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Assessment of Potential Antifungal of new Synthetic Compounds Organotin on Penicillium Fungi Growing on Cheese Ripening Chambers

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Abstract— *The use of organotin compounds are increasing, mainly due to their applications in various technological and industrial areas such as plant protection agents with broad application in agriculture, veterinary, pharmacy and medicine. The increase in the publication of works on applications of organotin compounds containing organic ligands is a milestone in the development of chemical organoestânic as possible research and the discovery of complex, especially in medicine. Brazil has excelled in the production of cheese, however many contamination has hindered the development of cheese with qualities, this fact affects mainly small farmers and family farming. This study aimed to evaluate the potential inhibition of mycelial average growth of fungi Penicillium brevicompactum, Penicillium camembert, Penicillium comunne, Penicillium expansum and Penicillium solitum, collected in a cheese ripening chamber dairy from UFLA – Universidad Federal of Lavras a)α-hydroxycarboxylic acid (DL-mandelic acid, benzylic acid, dl-4-bromomandelic acids acid, dl-4-methoxymandelic acid and dL-2-chloromandelic acid) at concentrations of 1 and 50 ppm; b) with trimethyltin chloride in concentrations of 1 and 50 ppm; c) the complexes derived from the reactions of α-hydroxycarboxylic acids listed reacted with trimethyltin ([$Me_2SnMand$] [$Me_2SnBenz_2$] [Me_2SnBrm_2] [Me_2SnMeo] and [Me_2SnClm_2]) at concentrations of 1, 5, 10 and 50 ppm. The compound inhibited triorganoestânic generally, the mean mycelial fungal growth in concentrations of 1 and 50 ppm. With respect to the complex, It observed that the [Me_2SnClm_2] showed the highest overall mean percentage inhibition (90.0%), while the complex [Me_2SnBrm_2] showed the lowest average (57.3%). The inhibitory percentage was calculated on the overall average concentration of 50 ppm and fungi that have suffered greater inhibition were Penicillium commune and Penicillium solitum. These compounds showed excellent results in the inhibition of fungi that infect cheese ripening cameras, and can be an alternative to the social improvement of Brazil, as its low cost allows small producers to make use of this technology, it is expected that this work can be the first step towards a revolution in this segment and that further research be promoted from this work. The inhibitory percentage was calculated on the overall average concentration of 50 ppm and fungi that have suffered greater inhibition were Penicillium commune and Penicillium solitum. These compounds showed excellent results in the inhibition of fungi that infect cheese ripening cameras, and can be an alternative to the social improvement of Brazil, as its low cost allows small producers to make use of this technology, it is expected that this work can be the first step towards a revolution in this segment and that further research be promoted from this work.*

Keywords— antifungal; compounds organotin; Penicillium fungi.

I. INTRODUCTION

Organotin compounds include a group of substances characterized by an organometallic tin atom covalently attached to one or more organic radicals as methyl groups, ethyl, propyl, butyl, phenyl, etc. Chemically, these compounds are represented by formulas R_4Sn, R_3SnX, R_2SnX_2 $RSnX_3$ and in which R can be any alkyl or aryl group, and X is an anionic species as halide, oxide or hydroxide, for example. Besides these, there are some organic compounds, which do not arouse chemical interests for lack of practical applications (HOCH, 2001).

In 1950, the Organic Chemistry Institute in Utrecht, the International Council for Research on Tin made the first correlations between organotin compounds

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and biological effects. From this date, investigations have shown the action of these compounds in relation to fungi and bacteria, marine organisms, parasitic worms, insects and aquatic snails, among others (JONHSTON, 1976). Pesticides are currently studied compounds (fungicides, insecticides, bactericides, anthelmintics, repellents and biocides in general) with applications in agriculture, veterinary medicine and pharmacy (LUIJTEN, 1972).

The growth of fungi and molds in food constitutes one of the great problems of the food industry. In the dairy industry this fact is observed more frequently in almost all types of aged cheeses, it is difficult to prevent the deterioration of the cheese by fungi (Becker, 2017). The most common genera of molds that grow on the surface of cheeses are: *Penicillium, Muccor, Aspergillus, Clodosporium, Monillia, Geotrichum*. They are present in nearly every ecological niche, with many diversities, and are currently about 70,000 described species of fungus, although it is estimated that there are 1.5 million different species distributed throughout the world.

