LACTOFLORA AND SENSORIAL CHARACTERISTICS OF EXPERIMENTALLY PRODUCED BOSNIAN SOUDJOUK

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SUMMARY

Results of research on lactoflora and sensorial characteristics of experimentally produced Bosnian Soudjouk, the most preferred Bosnian fermented sausage, were presented. In addition, microbiological profile of raw materials used for production of the Soudjouk was investigated. The Soudjouk was produced in three batches (n=30) based on a production specification and a traditional recipe. Fermentation process lasted for 28 days, including a 7-day smoking phase. Sausage samples for microbiological analyses were taken in triplicate on day 0, 2, 4, 7, 14, and 28 of the fermentation process. Identification of bacterial isolates was performed by classical microbiological methods (morphologic and biochemical identification), while the lactic acid bacteria isolates were identified using API50CHL® kits. Sensorial characteristics of final products were assessed by assigning a score from the range from 0 to 10 by an independent expert panel (n=10).

In all stages of the production process predominant microbial population in microflora of the Bosnian Soudjouk were lactic acid bacteria (LAB), primarily Lactobacillus spp. The major importance of our research is a detailed investigation of microflora and LAB of the sausage during the fermentation process, as well as to describe dynamics and dominance of LAB species, which surely represents an important contribution to detailed description and preservation of the Bosnian Soudjouk as the main symbol of Bosnian gastronomic tradition and culture. Desirable sensorial characteristics of the produced sausages, as well as absence of certain bacterial foodborne pathogens in the final products, argue in favor of accepting the applied technological procedure of production of the sausage as an acceptable basis for further technological investigation and establishment of standard operating procedures for production of the Soudjouk. Finally, autochthonous LAB isolates from this research may serve as solid basis for further molecular and technological research.

Key words: *Bosnian Soudjouk, lactic acid bacteria, API identification, sensorial evaluation*

INTRODUCTION

After enormous destruction of human and production resources during the last aggression on Bosnia and Herzegovina, production and marketing of safe food on the regional and other foreign markets surely is one of the most important industrial potentials of our country. The lack of revitalization of broad industrial production during the post-war period in our country has the only positive side, which is a relative protection of environment from an intensive pollution. Consequently, production and promotion of traditional Bosnian foods, such as Bosnian Soudjouk, beef and lamb smoked meat, Vlasic Cheese, or Livanjski Cheese, certainly represents one of fundamental export potentials of our country, and a very important and attractive segment of touristic offer of Bosnia and Herzegovina.

Assurance of consistency of quality and safety of final food product is based on standardization of technological production process. Detailed description of final food product and all of its specificities plays an essential role in establishing efficient systems for control of food safety and quality. In all types of foods, particularly in fermented meat products, basic characteristics and determinants of sensorial quality and hygienic status are microbiological profile and lactoflora.

The goal of the study was to define dynamics and profile of microflora during experimental production of Bosnian Soudjouk, with particular attention on profile of lactic-acid bacteria (LAB) and sensorial characteristics of the final product. Results of the study may contribute to

