

# **Biorenewable Plastics : Proteins and derived Esters**

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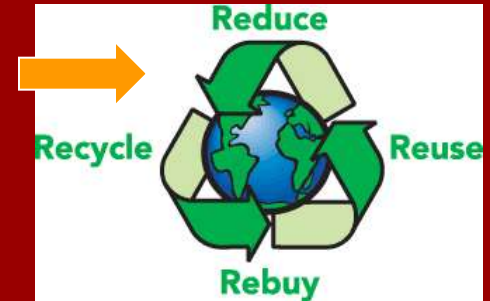
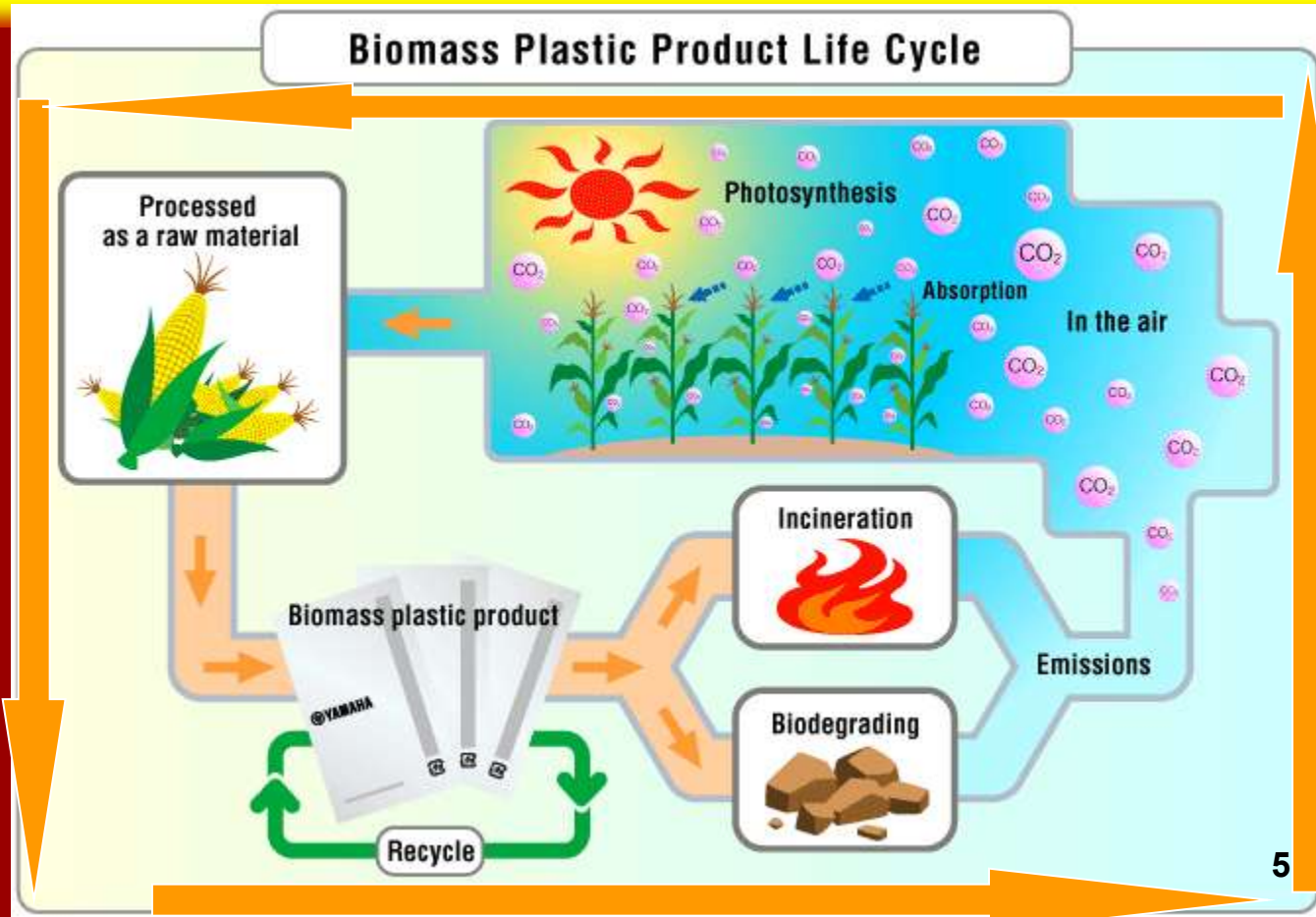
# Presentation Outline

- **Objectives**
- **Experimental (Material**
- **Findings and applications**
- **Conclusions**
- **Impacts**

# Objectives

- **Reduce the environmental impact of conventional polymeric waste.**
- **Develop consumer friendly and economically viable renewable plastic materials that have minimal carbon footprint.**
- **Redesign and improve plastics recycling process.**
- **Collaborate and innovate manufacturing process to improve process efficiency.**

