

QUALITY OF DRY AND GARLIC SAUSAGES FROM INDIVIDUAL HOUSEHOLDS

Kozačinski¹, L., M. Hadžiosmanović¹, Ž. Cvrtila Fleck¹, N. Zdolec¹, I. Filipović¹, Z. Kozačinski²

SUMMARY

This paper presents the results of sensorial, chemical and microbiological analysis of traditional dry and garlic sausages produced in households, as well as the results of analysis of microbiological cleanness of working surfaces and equipment. Problem of safe production of traditional sausages has been pointed out in connection to raw material, production technology and quality and safety of products with all the characteristics of autochthonous production.

Key words: traditional products, safety

INTRODUCTION

Regional food specialities, such as dry-fermented meat products and sausages and other food products of animal origin, have been traditionally manufactured in rural households and family farms. In general, these are traditional products that should be recognised as autochthonous Croatian products. The production of most autochthonous and traditional products is not standardised or accompanied by the corresponding regulations, and thus presents a risk to human health because of the possibility of development of alimentary diseases

(Živković and Cvrtila, 1998). Problem of food health safety arises with the production of food in households where the conditions are difficult to control. The fact is that the natural production of traditional meat products, sausages, dry-cured meat products and ham, dairy products and other foods of animal origin for public consumption does not follow the veterinary-sanitary regulations in force and present potential risk to human health. Only some of these food products (e.g. paprika-flavoured salami "kulen") are produced under control in rural manufacturing facilities and then put on the market. Such production often develops into artisan production. General measures of human health protection imply primarily the assurance of food safety and sanitary-technical and hygienic conditions for the production of these products, which is also the main task of veterinary public health. As regards veterinary-sanitary conditions of production of autochthonous meat products, of utmost importance is the quality of raw material. It is imperative to act in accordance with the laid down regulations for slaughter of animals in the registered slaughterhouses. Permanent surveillance should be provided in compliance with the provisions of the Rules on veterinary-sanitary examination (OJ, No. 149/2003; 9/2007; 99/2007)

▼ **Table 1.** Methodology of microbiological analyses

Microorganisms	Method	Nutrient media	Incubation conditions
Enterobacteria	HRN ISO 5552	VRBG (Oxoid)	37° C 24 hours
<i>E. coli</i>	-	Coli ID (BioMerieux)	37° C 24 hours
Enterococci	-	KEA (Merck)	37° C 48 hours
<i>Staphylococcus aureus</i>	HRN ISO 6888-1	BP (Merck)	37° C 48 hours
Sulphite-reducing clostridia	HRN ISO 15213	(SPS, Merck)	37° C 72 hours
<i>Salmonella</i> spp.	HRN ISO 6579	BPLS, XLD (Merck)	37° C 24 and 48 hours
<i>Listeria monocytogenes</i>	HRN ISO 11290-1	Palcam, Oxford (Merck)	30° C, 37° C, 24 and 48 hours

¹ Lidija Kozačinski, DSc, Associate Professor; Mirza Hadžiosmanović, DSc, Full Professor; Željka Cvrtila Fleck, DSc, Assistant professor; Nevijo Zdolec, DSc, junior researcher - Senior Assistant; Ivana Filipović, DVM, Junior Research Assistant, Institute of Foodstuff Hygiene and Technology, Veterinary Faculty, University of Zagreb, Heinzelova 55, Zagreb