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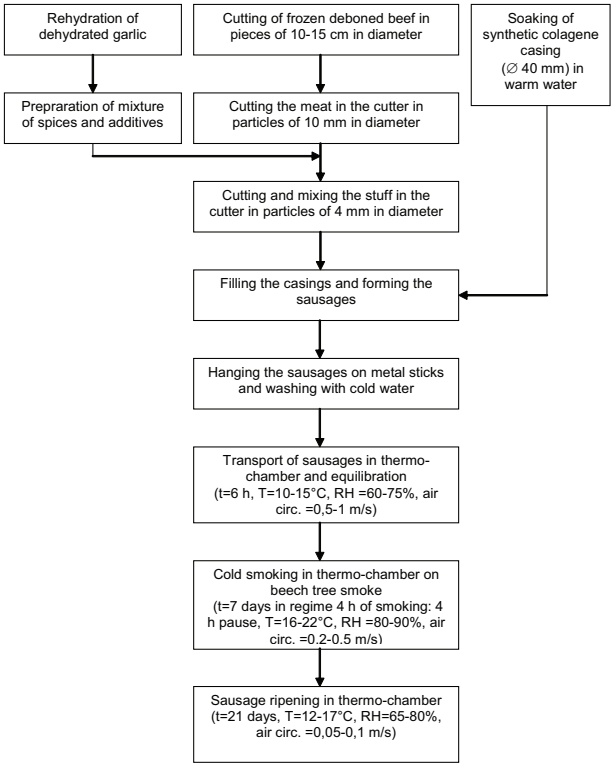
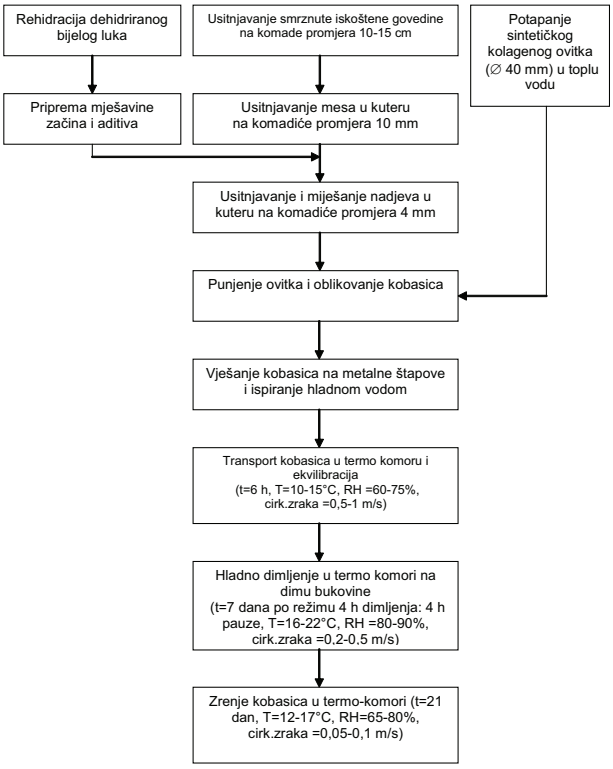
Figure 7. Flow-chart of experimental production of Bosnian Soudjouk



Slika 7. Dijagram toka eksperimentalne proizvodnje bosanskog sudžuka



a better understanding and knowledge on characteristics of Bosnian Soudjouk, aimed toward standardization and legal protection of the sausage as an original Bosnian meat product and one of the most preferred sausages regionally.

MATERIAL AND METHODS

For the purpose of the research, experimental production of Bosnian Soudjouk was carried out in a private meat industry in the Sarajevo Canton. The Soudjouk was prepared in three successive batches according to the production specification and recipe of the meat company, and the experimental production per batch lasted 28 days in total. (Figure 1). From each batch the sausage samples were taken in triplicate on Day 0, 2nd, 4th, 7th, 14th, and 28th day after the sausage formulation. On each sampling day, three sausages were transported to the Department of Food Hygiene & Technology of the Veterinary Faculty of the University of Sarajevo and subjected to microbiological analysis (Table 1). Aside from the sausage samples, samples of raw materials (meat, synthetic casing, garlic, pepper, salt, commercial mixture of sugars and antioxidants) for each of the three batches were also microbiologically analyzed (Table 1).

Microbiological analyses were chosen according to the previous studies (Samelis et al., 1994, Samelis et al. 1998). Preparation of sausage and raw material specimens for microbiological analyses was done according to the provisions of the Regulation on methods of microbiological analyses and superanalyses of foods («Official Gazette of BiH", no. 2/92, 13 and 14/94) by preparing decimal dilutions of samples depending on methodology of particular analysis. Further analyses were done by standard routine procedures of quantitative cultural examinations, i.e. by plate count methods on selective or non-selective media (Table 1).

The total of 150 LAB isolates (50 isolates from each of the three experimental batches) was collected from MRS agar plates during the sausage fermentation process. For each sausage sampling day (Day 0, 2, 4, 7, 14 and 28) isolates were collected from one representative MRS agar plate of 10^{-5} dilution. Half of the isolates were collected from Day 0 to Day 7 of the fermentation, while the other half was isolated from sausages samples from Day 14 to Day 28. The isolates were morphologically tested by Gram staining, contrast microscopy, and catalase-test performance.

