Valorisation of oilseed meals for development of biopolymeric films and biodegradable plates using natural gums and plant fibres

A Thesis to be submitted to Tezpur University in part fulfillment of the requirements for award of the degree of

Doctor of Philosophy

By

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June 2024

Chapter 6

Summary, Conclusion and future scope

6.1. Summary and conclusions

This study was initiated with a focus to valorize the oilseed meals and plant fibres by developing biopolymeric films and biodegradable plates using natural gums and plant fibres. The motive was to utilize the by-products and wastes of agriculture and foods. This chapter summarizes the present research study's summary, conclusions, and future scopes. The study involved the development of biocomposites and biodegradable plates as final products and was compared to other literatures as well. The research work included the pre-treatment and characterization of oilseed cake and defatted oilseed meals. The research work concluded that mustard seed, flaxseed and soybean seed meals had significant difference in their functional properties. During the investigation, the protein content for all three oilseeds meals were found quite high and their emulsifying capabilities enhances after defatting of the oilseed cakes. Further studies involved optimization of the mustard, soybean and flaxseed meal blend for the development of the biopolymeric films through D-optimal mixture design. The results obtained through properties analysis of biopolymeric films found that mustard seed meal (20.50%), flaxseed meal (67.15%) and soybean seed meal (12.33%) was best compactable in production of a successful biopolymeric film. Soy Lecithin (2%) and Glycerol (75%) plays an important role in the development of biopolymeric films. Natural gums and crosslinkers were further optimized to be added in the oilseed meals based biopolymeric films using full factorial design. The blend of natural gums i.e. acacia gum and xanthan gum in ratio 0.5: 1.5% along with 10% citric acid enhanced the properties of the biopolymeric films in comparison to blended oilseed meal based biopolymeric films. The texture of the oilseed meals-gums crosslinked biopolymeric films appeared more flexible and the surface of the films morphologically also improved.

The research study further aimed to find an alternative to replace fossil based packaging materials by improving mechanical strength of the biopolymeric films. Thus, plant fibres was found boon to the research work. The banana pseudo-stem, coconut coir and sugarcane bagasse plant fibres were used for the formation of biocomposites and biodegradable plates. This involved the extraction procedures and characterization of plant fibres. While investigation on the properties, we found that the plant fibres had found the presence of a significant amount of cellulose, hemicellulose, lignin and ash and had significant different in their properties. Additionally, the plant fibres were further optimized to reinforce into the oilseed meals-gum crosslinked biopolymeric films at

different concentrations. After the characterization of the biocomposites, 5% of plant fibres were found compactable for the development of biodegradable plates. The addition of plant fibres were found effective in case of mechanical properties as well as thermal properties. The morphological analysis showed that the plant fibres had structurally rough edges which helped to bind well in the biocomposites as fillers. Lastly, three different biodegradable plates were developed successfully using plant fibres as 5% banana pseudostem, 5% coconut coir and 5% sugarcane bagasse. The hardness and fracturability test on biodegradable plates reported acceptable results. The biodegradable plates had less spreadability rate with food products and its capacity to easy biodegradability within interval of 20 days can make the plates highly acceptable to consumers.

6.2. Future Scopes

The potentials of oilseed meals and plant fibres has been highlighted in the present research work. Instead of wasting these by-products and polluting the environment, they can be highly useful in various food sectors. The research work aimed to use the whole oilseed meals and plant fibres without further wastage into valuable products. It also paves the way for future research projects that will evaluate the unique functions and qualities of packaging. In terms of future applications, various bioactive substances may also be isolated from oilseed meals, and research on the anti-nutritional aspects of oilseed meals can expand the field and ensure their safety as food items. For greater acceptance, the oilseed meals-gum crosslinked biopolymeric films and biocomposites must have improved sealing properties with good water and oil barrier qualities. The use of smooth Teflon surfaced heating molds or injection molding machines can provide different shapes to the containers. Furthermore, animal study can also be performed in future on safety of biodegradable plates to be feed to cattles instead of decomposting them after use. And lastly, bleaching of raw materials can also improve the color of the biodegradable plates and visual acceptance in market. Nevertheless, the produced oilseed meals-gum crosslinked biodegradable plates reinforced with plant fibres are biodegradable, moderately sturdy, and suitable for usage as single-use fast-food containers.