Developing Biopolymer Based Edible Films with Improved Anti-Microbial Properties.

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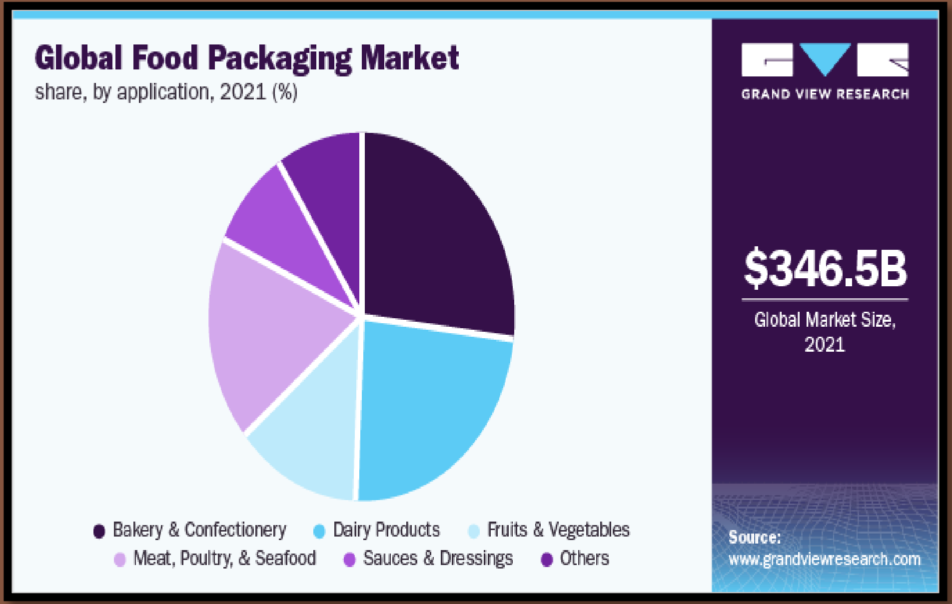
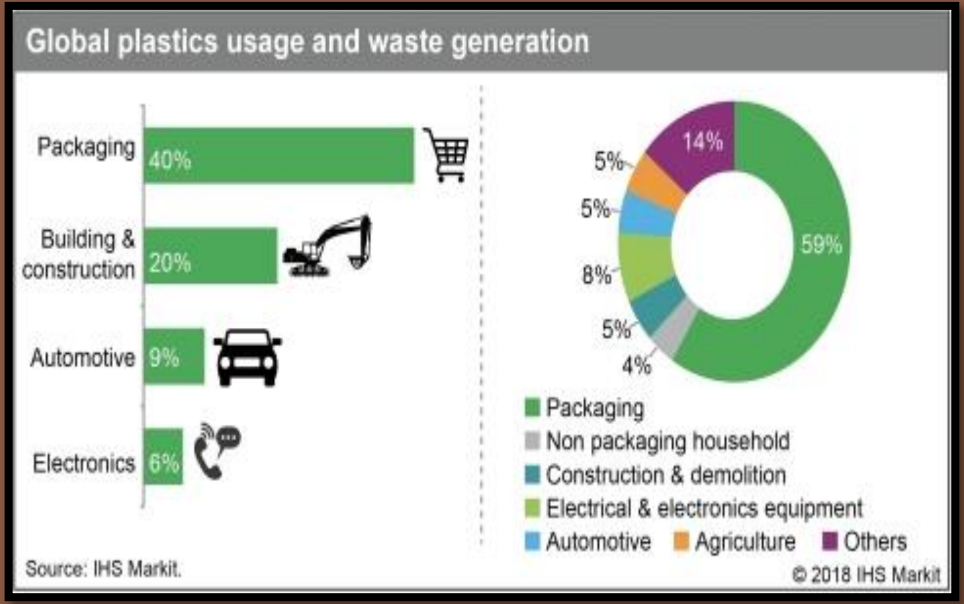
INTRODUCTION

