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# Development of Cottonseed Oil–Carnauba Wax–Pectin Emulsion Gels as Innovative Fat Replacers in Processed Meat Products

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## INTRODUCTION

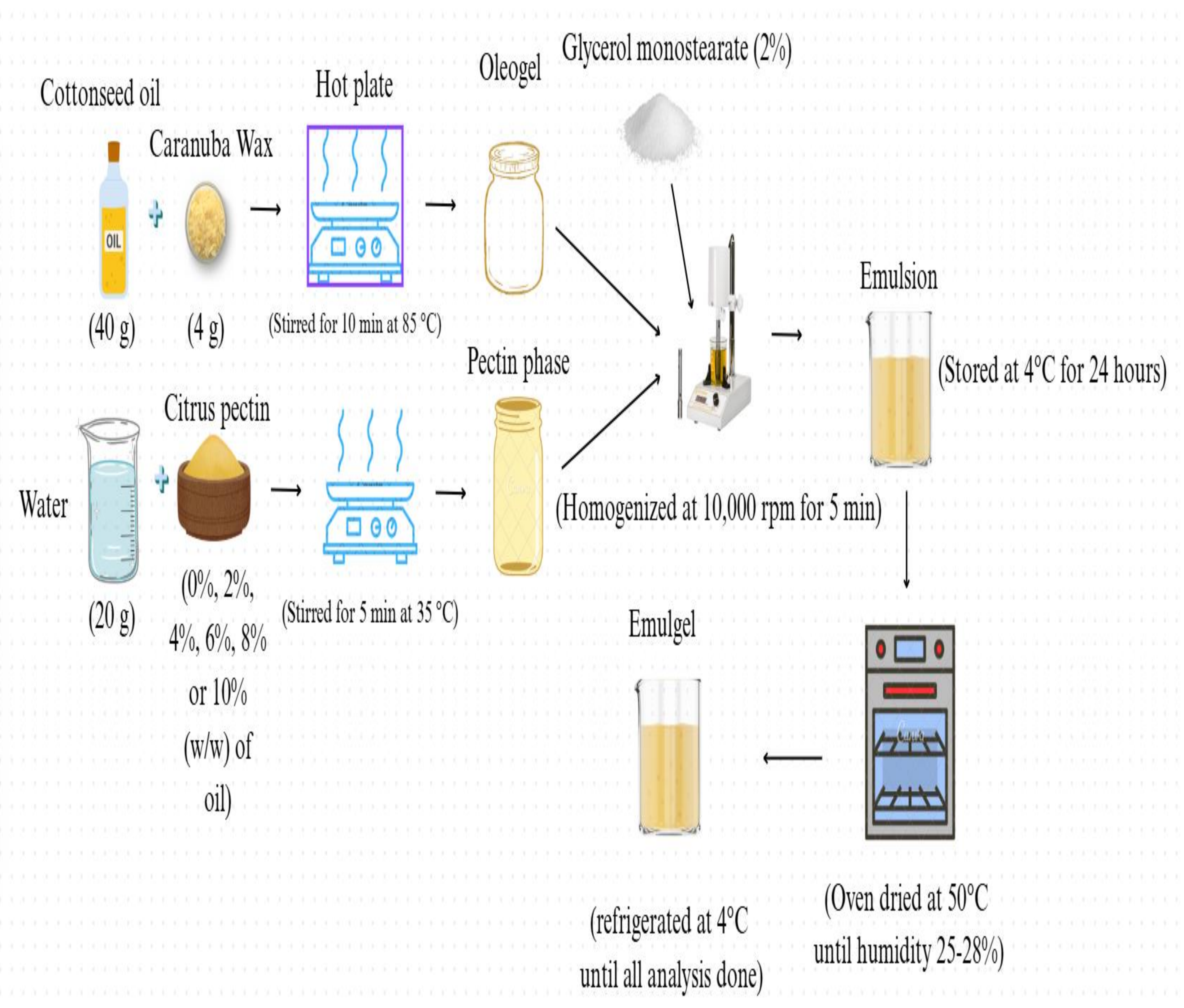
Excessive consumption of saturated fat is linked to cardiovascular disease, colorectal cancer, and diabetes (1). The emulsion gels shows a potential route to saturated fat reduction in meat products through structuring of unsaturated oils into semi-solid networks without sacrificing functionality (2). Processing was achieved by controlled temperature processes (oleogel preparation at 85°C, dehydration at 50°C to 25-28% humidity) followed by a subsequent 24-hour stabilization process at 4°C. The systems were evaluated by differential scanning calorimetry, rheology, polarized light microscopy, and oil binding capacity. Even at low concentrations of pectin, onset of melting was delayed. In addition, low concentrations of pectin also improved the viscoelastic characteristics of the emulsions. The oil-binding capacity of the emulsions decreased when 4% or more pectin was added. Cottonseed oil–carnauba wax–pectin emulgels represent an innovation in sustainable fat replacement technology for processed meat. Looking into the microstructure of the emulgels, it is evident that the crystalline structure is maintained with the addition of 2% pectin, resulting in improved rheological properties while preserving gel stability compared to the control (OCWGP-0%). However, when pectin is added at levels higher than 2%, a decrease in the bright crystalline structures is observed.

