sciendo

Acta Veterinaria-Beograd 2018, 68 (4), 373-390
UDK: 637.52(497.11)
DOI: 10.2478/acve-2018-0031

Review article

PRODUCTION OF TRADITIONAL MEAT PRODUCTS IN SMALL AND MICRO ESTABLISHMENTS IN SERBIA: CURRENT STATUS AND FUTURE PERSPECTIVES

KARABASIL Nedjeljko[1*], BOŠKOVIĆ Tamara[2], TOMAŠEVIĆ Igor[3], VASILEV Dragan[1], DIMITRIJEVIĆ Mirjana[1], KATANIĆ Nenad[4], ANTIĆ Dragan[5]

[1]University of Belgrade, Faculty of Veterinary medicine, Department of Food Hygiene and Technology, Bulevar oslobodjenja 18, 11000 Belgrade, Serbia; [2]Ministry of Agriculture, Forestry and Water Management, Veterinary Directorate, Veterinary Public Health Department, Omladinskih brigada 1, 11070 Belgrade, Serbia; [3]University of Belgrade, Faculty of Agriculture, Department of Animal Origin Products Technology, Nemanjina 6, 11080 Belgrade-Zemun, Serbia; [4]Ministry of Agriculture, Forestry and Water Management, Nemanjina 22-26, 11000 Belgrade, Serbia; [5]University of Liverpool, Faculty of Health and Life Sciences, Institute of Veterinary Science, Leahurst, Neston, CH64 7TE, United Kingdom

(Received 02 November, Accepted 19 November 2018)

The production of traditional meat products has a considerable potential in the Republic of Serbia, particularly in small and micro (household) establishments. Among a large number of traditional meat products, dry fermented sausages and dried meat products are the most important and commonly appreciated by consumers. There is, however, a need for a better standardization of the production in this meat sector, and also implementation of necessary food hygiene rules and HACCP principles according to hygiene regulations. There are provisions in the Food Safety Law, stating the principles of flexibility, which would allow for traditional meat producers and their associations to apply for derogations in food hygiene regulations. This would enable traditional small and micro food business operators to better use their resources, relax administrative burden and use traditional production methods in the most appropriate manner, always respecting hygiene and safety principals. This review paper analyses the current status of traditional meat production in small and micro establishments in Serbia, emphasizing a need for further improvements in food safety management and standardization.

Key words: food, traditional, hygiene, safety, management, flexibility.

INTRODUCTION

Traditional foods represent an important part of European culture, identity, and heritage [1] and are also highly appreciated among consumers in Serbia [2]. Serbia is a relatively small country, but with many approved establishments (1,000) for production of meat and meat products [3]. A live tradition in the production of meat

*Corresponding author: e-mail: nedja@vet.bg.ac.rs

and meat products is deeply rooted in the Serbian culture. The majority of meat establishments are small capacity facilities with significance to the local community or to the region where they are located. Traditionally, pork is the most consumed type of meat and this also correlates to pork production which by far is the most commonly produced meat, followed by poultry (Table 1) [2,4-6]. Beef is also highly valued and more commonly consumed in some parts of the country, especially due to religious reasons [7].

Table 1. Meat production in Serbia 2010-2017 (000 t) (Statistical Yearbook of the Republic of Serbia, Chapter Agriculture, 2012, 2015, 2018)

Year	Beef	Pork	Ovine	Poultry	Total
2010	96	269	23	84	472
2011	81	271	24	103	479
2012	82	252	22	94	450
2013	70	249	30	92	441
2014	73	258	27	94	452
2015	77	278	30	86	471
2016	77	301	34	88	500
2017	71	307	30	95	503

There is a wide variety of establishments within the meat sector, and they can be classified as: (i) slaughterhouses (red meat: pig/cattle/sheep and white meat: poultry/lagomorph), (ii) meat processing establishments, and (iii) combined establishments activities (slaughter and/or meat cutting and/or meat processing) [3]. In such a diverse meat sector in Serbia, there is a large number of small food business operators which produce a substantial amount of meat products, thus potentially having significant impact on a large number of consumers. Also, some quantity of meat products is regularly produced and placed on local markets by a number of household producers, which could be considered as "micro" businesses [8]. The most common classification of food business operators (FBOs) according to their size is the number of persons employed, which in the case of micro FBOs is fewer than 10 persons and in small FBOs from 10 to 49 persons [9]. Small-scale livestock production is still dominant in Serbia (i.e. "backyard" farming), and even 80% of all registered farms keep up to 5 LSU (Live Stock Unit) and an estimated 35% of all food-producing animals in Serbia [10]. This meat sector obviously holds a large share of the meat market, but is not adequately addressed in the related policies and strategic development [2]. One should also take into account the fact that traditional meat production in small and micro (household) facilities often lacks thorough official controls and therefore could be associated with food safety risks. Therefore, meat manufactured and placed on the market by these traditional producers has to be produced according to the hygiene rules and HACCP principles thus reducing related meat and meat products safety risks [2].

The objective of this review paper is to analyse the current status of meat production in small and micro, traditional meat establishments in Serbia, food safety management in this meat sector and explore future perspectives for all stakeholders in the meat chain.

FOOD SAFETY LEGISLATION IN SERBIA

In Serbia, food safety principles were firstly mandated by the Law on Veterinary Matters [11], which introduced for the first time the notion that the safety of food of animal origin should be based on the principles of Good Manufacturing Practice (GMP), Good Hygiene Practice (GHP) and Hazard Analysis and Critical Control Points (HACCP). With the adoption of the Law on Food Safety [12], which introduced a concept of food business operators' (FBO) responsibility to produce safe food, obliging them (regardless of their size) to adopt and implement a food safety system, and the deadline for all producers to develop and implement such systems (GMP/GHP/HACCP) was set to the 1st June 2011. Law on Food Safety [12] is harmonized with Regulation (EC) No. 178/2002 and derived secondary legislation, i.e. Ordinances on general and specific hygiene rules for food of animal origin [13-15], are mostly in line with the EU "Hygiene Package" (Regulation (EC) No. 852/2004; 853/2004 and 854/2004). Serbian "Hygiene Package" stipulates duties and responsibilities of FBOs in protecting public health, and more specifically covers the main areas in food producing establishments: animal slaughter, production and processing of food of animal origin (e.g. meat cutting and processing), distribution of food of animal origin, and food at retail level. Animal welfare aspects are covered within the Law on Animal Welfare [16], with derived Ordinances on the protection of animals during transport and during slaughter and killing [17,18]. Therefore, food safety system is based on principles of the responsibility of FBOs in the food chain; traceability of food along the food chain; and application of risk analysis in every part of the food production chain [2,19].