- *Penicillium brevicompactum* - colony on CYA at 25 ° C, have a diameter between 3.84.1 cm, Gray-green color, furrowed colonies, with few white mycelia at the edges. Colony in Malt Extract Agar (MEA), dense.toxic metabolites: botriodiploidina and mycophenolic acid. Found in foods, soil and fruit (PITT, 2000; SAMSON et al, 2001 and CHALFOUM, BATISTA, 2003).

- *Penicillium camembert* - colony on CYA at 25 ° C, reached a diameter between 2.3 and 5 cm. with mycelium1 cmheight. Conodióforos up to 50 microns. Found in foods, soft cheeses. As it has toxic metabolites, primarily ciclopropriazônic acid. Raper and Thom (1949) recognized two species used for the manufacture of white cheeses: *Penicillium camembert* and *Penicillium caseicola*. The two species are distinguished by the color of the mycelium (PITT, 2000; SAMSON et al, 2001 and CHALFOUM, BATISTA, 2003).

- *Penicillium commune* - colonies in CYA at 25 °C, reach the diameter 2.53. cm In 7 days, producing gray-green spores. They occur also in yellow colonies. The ciclopropriazônic acid is its principal toxic metabolite (PITT, 2000; SAMSON et al, 2001 and CHALFOUM, BATISTA, 2003).

- *Penicillium expansum* - Colonies on CYA at 25 °C, have diameters which can vary from 4 to 5 cm. In 14 days. Shows yellow or bluish-green color. aromatic odor of fruits, like apple smell. Main toxic metabolites: roquefortine c and patulin, citrus. Found in foods, especially in fruits, which is primarily responsible for the rot (PITT, 2000, SAMSON et al, 2001 and CHALFOUM, BATISTA, 2003).

- *Penicillium solitum* - synonymous with *Penicilllum verrucosum*. Colonies on CYA at 25 °C, have a diameter ranging between 1.9 and 2.5 cm. gray-green color, with little white mycelium on the edges of the colonies. Found in foods, generally. Main toxic metabolites: ciclopenin, cyclophenol, viridicatol, compactin (Pitt, 2000; SAMSON et al, 2001 and CHALFOUM, BATISTA, 2003).

The exact definition of the limits of the fungus group is virtually impossible. Currently biologists use the term fungus to include "the aclorophilates bodies, nucleated spore-producers, which usually reproduce sexually or asexually and whose filamentous and branched somatic structures are surrounded by cell walls containing cellulose or chitin or both" (ALEXOUPOULOS et al , 1996).

About have 1000 species of cheese are produced in the world, most of which is made in France (BURKHALTER, KALANTZPOULOS 1981 and 1993) .The cheese ripening is made in most cases, in chambers with controlled temperature and humidity, ranging 10 to 15 °C and 80 to 85%, respectively. The maturation can be performed in two stages, since it has two maturation chambers, one with a temperature of 10 °C and humidity of 80% and another with 14 °C temperature and 85% humidity. This procedure is interesting because the first week of aging at lower temperature prevents violent fermentations therefore prevents the cheese stuffing. After the first week, as in higher temperature and humidity, the risk of bloating was insignificant since all of the lactose has already been fermented. It must be emphasized, however, that there is suspicion of the presence of coliform the temperature of the ripening chamber should be set at 2 to 5 °C. (ABREU, 2000).

The literature also records the stage of monitoring of cheese ripening using ultrasound. Being a non-destructive technique allows to detect any defects arising from abnormal fermentation (BENEDITO et al, 2001).

The main process occurring in aging, especially hard cheese, is protein degradation or proteolysis effected by rennet enzyme systems, an important factor for the quality of the cheese, especially in regard to taste and consistency. In cheeses whose mass is baked at high temperatures, such as Gruyere, which is processed at 52 ° C or scalded dough in as Parmesan, plasmin is the

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primary proteolytic enzyme. In semi-hard cheeses such as Tisilt, two concurrent processes occurring maturation: An usual, within the mass, where the peptide bonds of the proteins are broken, releasing short peptides and amino acids; another, on bark where proteins can be degraded to ammonia formation (BERESFORD et al, 2001).

When the mold problem in an industry becomes chronic, specifically in a chamber of maturation, it is advisable to adopt preventive measures for cheese and sanitize the cameras, after the removal of all cheeses. Two types of treatment may be applied to. Solutions of sanitized with sodium hypochlorite containing less than 400 ppm of free chlorine; spraying with quaternary ammonium solution at 800 ppm, and sprayed with an alcoholic solution containing10 to Wellas 30% formaldehyde fumigation with formaldehyde gas, recommended for removal of the mold ripening chambers when in a room with 30 min.

