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ANIMAL WASTE AS A RISK FACTORS FOR AIR, WATER, EARTH AND A THREAT FOR PUBLIC HEALTH

Abstract

Animal waste includes animal carcasses, slaughterhouse confiscates, slaughter by-products, high-risk tissuea, the blood of slaughtered animals and other. It presents a specific hazardous material that can be a source of infection and environmental pollution. The disposal of animal waste must be carried out safely, otherwise dangerous pathogens are spread by water, air and soil at different distances and endanger public health. In the paper the state of animal waste in Serbia is presented, as well as the ways of spreading and survival of most common zoonotic pathogens in water, soil and manure. According to the research in the countries with developed cattle breeding, the proposed method for safe disposal of animal waste are intended to protect the environment and are economically justified. In these countries the method of directed composting in closed systems are often applied and they are named biovators.

Key words: *animal waste, zoonotic pathogens, survival of pathogens in the water, earth, manure.*

INTRODUCTION

Developed industrial production, especially intensive livestock farming, provides the production of necessary protein and high demand products, but at the same time

it creates large amount of waste, among which the most important is animal waste. Generated animal waste contains various forms and types of microorganisms that cause the occurrence of zoonoses, but also the spread of infectious diseases among animals. The waste includes: animal carcasses, slaughter byproducts, liquid and solid manure. These materials are disposed in nature and if they are not safely removed they present a threat to soil, water and air, and endanger public health.

Pathogenic agents (*Salmonella sp., Campylobacter sp., E. coli* O157: H7, *Listeria, Yersinia enterocolitica*, etc.) that are present in waste materials, remain vital relatively long in nautre. Aerob micro-organisms in the tissues of dead animals survive longer if the carcasses if they are not removed safely. Poor management of animal waste opens a possibility of infection through a variety of vectors from nature such as insects, rodents, dogs, wild beasts, birds.

More and more food is contaminated with biological and chemical contaminants. On the other hand, each year around 20 million people die of starvation and nearly 800 million are hungry. In last 100 years the number of population in the world is four times higher. It is feared that by 2050 the number of people on the Earth will be around 9 billions.

In the European Union (EU), and consequently in our country, the legislation regarding animal waste management has been introduced. The EU adopted Directive 1774/2002 and its Annexes. The member states are obliged to respect and implement the methods for safe handling of byproducts of animal origin. On the basis of European law our country has adopted the Regulation on the classification and treatment of animal by-products, veterinary and sanitary conditions for the construction of facilities for collecting, processing and destruction of by-products of animal origin, the method of implementation of official controls and self-control, the conditions for the animal cemetery and cattle graveyard (Official Gazette RS, No. 31/2011). This Regulation governs how animal waste is disposed (the places of generation, waste classification, treatment methods, control and standardization of the obtained products). The obligtion of the all generators in animal breeding and industrial production to respect and obey the law because only in this way production of safe food will provided, health accuracy of products wil be maintained, and publich health will be protected.

MANAGEMENT OF ANIMAL WASTE IN THE REPUBLIC OF SERBIA

In the Republic of Serbia there are no regulations on animal waste management, although many studies have been written and certain measures recommended. First actual step is the adoption of a new Regulation. However, in order to achieve implementation of recommended measures for safe disposal of waste it is necessary to educate the producers and consumers of animal products, as well as to providie significant financial resources. The rule „polluter pays" governs in the world, and it should be applied in our country as well.

Animal waste is generated in animal production and the production of food of animal origin on the following spots: farms, farms for individual production in settlements, large livestock systems, and meat-packing industry, dairy industry, processing of by-products (town pound), the city garbage dump and others. The largest source of pollution and a threat to the environment present sick and dead animals and inadequate care for them (Orlic et al., 2005, Plavsa et al., 2005). In every technological procedure of animals breeding the by-products, dangerous for the environment, are created, like for example solid and liquid manure. The quantities are great. For example, on the farms in the U.S.A. more than 335 million tons of manure, that has to be disposed into the environment, is generated annually (www. sustainabletable.org). Such waste can be used corectly if handled appropriatelly, and if the obtained productsare laboratory controled.

The data on the quantity of animal waste in the Republic of Serbia is not known. According to information given in the Study on the Resolution on Disposal and Treatment of Animal Waste in the City of Novi Sad, large quantities of animal waste are generated. In the area of Novi Sad in large industrial slaughterhouses, abattoirs and small meat processing plants about 73 tons are generated daily, i.e. about 18,517 tons anually. This animal waste is to be safely removed by burning or processing in town pound, depending on the assinged waste categories. The amounts are huge. No data are available for other urban areas in the Republic of Serbia.

