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Studies on adsorptive dehydration of pasteurised milk by filled polymeric IPN hydrogel

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ABSTRACT

Adsorptive dehydration utilising polymeric hydrogels presents an effective technique for removing excess water from pasteurised milk. This study investigated three Interpenetrating Polymeric Network (IPN) hydrogels comprising Polyvinyl Alcohol (PVOH) and Hydroxyethyl Cellulose (HEC) at mass ratios of 90:10, 70:30 and 50:50, respectively, with Maleic Anhydride (MAn) as a cross-linker at concentrations of 2% 4%, and 8% based on total polymer weight. It was observed that the rate of dehydration increased with higher HEC content in the hydrogels. However, the stability decreased due to changes in the structural alignment of polymer chains and weak cross-linking. Among the tested hydrogels, the one with a composition of 70:30 for PVOH and HEC, respectively, cross-linked with 8% MAn (0.096gm), exhibited the best adsorption (569% Swelling) with minimal changes in pH (<10%) and conductivity (<10%) and was, therefore, selected for further study. This selected hydrogel composition was further enhanced by incorporating a hydrophilic nanofiller (Bentonite) at proportions of 2%, 4% and 6% based on total polymer weight during hydrogel synthesis. The hydrogel with 4% nanofiller (0.081 gm) showed the best results in terms of swelling and stability although the 6% filled hydrogel exhibited superior swelling but lower stability. Finally, the dehydration process was optimised using Type 1 fuzzy logic (T1FL), achieving an R^2 value of 95.13%.

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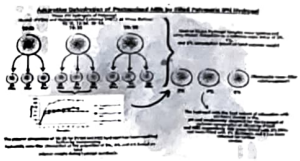

1. Introduction

Hydrogels are 3-D polymeric network structures having a high affinity to adsorb water due to the presence of hydrophilic groups (-OH, -CONH, etc.) [1,2]. IPNs are crosslinked with several polymers having network structures but not covalently bonded to each other and can't be separated unless chemical bonds are broken [3]. Depending upon the existing chemical bonds formed in the IPN network it can be classified into three categories: (1) Covalent IPN (Single Network formed by two separate polymers) (2) Noncovalent semi-IPN (Only one polymer crosslinked) (3) Noncovalent full-IPN (two separate polymers crosslinked independently) [4]. Based on Synthesis Procedure there are five categories (1) Sequential IPN (Here sequential means time order of polymerisation) (2) Simultaneous IPN (prepared in one step by mixing and crosslinking) (3) Latex IPN (both polymer networks are included in single latex by polymerisation with the second monomer with the crosslinking agent) (4) Thermoplastic IPN (forms ionomer at elevated temperatures IPN behaviour at elevated temperature) (5) Gradient IPN (compositions varies from location to location on a macroscopic level).

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