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EVALUATION OF MECHANICAL PROPERTIES OF BIODEGRADABLE PACKAGING MATERIALS

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Abstract: A study was conducted to evaluate the mechanical properties of biodegradable packaging materials. The different packaging materials viz. Areca Sheath trays (T_1) and Coconut shell trays (T_2) and commercially available Styrofoam trays (control) were used and the mechanical properties of packaging materials (Tensile strength (MPa), Maximum Force (%), Elongation at Maximum (%), Elongation (%) were assessed.
Keywords: Biodegradable packaging materials, Mechanical properties.

Introduction

In recent years, the development of biodegradable packaging materials from renewable natural resources (e.g. crops) has received increasing attention. In current generation, the available meat packaging materials are petroleum based derivatives which cannot be decomposed by natural processes. In terms of health and safety issues, natural fiber possesses environmental friendly processing, with no wear of tooling and skin irritation. Natural fiber also has good thermal and acoustic insulating properties (Nor, 2007). Keeping this in mind and its right time to design biodegradable packaging materials from natural fibers with good mechanical properties for food packaging is need for our generation.

Materials and methods

A study was carried out to evaluate the mechanical properties of biodegradable ecofriendly packaging materials for storage of chicken meat in Department of Meat Science and Technology, Madras Veterinary College, Chennai-7. The Areca sheaths were immersed in cold water for cleaning and then dried. The trays were prepared by applying pressure for 30 seconds over the sheath using electrically operated aluminum die. The coconut shell powder trays were prepared by blending coconut shell powder with Acacia gum powder to make a paste and then pressed to the desirable shape using steel mould. The Mechanical properties of packaging materials were tested using UTM/HICKS, TINUS OLSEN, U.K. (QMART

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SOFTWARE). Samples were prepared according to ASTM (American Society for Testing materials) Standards D3039 (2010).

Results

The results of Mechanical properties of different packaging materials are presented in Table 1. Tensile strength is the ultimate strength of the material subjected to tensile loading. It is the maximum stress developed in a material in a tension test. Tensile strength is calculated by dividing the load at break by the original minimum cross- sectional area. The results are expressed in Megapascals (MPa). The Tensile strength values of Areca sheath trays, coconut shell powder trays and Styrofoam trays were 0.3864 MPa, 8.00 MPa and 0.790 MPa respectively. The Coconut shell powder trays are superior in Tensile strength followed by Styrofoam and Areca sheath trays.

The elongation of packaging material is the percentage increase in length that occurs before it breaks under tension. Percent elongation is calculated by dividing the elongation at the moment of rupture by the initial gauge length and multiplying by 100. The Elongation (%) of Areca sheath trays, coconut shell powder trays and Styrofoam trays were 10.88, 12.98 and 22.80 respectively. The Styrofoam trays showed higher percentage of Elongation whereas Areca sheath trays and Coconut shell powder trays possessed comparatively lesser Elongation percentage.

The percentage total elongation at maximum force is calculated as being the extension expressed as a percentage of sample gauge length, at the position where the load readings are highest. The Elongation at Maximum force (%) for Areca sheath trays, Coconut shell powder trays and Styrofoam trays were 2.760, 12.98 and 22.73 respectively. The graphs for Elongation at Maximum force (%) are presented in Figure 1, 2 and 3.

The Styrofoam trays showed higher percentage of Elongation at Maximum force whereas Areca sheath trays and Coconut shell powder trays possessed comparatively lesser Elongation at Maximum force (%). The force per unit area acting at point along the length of sample resulting from the bending moment applied at that point. It is the maximum force recorded when a test specimen is taken to rupture during a tensile test under specified conditions. The Maximum Force (N) for Areca sheath trays, Coconut shell powder trays and Styrofoam trays were 48.30, 1000 and 98.7 respectively. It represents that when materials are subjected to maximum strain, Coconut shell powder trays can withstand higher maximum force than Styrofoam trays and Areca sheath trays.