² Zvonimir Kozačinski, MSc, Veterinary health station Velika Gorica, Sisačka bb

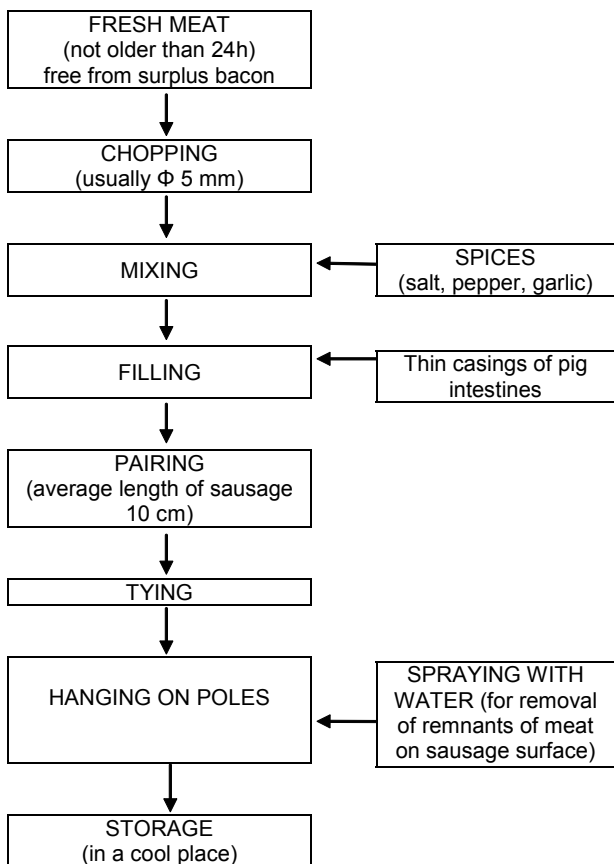
The aim of this paper was to investigate the safety of production of traditional sausages in households with respect to raw material, production technology and quality and safety of products with the already established autochthonous characteristics. Such production activity can be performed in rooms for treatment, processing and storage of animal food products within one's own house. Products manufactured in households are sold either on the market or directly from households or within the general offer of rural tourism.

MATERIALS AND METHODS

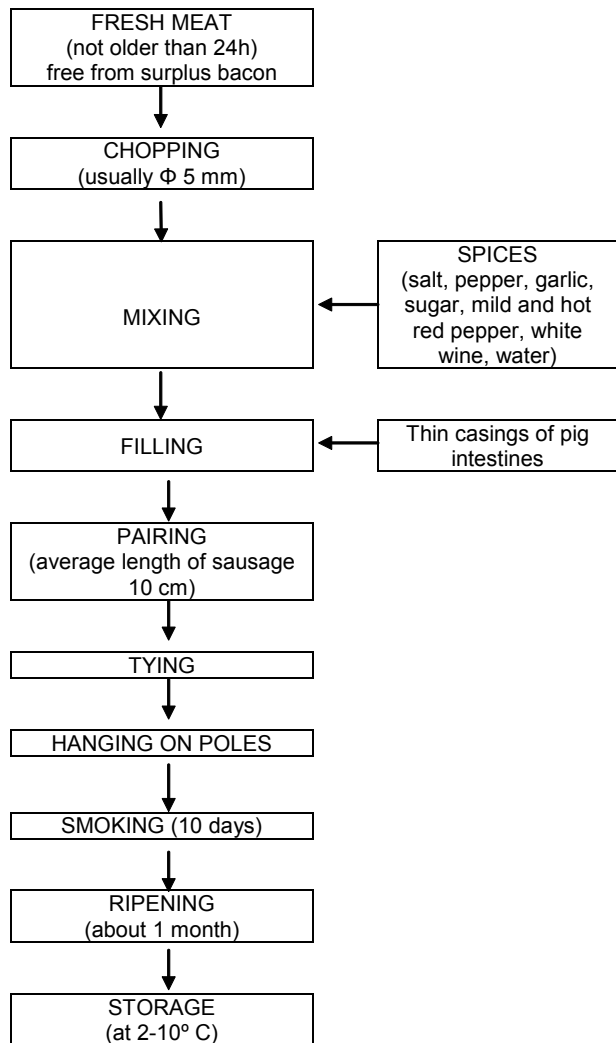
Samples of traditionally produced sausages for cooking and roasting (garlic sausages and home-made dry-fermented sausages) were collected from a family farm engaged also in rural tourism. Sausage production process is presented in the Enclosures (1 and 2).

