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COMPARATIVE RESEARCH ON THE TECHNOLOGY AND EQUIPMENT USED FOR DECONTAMINATION BERRIES

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Abstract: *No matter how careful berries would be harvested, they will not have the physical-biological purity required for processing and for direct transmission to consumers. Therefore, various types of technology are applied in order to remove the foreign or degraded plant material, the mineral or organic impurities and even for the destruction of some microorganisms or germs, which shouldn't come in finished products.*
Keywords: *alteration, berries, decontamination*

1. INTRODUCTION

The specific conditioning technology for each plant should include operations that simultaneously satisfy the requirements of purity, keeping valuable items undegraded and minimal costs, so that the final product has the best characteristics at affordable prices. Important roles in this ensemble have the equipment used which must be continuously improved and adapted to the specific requirements of each plant [1].

2. TECHNOLOGY AND EQUIPMENT USED FOR DECONTAMINATION BERRIES

After harvesting, the berries are directed to a particular technological process according to the purpose of use, i.e. immediate outlet for food consumption, storage and keeping fresh for staggered distribution in human food consumption, for seed or further processing. Each of the destinations of use requires a certain way of previous preparation, summary or more complex, known as conditioning.

After breaking the link with the parent plant, berries remain living organisms maintaining their natural immunity and continuing to carry out life slowly. To prolong this state appropriate measures are required to be taken to ensure the equilibrium between berries internal factors and the external factors of the environment. However, even in these circumstances, the berries can maintain their original quality only a certain time, because a number of physicochemical, chemical, biochemical and microbiological changes occur gradually [2].

2.1. Decontamination of berries by washing

Soft textured fruits that have a low degree of mechanical impurities and microbiological contamination are cleaned with washing machines by splashing. This type of machine can operate independently or be part of a complex technological line of industrialization, making the final washing operation. Washing is done only by sprinkling.

Equipment shown in Figure 1, produced by CESARE TAVALAZZI SRL, ITALY, is entirely made of stainless steel except for the elevator belt, is used for effectively washing different types of little fruit.

The product is washed by means of the forced turbulent water flow and by the air that is sent from a compressor on the bottom of the tank.

Figure 1: Washing tank with elevator manufactured by CESARE TAVALAZZI, Italy [3]

In Figure 2 is shown a washer equipment produced by the company NIKO, Slovenia. The equipment is designed for washing and cleaning fruit before processing.

Figure 2: Washer equipment produced by the company NIKO, Slovenia [4]

Fruit in the washer is washed with water and soft brushes which leave it intact.

2.2. Decontamination of berries through chemical methods

Chlorine has been used for a long time as a disinfectant in the food industry. Several studies have evaluated its effectiveness for the decontamination of fresh produce and the concentrations used are generally about 5 to 20 ppm, for 1 to 2 minutes of decontamination.
Some of the problems that may occur at the disinfection of surface products using clorine depend on the products' topography. The presence of fissures, cracks or other natural openings may cause the formation of hypochlorous acid and decreases the efficiency of accessing microbial cells.
Treatments carried out with *hydrogen peroxide* (H_2O_2) to the fruit and vegetables such as carrots, broccoli, cauliflowers, strawberries, and raspberries were found to be ineffective, and even more, may lead to changes in the organoleptic properties of the product [5]
Using *water electrolysis* (AcEW) in the decontamination of fruit is a relatively new phenomenon. This method involves the electrolysis of an aqueous solution of sodium chloride (NaCl) between an anode and a cathode. AcEW generally has a pH below 2.7, a high oxidation power and can provide between 30 to 50 ppm of free chlorine [6].

2.3. Decontamination of fruits using ultrasound

By travelling through water with a frequency of 30 to 50 kHz, *ultrasonic waves* produce millions of microscopic air cavities loaded with vacuum energy. These air cavities, when getting in contact with surfaces create a vacuum effect. The result is the quick separation of greases, carbons, chemicals, blood, particles from these surfaces. In the mean time, these surfaces are also cleaned from any *bacteria* or living organism [7].

Figure 3: Ultrasonic equipment for decontamination RKT 2000

An equipment that uses ultrasound to decontaminate fruit (Figure 3) is manufactured by RKTransonic Engineers Pvt. Limited, India. It has a load capacity of 25 kg of fruit or vegetables and an average power of 4000 Watts.

