prodotti: l'uso dei sostituti sale, dei rinforzanti di odore e i soggetti di maschera, l'uso del sale con le caratteristiche cambiate e l'applicazione delle tecniche alternative di processo. È stato scritto un riassunto breve delle possibilità e dei trattamenti di riduzione del sale in alcuni gruppi di prodotti: i prodotti della carne macinata - le salsicce cotte pasterizzate, il prosciutto cotto ed i prodotti affumicati, cioè fermentati.

***Parole chiave**: prodotti di carne, sale (NaCl), riduzione di concentrazione*

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HAZARD ANALYSIS AND CCP DETERMINATION IN THE SMOKED CHICKEN LEG PRODUCTION PROCESS

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SUMMARY

Hazard analysis, the first principle within the HACCP system has been identified as one of the most demanding tasks for a HACCP team. The second principle of HACCP is determination of Critical Control Points, at which control can be applied and is essential to prevent or eliminate a food safety hazard or to reduce it to an acceptable level. In this study hazard analysis and CCP determination for the smoked chicken leg production was made. Using UGent method 5 production processes/steps were determined as CCPs.

***Key words:** CCP, HACCP, hazard analysis, smoked chicken leg*

INTRODUCTION

Hazard analysis, the first principle within the HACCP system has been identified as one of the most demanding tasks for a HACCP team (Mortimore and Mayes, 2002). It is the process of collecting and evaluating information on hazards and conditions leading to their presence in foods to decide which are significant for food safety and therefore should be addressed in the HACCP plan. Hazard analysis is composed of: 1.inventarisation of all the hazards present in the food, which can cause adverse effect, 2.hazard assessment/evaluation (probability and severity) and 3.identifying control measures for the hazards control (Codex Alimentarius, 2003; Luning et al.,

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2002). Risk assessment can be quantitative (risk matrix) and qualitative (Codex decision tree). The second principle of HACCP is determination of Critical Control Points. CCP is any point or process step at which control can be applied and is essential to prevent or eliminate a food safety hazard or to reduce it to an acceptable level (Baert et al., 2005). Only the steps, points or processes where an efficient control is possible should be consider as CCPs. CCP can be identified by using the Codex decision tree, using risk matrix, or by combination of those two.

MATERIALS AND METHODS

In this work, hazards analysis and CCP determination for smoked chicken legs production is made using UGent (University of Gent, Faculty of Bioscience Engineering, Laboratory of Food Microbiology and Food Preservation) method. Information about production process was collected from the meat industry (figure1). Grades for probability and effect are assigned according to the definitions described by Baert et al. (2005) and using assessed grade of risk category (probability x effect) in a risk matrix (table 1), CCPs are determined. For the grades 1 and 2 no specific actions are necessary because control is covered by Prerequisite Programs (PRPs). Grade 3 or 4 is possible CP, if PRPs control of the identified risk is not enough. Grades 5, 6 and 7 are recognized as CCPs. In the case of doubt Codex decision tree is applied.

RESULTS AND DISCUSSION

HAZARDS RELATED WITH RAW MATERIAL

Different microbial hazards can be found in raw poultry. Bacteria belonging to *Campylobacter* genera are most commonly reported food pathogens and raw poultry is considered as major source of *Campylobacter* spp. Raw poultry is also an important source of *Salmonella* spp. and *L. monocytogenes* (Kozačinski et al., 2007; Schuchat et al., 1992). Strains of *S. aureus* associated with poultry carcasses are generally not of a public concern, because enterotoxin production is uncommon for these strains. *Clostridium* spp. occurs on the surfaces of raw poultry, usually in small numbers.

Chemical hazards related with poultry are: residue of veterinary drugs, residue of pesticide (organochlorine residues), heavy metals (cadmium, lead, arsenic), ochratoxin A, dioxins and PCBs. Physical hazards related with poultry are intrinsic (bones fragment) and extrinsic foreign objects (metal, plastic).

Water, especially if not potable, can harbor ubiquitous or fecal or aquatic bacteria such as *Cl. perfringens, Salmonella spp., L. monocytogenes*, *Campylobacter jejuni*, *Shigella*, *Vibrio* spp., *Bacillus cereus, Yersinia enterolitica* and *Escherichia coli.* Being environmental contaminants residue of pesticide, nitrates, heavy metals, PCBs and dioxins, as well as polycyclic aromatic hydrocarbons (PAH) can be found in the water. Sodium chloride, sodium nitrite and polyphosphate are associated with chemical hazards: heavy metals (arsenic, lead, mercury) and iodine compounds.

