

AGRIBUSINESS

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REVIEW AND ANALYSIS OF APPLICATION OF RAPID TESTS FOR ANTIBIOTICS IN RAW COW MILK

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Abstract

This paper describes organoleptical and physico-chemical parameters of raw cow milk. The acceptable levels of antibiotic residues in raw milk are shown. Main rapid antibiotics tests for raw cow milk are being analyzed. The application of a rapid test directly on farms is offered at the first yield of milk after the withdrawal period of a treated animal.

Keywords: cow milk, raw milk, antibiotics, rapid test, farm enterprise

Recently it has become very popular to speak about the problem of healthy lifestyle. Many different types of mass media stakes on fight for ratings on the broadcasts devoted to health

improvement due to normal physical activity and an eutrophy based on organic foods.

Milk is the product of cow mammary glands of normal physiological secretion, received from one or several animals during the lactation period in one or more milking without any addition or extraction any substances [2].

The growth of milk and dairy products consumption takes place everywhere as it is one of the main foods and an extremely necessary component of a healthy diet for people of any age all around the globe [4,5].

Milk is healthy for cholesterol metabolism normalization, it positively influences the work of digestive organs, stimulates kidneys, normalizes the structure of intestinal flora and impedes putrefactive processes. The macronutrients in milk and dairy products, such as calcium, potassium and magnesium improve the condition of blood and musculo-skeletal systems of a human body [6,7]. Also milk is known for its richness in complete proteins consisting of essential amino acids, which are quantitatively equal to the content of its in meat.

Table 1 - Organoleptic and physical-chemical parameters of raw cow milk

Indicator	Norm for the grade of milk		
	High	First	Second
Consistence	Homogeneous liquid without sediments and flakes		
Taste and flavor	Freezing is prohibited.		
	Clear, without any foreign odors and after-tastes abnormal to genuine milk		
			Mild forage after-taste and odor is allowed
Color	From white to light-cream		
Protein weight percentage, %	No less than 2,8		
Acidity, °T	No less 16,0 than or equal to 18,0	No less 16,0 than or equal to 18,0	No less 16,0 than or equal to 21,0
Group of purity, no lower	I	I	II
Density, kg/m ³ , no less than	1028,0	1027,0	1027,0
Freezing point, °C	Less than or equal to 0,520		

Complexity of the nutrition balance consists of solving the main modern food industry problem: search of safe technologies in food manufacturing and quality control through all production stages.

One of the serious modern problems in cattle breeding is the mastitis of milk cows. This widespread illness, along with others,

is treated with antibiotics which is the reason of detection of these drugs in cow milk.

According to the interstate standard adopted in the territory of Russia, Azerbaijan, Kazakhstan, Uzbekistan and Kyrgyzstan [2] and put into operation as the national standard of the Russian Federation since July 1, 2014, raw milk is the milk exposed to no heat treatment at a temperature more than 40 °C or processing which results in the change of components. Due to organoleptic and physico-chemical indicators, milk has to conform to the requirements specified in table 1.

One of raw milk quality indicators is absence of antibiotic residues as they are used not only in medicine, but also in such spheres as cattle breeding and plant growing. There are several ways of antibiotic substances entry into raw milk which are more connected with non-compliance of hygiene conditions:

- The consequences of cows treatment (usually medicine is eliminated through 4 – 6 milkings after reception, however it depends on specific physiology of an animal, liver conditions, etc. Such cows are usually milked separately, and medicinal prophylaxis is carried out during the dry period);

- The consumption of a mouldy silo and other infected forage by cows (it is well known, that mold is a Penicillium source, therefore consumption of mouldy forage leads to antibiotics entry in milk);

- The use of a moulded detergent for washing milking-machines (many detergents carelessly kept in closed containers are covered with a mold film which then passes on milking equipment, multiplies there and saturates milk with antibiotics).

The acceptable levels of potentially dangerous substances such as antibiotics, toxic elements, mycotoxins, pesticides and radionuclides in milk must conform to the requirements established by the regulatory legal acts of the Technical regulation of the Customs union "About safety of milk and dairy products" (TR CU 033/2013) functioning in the territory of the Russian Federation. If the excess of the inhibiting substances amount (table 2) is detected, the milk is labeled as off-grade even if other indicators meet the present standard requirements [1].

Current restriction is bound to the fact that the consumption of products containing antibiotic substances can do irreparable harm to human health. Generally, milk with the remains of antibiotics can cause dysbacteriosis and allergic reactions to people with a hypersensitivity to them and can enduce pathogenic microorganisms resistance to these drugs. Besides, accumulating in bone tissue, the

inhibiting substances promote its destruction and can generate negative impact on eyes, lungs and other organs.

Table 2 - Acceptable levels of antibiotic residues in raw milk

Antibiotics	Acceptable level of residues, mg/kg (l)
Laevomycetin	0,01
Chloramphenicol	0,0003
Tetracycline group	0,01
Streptomycin	0,2
Penicillin (Betalactam)	0,004

Antibiotics worsen sanitary quality and technological properties of milk. Antibiotic residues even in small concentration suppress development of the lactobacillales used in production of fermented milk and other dairy products. Antibiotics break milk renneting in cottage and regular cheese production, which has an adverse effect on a consistence and taste of these products. Bitterness and flat aroma are typical for butter made from cream with a high content of antibiotics.

