THE IMPLEMENTATION OF THE HACCP SYSTEM ON THE TECHNOLOGICAL FLOW FOR OBTAINING VEGETABLE JUICES LACTO-FERMENTED

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Abstract

The Quality and the safety of food products represents a right of the consummer with direct effects on the quality of life. On the other hand, in the present competitional context, the quality of products constitutes a main factor of the economic-technic performances of the enterprises.

The application of the HACCP system in the food products circuit, which is promoted by the World Health Organization (WHO) in collaboration with the United Nations Organization for Alimentation and Agriculture (FAO) and with other international organisms, has as purpose assuring the safety of food products for protecting the health of the consummer against risc biological microbiological and chemical factors. This system represents a set of elements, principles, rules mutually dependent which form a whole superiorly organized as efficiency of the activity of its components.

The assurance of food products safety implies adaptation of material, technical and human ressources of the enterprises to objectives clearly defined. This leads to identifying the following fundamental functions of the HACCP method, the analyses of the dangers, the identification of the critical points, the surveillance of the execution and the verification of the system's efficiency.

Keywords: HACCP system, critical points of control, juices lacto-fermented;

INTRODUCTION

The HACCP method is a philosophy of conducting concentrated on the control prevention systems of food safety that has at its basis the principle : „Do it right the firts time and you will always have a final product safe for consummers."

The demand for fresh fruit and vegetables is continually growing keeping in mind that a large part of the population wants to have access to healthy food. The availability of these products, once considered seasonal, is today almost unlimitted all the year round. The mondialization of fruit and vegetables trade, respectively the modification of the horticulture practices have made possible the annual abundence and the appearance on the market of new varieties of fresh vegetable products.

Many of these products are consummed without a preliminary processing. Some of them are packed in a modified atmospheare for growing their life expectancy and the assurance of an acceptable level of quality and safety.

Fruit and vegetables contain naturally a non-pathogenetic epiphyte microbiota. During their growth, harvest, transportation and other processings and manipulations it is possible that they are contaminated with pathogenetics of animal or human origin.

In most cases fruit and vegetables are washed after being picked up by the producers, processors, packagers and consummers with drinkable water.

Consummers are also preoccupied by the possible contamination of fruit and vegetables as they are applied with chemical fertilizers and pesticides in agriculture, the reason why we are the witnesses of a growing demand for ecological products.

THE IMPLEMENTATION PRINCIPLES OF THE HACCP SYSTEM

The HACCP system is based on seven principles, of which application is included in the frame of specific steps of elaboration of the HACCP plan.

1. The evaluation of the risks associated with obtaining and harvesting of prime matter, the processing, the manipulation, the depositing, the

distribution, the cullinary preparation and the consume of food products..

2. The determination of critical points though we can keep under control the identified risks.
3. The establishment of critical limits that must be respected in every critical point of control.
4. The establishment of monitarization procedures of critical points of control.
5. The establishment of correlative actions that will be applied when it is registered a deviation of critical limits.
6. The organization of an efficient system of maintenance of the registrations , which form the documentation of the HACCP plan..
7. The establishment of the procedures through which it is verified if the HACCP system fonctions properly..

RESULTS AND DISCUSSIONS

The first step in identifying the dangers which can be associated with the production process is realized with the help of the brainstorming technique and the analysis cause-effect, respectively of the decisional tree for identifying the microbiological risks.

The HACCP team must utilyse the flux diafragm and the description of the product which were ellaborated in the previous steps and analyse systematically what might happen during every frequency of the productive process.

After identyfing the risks we must come up with a list of dangers potentially possible from the reception of the prime matter until the final product is delivered. During the danger identification process the team must not limit only to the probability of apparition of the risk or of its potantiallity to cause diseases. All potentially signifiant risks must be analysed.

The second step in realising the analysis of the risks consists of the identification of preventive measures which might be applied for the monitarization of every single risk.

The obtaining of lacto-fermented vegetables juices – stable products form a microbiological point of view taking into account the containing of the lactic acid and of some ellements of composition obtained after the fermentation process, excludes the requirement of including in the HACCP plan the control measures for pathogenetics. Even if a microorganism is identified as potential danger in the risk identification step, in the phase of evaluating risks one can conclude that such a hazard cannot appear in the finite product, taking into account that the vegetable juice is in such a way processed so as to obtain stability.

The critical point of control (CPC) is the phase (point) in which the applied control on the risk determines the prevention, the ellimination or the reduction to an acceptable level.