Therefore, this study aimed to verify the antifungal potential of the new organotin compounds synthesized against of *Penicillium* fungi, contaminants cheese ripening chambers, where they were collected.

It was the subject also of this study was to compare the biocidal inhibitory effect of the new complex with the inhibitory effect of biocide binders.

II. MATERIAL AND METHODS

2.1 - Instrumental

2.1.1 - Melting point

Melting ranges without correction, they were determined on the device to determine the melting point of 340-D, Quimis of the University Vale do Rio Verde - UNINCOR, Three Hearts.

2.1.2 - Analysis

Elemental analyzes of carbon and hydrogen were held in elementary equipment 2400CHN Analyzer Perkin-Elmer, the Department of the UFMG Chemistry.

2.1.3 - infrared vibrational spectroscopy

Infrared spectra were obtained on a spectrophotometer Shimadzu FTIR-8201 Fourier transform (4600-400 cm^{-1}), Department of Chemistry, University of Lavras using the technique tablets with potassium bromide.

2.2 - Reagents

All reagents and solvents used in the experiments described in this thesis were used without further purification.

The compounds used are as follows:

- Acetonitrile, CH_3CN, Quimex;
- DL-mandelic acid, C_6H_5CH (OH) COOH, Vetec;
- DL-p-methoxymandelic acid, 4-$CH_3OC_6H_4CH$ (OH) COOH, Aldrich;
- Dl - p -bromomandelic acids acid, 4-$BrOC_6H_4CH$ (OH) COOH, Aldrich;
- Benzylic acid, $(C_6H_5)_2W$(OH) COOH, Aldrich;
- DL-mandelicacid o-chloro, 2-ClC_6H_4CH (OH) COOH, Aldrich;
- BDA culture medium, Merck;
- Trimethyltin chloride, (CH_3) 3SnCl Aldrich;
- Dichloromethane, CH_2Cl_2, Merck;
- Phenylhydrazine, $C_6H_5NH_2$, Merck.

2.3 - Synthesis of α-hidroxicarboxilatosorganoestânicos

2.3.1 - Synthesis of [$Me_2SnMand$] = {Manda C_6H_5CH (OH) -COO-}

In a 50 mL round bottom flask was dissolved 1.000 g (6.57 mmol) dl-mandelic acid in 30 ml of acetonitrile were added and 0.839 goftrimethyltin chloride (4.21 mmol). Was added 0.1 mL of phenylhydrazine and the system was maintained under magnetic stirring and slow reflux for an hour at 80 ° C. The volume was reduced to half the mixture and allowed to stand for one hour. The solid obtained was separated by vacuum filtration using 4 porosity funnel and washed with 3 portions of dichloromethane with 2 ml each and dried in an Abderhalden pistol at 100 °C for 1 hour. They got up 0.670g product, 67.9% yield.

2.3.2 - Synthesis of [$Me_2SnBenz_2$] Benz = {(C_6H_5) 2CH (OH) -COO-}

Repeated the process from 2.3.1, using 1.000 g (4.38 mmol) of benzyl acid and 1.260 goftrimethyltin (6.32 mmol) chloride, replacing DL-mandelic acid.They were obtained from 0,480g of the product, 44.7% yield.

2.3.3 - Synthesis of [$MeSnBrm_2$] = {4-Brm BrC_6H_5CH (OH) -COO-}

Repeated the process from 2.3.1, using 1.000 g (4.30 mmol) of DL-p -bromomandelic acids and acid 0.713 goftrimethyltin chloride (3.66 mmol). They were obtained from 0,565g of the product, 44.7% yield.

2.3.4 - Synthesis of [Me_2SnMeo] = {4-Meo $CH_3OC_6H_5CH$(OH)-COO-}

Repeated the process from 2.3.1, using 1.000 g (5.48 mmol) of DL-p-methoxymandelic acid and 0.839 goftrimethyltin chloride (5.04 mmol). They were obtained from 0,625g of the product, 59.4% yield.

2.3.5 - Synthesis of [Me_2SnClm_2] = {2-ClC_6H_5CHClm(OH)-COO-}

Was repeated 2.3.1 procedure, using 1.000 g (5.36 mmol) of dl-o-chloro-mandéllico acid and 1.029 goftrimethyltin chloride (5.16 mmol). They were obtained from 0,412g of the product, 41.2% yield.

