LINDANE AND DDT DEGRADATION AS INFLUENCED BY SOME LACTOBACILLUS STRAINS

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SUMMARY

Studying the possibility of organochlorine pesticides degradation as influenced by microorganisms isolated from meat products, we found that some micrococcus strains were able to degrade these compounds. In this work we paid our attention to some lactobacillus strains which are the useful microflora of fermented sausages too.

Our aim was to examine lindane and DDT degradation in physiological saline and bouillon under the influence of two lactobacillus strains - one marked as strain 11 and the other one as strain 6/II.

The results we obtained show that concerning lindane degradation strain 11 was more effective than strain 6/II. Contrary to that, the strain 6/II degraded DDT with more efficiency than strain 11. As influenced by strain 6/II DDT was converted to DDD as an intermediary compound which gradually was degraded.

Comparing lindane and DDT degradation in bouillon and physiological saline, both lactobacillus strains were more effective in physiological saline. It may be explained by the fact that microorganisms in a physiological saline use pesticides as a source of energy.

Degradation of organochlorine pesticides as influenced by the useful microflora makes possible decontamination of those systems where the application of anaerobes is out of consideration.

INTRODUCTION

Up-to-now performed examination of the influence of microorganisms on pesticide degradation were mostly connected with the soil microflora. In that case microbial activities are of higher importance than those related to physical and chemical processes.

According to Alexander (1973) several conditions must be fulfilled for a particular substance to be subject to biodegradation. An organisms having the potential for metabolising the compound must exist; that microorganisms must be present in the environment; the compound must be accessible to the potentially active species; if the enzymes involved in the initial stages of degradation are intracellular, the substrate must penetrate into the cell; if the enzymes involved in the degradation are not constitutive, they must be induced; the environment must allow the growth microorganisms.

Results obtained by Munnecke (1974; 1982) indicate the fact that the majority of pesticides are subjected to biodegradation but organoclorine insecticides, particulary lindane and DDT, were observed to be highly resistant.

Ledford and Chen (1969) examined the possibility of lindane and DDT degradation as influenced by microorganisms isolated from the surface of a variety of cheeses. Non of the isolated strains of streptococci, micrococci, yeasts or the Gram positive rods were able to degrade lindane. The strain 16HE2, the Gram positive short rods, was able to convert DDT into DDD by means of dechloration. Degradation of 0.5 μg/gr DDT and DDE as influenced by the geotrichum strain was more effective. Quantities of both compounds were significantly lowered but without appearance of DDD as an intermediate.

Kim and Harmon (1970) did not observe any DDT and lindane degradation as influenced by some lactobacillus strains even after 14 days of incubation at 32°C.

Examining the possibility of DDT degradation in fermented meat products, Mirna and Hecht (1973) found that, due to the activity of micrococci, the quantity of this pesticide was lowered by 30 percents after 38 days.

Mirna and Coretti (1974) have examined the degradation of ^{14}C DDT and HCH, by micrococci and lactobacillus cultures.

It came that during the 14 days of incubation at 30°C a complete conversion of DDT into DDD was confirmed. Small quantities of DCB metabolites were observed. Lactobacillus strains did not have any capability of degrading DDT. As far as the degradation of HCH was concerned, 20 percent was degraded as influenced by micrococci and 10 percent as influenced by lactobacillus strains.

The concentration of pesticides in fermented meat products made from rabbits feed with ^{14}C DDT decreased during processing: aging and 38 days-storage

Table 1. Lindane degradation as influenced by lactobacillus strains

Lactobacillus strain	Initial quantity of lindane: 20 ug/ml — Degraded (ug/ml) Phisiological saline	20 ug/ml — Bouillon	0,5 ug/ml — Degraded (ug/ml) Phisiological saline	0,5 ug/ml — Bouillon
6/II	0,720	0,450	0,110	0,060
11	1,020	0,650	0,125	0,065

Table 2. DDT degradation (2 ug/ml) as influenced by lactobacillus strains

Lactobacillus strain	Physiological saline — DDT degraded (ug/ml)	Physiological saline — DDD degradation product (ug/ml)	Bouillon — DDT degraded (ug/ml)	Bouillon — DDD degradation product (ug/ml)
6/II	0,820	0,320	0,385	0,355
11	0,750	-	0,140	-

Table 3. DDT degradation (0,5 ug/ml) as influenced by lactobacillus strains

Lactobacillus strain	Physiological saline DDT degraded (ug/ml)	Physiological saline DDD degradation product (ug/ml)	Bouillon DDT degraded (ug/ml)	Bouillon DDD degradation product (ug/ml)
6/II	0,285	0,065	0,145	0,095
11	0,140	-	0,035	-

by 14-32 percent, curing by 34 percent. During cooking and smoking it increased by 25 and 15 percent respectively as a consequence of changes in water content. Small quantities of DDT, DDD, DDE, DCB and DDMU metabolites were detected.