## OBJECTIVES

- ✓ Develop and characterize cottonseed oil emulsion gels containing different concentrations of pectin (0%, 2%, 4%, 6%, 8%, or 10%) and glycerol monostearate (2%) as a putative saturated fat replacer in processed meat products.

## METHODOLOGY

**Figure 1.** Preparation of the emulsion gels.




## RESULTS

**Table 1.** Oil Binding Capacity of different emulsion gels.

| Treatment | OBC (%) |
|---|---|
| OCWGP-0% | 94.76±0.90$^{a}$ |
| OCWGP-2% | 95.76±0.85$^{a}$ |
| OCWGP-4% | 78.36±2.92$^{b}$ |
| OCWGP-6% | 78.95±3.95$^{b}$ |
| OCWGP-8% | 75.29±3.09$^{b}$ |
| OCWGP-10% | 73.80±1.41$^{b}$ |

## RESULTS

**Table 2.** Viscoelastic behavior of emulsion gels.

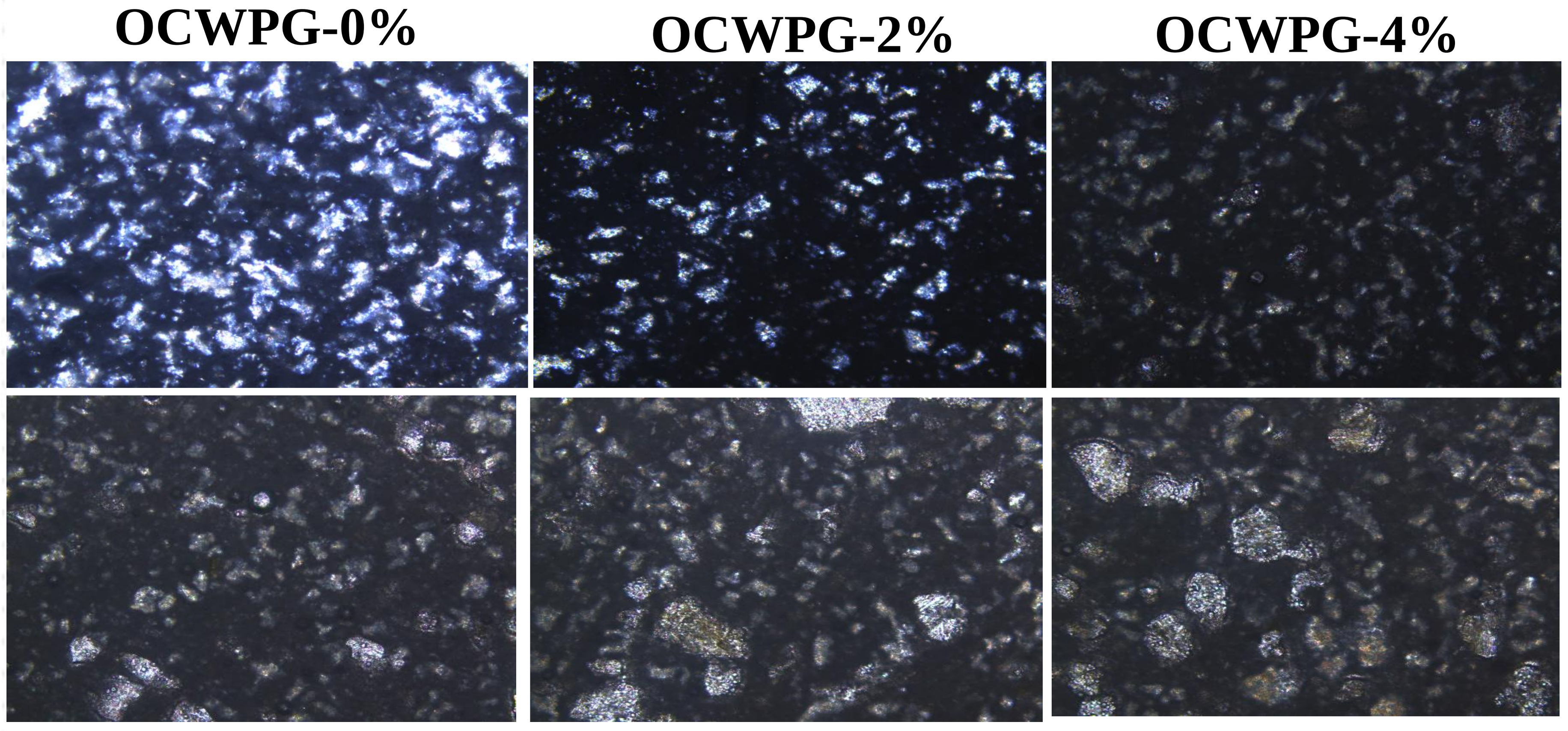
| Treatment | Storage Modulus | Loss Modulus |
|---|---|---|
| OCWPG-0% | 59.65±1.43$^{ab}$ | 10.96±1.80$^{ab}$ |
| OCWPG-2% | 125.74±2.01$^{a}$ | 23.58±2.03$^{a}$ |
| OCWPG-4% | 137.84±1.52$^{ab}$ | 25.50±3.12$^{ab}$ |
| OCWPG-6% | 40.93±0.90$^{b}$ | 8.62±2.42$^{b}$ |
| OCWPG-8% | 16.11±0.22$^{b}$ | 3.40±0.30$^{b}$ |