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2.4 - Biological Activity

To evaluate the biocide effect on fungi, *Penicillium brevicompactum, Penicillium camembert, Penicillium commune, Penicillium expansum and Penicillium solitum* were used the following compounds: dl-mandelic acid, benzylic acid, dl-p -bromomandelic acids acid, dl-p- methoxymandelic acid and dL-o-chloromandelic acid and trimethyltin chloride, plus the new organotin complex prepared [$Me_2SnMand_2$] [$Me_2SnBenz_2$] [$MeSnBrm_2$] [Me_2SnMeo_2] and [Me_2SnClm_2].

The genus *Penicillium* the above identified could be CYA or MEA, at temperatures of 25 °C and 37 °C (CHALFOUN, BATISTA, 2003).

The cultures used for the tests were obtained from a cheese ripening chamber through the collecting glass plates, which were arranged in cheese ripening chamber for five days. The bioanalytical method was used in vitro, observed growth inhibition of the microorganisms or with different concentrations of said chemical compound (GARCIA, 2018).

For each compound were prepared control a plate containing 25 ml of culture medium - BDA - and two plates of mycelial growth tests for each of the studied concentrations (1, 5, 10, and 50 ppm). The experiment was done in triplicate. The fungi were grown with a needle at three points of the plates, which were placed in a greenhouse at a temperature between 25 °C and 30 °C for 5 days.

After this period were performed measurements of mycelial growth of the fungus, the readings taken and the results averaged growth through the area.

III. RESULTS AND DISCUSSION

Table 1 contains the experimental data of absolute growth of Penicillium in the presence of the complex [$Me_2SnBenz_2$]. Numerical values representing the areas occupied by fungi cm^2 after 5 days incubation at the concentrations studied. These data were converted to percentage representing the relative growth of fungi and are shown in Table 2, while in Table 3, by complementarity of values, are shown in the figures for the inhibition on the growth of fungi in presence of the complex [$Me_2SnBenz_2$]. For other experiments, Tables 4 to 13 present the data already converted, expressing only the relative growth inhibition of fungi, either in the presence of the complex and in the presence of ligands.

Table.1: Development of fungi Penicillium in the presence of [$Me_2SnBenz_2$], concentration in ppm, in cm^2 area.

Concentration fungi	0	1	5	10	50
Penicillium brevicompactum	2.23	0.57	0.28	0.27	0.04
Penicillium camembert	2.23	0.71	0.62	0.55	0.08
Penicillium commune	2.23	2.08	1.42	0.70	0.42
Penicillium expansum	2.23	2.51	2.11	1.83	0.73
Penicillium solitum	2.23	0.41	0.37	0.30	0.06

Table.2: Percentage relative development of fungi Penicillium in the presence of [$Me_2SnBenz_2$], concentration in ppm.in cm^2 area.

Concentration fungi	0	1	5	10	50
Penicillium brevicompactum	100.0	25.6	12.6	12.1	1.8
Penicillium camembert	100.0	31.8	27.8	24.7	3.6
Penicillium commune	100.0	93.3	63.7	31.4	18.8
Penicillium expansum	100.0	99.1	94.6	82.1	32.7
Penicillium solitum	100.0	18.8	13.5	16.6	26.9

Table.3: Percentage inhibition relative Penicillium fungi in the presence of [$Me_2SnBenz_2$], concentration in ppm, in cm^2 area

Concentration fungi	0	1	5	10	50
Penicillium brevicompactum	0.0	74.4	87.4	87.9	98.2
Penicillium camembert	0.0	68.2	72.2	75.3	96.4
Penicillium commune	0.0	6.7	36.3	68.6	91.2
Penicillium expansum	0.0	0.9	5.4	17.9	67.3
Penicillium solitum	0.0	81.6	86.5	83.4	73.1

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Table.4: Percentage inhibition relative Penicillium in the presence of [Me_2SnBrm_2], concentration in ppm, in cm^2 area

Concentration fungi	0	1	5	10	50
Penicillium brevicompactum	0.0	1.4	43.1	56.5	70.4
Penicillium camembert	0.0	1.3	9.4	10.3	41.3
Penicillium commune	0.0	37.2	38.1	42.2	57.0
Penicillium expansum	0.0	0.4	1.3	1.3	32.7
Penicillium solitum	0.0	3.2	4.5	9.4	51.6

Table.5: Percentage inhibition relative Penicillium fungi in the presence of [Me_2SnMeo_2], concentration in ppm, in cm^2 area.