- Global market of edible packaging -US$1004 million with an annual growth rate of 6.3%
- Packaging contributes one-third to waste generated by industrial sectors
- Edible coating-An effective measure to tackle the global issue
- Improves shelf life of consumable items
- Improves barrier for moisture, gas and microorganism





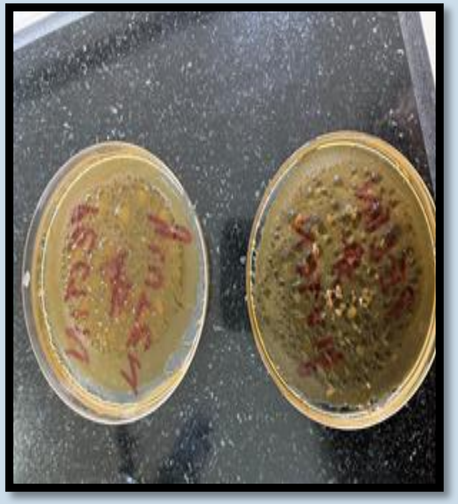
Source : https://www.grandviewresearch.com/industry-analysis/food-packaging-market(1)

https://news.ihsmarkit.com/prviewer/release_only/slug/chemicals-plastic-storm-ocean-plastic-waste-brewing-tidal-wave-consumer-activism-and-i(2)

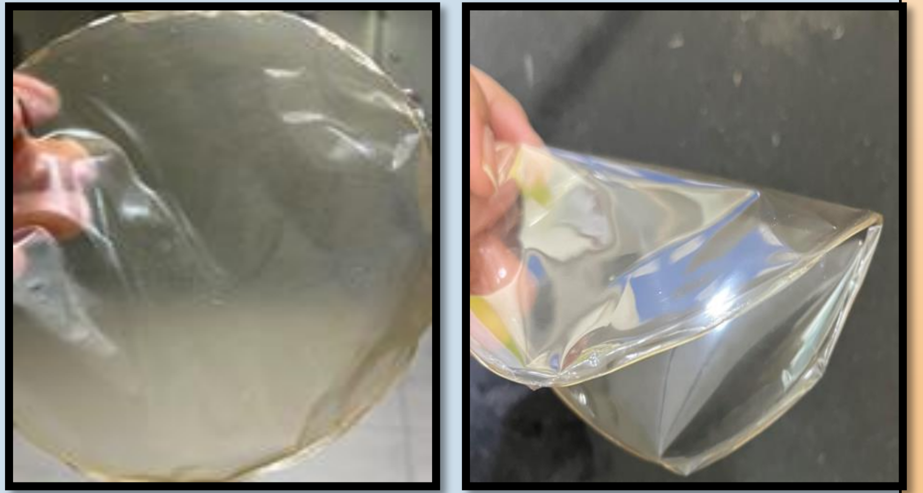
METHODOLOGY

- Multiple trials conducted using varied composition of components.
- Components weighed and dissolved in distilled water.
- Solution was homogenized(stirrer) at 40C and pH of 4.2 maintained.
- Homogenization using ultrasonic sonicator.
- Poured in petri dish and dried in a humidity chamber (Temp: 40C, Humidity-60%).
- Peeled off, sealed in pouches and stored in a vacuum desiccator.