2.4. Decontamination of berries using pulsed electric fields (PEF)

The cell membranes of microorganisms, plant or animal tissue can be made permeable by using Elea PEF technology. This process of electroporation is suitable for use in a broad range of food and bio-processes using low levels of energy and for this means the equipment shown in Figure 4 is used. [8].

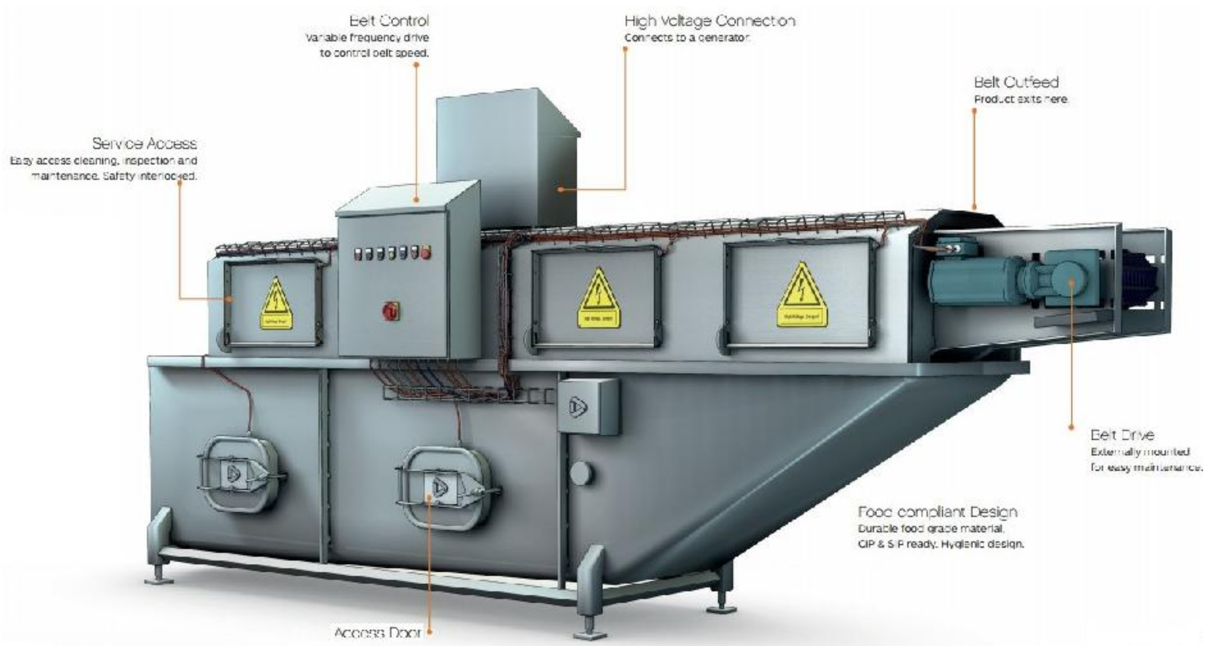

Figure 4: Technical equipment PEF used for microbiological decontaminating [8]

2.5. Decontamination of fruit using ultraviolet radiation UV-C

Worldwide there is an increasing concern related to the use of UV-C radiation for decontamination of food (cheese, meat, bread) and various fruits, companies involved perfecting technologies every year and always pulling new equipment on the market.

Generally, for the food decontamination, as a source of UV-C, low pressure UV-tubes are used, which have a maximum monochromatic emission at the wavelength of circa 254 nm, or average pressure UV-tubes, which produce a polychromatic light on a wider frequency spectrum. Their power ranges from 10 to 20 W to 25 kW.

Through the production and distribution of UV-C decontamination tunnel (Figure 5) North American company DDK SCIENTIFIC CORPORATION has allowed a wide range of food producers from the bakery industry, the fruit processors to enjoy the benefits of these new types of equipment [9].