The requirements stipulated in the Serbian "Hygiene package" are, however, mainly focused on the "standard", large and medium establishments, which usually have the resources and logistics to meet these requirements. This includes mandatory requirements for implementing HACCP principles to all FBOs (excluding primary production). On the other hand, small FBOs are often not able to meet all requirements due to different reasons discussed more in depth in the following chapters. However, there is a legal basis within the Law on Food Safety pertaining to the small and micro FBOs which could be exempted from meeting certain structural requirements, in the situations when they directly supply their primary products in small quantities to the final consumer [12].

TRADITIONAL MEAT PRODUCTION IN SERBIA

Traditional food products and production, being very subjective and complex concepts, are difficult to define [2,20]. Some key words and components describing traditional foods may include: (i) having traditional ingredients/composition, (ii) ripening/maturation over a certain period of time, (iii) little/no processing, *transmission between generations, (iv) associated to a certain local area and, (v) made according to gastronomic heritage [1]*. The European Union has recognized the early potential of traditional food manufacturing [21], as it represents nowadays one of the important sources of income and opportunities for employment [20,22,23]. In order to protect traditional and know-how food products, appropriate derogations from the "Hygiene package" have been set, aiming to support traditional practices that add to the variety of quality products on the market, but not at the cost of hygiene and safety [24,25]. Very important stakeholder in this respect are associations of traditional food producers which are well organised and efficiently represent producers' interests. They are the keepers of tradition and govern production standardisation establishing rules and standards, but they also set the requirements to the competent authority regarding the application or revision of certain legislation [26,27].

The system of certification of products with geographical indications and designations of origin in Serbia is in the early phase of development. Food products are branded with control marks issued by the Ministry of Agriculture, Forestry and Water Management, referring to as "Protected Designation of Origin" (PDO) or " Protected Geographical Indication" (PGI) [28]. This relates to the two types of geographical descriptions set in Regulation (EC) No 510/2006, i.e. PDO and PGI [29]. The common problem for many small and micro FBOs producing traditional meat products according to the procedures defined in the Code of practice [30] is that some of them are not registered in the Registry of registered/approved food establishments [3]. This means that they are not eligible to be officially certified as traditional producers and given a status of an authorised user of geographical indications and designations of origin, which would allow them to brand their meat products accordingly and place them on the market as such. The association of traditional food producers exists, but is not engaged enough to be of service to its members, as a key stakeholder to protect their interests [2].

There are two main clusters of traditional meat products in Serbia, i.e. dry fermented sausages and dried meat products, among which the most prominent are "Sremska šunka", "Zlatiborska pršuta", "Sremski kulen", "Petrovska klobasa" and "Sjenički sudžuk" (Table 2) [31-35]. These traditional, know-how products are highly appreciated among consumers, but also tourists visiting Serbia. There is a number of geographical areas well known and recognised as regions with the production of certain traditional meat products [30]. Srem region, a defined geographical area in the Autonomous Province of Vojvodina, has a substantial production of pigs and pork meat, processed in various types of raw and fermented sausages, ham, cracklings, bacon and pork fat.

The two most famous traditional meat products are "Sremski kulen" (dry fermented pork sausage) and "Sremska šunka" (dry ham). Other regions, particularly in the southern parts of Serbia, are well known for the production of beef and traditional beef products, such as Zlatibor mountain ("Pršuta", dried beef meats) and the area of Pešter ("Sjenički sudžuk", dry fermented beef sausage). Production processes, with associated hazards and control measures, of two well-known and commonly consumed traditional meat products, "Sremski kulen" and "Sremska šunka", will be briefly discussed in the following chapters.

Table 2. A list of some well recognized traditional dried and fermented meat products in Serbia (The Intellectual Property Office, Republic of Serbia, 2018)

Product	Production area	Description
Sremski kulen (Srem kulen)	Region of Srem in Vojvodina, Northern Serbia	Dry fermented pork sausage made of ground pork meat mixture with red hot paprika and table salt and stuffed into natural casings. The sausage is cold-smoked and stored in well aired spaces to dry and mature.
Lemeški kulen (Lemes kulen)	Area of western Backa in Vojvodina, Northern Serbia	Dry fermented pork sausage made of meat of older pigs and mixed with the locally produced powdered paprika. The batter is traditionally made manually, with prolonged mixing of meat, paprika and table salt. The sausage is cold-smoked and stored in a cool place to dry and mature.
Petrovska klobasa (Petrovac sausage)	Region of Bački Petrovac/Bačka (southern part) in Vojvodina, Northern Serbia	Dry fermented pork sausage made of ground pork meat, mixed with spices (red hot paprika of local origin, garlic, salt, sugar, cumin) and stuffed into natural or artificial casings. The sausage is cold-smoked and stored in a cool place to dry and mature.
Sjenički sudžuk (Sjenica sudzuk)	Area of Sjenica – South-western Serbia	Dry fermented beef sausage produced of beef meat and fat tissue (ratio 80:20), where beef meat can be optionally replaced with ovine meat (up to 30 %), and with added spices (salt, powdered garlic and small amount of red paprika). The sausage is cold-smoked and stored in a cool place to dry and mature.
Sremska šunka (Srem ham)	Region of Srem in Vojvodina, Northern Serbia	Dry ham is produced of pork leg and is only dry-salted. The ham is cold-smoked and stored in well aired spaces to dry and mature for up to 12 months.
Zlatiborska govedja pršuta (Zlatibor beef prsuta)	Zlatibor mountain, Western Serbia	Dry beef meat, made of top quality cuts (short loin, sirloin and round) of bovines three to five years old, therefore the meat has very strong aroma. The meat is dry-salted, cold-smoked (beech wood) and stored in well aired spaces to dry and mature for several months.

