

# Milk-protein-based 3D printing biocomposites

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## Abstract

Casein and whey have been explored as useful biopolymers. The goal of this project is to develop new biocomposites using casein and whey incorporated into polylactic acid (PLA) or photocurable resins which are used to make engineering part using 3D printing applications. The research seeks to provide pathways for valorizing waste milk proteins in the production of bio-based engineering materials that could stimulate future demand for dairy milk and allow the conversion of spoiled/bacteria contaminated milk to useful, marketable products. This approach has the potential to lower the environmental impact of dairy wastes, significantly reduce financial losses, and increase revenue for animal husbandry and the dairy processing industry.

## Problems and Opportunities for Dairy Industry

### Before the project

Millions of gallons of dairy products are dumped continually



### Reasons:

1. Emerging discrepancies between supply and demand
  - 43 million gallons dumped in 2016<sup>1</sup>
2. Occasional supply chain disruption
  - Recent Covid-19 close down
  - Wisconsin farmers dumped 30,000 gallons per day at the onset of Coronavirus<sup>2</sup>

### Now

Extruded milk protein based products for 3D printing

Pellets



Filaments



1. <https://time.com/4530659/farmers-dump-milk-glut-surplus/>

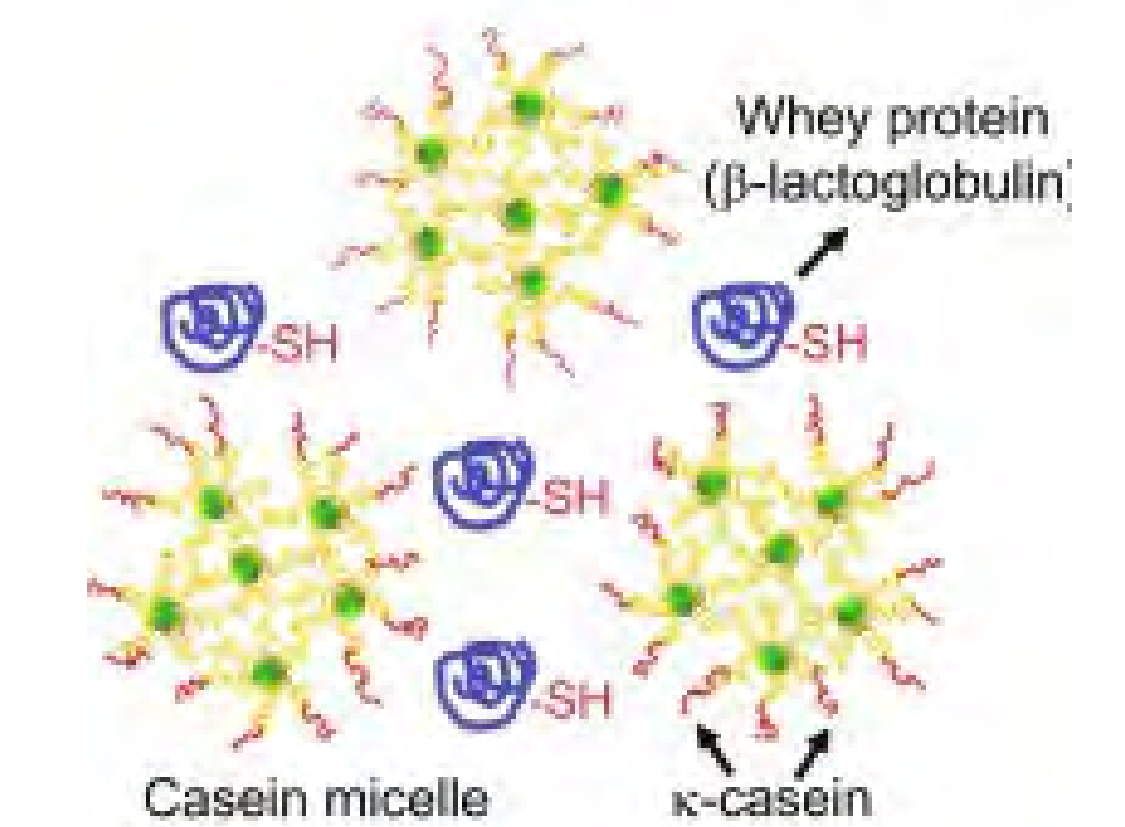
2. <https://www.usnews.com/news/best-states/wisconsin/articles/2020-04-02/dairy-farmers-begin-to-flush-away-milk-due-to-coronavirus>

