



RESEARCH PAPER

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Repulsive and biocide activities of leaves powder of *Crataeva religiosa* (Forst) on *Dermestes* spp. associated with the salty smoked-dried fish

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Abstract

This study is realized with the aim of proposing an alternative in the use of pesticides of synthesis in the fight against *Dermestes* spp, insects beetles, devastating main things of the dried fish. The activity adulticides and larvicides some powder of leaves of *Crataeva religiosa* Forst (Capparidaceae) was tested on *Dermestes* spp. The results allowed to say that this powder of leaves is very effective against the larvas of diverse stage and the adults of *Dermestes* spp associated to the smoked-dried fish with salt. The smallest measure D1 (0,05%) allows 86,31% of mortality corrected to larvas and to adults, 93,01%. With the biggest dose D6 (0,4%), 88% of mortality corrected to larvas is registered and 98 % of mortality corrected at the adults.

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Introduction

The excessive use of pesticides of synthesis in the field of the transformation of the halieutic products raises enormous problems, as far as it is not legal. Two tests of residues of pesticides were made on two matrices, some smoked-dried fish and some fermented-dried fish. The results showed the presence of four families of pesticides and among these pesticides, three of the most dangerous: lindane, dieldrin and parathion (Mbaye *et al.*, 2012). These measured pesticides are often obsolete and would not even be used in the domains where the use of phytosanitary products is approved and regulated. In made the use of pesticides in the sector of the transformation of the halieutic products does not date from today, for more than twenty years already, transformers use the DDT in Senegal (Watanabe, 1974). In spite of the awareness of the harmful character which represents the use of pesticides, the development of the alternative methods is still very shy in Senegal (Sow *et al.*, 2004). This study aims at developing alternative measures of the use of pesticides in the control of the devastating of stored foodstuffs generally, but particularly in the fight against beetles, devastating main *Dermestes* spp of the dried fish, by the study of the biological activity of a tropical plant, the *Crataeva religiosa* (Forst). The effect adulticide and larvicide leaves of *Crataeva religiosa* (Forst) are going to be make out a will on *Dermestes* spp. Indeed the biocide activity (effet ovicide and adulticide) of this plant was demonstrated on the seed-beetle of the cowpea (*Vigna unguiculata* Walp.) by Faye *et al.* (2012). The seed-beetle, *Callosobruchus maculatus*, being a Coleoptera in the same way as *Dermestes* spp where from the choice of *Crataeva religiosa* (Forst).

Material and method

Biological material

The biological material used for the biocides tests is constituted by the leaves of powder reduced *Crataeva religiosa* (Forst); some smoked-dried fish (*Sardinella aurita* and *Sardinella maderensis*) conditioned in the same way as the smoked-dried fish of the transformers of halieutic products, thus salty but untreated with a product biocide, nor with a pesticide

of synthesis and dried during a week; adults of *Dermestes* spp old at most than 72 hours; larvae of *Dermestes* spp of diverse stages.

Harvest and preservation of the plant material

The leaves of *Crataeva religiosa* (Forst) were picked on May 13th, 2013, early in the morning in front of the botanical garden of the Faculty of Science and Techniques of the University Cheik Anta Diop of Dakar. Leaves are dried shielded from the sun at room temperature during 7 days in the laboratory. Once dried, leaves are reduced in powder with the mixer and spent in the sieve of maille 0,5 mm in diameter to obtain one powder in homogeneous size grading. The powder of leaves so obtained is kept in a closed glass jar, in a dry and airy place of the laboratory for a later use.

Breeding of *Dermestes* spp

The breeding is made for the laboratory, in rubber jars. In every jar, we introduce enough smoked-dried fishes and some male insects and female; the jar of breeding is covered with the mosquito net to prevent the beetles from escaping because these are capable of flying. After a day of contact, *Dermestes* spp is removed and the infested fish is followed; larvae and adults who will emerge from it are used for the tests larvicides and adulticides.

Method

Tests of contact

The tests of contact are made with some powder obtained with leaves dried by *Crataeva religiosa* (Forst) at old adults at most than 72 hours and larvae of diverse stage of *Dermestes* spp. The essays are made in real environment, in similar conditions in the conditions of preservation and of application of the products of chemical fight used by the transformers of the production sites of halieutic products of Mbour city (Mbaye *et al.*, 2012). In a rubber jar, 2 kg of smoked-dried fish unhurt of any insecticidal treatment are introduced. Every portion or whole fish, is sprinkled on its two sides with the dose of leaves powder of *Crataeva religiosa* considered. The jar is covered with a mosquito net, then closed

partially and placed at room temperature, so that our conditions of treatment get closer as much as possible to those of the transformers which recovers their smoked fish with a tissue and sometimes more a plastic cover during wintering, having treated them with some salt (more the powder of pesticide). The dead specimens are considered every 24 hours. Insects and larvas are considered as died which do not move any more in the touch. Index cards of followed by the mortality of the adults and by the larvas of *Dermestes* spp according to the dose of powder of dried leaves will serve to find the observed data of mortality.

