

In Vitro Evaluation of The Biocompatibility and Mass-Loss Behaviour of A PVA–CMC-Based Wound-Dressing Film Incorporating Colloidal Silver Gel

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Abstract

Background: Biological compatibility and mass-loss behaviour are important preliminary properties of materials being investigated for wound-dressing applications. This study describes an in-vitro assessment of a polyvinyl alcohol (PVA)–carboxymethyl cellulose (CMC) film incorporating colloidal silver gel.

Materials and methods: The film was prepared from PVA, CMC, glycerol and colloidal silver gel by solution casting. Cytocompatibility was assessed using 3T3 fibroblasts with an MTT assay at 48 and 72 hours and fluorescence-based live/dead staining. Mass loss was assessed by incubating pre-weighed specimens in phosphate-buffered saline (PBS; pH 7.4) containing lysozyme at 37°C for up to 72 hours. The source material supplied for this revision contained graphical results but did not provide replicate-level raw data or complete experimental parameters.

Results: Values estimated from the supplied MTT graph indicated approximately 80% cell viability at 48 hours and approximately 95–100% at 72 hours for the experimental group. Values transcribed from the supplied mass-loss graph were approximately 0%, 8%, 15%, 27%, 41–42% and 57% at 0, 6, 12, 24, 48 and 72 hours, respectively. These values are approximate graphical estimates and should not be treated as validated quantitative results until checked against the original data. The fluorescence panels in the supplied figure were not interpretable in the provided document.

Conclusion: The supplied graphical results suggest that the film maintained fibroblast metabolic activity over the reported observation period and underwent progressive mass loss under the tested in-vitro conditions. Incomplete methodological details, unavailable replicate-level data and non-interpretable fluorescence images limit the strength of these findings. Verification using original experimental records is required before journal submission.

Keywords: polyvinyl alcohol; carboxymethyl cellulose; colloidal silver; wound-dressing film; cytocompatibility; 3T3 fibroblasts; MTT assay; mass loss.

1. Introduction

A wound dressing intended for direct tissue contact should provide a suitable temporary interface while maintaining compatibility with cells involved in tissue repair. Modern wound dressings use a range of materials and formats, including polymeric films.^{1–39, 11, 16–20}

Polyvinyl alcohol (PVA) has been investigated for wound-dressing biomaterials, while carboxymethyl cellulose (CMC) is valued for its hydrophilicity and film-forming properties.^{4–6} The properties of a blended film depend on its formulation and processing conditions and therefore require evaluation in the intended formulation.^{4–6, 9, 11, 16–19}

Fibroblasts contribute to tissue repair and extracellular-matrix production. In-vitro assays using fibroblasts can provide preliminary information about cytocompatibility, although metabolic assays alone do not establish overall biological safety.^{7, 8, 10, 13–15}

Mass-loss behaviour is another property relevant to temporary wound-dressing materials. However, mass loss in a laboratory medium should not automatically be interpreted as complete biodegradation or as a prediction of in-vivo degradation kinetics. The present work evaluates the supplied results for cytocompatibility and mass-loss behaviour of a PVA–CMC-based film incorporating colloidal silver gel.

Aim To evaluate the in-vitro cytocompatibility and mass-loss behaviour of a PVA–CMC-based wound-dressing film incorporating colloidal silver gel.

Objectives

1. To assess 3T3 fibroblast metabolic activity using an MTT assay.
2. To qualitatively assess cellular viability using fluorescence-based live/dead staining.
3. To measure the change in dry mass of film specimens under the specified in-vitro incubation conditions.

2. Materials and Methods

2.1. Preparation of the film

The formulation described in the supplied manuscript comprised 8 g of PVA dissolved in 100 mL of distilled water at 80–90°C under continuous stirring. CMC (1.5 g) was then added gradually, followed by glycerol (2 mL) and colloidal silver gel (10 g). The mixture was cast onto a levelled glass surface or Petri dish and dried until a flexible film formed. The film was peeled, cut into specimens and stored under reportedly sterile conditions.

Author verification required: Before submission, specify the PVA and CMC grades, the colloidal silver gel manufacturer and composition/concentration, the order and duration of mixing, casting volume/area, drying temperature and duration, sterilisation method, final film thickness, and storage conditions. These details were not available in the supplied material and have not been inferred.