One of the following steps in establishing the management and control system for safe disposal of animal waste is the creating a register of pollutants and determining the volume of production.

RELATION BETWEEN MICROORGANISMS FROM ANIMAL WASTE AND THE CONDITIONS IN THE ENVIRONMENT

The presented data indicate that improper handling with animal waste in the ecosystem threatens the basic life conditions, such as water, air and soil.

In the external environment pathogen microorganisms survive for several days, up to several months (the agents of anthrax can survive even for several decades), depending on the type of pathogen, environmental conditions, as well as chemical, biological and physical composition of the environment. Inactivation of bacteria, viruses and protozaoa in soil, water, manure, crop and livestock products, can be caused by temperature, pH values, UV radiation, inorganic ammonia, organic nutrients, osmotic pressure and competition. The importance of each mentioned factor is closely connected to the environment. The environments rich in nutrients, such as animal waste, protect the microorganisms from drying, temperature variations, solar UV radiation, what enables multiplication and development of bacteria. Unfavourable conditions, such as extreme temperature, high evaporation or high humidity, insufficient aeration, significantly shorten the life of microorganisms.

The research confirmed that *Salmonella* and *E. coli* O157: H7 survive 4 to 6 months in animal manure at 1-9°C, and survive 49 times longer at temperature 40-60°C. Nicholson et al. (2002) examined the survival of *E. coli* O157: H7, *Salmonella, Listeria* and *Campylobacter* in cattle, pig and poultry manure at 40 – 60°C and found out that aeration of solid manure reduces the survival of *E. coli* O157: H7 and *Salmonella* even up to 88%. The survival of *E. coli* O157: H7 and *Salmonella* is reduced if the content of dry matter in manure is higher. Kudva et al. (1998) confirmed similar changes in *E. coli* O157: H7 in sheep manure, where the pathogen survived 630 days at temperatures below 23°C without aeration, but 120 days when aeration was performed. The survival of parasitic protozoa, such as *Giardia* and *Cryptosporidiumparvum lamps*, in animal manure greatly varies depending on temperature conditions. Thus, *Cryptosporidium oocistis* survive for an hour at -70°C, 1 day at -20°C, one or several years at 4°C, 3 - 4 months at 25°C, 1 - 2 weeks at 35°C and only 1 minute at 64°C (Fayer and Nerad, 1996; Finstein, 2004). *Giardia* cysts behave in similar way, but are slightly less resistant to extreme temperature.The data regarding the survival of zoonotic viruses (picornavirus, rotavirus, parvovirus, adenovirus) in animal waste are rare. According to the reports of Pesaro et al. (1995) it was confirmed that viral pathogens remain much longer in manure. More research should be done and more attention paid to this in order to prevent the spread of these pathogens in the environment inhabited by humans and animals, both domestic or wild. Wild animals are not controlled by man, so often present a source of infectious pathogens, and are an important link in the chain of spread of zoonotic diseases. According to different authors zoonotic pathogen survive the most in water and soil (*Salmonella sp., Campylobacter sp., E. coli O157: H7, Listeria, Cryptosporidium, Giardia*, etc.) and the data are displayed in Table No. 1.

Pathogen microorganisms stay long in water wherefrom they are transmitted. Some microorganisms in water are infective even after 448 days (*Yersinia enterocolitica). E. coli* O157: H7, a zoonotic pathogen that is very often found in epidemiological reports, survives even 90 days in drinking water and over 300 days in surface waters. Water pollution is very important environmental issue. It is regarded that all rivers are poluted. The demand for water will be the same as the demand for oil, and it is expected that about a third of humanity will suffer from thirst before the year 2025. At the International Conference on Water, Paris, (1998) it was noted that water shortage is the most critical factor that can downgrade human society (Pantelic et al., 2006).

Air pollution by zoonotic microorganisms has great impact on spreading aerogen infections, such as tuberculosis and Q fever. This indicates the huge importance of zoonotic and hygienic conditions in the facilities where the animals are raise and kept, and point on the importance safe disposal of animal waste. Intensifying livestock production increases the concentration of toxic gases. Although greatest gas producers are facilities for electricity generation, producing up to 65% of the total SO_2 emissions in the U.S., livestock and crop production are also a source of toxic gases. By-products in these areas food production must be properly disposed.

