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Study of bioaccumulation in Physalis peruviana using Buprofezin

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ABSTRACT

Background: Humans are exposed to an aggressive atmosphere full of different risks and more when it comes to food, which according to their care can produce from cancer to irritation or mild disease because of different pesticides, which in contact with some enzymatic processes; the chemicals react causing different disorders in health. Some of the chemicals instead of reacting, they accumulate in specific parts of the host body, as is the skin, organs, bones, in the case of the plants in the stems leaves, or even fruit. ***Objective:*** For this reason, this work presents the study of the bioaccumulation process in the active ingredient of Buprofezin in a crop of cape gooseberries, with the aim of observe the remnants of this compound in the Physalis peruviana and its fruit after two and a half months of being attacked by the Trialeurodes Vaporariorum. ***Conclusion***: As a main result, both the plant and its fruit does not eliminate the compound complete, leaving a remnant of 0.009 ppm and for higher quantities of the compound the plant's organism eliminates it faster, all of this after reaching the maximum capacity of the Physalis peruviana to absorbed the Buprofezin. The elimination rate of this compound makes necessary to increase the harvest time in some days or even weeks, lowering the production capacity, a cause of in some cases the value of Buprofezin accumulated in the harvest time is higher than the LMR.

KEY WORDS
bioaccumulation, buprofezin, Physalisperuviana, Trialeurodes vaporariorum, Cape gooseberry.

INTRODUCTION

Agriculture, one of the most ancient and basic processes of humanity, for several centuries has been altered including different chemical agents for the control and elimination of pests around the crops, reducing losses that may be caused. On the other hand pesticides are commonly known by the toxic effects that occur in health, it is for this reason that have developed different studies and have generated measures to curb this, but even so there are multiple factors that make it difficult to proper disposal of these before they are harmful to the health, as are the processes of bioaccumulation and biomagnification. [1]

The bioaccumulation as described in [2] Is the sum continues or discontinuous with chemical agents persevering in living organisms in such a way that these with the passage of time reach levels higher than concentrations in the environment and/or in the food, affecting many times in affections to human health.

In [3] There is evidence that in spite of the measures of control that the government and the Ministry of Health have post, are fruits with chemical residues of pesticides (chlorpyrifos) that exceed the limit allowed (MRLS) and which as reflected in [4] Has adverse effects of neurological in children and in the fetus and is highly toxic in small doses, so it is classified as a class II by the EPA.

On the other hand [5], pesticide residues were evidenced as lindane, aldrin, dieldrin, endrin, among others with values well above the maximum allowable limit in a product of common use as is the pasteurized milk. This strengthened with as described in [6], establishes that there is a pattern in the use of pesticides and their presence in food, once they have been processed and treated. This coupled with the fact that pesticides are toxic to a greater or lesser degree for the human being, sets a precedent that the food they normally consume can cause problems in health.

In general you can define that any pesticide independent of its origin has a potential for bioaccumulation, which in addition to the fact that each compound used in these is divided into different metabolites, many times more toxic than the same compounds, makes it necessary to carry out a more thorough study of each of the pesticides used in food, where through different techniques as shown in [7] And [8] It is possible to determine the concentrations of pesticides in food before applying them.

Therefore, this work presents the study of bioaccumulation of the active ingredient buprofezinin a crop of cape gooseberries in where it will be analyzed in depth the effect of this pesticide in the Physalis peruviana and waste of this for a crop of 2 and a half months exposed to the Trialeurodes vaporariorum. That as shown in [9], [10], [11] And [12] Several studies have been conducted of bioaccumulation on the plant Physalis peruviana and the various effects of buprofezin in different foods, but even so there is not a specific study of the potential for bioaccumulation of the compound in the plant.

Methodology:

For the development of the study it is necessary to pose a field of study and a model to use which based on a crop of Physalis peruviana in one hectare, the methodology to be used is shown in figure 1.

