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RISK ANALYSIS IN THE CRITICAL PIGMEAT CONTROL POINTS

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Abstract: *The pig meat is of particular importance in human food due to the high content of vitamins and minerals. To prevent the hazard of microbial contamination, physical contamination, chemical contamination, etc., before slaughtering and during slaughter of animals has been developed and implemented the system Hazard Analysis by Critical Control Points (HACCP).*

Keywords: *pork meat, HACCP, organoleptic indices, contamination hazard*

INTRODUCTION

Meat is particularly important for the proper functioning of the body due to increased protein content and quality of minerals. Fats from pork meat has a high caloric content, while lean pork is a good source of protein, iron and zinc and contains a small amount of sodium.

Pork is a good source of vitamin B1, with the highest concentration among all types of meat. Pigmear has a higher amount of saturated fats comparing with unsaturated fats and an increased content of linoleic acid, involved in the fight against cancer and cardiovascular diseases. Iron, zinc and D vitamin available in pork are easily assimilated by the body. It must be said that the described benefits are for lean meat and is recommended to avoid fatty meat and pig meat products that contain a high concentration of fat.

MATERIAL AND METHOD

The H.A.C.C.P. (Hazard Analysis and Critical Control Point) is a scientific approach to the process of control in general and the process of autocontrol in particular. The H.A.C.C.P. was designed in 1960 to prevent the biological, physical or chemical contamination for meat and meat products.

Food Safety and Inspection Service (FSIS) published final Regulation in July 1996, mandating that HACCP to be implemented as a process of the control system in all pork processing businesses inspected. Also, FSIS has developed generic models for each process, models which can be used on a voluntary basis by companies inspected.

The approach of a H.A.C.C.P plan in the units of meat industrialization and meat products will be a modern method of self-control and analysis, which aims at keeping food innocuousness (property of a physical, chemical, or biological agent, not to be a danger for the body) and eliminate the adverse effects over the health status of the consumer due to non-compliant food.

Generally, meat products, by their composition (protein, fat, vitamins, minerals and moisture) and the whole chain of processing, storage and disposal, fulfill favorable conditions for contamination and possibilities of transmitting certain pathogenic microorganisms with adverse effects on the health of the consumer.

Preliminary conditions for implementing of self-control based on HACCP in the units of this type are imposed ever since the design and construction of the unit, from the materials of which it is built, the location and proper water supply, to the place of the pipes and plumbing, that, by design, avoid crossover between salubrious and insalubrious portions of these facilities.

To avoid events related to physical risk, glass components require protection (lighting devices, windows etc). As is known, the existence of lockers "filter type" is mandatory in the meat industry; they are intended for separation of personal street clothes and of the protective equipment (working). Wearing the protective equipment will be carried only after a proper body hygiene of staff (mandatory shower).

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In the crossing space, at the exit/entry workspaces (sections) there will be floor mats imbued with disinfectant solution or disinfecting pools for rubber boots fitted with water jets for footwear washing. Adequately equipped sinks for washing and disinfecting hands will be also installed.

State of health of staff will be monitored at the entrance to the station by an official (head of department). There will not be accepted workers with injuries and infected wounds on the hands (unprotected) or carriers of contagious diseases (diarrhea in particular). Health status will be checked and tested with documentary evidences of the periodic medical examination. Operations of cleaning, washing and disinfection will be carried out after a well established schedule and whenever necessary. Both microbiological water quality and the effectiveness of the washing and disinfecting of the working surfaces, machinery and utensils will be checked periodically by laboratory tests (hygienic tests, sanitation tests, alkalinity tests).

Staff will be trained and formed to comply with good working practices and hygienic and sanitary conditions in their daily work, related both to condition of the equipment of protection and rules of proper food handling.

Monitoring methods will be extended to the immediate vicinity of the unit being controlled cleanliness of the outer zone to eliminate the possibilities of development and propagating rodents. Supervision will refer to municipal waste landfills for which there will be a firm periodic evacuation schedule. It will be taken in consideration measures against insects and rodents, all according to established programs and their effectiveness will be reviewed.

