Chapter 1
Minimally Processed Foods: Overview

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1.1 Introduction

Over the past decades, consumers want fresh like foods with their natural nutritive values and sensory attributes, such as flavor, odor, texture and taste (Huxley et al. 2004). Fresh fruits and vegetables are the good examples of convenient foods. This growing consumers' demand of minimally processed foods with no or lesser synthetic additives pose challenges to food technologists (Siddiqui et al. 2011). In addition, demand of functional foods to prevent or control of diseases are growing (Monteiro et al. 2011). All these demands force to develop safe foods with minimal processing techniques (Gilbert 2000). This is not a simple task to produce safe minimally processed foods with desired shelf-life.

Minimally processed foods can be kept safe with partial or minimal preservation treatment. In addition, it results fewer possible alterations to the food quality (Ohlsson 1996). Therefore, the fresh cut fruit and vegetable industry is working continuously on diversity of minimally processed products to meet the needs of the consumers (Ragaert et al. 2004). The minimal processing caused minimal influence on the quality attributes during their storage or shelf life (Allende et al. 2006; HuisIn't Veld 1996; Marechal et al. 1999). In food processing the term mild technologies is

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M.W. Siddiqui, M.S. Rahman (eds.), *Minimally Processed Foods*,
Food Engineering Series, DOI 10.1007/978-3-319-10677-9_1

also used to express the technique which allows minimal physicochemical, oxidative and mechanical damage to the food products. The aims of minimal processing are as follows: (i) to make the food safe chemically and microbiologically, (ii) to retain the desired flavor, color and texture of the food products, and (iii) to provide convenience to the consumers.

1.2 Purposes of Minimal Processing

The purposes of minimal processing are included in the Table 1.1 (Dharmabandu et al. 2007; Monteiro et al. 2010; Ohlsson and Bengtsson 2002). Overall the purpose is to prepare ready meals easily and quickly. The advantages of minimally processing are (1) convenience in terms of easy and quick preparation of meals, (2) low severity of the processing methods (i.e. most of the cases it uses multi-hurdles or multi-preservation methods), (3) maintain quality as fresh or close to the fresh prepared meals or products, (4) maintain products' nutritive values, (5) provide varied shelf-life depending on the types and severity of preservation hurdles used.

1.3 Applications of Minimal Processing

1.3.1 Plant Based Minimally Processed Foods: Fresh Fruits and Vegetables

Minimal processing can be broadly divided into two categories: first one is based on plant source, such as fruits and vegetables, and another one animal based, such as meat, fish and sea foods. In addition, other categories (i.e. combinations of different sources) are also appearing in the market, such as part-bread, ready-meal, cook-chill, cook-freeze products. The fruits and vegetables are composed of fragile tissues,

Table 1.1 The purposes of minimally processed foods

Minimally processed foods
• Include all the operations (sorting, washing, peeling, slicing, etc.) that must be carried out before blanching in a conventional processing line
• Include value addition, such as chopping, husking, coring, low level irradiation, and individual packaging
• Maintain quality attributes similar to those of fresh products (i.e. fruits and vegetables) or similar to the products' characteristics when consumed (i.e. part-bread, cook-chill, cook-freeze, sous-vide, ready-meal)
• Include procedures that cause fewer possible changes in the foods' quality (keeping their freshness appearance), and provide enough shelflife to transport it from the production site to the consumer

which need to be handled with care in order to prevent damages during processing and the damages can result spoiled fruits and vegetables. It needs to protect from initial microbial contaminations. Therefore, it is important to use the guidelines to maintain its quality.

