International Interdisciplinary Congress on Renewable Energies, Industrial Maintenance, Mechatronics and Informatics
Booklets

RENIECYT 1702902 CONACYT

RENIECYT - LATINDEX - Research Gate - DULCINEA - CLASE - Sudoc - HISPANA - SHERPA UNIVERSIA - Google Scholar DOI - REDIB - Mendeley - DIALNET - ROAD - ORCID

Title: Bio-based antimicrobial packaging: A response to a reduction in the use of plastics and an advance in food safety.

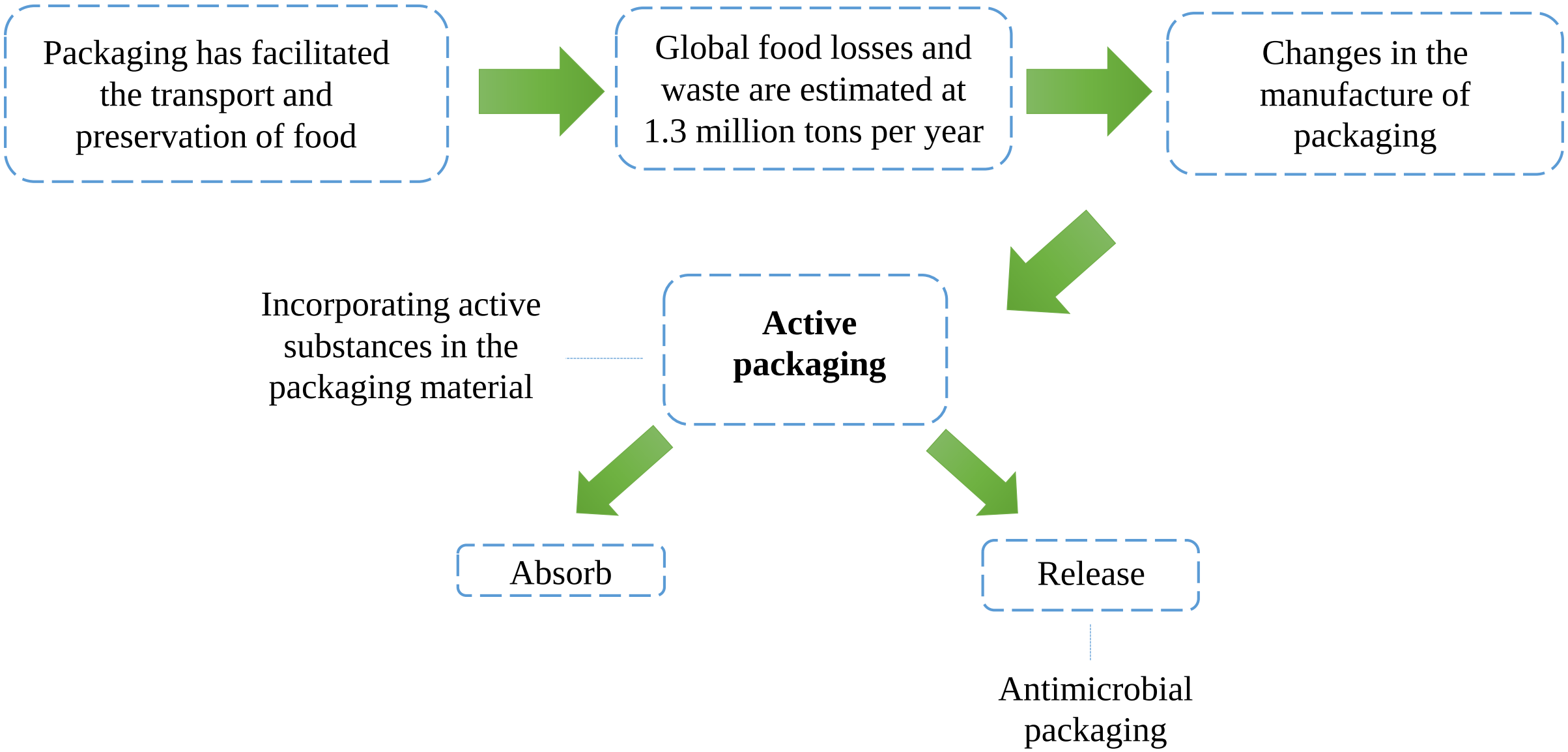
Food Technology

Authors: FONSECA-BARRERA, Itzel del Carmen, MENDOZA-GARCÍA, Patricia Guillermina, RAMÍREZ-HIGUERA, Abril and LOPEZ-ZAMUDIO, Amairany