Traditional meat processing practices and associated hazards

Traditional practices stem from the experience and monitoring of the outcomes of food production over a long period of time, usually many generations, having as a result a safe product of high quality for human consumption [36,37]. Traditional meat products in Serbia are usually made from high quality, carefully selected raw

meat, and by utilising traditional preservation techniques to achieve the stability, safety and prolonged shelf life of the product [31,34,35,38,39]. Production usually starts in the late autumn or winter, as low temperatures are necessary for the salting and curing process, and ends with the final maturation in the summer months when higher temperatures complete the formation of products' flavour and texture. A range of different traditional meat preservation techniques (i.e. salting and curing, fermentation, smoking and drying) performed with strict adherence to a good manufacturing practice (GMP) and good hygiene practice (GHP), should warrant the safety of the final meat products. Also, the combination of factors such as low pH value, high salt content, low water activity and water content in the product and smoke (on the surface), act as "multiple hurdles" to control microbial growth or even reduce/eliminate microbial hazards in these meat products [40-42].

Traditional meat products may represent a significant microbial or chemical food safety risk for the consumer. In many countries, consumption of dry fermented sausages has been associated with different foodborne illnesses in the past, caused by very cytotoxigenic *E. coli* (VTEC), *Salmonella*, *Listeria monocytogenes* and/or *Staphylococcus aureus* [41,42]. The *Salmonella* risk posed by dry fermented sausages produced from pork meat is increased by the pathogen's ability to grow in foods with a low a_w value [42]. Likewise, the risk of human exposure to *E. coli* O157 associated with the consumption of beef/lamb dry fermented sausages is potentiated by their ability to survive in a low pH environment [41]. However, there is, in general, a lack of published data on microbial safety of traditional meat products in Serbia. According to some studies, spoilage bacteria (*Pseudomonadaceae* and *Enterobacteriaceae*) regularly die out during fermentation process, while *Listeria monocytogenes* was not detected neither in examined samples of Sremski kulen and Sremska sausage [43] nor in Lemeski kulen [32]. On the other hand, being traditionally an endemic area for *Trichinella* spp. [44, 45], human trichinellosis due to the consumption of meat containing *Trichinella* larvae, particularly from home-made dry fermented sausages, is quite common [46]. The main underlying reason includes the fact that *Trichinella* larvae can survive curing, fermentation, cold-smoking and drying in these products. This is often the case with pigs slaughtered under home arrangements and/or meat from hunted wild boars, often lacking in knowledge and not performing tests for the detection of *Trichinella* larvae [45-47].

The critical steps in the production of traditional meat products to ensure their safety and quality are selection of raw meat, salting, smoking and maturation. The fact that these high quality products are not subjected to any heat treatment highlights the necessity of having raw meat of good hygienic quality with low level of microbial contamination [48]. Only in this case, the combination of antimicrobial factors will be sufficient enough to prevent growth, and in some cases reduce or even eliminate, potentially present foodborne pathogens [41]. One example of the chain of events in the production of dry ham leading to an increased risk of human exposure to *Clostridium botulinum* neurotoxins is in the case of inadequate hygiene during pig slaughtering and dressing (initial contamination), inadequate chilling of pork and insufficient salt

concentration. All these factors create favourable conditions for *Cl. botulinum* growth and toxin production during the maturation stage [49]. It is, therefore, essential to ensure that the cold chain for the raw meat material is continuously maintained, particularly when the production takes place during the spring and summer months. The salting process is usually performed using dry-salting method and table salt with concentrations ranging from around 3% (for dry fermented sausages) and up to 7% (for dried meats). Even though not sufficiently effective as a standalone antimicrobial factor, particularly against salt-tolerant pathogens such as *L. monocytogenes* and *S. aureus,* salt concentration in the products must not be less than minimum sufficient to inhibit the growth of most other pathogenic microorganisms [33,43].

Cold-smoking of traditional meat products is usually performed in the smoke chamber (i.e. "pušnica"), where products are exposed to a natural smoke originated from smouldering wood shavings (usually oak or beech). The smoke from the open furnace is introduced into the smoke chamber through small openings (protected from insects or birds). The smoking conditions (and the smoke) are very difficult to control due to a highly variable temperature of wood pyrolysis, which should not be higher than 300°C. A higher temperature of pyrolysis and incomplete wood combustion can lead to the production of a considerable amount of carcinogenic polycyclic aromatic hydrocarbons (PAHs) in the smoke, especially benzo(a)pyrene, which deposits and remains on the surface of meat products [50]. Therefore, wood shavings are sprinkled or sprayed with water to maintain optimal smoking temperatures and also add humidity to the smoke chamber. A proper temperature-relative humidity ratio is also essential to prevent formation of a dry edge on the surface of products (especially in dry fermented sausages), in which case proper drying and maturation of the inner parts of the product would not be possible [33].

Maturation is the final step which usually lasts for a longer period of time and requires a knowledge and experience to recognise when this process is completed. In the final stage of maturation, the products are stored in cool, well aired places (usually cellars). In the case when product maturation takes place in climatic chambers at around 15°C, the relative humidity should be lower than 75% in order to prevent mould growth on the product surface. As opposed to industrial production, traditional producers generally do not add starter cultures to fermented sausages. Therefore, fermentation and maturation processes, as well as final quality and safety of these products, are influenced by indigenous microbiota originated from the raw meat or environment [51]. Their activity, being a highly uncontrolled process, can cause the formation of biogenic amines, particularly toxic histamine and tyramine, which when present in high concentrations pose a significant public health risk [41,51].