The shelf life of fruits and vegetables is largely depicted from the perseverance of sensory parameters. The fruits and vegetables are prone to microbial spoilage since these are composed of enzymes, pectin and near acidic pH, and high water activity (González-Aguilar et al. 2010). Therefore, harvesting, processing, packaging and storage should be carefully guarded in order to maintain the quality. More regulations and guidelines need to be clearly defined. Microbes as *Staphylococcus aureus*, *Clostridium perfringens*, *Escherichia coli*, *Campylobacter jejuni*, *Clostridium botulinum*, *Listeria monocytogenes*, *Salmonella* spp. are concerned for the major damages. Therefore, standard requirements should be followed for grading, sorting, washing, peeling, chopping and shredding. It is important to avoid harsh washing and to use disinfectants during washing. The quality of the products depend on these treatments. The major enzymes present in these perishable products are polyphenoloxidase, polygalacturonase, lipooxygenase. These play an essential role in initiating the oxidation process. They are also responsible for the spoilage in the cases of cut surfaces for diced or sliced fruits and vegetables. In the cases of products with pH higher than 6, there is more possible growth of microbes since cut surface is exposed to air and invites bacteria, yeasts and molds. Minimally processed fruits and vegetables are not allowed to have heat treatment abuse and they must store at 4–7 °C chilled storage. The followings are important to maintain:

- Careful selection of cultivars, appropriate pre- and post-harvest condition, and maintain chill storage conditions.
- Abiding HACCP guidelines.
- Maintenance of hygiene.
- Maintain low temperature in the processing area.
- Maintain washing with flow of water and mild acids.
- Tender cutting, peeling and shredding.
- Preventheat abuse for retarding browning and oxidation.
- Keep the pH 5 or less than 5 throughout the controlled processing.
- Adequate chilled conditions for storage and distribution.
- Use vacuum packaging.

1.3.2 Animal Based Minimal Processed Foods: Meat and Sea Foods

Recently, non-thermal processing, such as high hydrostatic pressure, pulsed electric fields (PEF), oscillating magnetic fields, use of irradiation, use of natural antimicrobials are being applied animal based food products (i.e. tender meat, fish, and sea foods). These treatments can keep the texture, flavor and taste alive without any detrimental effects to their tender tissues. Sea foods are more prone to the attack of micro-organisms. Therefore, combination of minimal processing techniques can create wonder for inactivating the microbes on one side and maintain nutritive values.

The qualities of animal-based food rely on the desired flavor, taste, color, and odor by the consumers. The typical spoilage of seafood and meat occur by denaturation of their proteins, which further involve the dissociation of their structures, protein aggregation, and protein gelation (Cheftel 1995). Furthermore, denaturation depends on the internal and external factors. Examples of external factors are temperature, and internal factors are pH, and enzymes. The spores are difficult to kill using minimal processing of hydrostatic pressure. However, combination of heat and non-thermal techniques along refrigeration storage can result into the convincing strategy. High hydrostatic pressure has seemed to work well with surface property of fish and meat and preserved the texture and appearance to the acceptable limits.

1.4 Quality and Safety of Minimally Processed Foods

The types of minimally processed foods are given in Table 1.2. The first category of plant based products are: fruits and unsweetened fruit juices, vegetables as roots, tubers and beans (fresh, frozen, dried), legumes, grains, seeds, and nuts.

Table 1.2 Types of minimally processed foods

Plant based products				Animal based products	
Fruits	Vegetables	Legumes	Extracted foods	Milk	Poultry/ fleshy
Chilled	*Peeled and Slices*	Peas	Sweeteners	Pasteurized	Eggs
Peech	Potato	*Whole pulses*	Starches	*Fermented milk*	Dried meat
Mango	Carrot	Black gram	Oils	Curd	Frozen meat
Strawberry	*Shredded*		Nuts	Yoghurt	Fish
Sliced	Cabbage		Seeds	Probiotic drinks	
Mango	Lettuce		Grains	Cheese	
Pineapple	Spinach		Herbs infusion		
Apricot	*Diced*		Tea		
Orange	Onion		Coffee		
Guava	Broccoli florets				
Melon	Cauliflower				
	Roots				
	Tubers				
Frozen					
	Beans				
	Peas				

These products are subjected to varied processing steps. Second category includes: extracted form from plant source foods, such as starches, sugars, oils, and cereals, sweeteners, herbs, tea, coffee.

