Effect of Transglutaminase on the Film Properties Obtained by Blending *Nigella Sativa* Protein Concentrate and Pectin

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Problem statement (plastic wastes)

Plastic Facts

- Degradation of plastic wastes require more than 200 years
- Greatest quantity of plastic wastes is derived from food packages wastes
- Producing plastic about 350 million tons/year

Suggested solutions to solve the problem of plastic wastes disposal

- Incineration
- Plastic degradation
- Landfilling
- Recycling

Bioplastics application

- Disposable tableware
- Biowaste bags
- Carrier bags
- Rigid packaging
- Flexible packaging
Edible films applications

Edible films: are a primary packaging made from biopolymer materials.

Reference: Aguirre-Joya et al., (2018). In Food packaging and preservation (pp. 1-61).
Main component of edible films

Polysaccharide: provide good barrier for oxygen and carbon dioxide gases

Protein: produces edible films with distinctive mechanical properties

Fat: blocks water transmission

Strategic improvement of edible films

Blending protein/polysaccharide

Crosslinking

Objectives of study

- Blending protein + polysaccharide
- Cross linkage by TGase
- Physical properties
  - Water content/uptake
- Biodegradability
Materials-NSPC
Materials-Pectin (PEC)

Polymeric matrix

Safe

Bioactive components carrier

Gases barrier

Materials-TGase

Materials-Glycerol (GLY)

Methodology

1. Extraction of protein
2. Preparation of films
3. Evaluations of films properties
   - Thickness and Mechanical properties
   - Water content
   - Water uptake
   - Biodegradable test
1. Protein extraction

- NSDS
- Grinding for 5 min
- Dissolving in (DW) and stirring for 2h
- pH 12 by
- Centrifugation 3800 rpm for 20 min
- pH 5.4
- Collection of supernatant
- Centrifugation 3800 rpm for 20 min
- Collection the pellet
- Drying

_Nigella Sativa_ protein Concentrate (NSPC)
2. Preparation NSPC / PEC / GLY with/without TGase

- Preparation of NSPC/PEC
- pH 7.5 and stirring for 30 min
- Adding GLY (30%)
- Stirring for 30 min
- Incubation at 37°C for 2 h in water bath
- Without TGase
- With TGase
- Pouring on polystyrene Petri dishes
- Drying
- Peeling of film
3. Evaluation of films properties

Micrometer

Oven

Texture Analyzer

Balance

Protease

Water Bath

Desiccator
Results and Discussion

Next
Blended NSPC Films in the presence or absence of different concentration of TGase

[Image showing the effect of different TGase concentrations on NSPC films with varying pectin concentrations]
According to pectin concentration, TGase concentration and both PEC and TGase; the values significantly different were respectively reported by a, b, c at p<0.05.

Presence of (10U TGase / g protein) significantly increases the thickness values.

Synergistic effect of the 3:1 blends of (40:6, 40:10 w/w) with (20U TGase/g protein) significantly increases in thickness.

Thickness but significantly increases at concentration of PEC (60, 100 mg).
According to pectin concentration, TGase concentration and both PEC and TGase; the values significantly different were respectively reported by

- TS significantly to double TS of NSPC films at concentration of PEC 100mg.
- TS of films significantly in presence of 10U/g protein.
- TS of films significantly to 7 times of TS of NSPC films at 400mg of (PEC) in presence of 10U/g protein.
Elongation at Break

According to pectin concentration, TGase concentration and both PEC and TGase; the values significantly different were respectively reported by: 

- **a** for different TGase concentrations,
- **b** for PEC concentration,
- **c** for both PEC and TGase.

EB significantly at concentration of PEC (60, 100 mg).

EB of films significantly in presence of 10U/g protein.

EB of films significantly at (60, 100mg) of (PEC) in presence of 20U/g protein compared with NSPC films with 10U/g protein.
No significant differences in YM values with increasing PEC and TGase concentrations.

YM value significantly increased at concentration of PEC 400mg with low concentration of TGase.

According to pectin concentration, TGase concentration and both PEC and TGase; the values significantly different were respectively reported by a, b, c.
Values indicated by (*) was significantly different compared to the same film in the absence of TGase (p ≤ 0.05).
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Film biodegradation

Values indicated by (*) was significantly different compared to the same film in the absence of TGase (p ≤ 0.05).
Conclusion

• Concentration of pectin and concentration of TGase or both have significantly role on mechanical properties of NSPC based films.

• Crosslinked NSPC/PEC(40:40 w/w) with low TGase concentration generates films with high tensile strength values.

• Crosslinked NSPC/PEC with high TGase concentration forms films with high elongation at break values except high concentration of pectin (400 mg).

• Low concentration of enzyme increases water content and uptake of films. Also, it decreases biodegradability rate that means film more resistance.


Thank you for listening 😊