

## SPECIMEN FORMAT FOR THESES OF MONTH

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**Department** : FOOD SCIENCE AND NUTRITION

**Branch/ Area:** : FOOD SCIENCE AND NUTRITION

**Sub Subject Heading:** :

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**Title of the thesis** : SYNTHESIS OF ECOFRIENDLY  
NANOGRANULAR FILMS IN FOOD PACKAGING  
USING MEDICINAL PLANTS AND  
NANOPARTICLES

(i) In Roman Script -

(ii) In roman Script -

**Nomenclature of Degree:** :

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**Designation of Supervisor** : **M.Sc, M.Phil, Ph.D**

**Centre/department/school in which research was conducted** : Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore

**University's Name & Address**

: Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore

**Abstract within 300 words:**

Food borne diarrhea is becoming a major public health problem with higher morbidity and mortality rate among the people and food safety is becoming a worldwide issue due to the presence of pathogenic bacteria in foods. The findings of the study are among the four medicinal plants, it was observed that *Glycyrrhiza glabra* AgNP showed a smaller particle size of 34.7 nm with highest suspension stability of -28.9 mV, compared to other AgNP of plant extracts. The highest antioxidant content of *Glycyrrhiza glabra* could be due to presence of phyto constituents in the plant extract. The FTIR confirmed the presence of phenols, which showed a narrow and sharper peak at  $578.06\text{ cm}^{-1}$ , which could be one of the reason for its maximum antioxidant potential. Greater interaction of water with silver could be the reason for OH stretching at  $3410.10\text{ cm}^{-1}$  involved in capping of AgNP. It was observed that the DNA fragmentation increased on exposure to *Glycyrrhiza glabra* AgNP. Hence, 30  $\mu\text{l}$  of *Glycyrrhiza glabra* nanoparticles was selected as the best colloidal solution for coating onto the food packaging material such as PET, infant feeding bottles (Poly Propylene) and Zip lock covers (Poly Ethylene). In the present study, an increase in crystallinity of these Ag nanoparticle impregnated film of 0.01 and 0.05 per cent may be due to the OH groups of amylose in tapioca starch, which improved the interaction with nanoparticles and glycerol. Therefore, both the nanocoating and edible film are more potent against the diarrheal species which could be due to synergistic action of both the antioxidant and antimicrobial *property of Glycyrrhiza glabra* silver nanoparticles. It also increases the shelf life of foods against diarrheal pathogens ensure total food safety and are ecofriendly in nature.

**i) Major objectives :**

1. Develop food containers with longer inhibition for diarrhea causing bacteria employing plants extracted with silver nanoparticles
2. Design food packaging containers for sustained sterility over longer duration using silver nanoparticles
3. Synthesise edible films (*Glycyrrhiza glabra*) silver nanoparticle, which could serve as value added products

4. Optimize Silver nanoparticles from four medicinal plants
5. Identify the Silver nanocoats using medicinal plants with highest antioxidant, antimicrobial and anticancer potentials
6. Coating of AgNP (*Glycyrrhiza glabra*) onto three food packages namely PET, Infant feeding bottles (PP) and Zip Loc covers (PE)
7. Develop food containers with longer inhibition against diarrhea causing bacteria by employing silver nano plant extracts
8. Develop food packaging containers using silver nanoparticles for sustained sterility over longer duration
9. Develop edible films of *Glycyrrhiza glabra* AgNP, which could serve as a value added products.
10. Investigate the thermal, barrier and antimicrobial properties of Edible Films.

ii) **Hypothesis** : -

iii) **Methodology** : -

## **PHASE I**

### **SYNTHESIS, CHARACTERIZATION AND ANTIMICROBIAL STUDY OF SILVER NANOPARTICLES**

#### **A. Synthesis and Optimization of Silver Nanoparticles**

1. Selection of Medicinal Plants from Pilot Study
2. Collection and Authentication of Medicinal Plants from Botanical Survey of India (BSI)
3. Home Gardening of Medicinal Plants
4. Preparation of Plant Powder
5. Optimization of Silver Nanoparticles from *Leucas aspera*
6. Determination of Particle size and Zeta potential of Medicinal Plants
7. Determination of Antioxidant Activity of Synthesized Silver Nanoparticle (AgNPs)
8. Analysis for Antimicrobial Activity

#### **B. Characterization of *Glycyrrhiza glabra* Silver Nanoparticles**

1. Identification of *Glycyrrhiza glabra* Constituents
2. Identification of Individual Compounds

3. Determination of Functional Groups
4. Elemental Analysis
5. Morphological Studies of Synthesized *Glycyrrhiza glabra* Silver Nanoparticles
6. Determination of Structure and Crystallinity Studies
7. Determination of Anticancerous Activity

## **PHASE II**

### **COATING OF SILVER NANOPARTICLES ONTO COMMERCIALY AVAILABLE FOOD PACKAGES AGAINST ENTEROPATHOGENIC SPECIES**

#### **C. Assessment of Antimicrobial Property and Shelf life of Nanocoated Food Packages : Specifications of Commercially Available Food Packages :**