In the case of fresh cut minimally processed fruits and vegetables, elevated respiration and transpiration rates result water loss from the plant tissues. This decreases the firmness of treated products (Hui et al. 2006). The usage of chlorine in the processing can have the devastating effects. They tend to form carcinogenic derivatives in water, therefore, these encompasses the need of alternative disinfectant (Tripathi et al. 2011). The calcium used to extend the shelf life of fruits and vegetables reacts with pectins present in the cell walls of fruits and vegetables and form the salts like calcium pectate.

Animals based minimally processed foods are: fresh and pasteurized milk, fermented milk as yoghurt, cheese, probiotic drinks, dried and frozen meat, fish, poultry and fish. Several methods are currently available for the extension of shelf life in minimally processed foods (Table 1.3). Consistent interest in the mild preservation fosters the development of multidimensional preservation proposition.

Table 1.3 Methods available for shelf-life extension of minimally processed products

Method(s)	Example(s)	Target	Advantage(s)
Acidulants	Citric acid	Enzymatic browning	Cheap and available from natural sources
Antioxidant	Ascorbic acid	Enzymatic browning	Cheap
Preservatives	Sulphite	Enzymatic browning	Cheap and highly effective
Antiomicrobials	Hypochlorite	Microbial contamination	Cheap
Modified atmospheric packaging	Low oxygen atmosphere	Metabolic response, Enzymatic browning, Microbial colonization	Effective for prevention of deterioration resulting from several factors
UV-light	UV-C	Microbial contamination	Effective surface sterilization
Essential oils	–	Enzymatic browning, Microbial colonization	Highly effective, Natural products
Plant growth regulator	6-benzylaminopurine	Metabolic response, Enzymatic browning, Water loss	Effective for prevention of deterioration resulting from several factors

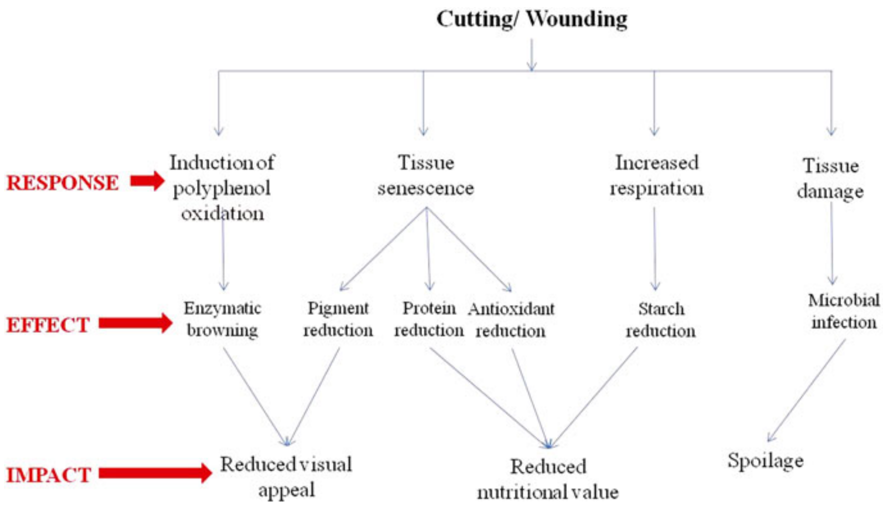

Fig. 1.1 Wounding or cutting consequences in minimally processed products

1.5 Impact of Minimal Processing on Quality of Food Products

The quality aspects of minimally processed products play an important role in marketing and securing consumer acceptance. Sensory appealing is one of the major factors for the freshness and organoleptic characteristics. These parameters include appearance, shape, color, flavor, textural quality as firmness, toughness, moistness and juiciness, and crispiness. Similarly the devoid of cut surfaces, avoid discoloration and fluid leaking from the tissues. The cutting or wounding of minimally processed products renders them vulnerable to microbial infection and enzymatic browning with higher metabolic activities (Fig. 1.1).