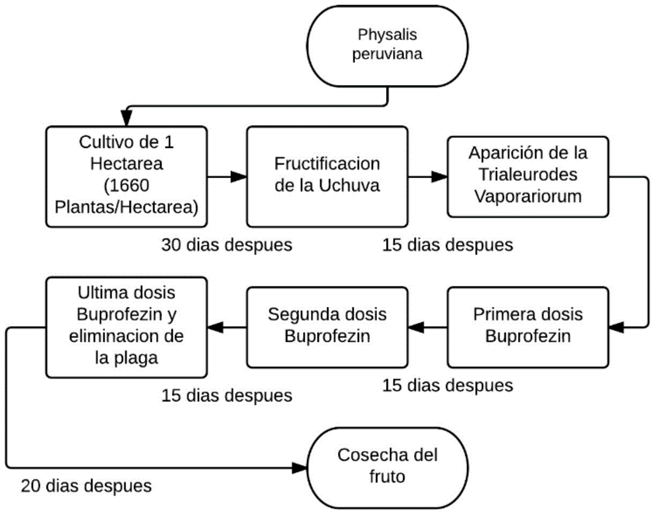

Fig. 1: Study Methodology

As shown in Figure 1 sets out a methodology from the cultivation of Physalis peruviana until the harvest of the fruit (cape gooseberry), where is affected by a plague known as the Trialeurodes vaporariorum once in the crop that according to studies in [13] And [14] And under appropriate climatic conditions, required between 2 or 3 doses of pesticide (in this case Buprofezin) to eradicate it in normal conditions. Apart from this between applications having a period of abstinence from 15 days usually, once this time has passed it is prudent to collect the fruit.

To conduct the study of bioaccumulation in the plant, took 3 points of analysis which correspond to the application of buprofezin, based on this was raised a model of bioaccumulation in the body as shown in the equation 1.

$$\frac{dx}{dt} = Entrada - Eliminacion \quad (1)$$

Where there is the entrance of the pesticide or of the compound either by mouth or dermal, plus the speed of elimination of this pesticide by the body, it becomes in the equation 2.

$$\frac{dx}{dt} = K_i X_o - K_e X \quad (2)$$

Where K_i is the rate of incorporation of the compound (buprofezin), K_e the rate of removal of the compound in the organism, X is the chemical concentration of the compound and X_o is the chemical concentration of the compound in the pesticide.

To resolve this equation is necessary to take into account that both K_i and K_e are constant and K_e is invariant in time, with resulting equation 3.

$$X = \frac{K_i * X_o}{K_e * V} * (1 - e^{-K_e t}) + X_i * e^{-K_e t} \quad (3)$$

For this model is taken into account t as the exposure time of the compound in the body, X_i such as the initial concentration of the compound in the body and V as the volume of the plant.

With the purpose of developing the model proposed in 3 it is necessary to find the constants, for K_i it must be borne in mind that is variant on the time, more specifically in 3 seconds of time corresponding to the 3 doses of the compound, once applied the dose this constant change its value to 0 because is not entering Compound to the plant. With this in mind in the equation 4 shows the value of the constant for the 3 time instants.