# Objectives



5) <http://www.yamaha-motor.co.jp/biomass/english/index.html>

# Experiment

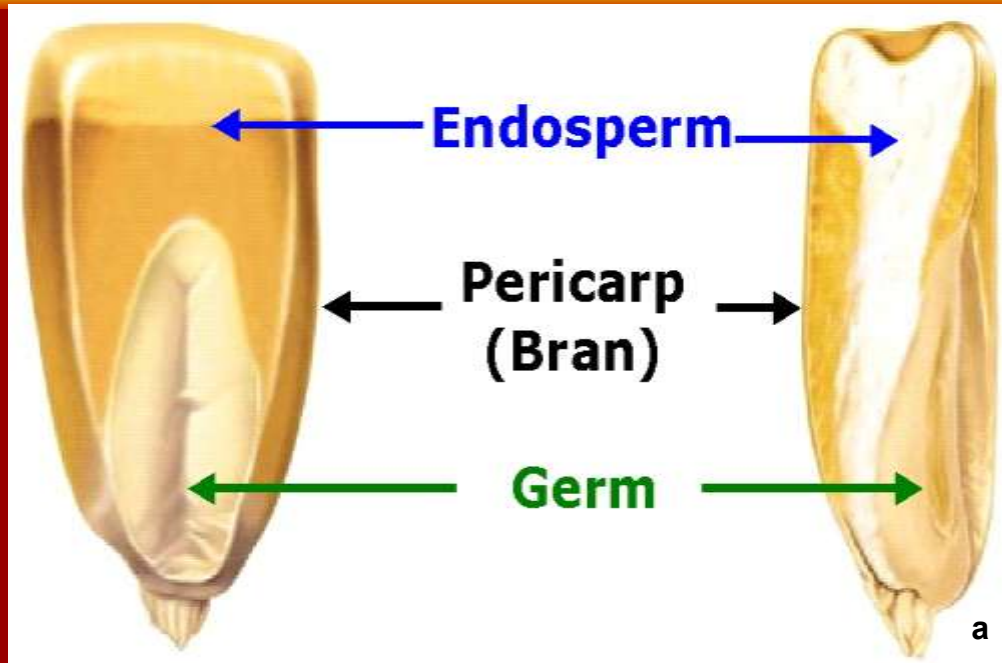
- **Materials**

- **Zein (Protein fraction of corn kernel).**
- **Soy flour, Soy concentrate, Soy protein Isolate.**
- **PLA (Polymerized Lactic acid made form corn starch)**
- **Commercial plastics PVC, PP, LDPE**

- **Procedure**

- **Single, Twin screw extrusion, Injection and Compression molding.**
- **Blow film extrusion, Vacuum thermoforming, Rotational molding.**
- **Ultrasonic treatment**
- **Tensile testing, DSC, TGA, MFI**

# Material: Zein



• *Zein is the major storage protein in corn composed of four subtypes of molecules which differ in terms of solubility*

• *Commercially zein is produced from gluten via solvent extraction from wet milling.*

• *Recent developments in extraction methods have enabled zein production from Dry Distillers Grains and Soluble (DDGs) from Dry milling process an attractive proposition.*

a) <http://reyntek.com/MOR/SC/fractionation.php>

# Process and Results : Zein



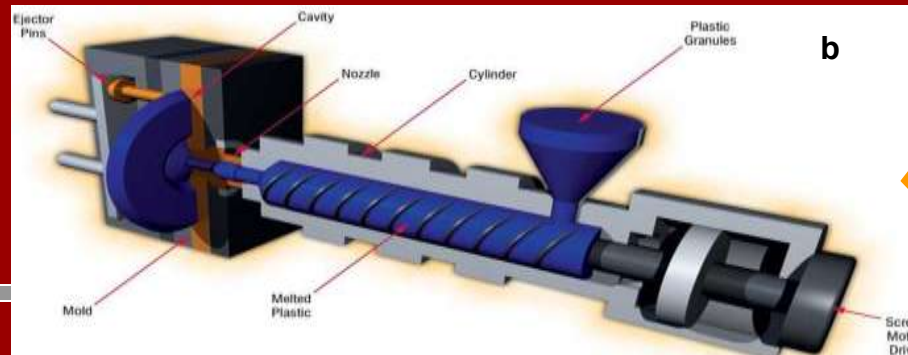
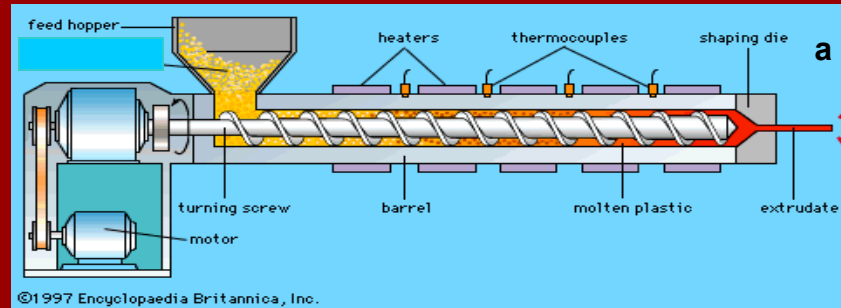
Plasticizers  
+ Additive