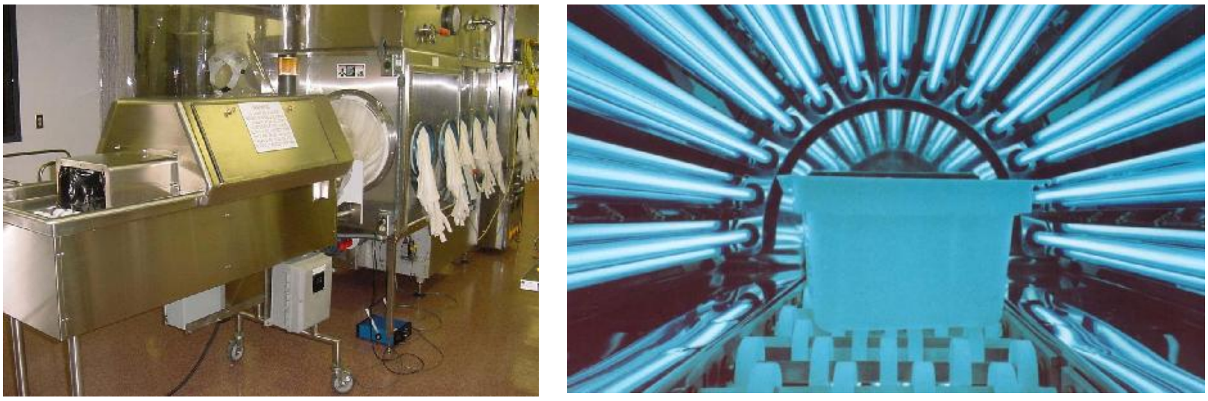

Figure. 5: The decontamination tunnel produced by DDK SCIENTIFIC CORPORATION [9]

The company DARO UV SYSTEMS LTD from the United Kingdom produces equipment primarily used for the meat and bread surface decontamination, and makes tunnels on request, which can be used by the customer specifications for any food product (Figure 6).

Figure 6: The UV-C decontamination tunnel produced by DARO UV SYSTEMS LTD [10]

Also, UV TECHNOLOGY LIMITED company from the United Kingdom has made equipment using UV-C technology with applications in fruit processing (Figure 7).

Figure 7: Decontamination tunnel produced by UV TECHNOLOGY LIMITED [11]

An equipment based on bactericidal effect of UV-C has been manufactured by the company REYCO SYSTEMS U.S.A. (Figure 8). It consists basically of a rotating stainless steel drum, where the products are rotated and exposed to the radiation over their entire surface. Thus viruses, bacteria, molds, fungi and yeasts are distroyed, by disrupting the structure of DNA or RNA of the cell.

Figure 8: The UV-C Trumbling Drum decontamination equipment produced by REYCO SYSTEMS [12]

Germicidal lamps and some special manufactured LEDs used for food decontamination emit UV-C radiation. This type of radiation induces the dimerization of nitrogen base pairs of DNA (for example, dimerization of thymine (Figure 9), welding the DNA strands in that place. As a result, gene transcription (copying of information from DNA to RNA) is blocked, resulting in stopping the cell division and ultimately the cell death (bactericidal).

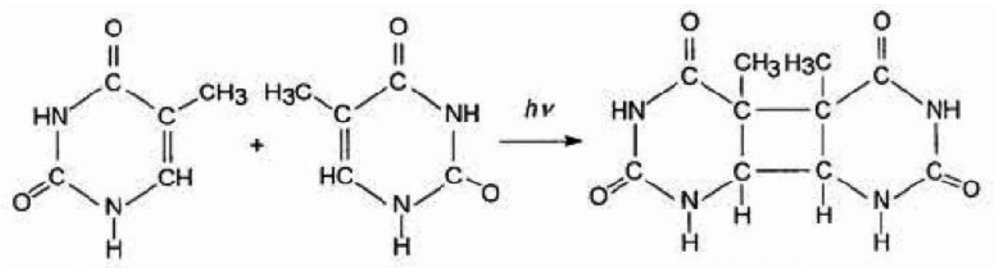

Figure 9: Dimerization of thymine

The amount of energy can be controlled to get the desired effects in terms of conservation, while maintaining quality, safety and nutritional caracteristiques of the fruit.

3. CONCLUSION

• No matter how careful berries would be harvested, they will not have the physical-biological purity required for processing and for direct transmission to consumers;
• The specific conditioning technology for each plant should include operations that simultaneously satisfy the requirements of purity, keeping valuable items undegraded and minimal costs, so that the final product has the best characteristics at affordable prices;
• After harvesting, the berries are directed to a particular technological process according to the purpose of use, i.e. immediate outlet for food consumption, storage and keeping fresh for staggered distribution in human food consumption, for seed or further processing.;
• Soft textured fruits that have a low degree of mechanical impurities and microbiological contamination are cleaned with washing machines by splashing;
• Other methods for decontamination berries are: chemical methods, ultrasound, pulsed electric fields (PEF) and non-ionizing radiation (UVC).

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