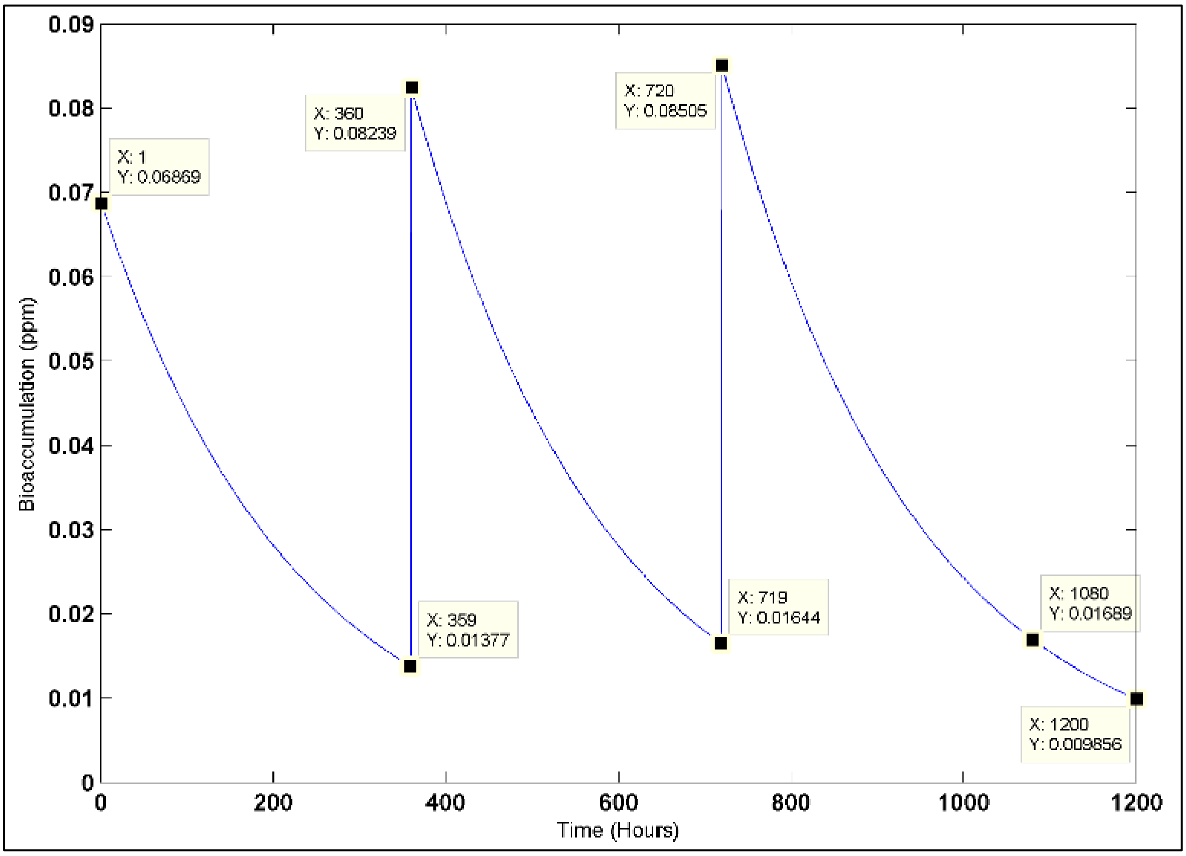

Fig. 2: Bioaccumulation and elimination of buprofezin in The Physalis peruviana

$$K_i = 0.8\frac{Litros}{Hectarea} * \frac{1\,Hectarea}{1660\,plantas} = 0.4819\frac{mL}{planta} \quad (4)$$

Of the equation 4 is the amount of solution to apply, which is $0.8\frac{Litros}{Hectarea}$, for one crop in one hectare determined where are 1660 plants as indicated in [15], hence the amount of compound per plant is $0.4819\frac{mL}{planta}$. By his side X_o is the concentration of the compound in the solution which is given in $250\frac{g}{L}$, t for this case was established in 1 hour, K_e was found in the equation 5 from the fact that the average life span $t_{\frac{1}{2}}$ of buprofezin is 6.42 days in plants such as indicated in [16].

$$K_e = \frac{\ln 2}{t_{\frac{1}{2}}} = 4.49x10^{-3}h^{-1} \quad (5)$$

For the volume of the panta took into account the equation 6.

$$V_{planta} = V_{tallo} + V_{ramificaciones} + V_{hojas} + V_{frutos} \quad (6)$$

For the volume of the stem approached this to a cylinder of radius constant, with a height of 144.64to cm according to [17] And a diameter of 1.323to cm according to [18], so that the area of the stem end was 198.83 cm3. In the case of the ramifications should be to take into account the volume of the primaries more than the secondary and therefore the number of both that according to [19] There are 4 primary ramifications with a diameter equal to the stem and a length of 8 cm and 8 secondary with a diameter of 0.5 cm and a length of 5 cm, all this to obtain a volume of 47.92 cm3.

In the case of the volume of the leaves will have an area of 15000 cm2 per plant according to [18] And [20] With an average thickness of 0.05 cm, with which the final volume approximately 750 serious cm3. Finally to the volume of the fruit is taken into account that each fruit has an average volume of 2.51 cm3 according to [21] And by culture there are approximately 300 fruits according to [19] And [22] So the average volume is 753 cm3. Finally Applying equation 6 the total volume of the plant is 1749 m3, in addition in the Table 1 shows the value of the constants found.

Table 1: Compilation of the Variables Found

Variable	Value
K_i	$0.4819\frac{mL}{planta}$
K_e	$4.49x10^{-3}h^{-1}$
X_o	$250\frac{g}{L}$
V_{planta}	$1.749\ m^3$
t	$1\ h$
$t_{estudio}$	$1200\ h$

Results:

Using the simulation tool MATLAB of Matworks® is proceeded to simulate the equation 3 with the constants shown in table 1 the results obtained for a plant Physalis peruviana with a time of study of 1200 hours and 3 dose every 15 days of buprofezin, shown in figure 2.

In Figure 2 you can see that for each one of the 3 doses of buprofezin the agency did not immediately deleted the compound if not that behaves exponentially decreasing, that when passing by $t_{\frac{1}{2}}$ decreasing with a lower speed.