Editorial label ECORFAN: 607-8695
BCIERMMI Control Number: 2021-01
BCIERMMI Classification (2021): 271021-0001

Pages: 12
RNA: 03-2010-032610115700-14

Introduction



Introduction

Antimicrobial packaging

Inhibiting the growth of microorganisms that can reduce food quality

In 2018, 550 million people fell ill due to contaminated food

Productivity loss due to ETAS of $92.2 billion per year

Contamination problems caused by plastics

Worldwide increase of 4.2 % in plastic production

The bio-based antimicrobial packaging

Methods of preparation of bio-based antimicrobial packages

The bio-based antimicrobial → Their efficiency is determined by the release of the antimicrobial

Methods of preparation → Wet process / Dry process

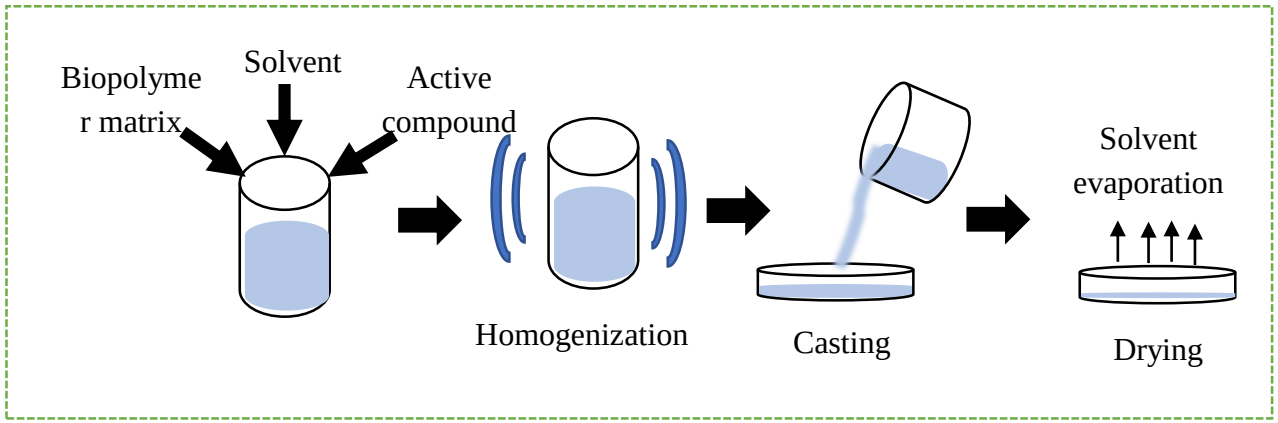


Figure 1 Steps of forming films by the casting method. *Source: Khan et al. (2018)*