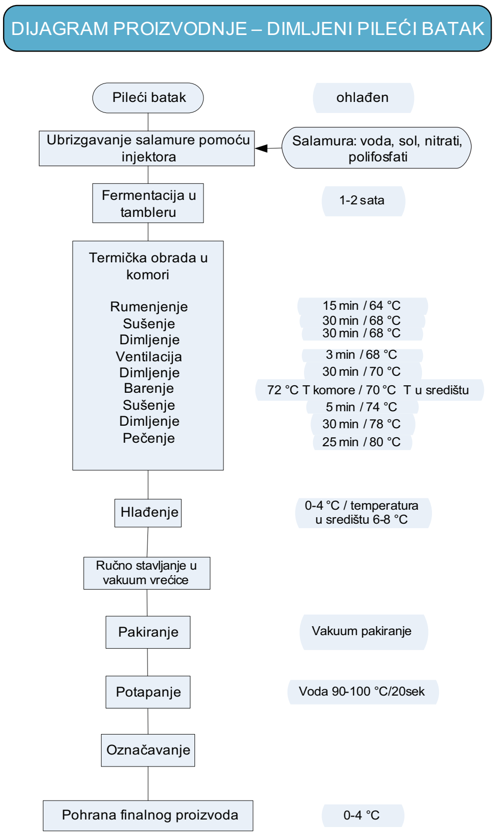
Spices (pepper, garlic, laurel) can be contaminated with *B. cereus*, *Clostridium* spp., *S. aureus, Enterobactriaceae* and *Streptococcus* spp. Residue of pesticides, mycotoxins (aflatoxin, ochratoxin A) and heavy metals are possible chemical hazards in spices. Presence of foreign objects is identified as physical hazard. (e.g. dirt, insects, plastic).

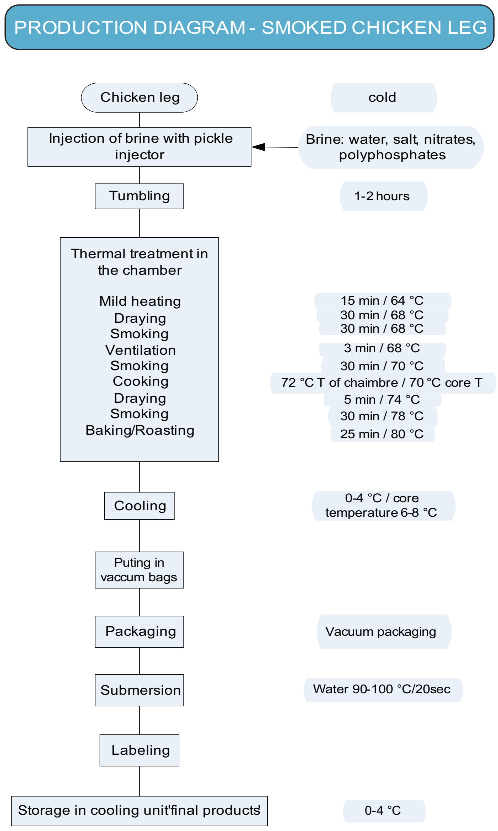
HAZARDS RELATED WITH PROCESSES

In spite of antimicrobial effect of thermal treatment (temperature -T), curing (nitrite and salt action), drying (T, low a_w), smoking (T, smoke compounds), cooling and cold storage (low T), there is a risk of surviving and growth of pathogens. In addition to spore-forming pathogens, vegetative pathogens may survive when integrated time and temperature regime is insufficient. Although brine inhibits growth of bacteria and germination of *Cl. botulinum* spores, *S. aureus* and *L. monocytogenes* can survive and grow in substrates having more than 15% NaCl. Some bacteria can also survive smoking process. Drying

Table 1. Risk evaluation procedure (Baert et al., 2005)

PROBABILITY	**High**	**4**	4	5	6	7
	Real	**3**	3	4	5	6
	Small	**2**	2	3	4	5
	Very small	**1**	1	2	3	4
			1 Limited	**2 Moderate**	**3 Serious**	**4 Very serious**
	EFFECT					





reduces water activity of the meat. Spores of *Clostridium* spp. and *Bacillus cereus* are most resistant to reduced water activity. Control of the growth of surviving spores is thus achieved through the use of an effective cooling regime. Temperature abuse during storage causes growth of spores as well as the surviving vegetative pathogens (Filipović, 2008).

Production-related chemical hazards are considered N-nitroso compounds (generated in curing process) and PAH (generated during drying and smoking) (De Meulenaer, 2006).