Discussion

The Tensile strength values of Areca sheath trays was 0.3864 MPa and was much lower than the values reported by Mohankumar (2008) who observed that the tensile strength values of areca sheath trays reinforcement with phenol formaldehyde was 101.85 MPa and the variations in results of tensile strength may be due reinforcement as well as the testing conditions. The Tensile strength values of coconut shell powder trays was 8.00 MPa as compared to the values reported by Sapuan (2003) who observed that the tensile strength of composites made from coconut shell filler particles with epoxy resins were 35.48N and the variations in results may be attributed to the inclusion of epoxy resins and the equipment used for measurement. The Tensile strength values of styroform trays were 0.790 MPa. However, Samsudin *et al.* (2006) observed higher tensile strength values of 45.1 MPa for polypropylene blends and the variation in values may be attributed to difference in sample thickness and testing machine.

Bhaskar and Singh (2013) observed elongation percentage values of 25.44, 25.43, 25.06 and 21.00 in materials prepared with coconut shell powder at levels of 20, 25, 30 and 35 wt percent along with epoxy resins. They concluded that as the level of coconut shell powder increased the elongation percentage decreased. Higher elongation percentage compared to the present study may be may be due to inclusion of epoxy resins with coconut shell powder at different proportions. The Elongation at Maximum force (%) for Areca sheath trays, Coconut shell powder trays and Styrofoam trays were 2.760, 12.98 and 22.73 respectively. The Elongation at Maximum force (%) of Styrofoam trays were higher than the values reported by Samsudin *et al.* (2006) who concluded that Elongation at Maximum force (%) of polypropylene blends were 2.6 percent and the variation may be due to difference in sample thickness and testing machine (Perkin Elmer DMA 7e). The Maximum Force (N) for Areca sheath trays, Coconut shell powder trays and Styrofoam trays were 48.30, 1000 and 98.7 respectively. The results of Maximum force (N) of coconut shell powder trays was slightly lower than the values observed by Rahul (2012) who reported 1623, 1690, 2437 and 1431 (N) as the maximum force (N) for materials prepared with 5, 10, 20 and 30 volume percent of coconut filler particles with epoxy resins respectively.

Conclusion

The mechanical properties of the different packaging materials revealed that Coconut shell powder trays were superior in terms of tensile strength whereas Styrofoam trays possessed better elongation properties. However biodegradability adds additional advantage for coconut shell powder trays which provides best way to utilize natural fibers in efficient way as food packaging material.

References

[1] ASTM (American Society for Testing Materials) D 3039, **(2010)**. Standard Test for Tensile Properties of Polymer Matrix Composite Materials. Annual Book of ASTM, **3**(1): 105-116.

[2] Bhaskar, J and V.K. Singh, (**2013**). Physical and Mechanical properties of Coconut shell particle reinforced epoxy composite. *J. Mater. Environ. Sci.* **4** (2): 227-232.

[3] Mohan Kumar, G.C., **(2008)**. A Study of Short Areca Fiber Reinforced PF Composites. *Proceedings of the World Congress on Engineering.* **2**, London, U.K.

[4] Nor, S.B.M., **(2007)**. Development of coconut shell powder reinforced HDPE composites. Thesis submitted to faculty of Mechanical Engineering, University of Technical Malaysia Melaka.

[5] Rahul,C., **(2012)**. Study of Mechanical and Flexural Properties of Coconut Shell Ash Reinforced Epoxy Composites. Thesis Submitted to Department of Mechanical Engineering. National Institute of Technology, Rourkela 769008.

[6] Samsudin, S.A, Azman Hassan, Munirah Mokhtar and Syed Mustafa Syed Jamaluddin,**(2006)**.Chemical resistance evaluation of polypropylene blends: Effect of Blend Compositions and SEBS Content. *Malaysian Polymer Journal (MPJ).* **1**(1): 11-24.

[7] Sapuan, **(2003)**. Mechanical properties of epoxy/coconut shell Filler particle composites. *The Arabian Journal for Science and Engineering.* **28**: 171-18.