To control and supervise all hygienic and sanitary conditions will be designated a person in charge who can follow the company hygiene compliance, which is usually HACCP team member. The main goal of all measures initiated by this person will be to avoid contamination or re-contamination of these products. He also will be responsible for the operations of washing and disinfection of means of transport and delivery. It will follow the water for washing, to have for auto means, temperatures above 80 ° C, their refrigeration system will be checked regularly, and for this vehicles, to be authorized by the competent health authorities.

To prevent the contamination hazard an important role has the study of the documentation relating to the evaluation of quality of pork meat and products. The most frequent possibility of contamination of pork meat is associated with bacterial risk source that is represented by a sick animal at slaughter and subsequent the contamination after slaughter. To prevent the contamination from human carriers of germs, rodent, insect, or from water used, or from dust, animal health issues at slaughter is the responsibility of the veterinarian while checking meat and meat products is the responsibility of ANSVSA.

Control team H.A.C.C.P. will be responsible of achieving the technological flow diagram (schematically), which will clearly outline each technological step that will move a product from raw material receipt to delivery of the finished product.

Broadly, production of meat preparations includes the following:

1. Reception of raw materials and ingredients. Harmlessness of the finished product will depend on the microbial load of raw materials and ingredients used, as well as their association with certain chemical risks. Establishments producing meat uses especially beef and swine. Cattle and pig meat comes dried, chilled and frozen. The reception consists in the general examination of meat and meat marking control. The product will be accompanied by sanitary documents - proving harmlessness of product (meat) and that it comes from healthy animals. Stamp on pig carcasses indicates that they have undergone examination for trichinosis and that the animals were healthy. Even if through a strict control can not eliminate risk, especially microbiological the control is a guarantee of reducing these types of risks to acceptable limits. Parameters monitored will be the temperature of the meat at the reception and organoleptic examination of meat as a sensory way of establishing of its freshness condition. Controlling hygienic and sanitary conditions of transport means of the meat will be important in selecting the supplier and the prevention of contamination.

The reception will appreciate meat organoleptic indicators based on the parameters listed in Table 1.

Table 1

MEAT ORGANOLEPTIC INDICATORS			
ASSESSMENT INDICATORS	FRESH MEAT	MEAT RELATIVELY FRESH	TAINTED MEAT
Aspect	The surface covered with a dry film, in the section: bright, light humid	Surface covered with a hard shell, or a wet layer, sometimes mucus; in section: wet with turbid juice	Dry or sticky surface; very sticky in section;
Colour	On the surface: pink to red; in section: red characteristic of the breed and of the anatomical region	Matte at surface and in section	On the surface: gray or greenish; in section: is discolored or like on the surface
Smell	Pleasant, characteristic of breed	Sour, slightly pungent, of mold;	Rotten, unpleasant
Fat	In cattle, white or yellowish, hard consistency; white or pink for pigs, soft, elastic; White for sheep and compact; characteristic odor	Matt appearance, consistent, less firm. Strong smell of stale, stifling	Gray; sometimes mucilaginous or mold surface; rancid odor
Bone marrow	Elastic, glossy; in section completely fills the intramedullary canal	soft; in section mat, sometimes light gray; detach from the intramedullary canal	Soft, gray dirty, does not fill the medullary canal
Tendons and joints	Glossy, elastic, strong, clear synovial fluid	Mate, soft, covered with mucus, turbid synovial fluid;	Gray, covered by mucus, lot of turbid synovial fluid.

2. Storage of raw materials and ingredients. After the reception, pork meat is stored in refrigerating rooms at temperatures of 2 to 4°C for cooling purposes. At this stage, it will monitor the storage temperature, which will have as upper limit the critical value of 4°C.