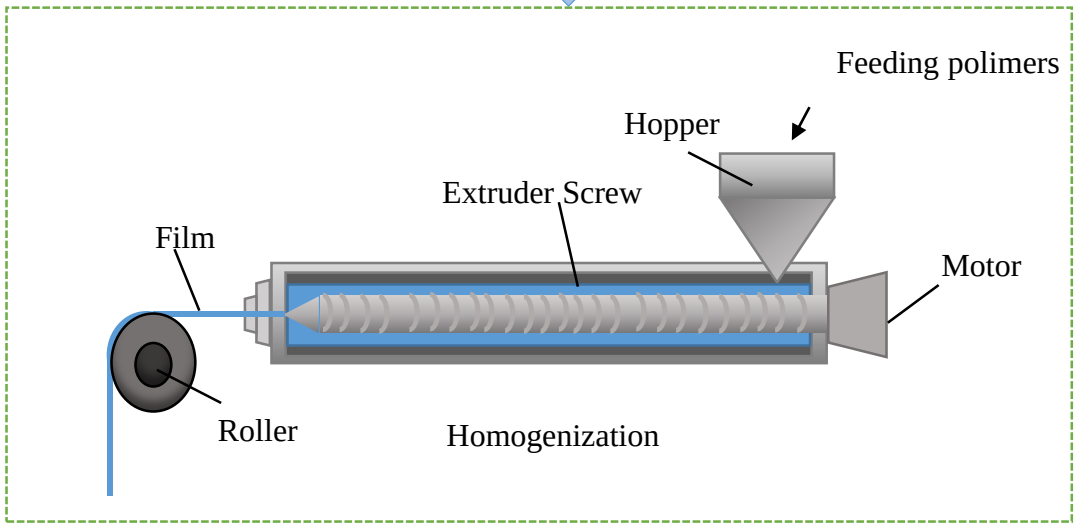
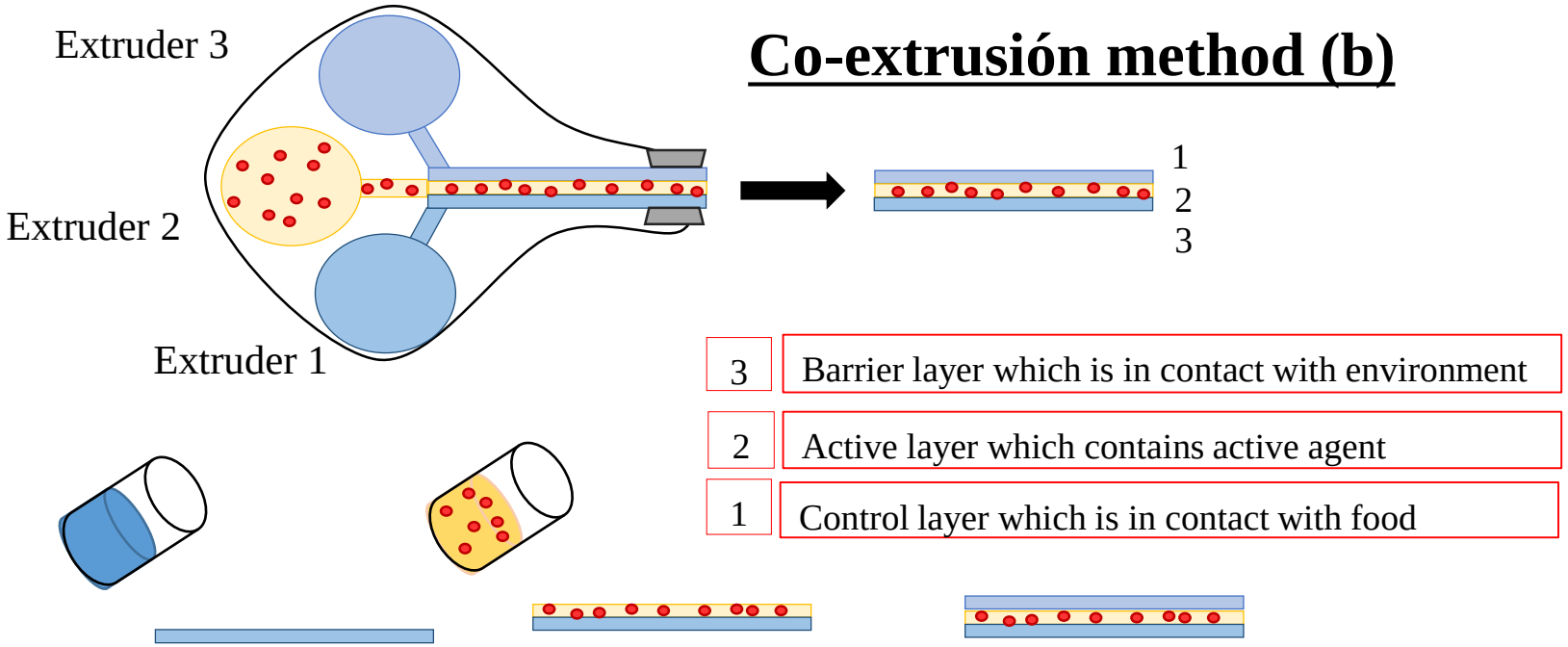


Figure 2. film production by extrusion method. *Source: Pranata et al. (2019)*

Structure of bio-based antimicrobial packages

The structure of antimicrobial packaging can improve mechanical and barrier properties of packaging .

