Extending shelf life of fruits by using some microorganisms biological products

Abstract
softening was considered a main problem in fresh fruits and vegetables during marketing from farm to consumer, that occur as a natural process of maturation and water loss which lead to making them loss of economic value, shortening of shelf life and undesirable for consumed by consumers, therefore, it became important to find some new technique to save these fruits and vegetables, so, pullulans witch know as a neutral water soluble polysaccharide that produced from starchy by the fungus Aureobasidium pullulans by fermentation and killer toxin witch know a neutral protein that produced by Yeast Saccharomyces cerevisiae (Bakery yeast) were use as a safe biological materials in this case to inhibit microorganisms growth and weight loss and spoilage to extending shelf life of fruits and vegetables by using some biotechnological methods and biological products from some microorganisms.

Keywords: pullulan, killer toxin, bakery yeast, Saccharomyces cerevisiae, Aureobasidium pullulans, microorganisms growth, weight loss, spoilage, fruits, extending shelf life

Introduction
In recent years; the increased demand of fresh foods led to the search and finding new method which ensures to keep foods, with freshness and high quality. Increasing consumer demand for extended plant material storage duration has mobilized the food industry to search for methods to maintain raw material quality and protection of a wide group of food products. All fruits and vegetables are harvested when they are completely ripe, the main problem with them it continues to ripen while they are being stored because it causes irreversible wilt and weight loss which results to shortened shelf-life and loss of economic and commercial value, so applying edible coatings that defined as thin layers of biomaterials, which form a barrier around products in the form of tightly adhering coating, and may concurrently be consumed together with the protected food, this edible coatings manufacture from natural materials like polysaccharides, proteins and lipids might be one of the effective methods to prolong shelf-life stability at storage in the room temperature for these types of foods by slows down gases exchange, controls respiration process, limits mass loss and R.H. transmission and decrease in microorganisms growth on the surface.

Type of biological products
Pullulan
Pullulan (C_{6}H_{10}O_{5})_{n}H_{2}O is a neutral, water-soluble polysaccharide produced from starchy by the fungus Aureobasidium pullulans, by means of a process of fermentation. Chemically, this polymer consists of α-1,6 linked maltotriose residues, which in turn are composed of three glucose molecules connected to each other by α-1,4 glycosidic bonds.

Pullulan characterized by nontoxic for human and animal, low caloric and totally biodegradable, have good adhesive characteristics that enables it to be applied for coating of food products, colorless, odorless, no taste, can be very thin and have a big barrier characteristics in relation between oxygen and carbon dioxide, which had effect upon growth inhibition of most of the tested microorganisms, responsible for decay of food, so it can be an useful element to ensure microbiological safety of food.

Pullulan as a carrier for drug delivery, particularly in the form of microgels and nano gels, leaf targeting of drug loaded pullulans, anti cancer drug, as drug delivery systems, particularly in the form of micro gels and nano gels, gene delivery, bio imaging by nanoparticles shell. Pullulan is also being used for the production of biodegradable plastics in Japan and U.S.A., because it resembles polyethylene with properties like tensile strength and ability to form thin transparent oxygen impermeable films.

Pullulan produced by the fungus Aureobasidium pullulans, by means of a process of fermentation. Aureobasidium pullulans (De Bary) G. Around is a ubiquitous, polymorphic and oligotrophi black yeast like micro fungus that occurs frequently in wide range of tropical and temperate environment with fluctuating moisture content in phyllosphere, and also isolated from damp indoor surfaces, food and feed substances, it has also been found in the osmotically stressed environments like hyper saline water in saltlars and the rocks.