Trial without humidifier



Excess humidity



Transparent, flexible thin protein-polysaccharide film

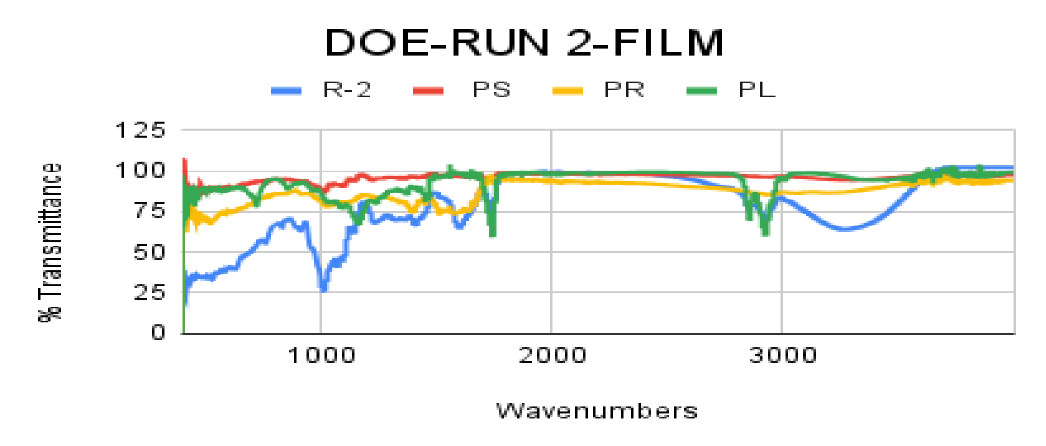
RESULTS AND DISCUSSIONS contd.,

- Design of Experiment

RUN NO.	GLUTEN(g)	CASTOR OIL(g)
1	0.75(+1)	0.125
2	0.25(-1)	0.125(-1)
3	0.75	0.375(+1)
4	0.25	0.375

- FTIR Results

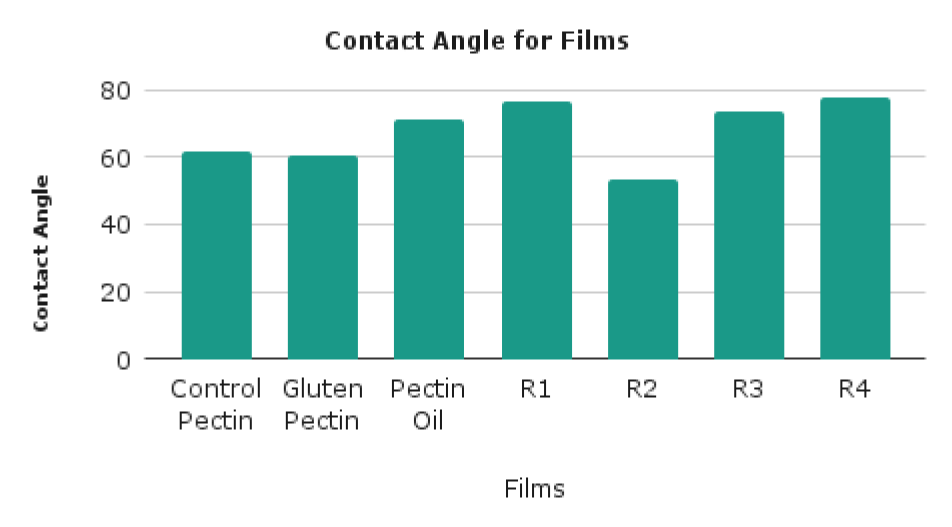
- DOE based FILM



RESULTS AND DISCUSSION contd.,

❑ Contact Angle

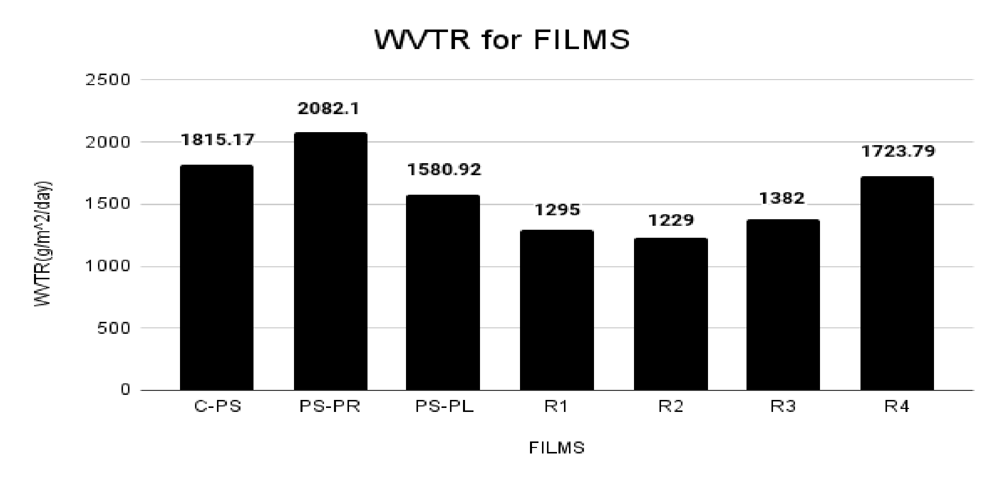