Biochemical identification and determination of the MRS agar isolates were done using API50CHL® MEDIUM

▼ **Table 1.** Microbiological analyses of raw material and sausage samples in different phases of experimental production of Bosnian Soudjouk.
▼ **Tablica 1.** Mikrobiološke analize uzoraka sirovina i kobasica u različitim fazama eksperimentalne proizvodnje bosanskog sudžuka.

Microbiological analysis Mikrobiološke analize	**Substrate / Substrat**						
	Raw materials Sirovine	***Sausage samples taken during sausage production process (days of fermentation)*** *Uzorci kobasica uzeti tijekom procesa proizvodnje (dani fermentacije)*					
		0	***2***	***4***	***7***	***14***	***28***
Total viable count Ukupan broj mikroorganizama	M, NS, SU, G, P, C	+	+	+	+	+	+
Lactic-acid bacteria Mliječno-kiselinske bakterije	M	+	+	+	+	+	+
Micrococci Mikrokoki	M	+	+	+	+	+	+
Escherichia coli	M, NS,SU, G, P, C	+	+	+	+	+	+
Fecal enterococci Fekalni enterokoki	M	+	+	+	+	+	+
Moulds and yeasts Kvasnice i plijesni	M, NS,SU, G, P, C	+	+	+	+	+	+
Listeria monocytogenes	M, NS	+	+	+	+	+	+
Salmonella spp.	M, NS,SU, G, P, C	+	+	+	+	+	+
Staphylococcus aureus	M, NS,SU, G, P, C	+	+	+	+	+	+
Psudomonas spp.	M	+	+	+	+	+	+
Sulphite-reducing clostridia Sulfitoreducirajuće klostridije	M, NS,SU, G, P, C	+	+	+	+	+	+
Aerobic sporeforming bacteria Aerobne sporulirajuće bakterije	M, NS,SU, G, P, C	+	+	+	+	+	+

Meat=M; nitrite salt=NS; commercial mixture of sugars and antioxidants SU; garlic=G; pepper=P; casings =C; += analyzed
Meso=M; nitritna so=NS; komercijalna mješavina šećera i antioksidansa= SU; bijeli luk=BL; biber=B; ovitak =O; += analizirano

(BioMerieux, France) system for LAB identification, which enables relatively fast parallel fermentation of 49 carbohydrates and derivates (alcohols, acids, etc.). Fermentation outcomes represented biochemical profile for each tested isolate, based on which and using compatible computer software APILAB Plus® (BioMerieux, France), final identification of bacterial isolate was carried out.

After finished experimental fermentation of 28 days, all the samples of final sausage products were subjected to sensorial analysis. To evaluate sensorial characteristics of the Soudjouk a panel was composed of 10 experts of different gender and age, who professionally and regularly are involved in sensorial evaluation of foods. On a scale 1.0 – 10.0, the panel members evaluated the following sensorial characteristics of the sausages:

- Outer appearance,
- Consistency,
- Juiciness,
- Cut-surface texture,
- Aroma (smell and taste),
- Acidity, and
- Overall acceptability.

▼ **Table 2.** Results of microbiological analysis (log_{10} CFU/g ± SD)* of sausage samples during experimental production of Bosnian Soudjouk.

▼ **Tablica 2.** Rezultati mikrobiološke analize (log_{10} CFU/g ± SD)* uzoraka kobasica tokom eksperimentalne proizvodnje bosanskog sudžuka.