The point of control (PC) represents any phase/point of the process in which we can control the biological chemical and physical risks.

Between CPC and PC one must make a distinction, because during the technological process there are many phases where we can control risks but only some in which the non-corresponding control leads to obtaining potentially unsafe food products. The last ones are CCP.

The HACCP team determines the critical points of control based on the results from analysing the risks. All the phases of the technological process, from obtaining prime matter to delivering the finite product, are studied from the point of view of identified risks.

The identification of a critical point for the control of a risk needs an instrument known as decisional tree.

The usage of a decisional tree consists in answering succesively to every question , in the indicated order, for every phase of the process and for every identified danger.

In HACCP practice we consider two types of CPC : the one in which the control assures the ellimination of the risk and the one in which the risk cannot be elliminated but reduced to an acceptable level.

For every risk regarding safety of food products we must identify preventive actions, respectively the phases in the process to which we can apply these preventive actions.

The reception of vegetables envisages general aspects of the quality (maturity stade, dry substance content, starch, acidity, etc.) and not the replacement, reason for which the operation can be considered only a point of control. Detection of pesticides, micotoxines, hard metals, nitrates is made for assuring the safety of the consummer. If one can set up a program to verify them, the reception of prime matter is a critical point of control. Normally, the adhesion to Good Practices in Agriculture (GAP)the selection of the suppliers constitute preventing measures much more efficient, the reception not being a critical point of control from a microbiological point of view.

The depositing of the prime matter until the introduction in the fabrication process must be limited as much as possible so as to avoid losing specific properties caused by physical and biochemical transformations , transformations whose intensity depends on the horticulture species, the maturity degree, and the preserving conditions.The values of air parametres in the deposit (temperature, circulation and humidity) must be chosen so as to present unwanted microbiological phenomenae such as mildew and fermentation. In this phase, even if the temperature favorizes tha raise of potential pathogenetics , their inhibation will be realized subsequently through thermic treatement and as a consequence of decrease of the juice PH by accumulating lactic acid. The possible presence of mildew that produces toxines does not lead to the decision of introducing the risk in the HACCP plan , taking into account the elimination of the non corresponding vegetables during the sorting out operation.

The sorting out of the prime matter has the role of eliminating the non-corresponding, crashed, altered vegetables. If the operation is done manually, with the help of sorting bands, the products can be contaminated by workers with pathogenetic germs(*Salmonella, Staphylococcus aureus*). The existence of a program of Standard Operation Procedures of Sannitation (SSOP) whose requirements mandatorily refer to the health status of the employees and to the endowment for the hygene of the stuff., requirements that can be introduced in the HACCP system, leads to the justification of introducing the operation in the control points group (CP).

The elimination of the non-edible parts with the help of construction devices adapted to the horticulture species and to the proposed goal represents a point of control.

The washing of the prime matter can be a phase of contamination with pathogenetic germs from water(ex. *Salmonella*), if specific programs for assuring the quality of water are not applied. The existence of a SSOP program is a justification of identifying the operation as being PC.

The crushing of the vegetables does not present a risk from a biological or chemical point of view, but from a physical point of view. The used platens, deteriorated knives can be the cause of the presence of metallical fragments in the product. Verifying permanently the state of these surfaces and mounting filters are actions that lead to classifying the operation of chopping in the group PC.

The pressing represents one of the most usual operations of extracting the juice. From a chemical point of view there is a risk of the presence of lubrificants, but the application of the SSOP program justifies the decision of apreciating it as insignifiant. As well, metalic fragments from the extraction equipment (due to the usage or fissures) can cause injuries through ingestion. Although this physical risk is considered signifiant, the operation does not represent a critical point because the control is done at the operation of filtration.

The levigation of vegetable juices is done with the help of enzymes (generally) , filtration and centrifugal action . The operation is a control point. (CP)

The filtration of vegetable juices is a critical point of control due to the risks of physical nature. The possibility of introducing in the juice of metalic fragments during the operation of pressing the vegetables leads to considering this operation as CPC.

The pasteurization of vegetable juices is a critical point of control only in the case of making vegetable juices for which the thermic treatment represents the only phase in which it is realized a control sufficient for distroying

pathogenic germs. In the case of obtaining lacto-fermented vegetable juices pasteurization represents only a point of control , because the conditions in which it will be created after the fermentation is responsible for the inhibation of the possible pathogenetic micro-organisms.

