orchards. In Lepidoptera, generally female release sex pheromones to attract males, at relatively large distances for reproduction and lays egg on fruit trees of orchards and larvae develop inside fruits which render them unfit for marketing. Generally mating disruption affects the behavior of males in their search of females for mating by releasing large quantities of synthetic pheromones in the atmosphere. It manipulates insect behavior in such a way which leads to reduction in their numbers. The atmosphere where species- specific insect pest needed to be controlled is saturated with synthetic sex pheromones, by which the ability of male to locate the natural pheromone emitted by female is disrupted. There are four mechanism which explain how it is work:-

- Competitive attraction- it happens when tends to response the synthetic pheromone plume produced by semiochemicals dispenser instead of natural plume emitted by female of its own species.
- Camouflage- This mechanism requires complete saturation of the environment with synthetic pheromone. By which, male cannot locate the positions of the female.
- Desensitization- Adaption of the male olfactory receptor system or habituation of the central nervous system may occur due to exposure to synthetic pheromones.
- Sensory imbalance- By the result of desensitization, insect pests lost their sensory balance.

4. **Repellants**: Many semiochemicals with repellant effect are available for management of insect pests. The repellant "Verbenone" is now commercially available for the management of Mountain pine beetle *Dendroctonus ponderosae*. They are either used alone or in combination with attractants as a part of push-pull strategy. In which, the use of semiochemicals to make a protected resource an attractive or unsuitable for the insect pest (push) while luring them to an attractive source (pull) where the pests can be removed.

11. POST HARVEST TECHNOLOGY

Novel Non-Thermal Food Processing Technologies for Quality Food Production

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Abstract: Conventional heat treatment methods are generally followed to process the raw agricultural commodities in order to reduce microorganism contamination and to increase the shelf life of the product. These methods can lead to reduction of nutritional quality and sensory properties of the processed foods products. Therefore, to avoid these undesirable changes during the heat treatment and to improve/maintain food quality and safety, novel non-thermal technologies plays very important role in processing of food products.

Introduction: Thermal processing involves heating of foods for a predetermined time at a temperature to eliminate the pathogenic microorganisms that endanger the public health as well as those microorganisms and enzymes that deteriorate the food. But due to very high temperature, the nutritional factors of foods such as vitamins, minerals, proteins, fats etc which are highly sensitive to temperature, deteriorates during processing which leads to reduction of nutritional quality and generation of off flavor, off color and other sensory properties of food. Therefore in order to improve food quality and sensory properties, novel non-thermal food processing technologies are the need of food engineers, food processors and product developers. High hydrostatic pressure, pulsed electric fields, irradiation, pulsed light technology are some of the non-thermal technologies are discussed

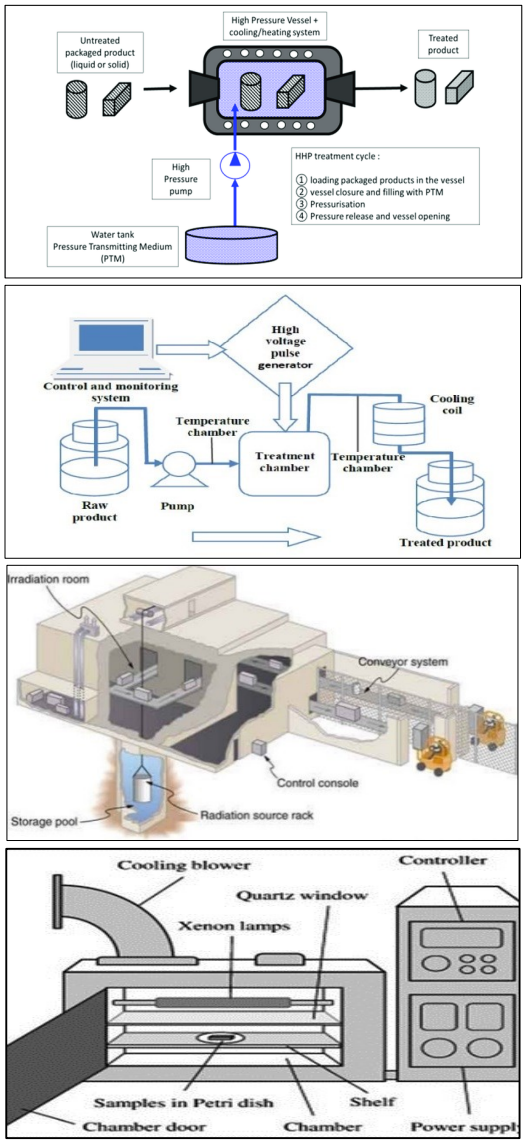
below.