Microorganisms Mikroorganizmi	**Day 0** Dan 0	**Day 2** Dan 2	**Day 4** Dan 4	**Day 7** Dan 7	**Day 14** Dan 14	**Day 28** Dan 28
Total viable count /Ukupni broj mikroorganizama						
Batch / Serija 1	5,95±0,03	6,89±0,36	7,58±0,24	8,21±0,21	8,48±0,13	8,21±0,20
Batch / Serija 2	6,05±0,09	7,20±0,08	7,95±0,37	8,19±0,33	8,33±0,21	8,12±0,08
Batch / Serija 3	6,08±0,03	7,10±0,06	8,10±0,13	8,56±0,39	8,50±0,10	8,23±0,12
Lactic-acid bacteria / Mliječno-kiselinske bakterije						
Batch / Serija 1	5,65±0,14	6,30±0,25	7,33±0,11	7,55±0,23	8,13±0,20	7,90±0,03
Batch / Serija 2	5,74±0,09	6,85±0,10	7,14±0,06	7,25±0,12	7,95±0,08	8,10±0,14
Batch / Serija 3	5,81±0,04	6,80±0,13	7,45±0,28	7,33±0,30	8,22±0,31	7,99±0,31
***Micrococcus* spp.**						
Batch / Serija 1	5,39±0,21	5,20±0,22	4,33±0,04	3,88±0,40	3,24±0,03	2,95±0,13
Batch / Serija 2	5,57±0,06	5,90±0,35	4,88±0,12	4,20±0,15	3,77±0,10	3,10±0,21
Batch / Serija 3	5,64±0,11	5,79±0,42	5,21±0,31	4,85±0,22	4,10±0,06	3,68±0,23
Fecal enterococci / Fekalni enterokoki						
Batch / Serija 1	3,56±0,08	2,98±0,30	2,00±0,13	2,15±0,12	2,35±0,09	2,68±0,21
Batch / Serija 2	3,09±0,09	2,67±0,16	2,20±0,31	2,30±0,30	2,50±0,03	2,79±0,22
Batch / Serija 3	3,27±0,09	2,90±0,03	2,46±0,20	2,10±0,21	2,42±0,06	2,90±0,25
E. coli						
Batch / Serija 1	2,08±0,07	1,58±0,02	<1,00	<1,00	<1,00	0/3
Batch / Serija 2	2,15±0,10	1,89±0,11	1,50±0,31	<1,00	<1,00	0/3
Batch / Serija 3	2,26±0,24	2,05±0,21	1,68±0,19	<1,00	<1,00	0/3
***Pseudomonas* spp. (3 batches / serije)**	0/3**	0/3	0/3	0/3	0/3	0/3
Aerobic sporeforming bacteria / Aerobne sporulirajuće bakterije						
Batch / Serija 1	5,32±0,21	4,89±0,33	4,04±0,17	3,20±0,12	2,25±0,03	2,10±0,05
Batch / Serija 2	5,00±0,05	4,05±0,18	3,78±0,03	2,69±0,15	2,73±0,13	2,14±0,08
Batch / Serija 3	5,11±0,15	4,66±0,35	4,12±0,05	3,44±0,19	2,83±0,21	2,23±0,02
Moulds and yeasts / Kvasci i plijesni						
Batch / Serija 1	3,50±0,07	3,24±0,13	2,57±0,23	2,15±0,20	<2,00	<2,00
Batch / Serija 2	3,48±0,06	3,56±0,44	2,68±0,09	2,09±0,03	<2,00	<2,00
Batch / Serija 3	3,40±0,10	3,39±0,04	2,88±0,22	2,25±0,06	<2,00	<2,00
***S. aureus* (3 batches / serije)**	<2,00	<2,00	<2,00	<2,00	<2,00	0/3
Sulphite-reducing clostridia Sulfitreducirajuće klostridije **(3 batches / serije)**	0/3	0/3	0/3	0/3	0/3	0/3
***Listeria* spp. (3 batches / serije)**	0/3	0/3	0/3	0/3	0/3	0/3
***Salmonella* spp. (3 batches / serije)**	0/3	0/3	0/3	0/3	0/3	0/3

*: Each number is the mean of three sausage samples taken from the same batch / Svaki broj je srednja vrijednost za tri uzorka kobasice uzetih iz iste serije

**: Number of samples positive/Number of samples tested / Broj pozitivnih uzoraka /Broj testiranih uzoraka

▼ **Table 3.** Results of sensorial evaluation of experimentally produced Bosnian Soudjouk after 28 days of fermentation

▼ **Tablica 3.** Rezultati senzorne evaluacije eksperimentalno proizvedenog bosanskog sudžuka nakon 28 dana fermentacije

	Sensorial characteristics * Senzorne karakteristike						
	Outer appearance Vanjski izgled	**Consistency** Konzistencija	**Juiciness** Sočnost	**Cut-surface texture** Izgled površine presjeka	**Aroma (smell and taste)** Aroma (miris i okus)	**Acidity** Kiselost	**Overall acceptability** Sveukupna prihvatljivost
Batch/ Serija **1 (n=30)**	8,7	9,6	8,9	8,2	9,2	8,3	9,3
Batch/ Serija **2 (n=30)**	8,0	7,8	7,7	7,8	9,3	8,0	9,0
Batch/ Serija **3 (n=30)**	8,5	9,3	9,3	7,1	9,5	8,6	8,8
Mean/ Srednja vrijednost	8,40	8,90	8,63	**7,70**	**9,33**	8,30	9,03
SD	0,36	**0,96**	0,83	0,56	**0,15**	0,30	0,25

* Each score represents mean value of scores assigned by expert panel members (n=10) / Svaka ocjena predstavlja srednju vrijednost ocjena datih od strane članova stručne komisije (n=10).