Sausages were sampled at the end of production process (garlic sausages after 10 days and dry sausages on day 28 of ripening). Sausage samples were sent to the laboratory of the Department of foodstuff hygiene and

▼ Enclosure 1. Production process of home-made garlic sausages for cooking and roasting



▼ Enclosure 2. Production process of home-made dry sausage



technology of Veterinary Faculty in Zagreb for sensorial, bacteriological and chemical analysis. Twenty samples of each type of sausages were analysed. In addition, smears were taken from the equipment, accessories and working surfaces used for preparing raw material for production of sausages. The 5 membered committee was evaluating the sensorial properties, including consistency, flavour, savour, cut appearance and final technological processing of end product. By chemical analysis, we have determined basic chemical composition, water (ISO 1442), fat (ISO 1443), nitrogen (ISO 937) and have calculated the quantity of proteins and ash (ISO 936). In bacteriological analysis of product and in microbiological evaluation of cleanliness of working facilities and equipment the presence of *Salmonella spp.* and *Listeria monocytogenes* and number of *Staphylococcus aureus*, enterobacteria,

sulfite-reducing clostridia, *E. coli* and *Enterococcus spp.* were determined according to the methods listed in table 1. API-identification method was used for the biochemical determination of bacteria.

RESULTS AND DISCUSSION

Production of sausages was described according to the recipes traditionally used in individual households. The production is characterised by selection of raw material and spices, and in case of dry-fermented sausages, by cold smoking and ripening process, and finally storage. From these recipes, it is obvious that dry and garlic sausages are made mostly from the same compounds, which, afterwards, according to need, enter different technological procedures. In fact, the composition of raw material is identical, and later various spices are added.

▼ **Table 2.** Results of chemical analysis of garlic sausage

SAMPLE NUMBER	PARAMETER. %			
	Water	Fat	Proteins	Ash
1.	35.9	37.7	17.5	3.8
2.	36.0	39.8	17.1	3.8
3.	35.8	39.7	17.9	3.9
4.	36.2	38.2	17.8	3.7
5.	34.9	39.1	18.0	3.8
6.	35.6	37.6	17.7	3.8
7.	35.7	38.4	18.1	3.8
8.	35.1	38.6	18.3	3.7
9.	35.6	39.2	18.0	3.8
10.	36.0	39.0	17.8	3.7
11.	34.8	37.9	17.7	3.8
12.	35.3	37.6	18.1	3.9
13.	35.9	37.8	17.9	3.7
14.	34.6	36.4	17.5	3.6
15.	35.8	37.1	18.2	3.7
16.	36.5	36.9	17.6	3.8
17.	37.0	36.4	17.4	3.8
18.	36.1	37.5	17.9	3.6
19.	36.8	37.1	18.0	3.7
20.	36.5	37.2	18.1	3.8

▼ **Table 3.** Results of chemical analysis of dry sausage

SAMPLE NUMBER	PARAMETER. %			
	Water	Fat	Proteins	Ash
1.	32.1	38.7	19.5	3.5
2.	33.0	39.1	18.2	3.4
3.	32.9	40.7	18.3	3.4
4.	31.5	38.9	19.1	3.6
5.	34.2	39.8	18.4	3.9
6.	32.6	38.2	17.8	3.7
7.	32.4	38.6	17.2	3.9
8.	33.1	39.9	17.6	3.2
9.	31.6	40.2	19.1	3.8
10.	33.0	38.7	18.2	3.7
11.	33.2	39.8	19.1	3.8
12.	30.3	39.7	19.2	3.6
13.	31.8	39.1	18.6	3.8
14.	32.6	37.9	18.1	3.4
15.	30.5	38.2	18.9	3.9
16.	30.9	40.1	17.9	3.8
17.	32.0	39.8	17.7	3.7
18.	33.2	38.5	17.6	3.6
19.	31.8	38.9	18.2	3.7
20.	32.5	37.6	18.2	3.9