Dosage and essay

Beforehand powder of leaves dried by *Crataeva religiosa* (Forst) was weighed with an electronic balance (GIBER EU 600) of the precision 0,01 g in weights of 1, 2, 3, 4, 6 and 8 g which are used for the essays. Doses retained for the tests adulticides and larvicides are among 6 for every specimen:

- D1 = 1 g leaves powder/2 Kg smoked-dried fish
- D2 = 2 g leaves powder/2 Kg smoked-dried fish
- D3 = 3 g leaves powder/2 Kg smoked-dried fish
- D4 = 4 g leaves powder/2 Kg smoked-dried fish
- D5 = 6 g leaves powder/2 Kg smoked-dried fish
- D6 = 8 g leaves powder/2 Kg smoked-dried fish

For every dose we make a white essay R0 (witness), that is a essay without application of leaves powder and 3 repetitions: R1, R2 and R3. 6 essays are made for larvas: E1, E2, E3, E4, E5 and E6 and 6 others for the adults: E7, E8, E9, E10, E11 and E12. Every essay contains 1 white witness or white essay and 3 repetitions for every specimen, what carries the total essay number in 12 with 48 repetitions.

Larvicides tests

The larvicides tests are made on 20 larvas of *Dermestes* spp of diverse stage with 6 doses of leaves powder of *Crataeva religiosa* by the described methodology higher.

Adulticides tests

The adulticides tests are made on 10 couples of adults

of *Dermestes* spp old at most than 72 hours with 6 doses of leaves powder of *Crataeva religiosa* by the described methodology higher.

Statistical analyses

The statistical calculations and the multivariate analyses are made thanks to the software Excel. The averages of mortality of the biological essays are calculated then corrected by the formula of Abbott

$$(1925) : CM = \frac{(OM-WM)}{(100-WM)} \times 100$$

CM = Corrected Mortality; OM = Observed Mortality; WM = Witness Mortality.

The DL50 or lethal dose 50 (weight of necessary substance to kill 50% of specimens in experience at given time) is estimated to determine the toxicity and the efficiency of the leaves powder of *Crataeva religiosa* (Forst) on *Dermestes* spp. The averages of obtained mortalities are submitted to an ANOVA in a factor, the entomological parameters adultes and larvas mortalities are compared. The STUDENT.TEST at the threshold of meaning 5% allows us to detect possible differences between treatments.

Results

Repulsive effects

Immediately after the leaves powder of *Crataeva religiosa* (Forst) on the smoked-dried fish was sprinkled, we note a repulsive effect of leaves powder which shows itself by a grouping of larvas and adults of *Dermestes* spp towards the edges of the jar to escape the action of the powder (fig.1). The leaves powder of *Crataeva religiosa* (Forst) thus has a repulsive action on *Dermestes* spp.

Effect larvicide

The effect larvicide of leaves powder of *Crataeva religiosa* on the larvas of diverse stages of *Dermestes* spp shows itself in 86,31% of larvas mortality corrected in the lowest dose D1 (0,05%). This mortality rate observed in the lowest dose is upper to the mortality rates noted for the biggest doses excepted the dose D6 (0,4%) where 88% of larvas mortality were registered (table 1).

Table 1. Corrected mortalities of larvas according to the dose of leaves powder.

DOSES	LARVAS MORTALITIES (%)
D1=1 g/2 Kg (0,05%)	86,31 ^a
D2=2g/2Kg (0,1%)	84,32 ^a
D3=3g/2Kg (0,15%)	86 ^a
D4=4g/2Kg (0,2%)	84 ^a
D5=6g/2Kg (0,3%)	83 ^a
D6=8g/2Kg (0,4%)	88 ^a

Numbers followed by the same alphabetical letter are statically equal according to ANOVA and STUDENT tests.

The kinetics of the mortality of the larvas of *Dermestes* spp by report the leaves powder of *Crataeva religiosa*, spread out in the time until 12 days according to the dose. Globally the toxicity of the powder of leaves of *Crataeva religiosa* (Forst) is characterized by a decreasing mortality in time.

However whatever dose, the biggest mortality rates observe the first 3 days J1, J2 and J3. These results also show the DL50 of leaves powder of *Crataeva religiosa* (Forst) for the larvas of diverse stage which is registered to D5 equal to 0,3 % that is 6g/2Kg (fig. 2).