Process of production of "Sremski kulen" (dry fermented sausage)

Kulen is a traditional dry fermented sausage manufactured for centuries in the whole region of the Balkans, primarily in the planes of Srem and Bačka in Serbia and Baranja

and Slavonija in Croatia. Depending on the region where it is produced, kulen has an adequate local name [32], i.e. kulen produced in the region of Srem is called "Sremski kulen" (Srem kulen). Apart from the traditional production within households and exclusively during the winter season, products branded with name "kulen" are also produced in industrial facilities in a more controlled manner, i.e. using starter cultures, curing salt (with nitrites), powdered paprika, sugars, and stuffed into artificial casings, which improve product safety [33]. Sausages produced in such manner significantly differ from the traditional "Sremski kulen", especially in their sensory characteristics [2].

Table 3. Flow diagram of "Sremski kulen" (dry fermented sausage), hazards and control measures

Flow diagram	Hazards	Control measures
Raw meat receiving ↓	Pathogenic bacteria: *Salmonella, Yersinia enterocolitica, Staph. aureus, L. monocytogenes, Clostridium spp.* *Parasites: Trichinella spiralis*	Raw meat of good quality; Rapid chilling of meat; Meat examination for *Trichinella*
Meat chopping ↓	Cross-contamination	GMP/GHP
Mixing and seasoning (table salt and paprika) ↓	Cross-contamination, bacterial growth	GMP/GHP; Storage of spices in dry space; Minimum table salt added 2.2%
Stuffing into natural casings ↓	Cross-contamination	GMP/GHP; Adequate preparation of natural casings
Draining ↓	/	GMP/GHP
Cold-smoking and fermentation ↓	PAH (benzo(a)pyrene)	GMP/GHP; Control of smoking conditions and optimal smoking temperatures and humidity
Drying and maturation (up to 6 months) ↓	Bacterial growth; Production of toxic biogenic amines (histamine, tyramine)	GMP/GHP; Temperature and humidity control; Control of the pH
Final product Sremski kulen	Physico-chemical parameters: pH ~ 5.3 Table salt content ~ 3% Water activity (a_w) < 0.89 Water content (%) < 35 Fat content (%) < 30 Meat protein content (%) >30	

Sremski kulen is produced from high quality meat of matured pigs containing less water, more dry matter and has a more intensive red color and firmer consistency [33]. Meat originates primarily from the leg, shoulder and some parts of the neck region, with less fat and without connective tissues. In some regions, there is still a tradition of making kulen from non-chilled meat, not long after slaughtering, but most of producers use nowadays chilled meat. The only additives used are table salt and an adequate mix of sweet and hot powdered red paprika which are added in the amount of 2.2% to 2.5% and 0.9% to 1.4%, respectively (Table 3). Sweet paprika is added to give the colour and aroma, while the hot one for a piquant taste of the sausage. Meat is chopped into more coarse pieces, mixed well with salt and paprika, and the batter is stuffed into natural casings (caecum). Kulen is tied with the strings at both ends, and left for a short draining. The sausages are then cold-smoked in chambers, with smoke generated from wood (beech) in an open furnace. The smoke should be white to greyish-white in color which indicates the proper smoking conditions and optimal smoking temperatures to prevent PAH formation [33]. The smoking process, accompanied with fermentation, usually lasts two to four weeks, until the product gets a copper red color. The last step is drying and maturation of the sausages which duration depends on the diameter of the sausage, and could take up to six months. The final product has very low pH and water activity, and is considered shelf-stable (Table 3).

Process of production of "Sremska šunka" (dry ham)

"Sremska šunka" (Srem ham) is a traditional dried meat produced in the geographical area of Srem, by salting, smoking and drying of pig hams [34]. Sremska šunka is produced from high quality pig hams of matured, heavy pig breeds containing less water and with a more intensive red colour and firmer consistency. Production usually starts in the late autumn or winter, and ends with the final maturation in the summer months. Ham is cut from the pork carcass, the fat is removed and the ham shaped (Table 4). Table salt (4%) is the only additive used. The salt diffusion process should last long enough (usually 4 days per 1 kg meat) and requires temperatures under 5°C in order to prevent bacterial growth, with emphasis on *Clostridium botulinum* growth and neurotoxin production [52]. After salting, hams are usually washed and drained before smoking. Cold-smoking is performed in smoke chambers in conditions similar to the ones used for kulen. After smoking, hams are stored in well aired spaces to dry and mature for up to 12 months (Table 4). In order to protect them from infestation by insects during the summer months, dry hams are usually coated and adequately packaged [53].

Table 4. Flow diagram of "Sremska šunka" (dry ham), hazards and control measures

Flow diagram	Hazards	Control measures
Raw meat receiving ↓	Pathogenic bacteria: *Salmonella, Yersinia enterocolitica, Staph. aureus, L. monocytogenes, Clostridium spp.* *Parasites: Trichinella spiralis*	Raw meat of good quality; Rapid chilling of meat; Meat examination for *Trichinella*
Cutting and processing of ham ↓	Cross-contamination	GMP/GHP
Dry-salting ↓	Cross-contamination, bacterial growth	GMP/GHP; Storage of salt in dry space; Minimum table salt added 4%; Salt diffusion should last long enough (4 days per 1 kg meat) and at <5°C
Curing (salt diffusion) ↓	Cross-contamination, bacterial growth	GMP/GHP; Hams should be turned around and rotated to allow for uniform salt distribution
Washing and draining ↓	Cross-contamination	GMP/GHP; Water quality
Cold-smoking ↓	PAH (benzo(a)pyrene)	GMP/GHP; Control of smoking conditions and optimal smoking temperatures and humidity
Drying and maturation (12 months) ↓	Bacterial growth	GMP/GHP; Temperature and humidity control
Final product Sremska šunka	Physico-chemical parameters: pH 6.0-6.6 Table salt content - 5 - 6% Water activity (aw) 0.89 - 0.92 Proteins (%) 25.8 - 27.2 Fat (%) 4.2 - 6.3	