Final results of the sausage sensorial evaluation were obtained by calculating average values of single grades given by each of the panelists, as well as of all of the single evaluated sensorial characteristics.

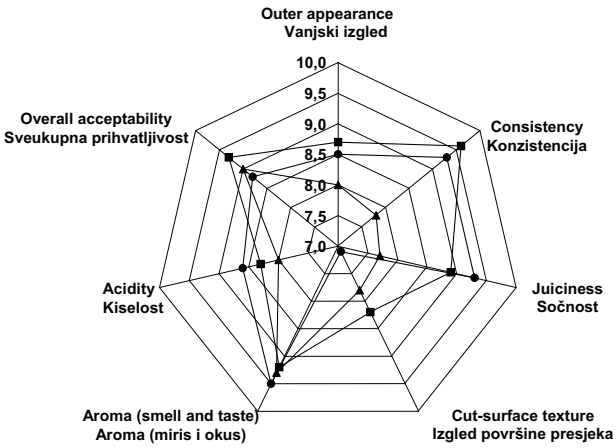
RESULTS AND DISCUSSION

The results of the microbiological analysis (Table 2) showed a dominance of the LAB population in the overall microflora of the Bosnian Soudjouk, which may be seen from similarity between total viable count and MRS count values during the whole fermentation process of sausages in all batches. Initial LAB population, which counts ranged from 5.65 do 5.81 $\log_{10}$ CFU/g in Batch 1 and 2, respectively, continued to grow and its counts in Day 4 exceeded 7 $\log_{10}$ CFU/g in all three batches. During the last two weeks of fermentation these values reached as much as 8 $\log_{10}$ CFU/g, despite the numerous populations of other competitive microbes, such as aerobic sporeforming bacteria and micrococci. Dominance of LAB in microflora during fermentation of dry sausages explained Hadzibeganovic (1975) as a result of an intensive fermentation of carbohydrates and fats in the stuff and consequent decrease of pH value, which favors LAB growth. Similar results obtained Samelis et al. (1994, 1998), who also observed a domination of LAB during the fermentation of a traditional Greek dry sausage. A dominance of LAB, particularly of lactobacilli, was also described in microflora of Spanish naturally fermented sausages (Rovira et al., 1997), traditional French dry sausages (Huerta et al., 2004), and in microflora of fermented sausages produced in Argentina (Fontana et al., 2005).

Results of sensorial analysis of final sausages are shown in Table 3 and Picture 2. Final sausages in al three batches displayed desirable organoleptic characteristics. The best evaluated sensorial property in all three batches was aroma (smell and taste), for which the mean value ranged from 9.2 to 9.5 in Batch 1 and 3, respectively (X=9.33±0.15), while the worst evaluated characteristic was cut-surface texture, for which scores ranged from 7.1

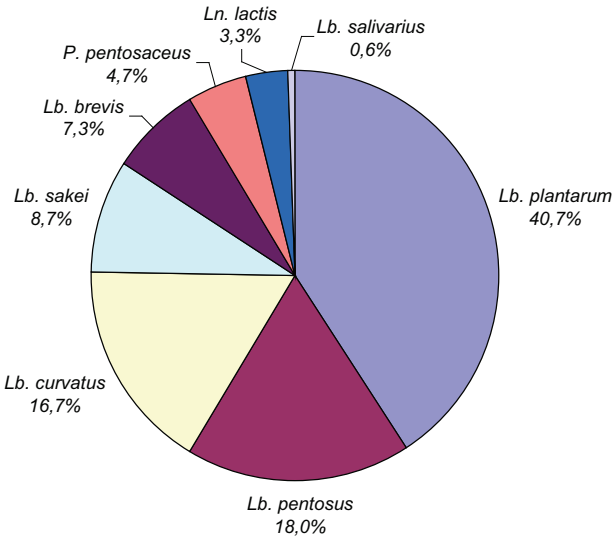
▼ **Figure 2.** Results of sensorial evaluation of final products of experimental production of Bosnian Soudjouk. (■) Batch 1, (▲) Batch 2 i (●) Batch 3.