Cooling down of the vegetable juices for inoculation is deployed usually in the last phase of the pasteurizator by fixing the temperature of the cooling water at an optimum temperature for the utilyzed culture (generally between 21^0 and 30^0 C).

The instalation of pasteurization must be correctly mounted, exploited, maintained and controlled. At certain periods it is imposed to inspect the diagrams of temperature.

The insemination – the fermentation of vegetable juices supposes adding in the juice certain active cultures that can allow first of all a rapid formation of lactic acid. In this phase there is a possibility to contaminate the juice from the environment or from the equipments. If the indicated concentrations are not respected leads to a defectous fermentation , respectively the risk of developping an epiphyte microbiota post pasteurization. The operation reprezents a critical point of control because of the microbiological risks: multiplication of micro-organisms for post – pasteurization contamination, contamination with pathogenes if the acidity of the conditions is not sufficient. The control is done by respecting the working procedures , the PH automatically, the microscopic exam and the maintenance of a rigourous hygene.

The dozing of lacto-fermented vegetable juices is done in aseptic packs, this being a CPC. The control of microbiological risks is done by assuring strict conditions of hygene for the packaging, instalation and conditions in this section of fabrication. The disinfection of the air, equipments and packs can be done with ultraviolet radiations. For the chemical risks that result from the packaging (for eg utilyzing hydrogene peroxide for the sterilization of the material used for packaging), the operation is PC taking into account the SSOP program that keeps under control the level of this substance.

Depositing is done at temperatures of refrigeration for preventing an excessive accumulation of lactic acid due to the continuation of the activity of the bacteria used as inocule. The maintenance in certain limits of the PH is essential for avoiding the formation of some big quantities of biogene amines in such a way that the phase can be considered a critical point of control. The monitorization is done by verifying the temperature and the period of depositation.

Each measure of control referring to a critical point of control must be accompanied by a specification of the critical limits.

The critical limit represents the prescribed value of one parameters of the product or of the process in a critical point of control of which outrunning or disrespecting could endanger the health or the life of the consummer. The parameters most encountered are temperature, the duration of thermic treatement, the PH, the content of additives, the content of salt for food products, the senzorial, characteristics (for vegetables – exterior aspect, texture, etc.)

The critical limits can de established by consulting more sources: legislation, standards, norms, international guides and nationales refering to food products (Codex Alimentarius, directives of EU, documents of FDA), scientific literature, opinions of external experts, own experimantal data.

When the critical limits are not taken from the standards, norms or guides of good hygene practices, the HACCP team must establish their validity as concerned to the CPC control and to present them in the monitorization form.

The parametres that have relevance for the hygenic quality of the product and for which there are established critical limits at reception are residues of pesticides, nitrates, micotoxines and heavy metals .

The auxiliary materials must coincide with the normative technical documents for the product.

In the case of using salt in the technological process (in proportion of 1-2%) for favoring the selection process of micro-organisms, this must have a humidity of maximum 0,15%, the reaction of the sollution to be neutre , not to contain magnezium sulfate, neither copper, lead or arsenic.

In literature it is mentioned also the possibility to add glucose supplement for assuring a

vigourous fermentation, respectively to correlate the content of fermentable glucides, especially after the period of depositing the vegetables. Solid glucose must have an acidity of maximum 2,8 degrees , the content of dextroze reported to dry substance to be 87%, and the quantities maximum admitted of metals , expressed in mg/kg to have the following values: 1 for lead, 5 for sopper and 0,050 for arsenic.

At the operation of pasteurization the critical parameters are temperature and the period of maintaining of it. In the case of vegetable juices the thermical regime is chosen depending on the prime matter respectively its acidity. Thus for obtaining carrot juice there will be utilized a more strict regime than in the case of making tomato juice, taking into account the reduced PH of the latter.

From the literature of speciality it is known the fact that the application of a temperature of 80^0C with a duration of maintenance of 10 minutes not only it keeps to a great extent the nuritional qualities of the vegetables but also it assures optimum conditions for an ulterior development of lactic bacteria. These critical limits thus compete to attaigning some decreased values of the PH of the juice (3,8-4), to the formation of lactic bacteriocines , to the production of other primary metabolits with inhibating effect (charbon dioxide, oxygenated water , diacetyle)

The inoculation of vegetable juices with lactic bacteria is done with respecting some concentrations in such a way that fermentation is done in optimum conditions. It is frequently utilized the singular static cultures of *Lactobacillus plantarum* in concentration of 10^6CFU/ml, or a mixture of starter concentrations of *Lactobacillus plantarum* and *Saccharomyces cerevisiae* yeasts in concentration of 10^6CFU/ml and 10^3CFU/ml (MIX).