The above factors largely depend on the composition and nutritional components. The available phenolic compounds and colored pigments render antioxidant activity. Tissue sensitivity is also a delicate issue of the fresh fruits and vegetables as it can be the source of microbiological spoilage activity (Hodges and Toivonen 2008). Tissue softening is also resulted from the wounds and ripening of the plant based foods (Toivonen and Brummell 2008).

Sensory parameters, such as flavor, sweetness, sourness, acidity, astringency, bitterness largely depend on the post harvesting operations and maturity at the harvest (Bai et al. 2004). However, postharvest parameters are not clearly related to the presence of flavor compounds. It is mainly dependent on the metabolic and physiological process at the maturity of fruits and vegetables (Rico et al. 2007). Furthermore, proper sanitation, storage and transportation conditions (i.e. temperature and humidity) need to be considered (Plotto et al. 2006). Therefore, contamination in the raw products and attached during minimal processing determines the shelf life.

1.6 Impact of Minimal Processing on Nutrition Contents

In addition to sensory attributes, nutritional and health functional components also determine products' key quality parameters. These further rely on the climatic conditions, harvesting operations, and methods of harvesting as well as the processing steps used, such as cutting, shaping, packaging, speed of operations as churning, cooling, and mixing. Functionality of the treated products is largely dependent on the bioactive compounds and antioxidant capacity. Other important factor of the post processing is the packaging techniques. The appropriate compositions of carbon dioxide or oxygen during modified atmosphere packaging avoid unfavorable changes (Goswami and Mangaraj 2011).

1.7 Concept of Hurdle Technology

The multi-hurdle approach is the most feasible and reliable for controlling the microbial growth and it ensures the minimum reduction of food quality. Hurdle technology uses combination of preservation methods and it provide desired safety of the food products (Leistner 2000). Applying hurdle technology by coupling of pasteurization and blanching can result in complete eradication of the microorganisms. Further hurdle could be applied by refrigeration and it can further reduce chemical reaction rate. There are other potential hurdles to enhance preservation, such as reduced water activity, and lowered pH. These could be applied by adding agents, such as glucose, fructose, sodium, potassium chloride, and citric acid, tartaric acid, and benzoic acid. In addition to chemical agents, preservatives in the form of sorbates, propionates, sodium benzoate can be added for preventing the growth of pathogens. Therefore, combined techniques strengthen the efficiency of the treatment and improve quality. Moreover, it results economic gain in terms of energy, money and time. This technology has been shown promising results on sliced apple, mango, banana puree, plum, strawberries, tamarind, and passion fruit.

1.8 Fresh-Cut Fruits and Vegetables

1.8.1 Washing, Peeling, and Slicing of Fresh-Cut Fruits and Vegetables

The appearance, taste, color and texture of fresh cut fruits and vegetables are the most appealing attributes to the consumers. Fresh cut products are presently in the great demand in the Europe and North America. Fresh-cuts are preferred products due to their benefits (1) convenient to consumers, (2) available at different portion sizes,

(3) reduced labour in preparation before consumption, (4) retained nutrients and fresh aroma. All these factors are contributing to the tremendous growth of fresh-cut industry in the global markets.

Fresh-cut fruits and vegetables need to be stored in chilling conditions at around 0–5 °C. The techniques used for the processing of fresh fruits and vegetables as canning, drying, steaming do not play an essential role for enhancing the shelf life of fresh products (Kader and Mitcham 1995; Beaulieu and Gorny 2001). The limitations related to the stability of the fresh-cut products are desiccation, microbial spoilage, browning of tissues, discoloration, development of off flavour and taste. The consumers always look at these quality aspects prior to purchase.

Processing of fresh-cut fruits and vegetables require preparatory steps, such as washing, peeling, shredding, cutting. These steps result cuts, bruises and injuries to internal tissues and can cause desiccation and wilting as well as microbial and enzymatic spoilage. These injuries fasten the respiration rate, which further triggers the increased production of ethylene, senescence, and enzymatic browning.

