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BIODEGRADABLE SMART FILM USING JACKFRUIT (*Artocarpus heterophyllus*) SEED STARCH AND BEETROOT (*Beta vulgaris*) EXTRACT AS A FRESHNESS INDICATOR

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INTRODUCTION & AIM

- Food safety, quality deterioration, and postharvest losses are major global concerns.
- Smart packaging has emerged as a critical solution to address these challenges.
- The global smart packaging market is projected to reach USD 34.35 billion by 2030 with a CAGR of 7.12%.
- Jackfruit seed starch (JSS) is a promising biodegradable polymer due to its high amylose content and strong film-forming ability.
- Beetroot extract (BE), rich in natural betalain pigment, provides pH sensitivity and freshness indication.

Objective

- To develop a smart bio polymeric film using jackfruit seed starch with beetroot extract as a natural freshness indicator.

METHOD

Extracting jackfruit seed starch by the distilled water method

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Extracting beetroot extraction via 50% ethanol-water extraction method

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Preparing films as C, F1, F2, F3 by incorporating 0 ml, 10 ml, 7 ml and 4 ml beet root extract

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Preparing the bio polymeric films by casting technique at 50 ℃ for 24 hours

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Measuring the physical and mechanical properties of the films

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Determining the biodegradability for the all formulations

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Evaluating the pH sensitivity of films using 1-13 buffer solutions

Figure 01: Procedure of preparing the bio polymeric film from jackfruit seed starch and beetroot extract

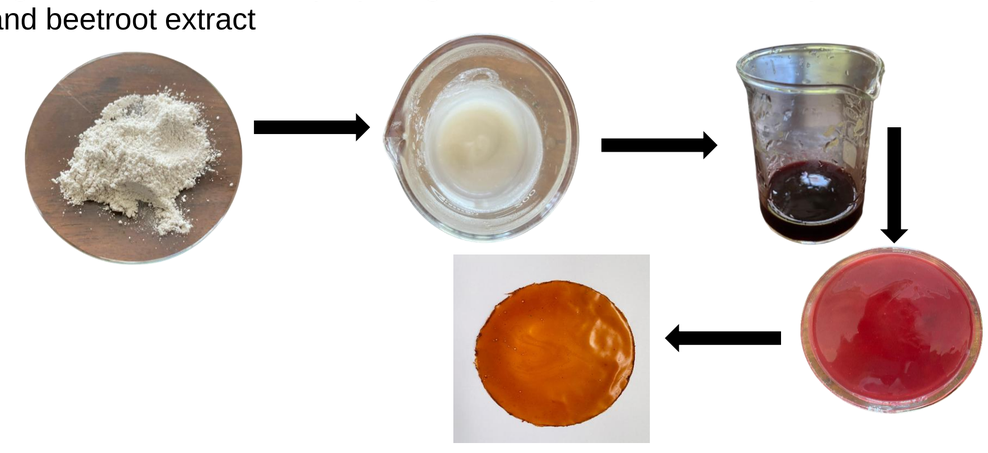

Figure 02: Graphical illustration of the preparation process of bio polymeric films from jackfruit seed starch and beetroot extract.

RESULTS & DISCUSSION

Table 01 : Physical and mechanical properties of the prepared films

Property of the film	Control (C)	F1	F2	F3
Water activity	0.662 ± 0.003^{b}	0.674 ± 0.004^{a}	0.627 ± 0.003^{c}	0.671 ± 0.002^{a}
Moisture content (%)	20.786 ± 0.035^{a}	17.130 ± 0.137^{b}	10.596 ± 0.106^{d}	12.953 ± 0.056^{c}
WVTR (%)	12.957 ± 0.059^{c}	14.722 ± 0.010^{a}	11.636 ± 0.082^{d}	14.281 ± 0.015^{b}
Water solubility (%)	27.143 ± 0.111^{c}	33.330 ± 0.020^{b}	33.330 ± 0.000^{b}	37.490 ± 0.079^{a}
Biodegradability (%)	91.513 ± 0.189^{b}	94.837 ± 0.552^{a}	92.003 ± 0.115^{b}	88.050 ± 0.437^{c}
Hardness (g)	221.40	258.40	422.40	188.40

Note : C= Without beetroot extract, F1= 10 ml beetroot extract, F2= 7 ml beetroot extract, F3= 4 ml beetroot extract

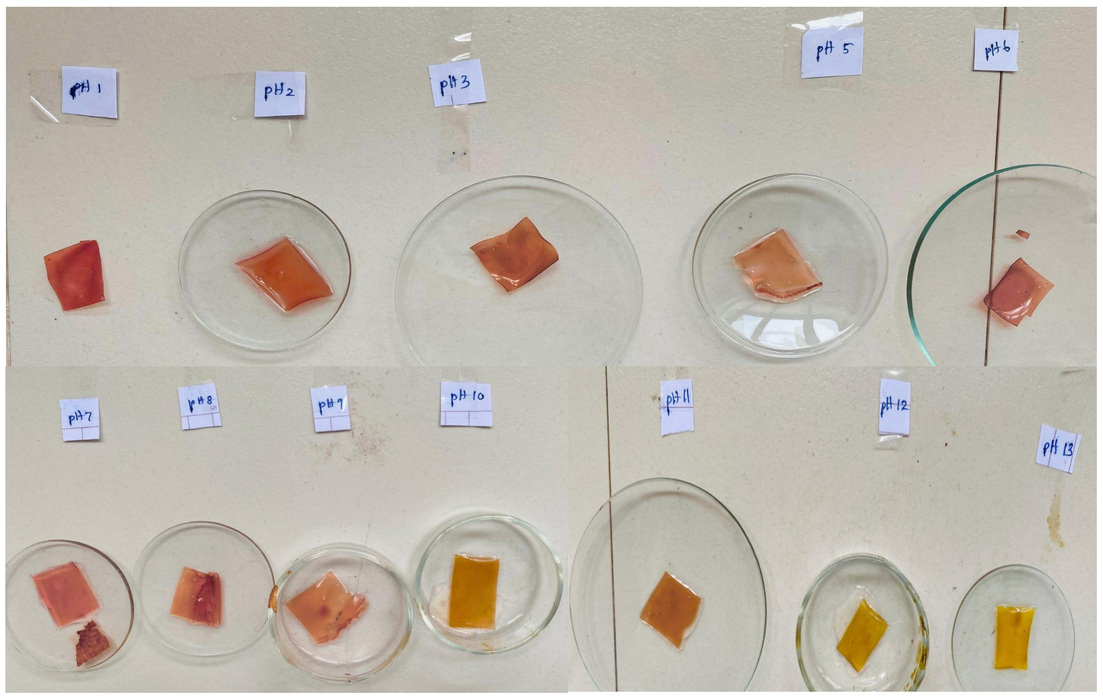

Figure 03 : pH sensitivity of F1 film to the buffer solutions from 1-13

CONCLUSION

- The F2 film (7 ml beetroot extract) exhibited the best balance of physical, mechanical, and barrier properties, making it the most suitable formulation.
- The developed biofilm demonstrated clear pH-sensitive color changes, proving its potential as a natural freshness indicator and an eco-friendly alternative for sustainable food packaging.

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