Table 2. Corrected mortalities of adults according to the dose of leaves powder.

DOSES	ADULTS MORTALITIES (%)
D1=1g/2Kg (0,05%)	93,01 ^b
D2=2g/2Kg (0,1%)	97,50 ^b
D3=3g/2Kg (0,15%)	92,50 ^b
D4=4g/2Kg (0,2%)	95 ^b
D5=6g/2Kg (0,3%)	95 ^b
D6=8g/2Kg (0,4%)	98 ^b

Numbers followed by the same alphabetical letter are statically equal according to ANOVA and STUDENT tests.

Effect adulticide

The effect adulticide of leaves powder of *Crataeva religiosa* (Forst) observes strongly in the lowest dose D1 (0,05%) which registers a strong 93,01% mortality rate on the adults of *Dermestes* spp; with D2 (0,1%),

the mortality of adults increases until 97,50% ; then decreases with the dose D3 (0,15%) in 92,50% ; to increase then still 98% of mortality with the strongest dose D6 (0,4%) (table 2).

Table 3. STUDENT.TEST made on the averages mortalities of larvas and adults at alpha = 0,05.

Day	Dose1	Dose2	Dose3	Dose4	Dose5	Dose6
	p-value	p-value	p-value	p-value	p-value	p-value
J1	0,121	0,352	0,102	0,397	0,352	0,397
J2	0,371	0,187	0,079	0,352	0,045	0,500
J3	0,313	0,250	0,147	0,455	0,147	0,102
J4	0,045	0,250	0,352	0,128	EA	0,250
J5	0,250	0,437	0,352	0,397	0,397	0,352
J6	0,250	0,250	0,250	0,250	EA	0,250
J7	EA	0,250	0,250	0,250	0,352	0,250

EA = Equal Averages.

The mortality of adults of *Dermestes* spp evolves as that of its larvae, it spreads out in the time until 13 days according to the dose of leaves powder of considered *Crataeva religiosa*. In a global way the toxicity of the leaves powder of *Crataeva religiosa* on adults is decreasing in the time as for larvae, but here the biggest mortality rates observe the first 4 days J1, J2, J3 and J4 and it is which that the applied dose. The DL₅₀ for adults of *Dermestes* spp with leaves powder of *Crataeva religiosa* is observed to D6 equal to 0,4% that is 8g/2Kg (fig. 3).

Efficiency compared of treatments larvicides and adulticides of *Dermestes* spp

The observation of the results of the effect biocide of leaves powder of *Crataeva religiosa* (Forst) between the larvae and the adults of *Dermestes* spp shows a bigger mortalities of the adults of the order of 90% which aims towards 100%, while for larvae the mortalities rates are between 80 to 90%, whatever dose of considered leaves powder.

Thus there is a bigger mortality of the side of the adults than that of the larvae of *Dermestes* spp with treatments biocide of leaves powder of *Crataeva religiosa* (fig. 4). However the DL₅₀ in 24 hours, for the larvae of diverse stage of *Dermestes* spp is 0,3% (6g/2Kg) which corresponds to the dose D5 and for the adults of *Dermestes* spp it is bigger because we obtain it in dose D6 equal to 0,4% (8g/2Kg). It allows us to say that leaves powder of *Crataeva religiosa* is much more toxic on the larvae than on the adults of *Dermestes* spp (fig. 4). But the STUDENT.TEST (table 3) allows to say that there is no significant difference of the statistical point of view between the mortalities of the larvae of diverse stage and the adults of *Dermestes* spp with the same dose of *Crataeva religiosa* (Forst). Thus for the same dose of leaves powder of *C. religiosa* (Forst), the entomological character larva or adult of the genre of *Dermestes* spp has no significant effect on the observed mortality.

Discussion

The strong biocide activity of *Crataeva religiosa* (Forst) was already highlighted by Faye *et al.* (2012). They demonstrated the adulticide effect on the forms aviaries and normal with 100% mortalities and the effect ovicide going from 70 to 90%, according to the dose. However these authors used *Crataeva religiosa* (Forst) not on *Dermestes* spp but on *Callosobruchus maculatus*, in more they worked with aqueous and organic extracts and not with leaves powder. Also let us note, the antifungal activity of *Crataeva religiosa* (Forst) which was demonstrated on *Candida* spp, *Cryptococcus marinus*, and *Aspergillus niger* by Sahoo *et al.* (2008).



Fig. 1. Repulsive action of the leaves powder of *Crataeva religiosa* (original photo).