1.8.2 Operations Affecting the Quality of Fresh-Cut Fruits and Vegetables

Most of the fresh produce requires the processing operations in order to produce the products (Siddiqui et al. 2011). These are discussed below:

1. Sorting: Sorting is the preliminary step for segregating the acceptable and non-acceptable products. It is done to remove the physiological defects from the produce. Commonly, manual sorting results in high quality results in comparison to sorting by equipment in terms of peculiar minute defects.
2. Peeling: It is one of the common operations used for fruits, such as apple, sapota, and citrus fruits; and for vegetables, such as carrots and onion. Methods used for peeling directly influence the quality parameters of the final products (Cantos et al. 2001). Peeling is usually carried out by hand or by abrasive peelers. Hand peeling provides the high quality product but often leads to expensive labour. However, abrasive peelers are also used for producing fine quality products, but they tend to damage the fresh products by causing scaring on the surface and edible portion can also be damaged.
3. Cutting: The unwanted parts of the plant based foods, such as seeds and stems need to be discarded before further processing. Therefore, trimming of the unwanted parts with eroded knives, cutters can pose a threat to the quality. The cutting tools should be cleaned and stored under good conditions. In addition, the overripe area or contaminated area should be discarded during initial sorting in order to prevent the growth of microbes and to avoid contamination of other infecting agents.

1.8.3 Factors Affecting the Washing of Fresh-Cut Fruits and Vegetables

Washing is an important step for minimally processed fruits and vegetables and the following factors need to be considered:

1. Washing: Proper washing of fresh cut fruits and vegetables is the utmost desired immediately after cutting. This step removes the dirt and some microbes present on the surface of products. Usually chlorinated water is used for rinsing the peeled fruits and vegetables. Therefore, the contact time during washing, pH and temperature of the rinsing water play a key role for assuring the quality of products (Sapers 2003).
2. Contact time: The contact period needs to be consider for an effective operation. Generally, chilled water is required for rinsing the peels and fresh-cut fruits and vegetables. Thus it is one way to cool the products before further processing and their packaging.
3. Temperature: Temperature needs to be controlled for avoiding the spoilage at preliminary step. It should be maintained at around 0 °C.
4. Chlorination: Optimum concentration of chlorine needs to be used. The concentration of chlorine should be kept between 50 and 100 ppm. However, higher concentration of chlorine can affect the quality of the peeled fruits and vegetables. Proper kits for chlorine testing should be used for controlling chlorine level in water.
5. pH: Optimum controlled pH is required for maintain the bactericidal activity of chlorinated water. If the pH rise above 7.5, the antibacterial effect would be vanished and spoilage of the products can occur due to microbial growth.

1.9 Packaging Technologies for Minimally Processed Foods

Tremendous progress has been made in the modified atmosphere packaging of fresh fruits and vegetables (Marsh and Bugusu 2007; Alzamora et al. 2000; Devlieghere et al. 2004; Al-Ati and Hotchkiss 2003). As oxygen is a prerequisite for the aerobic microorganisms' growth and replacing it with gases, such as carbon dioxide can hinder the growth of organisms. However, optimum gas compositions need to be used for each product. The use of antimicrobial packaging is a new trend (Ayala-Zavala and González-Aguilar 2010). These antimicrobial substances in packaging are released to the food product during storage, which prevent the undesirable growth of micro-organisms on the surface of food (Vermeiren et al. 2002). There are different ways of adding these antimicrobials to the food product. Either they can be incorporated as a sachet inside the packaged or surface of the packaged can be coated with the antimicrobial compounds (Ayala-Zavala et al. 2008). In addition, silver nanoparticles are coated in non-edible films and could be used.

However, WHO and European legislations need more studies before their usage in food products. The spraying of antimicrobials on the product can prevent the microbial growth and can provide improved shelf life.

1.10 Minimal Processing Techniques

The thermal treatments, non-thermal treatments, low temperature storage, applying new packaging techniques, and treated with natural antimicrobials alone or in combination are commonly used for minimally processed foods.

