level or even in the consumer's home [10-12]. The widespread use of these susceptible food packaging materials should be carefully considered, as losses due to insect infestation in packaged food may be equivalent to the costs of cultivation, harvesting, transport, processing and packaging [13, 14]. The aim of our work was to evaluate different packaging and to consider the possibility of using this packaging to better protect the food, in our case pasta, from insect attack.

Methods

In this research, 3 different types of packaging were used as presented in Table below.

Sample	Packaging	Material – outer base	Material – inner barrier	Package dimension [mm]
Sample A not laminated	Paper tube	Recycled kraft paper; unprinted	Recycled kraft paper	275.0 × 65.7[a]
Sample B laminated	Paper tube	Recycled kraft paper; unprinted	Laminated kraft paper with bio-PE film	275.0 × 65.7[a]
Sample C foil	Plastic pillow pouch with gussets and fin seal	Polypropylene	No	95 × 304[b]

Pasta packages of durum wheat commercial spaghetti sample of 500 g, were used in the tests. The tests were performed using 20 rectangular olfactometer arenas.

Material characterization: moisture, Cobb value, Capillary rise, WVTR, compressive strentgh.

Insect trails: 1–2 week old adults S. zeamais reared in a laboratory on durum wheat. In each test, 50 S. zeamais adults were used. The experimental plan duration was 30 days.

Results

When selecting suitable materials for food packaging, it is important to analyze the moisture properties as shown in Table below.

Sample	Moisture content [%]	Cobb value [g/m²]	Capillary rise [mm]	WVTR [g/m²·day]
Sample A not laminated	10.1	2.15	54.2	3.52
Sample B laminated	8.9	1.95	34.6	2.34
Sample C foil	0.2	0.00	0.00	0.004

Results of mechanical properties of the packages are shown in Figure 1.

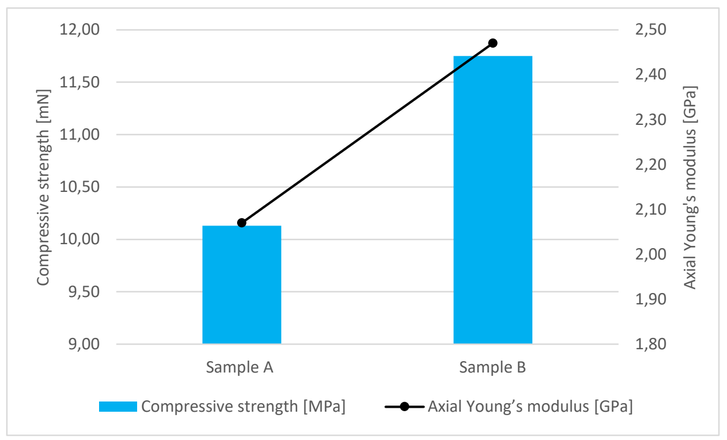

Figure 1: Results of mechanical properties of tube packaging.

Results of the insect trails are presented in Figure 2 and 3.

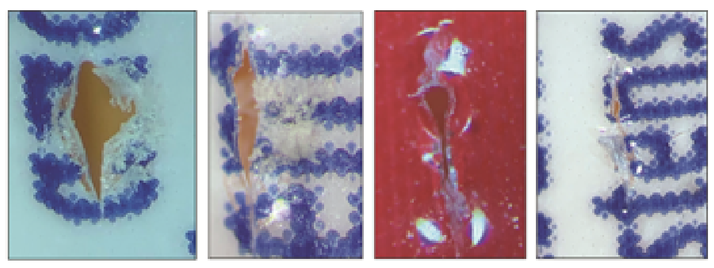

Figure 2: Damages produced by S. zeamais adults on Sample C, packages of polypropylene pillow pouch with gussets and fin seal.

Figure 3: Attack by S. zeamais adults on Sample A

Discussion / Conclusion

In our case, no infestation was observed within the packaging of two different paper tubes without and with a biologically based PE barrier film. The paper tube with bio- PE achieved better mechanical and moisture properties; therefore, such packaging could be used for pasta products. Moreover, it can be refilled after the first use. The shelf life of the mentioned packaging is long compared to traditional polypropylene and other paper packaging on the market. Therefore, in order to obtain safer, healthier and higher quality food products, the lamination of paper tubes can be a more effective packaging for pasta products. An additional analysis should be carried out to determine the toxicological risk.
The risks of pasta contamination along the processing cycle, from the field raw material to the consumer, remain unclear due to specific aspects of carelessness in warehouses and shops and due to the long shelf life of the products. For these reasons it would be necessary to pay more attention to the packaging and the material used for packaging, which must be resistant to insect infestation.

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