2.2. In-vitro cytocompatibility

2.2.1. MTT assay

The supplied methods describe the use of 3T3 fibroblast cells exposed to a film extract, with untreated cells used as the control. After 48 and 72 hours, MTT reagent was added and the resulting formazan was solubilised before absorbance measurement. Cell viability was calculated relative to the untreated control:

Cell viability (%) = (Absorbance of experimental group / Absorbance of control group) × 100

Author verification required: Report the cell source and passage, seeding density, culture medium, extract preparation and extraction ratio, extract concentrations, exposure conditions, MTT concentration and incubation time, solubilising agent, absorbance wavelength, number of biological and technical replicates, positive/negative controls, and statistical analysis. The supplied description did not include these details.

2.2.2. Live/dead fluorescence staining

The supplied methods describe fluorescence-based live/dead staining, with viable cells expected to show green fluorescence and membrane-compromised cells expected to show red fluorescence.

Author verification required: Insert the original, interpretable fluorescence micrographs and provide the staining kit/reagents, staining protocol, microscope settings, magnification, scale bars and image-selection method. The fluorescence panels in the supplied document were not interpretable; no claim about their visual findings can be independently confirmed from that figure.

2.3. In-vitro mass-loss assessment

The supplied methods describe immersing pre-weighed film specimens in PBS (pH 7.4) containing lysozyme and incubating them at 37°C. Specimens were reportedly assessed at 0, 6, 12, 24, 48 and 72 hours, then washed, dried to constant weight and reweighed. Percentage mass loss was calculated as:

Mass loss (%) = $[(W_0 - W_t) / W_0] \times 100$

where W_0 is the initial dry mass and W_t is the dry mass at the relevant time point.

Author verification required: Specify lysozyme concentration and source, medium volume, specimen dimensions and initial mass, number of replicates, agitation conditions, washing and drying procedures, the criterion for constant mass, and whether separate specimens were used at each time point. Unless degradation products or a degradation mechanism were independently characterised, report this endpoint as mass loss rather than definitive biodegradation.

2.4. Statistical analysis

The supplied material did not contain replicate-level data or a statistical-analysis plan. No inferential statistical analysis can therefore be reported in this revision. The original data should be analysed using a method appropriate to the experimental design, with the sample size, summary statistics, effect estimates and exact statistical tests reported. Do not derive standard deviations, p-values or sample sizes from the displayed graphs.

3. Results

3.1. MTT assay

The supplied graph suggests approximately 80% viability in the experimental group at 48 hours and approximately 95–100% at 72 hours, while the control was shown at approximately 100%. These are estimates read from the graph, not values calculated from raw absorbance data. Replicate-level results and statistical comparisons were not supplied.

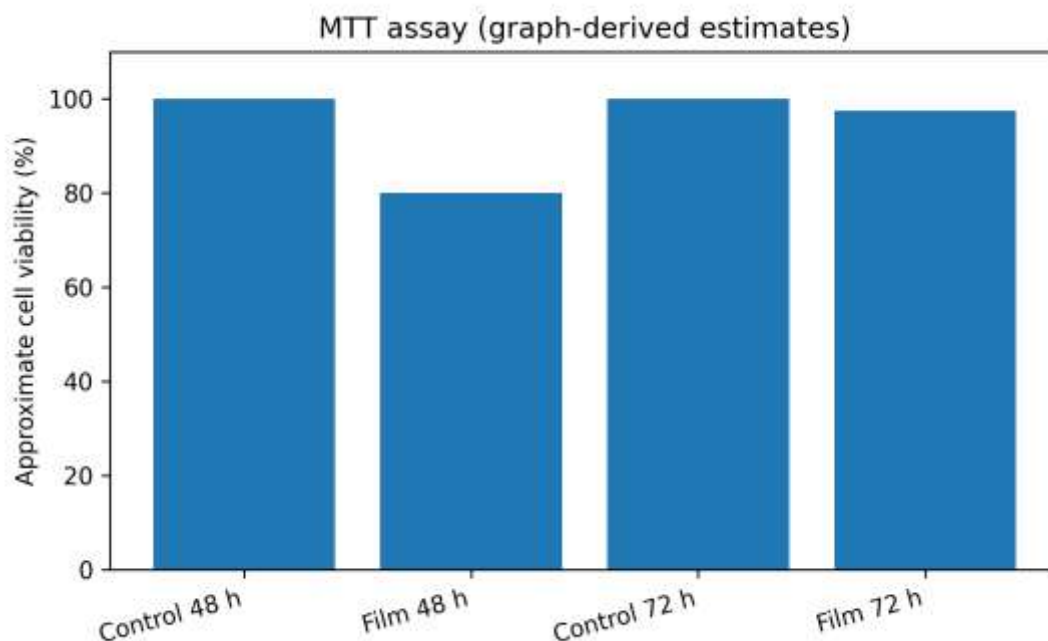


Figure 1. MTT viability values approximated from the graph in the supplied manuscript. These are graphical estimates only; raw replicate-level data, error bars and statistical comparisons were not supplied.