▼ **Slika 2.** Rezultati senzorne evaluacije finalnih proizvoda eksperimentalne proizvodnje bosanskog sudžuka. (■) Serija 1, (▲) Serija 2 i (●) Serija 3.



▼ **Figure 3.** Distribution of LAB species identified from MRS agar isolates (n=150) of indigenous lactoflora of experimentally produced Bosnian Soudjouk (biochemical and morphological identification). *Lb.: Lactobacillus; Ln.: Leuconostoc; P.: Pediococcus*

▼ **Slika 3.** Distribucija vrsta mliječno-kiselinskih bakterija identificiranih iz MRS agar izolata (n=150) autohtone laktoflore eksperimentalno proizvedenog bosanskog sudžuka (biohemijska i morfološka identifikacija). *Lb.: Lactobacillus; Ln.: Leuconostoc; P.: Pediococcus.*



(Batch 3) to 8.2 (Batch 1) (X=7.70±0.56). Overall acceptability of experimentally produced Bosnian Soudjouk was highly evaluated (X=9.03±0.25). The best agreement among the panel evaluators was achieved in scoring aroma (SD = 0.15), while the highest disagreement was observed in consistency evaluation (SD = 0.96).

After morphological and biochemical identification of the MRS agar isolates using API50CHL® system, and based on Bergey's taxonomic criteria (Kandler and Weiss, 1986, Schleifer, 1986), all the isolates were determinated as follows:

- Facultative heterofermentative lactobacilli (*Lactobacillus plantarum, Lb. pentosus, Lb. curvatus* and *Lb. sakei*), 126 isolates,
- Obligate heterofermentative lactobacilli (*Lb. brevis*), 11 isolates,
- Obligate homofermentative lactobacilli (*Lb. salivarius*), 1 isolate,
- Homofermentative arginine cocci (*Pediococcus pentosaceus*), 7 isolates, and
- Obligate heterofermentative arginine-negative cocci/coccobacilli (*Leuconostoc lactis*), 5 isolates.

Out of all 150 MRS agar isolates, the most prevalent were *Lactobacillus* spp. (92%), 4.7% of the isolates were identified as *P. pentosaceus,* 3.3% were identified as *Ln. lactis*. In all three production batches of Bosnian Soudjouk, the most prevalent lactobacillus was *Lb. plantarum* (40.7%), followed by *Lb. pentosus* (18.0%), *Lb. curvatus* (16.7%), *Lb. sakei* (8.7%) and *Lb. brevis* (7.3%). Less prevalent species were *P. pentosaceus* (4.7%) and *Ln. lactis* (3.3%), while only one isolate from Batch 3 was identified as undesirable *Lb. salivarius* (0.6%) (Picture 3).

Identification profiles of MRS agar isolates obtained by the API50 CHL® identification system varied from the level of excellent to good identification (ID% >90) to the level of low discriminatory results (ID% < 85-90). In some instances of low ID profile it was not possible to achieve identification to the species level, despite the performance of complementary tests suggested by the APILAB® software. Such experiences with this identification method were described by other authors (Andrighetto et al., 1998, Guarneri et al., 2001), where a parallel identification of LAB by conventional and API® identification system and by molecular identification was suggested, which should be done in future research of microflora of Bosnian Soudjouk.