3. Cutting, deboning and meat choosing. In the industrial establishments preparing the meat and meat products from the European Union, due to the fact that also slaughterhouses have implemented HACCP self-control begins with the cutting of meat, the stage must comply very strict hygienic and sanitary conditions. Air temperature in the cutting and boning chamber must be within 10 ° C. The second parameter that requires monitoring is the process of cutting. It is good that the whole process of cutting does not exceed two hours duration in order not to be real possibility of multiplication of microorganisms existing cryophilic. It is recommended that each worker to be equipped with two knives. Working knife for carcass and a second knife in a bowl with 1% chloramine for disinfection. Process will resume cyclically with changing utensils used and disinfection after each cutted carcass.

4. Meat salting. Pigmeat will be salted with a salting mixture. Salting operations will strictly comply with technical rules that indicate what quantities to use each of these ingredients.

The mixture of salt and saltpeter will be made only by the laboratory and the content of nitrates and nitrites will be periodically monitored by the laboratory, since nitrates and nitrites, when not respected the recipe, represents a significant chemical risk.

The mixture of nitrates and nitrites is added both for the color preservation of the product after heat treatment and especially as a prophylactic method for the prevention of botulism.

This stage is encountered only in cold cuts manufacturing technology.

5. Organoleptic examination will follow the color temperature foaming rinse the taste smell and flocculation. (Table 1).

6. Chemical examination will follow the pH content of ammonia, salt and nitrite content. Areometric will be determine the brine concentration.

7. Grist and minced meat paste preparation and storage. Grist means meat meal selected, cut into pieces of 6-10 cm salted and stored in a refrigerator for maturing. Pieces of meat can be minced through the screen and then put in trays in the refrigerator to speed up the process. The storage should be carried out in refrigerated rooms at 4 ° C for 24-72 hours. It is advisable not to exceed 72 hours time or to use meal before switching to 24 hours of production. Minced meat paste (bradt) is a paste finely chopped from meat mixed with salt and water so that they form a thick paste for meat and water, which is still stored in refrigerated space for maturing. This paste is used to bond the composition of the majority of sausages. Water for preparation of the minced meat paste (bradt) must be as cold as possible during processing because in the meat cutter temperature increases so much that "bradt" "cut". minced meat paste (Bradt) is stored at the same temperature for a period of at least 48 hours, but preferably within 72 hours. During maturation, minced meat paste became "bound", is thickened, it changes color from pink to red and it catch a glossy darker crust at surface, its appearance after 72 hours is a good indicator for assessing quality. Grist and Bradt, refrigerated for maturing, are used to prepare the paste (in the wolf). The operation consists in mixing different proportions of meat, fat and spices to obtain sausage processors. It is recommended that, at this stage, to be determine in the laboratory the ammonia and hydrogen sulfide content, as well as the pH. If the test results are inadequate, the blank should be removed from production.

Once prepared the composition is introduced into membranes, after which the membranes binds such that the composition can not escape from it. Filled membranes are hung on sticks washed and disinfected. Binding bars must be manufactured carefully in order sausages not to fall down during the smoking process or boiling. It is recommended that thick sausages to be pierced to remove the air from them.

Heat treatment (smoking hot, boiling, cold smoking) is performed in the same rooms that have control devices which allows the monitoring. In view of the fact that the heat treatment leads to the elimination of microbiological risk, this step is typically a critical control point in which the temperature and duration should be monitored.

Hot smoking: Cubicle load must be controlled to be done correctly. The red color of membranes is an indication that the hot smoked is finished, the product is elastic. This process increases the keeping quality of the product. Wood and sawdust used for hot smoked should be a hardwood and not moldy.

During boiling, the temperature should be monitored frequently. When boiling is done at low temperatures will not succeed in eliminating or reducing pathogenic germs, so that both the boiling point and the duration should be monitored. After boiling some assortments (mortadella, hot dogs) should be cooled in the shower, so as not to wrinkle. Cooling is done until salami reach temperatures of 40-45 ° C and products that are not smoked shall be kept in refrigerated warehouses. Cooling must be carried out as quick as possible.

Half smoked sausages must be cold smoked. The operation aims pronounced drying and smoking them because by lowering humidity increases keeping quality of the product. After cold smoking, sausages acquires a reddish-brown color and a characteristic luster.

