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Insecticidal effects of Lamiaceae species against stored products insects

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Some Lamiaceae species were selected to test their biological activity against *Tribolium castaneum* Herbst (Coleoptera, Tenebrionidae), CIPEIN strain.

A screening was done with *Ocimum basilicum* L, *Mentha rotundifolia* L, *Origanum vulgare* L ssp.*vulgare, Rosmarinus officinalis* L and *Thymus vulgaris* L, comparing the efficacy of their extracts with that of *Lavandula spica* extracts.

Dichloromethane extracts and infusions from each plant were applied to the diet of *T. castaneum* first instar larvae at a dose of 5000 ppm. The effect on development delay and mortality until adult emergence, using ANOVA, LSD and Probit analysis ($p<0.05$) was evaluated.

Higher lethal effect of dichloromethane extracts was achieved with *M. rotundifolia* while subletal effect only was produced with *O. vulgare* L ssp.vulgare.

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Key words: *Tribolium castaneum*, Lamiaceae species, natural pesticides.

INTRODUCCTION

During the last decades the increasing use of synthetic insecticides caused several negative effects such as enviromental pollution, toxicity at different trophic levels and selection of resistant insect populations (HERNANDEZ ESCALONA *et al.*, 1999). Then, research on new insecticides, safer and ecologically appropriate is necessary (BROUSSALIS *et al.*, 1999).

Higher plants offer an excellent source of biologically active natural products. There are many examples of plant natural products which demostrate potent activity as insecticides (BENNER, 1993)

A screening of plants extracts from many species selected for insecticidal activity could lead to the discovery of new agents for pest control (OLIVEIRA, J.V.D.,1997)

Recently, a selection of ten aromatic herbs belonging to different botanical families showed different degrees of insecticidal efficacy (CLEMENTE, 2000, CLEMENTE *et al.*, in press). One of these herbs, *Lavandula spica* (Lamiaceae), produced maximun lethal and subletal effects on T. *castaneum*. A bioguided fractionation of *L. spica* indicated that its essential oil contains 4-11 % of 1-8 cineol, responsible of lavender insecticidal activity (MAGA *et al.*, 2000). This compound is present in the essential oil of

Rosmarinus officinalis, Ocimum basilicum and *Artemisia* spp., their toxicity and repellency having reported (GRAINGE and AHMED 1988).

The present report is related to insecticidal activity of five more Lamiaceae species, comparing the efficacy of their infusions and dichloromethane extracts with that of *L. spica.*

MATERIALS AND METHODS

Plant material: Aerial parts of *Ocimum basilicum* L. (basil), *Mentha rotundifolia* L. (mentha), *Origanum vulgare* L. ssp vulgare (oregano), *Rosmarinus officinalis* L. (rosemary) and *Thymus vulgaris* L. (thyme) were cut from a crop free from agrochemicals and fertilizers, specially grown up in the campus of Facultad de Agronomía, Universidad de Buenos Aires. Serial parts of *Lavandula spica* L. (lavender) were used as positive control.

Extracts assayed:

Dichloromethane extracts: Powdered plant materials were sucessively extracted by maceration with dichloromethane three times for 24 hours. Later, it was taken to dryness under vacuum.

Infusions: Five grams of the powdered plant materials were added to 100 ml of destilled water (5% P/V infusion)

Insect assayed: *Tribolium castaneum* Herbst (Coleoptera, Tenebrionidae) neonatae larvae from a colony reared in our laboratory

Bioassay: A completely randomized design with four replications was used. Insects were mantained in standard conditions (temperature: 25 + 1ºC, HR: 75 + 5%). An acetonic solution 5000 ppm of each extract was mixed with the diet (flour, beer yeast and corn starch, 10:1,5:10). Fourty eight hours later, ten neonatae larvae were added to each replication. Each ten