In addition to garlic, salt and pepper, to dry sausage fillings are added mild and hot red pepper, sugar, white wine and the required quantity of water. Sausage production process is characterised by identical phases of mixing, filling in casings, pairing and tying. Garlic sausages are then hanged on poles and kept in separate, cold rooms. Interval of storage is limited, a few days at the most. In individual households, for the demands of rural tourism, it is common procedure to put sausages into freezer (up to -25°C) for a longer period of time, in order to avoid their deterioration. Dry sausages, however, are subjected to smoking process (about 10 days) and then left to ripen for approx. 1 month, usually in the loft area. They are then transferred to the cellar where the temperature is between 2 and 10°C . Finally, their consistency and the degree of maturity are evaluated.

Sensorial properties of sausages were unequal but

within the limits of characteristics specific to autochthonous production in individual households. Garlic sausages were elastic, with characteristic and pleasant odour to spices. Pieces of dark red meat and white fat tissue could be seen when cut. Similarly, the dry-fermented sausages were of characteristic odour and taste, with peasant smell to smoke and added spices. They were firm and pieces of red-brown meat and white to orange fat tissue (red pepper) could be seen at sections. Non-uniformly mixed filling was a common characteristic of both types of sausages, which resulted in different ratio of fat and muscular tissues at various sections, and it often appeared that there was more fat tissue than muscular tissue.

Physicochemical quality parameters with regard to

basic chemical composition suggest the use of different both raw material and production procedure for meat products of the same type. Protein content in garlic-type sausages (Table 2.) was identical in all samples and ranged between 17.1% and 18.3%, while the range of fat content was 37.1% - 29.8%. Water content was relatively low and amounted to 35.1% to 36.8%. Protein and fat ratio was on average 1.00:2.12, suggesting a high biological value of the product. This should be specially emphasised, since the general impression after the examination of sections was that fatty tissue is predominant. Water content in samples of dry sausages was uniform and ranged from 30.3-33.2 %. Maximum fat content was 40.7%, 19.5% protein content, respectively.

As reported by Samelis et al. (1998), water content

in samples of Greek dry sausages amounted to 27.7-30.3%. In the study performed by Bruna et al. (2001), the content of dry matter in dry sausages amounted to 70 % at the end of fermentation. In the study performed by Ferreira and colleagues (2007) the quality of traditional dry sausages produced in the North of Portugal has been investigated. They have pointed out in the first place the diversity of organoleptic properties, depending on the region of production and consumers' preferences. Sausages were made of pork, and the meat was brined in a mixture of salt, wine and water. Their chemical composition was as follows: 30.1% to 57.3% of water, 3.6% to 68.2% of fat, and 31.6% to 43.5% of proteins. Such great differences in the quantities of different ingredients could be explained also by different ways of preparation of individual ingredients prior to filling. In fact, the standard procedure in some regions is cutting of meat and fat tissue into smaller pieces, whilst the dry sausages with markedly greater pieces of lean meat are preferred by the customers in other parts of Portugal.

By the bacteriological analysis of garlic sausage *S. aureus* (4 samples), enterobacteria (3 samples), sulphite-reducing clostridia (9 samples) and *Enterococcus faecalis* (16 samples) were isolated from samples of garlic sausages. In samples of dry sausages were isolated *S. aureus* (4) and sulphite-reducing clostridia (2). Results of another study (Samelis