CONCLUSIONS

1. In microflora of all samples of experimentally produced Bosnian Soudjouk, as well as in samples of beef as the basic raw material, dominance of LAB, especially of *Lactobacillus* spp. was observed.
2. During the fermentation of Bosnian Soudjouk the most prevalent species in all the three batches was *Lb. plantarum,* followed by *Lb. pentosus,* less prevalent were *Lb. curvatus, Lb. sakei, Lb. brevis, P. pentosaceus* and *Ln. lactis,* while the only one isolate was identified as *Lb. salivarius.*
3. Experimental production of Bosnian Soudjouk resulted in very good to excellent sensorial characteristics of final products in all three batches, which, in addition to the absence of certain bacterial foodborne pathogens in final products, implies acceptability of the proposed experimental procedure for the sausage production for further technological research and establishment of standard operative procedures for production of the Bosnian Soudjouk

SAŽETAK

LAKTOFLORA I SENZORNE OSOBINE EKSPERIMENTALNO PROIZVEDENOG BOSANSKOG SUDŽUKA

U radu su prezentirani rezultati istraživanja laktoflore i senzornih karakteristika eksperimentalno proizvedenog bosanskoh sudžuka, najomiljenije bosanske trajne koba-

sice. Pored toga, istraživan je i mikrobiološki profil sirovina korištenih za proizvodnju sudžuka. Sudžuk je proizveden u tri serije (n=30) na osnovu proizvodne specifikacije i tradicionalne recepture. Proces fermentacije kobasica trajao je 28 dana, uključujući sedmodnevnu fazu dimljenja. Uzorci kobasica za mikrobiološke analize su uzimani u triplikatu na dan 0, 2, 4, 7, 14, i 28 fermentacijskog procesa. Identifikacija bakterijskih izolata je izvođena klasičnim mikrobiološkim metodama (morfološka i biokemijska identifikacija), dok su izolati mliječno-kiselinskih bakterija identificirani korištenjem API50CHL® kitova. Senzorne osobine finalnih proizvoda su prosuđivane ocjenjivanjem u rasponu od 0 do 10 od strane neovisne stručne komisije (n=10).

U svim fazama proizvodnog procesa predominirajuća mikrobna populacija u mikroflori bosanskog sudžuka su bile mliječno-kiselinske bakterije (MKB), prvenstveno Lactobacillus spp. Glavni značaj našeg istraživanja je detaljna analiza mikroflore i MKB sudžuka tokom procesa fermentacije, kao i opisivanje dinamike i dominacije MKB vrsta, što zasigurno predstavlja značajan doprinos detaljnom opisu i zaštiti bosanskog sudžuka kao glavnog simbola bosanske gastronomske tradicije i kulture. Poželjne senzorne osobine kobasice, kao i odsustvo određenih bakterijskih patogena prenosivih hranom u finalnom proizvodu, govore u prilog usvajanju primijenjene tehnološke procedure proizvodnje kobasice kao prihvatljive osnove za dalja tehnološka istraživanja i uspostavu standardnih operativnih procedura za proizvodnju bosanskog sudžuka. Konačno, autohtoni izolati MKB iz ovog istraživanja mogu poslužiti kao solidna osnova za dalja molekularna i tehnološka istraživanja.

Ključne riječi: *bosanski sudžuk, mliječno-kiselinske bakterije, API identifikacija, senzorna evaluacija*

ZUSAMMENFASSUNG

LAKTOFLORA UND SENSORISCHE EIGENSCHAFTEN DER EXPERIMENTAL HERGESTELLTEN BOSNISCHEN SUDŽUK

In der Arbeit sind Untersuchungsresultate von Laktoflora und sensorischen Charkteristiken der experimental hergestellten bosnischen Sudžuk, der beliebtesten bosnischen Dauerwurst, dargestellt. Es wurde auch das mikrobiologische Profil, der für die Herstellung von Sudžuk benutzten Rohstoffe, untersucht. Sudžuk ist in drei Serien (n=30) auf Grund der Herstellungsspezifikation und der traditionellen Rezeptur hergestellt worden. Der Fermentitionsprozess der Würste dauerte 28 Tage, einschließlich 7 Tage Räuchern. Die Wurstmuster wurden zur mikrobiologischen Analyse an 0, 2, 4, 7, 14 und 28. Tag des Fermentationsprozesses genommen. Die Identifikation von bakteriologischen Isolaten wurde durch klassische mikrobiologische Methoden durchgeführt (biologische und chemische Identifikation), während die Isolate der Milchsäurebakterien durch Benutzung von API50CHL® Kits identifiziert wurden. Die sensorischen Eigenschaften der Finalprodukte wurden von 0 bis 10 seitens einer unabhängigen Fachkomission bewertet (n=10).