##### **1. PET bottles**

- Shelf-life of Tomato Puree
- Shelf-life of Lemon Juice

Material – Poly Ethylene Terephthalate (PET)

Neck size – 25 mm

Weight – 12.5 gms

Colour – Transparent White Colour with Cream Cap

Shape – Round

##### **2. Infant feeding bottles**

- Shelf life of Milk and Lemon Juice

Material – PP (food grade)

Description – Available in 4 oz (150 ml) Sizes with Multi Colour Printing

Accessories – PP Feeding Bottle, Hood Cap Set and Latex Nipple

##### **3. Ziploc covers**

- Shelf life of Tomato Puree in Ziploc Covers

Material – Poly Propylene (PP)

Package contents – 100 g

Size – 7 cm X 11 cm; 8” X 4.3” (W XL)

Thickness – 2 Mil

Net weight – 33 g

Colour – Clear, Transparent

### **PHASE III**

#### **SYNTHESIS, OPTIMIZATION AND CHARACTERIZATION OF NANOGRANULAR EDIBLE FILMS**

D. Synthesis and Standardization of Silver Nanoparticles (*Glycyrrhiza glabra*) Edible Films

E. Characterization of Edible Films

1. Thermal Analysis by Differential Scanning Calorimetry (DSC) (Q2000, USA)
2. Thermo Gravimetric Analysis (TGA, 2920, USA)
3. X-Ray Diffraction (XRD) (Rigaku Miniflex, Japan)
4. Water Vapor Permeability (WVP)
5. Antibacterial Testing of Edible films with Inoculated Bacterial Culture

#### **iv) Findings:**

##### **Phase I**

##### **Synthesis and Optimization of Silver Nanoparticles**

Among the four medicinal plants, it was observed that *Glycyrrhiza glabra* AgNP showed a smaller particle size of 34.7 nm with highest suspension stability of -28.9 mV, compared to other AgNP of plant extracts.

##### **Antioxidant and Antimicrobial Quality of Phytochemical Constituents**

- Of the four medicinal plants, *Glycyrrhiza glabra* had the maximum antioxidant potential of 520 µg and *Leucas aspera* had the minimum antioxidant potential of 132 µg respectively. The highest antioxidant content of *Glycyrrhiza glabra* could be due to presence of phytoconstituents in the plant extract.
- Module 1 revealed that of the different concentrations, 30 µl of *Glycyrrhiza glabra* AgNP had the smallest particle size, stable zeta potential with highest antioxidant and antimicrobial potential. Hence, 30 µl of *Glycyrrhiza glabra* nanoparticles was selected as the best colloidal solution for coating onto the food packaging material such as PET, infant feeding bottles (Poly Propylene) and Zip lock covers (Poly Ethylene).
- Shelf life study of nanocoated PET bottles stored with foods such as tomato puree and lemon juice were studied against the three enteropathogenic diarrheal species. No microbial growth was observed from 0th day to 6th day in nanocoated PET bottles against *Sh.dysenteriae* (PSGIMS & R). On 8th day and 10th day of storage, there was an increase in

inhibition of 87.5 per cent to 87.66 per cent against the *S.dysenteriae* (PSGIMS & R) respectively. The difference between the efficacy of nanocoated and uncoated PET bottles in terms of microbial growth inhibition was statistically significant ( $P < 0.01$ ).

- Similarly, Nanocoated PET bottles with lemon juice revealed that from 0 day to 6th day, showed no microbial growth, while control (uncoated) PET bottles had a higher microbial growth *S.dysenteriae* (PSGIMS & R). On 8th day, it was found that 91.5 per cent of inhibition decreased to 87.67 per cent, when compared to the control (uncoated) against *S.dysenteriae* (PSGIMS & R).
- At 2hrs of storage of milk, nanocoated feeding (PP) bottles showed 92.33 per cent of microbial inhibition against *S.dysenteriae* (PSGIMS & R). At 2. and 3 hour, the inhibitory activity decreased from 86.33 per cent and 84 per cent, compared to the control (uncoated) PP feeding bottles which showed no inhibition against *S.dysenteriae* (PSGIMS & R).
- It was observed that the tomato puree stored in nanocoated zip loc covers showed the maximum inhibition of 87.67 per cent than the control (uncoated) against the *S.dysenteriae* (PSGIMS & R) until a storage period of ten days. These silver nanoparticles were found to be highly effective against the diarrheal species. Therefore, these nanoparticles coated onto surface of the food packages could inhibit the growth of microbial pathogens.
- In addition, these nanoparticles were impregnated onto tapioca starch which produced edible film with improved thermal, barrier and antimicrobial property against the diarrheal species. Therefore, both the nanocoating and edible film are more potent against the diarrheal species which could be due to synergistic action of both the antioxidant and antimicrobial property of *Glycyrrhiza glabra* silver nanoparticles. It also increases the shelf life of foods against diarrheal pathogens ensure total food safety and are ecofriendly in nature.

## **Examiners**

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