FINAL PRODUCT ASSOCIATED PATHOGENS

Vacuum packed smoked chicken leg is ready to eat product belonging to a group of perishable, cooked poultry products. All vegetative pathogens are expected to be eliminated at thermal treatment. Yet, products are possibly subjected to post-process contamination during subsequent handling and packaging. Staphylococcal food-borne illness is primarily associated with poultry products that are cooked and served in homes or food-service establishments (Mead, 1992, ICMSF, 2005) Proper refrigeration will prevent *S. aureus* multiplication and the risk of enterotoxin production. Commercially manufactured ready to eat poultry products have been implicated in outbreaks of human listeriosis, caused by persistent strains of *L. monocytogenes* that contaminated products after thermal treatment. Outbreaks of salmonellosis are mostly due inadequate cooking or recontamination/cross-contamination of ready to eat food. Food-borne illness from anaerobic *Clostridium* spp. could occur only after product is held at >10 ºC/ 15 ºC (*Cl. botulinum*/*Cl. perfringens*) for sufficient time for extensive multiplication to occur. Cured poultry products have rarely been implicated in *Cl. perfringens* illness, because of pathogen's relative sensitivity to the combined effect of salt and sodium nitrate. *Cl. botulinum* has been reported to cause human botulism (Tompkin, 1980).

CCPS IN THE PRODUCTION PROCESS

First steps recognized as CCP (≥5 in the matrix table) are brine preparation and injection with possible microbial and chemical hazards, which can not be eliminated or reduced to acceptable level by subsequent steps.

Too little nitrite and polyphosphate harbor risk of growth of pathogens, especially *Cl. botulinum*, while adding too much of them will result in a chemical hazard of exceeding the maximum allowed level in the final product. Heat treatment is considered as third CCP (grade 6) because of the risk of vegetative pathogens survival at insufficient temperature/time integral. There are no next steps in the production to control pathogens. Another hazard in this step is chemical - benzo(a)pyrene contamination. Because of the PRPs (indirect drying and smoking, smoke filtering), PAH level should not be high; this is considered as CP. Next ≥5 points step considered as CCP is cooling after thermal treatment. Microbial hazard is related to growth of surviving spores at inadequate cooling. The last step described as CCP is submersing in water that serves as post pasteurization step to eliminate pathogens post contaminating product after thermal treatment during handling and packaging. If residence time in the water is too long or short, and temperature is improper, surviving or even growth of pathogens is possible.

CONCLUSION

In the smoked chicken leg production process 5 CCPs are determined: 1. preparing the brine (sodium nitrite and polyphosphate concentration), 2. brine injection, 3. thermal treatment of chicken legs, 4. cooling after thermal treatment, and 5. submersing of product packages.

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SAŽETAK

ANALIZA OPASNOSTI I ODREĐIVANJE KRITIČNIH KONTROLNIH TOČAKA U PROCESU PROIZVODNJE DIMLJENOG PILEĆEG BATKA

Analiza opasnosti, prvi princip HACCP sustava, identificiran je kao jedan od najzahtjevnijih zadataka HACCP tima. Drugi princip HACCP-a je određjivanje kritičnih kontrolnih točaka - procesa, koraka koje podliježu kontroli koja je esencijalna za prevenciju ili eliminaciju opasnosti za sigurnost hrane ili za njegovo smanjenje na prihvatljivu razinu. U ovom radu napravljena je analiza opasnosti te su određene kritičnih kontrolne točke u procesu prizvodnje dimljenog pilećeg batka. Pomoću UGent metode utvrđeno je da pet proizvodnih procesa/koraka u navedenoj proizvodnji pripada kritičnim kontrolnim točkama.

Ključne riječi: *analiza opasnosti, HACCP, kritična kontrolna točka, dimljeni pileći batak*

ZUSAMMENFASSUNG

GEFAHRANALYSE UND BESTIMMUNG DER KRITISCHEN KONTROLLPUNKTE IM HERSTELLUNGSPROZESS DER GERÄUCHERTEN HÜHNERKEULEN

Gefahranalyse, das erste Prinzip des HACCP Systems, ist als die anspruchsvollste Aufgabe des HACCP identifiziert. Die zweite Aufgabe ist die Bestimmung der kritischen Kontrollpunkte des Prozesses, bzw. der Kontrolle unterliegenden Schritte, die für die Vorbeugung oder Beseitigung der Gefahren hinsichtlich Nahrungssicherheit oder deren Verringerung auf annehmbares Niveau essentiell ist. In dieser Arbeit ist die Gefahranalyse durchgeführt und es wurden die bestimmten kritischen Kontrollpunkte im Herstellungsprozess der geräucherten Hühnerkeulen bestimmt. Mit Hilfe der UGent Methode wurde bestimmt, dass fünf Prozesse/Herstellungsschritte in der erwähnten Herstellung den kritischen Kontrollpunkten gehören.