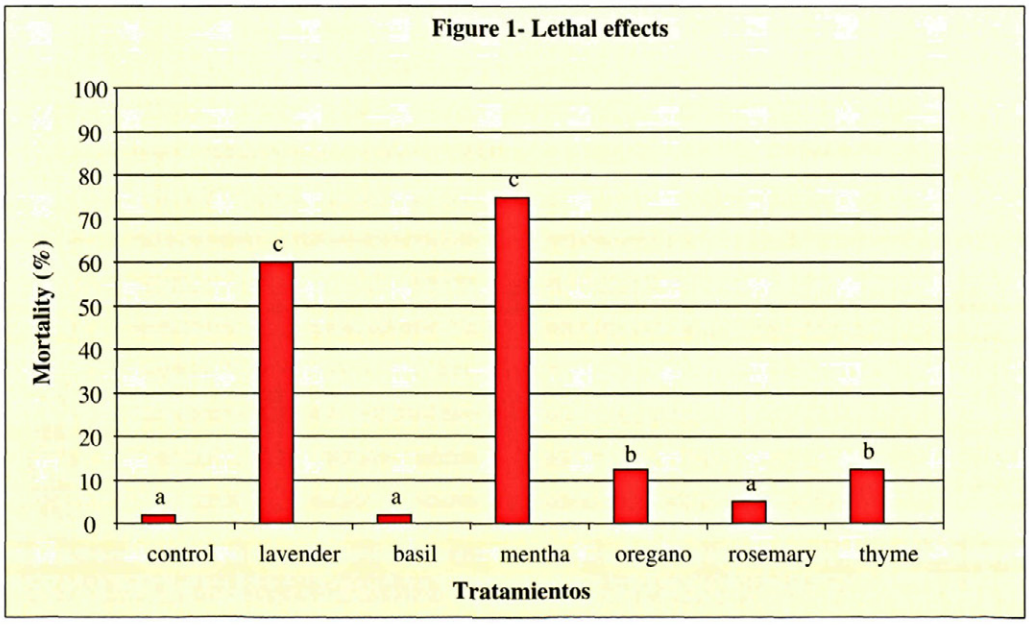

Figure 1.- Lethal effects of *Tribolium castaneum* larvae exposed to 5000 ppm on dichloromethane Lamiaceae species extracts. Same letters at the top of the bars indicates significative difference ($p \leq 0.05$).

days, number of individuals in each development instar (larvae, pupae and adults) was counted.

Statistical analysis: ANoVA and LSD Múltiple Range Test was used for mortality (STEEL and TORRIE, 1993). Data of pupae numbers each ten days were used to calculate the time necessary for 50 % of the larvae to reach the pupal instar (PT 50: pupation time 50%) with Probit analisys (LITCHFIELD, J.T. and F. WILCOXON, 1949).

RESULTS AND DISCUSSION

Figure 1 ilustrates that dichloromethane extracts from *M. rotundifolia* L (mentha), *O. vulgare* L ssp.vulgare (oregano) and *T vulgaris* L (thyme) had significant letal effects producing higher mortality than the control. Mentha extract produced similar mortality than lavender extract (positive control) while oregano and thyme extracts produced lower mortality.

Previous work (CLEMENTE *et al.*, 2002, in press) showed that mentha and oregano methanol extracts did not have lethal effects. It indicates that dichloromethane could be a better solvent than methane for extraction of insecticide compounds from these herbs.

As it is seen in Figure 2, basil, mentha, rosemary and thyme infusions had significant effects on mortality. Mentha results implice that organic solvent could be better than water to extract metabolites with biological activity.

Polar extracts of *M. longifolia* produce 70-100% of mortality when applied topically (PASCUAL-VILLALOBOS M.J and A. ROBLEDO, 1998). When *M. spicata* extracts were tested against *Callosobruchus analis*, dry leaf powder was highly effective (GEORGE, G. and PATEL J.R., 1992)

