

Untersuchungen über die Laktobazillenarten in Dauerwurst

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Gegenstand der Untersuchungen sind die Laktobazillenarten während der Reifungsperiode von Dauerwurst, Typ "Panagürska Lukanka" und "Hemus". Dabei wird es festgestellt, dass die homofermentativen Mikroorganismen, insbesondere *L. plantarum*, das eine dominierende Art bis zum Ende der Reifung bleibt, überwiegen. Seltener werden *L. casei* und seine Unterarten *L. casei v. alactosus* und *L. casei v. rhamnosus* der Gruppe *Streptobacterium* isoliert. Beim Vergleich der prozentuellen Verhältnisses zwischen den einzelnen Arten von Laktobazillen in beiden Dauerwurstsorten wird festgestellt, dass die Menge von *L. casei* in der Wurstsorte "Hemus" grösser ist als in der Wurstsorte "Lukanka".

In einzelnen Fällen ist auch das Vorhandensein von heterofermentativen milchsäuren Mikroorganismen der Gruppe *Betabacterium* - *L. brevis*, *L. cellobiosus*, *L. büchneri* - nachgewiesen.

Studies on the lactobacilli species in raw-dried sausages

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The species composition of lactobacilli was studied during the ageing of the raw-dried sausages, Panagyurska Loukanka, and "Hemus". Homofermentative microorganisms were found to predominate, and particularly *L. plantarum* which remains a predominating species till the end of ageing. *L. casei* and its subspecies *L. casei v. alactosus* and *L. casei v. rhamnosus* from the *Streptobacterium* group are isolated less frequently. On comparing the per cent ratios between the individual lactobacillus species in the two types of raw-dried sausages, the number of *L. casei* was found to be higher in the Hemus sausage than in the Loukanka.

The presence also of heterofermentative lactic acid microorganisms was shown in individual cases: *L. brevis*, *L. cellobiosus*, *L. büchneri* from the *Betabacterium* group.

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Etude sur les espèces de lactobacilles dans les saucissons secs

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On a étudié les espèces de lactobacilles pendant la maturation des saucissons secs comme Loukanka Panagurska et Saucisson "Chémus". On a établi la domination des microorganismes homofermentatifs, et plus particulièrement celle de *L. plantarum* qui restait une espèce dominante jusqu'à la fin de la maturation. Plus rarement étaient isolés *L. casei* et ses sous-espèces *L. casei v. alactosus* et *L. casei v. rhamnosus* du groupe *Streptobacterium*. Lors de la comparaison des rapports des pourcentages entre les différentes espèces de lactobacilles dans les deux assortiments de saucissons secs on a constaté que la quantité de *L. casei* était plus grande dans le Saucisson "Chémus" que dans la Loukanka.

Dans des cas isolés on a prouvé aussi la présence de microorganismes lactiques hétérofermentatifs du groupe *Betabacterium* - *L. brevis*, *L. cellobiosus*, *L. büchneri*.

Исследования видового состава лактобацилл в сыро-вяленых колбасах

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Изучен видовой состав лактобацилл во время созревания сыро-вяленых колбас - Панагурска луканка и "Хемус". Обнаружено преобладание гомоферментирующих микроорганизмов и в особенности *L. plantarum*, который остается преобладающим видом до конца созревания. Реже изолируются *L. casei* и его подвиды *L. casei v. alactosus* и *L. casei v. rhamnosus* группы *Streptobacterium*. При сравнении процентных соотношений между отдельными видами лактобацилл в двух ассортиментах сыро-вяленых колбас установили, что количество *L. casei* в колбасе "Хемус" выше, чем в луканке.

В отдельных случаях доказано наличие также гетероферментирующих молочнокислых микроорганизмов - группы *Betabacterium* - *L. brevis*, *L. cellobiosus*, *L. büchneri*.

Studies on the lactobacilli species in raw-dried sausages

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It is well known that the lactic acid microorganisms play an important role in the ripening of raw sausages. It is believed that the main representatives are the homofermentative *L. plantarum* and *L. leischmannii* and the heterofermentative *L. brevis* and *L. büchneri* (20). Niinivaara (10) has found out that at the end of the production process, the microflora consists mainly of *L. plantarum* and *L. leischmannii*. Nurmi (12) examines the role of lactobacilli during ripening of raw-dried sausages and proves their positive effect on the consistency. Reuter (13,14,15) recommends the use of lactobacilli as starter cultures in fastripening sausages. According to Coretti (5,6), some disadvantages in the production of raw-dried sausages relating to colour and taste, are due to the group of heterofermentative lactobacilli.

In the literature exist a considerable number of publications in reference to the lactobacilli and their use as starter cultures in the production of raw-dried sausages. In spite of this, there are still a lot of unsolved problems related to the participation of the different species of the microorganisms in the ripening of raw-dried sausages. The present studies are intended to determine the species composition of lactobacilli during the ripening of raw-dried sausages.

Materials and methods

The studies were conducted with 12 regular production lots of 'panagyurska loukanka' and 5 lots of 'Hemus' sausages, produced as per the accepted technological instructions (1). The material for the study was taken on the first day of production from the experimental lots of sausages, and periodically during ripening and drying on the 7th, 14th, 21st, 28th, and 35th day.

The isolation of the lactobacilli is carried out on solid mediums MRS, Rogosa (17,18) and on tomato agar with glucose. In the identification of the isolated strains, the formation of catalase (9) was taken into consideration, gas from the glucose (8), ammonium (11) from the arginine, growth rate at 15 and 45°C (4), reduction of nitrates (2), hydrolyses of esculine (7), limit acidity of milk (19), sugar and high alcohols fermentation (18). The differentiation was done after Rogosa and Sharpe (17), Sharpe (18), Rogosa (16), and Bergey (3).