▼ **Table 4.** Results of bacteriological analysis of garlic sausage

SAMPLE NUMBER	PARAMETER						
	S /25 g	SA /g	E/g	SRK/g	EC/g	LM/25g	EF/g
1.	neg.	neg.	neg.	neg.	neg.	neg.	neg.
2.	neg.	neg.	neg.	10000	neg.	neg.	60
3.	neg.	neg.	neg.	neg.	neg.	neg.	130
4.	neg.	neg.	neg.	300	neg.	neg.	300
5.	neg.	neg.	neg.	200	1000	neg.	20
6.	neg.	neg.	neg.	2900	neg.	neg.	20
7.	neg.	3000	500	neg.	neg.	neg.	260
8.	neg.	neg.	neg.	100	neg.	neg.	150
9.	neg.	1200	neg.	neg.	1200	neg.	neg.
10.	neg.	neg.	200	neg.	neg.	neg.	500
11.	neg.	neg.	neg.	neg.	neg.	neg.	450
12.	neg.	neg.	neg.	neg.	5000	neg.	100
13.	neg.	neg.	neg.	neg.	neg.	neg.	neg.
14.	neg.	neg.	neg.	12000	800	neg.	200
15.	neg.	neg.	neg.	neg.	neg.	neg.	140
16.	neg.	100	neg.	500	neg.	neg.	1000
17.	neg.	neg.	100	1800	neg.	neg.	neg.
18.	neg.	neg.	neg.	neg.	neg.	neg.	70
19.	neg.	150	neg.	9000	neg.	neg.	50
20.	neg.	neg.	neg.	neg.	neg.	neg.	500

S – *Salmonella* spp.; SA – *Staphylococcus aureus*; E – *Enterobacteriaceae*; SRK – Sulphite-reducing clostridia; EC – *Escherichia coli*; LM – *Listeria monocytogenes*; EF – *Enterococcus faecalis*

et al., 1998) have shown a constant number of enterococci throughout the ripening period (10^5 cfu/g). Maximum enterococci count in our study was 10^3 cfu/g in garlic sausages, but in dry sausages the finding was negative. Study performed by Zdolec et al. (2007) have shown a continuous reduction of the enterococci population in the course of ripening of traditional fermented sausages from households. However, their final count was about 10^3 /g. As reported by Giraffa (2002), the enterococci can survive and multiple in meat products during the fermentation process, especially in the absence of starter cultures. Survival of enterococci under fermentation conditions was also confirmed by Holey et al. (1998). Enterobacteria, coliform bacteria, *E. coli*, enterobacteria and sulphite-reducing

bacteria, in addition to *L. monocytogenes* and *Salmonella* spp. were isolated from samples of Mediterranean dry sausages (Lopez et al., 2000). Their count decreased during fermentation process, and the final product contained the acceptable level of microorganisms in all the tested samples. Presence of *Salmonella* spp., sulphite-reducing clostridia and *Listeria* spp. has been discovered in several sausage samples before the start of ripening, what the authors have attributed to hygienic quality of raw material. Bacteria of the genus *Listeria* (26.6%) were isolated from samples of dry-fermented sausages (n=60) and identified as *L. monocytogenes* (5%), *L. innocua* (18.3%) and *L. welshimeri* (3.3%) (Pellicer et al., 2002). The authors have concluded that adequate measures of control must

▼ **Table 5.** Results of bacteriological analysis of dry sausage

SAMPLE NUMBER	PARAMETER						
	S /25 g	SA /g	E/g	SRK/g	EC/g	LM/25g	EF/g
1.	neg.	50	neg.	neg.	neg.	neg.	neg.
2.	neg.	neg.	neg.	neg.	neg.	neg.	neg.
3.	neg.	neg.	neg.	neg.	neg.	neg.	neg.
4.	neg.	neg.	neg.	neg.	neg.	neg.	neg.
5.	neg.	10	neg.	neg.	neg.	neg.	neg.
6.	neg.	neg.	neg.	50	neg.	neg.	neg.
7.	neg.	10	neg.	neg.	neg.	neg.	neg.
8.	neg.	neg.	neg.	neg.	neg.	neg.	neg.
9.	neg.	neg.	neg.	neg.	neg.	neg.	neg.
10.	neg.	neg.	neg.	neg.	neg.	neg.	neg.
11.	neg.	50	neg.	neg.	neg.	neg.	neg.
12.	neg.	neg.	neg.	neg.	neg.	neg.	neg.
13.	neg.	neg.	neg.	neg.	neg.	neg.	neg.
14.	neg.	neg.	neg.	neg.	neg.	neg.	neg.
15.	neg.	neg.	neg.	neg.	neg.	neg.	neg.
16.	neg.	neg.	neg.	neg.	neg.	neg.	neg.
17.	neg.	neg.	neg.	10	neg.	neg.	neg.
18.	neg.	neg.	neg.	neg.	neg.	neg.	neg.
19.	neg.	10	neg.	neg.	neg.	neg.	neg.
20.	neg.	neg.	neg.	neg.	neg.	neg.	neg.