Some products follows another technological flow. Meat specialties (bacon, gypsy tenderloin, smoked specialties etc.) are salted after cutting after previously were well chilled. Salting is done all with a mixture of salt, nitrates and nitrites. Brine salting is done by injecting brine into the meat, either by placing meat in brine pools. Brine should be clear, no foam, no sour taste. At this stage it controls the amount of salt in salted meat and nitrites and it is performed a bacteriological exam as a control method. After salting, the products are rinsed with water, shaped cut and tied (gypsy tenderloin). At the boiling of products will be monitored temperature and duration of boiling, depending on the size of the products. After boiling products are pressed to eliminate voids are trimmed and gypsy tenderloin is smoked.

8. Checking the finished product. At the introduction of self-control management, product harmless examination by the method of rapid tests (pH, temperature, duration) is completed with the determination of ammonia and hydrogen sulfide, and periodically checking will be done by determining pathogen agents. Along with organoleptic examination will be made also determinations regarding technological control.

9. Storage and delivery. The finished products are stored in refrigerated rooms at a temperature between 0°C and 6°C in the case of fresh meat . Fresh meat shall not be kept for more than 4 days until consumption and smoked or half smoked sausages are kept hanging, without touching each other, at temperatures of maximum 10°C in dark warehouses, dried, well-ventilated and ventilated. The appearance of mold can raise issues of biological contamination. Rooms where meat products are stored are disinfected at least three times a year with lime chloride solution of 1% or chloramine.

RESULTS AND DISCUSSIONS

Failure to implement the protective measures provided by the HACCP plan involves significant risks to human health namely:

1. The risks of contamination by microorganisms

A. Microorganisms that affect the animal or carcass. This category includes the bacteria. For this reason, studies have been made in close connection with the flow technological the product. For pork main specific pathogens are:

1. Salmonella. Salmonellosis is the disease most commonly occurs in animals. Salmonella can contaminate both animal by ingesting feed and water, and meat, which makes the illnesses caused by them to prevail among food-borne. Carcass contamination is done by the contamination of from carcass already contaminated. To avoid contamination of meat with Salmonella during cutting is recommended to apply the following preventive measures:

- temperature regulation of cutting rooms below 10 ° C, which will lead to stopping the multiplication of Salmonella existing on work surface or carcasses;
- introduction to cutting only the carcasses cooled at temperatures below 6 ° C;
- washing and disinfecting cutting rooms after each shift.

All these measures will not prevent Salmonella contamination of meat, but will reduce it. From the above it can be deduced that the essential measure remains holding carcasses at temperatures below 6°C, the temperature at which salmonella multiplication is much diminished.

2. Clostridium. Clostridial reach the meat from the surface of animals (fur, leather) from the feces and not properly sanitized environment, or from the environment in which animals are cut, the meat is stored and handled. For animals slaughtered in accentuate tiredness status, those eviscerated later after bleeding, clostridium along with other clostridial bacteria from the digestive tract can penetrate deep muscular masses.

3. *Staphylococcus aureus* can contaminate carcasses frequently since obtaining them, or later when meat suffer more handling. Various pathogenic bacteria can come from the hands of personnel injuries. Staphylococcal toxin is thermostable, can not being destroyed by heating, and its presence in food can cause foodborne disease.

4. *Campylobacter jejuni* is quoted more often in recent years as a frequent contaminant of meat, being a criofil germ. At temperatures below 10°C, will continue to multiply. For these reasons, chilling of carcasses must be carried out as soon as possible after preparation. For these reasons it is recommended as a critical limit temperature monitoring to preserve carcasses before cutting, 5°C. This temperature value will help reduce microbiological risk without eliminating it.

