ABOUT SAFETY OF FERMENTED RICE

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Introduction

A food colorant of microbiological origin – fermented rice (red rice) is widely used in meat industry of Russia.

This natural colorant is produced by the fermentation of rice with cultures of fungi of the genus *Monascus* with pH values 5-6 and temperature 30^0C. These fungi form red, orange and yellow pigments on the rice, presented predominantly by monacsorubin and monacsin (Sarafanova L.A., 2003). The obtained colorant is stable to light, high temperatures, oxidation, metal ions, change of pH of the environment, doesn't change color both during production process and storage of meat products.

Fermented rice possesses preserving and curative properties, in several countries fermented rice is considered as the alternative to sodium nitrite. When the fungus culture produces one of its numerous metabolites – monoscidin A, the colorant shows some antimutagenic activity. It should be noted that an essential drawback of fermented rice is its incomplete solubilization in water that can lead to the appearance of non-uniform coloring of meat products.

In Russia fermented rice is officially allowed and is the most common colorant in meat industry, mainly because of its low cost. However, in the international food law, fermented rice is one of the most "controversial" from the safety point of view colorants, used in production of different comminuted meat products.

In Europe and USA red rice is not allowed for meat products manufacture. This colorant is not recognized by FAO/WHO as a food supplement and doesn't have index E, mainly due to the fact that it can contain a toxic substance citrinin, produced during fermentation of rice with the cultures of fungi *Monascus purpureus* and *Monascus rubber.* Thus, the confirmation of toxicological safety of red rice could become a decisive factor for its official approval as a food supplement. The important aspects are also the standardization of the main stages of production of fermented rice and full identification of the functioning *Monascus*-cultures.

Because of toxicity of citrinin, it is important that the simultaneous formation and isolation of citrinin shouldn't take place during production of red pigments from *Monascus.* But it is not always possible to control this process, because fermented rice – is a complex microbiological product with unsteady chemical composition. The obtained preparations can possess different characteristics, which depend upon quality of the used raw materials, level of purification and degree of refining. Besides, the level of production influences the properties of the colorant as well.

Some foreign investigators made attempts to find conditions unfavorable for cultivation of citrinin in production of fermented rice. It was found that the addition of methionine and urea reduced the level of citrinin in the product. But an inhibitor having a particular effect against biosynthesis of citrinin still has not been found. The necessary requirement for the use of fermented rice in meat industry as food supplement in EU countries is the complete absence of citrinin in commercial preparations that can be achieved by detoxication during production process, or by isolation of cultures, not forming citrinin.

In connection with this the determination of one of the constitutional parts of this colorant, produced by fungal cultures – monascidin A - is rather important.

This pigment has the ability to inhibit the growth of some pathogenic microorganisms. A number of foreign findings suggest that monascidin and citrinin have similar chemical composition. Therefore, the control over production of the red rice colorant to assure the production of only those strains of fungi, not helping to form monascidin A as a by-product, becomes important.

Thus, natural origin of fermented rice doesn't provide full guarantee of safety of final products, produced with its use. In connection with this the evaluation of toxicological properties of different commercial preparations of this colorants used in meat industry is important.

Materials and methods

To make such an evaluation under production conditions the samples of fermented rice were chosen. Toxicological properties were determined by the method of automated toxicological testing with the use of the device "BiolaT, on the basis of quantitative and qualitative determination of the response of test-objects (infusoria) for toxic components of the studied objects [Dolgov, 1992, Cheremnykh, 2005, Rozantsev et al., 2006].

The solutions of the samples of colorant of similar concentration were introduced into the medium of microorganisms culturing, consisting of infusoria, peptone, glucose, yeast extract, food grade salt, water,

antibiotic amoxicyline. The control and experimental solutions were subjected to heating to 80^0C during 1 hour and cooling.

A generalized indicator of the efficiency of action of the studied substance on the indicator organism was its survival or gain in quantity. To construct the curves of growth a daily enumeration of infusoria was conducted.

The data obtained allowed us to compare toxicity of experimental samples of the solutions of colorant with the control solution, in this case the counts of microorganisms in the control, determined during 10 days, were taken as 100%.

Results and discussion

Of the three samples of the fermented rice, one sample exhibited some toxic properties in relation to the microorganisms *Tetrahymena pyriformis* in the course of the whole experiment. On the average, the reduction in the numbers of infusoria in this solution as compared to the control one was 25%. In the other experimental solutions there was a gain in the numbers of infusoria, suggesting the absence in the manifestation of toxic properties of these samples of fermented rice.

The results of these studies have shown good reasons to continue the investigations of toxicity of the samples of fermented rice and the necessity of the incorporation into the existing legislation of Russia on the use of food supplements the additional indices of safety for this colorant.

The purposeful use of fermented rice in meat industry without any harm to health of consumers of the products, containing this component is only possible if there is a scientifically-grounded allowed norm on the level of citrinin in the composition of the preparations, or in the case of its complete absence. Therefore, increased attention should be given to the identification of this neurotoxic agent in commercial preparations of fermented rice coming on the market of food supplements in order to incorporate this index in the existing hygiene norms and rules on the use of food additives under the condition that this multifunctional colorant will obtain index E and the generally recognized official status of the food ingredient.

In the course of time a new colorant of microbiological origin, being the product of biosynthesis of the microorganisms *Penicillium oxaliam varietas* can become an alternative to fermented rice. This colorant has a commercial name Arpink Red and is successfully used in Czech Republic, where it is industrially produced by the approval of the Ministry of Health. It is a substance of antrachinone type, chemically similar to carminic acid and possessing a red saturated color.

Toxicological studies carried out in Czech Republic confirmed compliance of this colorant with safety requirements of FAO/WHO established in Europe (Codex Alimentarius).

According to preliminary investigations of functional and technological properties Arpink Red by many indices (solubility, color stability in relation to temperature, light, change in pH of the environment, stability of color during storage) behaved better than many preparations of fermented rice.

Further investigations of ready products manufactured with the use of fermented rice and Arpink Red, are scheduled, and the comparative evaluation of toxicological properties of these colorants by the method of automated biotesting on microorganisms will be conducted.

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