Whey Protein Isolate from Milk as an Active Packaging Material

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Abstract

The objective of this study was to optimize the plasticizer glycerol content for developing biodegradable whey protein isolate (WPI) packaging films as the alternative of plastic packaging for protecting the environment and sustainability of the food processing industry.

Four different whey protein isolate biodegradable packaging films with the four variations (20, 40, 60 and 80%) of glycerol content in the packaging films were developed.The physicochemical (color, moisture content, water activity and thickness), water update and migration properties of the films were determined and compared those properties among the developed packaging films.

The results indicated that 60-80% glycerol content could be used to develop quality whey protein isolate biodegradable packaging films. Whereas 20-40% glycerol content gave the brittle structure of the packaging films. The findings of this study are expected to be beneficial for the whey protein based biodegradable packaging film development as the alternative of plastic packaging.

Introduction

The attention of food industry and research industry is growing towards sustainable packaging materials, including active edible packaging due to environmental awareness and consumer demands for healthy diets (1).

Whey and casein proteins have shown considerable promise in replacing fossil-based plastics in a variety of food applications, such as for O_2 susceptible foods, thereby, rendering milk proteins certainly one of the most quality-assured biopolymers in the packaging discipline.

The unique structural and functional properties of milk proteins make them a suitable candidate for tailoring novel active package techniques for satisfying the needs of the food and nutraceutical industries. Milk proteins, especially whey proteins, serve as excellent carriers of various ingredients which are incorporated in films/coatings to strengthen barrier properties and enhance functional properties viz. antioxidant and antimicrobial (2).

In this study we used whey protein isolate from milk protein along with glycerol as plasticizer. We used different concentrations of glycerol 20%, 40%, 60% and 80% to observe which one gives the best film that can be used as biodegradable packaging material instead of plastics which we usually use. Our results show that 80% glycerol as a plasticizer produces best result which can be used in replacing packaging material with these bio-edible sheets.

Materials & Apparatus

- 10% solution of WPI in water
- Glycerol
- Culture tubes
- Petri dishes
- Stopwatch
- pH meter
- Spectrometer
- Hot plate Beaker (100 mL)
- Weighing balance Volumetric flask (100 mL)
- Pipette (5 mL) and
- filler Stand to hole pipette.
- Thermometer

Methods

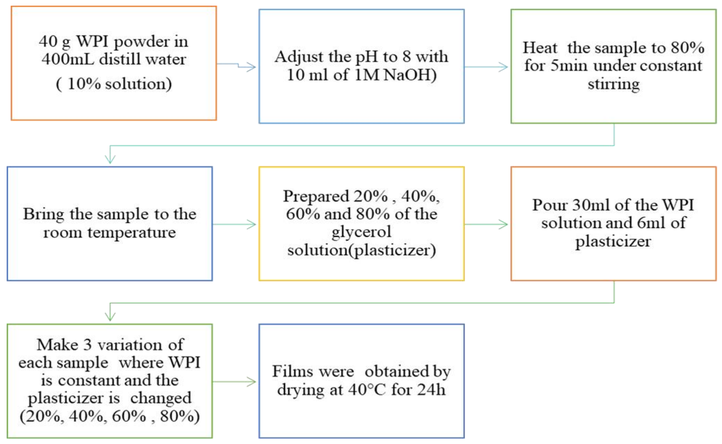

Fig. 1. Experimental design and manufacturing procedure of whey protein isolate packaging films