S – *Salmonella* spp.; SA – *Staphylococcus aureus*; E – *Enterobacteriaceae*; SRK – Sulphite-reducing clostridia; EC – *Escherichia coli*; LM – *Listeria monocytogenes*; EF – *Enterococcus faecalis*

be established in order to insure that the products will be free from bacterial contamination. As regards our study, *Salmonella* spp. and *L. monocytogenes* were not isolated from any sample of both types of sausages. According to the finding of Buncic (1991), *L. monocytogenes* was found in 19% of samples of dry sausages and in 21% of samples of vacuum-packed dry sausages. High levels of staphylococci in the filling of fermented sausages were reported by a large number of authors (Comi et al., 1992; Hugas and Roca, 1997; Samelis et al., 1998; Garcia-Varona et al., 2000; Papamanoli et al., 2002). The conclusion of the study on production and quality of fermented sausages in households (Bartolović, 1977) has been that the hygienic conditions of natural production of red pepper-flavoured salami "kulen" are not always satisfactory. The conclusion has been based on the finding of coagulase-positive staphylococci, sulphite-reducing clostridia and *E. coli* in the analysed products. According to the author, the improvement of the current hygienic conditions is indispensable, and the organisation of veterinary-sanitary control of pig slaughtering and natural processing of meat in households is of special importance. Number of sulphite-reducing clostridia in garlic sausages analysed in our study exceeded 10^4

▼ **Table 6.** Assessment of microbiological quality of working surfaces and accessories

	Smear	UB/cm ²	S/25ml	SA/ml	EF/ml	P/ml
1.	Working table	3.0x10 ³	Neg.	Neg.	Neg.	Neg.
2.	Working table	5.0x10 ²	Neg.	Neg.	1.0x10 ³	Neg.
3.	Working table	2.5x10 ³	Neg.	Neg.	Neg.	Neg.
4.	Chopping board - wood	3.9x10 ³	Neg.	Neg.	Neg.	Neg.
5.	Chopping board - PVC	2.9x10 ³	Neg.	Neg.	Neg.	Neg.
6.	Chopping board - PVC	>10 ⁶	Neg.	50	Neg.	Neg.
7.	Container -PVC	4.1x10 ²	Neg.	10 ²	10 ²	1.0x10 ²
8.	Container - inox	1.3x10 ³	Neg.	4.0x10 ²	10 ²	Neg.
9.	Container - inox	10 ²	Neg.	Neg.	Neg.	Neg.
10.	Container - inox	3.5x10 ²	Neg.	Neg.	Neg.	Neg.
11.	Knife	2.0x10 ²	Neg.	Neg.	Neg.	Neg.
12.	Knife	2.2x10 ²	Neg.	Neg.	Neg.	Neg.
13.	Knife	>10 ⁶	Neg.	Neg.	Neg.	Neg.
14.	Knife	1.2x10 ²	Neg.	Neg.	Neg.	Neg.
15.	Refrigerator	2.5x10 ⁴	Neg.	2.0x10 ²	Neg.	Neg.
16.	Refrigerator	1.5x10 ³	Neg.	Neg.	Neg.	Neg.
17.	Deep-freezer	6.0x10 ²	Neg.	Neg.	Neg.	Neg.
18.	Deep-freezer	2.0x10 ³	Neg.	Neg.	Neg.	Neg.
19.	Sink	3.2x10 ³	Neg.	Neg.	Neg.	Neg.
20.	Sink	4.0 x10 ³	Neg.	Neg.	Neg.	Neg.