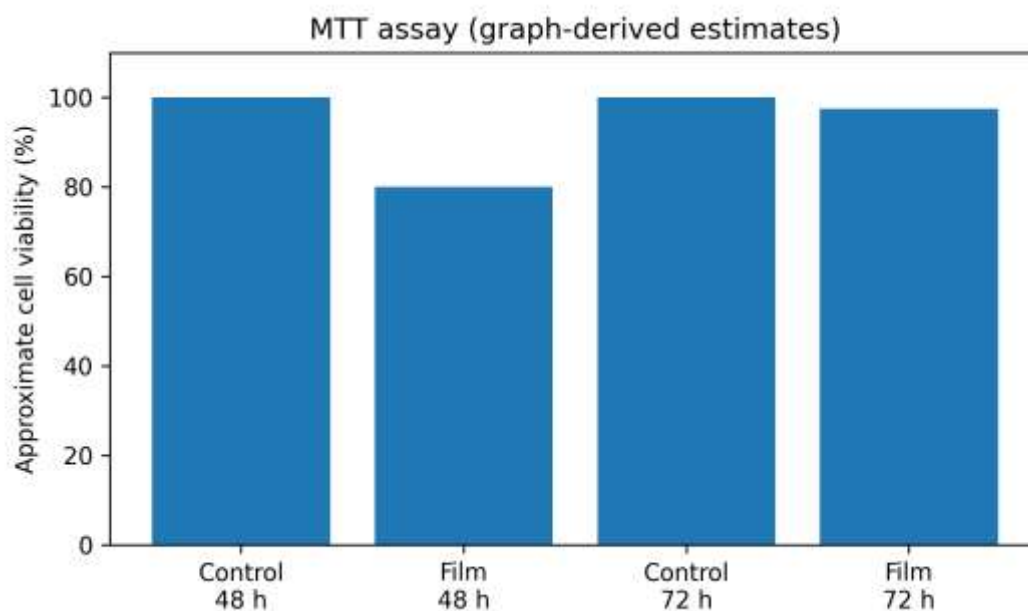


Figure 1. MTT viability estimates read from the supplied graph. The 72-hour film value is displayed at the midpoint of the reported 95–100% range for visualisation only. Confirm all values against raw data; no error bars or inferential statistics are available.

3.2. Live/dead fluorescence staining

The supplied document did not contain interpretable fluorescence panels that would allow independent assessment of cell morphology or the relative distribution of live and dead cells. This outcome cannot be reliably described until the original images and associated records are recovered.

3.3. Mass loss over time

Approximate values transcribed from the supplied graph are shown in Table 1. Because the graph embedded in the supplied document contains a description referring to a chitosan film, the material identity and provenance of this graph must be verified against the original experiment before these values are used as results for the PVA–CMC/colloidal-silver film.

Table 1. Approximate values read from the supplied graph; values are not validated against raw measurements.

Incubation time (h)	Approximate mass loss (%)
0	0
6	≈8
12	≈15
24	≈27
48	≈41–42
72	≈57