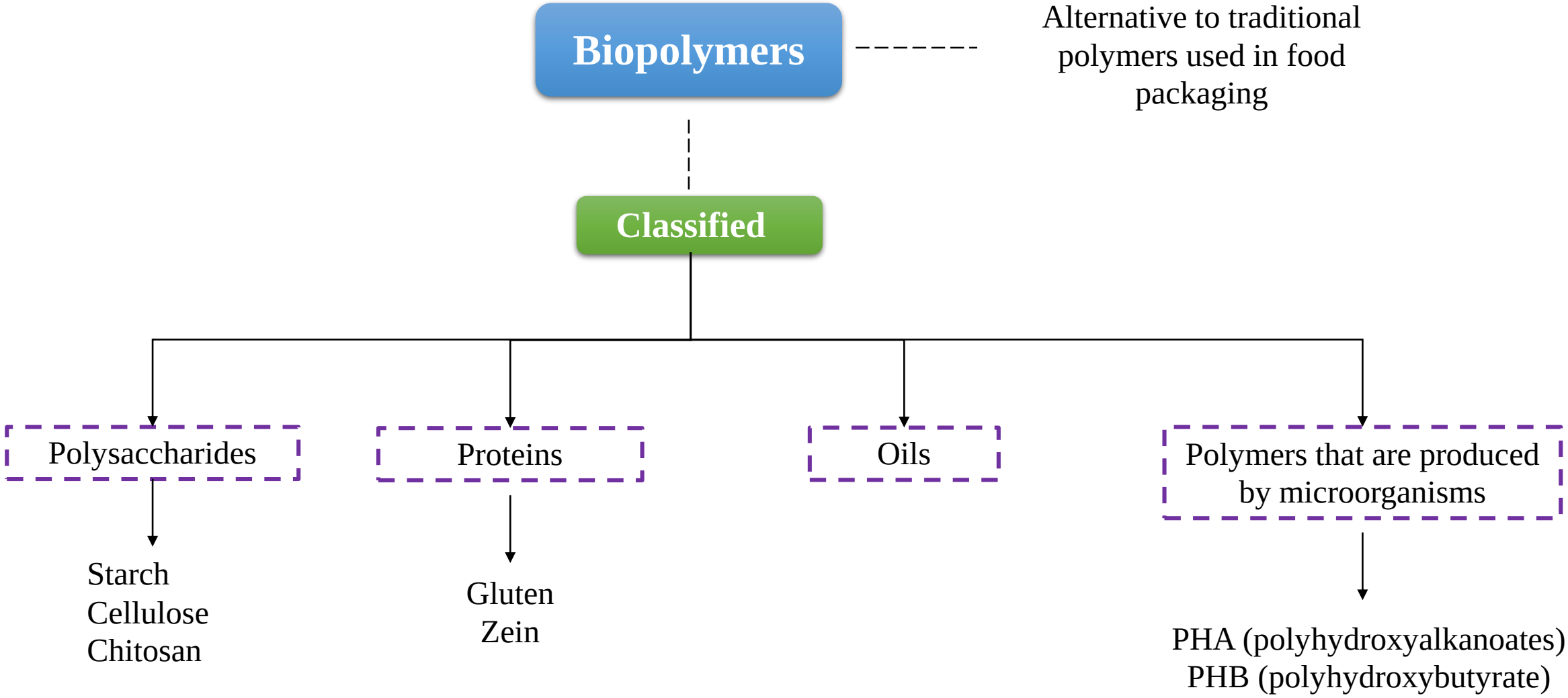


Use of several materials like:

- PLA (polylactic acid) and PHB (polyhydroxybutyrate).
- Cellulose and ZnO nanoparticles
- Chitosan, sodium alginate and carboxymethyl chitosan

Figure 3. Methods for the production of multilayer films (a) wet method (casting) (b) dry method (co-extrusion)
source: Almasi, Jahanbakhsh Oskouie y Saleh (2020)

Biopolymers used in antimicrobial packaging



Examples of Researches about biopolymers used in antimicrobial packaging

Polysaccharides	The effect of polyethylene glycol and triacetin in hydroxypropyl methylcellulose coatings Developing of films of starch and carboxymethyl cellulose the effect of four different plasticizers on the mechanical properties of chitosan films and their storage stability
Proteins	Incorporated cinnamon essential oil and chitosan nanoparticles into zein films. Developing of gluten films with different ethanol concentrations (70-20 mL/ 100 mL) and pH (2-6)
Oils	Studied of candelilla wax films with *Bacillus subtilis* strain HFC103 to preserve strawberries Performance of carnauba wax-nanoclay emulsion coatings on postharvest quality of “Valencia” orange fruit.
Polymers synthesized by microorganisms	Synergized Antimicrobial Activity of Eugenol Incorporated Polyhydroxybutyrate Films Antimicrobial and Physical–Mechanical Properties of Polyhydroxybutyrate Edible Films Containing Essential Oil Mixtures.

