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# A Smart Film Forming Agent from *Phaseolus vulgaris*

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**ABSTRACT**

Current research work aims to isolate a biomaterial from *Phaseolus vulgaris* and evaluate its film-forming ability. *Phaseolus vulgaris* was subjected to isolating the biomaterial in a simplified and economic process. Using this biomaterial films were prepared taking phenytoin as a model drug. The prepared films were evaluated for weight, thickness, folding endurance, swelling index, surface pH, tensile strength, percent elongation, percent moisture uptake, percent moisture loss, vapour transmission rate, and content uniformity. The research results revealed that the formulated films using biomaterial were uniform in thickness with appreciable folding endurance. Hence *Phaseolus vulgaris* biomaterial can serve as a novel film-forming agent.

## INTRODUCTION:

*Phaseolus vulgaris* is an annual herbaceous plant belonging to the family *Leguminosae*. It is a common bean; the most widely cultivated of all beans in temperate regions and widely cultivated in semitropical regions. In temperate regions, the green immature pods are cooked and consumed. The plant is herbaceous, erect, and bushy, 20–60 cm tall with a taproot and nitrogenous nodules. The leaves are alternate, green or purple, trifoliolate, stipulate, and petiolate. Flowers are white, pink or purplish, zygomorphic, and variegated. Seeds or beans can be white, red, tan, purple, grey, or black, often variegated, reniform, oblong, or globose, up to 1.5 cm long, the endosperm is absent. Phaseolus vulgaris seeds can be associated with a decreased risk for a wide variety of chronic diseases like cancer, obesity, cardiovascular diseases, and diabetes [1]. Phytochemical screening showed that *Phaseolus vulgaris* seeds have some bioactive components such as alkaloids, anthocyanin, carbohydrate, catechin, fibers, flavonoids, phasine, phytic acid, quercetin, saponins, steroids, tannins, and terpenoids [2].

Phenytoin is an antiepileptic drug, which is chemically 5, 5-diphenylimidazolidine-2, 4-dione. Its molecular formula is $C_{15}H_{12}N_2O_2$ and its molecular weight 252.268 g/mol [3]. Phenytoin acts by blocking voltage-sensitive sodium channels in the neurons. It is used to control generalized tonic-clonic and complex partial seizures [4]. Our research work aims to isolate a biomaterial from the pulp of *Phaseolus vulgaris* and evaluate its film-forming ability.

## MATERIALS AND METHODS:

Phenytoin was obtained as a gift sample from Zeneca Pharmaceuticals, Haridwar. *Phaseolus vulgaris* was purchased from the local market, Dehradun. Acetone was purchased from Swastik Pharmaceuticals.

### Isolation of biomaterial

The biopolymer was isolated from the *Phaseolus vulgaris* beans using an economical process [5]. First of all *Phaseolus vulgaris* beans were taken & soaked in water. The outer covering of beans was removed & the inner portion was collected. It was mashed with distilled water & filtered. Acetone was added to the filtrate. The filtrate was kept overnight & centrifuged. The biomaterial was collected & dried in a desiccator.

**Physico-chemical characterization of biomaterial**

The isolated biomaterial was subjected to various physical tests like colour, solubility, colour changing point, viscosity, surface tension, and pH [6, 7, 8].

**Formulation & evaluation of biofilms**

It was then used for formulating biofilms using phenytoin as a model drug. Six different film formulations i.e. PP1, PP2, PP3, PP4, PP5 and PP6 were prepared using biopolymer & phenytoin in six different ratios by solvent casting method **(Table 1)**. The biomaterial was dissolved in distilled water with constant stirring. Dextrose and mannitol were added to it as a plasticizer for the formulations of film. Phenytoin solution was separately prepared and added to the biomaterial solution containing dextrose and mannitol. This mixture was then transferred into Petri plates and allowed for controlled evaporation of solvent at room temperature. Dried films were carefully removed, and cut into films of 1sq.cm [9}.

The prepared phenytoin-loaded biofilms were evaluated for the parameters namely weight, thickness, folding endurance, swelling index, surface pH, tensile strength, percent elongation, percent moisture uptake, percent moisture loss, vapour transmission rate, and content uniformity [10]. The mean of three readings was determined.



**RESULTS AND DISCUSSION:**

*Phaseolus vulgaris* was yellowish-white in color with colour changing point 220ºC, pH 6.4, viscosity 0.9 cp, and surface tension 71.12 dyne/cm. It was slightly soluble in water, insoluble in methanol & acetone.