- The results show that in general the hydrophobicity was improved for films based on design of experiment in comparison to control films.



❑ WVTR Test

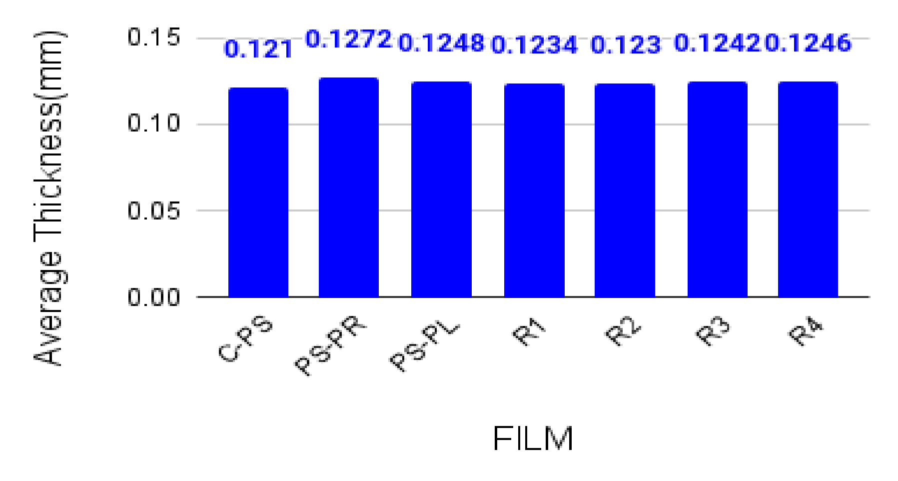
- Standard specimen size sent to Northern India Textile Research Association and Sree Chitra Tirunal Institute For Medical Sciences & Technology

- Analysis done for the test using water method



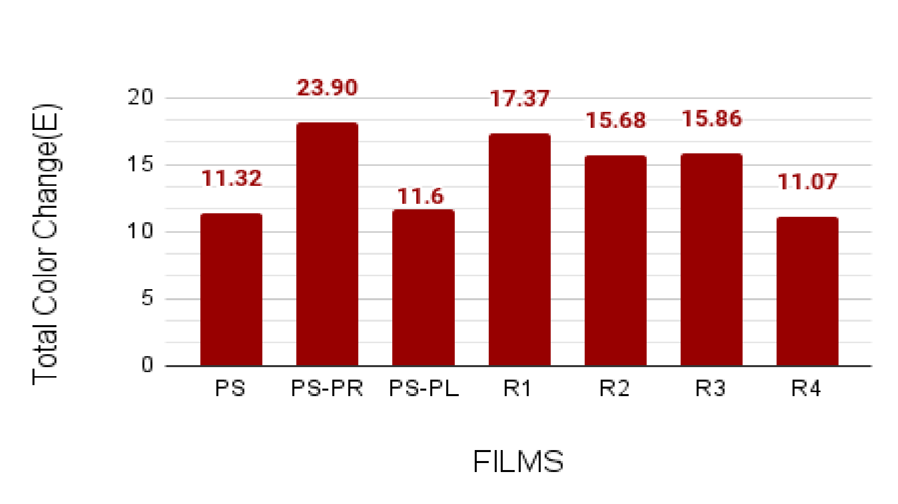
RESULTS AND DISCUSSION contd.,

❑ Thickness Test



All films were thin and falls in the range of 0.125±0.004 which is in accordance with the std. range(≤0.25 mm).