a: [www.tarad.com](http://www.tarad.com)

b: <http://www.britannica.com/eb/art/print?id=273&articleTypeId=1>



Extrusion temp 75-110 C



ASTM 638 Sample

Injection molding at 100-125 C

# Process and Results : Zein

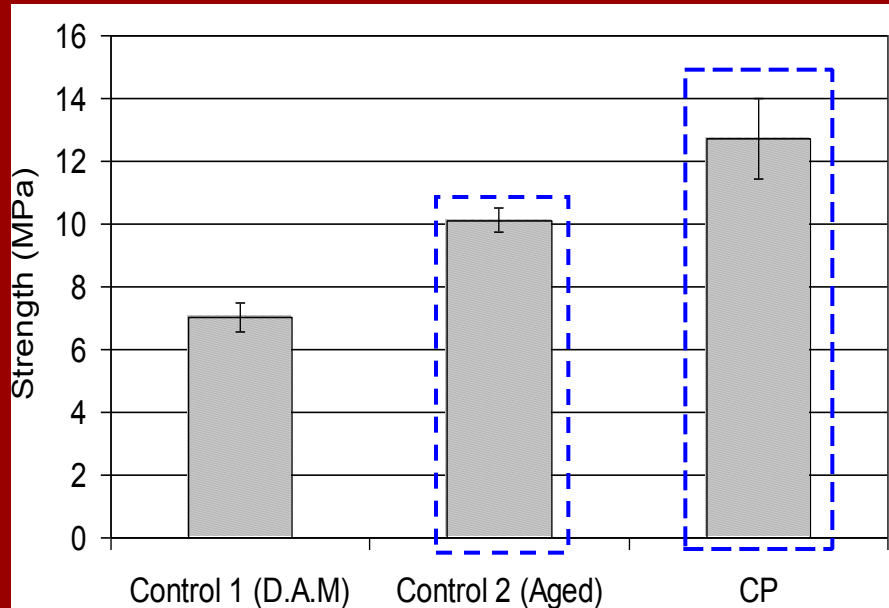


Figure 1: Strength of control formulation with aging and cross-linking agents.

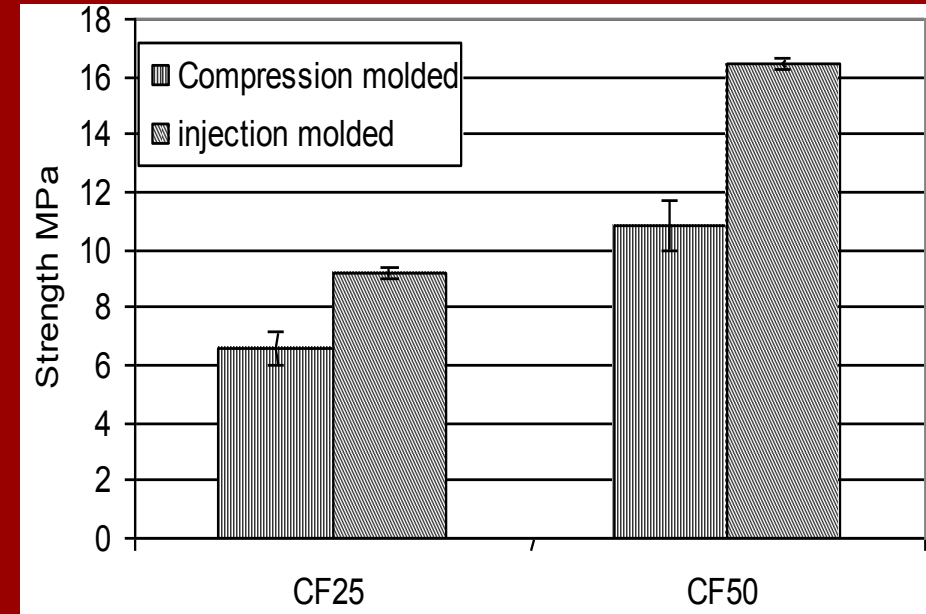


Figure 6: Strength of Coconut fiber formulations as a function of fiber content and molding technique



# Applications: Zein



# Applications: Zein



# Conclusions

- **Zein based polymers are water stable**
- **Strengths as high as 12 MPa are possible**
- **Composites strengths as high 20 MPa are possible**
- **Zein are easily compostable**

# Impacts

- **What are the impacts such as**
  - **Reduced green house gas generation**
  - **Better adoption of bioplastics**
  - **Less dependence on foreign oil**
  - **Etc.**