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Fresh-cut fruits and vegetables: scope in developing countries and approaches to improve quality and safety

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Abstract

Consumption of fresh-cut fruit and vegetable is expanding worldwide mainly due to convenience in use and their health goodness like decrease in the threat of cardiovascular disorders and cancer. There is a rapid expansion of demand of these commodities attributable to the busy lifestyle and improved procuring capacity of the customer. Now with the rising awareness of consumers with these kinds of commodities, advance study is necessary to extend ample techniques to processors in an effort to promise safety even though retaining the sensory and nutritional aspects of the end products. To ensure consumer's acceptability and achievement of the product it is crucial to study and also maintain certain key factors of fresh-cut fruit and vegetable produce i.e., texture, flavor, color, and the nutritive value. So, considering the enormous possibility and advantages of fresh-cut products, this paper provides an informative review on various methods to enhance the serviceable life and curtail the threat of intoxication while consumption.

Keywords: Fresh-cut fruits and vegetables, quality, safety, minimally processing, developing countries

Introduction

Fresh-cut fruits and vegetables are the power pack source of vitamins, dietary fiber and minerals which are considered vital in human nourishment. They also help in retaining the health and minimize the probability of cardiovascular disorders, stroke, cancer and additional chronic disorders as it contains many phytochemicals for example phenolic compounds, antioxidant and carotenoids. Fresh-cut products, as the name indicates, always remain fresh and ready to eat or cook in a raw and even processed state. Being enriched with dietary fibres, minerals, carbohydrates and vitamins, these comprise an essential portion of our day-to-day diet. Their significance is being acknowledged increasingly in advanced countries with the aim for minimizing the rising of the diseases related with the modern life style. Any physical modification done on fresh fruit and vegetable like cleaning, peeling, cutting, trimming which are then subsequently pre-packed and refrigerated, making the product 100% edible is said to be fresh-cut or minimally treated fruits and vegetables (IFPA, 2000) [11]. These are accessible to the consumers as a direct and instant intake without any requirement for additional preparation or alteration (Rojas-grau *et al.*, 2007) [17]. Consumers usually procure fresh-cut products not only for suitability, nutrition, freshness, safety and the eating skill but even saves food preparation time and does not generate waste material. Apart from being 100% consumable, it subsequently decreases the labor requirement for home produce and also curtails the burden of waste disposal.

The sales and intake of fresh-cut commodity has risen up in current years because they save time, space, manpower, equipment and are convenient to use. Several organizations for example the United States Department of Agriculture (USDA), World Health Organization (WHO), European Food Safety Authority (EFSA) and Food and Agriculture Organization (FAO) suggest expanding the intake of fruits and vegetables which can lessen the chance of cancer and cardiovascular diseases (Allende *et al.*, 2006) [1]. And answering to this demand, the food industry has evolved with an innovative idea of product development like fresh-cut fruits and vegetables with novel output techniques, creative application of technology and skillful promotion initiative (James *et al.*, 2010) [13].

There is a requirement of skillful processing techniques of fresh-cut fruits and vegetables to preserve and protect the produce as they are extremely perishable. Various processing

approaches are used to prolong the safety and to increase the serviceable life of the commodities. The factor which determines the acceptability and success of fresh-cut fruit and vegetable are flavor, texture, color, and nutritional value and also enhances the scope of minimally process commodities in the market.

Scope of Fresh-Cut Fruits and Vegetables in Developed and Emerging Countries

Fresh-cut commodity is the prime rapid budding food categories in U.S. superstores. The requirement of fresh-cut commodities is also increasing as a healthier preference from the means of different fast food sectors. The fresh-cut manufacturing is growing in various European nations with the United Kingdom, France, and Italy as share pioneers. Currently, the nations with higher advancement in the fresh-cut commodities are Germany, Netherlands, Spain, United Kingdom, Belgium and Netherlands. In the nations of Eastern Europe, they are starting to see incredible development in this sector (Rojas-Grau *et al.*, 2011) ^[18].

In the above stated developed countries, fresh-cut fruits and vegetables are developed at the industrial segment but in India and other such developing countries, the production is yet small scale. Now with the rising awareness in these varieties of commodity, there is a massive opportunity of fresh-cut commodity in the emerging countries. Small scale industry also imparts a significant share in supplying packages for fresh-cut commodities to the developing countries as per the demand by the consumers for ready-to-use products. Small scale businesses and small vendors are the fundamental distributors of fresh-cut commodities in most emerging nations. With the advancement of innovative products, scope for the yield of fresh-cut commodities is increasing as same level of growth is anticipated in emerging countries in near future as it is marked in the developed nations.