High Hydrostatic Pressure (HHP): By subjecting food to high pressure in the range of 5000-8000 bars microorganisms and enzymes can be inactivated without degradation in flavor and nutrition. It is an effective non thermal sterilization/pasteurization treatment for liquid and solid foods which permits microbial inactivation at low or moderate temperature with minimum degradation. The energy required for high pressure processing is also less than thermal processing and it can be applied to very wide range of food products like milk, juice, meat, seafood and many other solid and liquid foods.In typical HPP the product is packaged in a flexible container usually a pouch or plastic bottle and is loaded in to a high pressure chamber filled with a pressure transmitting (hydrodynamic) fluid like oil or water as shown in fig 1. The fluid in the chamber is pasteurized with pump and this pressure is transmitted uniformly through the package in to the food itself. Pressure is applied for specific time usually 3 to 5 minutes. The processed product is then removed and stored in conventional manner. Because the pressure is transmitted in uniformly in all directions simultaneously food retains its shape even at extreme pressure and because no heat is needed the sensory characteristics of food are retained without compromising the food quality and microbial safety. It only affects non covalent chemical bonds; leaving covalent bonds which permit destruction of microorganisms without affecting food molecule that contribute texture or flavor of food.

Pulsed Electric Field (PEF): PEF is an innovative and promising method for non thermal processing of food stuff. It uses short electric pulses to preserve the food having short treatment time (below one second) and reduced heating effect. Produces food having fresh like characteristics along with high sensory quality and nutrient content. It is suitable for preserving liquid and semi liquid foods ex milk, fruit juices, soup, eggs etc.Basic principle of PEF includes application of short pulses of high electric field with duration of microseconds and intensity in the order of 20-80 kv/cm. The process is based on pulsed electric current delivered to a product placed between a set of electrodes as shown in fig 2, the distance between electrodes is termed as treatment gap of PEF chamber. The applied high voltage results in an electric field that causes microbial inactivation. The PEF equipment consists of a high voltage pulse generator, a treatment chamber and monitoring and controlling devices. Food product is placed in a treatment chamber either in static or continuous manner. Generally high electrical pulses applied to electrodes which then conduct the high intensity electric pulses to the product placed between two electrodes. The food product experience a force per unit change so called electric field which is responsible for irreversible cell membrane breakdown. This leads to dielectric breakdown of microbial cell membrane. Less treatment time, low temperature, batch or continuous process, increased shelf life of the product, maintaining food safety with low processing cost, inactivation of vegetative microorganisms including yeasts, spoilage microorganisms and pathogens are some of the advantages of PEF. However, its limitations include higher capital cost, effective for inactivate vegetative microorganisms only, does not inactivate enzymes, refrigeration is required to extend shelf life and not suitable for solid food products that are not pumpable.

Irradiation: Irradiation can be defined as exposing food to gamma rays, x- rays or electrons to improve shelf life and safety. It has range of effects including killing bacteria, moulds and insect pests, reduces ripening and spoilage of fruits and at higher doses it can be used for sterility. It is sometime called as cold pasteurization/sterilization as the product is not heated. It is also known as Ionizing radiation, Surface pasteurization, Electronic pasteurization or E-beam sterilization /pasteurization. In actual processing the food is packed and moved by conveyer belt in to shielded room. Food is exposed briefly to radiant energy source. Food is left virtually unchanged but the number of harmful bacteria, parasite and fungi are reduced or eliminated. Irradiation can decrease the loss of food due to insect infestation, food borne pathogens and spoilage. It can be used for preservation, sterilization, control sprouting, ripening, food borne illness and insect damage. Irradiation

keeps the nutritional value and appearance of food is unchanged without any harmful chemical changes and food does not become radioactive. However, irradiation can be used only for limited range of foods not all fresh produce is suitable for irradiation and some treated food may taste different.