Synergized Antimicrobial Activity of Eugenol Incorporated Polyhydroxybutyrate Films

Main active agents used in antimicrobial films

The antimicrobial activities of packaging are based on the migration of antimicrobial substances from the package to the food

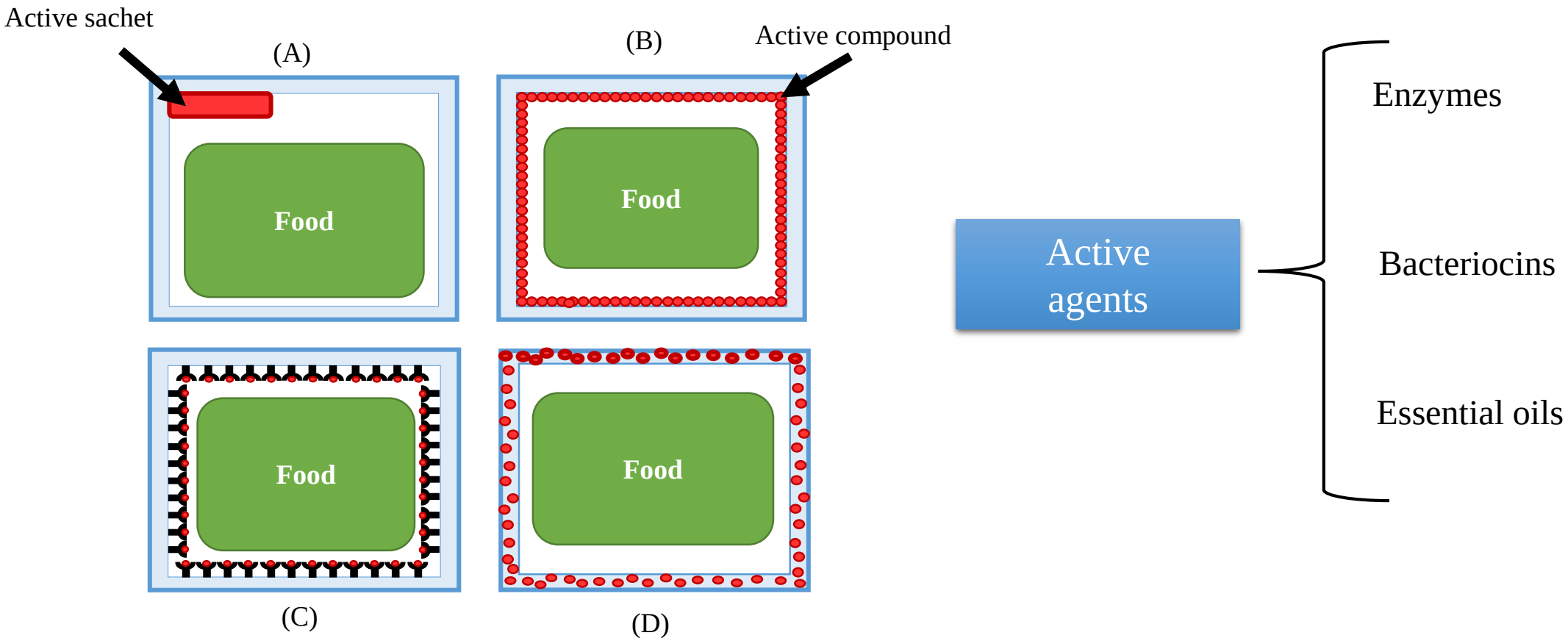


Figure 4 Active food packaging system designs. *Source: Almasi, Jahanbakhsh Oskouie y Saleh (2020)*

Examples of films with active ingredients

Enzymes

- Lysozyme in two different polymeric matrices (corn starch and pea proteins)
- Catechin-lysozyme gelatin films to maintain the quality of ground pork
- Antimicrobial film with wheat gluten, lysozyme and ethylenediaminetetraacetic