Killer toxin
Yeast Saccharomyces cerevisiae (Bakery yeast) have the ability to produce of some types of proteins which working for prevent or delay the growth of other microorganisms in the same growth medium and these proteins hers acidic nature and specific reaction which depend of some environmental factors such as pH, temperature and ventilation. Moreover, the yeast has many mechanisms that explain their ability to neutralizing some of microorganisms through the directly influence, or by inhibition of some pathogens, contribution to stimulating the
immune system and prevent bacterial toxins from access to receptors in the cells. So, yeast widely used instead of antibody for the ability to prevent pathogenic bacteria of colonize the gastrointestinal area through competition for nutrients, which prevents or reduces effect these microorganisms, several studies proved that yeast hers an important role in providing immune protection against pathogenic infections of the digestive tract by stimulating the increase production of immunoglobulin IgA as well as work on organize of the intestinal environment and reduce division of cells pathogens, as it proved high efficiency in the treatment of acute and chronic diarrhea which caused by intestinal bacteria which endemic to intestines of infected adults and children, as well used to prevent diarrhea for the traveler’s and relieve abdominal pain of enteric nervous, Likewise used as therapy for children who suffer from Candidiasis disease which caused by C. Albicans.

Applications

Effect of microorganism’s growth

Many research refer to inhibitory effect for killer toxin which purification from bakery yeast and pullulans that production from locally isolate Aureobasidium pullulans on bacteria, mold and yeast, Alsoufi & Aziz found that inhibition of E. Coli, S. Typhimurium, Aspergillus spp., Penicillium spp., C. Albicans, P. Jadini, was 71, 62, 52, 59, 68 and 76% respectively, at a rate of 46.6% for killer toxin, and was 68, 70, 42, 48, 61 and 63% respectively, at a rate of 58.6% for Pullulan, and 74, 68, 65, 68, 71 and 73% respectively, at a rate of 69.83% for 25% Pullulan+75% killer toxin, and was 83, 76, 72, 81, 76 and 87% respectively, at a rate of 79.16% for 50% Pullulan+50% killer toxin, and was 67, 72, 54, 56, 64 and 69% respectively, at a rate of 63.66% for 75% Pullulan+25% killer toxin; while, Chlebowska-Smigiel & Gniewosz studied effect of pullulans coating as antimicrobial activity on moulds, yeasts and bacterial growth, they found that the inhibition of pullulans was 100% on bacterial species such Citrobacter freundii ATCC 8090, Lactobacillus plantarum ATCC 4080, and Pseudomonas fluorescens, while the inhibition was 80% on Lactobacillus brevis. The inhibition was 70% on Escherichia coli ATCC 25922 and Tetracoccus sp. and 60% on Micro-coccus luteus ATCC 9341 and Bacillus subtilis ATCC 6650, They suggest that pullulans coating can be a useful application to ensure food safety and quality from microbiological deterioration, because it had important effect on relation between oxygen and carbon dioxide in microorganisms. In the same context, Gniewosz, et al. studied antimicrobial activity of pullulans film incorporated with meadowssweet flower extracts (Filipendula ulmaria flos) on postharvest quality of apples, They found that inhibition of pullulans on Staphylococcus aureus ATCC 25923, Bacillus subtilis ATCC 6633, Salmonella enteritidis ATCC 13076 and Escherichia coli ATCC 25922 was more than degree of mold species such as Penicillium expansum ATCC 7861, Rhizopus arrhizus ATCC 11145 and Aspergillus niger ATCC 9142, also they refer that gram-positive bacteria like S. Aureus & B. Subtilis were demonstrated higher resistance (MIC 0.6-6.0μg/ml), also Krzewska, et al. used Pullulans coating that enrich with plant extracts from Satureja hortensis L. in different concentrations to maintain pepper and apple quality and safety and they obtained that the inhibition zone was significantly increased (p<0.05) for all the tested strains as the concentrations of extracts in the pullulans film, in 5% addition of extract to the pullulans film inhibited the growth of gram-positive bacteria, while gram-negative bacteria were inhibited by 20% in the film, they explain that, the gram-negative bacteria are more resistant to antimicrobial compounds than gram-positive bacteria and this fact may be related to the structure of the cell wall of gram-negative bacteria which is characterized by the presence of an additional external lipopolysaccharide (LPS) membrane, whilst, Kamnani & Lim were refer to antimicrobial activities for pullulans-mediated silver nanoparticles against some microorganisms that causes food-born and multidrug resistant pathogens, they found that all bacterial pathogens were highly inhibited in a dose-dependent manner, increases in the inhibition zones were observed with an increase in the amount of AgNPs. The bacterial pathogens like Pseudomonas. Aeruginosa was more susceptible to AgNPs followed by Klebsiella, Pneumoniae and E. Coli, the food-born pathogen Listeria. monocyogenes was less susceptible to the AgNPs, overall, the gram negative bacterial pathogens were highly suppressed by the AgNPs compared to gram positive bacterial pathogens, that probably due to the thick cell wall of gram positive bacteria, which are generally composed of a three-dimensional thick peptidoglycan (PG 20-80nm) layer compared to that of gram negative bacteria (~7-8nm), the PG layer possesses linear polysaccharide chains cross linked by more short peptides and thus forms a complex structure which makes it difficult for AgNPs to penetrate gram positive bacteria, also Jitinnan, et al. was observe that oral film of herbal extract which contain different concentration of pullulans showed antimicrobial activity against Streptococcus mutans, Streptococcus sanguis and Porphyromonas gingivalis, while Wagner, et al. explain that A. pullulans solution with different concentrations was very active against grey mold Botrytis cinerea and Monilia fructigena. On the other side, Premanathan, et al. was refer to killer toxin form S. cerevisiae as a active agent for inhibition of C. Albicans and Veesinia ruckeri, also, all of Aziz, et al. & Aziz, et al. observe that crude extract and purified killer toxin form S. cerevisiae was active antimicrobial against E. Coli, Salmonella enterica, S. Typhimurium, Shigella flexneri & Shigella sonni, while, Alsoufi observed the effect coating of pullulans, which production from locally isolate Aureobasidium pullulans on growth of Bacillus subtilis, Staphylococcus aureus, Escherichia coli and Salmonella typhimurium, it was 63, 65, 70 and 75% for respectively.