However, the concentration of active insecticidal metabolites in infusions could

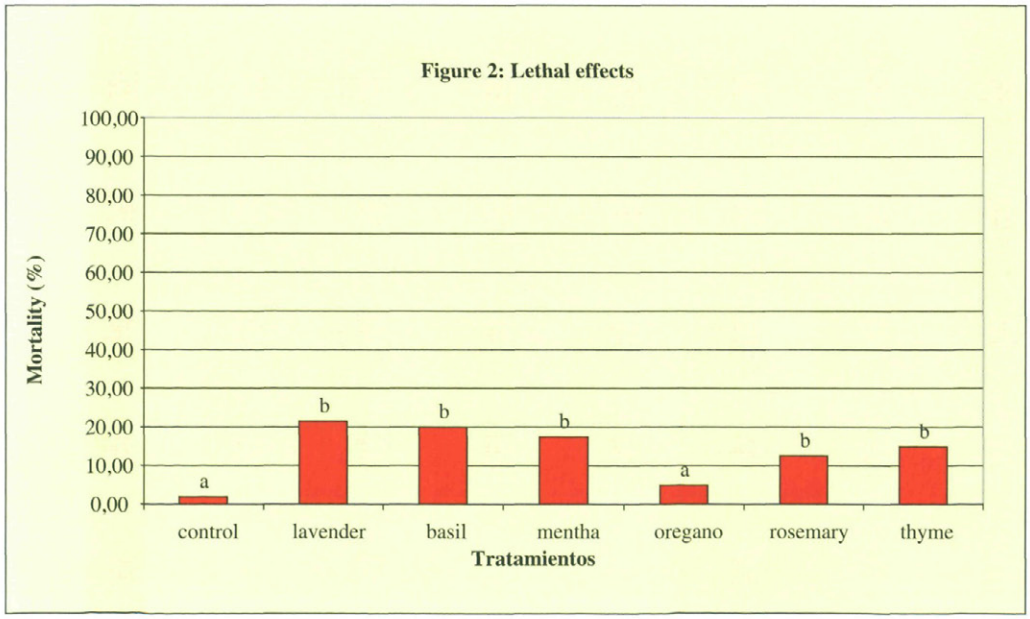

Figure 2.- Lethal effects of *Tribolium castaneum* larvae exposed to 5000 ppm Lamiaceae species infusions. Same letters at the top of the bars indicates significative difference ($p \leq 0.05$).

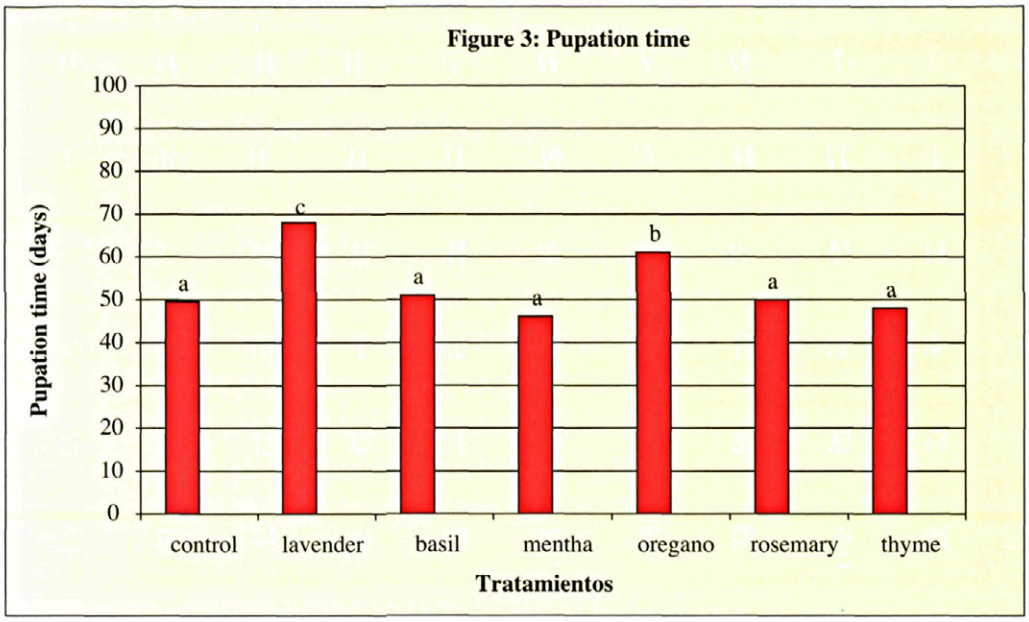

Figure 3.- Development delay in *Tribolium castaneum* larvae exposed to 5000 ppm on dichloromethane Lamiaceae species extracts, expressed as pupation time 50.
Same letters at the top of the bars indicates significative difference ($p \leq 0.05$).