Schlüsselwörter: *Gefahranalyse, HACCP, kritischer Kontrollpunkt, geräucherte Hühnerkeule*

SOMMARIO

ANALISI DEL PERICOLO E DETERMINAZIONE DEI PUNTI CRITICI DI CONTROLLO NEL PROCESSO DI PRODUZIONE DELLA COSCIA DI POLLO AFFUMICATA

Analisi del pericolo, il postulato principale del sistema HACCP, è stato identificato come uno dei più esigenti compiti del gruppo di HACCP. Altro postulato di HACCP è la determinazione dei punti critici di controllo – i processi, cioè i passi che vengono sottoposti ad un controllo essenziale nella prevenzione o nell'eliminare del pericolo che riguarda la sicurezza alimentare, o la sua riduzione al livello accettabile. Nel questo brano è stata fatta un'analisi del pericolo, dopo di che sono stati determinati i punti di controllo nella produzione della coscia di pollo affumicata. Usando il metodo UGent, è stato concluso che cinque processi, cioè passi produttivi (nella suddetta produzione) appartengono ai punti critici di controllo.

Parole chiave*: analisi del pericolo, HACCP, punto critico di controllo, coscia di pollo affumicata*

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Pussa, T., P. Raudsepp, P., Toomik, R. Pallin, U. Maeorg, S. Kuusik, R., Soidla, M. Rei (2009): **A study of oxidation products of free polyunsaturated fatty acids in mechanically deboned meat. Istraživanje oksidacijskih procesa slobodnih polinezasićenih masnih kiselina u mehanički otkoštenom mesu. Journal of Food Composition & Analysis. 22, (4): 307-314.**

Priprema mehanički otkoštenog mesa omogućuje ekonomičniju uporabu animalnih proizvoda i smanjenje količine biološkog otpada. S druge strane, pojačana oksidacija masti uzrokuje zabrinutost oko sigurnosti i kakvoće strojno otkoštenog mesa. No, nema informacija o aktualnoj kemijskoj strukturi i mogućim učincima po zdravlje ovih oksidacijskih produkata. Relativno niska cijena strojno otkoštenog mesa (SOM) može dovesti do iskušenja patvorenja mljevenog mesa sa SOM-om. Do sada, nisu poznati dobri kemijski biljezi (markeri) koji ukazuju na prisutstvo SOM. Mi smo istraživali kemijski sastav različitih vrsta SOM pomoću LC-tandem spektrometrije masa (MS) i identificirali velik broj oksidacijskih produkata slobodnih masnih kiselina (oksilipina). Sve istraživane vrste SOM-a sadržavale su značajno veće količine slobodnih nezasićenih masnih kiselina i oksilipina nego odgovarajuće vrste ručno-otkoštenog mesa. Njihova koncentracija, općenito je rasla i tijekom pohrane SOM-a. Najviši pik (najviša točka), na MS baznom kromatogramu SOM-a pripadala je 9,10,13-trihidroksi-11-oktadecenoičnoj kiselini (9,10,13-THODE), glavnom kandidatu za kemijske markere strojno otkoštenog mesa i netopivoj mješavini 13-hidroksi-9,11-oktadecadienoičnoj (13-HODE) i 9-hidroksi-11,13-oktadecadienoičnoj (9-HODE) kiselini. U većini oksidiranih SOM uzoraka, 9,10-dihidroksi-12-oktadecenoična kiselina (9,10-DiHOME; LTX-diol) primjećena je u koncentracijama koje bi mogle uzrokovati povećanje nekih toksikoloških briga.

Kandeepan G., A.S.R. Anjaneyulu, N. Kondaiah, S.K. Mendiratta, V. Lakshmanan (2009): **Effect of age and gender on the processing characteristics of buffalo meat. Utjecaj dobi i spola na preradbena svojstva bivoljeg mesa. Meat Science, 83, 1, 10 -14.**

Napravljena je usporedba preradbenih svojstava mesa mladih mužjaka, te starih mužjaka i ženki bivola kako bi se otkrila prikladnost mesa za razvoj “ready to eat “ mesnih proizvoda. Meso intenzivno uzgojenog mladog mužjaka bivola imalo je veću vlagu, topivost kolagena, dužinu sarkomera, indeks miofibrilarne fragmentacije i kapacitet vezanja vode, u odnosu na meso drugih životinja. Viši pH, ukupni pigmenti mesa, slani topivi proteini, emulzificirajući kapacitet te niža topivost kolagena, opaženi su u mesu starih mužjaka bivola. Meso starih bivolica imalo je više masti i ukupnog kolagena, veći dijametar mišićnog vlakna te vrijednost poprečne sile. Senzorna procjena pod tlakom kuhanih komada mesa ukazala je na značajnu žilavost uzoraka mesa i muških i ženskih starijih bivola. Ovi rezultati ukazuju da je meso mladih bivola prikladnije za preradu u komadima, dok je meso starih bivola i bivolica prikladnije za preradu u malim komadima.

Ivana Filipović, univ. mag., dr.med.vet.