Bacteriocins

- New methods of absorption of bacteriocins:
- Pediocin PA-1 into polylactic acid (PLA) films and sawdust particles by diffusion method
- Films of polylactic acid and sawdust particles with bacteriocin 7293 produced by *Weissella hellenica* BCC 7293

Essential oils

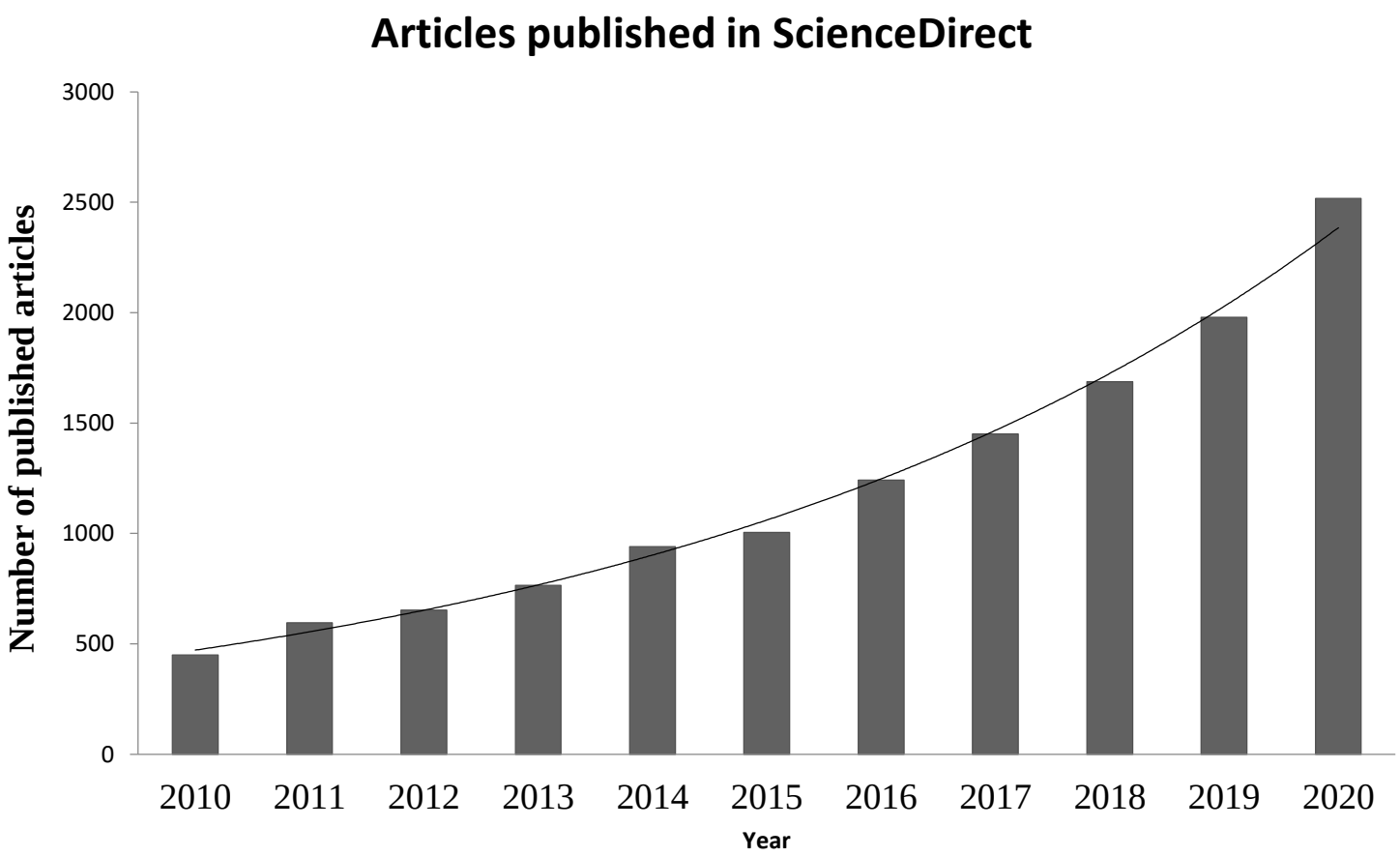
- Chitosan films with Eucalyptus globulus essential oil
- Essential oils from Zataria multiflora incorporated it into zein films
- Titanium dioxide nanoparticles and cinnamon essential oil in sago starch films

