Antimicrobials for bakery products

Identification

Key words

Latest version 2013/12/12
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How does it work?

Primary objective Finding reliable antimicrobials for bakery products.
Working principle

Two approaches can be followed to apply antimicrobials to bakery products: (1) adding antimicrobial substances directly as additive to the bakery products dough, or (2) generation of a packaging material film with an antimicrobial effect.

1. Product additives applications In this case, the basic principle to eliminate growth of microbes is adding antimicrobially active components directly to the dough. An example of this approach is the use of Cinnamon verum essential oil and Echinacea purpurea extract as additives into Kolompe (a traditional cookie in Kerman-Iran) [1]. The same principle was applied by Cizeikiene et al. [2], who demonstrated the antimicrobial activities of Lactobacillus sakei KTU05-6, Pediococcus acidilactici KTU05-7, Pediococcus pentosaceus KTU05-8, KTU05-9 and KTU05-10 strains producing organic acids and bacteriocins like inhibitory substances (BLIS) against undesirable microorganisms in the food industry. Likewise, the effectivity of Lactobacillus plantarum, producing lactic acid, was presented as an antibacterial tool in cereal products [3]. Lucera et al. [4] gave an overview on the application of various sorts of natural antimicrobial substances in foods during production or before packaging. Dipping, spraying, and coating treatments of food with active solutions are currently applied to products prior to packaging as valid options. Another example is low-salted bread [5]: calcium propionate and sourdough were used as natural preservatives against Penicillium expansum, Fusarium culmorum and Aspergillus niger. Essential oils of medicinal plants such as chamomile are very complex natural mixtures which can contain compounds at quite different concentrations and some of their components have antioxidant and antimicrobial activities in foodstuff [6]. The antioxidant and antimicrobial effects of chamomile essential oil in cake preparation were evaluated during 75 days of storage. Chamomile essential oil as a natural antioxidant and antimicrobial agent can increase the shelf-life of food products. The effectivity of various other antimicrobials were also tested in bakery products, e.g. Echinacea purpurea extract [7], plant extracts [8], lime essential oil [9], essential oils from clove, cedar wood, Cymbopogon species, peppermint, Eucalyptus and neem (Nimbe oil) [10]. Furthermore, a novel polysaccharide, isolated from the broth of Streptomyces virginia H03, exhibited strong antibacterial activities on food spoilage and food poisoning microorganisms such as Staphylococcus aureus, Bacillus subtilis, Listeria monocytogenes, Escherichia coli, Zygosaccharomyces bailii and Candida utilis [11].

2. Packaging applications Several examples of antimicrobial packaging materials can be found in literature: An antifungal active packaging system based on the release of carvacrol and thymol was found to increase the shelf life of bread [12]. Mono- and multilayer materials from polyvinyl alcohol and bacterial cellulose incorporating vanillin as natural antimicrobial ingredient were prepared. The vanillin release is influenced by the film’s composition; the multilayer films being promising in order to achieve controlled release of vanillin [13]. The same types of films, but containing potassium sorbate instead of vanillin as antimicrobial agent, were also tested against Escherichia coli and showed a good antimicrobial activity [14]. An overview of edible films and substances introduced to films in order to impart them antimicrobial activity was presented by Krasniewska et al [15]. It describes natural polymers applied for the production of food packages and active substances of natural origin added to them, including: bacteriocins, enzymes, oils, and plant extracts, chitosan - a polysaccharide used for film formation and characterized by strong antibacterial and antimimotic properties. Pereira de Abreu et al. reviewed intelligent packaging methods including packaging with antimicrobial activity [16].

Three types of packaging systems were tested for gluten-free breads by Gutiérrez et al.: active packaging, modified atmosphere packaging (MAP) and combinations of both. The results showed that the active packaging is a better option than MAP to increase the shelf life because, next to inhibiting microbial growth, it also maintained the sensorial properties of gluten-free breads better [17]. Films based on linear low-density polyethylene (LLDPE) and low-density polyethylene (LDPE) containing linalool or methylchavicol were prepared by extrusion film blowing [18]. Tests done confirmed the potential use of polymeric films containing basil constituents as antimicrobial films for enhancing quality and safety as well as the extension of the shelf life of foods. Antimicrobial packaging material based on the combination of the most active compounds of essential oils (hydrocinnamaldehyde, oregano essential oil, cinnamaldehyde, thymol, and carvacrol) together with some aromas commonly used in the food industry were developed. The most antimicrobial compounds are thymol, carvacrol, and cinnamaldehyde [19].
Additional effects

Some antimicrobial components exhibit also an antioxidant effect, e.g. cinnamon essential oil and Echinacea extract in kolompe, sourdough and calcium propionate, chamomile essential oil and Carvacrol and thymol [1, 5, 6, 12].

Important process parameters

The temperature during the processing of dough cannot be higher than the stability temperature of the antimicrobial component. In packaging applications, sufficient mass transfer of antimicrobial components from the packaging material into the bakery product surface is needed (to sufficiently limit the spoilage).

Important product parameters

Antimicrobial components have different antimicrobial activity against growth of various spoilage and poisoning microbes. Each antimicrobial component has to be tested beforehand on a group of microorganisms occurring in the bakery products or on their surfaces.

What can it be used for?

**Products**  
Bakery products.

**Operations**  
Baking, packaging.

**Solutions for shortcomings**  
Limit the spoilage of bakery products.

What can it NOT be used for?

**Products**  
No general limitation is known. Specified for given antimicrobial substance.

**Operations**  
No limitations given for baking operations.

**Other limitations**  
Antimicrobial additives to dough can only be used when they are stable at the temperatures used for baking. They have to be very well mixed into the dough before baking.

**Risks or hazards**  
All antimicrobial components have to be tested on toxicity and maximum allowable dose before they can be applied.

Implementation

**Maturity**  
Most of cited references on antimicrobial components refer to solving of practical bakery problems and products that were applied in practice.

**Modularity /Implementation**  
After testing, both antimicrobial additives and packaging can be applied in the standard bakery production and packaging lines respectively.

**Consumer aspects**  
Most consumers welcome higher microbial safety of products and their longer shelf life, although some consumers prefer bakery products with no antimicrobial components added, which have a relatively short shelf life.

**Legal aspects**  
Please check local legislation.

**Environmental aspects**  
No substantial influence of antimicrobial components applied in bakery produce and packing on the environment is known.

Facilities that might be interesting for you
Further Information

Institutes

Tarbiat Modares University, Tehran, Iran, http://www.modares.ac.ir/en
University of Alicante, Spain, http://www.ua.es/en
University of Alicante" cannot be used as a page name in this wiki., Spain,
Kaunas University of Technology, Lithuania, http://en.ktu.lt/
University of Foggia, Italy, http://www.unifg.it/__en/default.asp
Warsaw University of Life Sciences, Poland, http://www.sggw.pl
National University of Ireland, Ireland, http://www.nuigalway.ie/
Central Food Technological Research Institute, Mysore, India, http://www.cftri.com/
Tehran University of Medical Sciences, Tehran, Iran, http://www.tums.ac.ir/
University of Zaragoza, Spain, http://wzar.unizar.es
University of Mysore, India, http://www.uni-mysore.ac.in
Kasetsart University, Bangkok, Thailand, http://www.ku.ac.th/english/
Huazhong University of Science and Technology, China, http://english.hust.edu.cn/
University of Stellenbosch, South Africa, http://www.sun.ac.za/english

Companies

See on national list of producers of antimicrobial products.