❑ Transparency Test



All films were transparent with E ranging between 11-25.

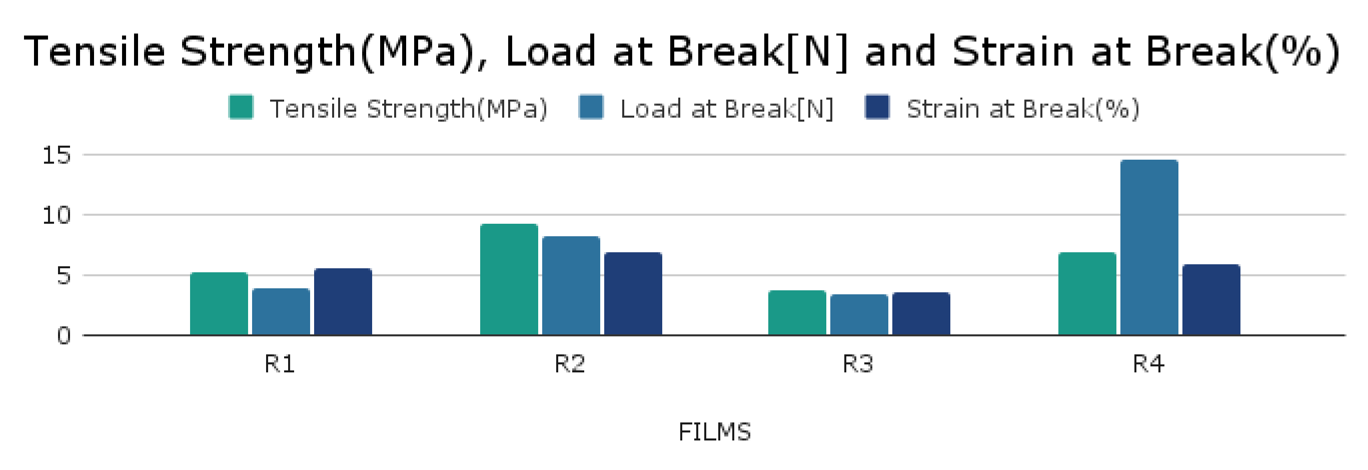
L-light/dark a-red/green b-yellow/blue

$$\Delta E^*_{ab} = \sqrt{(L^*_2 - L^*_1)^2 + (a^*_2 - a^*_1)^2 + (b^*_2 - b^*_1)^2}$$

where L_2^*, a_2^*, b_2^* are values of reference transparent film and L_1^*, a_1^*, b_1^* are values of prepared films

➢ Mechanical Properties

- ❑ Film R2 had the highest tensile strength.
- ❑ Film R4 had the maximum load at break.
- ❑ Lower gluten content with higher plasticizer content may improve mechanical properties.
- ❑ Film R3 had the lowest tensile strength and load at break.
- ❑ Higher plasticizer content may not always improve mechanical properties.
- ❑ Optimizing the gluten and plasticizer content can lead to films with improved mechanical properties.