In our previous reports (1979, 1981, 1982, 1983) we studied the possibility of organochlorine pesticides degradation as influenced by microorganisms isolated from meat products.

METHODS

Two lactobacillus strains, marked as strain 6/II and 11, were isolated from fermented sausages and examined for the capability of lindane and DDT degradation. The kinetics of pesticide degradation as influenced by lactobacillus strains was investigated in physiological saline and MRS bouillon. The degradation rate was examined during 144 hours of incubation at 37°C.

The initial bacteria count was 3.1×10^7 and 6.4×10^7/ml for strain 6/II in physiological saline and bouillon respectively. Strain 11 had a bacterial count of 4.9×10^7/ml in physiological saline and 5.7×10^7/ml in bouillon.

The initial pesticide concentration was 2.0 and 0.5 μg/ml, both for lindane and DDT.

Sample processing and analytical procedure we presented in our previous reports.

RESULTS AND DISCUSSION

a) Lindane Degradation

According to the presented results it becomes:

- that the initial quantity of the substrate has not been totally degraded during 144 hours of incubation;

- that the strain 11 is more efficient in degradation of lindane;

- that from the initial 2.0 μg/ml of lindane 0.720 μg/ml and 0.450 μg/ml was degraded in physiological saline and bouillon respectively as influenced by strain 6/II after 144 hours of incubation. The degradation of lindane as influenced by strain 11 reaches 1.020 μg/ml and 0.650 μg/ml in physiological saline and bouillon respectively;

- that the degradation rate for the initial 0.5 μg/ml of lindane is very small one. Only 0.110 μg/ml and 0.060 μg/ml was degraded in physiological saline and bouillon respectively as influenced by the strain 6/II after 144 hours of incubation. The degradation of lindane as influenced by strain 11 reaches 0.125 μg/ml and 0.065 μg/ml in physiological saline and bouillon respectively; and

- that lindane degradation in physiological saline was higher than in bouillon.

b) DDT Degradation

According to the presented results in tables 2 and 3 it becomes:

- that the initial quantity of the substrate has not been totally degraded during 144 hours of incubation;

- that the strain 6/II is more efficient in the degradation of DDT;

- that from the initial 2 μg/ml of DDT 0.820 μg/ml and 0.385 μg/ml was degraded in physiological saline and bouillon respectively as influenced by strain 6/II after 144 hour of incubation;

- that DDT as influenced by strain 6/II was converted into DDD as an intermediary compound. DDD in turn gradually was degraded;

- that 0.750 μg/ml and 0.140 μg/ml of DDT was degraded in physiological saline and bouillon respectively as influenced by strain 11 after 144 hours of incubation. There was no proof for DDD formation;

- that the ways of metabolizing DDT by means of the strain 6/II and 11 differ from each other;

- that DDT degradation in physiological saline was higher than in bouillon.

From the results we obtained we concluded t#at some lactobacillus strain were able to degrade organochlorine pesticides (lindane and DDT).

Differences that were observed in the degradation of these two pesticides are presumably due to their chemical structure. Namely, DDT as a aromatic compound was easier subjected to biodegradation than lindane which belongs to the alicyclic group of compounds.

A higher level of degradation of both pesticides in physiological saline might be explained, by the fact that in bouillon there is a more acceptable substrate to microorganisms than both lindane and DDT are.

At the lower initial quantities (0.5 μg/ml) of both lindane and DDT the degradation rate is lower. From the standpoint of the enzyme kinetics it indicates to be a first order reaction.

CONCLUSIONS

From the results of our experiment we concluded following:

- some of the lactobacillus strains were able to degrade lindane and DDT;

- that the lactobacillus strains 6/II and 11, as the useful microflora of fermented sausages, may have its application in the decontamination of food of the animal origin.

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