## Overview

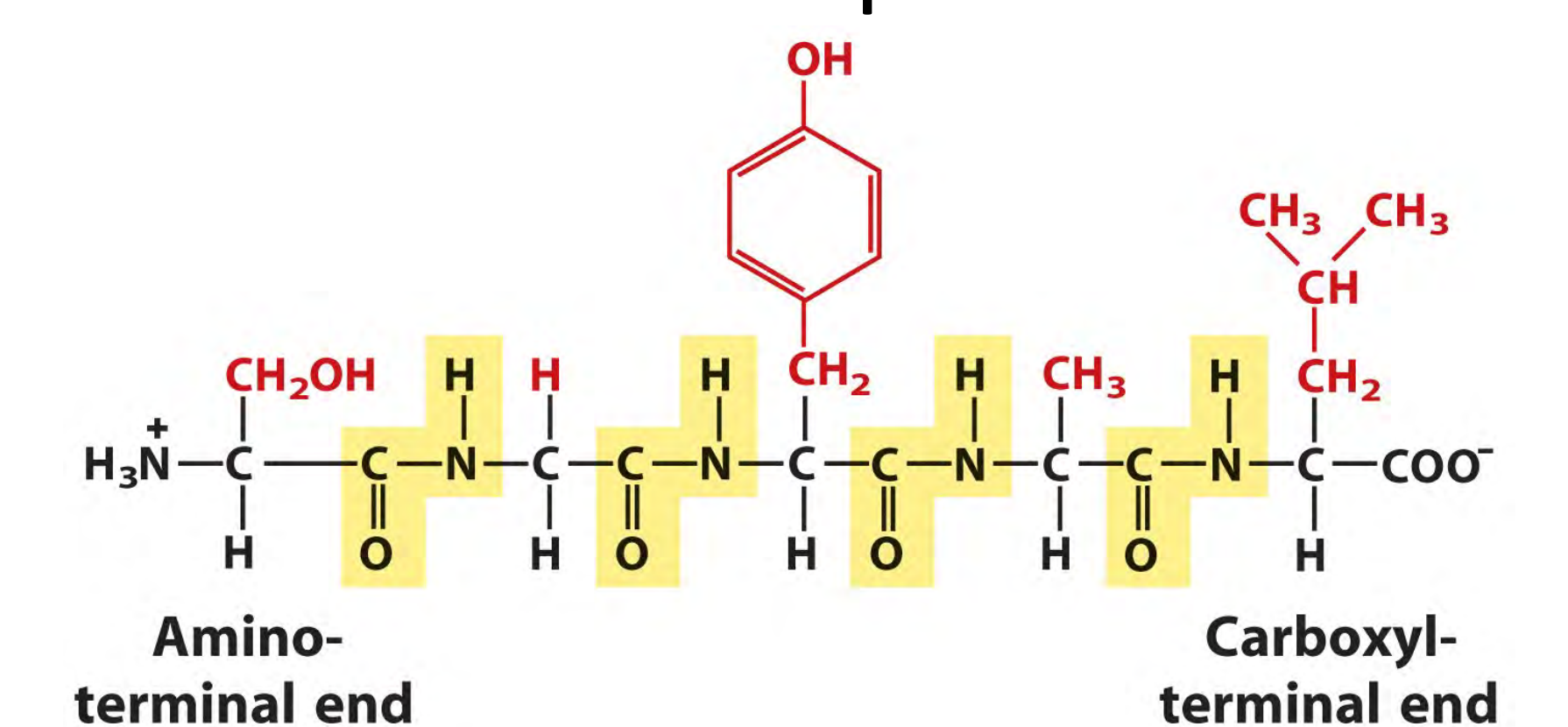


Waste Milk

Add acid



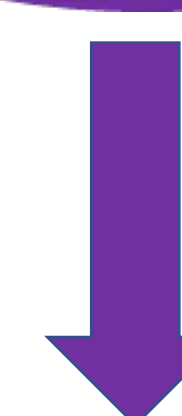
Precipitate  
milk protein



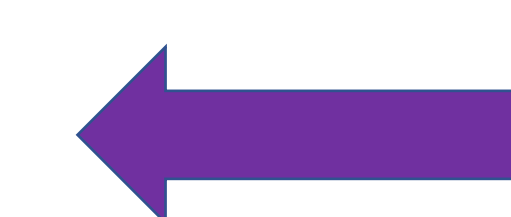
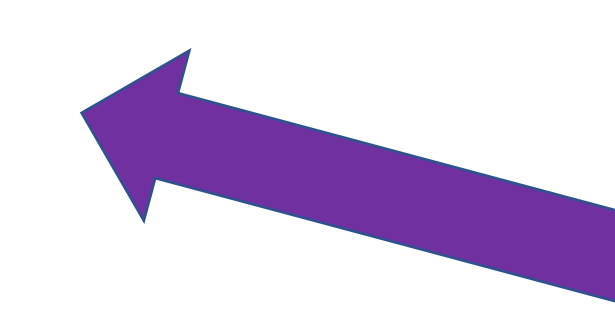
Protein behaves like a polymer  
from its peptide chain



Made into 3D printing  
raw materials



Fabricated tensile test specimens  
for mechanical properties evaluation



3D printing