B. Pathogenic microorganisms contaminating frozen meat. During the freezing process, a small amount of pathogenic microorganisms present on fresh meat are destroyed. During storage of frozen meat to freezing temperature, reducing the number of microorganisms will continue, but more slowly. Bacteria the most sensitive to these temperatures are Gram-negative bacteria and bacterial spores will remain unaffected. During defrosting the number of bacteria on the meat surface cryophilic increases about 100 times. Defrosting with hot air or hot water, favor the multiplication pathogenic germs, increasing the bacterial risks associated with product and leading to adverse impacts on the health of the consumer. Maintaining the storage of meat frozen at a temperature of -5°C to -10°C can lead to proliferation of pathogenic mold. Pathogenic germs are the same existing on meat before freezing but after freezing only reduces their number. We emphasize that the spores are resistant to freezing. A particular aspect is provided by *Yersinia enterocolitica* which is able to grow and multiply at a temperature of about 0°C and also grows well in vacuum conditions. For these reasons, during thawing process, more attention should be paid to cryophilic flora.

C. Pathogenic microorganisms from meat products heat treated by pasteurization. Preparations of this class (smoked and precooked) that is heat treated by pasteurization at a temperature of 70 ° - 75 ° C while maintaining the temperature in the deeper layers for a period of at least 10 minutes. In all products that are heat treated, spores bacteria of the genus *Clostridium* can survive. To prevent contamination of these preparations are added preserving agents. Among the pathogens that can be found in meat products and may trigger foodborne disease we emphasize: *Salmonella* and *Staphylococcus aureus*. *Salmonella* can survive in these products (mortadella, salami, half-smoked) when they are heat undertreated. It is recommended as a critical limit for the thermal process the value of 70°C and to maintain the product at this temperature for at least 10 minutes. For these reasons it is recommended for the verification of the compliance with heat treatment operations, to determine the following pathogens:

- at meat and salted products, fermented and dry will be determined *Staphylococcus aureus* (which must not exceed 10 / g immediately after processing);
- boiled meat products will be determined as pathogens: *Salmonella*, *Staphylococcus aureus*, and *Escherichia coli* *Clostridium perfringens*. The presence of *Salmonella* and *Staphylococcus aureus* reveals improper heat treatment or subsequent contamination (personal, work surfaces);

D. Pathogenic microorganisms found in the meat half-canned. HACCP team must have in sight pathogenic bacteria with high potential risk on canned meat. Internationally, the following bacteria are considered dangerous for their large epidemiological implication: *Salmonella*, *Shigella*, *Staphylococcus aureus*, *Clostridium botulinum*, *Clostridium perfringens*. Preventive measures in wards obtaining half-preserved meat will be especially targeted to prevent their contamination with bacterial species mentioned above. Depending on the possibility of contamination with microorganisms, certain preventive measures are required: veterinary examination before slaughtered, land disinfecting solution of potassium permanganate or sublimated, meat sterilization by boiling, autoclaving, brine, permanent pest control in farms pigs, confiscation.

II. The risks of contamination by viruses

1. Foot and mouth disease is a disease caused by a virus present in cattle, sheep, pigs etc. The man infected by contact with the contents of the vesicle from the animal, meat or organs by consumption. The virus persists for 6 months frozen meat, salted meat products 2-3 months. Acidity destroy the virus. Prophylactically when cases of FMD is observed among animals sent for slaughter, the whole batch will be slaughtered in the sanitary slaughterhouse. Meat from these animals will be sterilized by boiling and delivered so to the meat industry.

2. Q fever or Pneumoretziosa is a disease caused by the Rickettsiaburnetti. Man can become infected from sick animals. Suspected diseased animals are seized and treated and slaughtered only in the sanitary slaughterhouse. Damaged meat and organs are released after sterilization for technical industrialization.