In allen Phasen des Herstellungsprozesses waren Milchsäurebakterien die dominierende mikrobielle Population in der Mikroflora der bosnischen Sudžuk (MKB), an erster Stelle Lactobacillus spp. Die Hauptbedeutung unserer Untersuchung ist eine detaillierte Analyse der Mikroflora und MKB von Sudžuk während des Fermentationsprozesses, sowie die Beschreibun von Dynamik und Dominanz von MKB Arten, was bestimmt ein bedeutender Beitrag zu detaillierter Beschreibung und Schützung von bosnischer Sudžuk, als Hauptsymbol der bosnischen Gastronomie und Kultur, beiträgt. Die gewünschten sensorischen Eigenschaften der Wurst, sowie die Abwesenheit der bestimmten bakteriologischen Pathogenen übertragbar durch die Nahrung im Finalprodukt, sprechen zu Gunsten der Anwendung der technologischen Prozedur in Herstellung der Würste, als annehmbare Grundlage für weitere technologische Untersuchungen und Bestimmung der operativen Standardprozeduren für die Herstellung von bosnischer Sudžuk. Die autochtonen Isolate von MKB aus dieser Forschung können als eine solide Grundlage für weitere molekulare und technologische Forschungen dienen.

Schlüsselwörter: *bosnische Sudžuk, Milchsäurebakterien, API Identifikation, sensorische Evaluation*

SOMMARIO

FLORA LATTICA E CARATTERISTICHE SENSORICHE DI 'SUDJUK' DI BOSNIA, UN PRODOTTO SPERIMENTALE

Il testo presenta i risultati della ricerca di flora lattica e le caratteristiche sensoriche di 'sudjuk' di Bosnia, una tipica salsicca secca, la più preferita di tutte le salsicce secche di Bosnia, fatte in casa. Anzi, è stato esaminato il profilo microbiologico della materie prime usate nella produzione di 'sudjuk'. Il 'sudjuk' è stato prodotto in tre serie (n=30) a base di specificazione produttiva e ricette tradizionali. Il processo di fermentazione è durato 28 giorni, inclusi anche sette giorni di fase di affumicatura. Il giorno 0, 2, 4, 7, 14 e 28 del processo di fermentazione sono stati estratti i triplici campioni di salsicce, destinati alle analisi microbiologiche. L'identificazione degli isolati batterici è stata fatta con i metodi microbiologici classici (identificazione morfologica e biochimica), e gli isolati dai batteri di acido lattico sono stati identificati usando l'API50CHL® kit (attrezzi). Le caratteristiche sensoriche dei prodotti finali

sono state valutate su una scala da 0 a 10, e l'ha fatto una comissione di esperti indipendenti (n=10).

Durante tutte le fasi del processo produttivo la predominante popolazione di microbi nella microflora del 'sudjuk' di Bosnia sono stati i batteri di acido lattico (MKB), prevalentemente il Latobacillus spp. La cosa più importante in questa ricerca era l'analisi dettagliata di microflora e MKB del 'sudjuk' durante il processo di fermentazione, e la descrizione della dinamica e la dominazione dei tipi di MKB. Questo senz'altro aiuterà la descrizione e la protezione del 'sudjuk' di Bosnia, il simbolo della tradizione gastronomica e di cultura di quella zona. Le caratteristiche sensoriche preferilbili in questa salsiccia, e l'assenza di certi batteri patogeni che si trasmettono tramite il cibo accentuano il procedimento tecnologico della produzione di salsicce come la base delle future ricerche tecnologiche e la determinazione dei procedimenti operativi standard nella produzione di 'sudjuk' di Bosnia.Alla fin fine, gli autoctoni isolati MKB possono servire come la base alle seguenti ricerche molecolari e tecnologiche.

***Parole chiave:** 'sudjuk' di Bosnia, batteri dall'acido lattico, identificazione API, valutazione sensorica*

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ANTIMIKROBNA REZISTENCIJA BAKTERIJA MLIJEČNE KISELINE IZ HRANE

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SAŽETAK

Bakterije mliječne kiseline imaju veliko značenje u higijeni i tehnologiji hrane. Poznati su njihovi pozitivni učinci na zdravlje ljudi (zdravstvene tvrdnje; probiotici), zatim antimikrobni učinci prema štetnim bakterijama (sintetiziranjem antimikrobnih tvari; organskih kiselina, bakteriocina i

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