Techniques Involved in Standard and Safety of Fresh-Cut Products

The main target of the food industry should be the protection of fresh-cut commodity as far as safety and quality. This section will throw certain light on those various techniques which are used to upgrade the standard and safety of these commodities in an effort to lessen the chance of contamination and intoxication while consumption.

Washing

The foremost technique which affects the safety and standard of fresh-cut commodity is washing. Washing is done using water or with a sanitizing medium to discard of the cell exudates, pesticides residue, and spoilage microorganisms but not adequate to promise the safety of the amenity because various pathogens still persist and spoil the products (Gil *et al.*, 2011) ^[8]. It is observed that reusing the water while washing may give an adverse effect on the process (Allende *et al.*, 2008) ^[2]. So as to surpass this problem, it is mandatory to sterilize the water which consists treatment of the process water, with an intention to neutralize viruses, pathogenic microorganisms and fungi and to avoid the microbial defilement to the products (Gil *et al.*, 2011) ^[8].

Organic Acids

The expansion of degrading microorganisms and pathogenic species can be prevented by utilizing organic acids in fresh-cut products. Growth of almost all pathogens retards at pH levels lower than 4.5. Fruits contain numerous organic acids

for example succinic, citric, tartaric, malic, sorbic, benzoic and acetic that may inhibit the proliferation of bacteria. Certain fruits like pineapple and melon, and almost all vegetables, have lesser concentrations of organic acids and the pH is not below 5.0 and hence cannot promise the microbial safety. Ascorbic and citric acid are the commonly used organic acids in the dipping solution of fresh-cut fruits to decrease the microbial defilement and, consequently of their antioxidant properties, prevent from any oxidative reaction and browning (Rico *et al.*, 2007) ^[16].

Calcium Treatment

Calcium helps in retaining the textural firmness which is also considered as a significant standard attribute of the fresh-cut produce. The calcium ions create cross-links, or bridges amongst free carboxyl classes of the pectin chains, which assists in firming of the cell wall. A most calcium treatment given to boost tissue rigidity of fruits and vegetables is by simply dipping it in calcium solution. Calcium lactate shows an effective result as the chloride which does not develop a bitter taste at greater concentrations (Luna-Guzman & Barret, 2000) ^[15]. Besides providing firmness, calcium treatment also leads to the improvement in color, reduces respiration rate and lessen moisture loss (Lamikanra & Watson 2004) ^[14].

Ozone Treatment

Ozone is a significant antimicrobial and sporicidal specialist (Singh *et al.*, 2002) ^[19]. Ozone is considered as the furthestmost functional sanitizers, where non-toxic product leads to an impulsive decomposition (Gras *et al.*, 2003) ^[10]. Ozonized water is extensively utilized as sanitizer and successfully extends the serviceable life of fresh-cut commodity. Ozone has been acknowledged as GRAS by FDA as antimicrobial agent for the usage on raw and fresh-cut commodities in aqueous and gaseous phases.

Irradiation

Irradiation of fresh-cut fruits and vegetables is worthwhile in lessening the bacteria populations. The consequence of irradiation is not just for the surface level, but it probes into the commodity and eliminates micro-organisms existing in the food products. In-fresh cut products; microbes and pathogens can be remarkably checked by low-dose irradiation without influencing sensory attributes (Irtwange, 2006) ^[12]. The irradiation of fruits and vegetables is legalized by US-FDA to an utmost of 1kGy for sterilization. It is a favorable technology used to enhance the safety and standard which also includes protecting the color and textural parameter of fresh-cut minimally process products (Boynton *et al.*, 2006) ^[5].

Low Temperature Storage

Freshness and deterioration of the fresh-cut products can be effectively controlled through temperature. Fresh-cut produce have the possibility for losing a remarkable proportion of weight because of its greater surface area, especially at higher temperatures. Hence, storing it at low temperatures is considered to be most extensive method for lengthening the serviceable life and retaining its standard and safety (Toivonen & Brummell, 2008) ^[20]. Storage of fresh-cut commodity between 0-10°C lessens the chance of bacterial and fungal growth by keeping the harmful microorganisms at bay (Dea *et al.*, 2010) ^[7]. Furthermore, it is witnessed that storing fresh-cut fruits at lesser temperatures of 5°C is very helpful in delaying the microbial growth, prevents the loss of

firmness and preserves the sensory standard (Allong *et al.*, 1999) [3].