Once it takes 15 days there is a concentration of 0.0137 ppm of the compound for the first dose that then increases to 0.01644 ppm and 0.01689, taking into account that the MRLS for the buprofezin in this type of plants is of 0.05 ppm, the fact that residues with values close and that once applied the dose, this exceeds the MRL (0.06, 0.082 and 0.085), demonstrates that the control that you must have to apply the dose, is fairly detailed that goes from that applies the dose and their mode of application until the follow up after the harvest, as shown in the last point of the graph which Past 20 Days The application is maintained a dose of 0.009 ppm per plant.

Due to the foregoing was raised a study of the minimum and maximum values on the part of the compound, which must be taken into account at the time of application, the results are reflected in figure 2.

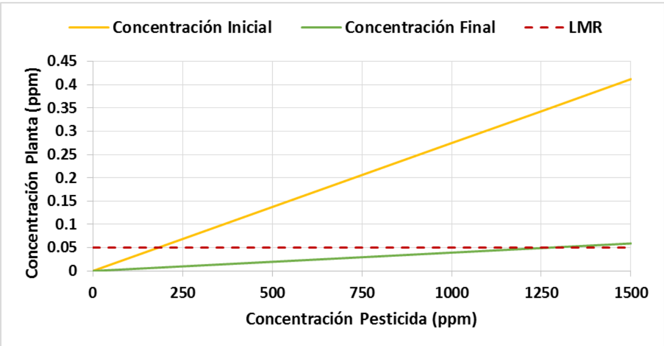

Fig. 3: Concentration of the pesticide vs. concentration in the plant

In Figure 3, is displayed as the concentration of the pesticide rises, the final concentration in the plant rises proportionately, where after 1200 ppm since the compound is harmful to health and as the initial concentration after the 200 ppm for the compound analyzed is driving a concentration of 250 ppm.

Because the time of presence of the compound in the body influences the concentration of the compound in the plant, a study was conducted by varying the time of income that goes from 0.1 hours to 1 hours. Theresults are show in figure 4.

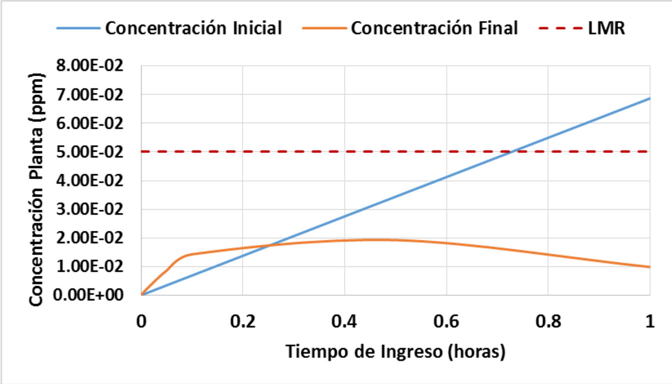

Fig. 4: Concentration of the plant vs. time of entry of the compound

In this case it was obtained a different graphic where as the time of entry or retention varies, the concentration in the plant varies in two ways. In the first part when the body is exposed to a time less than 30 minutes, the final concentration increases to a lesser degree to the initial concentration, then after the 30 minutes the final concentration decreases rapidly. This is due to the fact that the body has a maximum capacity of absorption, once reached this point the body rejects additional doing that the pace of elimination is faster at a higher amount of buprofezin.

Conclusions:

To observe the speed of elimination of the pesticide, it is necessary to establish that for crops with short crop time as is the case of the cape gooseberry, risk of handle dose above the permitted limit, as was displayed in Figure 2 where the normal time of harvest is 45 days, but due to the concentration of the compound (0.01 ppm) was necessary to prolong for 5 more days harvest.

In the study performed handled different conditions with the purpose of developing a more accurate analysis, if comes true the speed of elimination of the compound depends on different biological components, can be approximated to the value taken. Additionally, the model of bioaccumulation proposed in this study served to assess the critical points of dosage and retention of the compound. All this with the purpose of proposing times and dose more suitable for the proper care of the different crops.

This study used the Buprofezin as a compound to analyze, if comes true this presents a potential for bioaccumulation medium due to its half-life time ($t_{\frac{1}{2}}$), but applying this same system in another compound with the greatest potential for bioaccumulation or with a greater degree of toxicity, can provide a means for the early identification of hazardous compounds used in crops.

RECOGNITION

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