It has become possible to detect antibiotics in milk quickly and reliably as well as to prevent its entry to raw materials with the help of rapid tests. Currently, antibiotics testing in milk happens directly at the processing enterprise. The sample of milk is taken from the milk lorry and exposed to analyses in a laboratory of a milk-processing plant. However, rapid tests application directly at farms just after the first yield of milk of the healed animal after the withdrawal period will allow to determine the suitability of this particular cow's milk to mixing with the whole yield of a farm from healthy cows and to prevent entry of antibiotics into a general flow. This, in turn, prevents possible expenses for logistics of a low-quality milk batch to a milk-processing enterprise and return of reject back to the farm.

The following widespread models of the rapid tests which have undergone procedure of the state certification [3] have been chosen for analysis:

- SNAP Beta Lactam ST;
- Delvotest BLF;
- Twinsensor^{BT} ;
- SNAP Duo Beta-Tetra ST;

- Betastar Combo HS;
- Reveal for CAP/STREP;
- 4sensor^{BTCS} ;
- Betastar 4D.

The action of SNAP Beta Lactam ST is based on the method of immunoenzymatic reaction in the course of which antibiotics of beta-lactam type - and for SNAP Duo Beta-Tetra ST tetracycline group - are caught by specific albuminous receptors, labeled with an indicator enzyme. This leads to formation of a chemically strong complex, which blocks the property of the indicator to change the color of products of chemical reactions. Presence of antibiotics is established visually, comparing the intensity of a color zone of antibiotics definition with the intensity of the inspection zone color of the indicator device.

The work of the Delvostest BLF test is based on reaction of complex formation of beta-lactam type antibiotics with the albuminous receptors which are contained in lyophilisate. Further, the receptors which remained free are identified visually by a chromatography on the indicator strips of chromatographic paper containing reactionary and control zones in a form of the respective lines.

Twinsensor^{BT} acts under the principle of complex formation reaction of antibiotics beta-lactam type and tetracycline group with specific albuminous receptors, labeled by colloid gold. Further, the receptors which remained free are identified visually by a chromatography on the indicator strips of chromatographic paper containing reactionary and control zones in a form of the respective lines.

The method of 4sensor and Betastar 4D is based on the reaction of complex formation of a chloromycetin and streptomycin with specific protein receptors marked by colloidal gold. Further, the receptors which remained free are identified visually by a chromatography on the indicator strips of chromatographic paper containing reactionary and control zones in a form of the respective lines.

The selection of a specific rapid test depends on the purposes and scales of a farm as well as on the nature of drugs most commonly used for treatment. To improve the process SNAP Beta Lactam ST and SNAP Duo Beta-Tetra ST are recommended, because they do not require the additional equipment and high temperature condition of a test, possessing high sensitivity. The analysis technique itself is easily understood by the worker with any

educational level, as shown in table 3 (prices quoted for 2015). At a larger enterprise it is more rational to use multiplex rapid tests, such as 4sensor and Betastar 4D as in a large herd cattle there always is a high probability of different nature diseases requiring treatment by various types of antibiotics. Thus, these rapid tests will allow to promote coordination of laboratory employees, regardless the applied medicine and high precision of the analysis.

Table 3 – Comparison of rapid tests characteristics in raw cow milk.

Parameter/ Rapid test	SNAP Beta Lactam ST	Delvostest BLF	Twinsensor ^{BT}	SNAP Duo Beta-Tetra ST	Betastar Combo HS	4sensor ^{BTC5}	Betastar 4D
Defined antibiotics and limits of sensitivity	betalactam (0,002 u/c ³)	betalactam (0,003 u/c ³)	betalactam (0,003 µg/g) Tetracycline (0,01 µg/g)	betalactam (0,0013 µg/g) Tetracycline (0,0107 µg/g)	betalactam (0,002 mg/kg) Tetracycline (0,01 mg/kg)	betalactam (0,003 mg/kg) Tetracycline (0,01 mg/kg) streptomycin (0,15 mg/kg) laevomycetin (0,0003 mg/kg)	betalactam (0,003 mg/kg) Tetracycline (0,01 mg/kg) streptomycin (0,2 mg/kg) laevomycetin (0,0003 mg/kg)
Total test time, minutes	10	5	5	5	5	5	10
Temperature of test conducting, C ⁰	0-10	64+/-2	40+/-3	none	47,5 ±1	40+/-3	47,5 ±1
Supplementary conditions	horizontal position	-	-	horizontal position	-	-	-
Cost of 1 test, rubles	280	305	145	358	250	350	394
Thermostat-incubator	-	+	+	-	+	+	+
Cost of supplementary equipment, rubles	1710	18 800	19 920	0	18650	17 920	18650

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promote coordination of laboratory employees, regardless the applied medicine and high precision of the analysis.

Considering the above mentioned it is possible to come to the conclusion that, thanks to constantly growing consumption of milk and dairy products, the study of the methods of quality control and decrease of antibiotics quantity in raw milk are demanded nowadays. Further it is planned to develop the research work to study the economic efficiency of rapid tests for antibiotics in raw milk on farms.

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