UV Influence on *Yersinia enterocolitica* strains

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Abstract

Investigations were focused on the UV effect on different strains of Yersinia enterocolitica. The experiment was performed either on various bacteriological media inseminated with Y. enterocolitica germs or on food of animal origin contaminated experimentally. Our investigations showed that using a normal bacteriological lamp the Y. enterocolitica species may be destroyed over maximum 115 minutes until a 10 cm deep in product. The studies of Yersinia enterocolitica tolerance to UV radiation have been performed with a view to offer technologists from the food industry the most practical and efficient way for decontamination and sterilization of installations, work tables and surfaces, likely to be contaminated with this bacterial species.

The resistance of Y. enterocolitica to UV radiation is reduced in 75 minutes of action but in two situations it has been observed that the value of 10 CFU/ ml remained; in both of the cases the remanence was achieved on a liquid column (in tubes) because the UV radiation penetrates with more difficulty. In the samples that were contaminated by means of the experiment, the Yersinia strains were quickly neutralized even if the exposure is done in a thick layer. No matter the nutritive substrate in which the grown took place (contaminated samples or bacterial medium) the wrack of Yersinia strains by exposure on UV rays is ditto efficaciously (highly effective). Irrespective of the substrate thickness in which the exposure was performed (from 1 cm to 10 cm) the action of UV rays is ditto efficaciously (highly effective).

Keywords: Yersinia enterocolitica, UV, bacteriological medium, food of animal origin

Introduction

The general interest about yersinioses is currently shown by bacteriologists, epidemiologists and clinical specialists paying attention to the issue (1, 2, 12). Many studies and research papers on infections produced by those bacteria, especially by Yersinia enterocolitica, papers that have been published in recent years, acquired large interest.

Over the last decade of the past millennium, the fact that Yersinia enterocolitica has been frequently involved in food diseases of human beings with acute diarrheic syndrome has caught the eye of many researchers. Although clinically those yersinioses aren't complicated and are treated efficiently, the epidemiological risk is important because there have been episodes with hundreds of cases (4, 9, 13). The grown frequency of Yersinia enterocolitica isolation from different type of foods (meat and meat products, milk and milk products, fish and aquatic food products, sea fruits, vegetables, fruits stuff and garden stuff) had led to statistical studies in isolation frequency of these bacteria from water, vegetal products, soil, animals and animal products and clinical human cases.

The studies of *Yersinia enterocolitica* tolerance to UV radiation have been performed with a view to offer technologists from the food industry the most practical and efficient way for decontamination and sterilization of installations, work tables and surfaces, likely to be contaminated with yersinias, also to improve the actual systems of food safety management (3, 5, 7, 11).

Materials and Methods

The behavior of different *Yersinia enterocolitica* strains has been studied on different values of temperatures. The food products contaminated artificially and the solid or liquid culture media inoculated with purified strains were subjected to tests. The bacterial strains included in the analyze were isolated from samples of different food products of from human faeces which presented acute diarrheic syndrome, identified through several comparative biochemical tests and afterwards coded by numbers. The first stage resulted in the obtaining of young cultures (maximum 24 hours) from the strains purified before, used to contaminate artificially the food products (aquatic products, milk or milk products, meat or meat products), liquid culture media (peptone saline alkaline water, saline broth with glucose, broth with phosphate-sorbitol-biliar salts, after the formula proposed by Mehlman and Aulisio, broth with irgasan-ticarciline-potasium chlorate after the formula proposed by De Zuter and co.) or solid ones (Salmonella-Shigella agar, Hektoen-Enteric agar, and also some media with lactose, like Mac Conkey agar or Drigalski agar).

It has obtained bacterial cultivation in 24 h on saline broth with glucose (SBG) and peptone saline alkaline water (PSAW) with 10^9 CFU/ ml which have been exposed to UV radiation in a liquid column (into glass test tube) and respectively on thin layer of 1 cm high (into Petri plate). Samples of fish and aquatic products, milk or milk products, meat or meat products and sea fruits have also been contaminated experimentally (by homogenization in Stomacher of 250 g sample with 25 ml of saline broth with glucose with 10^9 CFU/ml) and exposed on a 10 cm layer (into crystallizer).

The bacterial strains used have been: *Yersinia enterocolitica* isolated from human faeces samples (strain 256p; strain 816p; strain 1477; strain 679 and strain 192p), Yersinia enterocolitica isolated from raw milk (strain 625v; strain 512v; strain 1215v; strain 2569 and strain 2548) and Yersinia enterocolitica isolated from beef or poultry (strain 196a; strain 216a; strain 225a; strain 1432 and strain 912a).