III. The risks of contamination by parasites. The main consumer parasitic diseases transmitted by meat consumption are:

1. Trichinosis - *Trichinella spiralis* is a small roundworms (2-4mm), hardly visible macroscopically. In the adult state is the parasite of the small intestine, while the larval form is localized in the muscle where encysted. *Trichinella spiralis* is a parasite of man accidentally also appears in pigs, rats, dogs, cats, and wildlife bear, fox and wild boar. Man ingesting meat infected with larvae trichinela becomes ill of the so-called trichinosis. Encysted larvae are released in the intestine from cystic envelope and within 24 to 48 hours, become adults, male or female. Maturing process takes place in a period of about 8 days from the ingestion of infected meat. Subsequently from eggs are released larvae in the intestinal mucosa, where they migrate either lymphatic or venous, throughout the body. Typically, larvae affects muscles with increased activity, diaphragm, intercostal muscles, neck muscles and muscles of the extremities, being localized near the tendon. In about two weeks the larvae grow, reaching their final size. Due to its size, is spiraling and is coating with a cystic surrounding that isolates the larvae. *Trichinella spiralis* cyst closes 1-2 larvae then calcify. Such encapsulation larvae may remain viable and infesting for a period of time up to 2-3 years. In animals, the larvae remain alive, and if their meat is consumed by humans or animals, the cycle resumes.

Trichinosis is a zoonosis whose prophylaxis for humans depends on good organization of veterinary measures, of meat control using trichinosis exam, compulsory in all slaughterhouses. Practice has shown so far that incidents in our country were caused by cutting the animal in households conditions or less from consumption of meat from wild animals (bear, boar). Since the main vector of spread of trichinosis is represented by rats that devour each other, especially in the pig farms using pest control methods that performs better, will prevent animals infestation. Thermal processing of the meat to a minimum 77°C, within the pieces of meat, will prevent disease. Must be avoided consumption of raw meat, or meat derived from veterinary uncontrolled cutting. *Trichinella* larvae have a good resistance to cold, even living at -12°C for 2 months and at -15°C for 3 weeks. Salting and smoking methods fail to destroy the larvae from depth and larvae, is therefore, recommended for exposure to boiling for 30 minutes per kg of meat.

2. Cysticercosis is a disease caused by the larvae of *Taenia saginata* and *Taenia solium*. Infection in humans is through ingestion of meat, vegetables, fruits, salads, etc., unwashed and contaminated with tapeworm eggs. From egg are formed larvae or cysticercus. Larvae localize in skin or muscle tissue. Worst forms occur when larvae are localized in the brain, causing brain compression, cardiac level and pituitary level. To prevent contamination is necessary to take some measures to avoid infections such as: detection and treatment of patients, mandatory control of meat, washing fruits and vegetables, avoid use of contaminated water for irrigation agriculture, destruction of eggs and larvae by boiling and scalding.

3. Hydatidosis or echinococcosis is the larval form of *Taenia echinococcus granulosus*, which is parasite in the small intestine in some domestic animals such as cats and dogs. Infected dogs eliminate with feces, a large number of eggs, which, in the external environment can withstand at low temperatures for about 1-2 years. These eggs can reach accidentally in meat. Man can be infected only on oral way with eggs. It is obvious that preventive measures must aim: banning dogs and cats in slaughterhouses and farms, veterinary inspection of meat and animals.

IV. The risks of chemical contamination. Such risks can be harder to control through HACCP. If HACCP team can control and prevent risks arising from the use of food additives (nitrates - nitrites), the specialists will control and eliminate more difficult, or to reduce to acceptable limits, chemical hazards caused by environmental pollution (water, air, soil) or by industrial pollution. Among chemical risks associated with meat and meat products recall: pesticides, antibiotics, detergents, mycotoxins, etc.

V. The risks of physical contamination. They come from technological operations represented by: glass, stones, bone chips, closing clips, bits of packaging, pieces of metal, paint particles etc.

CONCLUSIONS

This paper brings to the attention of interested parties (producers, processors, consumers) quality control criteria of pork and pork meat in accordance with the HACCP system.

Systematization of the controls based on HACCP system in slaughter plants and industrialization of meat and meat products, specifying methods to prevent contamination with microorganisms, viruses, parasites, chemical and physical contamination of meat and pork, as well as their presentation, have the role of inform correctly and to the point the workers in the industry and consumers about the dangers that can occur in the technological flow, helping to reduce the incidence of diseases.

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