

INFLUENCE OF CERTAIN PHYSICO-CHEMICAL FACTORS ON THE POSSIBILITIES OF T. SPIRALIS LARVAE SURVIVAL IN MEAT PRODUCTS

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Numerous literature data indicate that in many countries trichinellosis still appears in the form of sporadic epizooties, covering most frequently one household but also a few tens and even hundreds of men can be diseased. According to Yugoslav regulations (13), trichinoscopic examination of all pigs slaughtered in slaughterhouses is obligatory. Investigations of the spread of trichinellosis in certain parts of our country (8) have shown that from the total number of slaughtered pigs in the Socialistic Republic of Serbia, in the period from 1962 to 1973, only about 40% was slaughtered in slaughterhouses and that all trichinous pigs detected in slaughterhouses derived from individual agricultural producers. The most frequent cause of trichinellosis in men, in our country, was insufficiently heat processed meat or meat products produced from meat of trichinous pigs slaughtered in households without being examined for the presence of *T. spiralis* larvae.

Having in mind the above mentioned data, we set the task to examine whether and under which conditions does the survival of capsulated *T. spiralis* larvae occur in common microclimatic conditions of dry sausage production as well as in the conditions of traditional heat processing of pork by grilling.

MATERIAL AND METHODS

For the preparation of the examined experimental dry sausages, we used meat of experimentally infected pigs in which the capsulated *T. spiralis* larvae were 30, 60, 90, namely 110 days old after infection (p/i). The obtained meat was first frozen at -2°C to -3°C for 10 hours and then ground and cured with the addition of 2.5% of nitrate salt containing 0.5% of sugar as well. After the addition of common natural ground spices (pepper, garlic, paprika), the stuff was filled in artificial casings of different diameter, whereupon the sausages were smoked and dried in climate-chambers at conditioned microclimatic conditions (air temperature - 20° to 26°C , relative humidity - 85 to 60%, air circulation - 2m/sec/. From trichinous pork we produced four series of experimental dry sausages, the production processes of which lasted 15, 16, 18, namely 20 days. The quantities of water and common salt during dry sausage production and in finished products were determined by chemical analyses. Experimental sausages differed from similar products at the market due to considerably smaller quantity of fatty tissue, what influenced also the relations of water quantities during drying and in finished products. From trichinous meat of the same experimental pigs, in which larvae were 60, namely 110 days old p/i, we prepared three kinds of products (meat in pieces, ground formed meat and frying sausages). We grilled these products on the heated electrical grill for such a period of time as to obtain, in the center of products, temperatures of 55 to 60°C , 60 to 65°C , namely 65 to 70°C for 5 minutes, what was controlled by thermocouple. After grilling at the mentioned temperature conditions, we evaluated the roastness of experimental products visually, on the basis of the denaturation rate of muscular tissue.

The presence of *T. spiralis* larvae in white rats (fed with experimental products) was examined by trichinoscopic examination of the diaphragm and by the method of artificial digestion of the whole musculature.

RESULTS AND DISCUSSION

The examination results have shown that relatively high content of common salt and at the same time relatively low quantity of water had decisive influence on the survival of *T.spiralis* in dry sausages. On the basis of minimum and maximum values for the quantities of NaCl and water in all experimental series of the examined dry sausages, their influence on the possibility of capsulated *T.spiralis* larvae survival (evaluated on the basis of positive and negative biological tests) was presented in Figure 1.

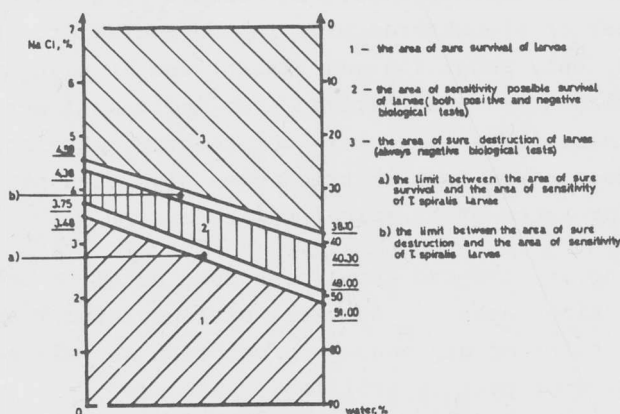
From Figure 1 it can be seen that in the applied conditions of dry sausage production (increased quantity of NaCl and reduced quantity of water), and on the basis of their activity on capsulated larvae, it is possible to differentiate three areas - the area of sure destruction of larvae, the area of larvae sensitivity with the possibility of their survival (what depended on their p/i age) and the area of sure survival of *T.spiralis* larvae.

The area of survival of capsulated larvae and the area of their sensitivity to the effect of NaCl and drying, namely the area of their sure destruction, border on the zones in which, dependent on the influence of individual factors (p/i age of larvae, relation of NaCl and water quantities), the beginning of their sensitivity (zone a) or their possible survival namely destruction (zone b.) take place.

The results of biological tests on rats fed with grilled products are presented in Table 1.

The obtained results show that negative biological tests were obtained in rats fed with products being heat processed at temperature reaching 65 to 70°C in the product center for 5 minutes. These products were visually evaluated as sufficiently grilled. In the case of products in the center of which the temperature from 55° to 60°C was obtained for 5 minutes, the majority of biological tests on white rats was positive, and the products were visually evaluated as semi-grilled. In addition, *T. spiralis* larvae were also established in muscular tissue of white rats in the case when they were fed with products in the center of which the temperature from 60° to 65°C was obtained for 5 minutes, and the products were evaluated as insufficiently grilled.