Table 1. Mechanical properties of different packaging materials

Mechanical properties	**Areca sheath tray sample**	**Coconut shell powder sample**	**Styrofoam tray sample**
Tensile strength (MPa)	0.3864	8.00	0.790
Elongation (%)	10.88	12.98	22.80
Elongation at Maximum force (%)	2.760	12.98	22.73
Maximum Force (N)	48.30	1000	98.7

FIGURE 1

Areca sheath tray sample - Maximum force at Elongation

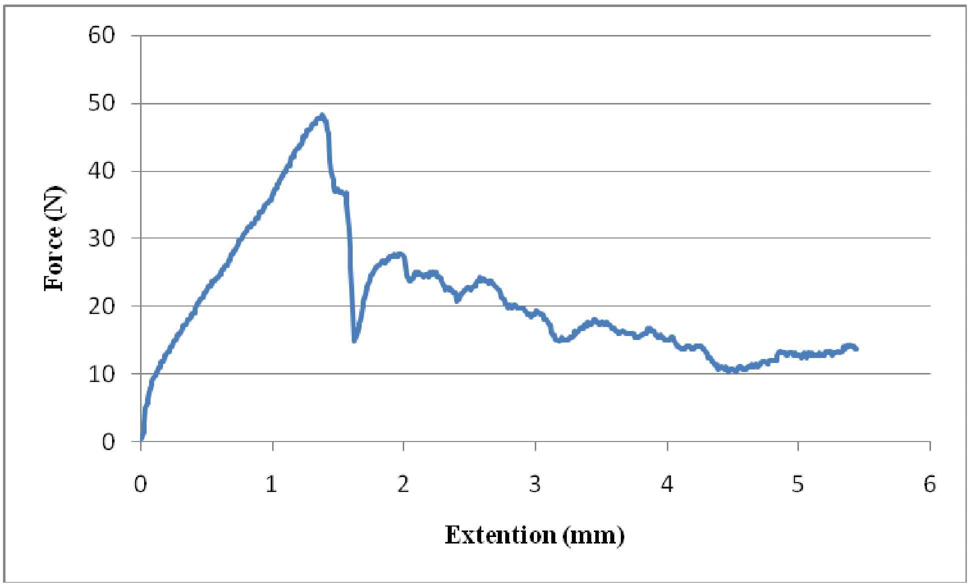

FIGURE 2

Coconut shell powder tray sample - Maximum force at Elongation

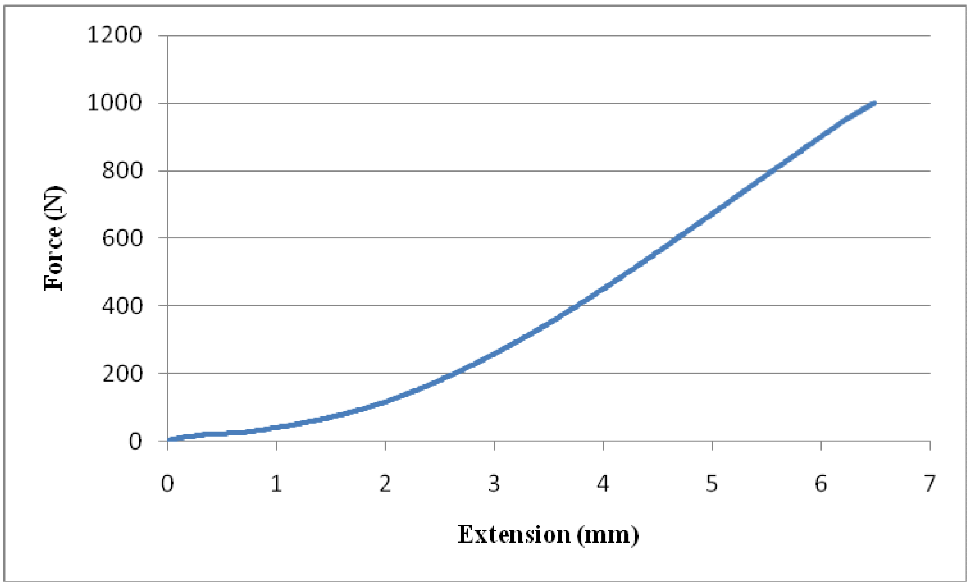

FIGURE 3

Styrofoam tray sample - Maximum force at Elongation