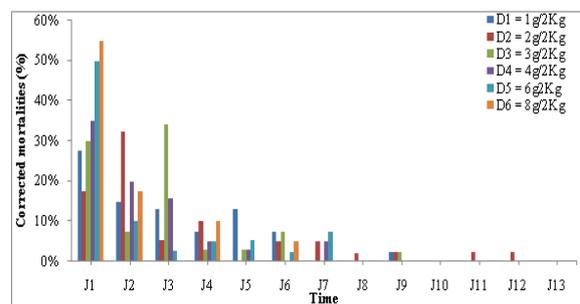


Fig. 2. Percentages of corrected mortalities for the larvicides tests.

The persistence or the toxicity of the leaves powder of *Crataeva religiosa* (Forst) on the man could not raise problem. Indeed leaves of *Crataeva religiosa* (Forst) is edible and medicinal at the same time. They are edible for goats and for men (people) in the countries of Sahel (Bergeret and Ribot, 1990). The anti-inflammatory action of *Crataeva religiosa* was demonstrated by Chichioco-Hernandez *et al.* (2010). In Senegal *Crataeva religiosa* (Forst) it is very used

in the field of the traditional medicine, is for Sereres and Wolofs the archetypal medicine against all the diseases of eyes (Kerharo and Adam, 1974).

The active ingredient to the leaves of *Crataeva religiosa* (Forst) responsible for the repulsive effect and biocide and consequently for the death of *Dermestes* spp could be between the secondary metabolites of these leaves. According to Guignard (1894), Capparidaceae tropical and subtropical families such *Crataeva religiosa* contains of the myrosine in isolated or grouped cells and sometimes glycosides (qualified as glucosinolates) giving rise in essence to senevols reminding those of the Crucifers. This glucosinolates is *S*-hétérosides, analogues sulphurated by *O*-hétérosides (Kerharo and Adam, 1974). These glucosinolates reminds the methyl glucosinolate or glucocapparine precursor of the isothiocyanate of methyl responsible for the effect biocide at *Boscia senegalensis* (Seck, 1994).

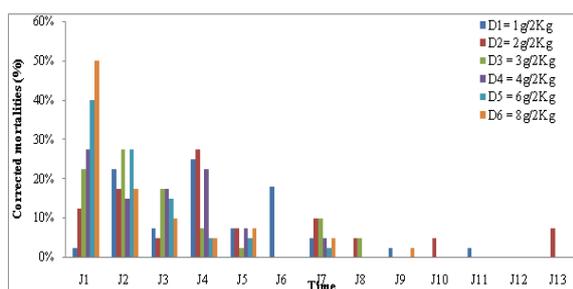


Fig. 3. Percentages of corrected mortalities for the adulticides tests.

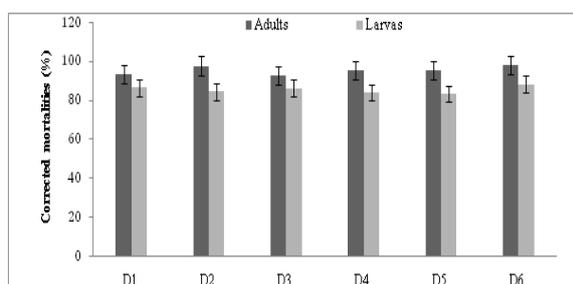


Fig. 4. Comparison between corrected mortalities for the larvae and adults.

These biological tests on *Dermestes* spp are made in a very simple way so that the transformers of halieutic products can assimilate it very fast and accept it. That is why we do not have to test the aqueous extracts neither organic because the transformed halieutic

products have to be to dry for the preservation but also to improve their organoleptic qualities thus not need for gaseous formulation nor liquid, so leaves powder of *Crataeva religiosa* (Forst) can replace the powder of insecticide which the transformers of halieutic products mix with the salt (Mbaye *et al.*, 2013).

Conclusion

The results of these biological tests allow to say that the leaves powder of *Crataeva religiosa* (Forst) is very effective against the larvae of diverse stage, males and females of *Dermestes* spp associated in smoked-dried fish with salt with reports leaves powder/smoked-dried fish is 1g/2Kg to 8g/2Kg. Besides this effect biocide, leaves powder of *C. religiosa* present a very remarkable repulsive effect especially to the larvae of diverse stage. So insects are at first to take away then to kill and it until least 12 days. With this method of integrated fight, there is neither cost, nor difficulty of application to transformers and the chemical fight can be substituted. The fight with pesticides of synthesis is not only very expensive but very dangerous for our health. So thus, these results allows to propose an alternative in the use of pesticides of synthesis in a general way.

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