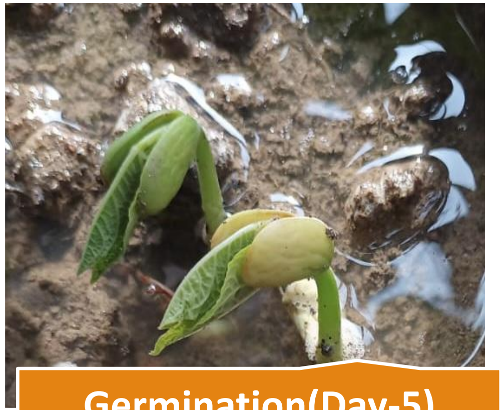


RESULTS AND DISCUSSIONS contd.,

❑ BIODEGRADABILITY

Film sown in soil

In 15hrs,film was biodegraded

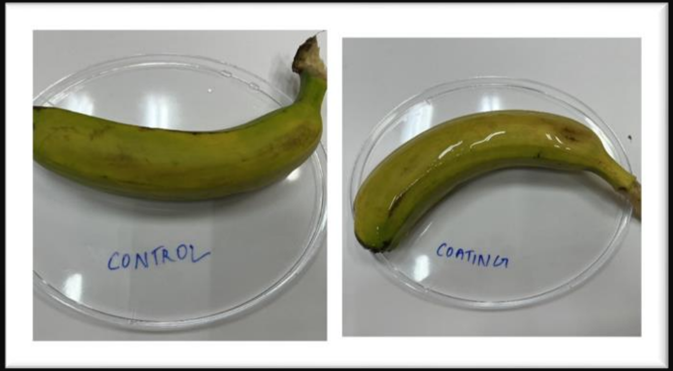


Germination(Day-5)

Leaves grown(DAY-7)

RESULTS AND DISCUSSIONS contd.,

- Coating on fruits and vegetable



Day-1

Day-6

- **Antimicrobial Test**

  Bacteria Used: E. coli

  Purpose: To prove improved anti-microbial property using growth of inhibition

  Result: Zone of inhibition was formed of 3.2 cm against well created of 1 mm in which film solution was added

CONCLUSIONS

- ❑ The polysaccharide-polymer films were successful developed with plasticizer range between 5% to 15% and protein range between 10% to 30%.
- ❑ All films made including control films were thin, flexible and transparent
- ❑ Films based on DOE compared to control films showed:
  - o Improved barrier properties
  - o Improved shelf life
  - o Improved hydrophobic properties
  - o Biodegradability and anti-microbial properties
- ❑ All films were completely soluble in water
- ❑ Moisture content for all films ranged between 0.05-1%
- ❑ FTIR spectra provides information regarding material state and new bond formation for the samples
- ❑ Polysaccharide based edible films- An environmental friendly alternative to petroleum-based polymers

REFERENCES

- Abral, H., Basri, A., Muhammad, F., Fernando, Y.,Hafizulhaq, F.,Mahardika, M.,Sugiatri, 12 E., Sapuan, S. M., Ilyas, R. A., & Stephane, I. (2019). A simple method for improving the 13 properties of the sago starch films prepared by using ultrasonication treatment. Food 14 Hydrocolloids,93, 276–283.

- J. Bai & A. Plotto, Coating for fresh fruits and vegetables,In edible coating and films to improve food quality, Edited by Jinhe Bai CRC Press, pp. 186-248 (2012)

- E.A. Baldwin, M.O. Nesperos-Carriedo & R.A. Baker, Use of edible coating to preserve quality of lightly and slightly processed product, Criti. Rev. Food Sc. Nutri. 35, pp. 509-552 (1995)

- W. Borchard, A. Kenning, A. Kapp & C. Mayer, Phase diagram of the system sodium alginate/water: A model for biofilms, Int. J. Boil. Macromol.; (2005)

- F. Debeaufort, G.J.A. Quezada & A. Voilley, Edible films and coating: Tomorrow's packaging: A review, Criti. Rev. Food Sc. and Nutri. 38, pp. 299-313 (1998).

- L.J. Harris, J.N. Farber, L.R. Beuchat, M.E. Paris, T.V. Suslow, E.H. Garrett & F.F. Buster, Outbreak association with fresh produce, Compre. Rev. Food Sc. 78-141 (2003)

- J.J. Kester & O.R. Fennema, Edible films and coatings: A review, Food tech., 40, pp. 47-49 (1986)

THANK YOU