TRADITIONAL MEAT PRODUCTION AND FOOD SAFETY MANAGEMENT IN SMALL AND MICRO ESTABLISHMENTS

Compliance with official requirements

As stipulated in the Serbian "Hygiene package" [12-15], there are mandatory requirements for implementing food safety and HACCP principles for all FBOs, with the exception of primary producers (farm production). A recent survey of Serbian meat industry revealed that 93.5% of registered abattoirs, meat processors and retailers had a fully developed, implemented and certified HACCP system in place, while 6.5% had implemented but not certified HACCP [54]. Food safety management (FSM) activities

usually do not pose a problem for large FBOs, which employ a multidisciplinary team actively involved in the development and implementation of the system. They also have necessary resources and logistics to constantly improve FSM system, which is often a limitation for small FBOs. Consequently, some of the small FBOs are currently "invisible" for the system of official controls even though their number is quite significant and they produce substantial amount of meat products [24]. It is often a case that workers involved in traditional meat production are very experienced in the production process, but have very limited hygiene awareness and knowledge about public health hazards and risks associated with their productions. A recent survey of food safety knowledge among meat handlers in Serbia revealed that around 30% of them had not received any form of education and training in food hygiene and safety. They also showed significant deficiencies in the knowledge of public health risks associated with the meat production they are involved with [55]. Additional problem for small FBOs is an amount of documentation related to FSM systems which is often complicated, unclear and confusing to them [2,56]. There is also a lack of awareness for, and commitments to, the necessary changes in their attitudes and practices as well as need for food safety training [55]. Consequently, small FBOs usually do not have sufficient knowledge to take participation in the FSM activities [2], but engage external consultants for the development and the implementation of FSM system [54,57].

Up to the end of the 2017, small FBOs have to passed complete approval process and implement strict hygiene criteria [24]. A significant number of small-scale meat producers have already been approved and listed within the Registry of approved food establishments [3]. The most demanding part of approval procedures, from the official authorities' point of view, is lack of available veterinary staff/capacities to cover in an efficient way all FBOs so to ensure that most complete approval procedure is in place. On the other hand, the most demanding part of the approval procedures from the FBOs' point of view is that they have to meet and satisfy all necessary requirements given in the hygiene legislation. The objective difficulties that they encounter, beside lack of resources and expertise in FSM systems, also stated as very important issue the cost of the product testing including microbiological and chemical analyses [54].

In addition to a traditional meat production in small food business, a large number of household, micro producers are engaged in traditional meat production at the farm level. They produce small quantities of food products, usually consumed by their family and friends, sold directly to consumers at the farm or through a network of relatives, or sometimes at the local green markets [8]. However, in total they hold a large share of meat market, which indicates a need to control the safety of their meat products and make them "visible" for the system of official controls. In order to facilitate this, ongoing approach is to make a distinction between those FBOs that would require approval in accordance with the specific hygiene rules and those that could be just registered following simplified procedure, such as these traditional micro producers [24]. The purpose of simplified registration is to allow for the competent authorities to gather information relating to micro FBOs' location, activities and products as well

as to enable more efficient official controls in their production premises and products. The forthcoming bylaws regulating this area will also detail the criteria for defining micro FBOs according to their throughput and retail activity (Table 5). In particular, it would specifically describe the techniques used in traditional production and the list of the traditional products.

Table 5. The criteria for defining micro food business operators according to their throughput: meat and meat products

Type of food	Throughput		Place of direct sale to final consumer
	per week	per year	
Meat (unprocessed) (number of animals processed)			Place of production/farm
Cattle	2	24	Local greenmarket
Pig/ovine/caprine	5	120	Local retail shop
Meat products (in kg)			Local catering service
Processed meat products	50	~ 600	

Food safety management in small and micro traditional meat establishments

Food safety management in small and micro traditional meat establishments heavily relies on the application of Good Hygiene Practice (GHP) and Good Manufacturing Practice (GMP). There are many differences in meat production, from slaughtering to meat processing, between small and micro comparing to large industry facilities [56,58,59]. One of the typical examples is backyard pig production, slaughtering and meat cutting, which has for an output a raw meat material for traditional meat products. The introduction of Animal Welfare Law and derived Ordinances made home pig slaughtering for own use illegal if a proper stunning procedure is not followed [56]. Therefore, the majority of micro producers perform pig slaughtering in households with the facilities adapted to serve as a small scale slaughter line. Usually, these production facilities consist of one room for slaughter and dressing and appropriate equipment: apparatus for electrical stunning (head-only tongs), scalding tank of small capacity, accessories for manual hair removal and singeing of carcasses. If they perform meat cutting and preparation of raw meat for traditional meat products, then this is done in a separate room, if available, or in the same room where the slaughter was carried out but only after thorough cleaning and sanitation. Given the fact that all these procedures are highly unstandardized and lack of control, there is an obvious need for a clear guidelines and recommendations to small and micro producers on best practices in their production, to standardize quality and safety of traditional meat production. These guidelines could be based on the existing Code of practice [30]. Furthermore, some derogations from the existing hygiene regulation pertaining to these producers could be applied with respect to the requirements related to building,

construction, layout and equipment [2]. For instance, it could be accepted that they use one room for all operations if separation in time is applied; smoke chamber (with open furnace) placed outside of the production premises; and using wooden surfaces for meat cutting. Accordingly, there should be an appropriate risk categorization of these establishments based on the some parameters, such as hygiene assessment system, appropriate training in food safety and their commitment to produce safe food.