1.10.1 Thermal Methods

Thermal methods are can inactivate the lethal organisms and enzymes. It can form aromatic and flavor compounds. However, heating can also destroy the sensitive components like vitamins and health functional compounds (Bansal et al. 2014). Thus, optimum heat treatments can make the food microbiologically safe and nutrient enriched. High temperature short time (HTST) can be used to achieve the target.

1.10.2 Coupling with Non-thermal Methods

Non-thermal processing techniques are emerging in the food industry. These techniques are extended their potential to food preservation with limiting losses of the nutritional and sensory characteristics. These are high hydrostatic pressure, pulsed electric fields, high intensity pulsed light, pulsed white light, high power ultrasound, oscillating magnetic fields, irradiation, and microwave processing. All these techniques have provided a reliable alternative for processing of liquid foods, such as beverages, juices, soups, purees along with solid whole fruits, vegetables and packaged foods. Numerous reports have been published on the high hydrostatic pressure and pulsed electric fields for inactivating the lethal micro-organisms and enzymes. Apart from their microbial inactivation, these are used to extract bioactive compounds, such as polyphenols, flavonoids, hydroxycinnamic acids and. These are termed as non-thermal methods and temperature of processing remained within 30–55 °C. The low temperature safeguards the heat labile components, such as vitamin C, and pigments (e.g. carotenoids).

Pulsed electric fields The concept of treating foods with pulsed electric fields was introduced in 1960. Initially the technique was confined to kill microorganisms with optimized parameters such as electric field, pulse shape, pulse width and treatment time.

In PEF processing, food products are subjected to a high voltage electrical field such as 20–70 kV/cm for a few microseconds.

Earlier the principle of electroporation was proposed stating puncturing the cell membrane of the organisms. Afterwards, PEF was tested on the juices instead of the buffer solutions to inactivate the microorganisms and to have the increased shelf life of fruit juices. PEF technology inactivates or kills a number of vegetative bacteria however; it is not effective to inactivate the spores at ambient temperatures (Yousef and Zhang 2006; Park et al. 2014). During the last decade, the new scope of PEF has been evolved for enhanced mass transfer. PEF was advanced for inactivating or killing of organisms in the juices to an accepted level, and it was diverted to apply for retaining the nutritional parameters. Since PEF is one of the non-thermal processing techniques, the temperature remains between 30 and 50 °C that enables the significant retention of nutrients. There are several reports, which described the potential of preservation or pasteurization of a variety of liquid foods; however, it still seems premature to recommend its use in fresh cut fruit and vegetable products.

A few recent studies have also been carried to assess its effect of PEF on retaining the quality meat products. For example, O'Dowd et al. (2013) compared the impact of PEF [(electric field strength: 1.1–2.8 kV/cm; energy density: 12.7–226 kJ/kg), frequency (5–200 Hz) and pulse number (152–300)] and conventional treatments on quality characteristics of post rigour beef muscle. They reported that some PEF treatments increased weight loss and affected the size of myofibrils. In some cases, the PEF induced reversible changes in cell membranes, however, did not affect the instrumental texture profile of beef.

High pressure processing (HPP) It is also referred to "high hydrostatic pressure processing" or "ultra-high pressure processing", in which the elevated pressures (up to 600 MPa), with or without the addition of external heat (up to 120 °C), is used to achieve microbial inactivation or to alter food attributes (Park et al. 2014) without affecting flavor compounds and vitamins. It is mainly based on the inactivation of the microbial and enzymatic spoilage by exerting pressure. High pressure induces stress on the membranes and prevents them to come in their active state (Toepfl et al. 2006). However, the microbial resistance to pressure varies significantly as per the range of the applied pressure and temperature, treatment period, and types of microbes. Various food products such as jams, jellies, fruit dressings and sauces, toppings, yoghurt, and grapefruit, avocado and orange juice are subjected to HPP (Pasha et al. 2014). It also effects texture of the foods and various researchers are in the process of overcoming hindering aspects in order to make usage of the HPP technology (Hayman et al. 2004). Interestingly, HHP is used to restructure the food proteins and it results in denaturation, aggregation or gelation of the protein.

