Active Packaging From Food Waste

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BACKGROUND OF THE STUDY

- Annual global food waste at 1.6 billion tonnes (Food and Agriculture Organisation, 2013) .
- In 2018, food waste in the UK was estimated as 6.6 million tonnes and the estimated cost of annual food waste in 2019 was £9.7 billion annually (Caldeira et al., 2019).
- Food waste costs global rising demand for food and have negative impact on the environment (Scherhaufer et al, 2018).
- Effective food packaging plays key roles in addressing challenges associated with food wastage (Gronman et al, 2013).

Food waste example

Aquatic effects of plastic packaging

- Materials currently in use for food packaging have associated challenges, including their non-degradable nature. This leads to the accumulation of plastic within the environment, reduction in soil quality and danger to aquatic life-forms (Wohner et al, 2019).
- There is therefore a need for the development of non-oil-based plastic food packaging materials which are biodegradable, environmentally friendly and can add value to food preservation.
- Materials currently been explored for the development of biodegradable plastics include polyhydroxylalkanoates (PHAs), polylactic acids, starch, cellulose and lignins (Bratovcic et al, 2015).
- Butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA) as antioxidants, plant extracts, essential oils, and nanoparticles are used as active materials

AIM AND OBJECTIVES

The aim of this study is the development of a biodegradable active packaging using starch extracted from waste agricultural products. Specific objectives of the study include:

(a). Development and characterisation of biodegradable film from starch extracted from agricultural waste materials (such as cassava peel, banana peel, potato and corn)

(b). Assessment of the effects of selected plant extracts and essential oils as bioactive materials on physical characteristics of biodegradable starch based biofilms

(c). Investigation of antimicrobial effects and effectiveness of active packaging

MATERIALS

POLYMERS: Starch and cellulose from cassava, banana, maize and potatoes waste

Cassava

Banana

Maize

Potatoes

ACTIVE MATERIALS

- Selected essential oils with anti-oxidative and anti-microbial effects (e.g. eucalyptus oil)
- Extracts of selected plants with non-toxic antimicrobial actions and/or anti-oxidative effects (e.g. extracts of *Mangifera indica* and *Azadiracta india)*
- Inulin and maltitol as plasticizers will be added film mixture to determine their effects on film characteristics

RESEARCH DESIGN

Stage 1: Polymer

- Collect wastes and extract starch
- Determine starch yield
- Analyse cyanide content
- Analyse amylose/amylopectin ratio