Importance of biodegradable antimicrobial packaging and its applications

Inhibit the growth of pathogens like:

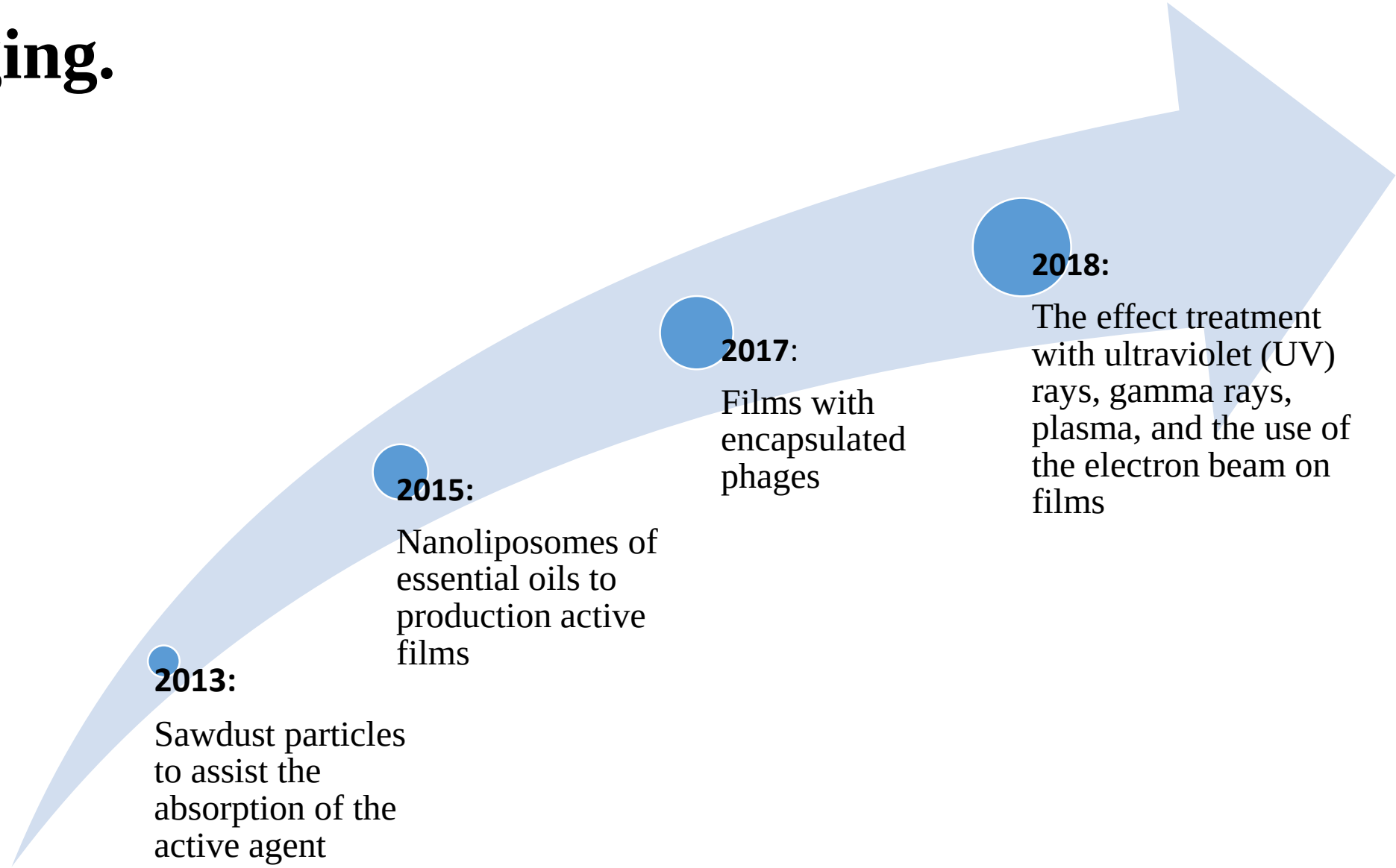
- ✓ *Salmonella*
- ✓ *Listeria monocytogenes*
- ✓ *Clostridium botulinum*
- ✓ *Aeromonas hydrophila*
- ✓ *Penicillium commune*
- ✓ *Penicillium Solitum*
- ✓ *Penicillium corylophilum*
- ✓ *Penicillium palitans*

The microorganisms most commonly used to test the inhibition of films are *Escherichia coli*, *Salmonella* and *Listeria monocytogenes.*



Graph 1. Articles published in ScienceDirect on food packaging, active packaging and antimicrobial packaging.