Apart from the implementation of prerequisite programmes (GMP/GHP) in small and micro establishments, which in general give some assurance that food is produced in a safe manner, there is also a need for application of hazard analysis and identification of critical control points (HACCP) which would be more specific for a given process/ product. In order to facilitate HACCP development for, and implementation in, small and micro establishments, one approach could be to develop a generic HACCP plan for the same type of traditional meat products, which in its essence would satisfy the requirements of having all seven HACCP principles in place, but in a simplified and more generic manner [2,60]. This would make HACCP plan more understandable and manageable from small and micro producers' point of view. One example, related to the HACCP principle seven, is establishing documentation and records keeping, which is particularly problematic for small and micro producers as it reduces their staff time available for other tasks [54,61]. To make this essential process more efficient and easy for staff in small and micro establishments, one solution could be to develop production log which would include the basic records of daily procedures representing the basic and key parameters of the production process. Some of the production log entries would essentially be related to process hygiene, equipment maintenance, calibration, temperature controls and etc [2].

CONCLUSION

Traditional meat production in small and micro establishments in Serbia holds large share of the meat market and consequently can have huge implications for public health, being highly unstandardized and not subject to adequate official controls. Therefore, there is a strong need for the standardization of meat production in small and micro FBOs as well as implementation of food safety management systems, taking into account their objective needs and potential for this to be a proper and meaningful process. The main barriers for these activities in small and micro FBOs are related to the lack of human resources and knowledge, low level of awareness and in depth understanding of regulations and lack of funding. Furthermore, associations of traditional food producers should be better organized to help their members in liaising with official authorities on the issues of registration and approval, possible derogations from regulatory requirements and protecting their overall interests. They should also help their members by issuing standards and guidelines covering at least minimum tasks that FBOs should achieve so to produce traditional meat products in a safe manner for the final consumer. In order to reduce administrative burdens for small and micro

producers, associations should also on their behalf, apply to the official authorities for the possible derogations and flexibility in food hygiene regulations, according to the local situation and in transparent manner. This would provide effective protection and support of traditional FBOs, enabling them to continue to produce foods with traditional characteristics and using traditional methods. Therefore, the responsibility to keep traditional meat production viable and sustainable, but at the same time without compromising public health, lies upon all stakeholders in the meat chain but predominantly upon competent authorities that need to address all these aspects.

Acknowledgements

This paper was supported by Ministry of Education, Science and Technological Development, Republic of Serbia, through the funding of the Projects No TR 31034 and No TR 31071.

Authors' contributions:

All authors performed literature searches, wrote, revised the article, read and approved the final manuscript.

Declaration of conflicting interests:

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

REFERENCES

1. Guerrero L, Guàrdia MD, Xicola J, Verbeke W, Vanhonacker F, Zakowska-Biemans S, Sajdakowska M, Sulmont-Rossé C, Issanchou S, Contel M: Consumer-driven definition of traditional food products and innovation in traditional foods. A qualitative cross-cultural study. Appetite 2009, 52(2): 345-354.
2. Karabasil N, Bošković T, Dimitrijevic M, Vasilev D, Teodorovic V, Ilić N, Djordjević V: Food hygiene – Flexibility in traditional and small meat establishments. Procedia Food Science 2015, 5: 140-143.
3. Ministry of Agriculture, F.a.W.M., Registry of Registered/Approved Establishments in the Veterinary Directorate, Republic of Serbia 2018.
4. Statistical Yearbook of the Republic of Serbia (Chapter Agriculture). Statistical Office of the Republic of Serbia 2018.
5. Statistical Yearbook of the Republic of Serbia (Chapter Agriculture). Statistical Office of the Republic of Serbia 2015.
6. Statistical Yearbook of the Republic of Serbia (Chapter Agriculture). Statistical Office of the Republic of Serbia 2012.
7. Dokmanović M, Lukić M, Baltić ŽM, Ivanović J, Marković R, Grbić S, Glamočlija N: Analysis of beef production volume in Serbia from 1985 to 2011. Meat technology 2014, 55(1): 73-80.

8. Baltić ŽM, Đurić J, Karabasil N, Dimitrijević M, Marković R, Kilibarda N. Tradicionalni proizvodi u duhu dobre proizvođačke prakse (Traditional products and good manufacturing practice). in Proceedia, Symposium „Tradition and future of livestock production in mountainous regions with special emphasis on Sjenica-Pester plateau", 2010 Sjenica.
9. Commission recommendation of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises. Official Journal of the European Communities 2003, L124(2003): 36-41.
10. Census of Agriculture 2012 in the Republic of Serbia – First results (Supported by the EU). Statistical Office of the Republic of Serbia 2013.
11. Law on Veterinary Matters, Official Gazette of the Republic of Serbia, No. 91/05, 30/10 and 93/12, 2005.
12. Law on Food safety, Official Gazzete Republic of Serbia, No. 41/09.
13. Ordinance on the general conditions of food hygiene. Official Gazette of the Republic of Serbia, No. 73/10.
14. Ordinance on general and specific conditions on food hygiene at any stage of production, processing and trade. Official Gazette of the Republic of Serbia, No. 72/10.
15. Ordinance on veterinary-sanitary conditions, general and specific hygiene conditions for the production of food of animal origin. Official Gazette of the Republic of Serbia, No. 25/11.
16. Law on Animal Welfare. Official Gazette of the Republic of Serbia, No. 41/09.
17. Ordinance on the conditions and means of killing of animals, procedures for animal handling immediately before slaughter, stunning and bleeding methods, conditions and means of animal slaughter without prior stunning and training programmes on the welfare of animals at slaughter. Official Gazette of the Republic of Serbia, No. 41/10.
18. Ordinance on the form and content of the plan and the mode of transport of animals which ensure the protection of life and welfare of animals. Official Gazette of the Republic of Serbia, No. 48/11.
19. Henderikx F: Labelling of food: a challenge for many. Veterinarski Glasnik 2017, 71(1): 16-23. doi: http://dx.doi.org/10.2298/VETGL170214001H
20. Jordana, J: Traditional foods: challenges facing the European food industry. Food Res Int 2000, 33(3): 147-152.
21. General report of a mission series carried out in six member states in the period november 2009 to march 2010 in order to gather informations regarding the application of the hygiene regulations in small establishemnts producing meat and meat products of mammals and dairy products. European Commision, Health & Consumers Directorate-General, directorate Food and Veterinary Office 2011.
22. Vanhonacker F, Kühne B, Gellynck X, Guerrero L, Hersleth M, Verbeke W: Innovations in traditional foods: impact on perceived traditional character and consumer acceptance. Food Res Int 2013, 54(2): 1828-1835.
23. Trichopoulou A, Soukara S, Vasilopoulou E: Traditional foods: a science and society perspective. Trends Food Sci Technol 2007, 18(8): 420-427.
24. Karabasil N, Šibalić S, Bošković T: Fleksibilnost u primeni propisa o higijeni hrane (Flexibility in applying food hygiene legislation). in Proceedia, XXXVI Seminar on knowledge innovation of veterinarians, University of Belgrade, Faculty of Veterinary Medicine; 2015.
25. Dwinger RH, De Smet K: Legal Requirements for Food Hygiene, in Encyclopedia of Food and Health. Academic Press: Oxford; 2016, 529-538.