Weight loss and spoilage

The main problem in fresh fruits and vegetables are turnover on the markets is softening that caused by the natural process of maturation and water loss, this changes are considered undesirable by consumers. Weight loss in fresh fruits and vegetables caused a short shelf-life and loss of economic value, additionally, this parameter has a strong impact on the appearance, due to shrinkage, both temperature and storage time contributed to increase weight loss. Storage at 16°C reported higher weight loss than storage at 6°C, polysaccharide coatings exhibit high barrier properties toward oxygen, the rate of oxygen transfer through pullulans films is lower compared to polypropylene and polyethylene films, this enables the formation of pullulans coatings to reduce the rate of fruit and vegetable respiration. So many researches discuss this important parameter.

Results of Alsoufi showed the weight loss for uncoated and coated peach with 10 and 20% pullulans water solutions which production from locally isolate Aureobasidium pullulans that storage at 25°C for 21days, the percentage of weight loss of uncoated peach was 3.2, 4.8, 6.1, 7, 7.2, 8.3 and 9.1%, Values of weight loss in coated peach with 10% pullulans were 2.9, 4.5, 5.8, 6.2, 6.8, 7.9 and 8.9%, while values in coated peach with 20% pullulans were 2.9, 3.8, 4.1, 4.6, 5.8, 6.4 and 7.6% when stored for 3, 6, 9, 12, 15, 18 and 21 days respectively, while the results of weight loss for uncoated and coated peach storage at 4°C for 10days showed the percentage values of weight loss for

Citation: Alsoufi MA, Aziz RA. Extending shelf life of fruits by using some microorganisms biological products. Int J Mol Biol Open Access. 2017;2(5):141–144. DOI: 10.15406/ijmboa.2017.02.00032
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Saccharomyces (baker's yeast) and Aureobasidium pullulans (bakery yeast) and Pullulan which produced from Aureobasidium pullulans lead to inhibition of microorganisms growth that is responsible for spoilage of fruits and it is very active for reduce weight loss in fruits during marketing which Leading to extending the shelf life of fruits.

Acknowledgements
None.

Conflict of interest
Author declares that there is no conflict of interest.

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