A. High Pressure Processing and **B.** Pulsed Electric Field **C**. Food Irradiation and **D.** Pulsed Light Technology

Fig. Novel Non-Thermal Food Processing Technologies

Pulsed Light Technology (PLT): It is an alternative to thermal treatment for killing pathogenic and spoilage microorganism in foods including bacteria, yeasts, moulds and viruses. The treatment consists of applying a series of very short high power pulses of broad spectrum light. It is very effective on product surface and marginally effective at penetrating to depths in food. Pulses of light for food processing applications typically emit 1-20 flashes per seconds of electromagnetic energy. The key component of pulse light unit is a flash lamp filled with inert gas such as xenon which emits broadband radiations that ranges from ultraviolet cutoff to near infrared cutoff (200 nm -1000 nm with peak 400-500 nm). A high voltage, high current electric pulse is applied to the inert gas in the lamp and the strong collision between electron and gas molecule cause excitation of latter which then emits an intense very short light pulse. The treatment is most effective on smooth, nonreflecting surfaces or in liquids that are free of suspended particles. Rough surface hinder inactivation of microorganisms due to cell hiding. The main limitation of pulsed light treatment is its limited penetration depth. It has very wide range of applications like decontamination of vegetables, dairy products, microbial inactivation of water, and sanitation of packaging material and disinfection of equipment surface.

Conclusion

The novel non-thermal food processing technologies mentioned above hold potential for producing safe and quality foods. All these methods are considered to be very promising alternative to conventional processing methods. A clear advantage of these techniques for certain operating parameters is the inactivation of microorganisms with maintaining of the foods' sensory attributes and minimal quality loss.

References:

Farkas, J. and Farkas, C. M. 2011. History and future of food irradiation. Trends in Food Science & Technology, 22 (2–3): 121-126.

Morris, C., Brody, A. L., and Wicker, L. 2007.

Non-thermal food processing/preservation technologies: a review with packaging implications. Packaging Technology and Science, 20(4): 275–286.

Zhang, Z.-H., Wang, L.-H., Zeng, X.-A., Han, Z., and Brennan, C. S. 2018. Non-thermal technologies and its current and future application in the food industry: a review. International Journal of Food Science & Technology.

12. AGRICULTURE

A Recent Approach to Disease Management and Crop Improvement

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The exponentially increasing population in the country has increased food demand also. But conventional plant breeding methods are not sufficient to meet such need. So Agriculture along with biotechnology has come up with new solution and techniques termed as genetic engineering. Transgenic crops or genetically modified crops with recombinant DNA technology have developed a number of varieties with different purposes eg. resistance against fungal, bacterial, viral diseases and insect pest attack, drought and herbicide tolerant crops and many more. But environmental, economical, safety and ethical issues related to of GM crops have put question mark on it. One of the major concerns of the general public about transgenic crops is the mixing of genetic material between species that cannot hybridize by natural means. In order to meet this concern, a new transformation concepts *viz.,* cisgenesis has been developed as alternative to transgenics. This implies that plants must be transformed with only genetic material derived from the species itself or closely related species which are capable of sexually hybridize. Thus cisgenic plant is genetically engineered transgenic plant with its own genetic material or genetic material from closely related species that could be intercrossed.

Additionally, foreign sequences such as selection marker genes and vector-backbone sequences should be absent in the final cisgenic plant. During the generation of transgenic plants, use of selectable marker to distinguish between transformed and non-transformed cells is an essential aspect, which are usually antibiotic or herbicide resistant gene, so that transformed cells expressing the marker gene are resistant to the appropriate antibiotic or herbicide. So public concern, over the use of such marker genes have raised the need for the production of marker free transgenic without any foreign gene. In this regard clean vector technology which aims to produce transgenic plant with only gene of interest by avoiding the use or continued presence of antibiotic resistant gene as selectable marker, fulfills the objective in form of cisgenics as these foreign sequences such as selection marker genes and vector-backbone sequences are absent in the final cisgenic plant.

Thus cisgenics potato for late blight resistant with Rpi-sto1 and Rpi-vnt1.1 R genes, cisgenics apple against apple scab with HcrVf1 and HcrVf2 genes , cisgenics grapevine against powdery mildew with vvtl-1 gene are some successful examples of cisgenics approach for disease management.

Along with several advantages of cisgenic approach of crop improvement, it has some limitations as well. As desired gene can only be transformed from sexually compatible gene pool and position effect on gene in which the expression of a gene get changed when its location is changed in chromosome after translocation are major limitations of this technique.

In nutshell by use of cisgenics approach new traits are introduced or existing traits are modified such as improved resistance to biotic and abiotic stresses, quality enhancement and