The resistance control has been made after different time intervals of exposure to UV radiation: 5 minutes, 15 minutes, 30 minutes, 45 minutes, 60 minutes, 75 minutes, 90 minutes, 115 minutes, 130 minutes though culturing by broth with phosphate-sorbitol-biliar salts, broth with irgasan-ticarciline-potasium chlorate and directly striating on Salmonella-Shigella agar, Hektoen-Enteric agar, Mac Conkey agar or Drigalski agar, then incubated 18 h at 37ºC.

Results and Discussions

The first experiments were made to testing the individual tolerance of *Yersinia enterocolitica* strains in different bacterial medium. The results are showing under the form of charts:

Table 1. Tolerance at UV rays of *Yersinia enterocolitica* strains isolated from human

***Yersinia enterocolitica* strain**	**Used medium**	**Exposing mode**	**Time of exposing (minutes)**								
			5'	**15'**	**30'**	**45'**	**60'**	**75'**	**90'**	**115'**	**130'**
Yersinia enterocolitica strain 256p	PSAW	Into test tube	10^9	10^8	10^6	10^3	10^1	0	0	0	0
	PSAW	Into Petri plate	10^9	10^7	10^5	10^2	0	0	0	0	0
	SBG	Into test tube	10^9	10^8	10^6	10^3	10^1	0	0	0	0
	SBG	Into Petri plate	10^9	10^8	10^7	10^1	0	0	0	0	0
Yersinia enterocolitica strain 816p	PSAW	Into test tube	10^9	10^9	10^6	10^4	10^2	10^1	0	0	0
	PSAW	Into Petri plate	10^9	10^8	10^6	10^3	10^1	0	0	0	0
	SBG	Into test tube	10^9	10^8	10^6	10^3	10^1	0	0	0	0
	SBG	Into Petri plate	10^9	10^7	10^5	10^2	10^1	0	0	0	0

Yersinia enterocolitica strain 1477	PSAW	Into test tube	10^9	10^7	10^5	10^2	10^1	0	0	0	0
	PSAW	Into Petri plate	10^9	10^8	10^6	10^3	10^1	0	0	0	0
	SBG	Into test tube	10^9	10^8	10^5	10^1	0	0	0	0	0
	SBG	Into Petri plate	10^9	10^7	10^5	10^1	0	0	0	0	0
Yersinia enterocolitica strain 679	PSAW	Into test tube	10^9	10^8	10^6	10^3	10^1	0	0	0	0
	PSAW	Into Petri plate	10^9	10^8	10^5	10^2	10^1	0	0	0	0
	SBG	Into test tube	10^9	10^9	10^7	10^3	10^1	10^1	0	0	0
	SBG	Into Petri plate	10^9	10^8	10^6	10^3	10^1	0	0	0	0
Yersinia enterocolitica strain 192p	PSAW	Into test tube	10^9	10^7	10^6	10^2	0	0	0	0	0
	PSAW	Into Petri plate	10^9	10^7	10^5	10^2	0	0	0	0	0
	SBG	Into test tube	10^9	10^8	10^5	10^1	10^1	0	0	0	0
	SBG	Into Petri plate	10^9	10^8	10^6	10^3	10^1	0	0	0	0

The resistance of *Yersinia enterocolitica* to UV radiation is reduced in maximum 75 minutes of action but in two situations it was observed that 10 CFU/ ml remain; in both of them the remanence was achieved a liquid column (in test tubes) because the UV radiation penetrates with more difficult. In the Petri plates that were charging with bacterial culture by means of the experiment, the bacterial strains are quickly neutralized even if the exposure is done in thick layer.

Table 2. Tolerance at UV rays of *Yersinia enterocolitica* strains isolated from raw milk