Because the acidity or the PH prevent the multiplication of pathogenic micro-organisms from the post pasteurization contamination during the fermentation phase these two parameters are critical. Their values must realize an equilibrium between the above mentioned aspect and the prevention of the formation by the lactic bacteria of biogene aminaes in big quantities.

A series of research have brought to the surface the fact that the increase of the biogene amina concentration happens in paralel with the values of PH under the limits of 3,8-3,6, reason for which it is recommanded to stop the fermentation process by pasteurization when the PH drops under 4.

The critical limits for these parameters vary with the nature of prime matter and utilized cultures as inocule. Thus the fermentation of the juice cabbage-carrot 2:1 (v/v) with *Lactobacillus plantarum* 92H (initial concentration 8 x 10^6 CFU/ml) at a temperature of 24°C has led to the modification of the PH from 5,87 to 3,81 after 150h. In paralel the acidity has raised from 1,35 to 10,60 g/kg. The authors (Karovičová, ş.a., 2002) have apprecaited that from a senzorial point of view the fermentative process must be stopped after 72 h, moment when it was attaigned a value of the PH of 3,99(total acidity of 8,55 g/kg). We should also mention that before inoculation it was added 2% D-glucoze and 0,5% salt.

The fermentation of the cabbage juice with *Lactobacillus plantarum* (and addition of 2%D-glucoze before inoculation) at a temperature of 22^0C, time 168h, was realized with the variation of the PH from 6,3 to 4,05, and of the total acidity from 0,5 to 6,5g/cm^3 .

The critical limits for deposition are the maximum admitted values for temperature and the period of preserving.

The control of the pollution of the juice with chemical substances utilized at washing and disinfection of the equipment is done by establishing the critical limits for the concentrations of the sollutions and he minimum period for rinsing with water.

An important part of the HACCP system is the elaboration of the monitarization procedures for every critical point of the process/product for assuring the respect of the critical limits established.

An important part of the HACCP system is the ellaboration of the monitorization procedures for every critical point of the product/process , for assuring the respect of the critical limits established.

The monitarization is a planned sequence of observations and measures of the critical parametres of the product or process realized with the aim to appreciate if a CPC is under control and is finalized with an exact registration subsequently realized in the verification process .
The data resulting from the monitorization must be evaluated by a designated person , with adequate knowledge and the necessary authority to take correlative actions when the situation imposes them. The adjustments must be realized until the apparition of deviations.

CONCLUSIONS

The HACCP plan for lacto fermented vegetable juices will stipulate the monitorization of the following operations and risks:

- The depositing of the prime matter – temperature, hygene degree of the storehouse.
- The filtring of vegetable juices – integrity of the filtring system , , its calibration in order to obtain retention of metal fragments that surpass a certain dimension , the utilization of metal detectors.
- Pasteurization and cooling of vegetable juices – the debit of the alimentation pomp , the temperature of the product at exit from the device, the parametres of the thermic agent (pressure, temperature), the difference of pressure between the circuit of the pasteurized juice and that of the thermic agent , the integrity of the fittings between the plates, visual control of the pomp position.
- Insemination and fermentation of vegetable juices – the activity of the culture of lactic bacteria, temperature of the product.
- Botteling of vegetable juices – quality of packaging, conditions of depositing of juices (visual);
- Depositing of vegetable juices – temperature, hygene of the storehouse.
- Hygene of the fabrication rooms, of the instalations, of the stuff – visual;

For every CPC the HACCP team must establish corrective actions so that these should be undertaken without hesitation in the moment when the monitorization indicates a diversion from the critical limit. The objectives of these actions refer to the protection of the consummer (by assuring that the products that present risks to health don't reach the distribution network), respectively to the correction of the cause that produced the deviation.
The monitorization may indicate the necessity of applying preventive measures in case of corrective actions for the same procedure must be implemented repeteadly.
The main document that lays at the foundation for implementing the HACCP system is the „HACCP Manual". This is an official document , that constitutes a basis in the relations of the commercial society and in the relations of the local authority representatives.
The editing and the administration of the „HACCP Manual" are normally realized by the leader of the HACCP team and its approval is done by the general director of the society.
In order to raise the market share and to win the trust of the consummer, the company can certify the products and the systems HACCP . The certification of the HACCP system aslo determines the possibility that the products of the firm can compete successfully on the EU market.

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