26. Bennett EA: Who Governs Socially-Oriented Voluntary Sustainability Standards? Not the Producers of Certified Products. World Development 2017, 91: 53-69.
27. Boström M, Jönsson AM, Lockie S, Arthur PJ, Oosterveer P: Sustainable and responsible supply chain governance: challenges and opportunities. Journal of Cleaner Production 2015, 107: 1-7.
28. Rilaković, I: Appellations of origin. Pravno-ekonomski pogledi 2013, IV(3): 50-62.
29. Regulation (EC) No. 510/2006 of 20 March 2006 on the protection of geographical indications and designations of origin for agricultural products and foodstuffs. Official Journal of the European Communities 2006.
30. The list of the indications of geographical origin registered in the intellectual property office. The Intellectual Property Office, Republic of Serbia 2018: p. available at: http://www.zis.gov.rs/intellectual-property-rights/inidications-of-geographical-origin/list-of-igo.91.html. (accessed October 2018).
31. Petrović Lj, Džinić N, Ikonić P, Tasić T, Tomović, V, Quality and safety standardization of traditional fermented sausages. Meat technology 2011, 52(2): 234-244.
32. Vuković I, Vasilev D, Saičić S: Mikroflora und qualität traditioneller rohwurst Lemeški Kulen. Fleischwirtschaft 2014, 94(8): 114-118.
33. Vuković I, Saičić S, Vasilev D: Contribution to knowledge of major quality parameters of traditional (domestic) kulen. Meat technology 2011, 52(1): 134-140.
34. Vuković I, Vasilev Dragan, Saičić S, Tubić M, Kričković D: Important properties of Srem dry ham produced by optimizing the traditional production procedures. Meat technology 2005, 46(3-4): 110-114.
35. Radovanović R, Stamenković T, Saičić S: Evaluation of sensory and chemical characteristics of the quality of Uzice prosciutto. Meat technology 2004, 45(3-4): 108-113.
36. Balogh P., Békési D, Gorton M, Popp J, Lengyel P: Consumer willingness to pay for traditional food products. Food Policy 2016, 61: 176-184.
37. Prakash V: The Importance of Traditional and Ethnic Food in the Context of Food Safety, Harmonization, and Regulations, in Regulating Safety of Traditional and Ethnic Foods. Academic Press: San Diego. 2016, 1-6.
38. Tomasevic I, Tomović V, Milovanovic B, Lorenzo J, Dordevic V, Karabasil N, Djekic, I: Comparison of a computer vision system vs. traditional colorimeter for color evaluation of meat products with various physical properties. Meat Sci 2018, 148: 5-12.
39. Suvajdžić B, Petronijević R, Teodorović V, Tomović V, Dimitrijević M, Karabasil N, Vasilev D: Qualität der Rohwurst Sremski Kulen Produktion unter traditionellen und industriellen Bedingungen in Serbien. Fleischwirtschaft 2018, 98(6): 93-99.
40. Vasilev D, Jovetić M, Vranić D, Tomović V, Jokanović M, Dimitrijević M, Karabasil N, Vasiljević N: Qualität und Mikroflora von funktionellen Rohwürsten - Untersuchungen von Würsten, die mit KCl und CaCl2 als Kochsalz-Ersatzstoffe hergestellt und mit dem Probiotikum L.casei LC01 sowie einem Präbiotikum angereichert worden sind. Fleischwirtschaft 2016, 96(2): 655-663.
41. Blagojevic B, Antić D, Adzic B, Tasic T, Ikonic P, Buncic S: Decontamination of incoming beef trimmings with hot lactic acid solution to improve microbial safety of resulting dry fermented sausages–A pilot study. Food Control 2015, 54: 144-149.
42. Ducic M, Blagojević B, Markov S, Velicanski A, Buncic S: General patterns of background microbiota and selected bacterial pathogens during production of fermented sausages in Serbia. Food Control 2014, 43: 231-237.