Figure 1.
INFLUENCE OF THE QUANTITIES OF NaCl AND WATER IN DRY SAUSAGES PREPARED FROM TRICHINOUS PORK ON THE POSSIBILITY OF SURVIVAL OF *T. SPIRALIS* LARVAE



The Results of Biological Tests with Rats Fed with Products Prepared from Trichinous Pork Being Grilled and Sensory Evaluation of Their Roastness

tbl. 1

Experimental series	Name of the product	Age of larvae (in days p/i)	Effect of different grilling temperatures (during 5 minutes) and the number of rats with positive and negative findings of larvae					
			55° - 60°C		60° - 65°C		65° - 70°C	
			+	-	+	-	+	-
I	GROUND FORMED MEAT	60	1	2	0	3	0	3
		110	3	0	1	2	0	3
II	MEAT IN PIECES	60	1	2	0	3	0	3
		110	2	1	0	3	0	3
III	FRYING SAUSAGE	60	2	1	1	2	0	3
		110	2	1	1	2	0	3
SENSORY EVALUATION OF ROASTNESS			SEMI-GRILLED		INSUFFICIENTLY GRILLED		SUFFICIENTLY GRILLED	

+ = Positive biological test (*T.spiralis* found)
- = Negative biological test (*T.spiralis* not found)

The results of our examinations of the possibility of *T. spiralis* larvae survival, namely the loss of their ability to cause infection, during dry sausage production, have shown that they are influenced by the relations of the obtained concentrations of NaCl and water. In the examined conditions of dry sausage production, the capsulated larvae did not lose their ability to cause new infection in any of the cases where the quantity of common salt in products was lower than 3.48% and the quantity of water higher than 51.00%. Further increase of NaCl concentration and further reduction of water quantity (drying) influenced the destruction of larvae, namely the loss of their ability to cause infection, till the increase of NaCl quantity to 4.59% and the reduction of water quantity to 38.10%, when, regardless of the p/i age of larvae, infection of experimental rats did not appear in none of cases. The effects of increased concentrations of common salt and the loss of water were supported by previous freezing of trichinous meat, what resulted in certain disturbances of the capsule integrity and later on in the increased sensitivity to the effect of the mentioned factors, specially in the case of younger p/i larvae.

In spite of considerable differences in the technique of work, the age of larvae in pork and other factors, we can say that our examination results of dry sausages are to a considerable extent in agreement with the literature data presented by Sach (14), Kniewallner (4), Löttsch and Rödel (6, 7) and some other authors. They have proved that trichinellosis can be easily transmitted to men by Rohwurst-type sausages, whereas Nemeseri (10) has concluded that *T. spiralis* larvae can survive the production process of dried sausages and salami. Sach (14) found alive *T. spiralis* larvae in Hartwurst-type experimental sausages containing 4.7% of NaCl and 41.08% of water. The results of Gammon et al. (3), Crouse and Kemp (2) and Zimmermann (15), who examined the possibility of *T. spiralis* larvae survival in the production of American dry hams and shoulders, deviate to a certain extent from our results due to quite different conditions of the production of these products.

The examination results of the possibility of *T. spiralis* larvae survival after grilling of products have shown that destruction, namely the loss of their abilities to cause infection, did not take place regardless of the achieved temperatures. On the basis of this we have concluded that in the product center, where muscular tissue is not completely denaturated (insufficiently grilled products), the capsulated *T. spiralis* larvae can survive even the temperatures from 60° to 65°C for 5 minutes. In addition, somewhat higher possibility of survival of p/i older larvae was observed, specially in ground meat products.

In the available literature, we did not find data on the examination of the possibility of *T. spiralis* larvae survival during grilling, namely frying of trichinous pork. Münchberg and Kniewallner (9) found severe infection in experimental rats fed with commonly fried and roasted meat, whereas Carlin et al. (1) state that capsulated larvae can survive roasting of large pieces of pork at 55° to 59°C in the product center. Our results (with smaller deviations due to different technique of work) agree in general with the results of Podhajecki (11, 12), Lörincz and Nemeseri (5) and some other authors, who state that temperature of 55°C for 10-15 minutes is sufficiently high to destroy *T. spiralis* larvae in meat. However, all the above mentioned experiments were performed by heating of trichinous meat pieces in water. In our experiments, the capsulated larvae showed somewhat higher thermoresistency.

CONCLUSIONS

Examining the possibility of survival of capsulated *T. spiralis* larvae in meat products prepared under the mentioned conditions, we have concluded the following:

- 1) The highest influence on the destruction of larvae in dry sausages was shown by the increase of common salt content and the water loss - drying, and to certain extent by freezing of pork prior to its use. Capsulated larvae were surely destroyed when the NaCl content exceeded 4.39% and at the same time the quantity of water was below 38.10%. Taking into

consideration the achieved quantity of NaCl and drying rate in the given conditions of dry sausage production, it is possible to expect the survival of capsulated *T. spiralis* larvae.

- 2) In all the examined meat products being grilled, the temperatures from 60 to 65°C and lower ones, obtained in the product center for 5 minutes, could not destroy all capsulated *T. spiralis* larvae. However, at the temperatures from 60 to 70°C, obtained in the product center for 5 minutes, meat products were free of larvae able to cause infection in experimental white rats.
- 3) Under the influence of the examined undesirable factors (increase of NaCl content, drying, heating), p/i older larvae retained the ability to cause infection for a longer time.

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