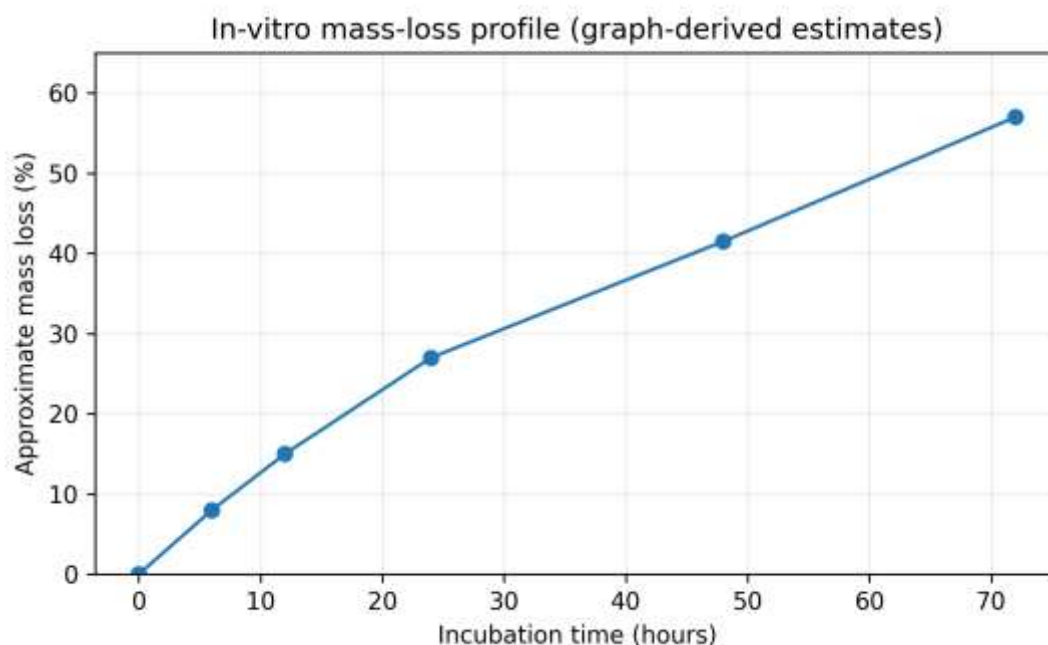


Figure 2. Approximate mass-loss values transcribed from the supplied graph. The original embedded figure referred to a chitosan film; confirm the graph belongs to the PVA–CMC/colloidal-silver formulation before submission.

Figure/data note: The quantitative plots are redraws of approximate values from the supplied image, not analyses of raw replicate-level data. The degradation panel's accompanying text identifies a chitosan film, so these values must not be attributed to the PVA–CMC/colloidal-silver film unless laboratory records confirm the material identity. The live/dead panels show placeholders rather than interpretable fluorescence micrographs.

4. Discussion

This manuscript addresses two preliminary properties of a PVA–CMC-based film incorporating colloidal silver gel: fibroblast metabolic activity and mass change during incubation. Both are relevant to early material characterisation, but neither alone establishes clinical suitability as a wound dressing.^{1–6}

The MTT graph supplied for this revision suggests approximately 80% viability at 48 hours and approximately 95–100% at 72 hours. These graph-derived estimates should be interpreted cautiously. MTT measures cellular metabolic activity, which is not identical to direct cell number or comprehensive cellular health.^{7,8} The absence of raw data, replicate numbers and statistical analysis prevents assessment of variability and the reliability of the apparent change over time.

The mass-loss graph suggests increasing mass loss during the 72-hour incubation period. However, the figure's embedded description refers to a chitosan film rather than the PVA–CMC formulation described in this manuscript. Until the original graph and experimental records are checked, the apparent trend cannot be confidently attributed to the film under study. Even when verified, mass loss under PBS–lysozyme conditions represents behaviour in that particular laboratory model and should not be equated directly with in-vivo biodegradation. Degradation behaviour may depend on polymer composition, crosslinking, medium composition and test conditions.⁹

Important limitations are the incomplete reporting of experimental conditions, absence of raw replicate-level measurements and statistical analysis, unavailable interpretable live/dead images, short observation period, and uncertainty regarding the provenance of the mass-loss graph. These issues should be resolved before drawing strong conclusions or submitting the work for peer review.

After verification, the study may provide preliminary characterisation of the specific film formulation. Further work may be needed to establish reproducibility, cytocompatibility using a fully reported protocol, degradation behaviour over an appropriate interval, and other performance characteristics relevant to the intended wound-dressing application.

5. Limitations

- The supplied results were available mainly as graphs; replicate-level numerical data were not provided.
- Sample sizes, variability measures and inferential statistical results could not be verified.
- The live/dead fluorescence panels in the supplied document were not interpretable.
- The mass-loss figure contains a description referring to a chitosan film; its identity and provenance must be confirmed.
- The observation period was limited to 72 hours, and the in-vitro model does not establish in-vivo degradation kinetics or clinical safety.
- Several experimental details required for reproducibility were absent from the supplied methods.

6. Conclusion

The graphical results supplied for this revision suggest that a PVA–CMC-based wound-dressing film incorporating colloidal silver gel may maintain 3T3 fibroblast metabolic activity over the reported 48- and 72-hour observation period and may undergo progressive mass loss under the described incubation conditions. These findings remain preliminary because the raw data, statistical analysis and interpretable fluorescence images were unavailable, and the provenance of the mass-loss graph requires confirmation. The results should be verified against original experimental records before the manuscript is submitted or the material is described as biocompatible or biodegradable.

7. References

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