Environment	Temperatur (°C)	Survival*, (days)						
		*Salmonella sp	*Campylobacter sp.	*Y. enterocol.	*E. coli O157:H7	*Listeria sp.	**Giardia	**Criptosporidium
Soil								
	-20 to -4	>84	56	>365	>300		<7	>365
	1 - 9	196	20	>365	100		49	56
	20-29	>45	10	10	>56		14	28
	0-22	120	120		34	128		30
Farm yard								
Beef	0-22	63	120		64	120		30
Dairy	0-22	120	120		34	120		30
Poultry litter								
Broilers	0-22	32	16		32	>32		
Broilers + layers	0-22	63	64		32	56		30
Sheep	0-22	120	34		32	120		30
Swine	0-22	120	34		32	120		30
Manure slurry								
Beef	0-22	120	64		32	120		30
Dairy	0-22	120	63		64	120		30
Swine	0-22	299	36		32	120		63

*Bacterial pathogen
**Parasites pathogen

THE PROCEDURE OF ANIMAL WASTE DISPOSAL

According to the existing European and national regulations, and established classification methods, the following procedures for safe disposal of animal waste have been suggested.

The waste from Category 1 explicitly requires burning in special furnaces at a temperature not lower than 850, up to 1200°C. The material from Category 2 and 3 should be disposed by using appropriate processing methods, i.e. the alternative methods that are in accordance with the Rule Book. According to the abovementioned Rule Book basic methods of processing are given in Article 9 and that are the methods of procesing 1, 2, 3, 4, 5, 6 and 7, which means shredding of waste to a certain size at a certain temperature. In the same article the alternative methods of processing are given, like for example: alkaline hydrolysis, hydrolysis under high pressure and high temperature, hydrolysis biogas process at high pressure, production of biodiesel, animal fat burning in furnaces, thermo-mechanical production of biofuels and „Brooks" gasification.

According to studies in the countries with developed cattle breeding, the proposed methods for safe disposal of animal waste are intended to protect the environment and are economically justified. These countries often apply the method of directed composting in closed systems, named biovators.

CONCLUSION

The increase of population on the Earth is the reason to make great efforts are ensure sufficient quality of safe food, especially the food of animal origin. Intisive livestock production generates the increase in production of animal waste. If adequately care is not taken, this can be a source of infection for humans, domestic and wild animals. This waste is also a significant factor in balancing the environment. Improper handling of animal waste in the ecosystem threatens the basic living conditions, such as water, air and land.

In urban areas, such as cities and suburban areas, at the places of animal breeding and the spots of technological processing of food of animal origin, large quantities of animal waste are generated.

It is important to register the producers that pollute and to determine the method of waste disposal.

Implementation of prescribed methods for handling safe disposal in managing biohazard materials is of utmost importance in order to prevent the spread of infections in the environment and to protect the public health.

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10. Pravilnik o načinu razvrstavanja i postupanja sa sporednim proizvodima životinjskog porekla, veterinarsko-sanitarnim uslovima za izgradnju objekata za sakupljanje, preradu i uništavanje sporednih proizvoda životinjskog porekla, načinu sprovođenja službene kontrole i samokontrile, kao i uslovima za stočna groblja i jame grobnice (Službeni glasnik RS, broj 31/2011).

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АНИМАЛНИ ОТПАД КАО ФАКТОР РИЗИКА ЗА ВАЗДУХ, ВОДУ, ЗЕМЉУ И ЈАВНО ЗДРАВЉЕ

Сажетак

Отпад животињског порекла у који спадају: животињски лешеви, кланични конфискати, споредни производи клања, ткива високог ризика, крв закланих животиња и остало представљају специфичне опасне материје које могу бити извор заразе и загађивачи животне средине. Збрињавање анималног отпада мора се вршити на безбедан начин, у противном опасни патогени се шире преко воде, ваздуха и земљишта на различите удаљености при чему могу угрозити јавно здравље становништва. У раду је приказано стање анималног отпада у нашој земљи, начини ширења и преживљавања најчешћих зоонозних патогена у води, земљишту и стајњаку. Према истраживањима земаља са развијеним сточарством, предложене методе за безбедно одлагање анималног отпада имају за циљ да заштите животну средину и економски су оправдане. У овим земљама се најчешће примењује метода усмереног компостирања у затвореним системима који се зову биоватори.

Кључне речи: *анимални отпад, зоонозни патогени, преживљавање патогена у води, земљи и стајњаку.*