43. Vuković I, Petrović Lj, Vasilev D, Saičić S: Untersuchung von Rohdauerwürsten aus Serbien: Mikroflora und Qualität von nach traditionellem Verfahren hergestellten Rohwürsten aus Nordserbien. Fleischwirtschaft 2011, 91(11): 118-122.
44. Dmitric M, Vidanović D, Vaskovic N, Matovic K, Sekler M, Debeljak Z, Karabasil N: Trichinella infections in red foxes (Vulpes vulpes) and golden jackals (Canis aureus) in six districts of Serbia. J Zoo Wildl Med 2017, 48(3): 703-707.
45. Dmitric M, Debeljak Z, Vidanovic D, Milanko S, Vaskovic V, Matovic M, and Karabasil N: Trichinella britovi in Game Meat Linked to Human Trichinellosis Outbreak in Serbia. J. Parasitol 2018, 104(5): 557-559.
46. Buncic S, and Mirilovic M: Trichinellosis in wild and domestic pigs and public health: a Serbian perspective, in Game meat hygiene in focus: Microbiology, Epidemiology, Risk Analysis and Quality Assurance, P. Paulsen, Bauer, A., Vodnansky, M., Winkelmayer, R., Smulders, FJM, Editor, Wageningen Academic Publishers, Wageningen, 2011, 143–156.
47. Tomasevic I, Novakovic S, Solowiej B, Zdolec N, Skunca D, Krocko M, Nedomova S, Kolaj R, Aleksiev G, Djekic I: Consumers' perceptions, attitudes and perceived quality of game meat in ten European countries. Meat Sci 2018, 142: 5-13.
48. Rašeta M, Mrdović B, Đorđević V, Polaček V, Beckei Z, Branković Lazić I, Vasilev D: Determination of Co-value as an indicator of nutritive value of PÂTÉ sterilised by regular and optimized regimes. Veterinarski Glasnik 2018, 72(2): 101-111. doi: https://doi.org/10.2298/VETGL180711011R
49. Vuković I: Clostridium botulinum: Inhibition and inactivation in meat products. Meat technology 2005, 46(3-4): 101-109.
50. Škaljac S, Petrović Lj, Tasić T, Ikonić P, Jokanović M, Tomović V, Džinić N, Šojić B, Tjapkin A, Škrbić B: Influence of smoking in traditional and industrial conditions on polycyclic aromatic hydrocarbons content in dry fermented sausages (Petrovská klobása) from Serbia. Food Control 2014, 40: 12-18.
51. Tasić T, Ikonić P, Mandić A, Jokanović M, Tomović V, Savatić S, Petrović Lj: Biogenic amines content in traditional dry fermented sausage Petrovská klobása as possible indicator of good manufacturing practice. Food Control 2012, 23(1): 107-112.
52. Vuković I, Dimitrijević M, Tubić M, Vasilev D, Kričković D: HACCP in production of dry Sremska ham. Meat technology 2005, 46(3-4): 115-120.
53. Relić R, Hristov S, Stanković B, Vasilev D: Biological life cycle, significance and control of dry ham parasites. Meat technology 2005: 46(3-4): 126-133.
54. Tomašević I, Šmigić N, Đekić I, Zarić V, Tomić N, Rajković A: Serbian meat industry: a survey on food safety management systems implementation. Food Control 2013, 32(1): 25-30.
55. Smigic N, Antić D, Blagojevic B, Tomasevic I, Djekic I: The level of food safety knowledge among meat handlers. British Food Journal 2016, 118(1): 9-25.
56. Karabasil N, Teodorović V, Dimitrijević M, Vasilev D, Janjić A, Čobanović N, Ilić N: Good hygiene practice and control of hazards in traditional food production. Veterinarski žurnal Republike Srpske 2015, XV(1): 5-14.
57. Violaris Y, Bridges O, Bridges J: Small businesses–big risks: current status and future direction of HACCP in Cyprus. Food Control 2008, 19(5): 439-448.
58. Čobanović N, Bošković M, Vasilev D, Dimitrijević M, Parunović N, Djordjević J, Karabasil N: Effects of various pre-slaughter conditions on pig carcasses and meat quality in a low-input slaughter facility. S Afr J Anim Sci 2016, 66(4): 380-390.

59. Čobanovic N, Karabasil N, Stajković S, Ilić N, Suvajdžić B, Petrović M, Teodorović V: The influence of pre-mortem conditions on pale, soft and exudative (PSE) and dark, firm and dry (DFD) pork meat. Acta vet-Beograd 2016, 66(2): 172-196.
60. Motarjemi Y: Hazard Analysis and Critical Control Point System (HACCP), in Food safety management: A practical guide for the food industry, Y. Motarjemi, Lelieveld, H., Editor. Academic Press, Elsevier 2014, 845–871.
61. Tomasevic I, Djekic I: HACCP in Fermented Meat Production, in Fermented Meat Products: Health Aspects, N. Zdolec, Editor. CRC Press 2016, 512-534.

PROIZVODNJA TRADICIONALNIH PROIZVODA OD MESA U MALIM I MIKRO OBJEKTIMA U SRBIJI: TRENUTNI STATUS I PERSPEKTIVA

KARABASIL Nedjeljko, BOŠKOVIĆ Tamara, TOMAŠEVIĆ Igor,
VASILEV Dragan, DIMITRIJEVIĆ Mirjana, KATANIĆ Nenad, ANTIĆ Dragan

Proizvodnja tradicionalnih proizvoda od mesa ima značajan potencijal u Srbiji, posebno u malim i mikro objektima. Među velikim brojem tradicionalnih proizvoda od mesa, suve fermentisane kobasice i proizvodi od sušenog mesa su najznačajniji i najcenjeniji od strane potrošača. Postoji, međutim, potreba za boljom standardizacijom proizvodnje u ovom sektoru, kao i primenom dobre higijenske prakse i HACCP principa u skladu sa zakonskim propisima iz oblasti higijene hrane. Na osnovu Zakona o bezbednosti hrane postoji mogućnost za tradicionalne proizvođače i njihova udruženja da podnesu zahtev za odstupanja koja se odnose na izgradnju i strukturu objekta kao i opremu. Ovo bi omogućilo malim i mikro tradicionalnim proizvođačima da bolje iskoriste svoje resurse, kao i da se oslobode administrativnih opterećenja i na taj način primene svoje tradicionalne tehnike, uz neminovno poštovanje higijene proizvodnje i bezbednosti proizvoda. Ovaj rad analizira trenutni status tradicionalne proizvodnje mesa u objektima malog i mikro kapaciteta u Srbiji, naglašavajući potrebu za daljim unapređenjem upravljanja bezbednošću hranom, kao i standardizaciji ove proizvodnje.