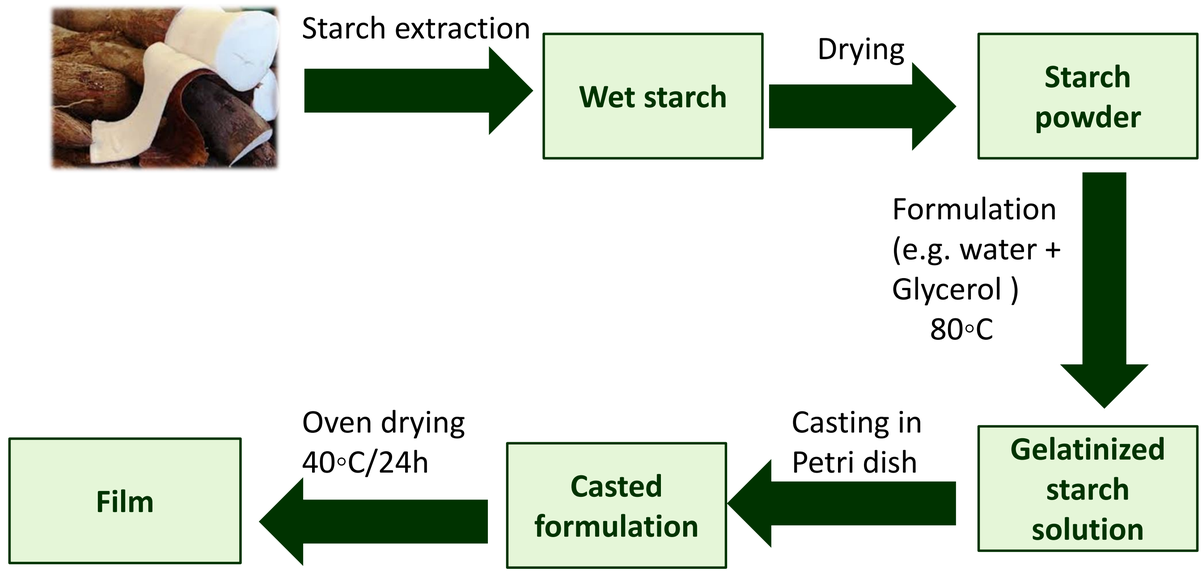
Stage 2: Film

- Develop film by casting method
- Assess optical characteristics
- Assess solubility
- Surface property by EM
- Chemical properties by FITR
- Barrier properties (WVTR, OTR, CTR)
- Mechanical properties (Tensile strength, elongation at break, elasticity
- Thermal properties
- Seal integrity

Stage 3: Functionality

- Transfer of active materials to food simulants
- Antimicrobial actions by Minimum Inhibitory Concentration
- Effect on packaging with film produced on the shelf-life of selected food items (long-term studies)

FILM PRODUCTION



PRELIMINARY RESULTS

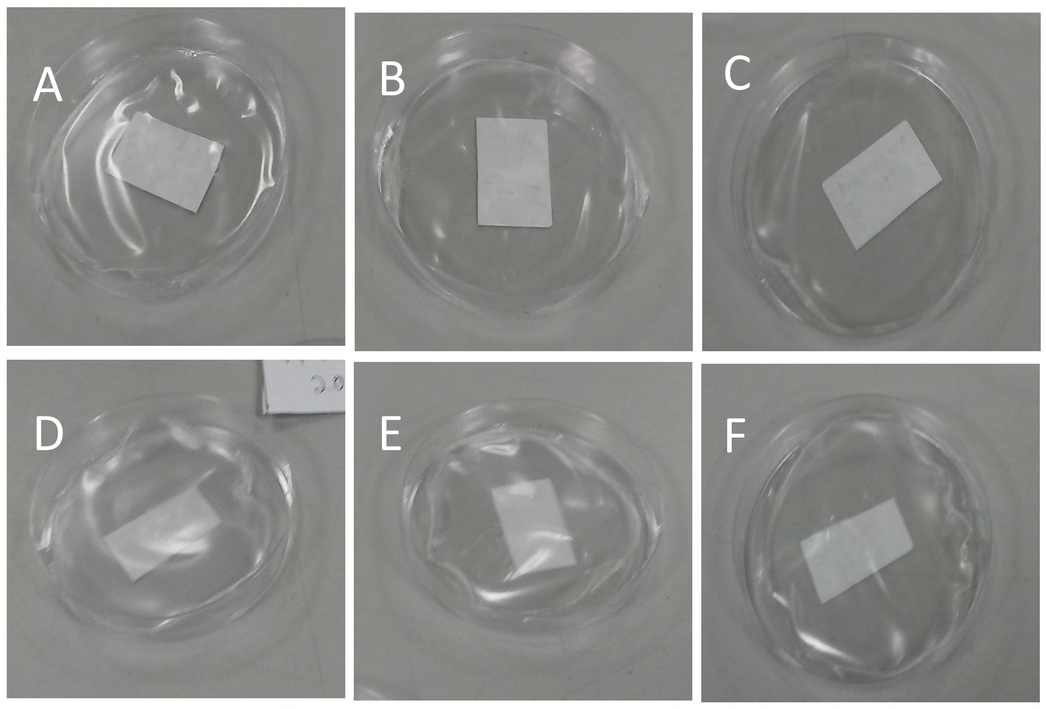


Figure 1: Representative films produced using potato starch and glycerol as plasticiser. Films A, B, and C were developed using starch (5% , w/w) and glycerol (30% w/w of starch). Films D, E and F were developed using starch (5% , w/w) and glycerol (40% w/w of starch).

CONCLUSION

- Films made with starch supplemented with 10% (w/w) and 20% (w/w) glycerol were brittle and could not be separated from the mould (pictures not shown)
- The use of glycerol at 30% (w/w) and 40% (w/w) produced films that are less brittle. The best result was observed for films developed using 40% (w/w) of glycerol

ONGOING STUDIES

- Characterization of developed films
- Development of films using other starch sources (banana and cassava), with starch supplemented with inulin, invert sugar, and antimicrobial essential oils
- Characterization of antimicrobial actions of active films and Food model studies

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