As discussed earlier, the microbial infection and enzymatic browning have been identified as major challenges in fresh cut processing, which directly influence the consumers' acceptance. A recent review on effect of HPP on quality-related enzymes in fruit and vegetable products revealed that HPP inactivates vegetative microbial cells at ambient temperature conditions without affecting the nutritional and sensory qualities. Enzymes such as polyphenol oxidase (PPO), peroxidase (POD), and pectin methylesterase (PME) are highly resistant to HPP and are at most partially inactivated under commercially feasible conditions, although their sensitivity towards pressure depends on their origin as well as their environment. Polygalacturonase (PG) and lipoxygenase (LOX) on the other hand are relatively more pressure sensitive and can be substantially inactivated by HPP at commercially feasible conditions. The retention and activation of enzymes such as PME by HPP can be beneficially used for improving the texture and other quality attributes of processed fruit and vegetable products as well as for creating novel structures that are not feasible with thermal processing (Terefe et al. 2014).

A recent review on high pressure processing of fresh meat published by Ma and Ledward (2013) summarized the facts and figures of its use in meat processing that are (1) At about 200 MPa actomyosin denatures and at 400 MPa myoglobin denatures, (2) At about 400 MPa and above the lipids in meat become more susceptible to oxidation, (3) At 100–150 MPa and ambient temperature pre-rigor meat is tenderized, and (4) At 100–200 MPa post-rigor meat is tenderized as the temperature is raised to 60 °C.

Natural antimicrobials Although synthetic antimicrobial and antioxidant agents are approved in many countries, the use of natural safe and effective preservatives are in demand by the consumers and producers (Ortega-Ramirez et al. 2014). Therefore, many European and Asian countries are exploiting natural ingredients that can protect the food against the deterioration. There are a great number of natural antimicrobials derived from animal, plant, and microbial sources. The bioactive functional compounds known as secondary metabolites, obtained from plant sources, are considered as good alternatives to synthetic antimicrobial and antioxidant food additives (Silva-Espinoza et al. 2013; Ortega-Ramirez et al. 2014). These constitute polyphenols, tannins, and flavonoids, which are mostly derived from plants and their antimicrobial and antioxidant in vitro effects have been reported in many publications in the last decade (Manas and Pagán 2005; Inbaraj et al. 2010; Krishnaiah et al. 2011; Martins et al. 2013). The antimicrobial and antioxidant properties of bioactive molecules are mainly due to their redox properties, ability to chelate metals, and quenching reactive species of singlet oxygen (Krishnaiah et al. 2011). These compounds can be added to beverages, sauces, meat like pork, and fish to prevent their spoilage. Compounds can either be coated or sprayed on the food products for their quick absorption and action. It is also important to keep the desired sensory properties when additives are used (Skandamis and Nychas 2000). However, the selection of the plant sources to extract these compounds must be guided for the safe use of food additives. Some key issues must be considered during the application of these natural antimicrobial agents into food products. The form of the antimicrobial, the type of food, storage conditions, types of processes used, and the target microorganism(s) are some of the important factors that could affect the efficacy of these agents (Davidson et al. 2013).

1.11 Conclusions

In the era of modern technology and changing in consumers' demand shifted the food habits and consumption. Consumers inclined towards the food products, which have high nutritional values along with freshness, safety, and extended shelf life. In the near future, the minimally processed foods are to be engulfed the global markets. The introduction of latest and reliable technologies such as non-thermal treatments assists in minimizing the quality degradation of foods and making full usage of the available resources.

The market of minimally processed foods has grown rapidly in recent years due to the health benefits and convenience associated with these foods. Its growth has increased the awareness regarding microbiological and physiological aspects associated with the quality. The consumerism tendency depends on multi-factors as nutritional value, simplicity, safety, and convenience. All these characteristics must be considered in minimal processing. Minimally processed foods have formed the well-established market and engulf the capital investment. The various schemes of research and development targeting the agricultural products have been established that provides long life to short life perishable and improves the quality of short life foods.

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