Concentration fungi	0	1	5	10	50
Penicillium brevicompactum	0.0	28.7	86.4	88.3	95.5
Penicillium camembert	0.0	18.8	81.6	86.5	96.0
Penicillium commune	0.0	22.0	80.3	80.3	96.4
Penicillium expansum	0.0	35.9	48.0	48.4	67.5
Penicillium solitum	0.0	92.8	92.4	93.7	98.7

Table.6: Percentage inhibition relative Penicillium in the presence of [Me_2SnClm_2], concentration in ppm, in cm^2 area.

Concentration fungi	0	1	5	10	50
Penicillium brevicompactum	0.0	83.4	85.2	88.2	91.5
Penicillium camembert	0.0	88.0	89.3	88.4	81.2
Penicillium commune	0.0	81.2	86.5	82.5	94.6
Penicillium expansum	0.0	0.40	90.0	0.40	79.5
Penicillium solitum	0.0	90.1	88.8	99.5	96.0

Table.7: Percentage inhibition relative Penicillium fungi in the presence of [$Me_2SnMand_2$], concentration in ppm, in cm^2 area.

Concentration fungi	0	1	5	10	50
Penicillium brevicompactum	0.0	88.4	90.6	87.9	87.0
Penicillium camembert	0.0	67.8	77.2	69.1	90.6
Penicillium commune	0.0	90.6	88.4	87.5	91.1
Penicillium expansum	0.0	34.6	43.5	42.7	80.3
Penicillium solitum	0.0	92.4	91.1	90.6	88.8

Table.8: Percentage inhibition relative Penicillium fungi in the presence of benzyl acid concentration in ppm, in cm^2 area.

Concentration fungi	0	1	50
Penicillium brevicompactum	0.0	52.1	56.6
Penicillium camembert	0.0	48.0	48.0
Penicillium commune	0.0	45.3	48.5
Penicillium expansum	0.0	2.30	7.70
Penicillium solitum	0.0	87.0	92.9

Table.9: Relative percentage inhibition of fungi Penicillium in the presence of DL-4 -bromomandelic acids acid concentration in ppm. in cm^2 area.

Concentration fungi	0	1	50
Penicillium brevicompactum	0.0	53.9	53.9
Penicillium camembert	0.0	40.9	42.2
Penicillium commune	0.0	36.8	48.9
Penicillium expansum	0.0	4.50	3.20
Penicillium solitum	0.0	86.6	85.7

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Table.10: Relative percentage inhibition offungi Penicillium in the presence of DL-4-methoxymandelic acid concentration in ppm, in cm^2 area.

Concentrationfungi	0	1	50
Penicillium brevicompactum	0.0	52.5	53.0
Penicillium camembert	0.0	48.9	50.7
Penicillium commune	0.0	40.9	42.7
Penicillium expansum	0.0	1.40	3.20
Penicillium solitum	0.0	51.2	93.7

Table.11: Percentage inhibition relative Penicillium fungi and in the presence of DL-2-chloromandelic acid concentration in ppm.

Concentration fungi	0	1	50
Penicillium brevicompactum	0.0	40.9	55.7
Penicillium camembert	0.0	42.7	44.0
Penicillium commune	0.0	52.1	53.9
Penicillium expansum	0.0	1.40	67.3
Penicillium solitum	0.0	56.1	55.2

Table.12: Percentage inhibition relative Penicillium fungi in the presence of DL-mandelic acid concentration in ppm, in cm^2 area.

Concentration fungi	0	1	50
Penicillium brevicompactum	0.0	41.3	46.7
Penicillium camembert	0.0	46.2	47.6
Penicillium commune	0.0	36.4	38.6
Penicillium expansum	0.0	4.50	3.20
Penicillium solitum	0.0	81.2	86.1

Table.13: Percentage inhibition relative Penicilium fungi in the presence of trimethyltin chloride concentration in ppm.

Concentrationfungi	0	1	50
Penicillium brevicompactum	0.0	94.6	95.5
Penicillium camembert	0.0	97.3	100.0
Penicillium commune	0.0	97.3	100.0
Penicillium expansum	0.0	99.6	100.0
Penicillium solitum	0.0	94.6	100.0

The trimethyltin chloride, Me_3SnCl, organotin precursor compound of the studied complexes were applied to cultures of fungi *Penicillium brevicompactum, Penicillium camembert, Penicillium commune, Penicillium Penicillium expansume, Penicillium solitum* in two replicates at concentrations of 1 and 50 ppm. The relative percentage inhibition data for growth of said fungi are shown in Table 6, with observed overall growth inhibition at the concentration of 50 ppm over the mold *Penicillium camembert Penicillium comune, Penicillium expansume, Penicillium solitum*, while for the *Penicillium brevicompactum*, the inhibition was not total, but was above 95%.