Future advances in antimicrobial active packaging.



Conclusions

Bio-based antimicrobial packaging (BBA) to food helps reduce losses caused by spoilage microorganisms and decreases the incidence of ETAs and the use of plastics.

BBA is limited because the interactions between their constituents have not yet been fully elucidated. It's for this reason that The industry must be promoting research on this type of packaging system, highlighting the environmental importance and cost reduction by obtaining products with a longer shelf life

References

Almasi, H., Jahanbakhsh Oskouie, M., & Saleh, A. (2020). A review on techniques utilized for design of controlled release food active packaging. Critical Reviews in Food Science and Nutrition, 1–21. doi:10.1080/10408398.2020.1783199

Almasi, H., Jahanbakhsh Oskouie, M., y Saleh, A. (2020). A review on techniques utilized for design of controlled release food active packaging. Critical Reviews in Food Science and Nutrition, 1–21. doi:10.1080/10408398.2020.1783199

Álvarez, M. F. (2000). Revisión: Envasado activo de los alimentos / Review: Active food packaging. Food Science and Technology International, 6(2), 97–108. doi:10.1177/108201320000600203

Blanco Massani M, Botana A, Eisenberg P, Vignolo G (2014a) Development of an active wheat gluten film with lactobacillus curvatus CRL705 bacteriocins and a study of its antimicrobial performance during ageing. Food Addit Contam Part A 31(1):164–171. doi: 10.108 0/19440049.2013.859398

Blanco-Pascual, N., & Gómez-Estaca, J. (2017). 5 Production and Processing. Edible Food Packaging: Materials and Processing Technologies, 153.

Castro, C., Zuluaga, R., Álvarez, C., Putaux, J.-L., Caro, G., Rojas, O. J., … Gañán, P. (2012). Bacterial cellulose produced by a new acid-resistant strain of Gluconacetobacter genus. Carbohydrate Polymers, 89(4), 1033–1037. doi:10.1016/j.carbpol.2012.03.045

Cazón, P., Velazquez, G., Ramírez, J. A., & Vázquez, M. (2017). Polysaccharide-based films and coatings for food packaging: A review. Food Hydrocolloids, 68, 136–148. doi:10.1016/j.foodhyd.2016.09.009

Cerqueira, M. A. P. R., Pereira, R. N. C., da Silva Ramos, O. L., Teixeira, J. A. C., & Vicente, A. A. (Eds.). (2017). Edible food packaging: Materials and processing technologies. CRC Press.

FAO. (2011). Global Food Losses and Food Waste - extent, causes and prevention. Rome, Food and Agriculture Organization of the United Nations.

Fathima, P.E., Panda, S. K., Ashraf,M. P., Varghese, T.O., Bindu, J. (2018). Polylactic acid/chitosan films for packaging of Indian white prawn (Fenneropenaeus indicus). International Journal of Biological Macromolecules, (177), 1002 1010.doi:10.1016/j.ijbiomac.2018.05.214

Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., … Law, K. L. (2015). Plastic waste inputs from land into the ocean. Science, 347(6223), 768–771. doi:10.1126/science.1260352

Jiang, Y., Lan, W., Sameen, D. E., Ahmed, S., Qin, W., Zhang, Q., … Liu, Y. (2020). Preparation and characterization of grass carp collagen-chitosan-lemon essential oil composite films for application as food packaging. International Journal of Biological Macromolecules. doi:10.1016/j.ijbiomac.2020.05.202

Jideani, V. A.; Vogt, K (2015). Antimicrobial Packaging for Extending the Shelf Life of Bread – A Review. Critical Reviews in Food Science and Nutrition, (), 00–00. doi:10.1080/10408398.2013.768198

Kaewklin, P., Siripatrawan, U., Suwanagul, A., & Lee, Y. S. (2018). Active packaging from chitosan-titanium dioxide nanocomposite film for prolonging storage life of tomato fruit. International Journal of Biological Macromolecules, 112, 523–529. doi:10.1016/j.ijbiomac.2018.01.124

ECORFAN®