| OCWPG-10% | 8.96±0.147$^{b}$ | 2.02±0.18$^{b}$ |

**Figure 2.** Visual analysis of emulsion gels.


**Table 3.** Differential Scanning Calorimetry.

| Treatment | Onset Temp. | Peak Temp. | Enthalpy |
|---|---|---|---|
| OCWPG-0% | 84.23± 0.71$^{b}$ | 85.47±2.50$^{b}$ | 309.45±92.16$^{ab}$ |
| OCWPG-2% | 101.71±3.58$^{a}$ | 104.13±3.95$^{a}$ | 211.41±82.58$^{b}$ |
| OCWPG-4% | 99.69±0.32$^{a}$ | 102.77±0.68$^{a}$ | 457.69±20.10$^{a}$ |
| OCWPG-6% | 100.37±1.19$^{a}$ | 104.02±1.98$^{a}$ | 451.69±43.46$^{a}$ |
| OCWPG-8% | 99.94±0.55$^{a}$ | 103.49±0.81$^{a}$ | 413.24±35.01$^{a}$ |
| OCWPG-10% | 95.06±9.52$^{ab}$ | 97.90±11.47$^{ab}$ | 301.94±238.96$^{a}$ |

**Figure 3.** Visual characteristics of emulsion gels under PLM.




## CONCLUSION

The 2% pectin formulas had the optimal compromise between oil retention, moderate gel strength, and acceptable thermal stability which displayed potentiality for a clean-label alternative to lower unhealthy saturated fat in processed meat.

## REFERENCES

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