Results and discussionLactobacilli in Panagyurska Loukanka.

Over 100 strains have been isolated, most of which were differentiated to species. All strains are Gram-positive, immobile, and catalase-negative. They develop at 15°C, do not produce CO₂ during the fermentation of glucose, with the exception of 4 strains.

Most of the lactobacilli are related to the homofermentative lactic acid microorganisms - the group of streptobacteria. Single strains were determined as heterofermentative - the group of betabacteria. Streptobacteria hydrolyse esculine and ferment cellobiose, salycine, galactose, maltose, mannit and sorbit. Some of the isolated strains do not ferment sorbit, salycine and mannit. In the differentiation of streptobacteria to species was taken into account their limit acidity of milk and the fermentation of arabinose, lactose, melibiose, raffinose, saccarose, ksilose. The strains identified as *L. plantarum*, in difference to *L. casei*, ferment melibiose and raffinose. In the identification of the sub-species of *L. casei*, was taken into account the degradation of lactose, ramnose, and saccarose (17). It was established that most of the lactobacilli are isolated one week after production, and that *L. plantarum* dominates during the whole ripening period.

The results obtained during the identification of the species types of the lactobacilli in

Loukanka sausage, show that during the ripening take part the streptobacteria : *L.plantarum* (79,8%), *L.casei v.casei* (11,0%), seldom *L.casei v.alactosus* (3,1%) and *L.casei v.rhamnosus* (3.1%), and in single cases the betabacteria *L.cellobiosus* (1,5%) and *L.büchneri* (1,5%) (figure 1). At the end of the ripening period the microflora consists mainly of *L.plantarum*

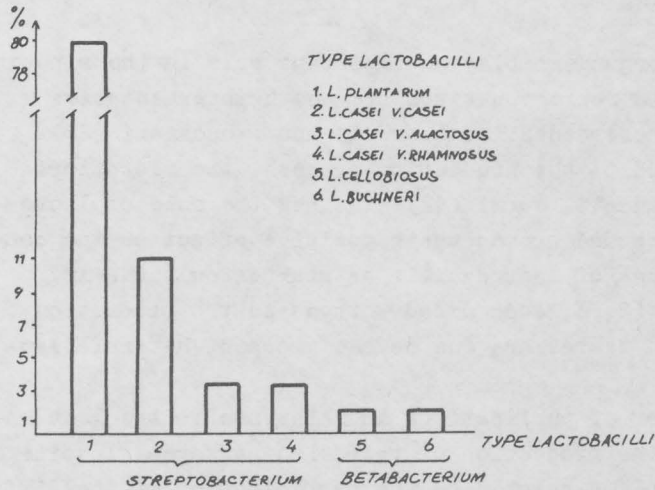


FIG. 1

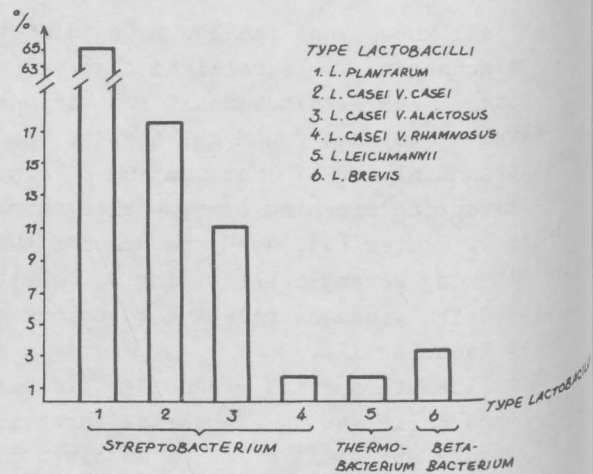


FIG. 2

Lactobacilli in 'Hemus' sausage.

The lactobacilli isolated from the sausage Hemus are also Gram-positive, immobile and catalase-negative. They grow at 15°C and do not form CO₂ from glucose, with the exception of single strains. Certain differences from the typical characteristics for given species have been observed, connected with some biochemical properties and especially concerning the fermentation of carbohydrates and higher alcohols. Some of the species belonging to the streptobacteria group, do not ferment sorbitol, salycine, and mannitol. Besides, the fermentation of raffinose is not always a permanent index for differentiation of *L.plantarum* from *L.casei*. The biochemical characteristics of the isolated betagroup strains are typical for the corresponding species.

The biggest number lactobacilli was isolated one week after production of the sausages. As was the case with Panaguyrska Loukanka, *L.plantarum* predominates over the other species of lactobacilli.

Of all isolated strains, *L.plantarum* represents 65,1% from the total number of lactobacilli. *L.casei v.casei* - 17,4%, *L.casei v.alactosus* - 11,1%, *L.casei v.rhamnosus* 1,6%, *L.leischmannii* - 1,6%, and *L.brevis* - 3,2% (figure 2). These data demonstrate that 95,2% of the lactobacilli are related to the group of streptobacteria, 1,6% are thermophilic, and 3,2% are from the betabacteria group. Characteristic for *L.casei* is, that the percentage of the isolated strains is higher in the sausage Hemus (30,1%) than in the Loukanka sausage (17,2%). These differences in quantity ratios of the species lactobacilli isolated from the two types of raw-dried sausages, is probably due to differences in their respective technologies for production.

Conclusion

In the study of the raw-dried sausages Panaguyrska Loukanka and Hemus was exhibited, that the predominant species lactobacilli is *L.plantarum*, and more seldom are observed *L.casei* and its sub-species *L.casei v.alactosus* and *L.casei v.rhamnosus*. In separate cases is proved the existence of *L.brevis*, *L.cellobiosus*, and *L.büchneri*.

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