About cultures of the same yeast were also applied DL-mandelic acid, DL-4 -bromomandelic acids, DL-4-methoxymandelic, benzyl and DL-o-chloromandelic also precursors of ligands studied in concentrations of 1 and 50 ppm in two replicates. Tables 8 to 12 are shown the results observed relative growth inhibition of fungi. It has been observed that the benzylic acid, dl-4 -bromomandelic acids, DL-4-methoxymandelic acid, 2-chloromandelic acid and dl-mandelic, Tables 8, 9, 10, 11 and 12 respectively, had a higher inhibitory effect of growth of the fungus *Penicillium solitum* and less effect on the fungus *Penicillium expansum.*

The novel organotin complex $[Me_2SnMand_2]$ $[Me_2SnBenz_2]$ $[MeSnBrm_2]$ $[Me_2SnMeo_2]$ $[Me_2SnClm_2]$ were applied to the fungi studied. The complex $[Me_2SnBenz_2]$ Table 3 showed greater inhibitory power on the growth of *Penicilliumbrevicompactum* and less inhibitory power over the fungus *Penicilliumexpansum.*

The $[MeSnBrm_2]$ complex in comparison with other complexes synthesized and applied studies on fungi showed the lowest power inhibition of fungi, the results as shown in Table 4. The fungus with more complex growth was affected by *Penicillium brevicompactum,*

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which development reached about 70%. In contrast, the inhibition was less effect on *Penicillium expansum*, whose development has reached about 32%.

For [Me_2SnMeo_2] complex, according to data presented in Table 5, the growth inhibition is nearly complete for all fungi except *Penicillium expansum* whose inhibition percentage was 67.5%, and the most satisfactory result on *Penicillium solitum* to 1ppm.

The complexes [$Me_2SnMand_2$] and [Me_2SnClm_2] According to data presented in Tables 6 and 7, showed similar behavior to each other, having a lesser effect on the fungus *Penicillium expansum*. The complex [$Me_2SnBenz_2$} showed high inhibiting power of *Penicillium solitum*, to 5ppm with the 81.6% rate in excess of 50 ppm, which was 73.1%.

Importantly, trimethyltin chloride, Me_3SnCl, the precursor of the complexes studied, even being the most effective compound in inhibiting the growth of fungi studied presents some drawbacks for use as a sanitizing agent can chambers mature cheese. In addition to being a very toxic compound has odor intense irritating and that would certainly be absorbed by the cheese maturing.

Moreover, even with a lower efficiency in inhibiting the growth of fungi studied, both the synthesized complexes, such as acids α-hydroxycarboxylic that gave rise to it, we obtained an inhibition in different ways to the growth of several fungi.

This work aims to support new investigations, with the synthesis of other complex series to work in any structural changes that might produce selective compounds for various fungi. As well as performing appraisal toxicity, and a new series of complexes.

IV. FINAL CONSIDERATIONS

(A) trimethyl tin chloride and acidα-hidrocarboxílicos (dl-mandelic acid, benzylic acid, dl-4-methoxymandelic acid, DL-2-chloromandelic acid and 4-dl acid - bromomandelic acids) used as precursors of the complexes studied showed inhibition of growth on the fungi *Penicillium brevicompactum* , *Penicillium camemberti*, *Penicillium comnune*, *Penicillium Penicillium* obtained in cheese ripening chamber.

(B) The inhibitory effect on the growth of fungi studied observed by use of acidsα-hidrocarboxílicos was generally smaller than the effect of the new organotin complexes described in this thesis.

(C) trimethyltin chloride showed to be highly effective in completely inhibiting growth of the fungus *Penicillium camemberti*, *Penicillium comnune*, expansume *Penicillium solitum*, while for the *Penicillium brevicompact* with inhibition was higher than 95%.

(D) new organotin complex prepared inhibited mycelial growth of fungi studied, and the mean percentage inhibition above 50%. The inhibitory complex with greater overall average was [Me_2SnClm_2], about 90.0% inhibition, while the average was less complex [Me_2SnBrm_2], which was 57 3% inhibition.

(E) The paper should be continued with the suggestion synthesis of new members of the series of complexes described in this thesis, aiming structural correlations of these compounds with selective inhibition of growth of fungi and other microorganisms, and especially the study of the toxicity there.

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