***Yersinia enterocolitica* strain**	**Used medium**	**Exposing mode**	**Time of exposing (minutes)**								
			5'	**15'**	**30'**	**45'**	**60'**	**75'**	**90'**	**115'**	**130'**
Yersinia enterocolitica strain 625v	PSAW	Into test tube	10^9	10^8	10^6	10^6	10^3	10^1	0	0	0
	PSAW	Into Petri plate	10^9	10^7	10^5	10^5	10^2	0	0	0	0
	SBG	Into test tube	10^9	10^8	10^6	10^6	10^3	10^1	0	0	0
	SBG	Into Petri plate	10^9	10^7	10^5	10^2	10^1	0	0	0	0
Yersinia enterocolitica strain 512v	PSAW	Into test tube	10^9	10^8	10^6	10^6	10^4	10^2	10^1	0	0
	PSAW	Into Petri plate	10^9	10^8	10^6	10^6	10^3	10^1	0	0	0
	SBG	Into test tube	10^9	10^7	10^6	10^6	10^3	10^1	0	0	0
	SBG	Into Petri plate	10^9	10^7	10^5	10^5	10^2	10^1	0	0	0
Yersinia enterocolitica strain 1215v	PSAW	Into test tube	10^9	10^7	10^5	10^5	10^2	10^1	0	0	0
	PSAW	Into Petri plate	10^9	10^8	10^6	10^6	10^3	10^1	0	0	0
	SBG	Into test tube	10^9	10^7	10^5	10^3	10^1	0	0	0	0
	SBG	Into Petri plate	10^9	10^7	10^5	10^2	10^1	0	0	0	0
Yersinia enterocolitica strain 2569	PSAW	Into test tube	10^9	10^8	10^6	10^4	10^3	10^1	0	0	0
	PSAW	Into Petri plate	10^9	10^8	10^5	10^5	10^2	10^2	10^1	0	0
	SBG	Into test tube	10^9	10^7	10^5	10^3	10^3	10^1	0	0	0
	SBG	Into Petri plate	10^9	10^8	10^6	10^5	10^3	10^1	0	0	0
Yersinia enterocolitica strain 2548	PSAW	Into test tube	10^9	10^7	10^6	10^4	10^2	0	0	0	0
	PSAW	Into Petri plate	10^9	10^7	10^5	10^3	10^2	0	0	0	0
	SBG	Into test tube	10^9	10^8	10^5	10^2	10^1	10^1	0	0	0
	SBG	Into Petri plate	10^9	10^8	10^6	10^5	10^3	10^1	0	0	0

The tolerance of *Yersinia enterocolitica* to UV radiation is older, observing that 90 minutes two strains remain at 10 CFU/ ml concentration level, concluding that the strains which are isolated from milk is more resistant to environment.

Table 3. Tolerance at UV rays of *Yersinia enterocolitica* strains isolated from meat

***Yersinia enterocolitica* strain**	**Used medium**	**Exposing mode**	**Time of exposing (minutes)**								
			5'	**15'**	**30'**	**45'**	**60'**	**75'**	**90'**	**115'**	**130'**
Yersinia enterocolitica strain 196a	PSAW	Into test tube	10^9	10^8	10^6	10^3	10^2	10^1	0	0	0
	PSAW	Into Petri plate	10^9	10^8	10^5	10^4	10^3	10^1	0	0	0
	SBG	Into test tube	10^9	10^9	10^6	10^3	10^1	0	0	0	0

	SBG	Into Petri plate	10^9	10^8	10^7	10^2	10^1	0	0	0	0
Yersinia enterocolitica strain 216a	PSAW	Into test tube	10^9	10^9	10^7	10^5	10^3	10^1	0	0	0
	PSAW	Into Petri plate	10^9	10^8	10^6	10^3	10^2	10^2	0	0	0
	SBG	Into test tube	10^9	10^8	10^6	10^3	10^3	10^1	0	0	0
	SBG	Into Petri plate	10^9	10^7	10^5	10^5	10^3	10^1	0	0	0
Yersinia enterocolitica strain 225a	PSAW	Into test tube	10^9	10^7	10^5	10^2	10^2	0	0	0	0
	PSAW	Into Petri plate	10^9	10^8	10^6	10^3	10^2	0	0	0	0
	SBG	Into test tube	10^9	10^8	10^7	10^5	10^3	10^1	0	0	0
	SBG	Into Petri plate	10^9	10^7	10^5	10^4	10^3	10^1	0	0	0
Yersinia enterocolitica strain 1432	PSAW	Into test tube	10^9	10^8	10^6	10^3	10^2	10^1	0	0	0
	PSAW	Into Petri plate	10^9	10^8	10^6	10^5	10^3	10^1	0	0	0
	SBG	Into test tube	10^9	10^9	10^7	10^3	10^1	0	0	0	0
	SBG	Into Petri plate	10^9	10^8	10^6	10^3	10^1	0	0	0	0
Yersinia enterocolitica strain 912a	PSAW	Into test tube	10^9	10^7	10^6	10^5	10^3	10^1	0	0	0
	PSAW	Into Petri plate	10^9	10^7	10^5	10^4	10^2	10^2	0	0	0
	SBG	Into test tube	10^9	10^8	10^5	10^4	10^3	10^1	0	0	0
	SBG	Into Petri plate	10^9	10^8	10^6	10^5	10^3	10^1	0	0	0

The resistance of *Yersinia enterocolitica* to UV radiation is reduced in maximum 75 minutes, very similarly with the experiments by strains isolated from human, concluding that the strains which are isolated from milk is more sensitive to environment.