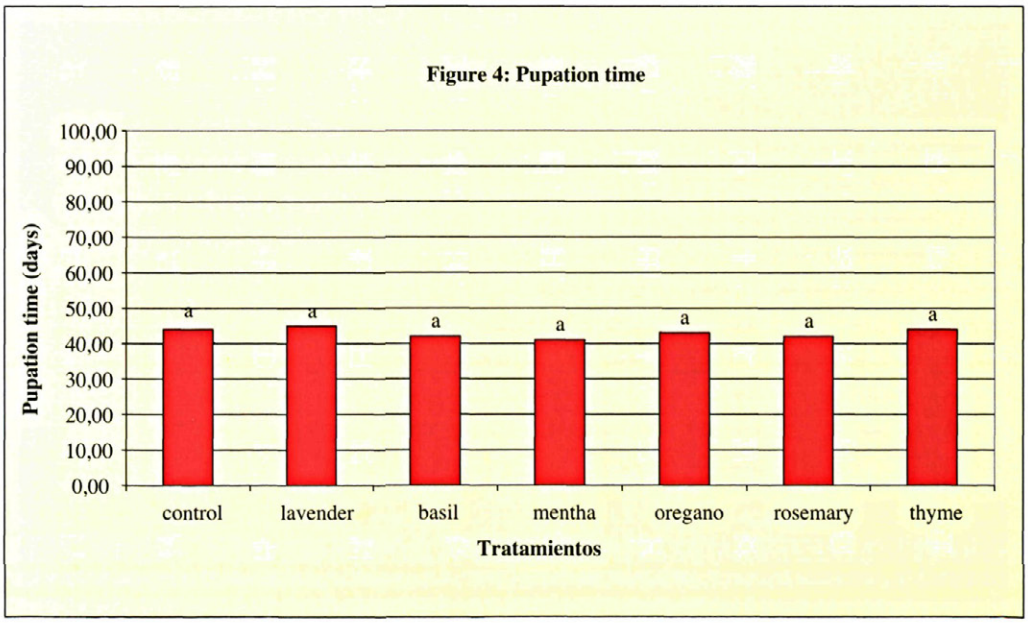

Figure 4.- Development delay in *Tribolium castaneum* larvae exposed to 5000 ppm of Lamiaceae species infusions, expressed as pupation time 50.
Same letters at the top of the bars indicates significative difference ($p \leq 0.05$).

justify their use in spraying organic crops to prevent pest attack.

Figure 3 ilustrates about sublethal effects of oregano dichloromethane extracts, compared with the control and with lavender. Time necessary for 50% of the larvae to reach the pupal instar (PT50) was significantly higher with oregano dichloromethane extracts ($p \leq 0,05$). It indicates that *T. castaneum* larvae growing in contact with this kind of compounds will need more time to develope until the adult instar. In this case, a lower number of generations along the year could be expected. The same result was obtained with lavender ($p \leq 0,05$).

Infusions (Figure 4) did not have significant effect on development delays ($p \leq 0,05$). Then, when infusions are sprayed on crops, only lethal effects should be expected.

Some of these results agree with those from other investigators who observed that monoterpenes (PRATES *et al.*, 1998), 1-8 cineol (MAGA *et al.*, 2000, OBENG OFORI, 1997) and essential oils (SHAAYA *et al.*, 1991) are good alternatives to achieve pest control without synthetic insecticides.

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ABSTRACT

CLEMENTE S., G. MAREGGIANI, A. BROUSSALIS, V. MARTINO, G. FERRARO. Efecto insecticida de especies Lamiaceae contra insectos de granos almacenados. *Bol. San. Veg. Plagas,* **29:** 421-426.

Se seleccionaron algunas especies de Lamiaceae para evaluar su actividad biológica potencial sobre *Tribolium* castaneum Herbst (Coleoptera, Tenebrionidae), cepa CIPEIN.

Se efectuó un screening con *Ocimum basilicum* L, *Mentha rotundifolia L, Origanum vulgare* L ssp.vulgare, *Rosmarinus officinalis* L y *Thymus vulgaris* L comparando la eficacia de sus extractos con la de extractos de *Lavandula spica* L.

Se aplicaron extractos en diclorometano e infusiones de cada planta a la dieta de larvas de primer estadio de *T. castaneum* en una concentración de 5000 ppm. Se evaluó su efecto sobre demoras en el desarrollo y la mortalidad hasta la emergencia de adultos utilizando ANoVA, LSD y análisis Probit ($p<0.05$).

El más alto efecto letal se obtuvo con el extracto en diclorometano de *M. rotundifolia L* mientras que sólo se produjo efecto subletal con *O. vulgare* L ssp.vulgare.

Palabras clave: Tribolium castaneum, especies de Lamiaceae, pesticidas naturales

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