RESULTS

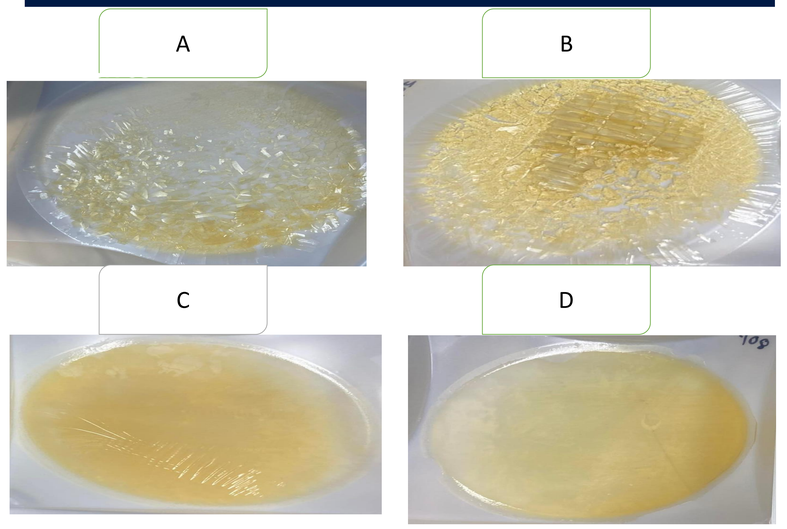

Fig. 2. Visual appearance of flours: A: 20% glycerol; B:40%; C 60% glycerol; D: 80% glycerol with constant WPI.

Sample	Solution	% Gain/Loss	(g/m²)	Migration/Scalping
20%	Water	496.27	0.15	Scalping
	Oil	12.63	0.01	Scalping
	Methanol	72.27	0.02	Scalping
	Acetic Acid	138.16	0.10	Scalping
40%	Water	1017.26	0.21	Scalping
	Oil	4.05	0.00	Scalping
	Methanol	37.18	0.01	Scalping
	Acetic acid	146.93	0.06	Scalping
60%	Water	9.71	0.00	Scalping
	Oil	6.20	0.00	Scalping
	Methanol	71.43	0.04	Scalping
	Acetic acid	244.12	0.04	Scalping
80%	Water	265.67	0.05	Scalping
	Oil	3.47	0.00	Scalping
	Methanol	33.87	0.01	Scalping
	Acetic acid	166.82	0.02	Scalping

TABLE 1: Shows Migration/ Scalping Of Different Concentration Of Solutions

As the concentration of water increases from 20% to 80%, the % gain/loss and (g/m2) also increase. Similarly, the % gain/loss and (g/m2) for oil, methanol, and acetic acid decrease as the concentration of water increases. The data suggests that water has a greater potential for scalping than other solutions.

Water activity (aw) of Glucose sample with different concentrations

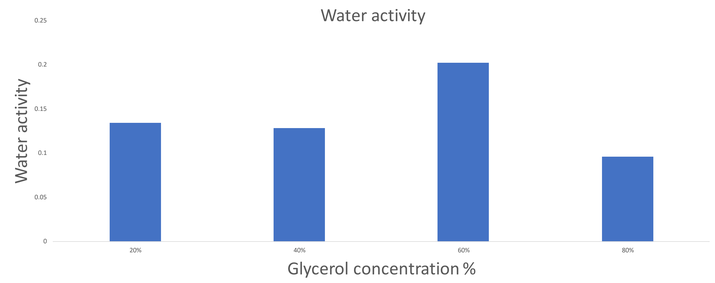

Fig. 3. Effect of glycerol content on the water activity of developed packaging films

Highest water activity was observed for 60% glycerol solution concentration. The results show that higher concentrations of glycerol solution lead to a decrease in water activity in the glucose samples.

Color	L*	a*	b*
20%	21.29	-0.98	1.93
40%	26.47	-1.22	2.01
60%	26.05	-1.18	3.01
80%	23.1	-0.95	0.9

TABLE 2: Shows Color of sample at different concentrations

The control sample has no concentration of glycerol. The L* value represents lightness, where higher values indicate lighter colors, while the a* and b* values indicate color on the red-green and blue-yellow axes, respectively. The data shows that as the concentration of glycerol increases, the L* value also increases, indicating lighter colors. There is a slight decrease in the a* value as the concentration of glycerol increases, indicating a shift towards green, while the b* value is more variable, with the highest value observed at 60% concentration.

Conclusion

- 80% glycerol as a plasticizer produced the best result whey protein film that had a potential as the alternative of plastic packaging.
- Packaging made of whey protein isolate showed scalping when tested in four different standard (hydrophilic to hydrophobic) solutions.
- The colorimeter values of the packaging showed high value of light color with the increasing concentration of the glycerol.
- Overall, usage of 60% and 80% glycerol with the whey protein produced the best results for our packaging material which showed that this packaging material was good for using in food packaging.

References

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Acknowledgement

This research was supported by the Evelyn Van Donk Steenbock Endowed Chair grant (CEHHHS-GM-00307-2-A-22) grant, University of Wisconsin-Stout, USA for conducting this research.