Table 4. Tolerance at UV rays of *Yersinia enterocolitica* strains added in food products

***Yersinia enterocolitica* strain**	**Used medium**	**Exposing mode**	**Time of exposing (minutes)**								
			5'	**15'**	**30'**	**45'**	**60'**	**75'**	**90'**	**115'**	**130'**
Yersinia enterocolitica strain 816p	milk	By crystallizer	10^9	10^8	10^8	10^6	10^3	10^2	10^1	10^1	0
	mixed fish	By crystallizer	10^9	10^8	10^7	10^5	10^4	10^3	10^1	0	0
	mixed beef	By crystallizer	10^9	10^9	10^8	10^6	10^3	10^1	0	0	0
	mixed poultry	By crystallizer	10^9	10^8	10^7	10^5	10^2	10^1	0	0	0
Yersinia enterocolitica strain 512v	milk	By crystallizer	10^9	10^9	10^8	10^6	10^5	10^3	10^1	0	0
	mixed fish	By crystallizer	10^9	10^8	10^8	10^6	10^3	10^2	10^1	10^1	0
	mixed beef	By crystallizer	10^9	10^8	10^7	10^6	10^3	10^3	10^1	0	0
	mixed poultry	By crystallizer	10^9	10^7	10^7	10^5	10^5	10^3	10^1	0	0
Yersinia enterocolitica strain 2569	milk	By crystallizer	10^9	10^9	10^7	10^5	10^2	10^2	0	0	0
	mixed fish	By crystallizer	10^9	10^8	10^8	10^6	10^3	10^2	0	0	0
	mixed beef	By crystallizer	10^9	10^8	10^7	10^5	10^5	10^3	10^1	0	0
	mixed poultry	By crystallizer	10^9	10^9	10^7	10^5	10^4	10^3	10^1	0	0
Yersinia enterocolitica strain 216a	milk	By crystallizer	10^9	10^8	10^8	10^6	10^3	10^2	10^1	10^1	0
	mixed fish	By crystallizer	10^9	10^8	10^8	10^5	10^5	10^3	10^1	0	0
	mixed beef	By crystallizer	10^9	10^9	10^7	10^5	10^3	10^1	0	0	0
	mixed poultry	By crystallizer	10^9	10^8	10^8	10^6	10^3	10^1	0	0	0
Yersinia enterocolitica strain 225a	milk	By crystallizer	10^9	10^9	10^7	10^6	10^5	10^3	10^1	0	0
	mixed fish	By crystallizer	10^9	10^9	10^7	10^5	10^4	10^2	10^2	10^1	0
	mixed beef	By crystallizer	10^9	10^8	10^8	10^5	10^4	10^3	10^1	0	0
	mixed poultry	By crystallizer	10^9	10^8	10^8	10^6	10^5	10^3	10^1	0	0

In the samples that were contaminated by means of the experiment, the bacterial strains are neutralized after 115' of UV exposure, because of lowest rate of penetrability and the thickness of used substrate (over 10 cm). In the mixed meat (beef or poultry) *Yersinia enterocolitica* has a low tolerance to UV radiation, comparative with tolerance in milk and fish, although the *Yersinia enterocolitica* strains resistance to an exposure of 75 minutes has been more frequently observed.

Conclusions

1. The most resistant to UV radiation is strains of *Yersinia enterocolitica* isolated from milk, the destruction following after 90 minutes of exposure.
2. The lowest level of tolerance on UV is recorded by strains of *Yersinia enterocolitica* isolated from human and meat samples which after 75 minutes of exposure is destroyed in most cases, and after 90 minutes it is total destroyed.
3. Indifferent of nutritive substratum in which grown (bacterial medium) the wrack of stains by exposure on UV rays is ditto efficaciously.
4. The thickness of substratum in which the exposure has done (from 1 cm to 10 cm) the action of UV rays is ditto efficaciously, but in more of 10 cm the efficiency is to low.

The final conclusion is that UV radiation could be used as an efficient method of decontamination of installations and surfaces, especially in the food industry, for meat preparation, storage and preservation of fish and aquatic products, where contaminations with *Yersinia enterocolitica* are frequently recorded, but the efficiency for food decontamination is not properly.

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