S – *Salmonella* spp.; SA – *Staphylococcus aureus*; EF – *Enterococcus faecalis*; P – moulds

cfu/g, while dry sausages contained low levels of bacteria. *E. coli* was not found in dry sausages.

Control of hygienic conditions in relation to cleanness of working rooms and equipment, as specified by the Rules on standards of microbiological quality and methods of its determination (OJ No. 46/94) has revealed that the hygienic conditions of household production are below standard (Table 6). Swabs taken from the equipment and accessories used in the production of sausages have shown an increased total number of microorganisms, including the bacterium *S. aureus* and enterococci. The same microorganisms were identified also by bacterio-

logical analysis of home-made garlic and dry sausages. Consequently, special attention should be paid to hygienic conditions of production of traditional products, including, among other things, better arrangement of working areas for the preparation of these products. Standards specified in various Rules on food hygiene and hygiene of food of animal origin (OJ No. 99/2007) and on standards of microbiological quality and method of its determination (OJ No. 46/94) should be implemented in practice also under the household conditions of productions. The assessment of microbiological quality of the facility and rooms for food production, as well as of accessories used in the preparation of food, suggest that certain measures for correction of production conditions should be introduced and implemented. These include the use of disinfecting agents and instructions for appropriate washing of equipment, utensils and accessories in the production of sausages.

CONCLUSIONS

All the examined samples of sausages produced on a family farm have been found to be of acceptable quality as regards their sensorial properties and chemical composition and in compliance with the Rules on meat products (OJ No. 1/2007)

The samples of sausages in the type of garlic sausage have not satisfied the criteria of microbiological validity according to Rules (NN RH 125/03), because of the presence of *S. aureus* (4 samples), enterobacteria (in 3 samples), sulfite-reducing clostridia (9 samples) and *Enterococcus faecalis* (16 samples), and samples of dry sausages because of the presence of *S. aureus* (4 samples) and sulfite-reducing clostridia (2 samples). *Salmonella* spp. and *L. monocytogenes* have not been found in evaluated samples.

Control of hygienic conditions in relation to cleanness of all the working rooms and equipment used in the controlled household were below the required standards of hygiene due to increased total bacterial count and finding of *S. aureus*, enterococci and moulds.

Despite low level of hygienic quality, we find that support should be given to the natural production of traditional products in rural households and small family farms. The production of meat products in rural households, however, should be harmonised with the veterinary-sanitary regulations in force. First step in the solution of the current problems is service slaughtering of animals in the registered slaughterhouses under constant control of veterinary service. However, the control of production, i.e. on the very place of production and storage, is difficult to perform. Instead, it would be necessary to control the hygienic conditions relative to cleanness of all the working rooms and equipment according to the provisions of regulations in force, as well as the finished products. Establishment of a contractual relationship between food manufacturers and an authorised analytical laboratory would make it possible.

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ZUSAMMENFASSUNG QUALITÄT DER DAUER- UND KNOBLAUCHWÜRSTE AUS INDIVIDUELLEN HAUSHALTEN

In dieser Arbeit sind Resultate dargestellt, die sich auf sensorische, chemische und mikrobiologische Untersuchungen von einheimischen Wurstsorten Typ "dauer" und Knoblauchwurst beziehen. Diese Wurstsorten werden traditionell in bäuerlichen Haushalten hergestellt. Die Arbeit enthält auch die Untersuchungsergebnisse in Bezug auf die Bewertung der Sauberkeit der Ausrüstung, des Zubehörs und der Arbeitsflächen, wo die Würste hergestellt werden. Gleichzeitig wurde auf das Problem der Herstellungssicherheit für traditionelle Wurstsorten hingewiesen, in Bezug auf die Rohstoffbasis, Herstellungstechnologie, Qualität und hygienische Richtigkeit des Erzeugnisses sowie die Charakteristiken der schon affirmierten autochthonischen Merkmale.

Schlüsselwörter: autochthone Fleischerzeugnisse, hygienische Richtigkeit, Würste

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