Modified Atmosphere Packaging (MAP)

Modified atmosphere packaging (MAP) reduces the respiration rate and delays senescence, hence extending the serviceable life of the fresh-cut commodities. The fundamental concept in MAP can be reflected in two attributes i.e., selection of appropriate permeable packaging medium and provision of creating suitable extent of carbon dioxide and oxygen interior of the package. The basic purpose of this principle is to build optimum gas equilibrium within the package, lowering the respiratory rate of a commodity while retaining the percentages of carbon dioxide and oxygen which are beneficial to the commodity (Rico *et al.* 2007) [16].

Moderate-Vacuum Packaging (MVP)

Moderate-vacuum packaging (MVP) is a significant technique for improving the standard of fresh-cut commodities. In this technique, fresh-cut product is enclosed in a firm, sealed package under 40kPa of atmospheric pressure and retained at refrigeration temperature of 4-7°C. The initial gas composition is that of normal air 0.03% CO₂, 21% O₂, and 78% N₂ but at a reduced partial gas pressure. The standard of the amenity can be retained by lowering the O₂ content which also stabilizes the metabolic activity and lowers spreading of degrading microorganisms (Gorris & Peppelenbos, 1999) [9].

Active Packaging

Active packaging is another vital packaging technique which utilizes various emitters and gas absorbents for fresh-cut fruits and vegetables which directly affects the plant hormone activity, microbial activity and respiration activity of the packed products. The usage of an active system, with a package engineered to scavenge molecules as O₂, CO₂ and ethylene finds good applications in fresh-cut sector. The best significant O₂ scavengers are built on the oxidation of ferrous ions; other active agents are unsaturated fatty acids, ascorbic acid, and enzymes (Brody *et al.*, 2001) [6].

Edible Films and Coatings

Coatings and edible films are amongst the finest possible techniques for prolonging the serviceable life of fresh-cut commodity. As the term depicts edible coating and films are layers of thin materials which are consumable. Simple and eco-friendly methods of edible films and coating can postpone the color change and water loss, improve appearance, retard ripening and reduce decay in fresh fruits and vegetables. Extensive study has stretched the usage of coatings and edible films for a collection of food products which includes fresh and minimally processed commodities in an effective way. The major dissimilarity among coatings and films is that, coating can be directly applied on the product surface while films are smeared after being formed distinctly. The main aim of edible films or coatings is to constrain moisture, gases, or any additional solute migration and enhance the standard as it reduces the decay and acts as a bearer for food additives like antimicrobials or antioxidants (Bett *et al.*, 2001) [4].

Future Research Prospects to Improve Standard and Safety of Fresh-Cut Products

The upgrade of fresh-cut commodity involves the suitable blend of skills for promoting the serviceable life of the commodities, sustaining the sensory and organoleptic attributes and achieving the microbial safety of the

commodity. Numerous researches have been done but much analysis is yet to be done to develop high standard and microbiologically safety fresh-cut products. A feasible shelf-life of 7-8 days is likely to attain at refrigeration temperatures. Fresh cut commodity can be kept at different temperatures to get better standard and increased serviceable life. The equipment employed in minimal processing, like peeling and shredding, needs further development with the aim of processing products in a better way. Hurdle technology is necessary to be studied and implemented specifically for different fresh cut products. Development of more and improved permeable plastic films matching the respiration rate of the commodities i.e., fruits and vegetables can be done which also include studies on active and MAP packaging for ensuring an increased serviceable life of minimally treated fruits. Researches should be put forward to check out the potentiality of edible coatings as future packaging materials for the fresh-cut products. Further, superior innovative technologies must to be investigated in an effort to obtain fresh-cut products of decent quality. At current scenario, maximum practices utilized in the minimal processing of fresh-cut commodity are being performed at a laboratory scale. However, additional research requires focusing on commercial scale so that more realistic information is achieved with the intention of resolve current concerns that limit the standard and serviceable life of fresh-cut commodity.

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