The prepared films from PP1to PP6 had 48.08 ± 0.06 mg to 82.46 ± 0.025 mg weight and 0.47 ± 0.025 mm to 0.65 ± 0.025 mm thickness. The films showed folding endurance 132 ± 1.5 to 162 ± 1.53. The swelling index of films ranged from 51.47 ± 0.12 to 67.39 ± 0.86. All films showed nearly neutral pH **(Table 2).**

The tensile strength of PP1 to PP6 films ranged from 71.33 ± 0.99 to 112.37 ± 0.26 and percent elongation was 5.72 ± 0.25 to 7.40 ± 0.18 %. Percent moisture uptake of films was 11.20 ± 0.16 to 14.92 ± 0.32 %. Percent moisture loss ranged from 10.86 ± 0.12 to 14.28 ± 0.24 % and Vapour Transmission Rate was found to be 6.12 ± 0.10 to 11.38 ± 0.15

gm/cm$^2$/hr. Finally, content uniformity for all film formulations was determined which varied from 87.61 ± 0.56 to 93.35 ± 0.12 % **(Table 3).**

## CONCLUSION:

Finally, the conclusion was drawn that *Phaseolus vulgaris* biopolymer can serve as a potential film former in pharmaceutical preparations.

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**Table No. 1: Phenytoin loaded biofilm of *Phaseolus vulgaris***

| Sr. No. | Mannitol (mg) | Dextrose (mg) | Biopolymer (mg) | Water (ml) | Phenytoin (mg) |
|---|---|---|---|---|---|
| **PP1** | 200 | 200 | 100 | 10 | 50 |
| **PP2** | 200 | 200 | 200 | 10 | 50 |
| **PP3** | 200 | 200 | 300 | 10 | 50 |
| **PP4** | 200 | 200 | 400 | 10 | 50 |
| **PP5** | 200 | 200 | 500 | 10 | 50 |
| **PP6** | 200 | 200 | 600 | 10 | 50 |

**Table No. 2: Comparative evaluation parameters of various films**

| Formulation | Wt.Uniformity (mg) | Thickness (mm) | Folding endurance | Swelling index | Surface pH |
|---|---|---|---|---|---|
| **PP1** | 48.08 ± 0.06 | 0.47 ± 0.025 | 132 ± 1.5 | 51.47 ± 0.12 | 6.8 ± 0.06 |
| **PP2** | 47.77 ± 0.09 | 0.45 ± 0.031 | 142 ± 2.08 | 58.73 ± 0.61 | 6.6 ± 0.12 |
| **PP3** | 52.62 ± 0.015 | 0.46 ± 0.050 | 143 ± 1.15 | 61.37 ± 0.45 | 7.0 ± 0.06 |
| **PP4** | 57.34 ± 0.035 | 0.55 ± 0.035 | 140 ± 0.58 | 66.98 ± 0.21 | 6.7 ± 0.15 |
| **PP5** | 70.14 ± 0.025 | 0.63 ± 0.015 | 154 ± 0.58 | 67.50 ± 0.41 | 7.1 ± 0.12 |
| **PP6** | 82.46 ± 0.025 | 0.65 ± 0.025 | 162 ± 1.53 | 67.39 ± 0.86 | 7.1 ± 0.10 |



**Table No. 3: Comparative evaluation parameters of various films**

| Formulation | Tensile strength | % elongation | % Moisture uptake | % Moisture loss | VTR (gm/cm$^2$/hr) | Content uniformity (%) |
|---|---|---|---|---|---|---|
| **PP1** | 71.33 ± 0.99 | 5.72 ± 0.25 | 11.20 ± 0.16 | 10.86 ± 0.12 | 6.12 ± 0.10 | 87.61 ± 0.56 |
| **PP2** | 78.04 ± 0.82 | 6.39 ± 0.14 | 10.56 ± 0.50 | 10.26 ± 0.36 | 7.23 ± 0.08 | 82.47 ± 0.57 |
| **PP3** | 81.21 ± 0.95 | 7.28 ± 0.10 | 11.60 ± 0.66 | 11.62 ± 0.37 | 7.20 ± 0.07 | 89.53 ± 0.52 |
| **PP4** | 86.74 ± 0.54 | 7.70 ± 0.15 | 12.95 ± 0.62 | 13.85 ± 0.71 | 8.65 ± 0.26 | 92.57 ± 0.50 |
| **PP5** | 111.40±0.32 | 7.61 ± 0.14 | 14.76 ± 0.39 | 14.53 ± 0.37 | 11.37 ± 0.06 | 95.03 ± 0.28 |
| **PP6** | 112.37±0.26 | 7.40 ± 0.18 | 14.92 ± 0.32 | 14.28 ± 0.24 | 11.38 ± 0.15 | 93.35 ± 0.1 |