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EFFECT OF ETHANOLIC PLANT EXTRACTS ON THREE STORAGE GRAIN PESTS OF ECONOMIC IMPORTANCE

FARKHANDA MANZOOR[1], GHAZALA NASIM[2*], SADIA SAIF[1], SAADIYA ASMA MALIK[1],

[1]*Department of Zoology, Lahore College for Women University, Lahore.*
[2]*Institute of Agricultural Sciences, University of the Punjab, Lahore-54590*

Abstract

Screening of plant extracts from wild species of plants for insecticidal properties could lead to the discovery of new agents for pest control. Keeping this in view, the ethanolic extracts of five plants leaves Bakain (*Melia azedarach*), Mint (*Mentha longifolia*), Habulas (*Myrtus communis*), Lemongrass (*Cymbopogon citratus*) and Datura (*Datura stramonium*) were tested against three stored grain pests viz., *Oryzaephilus surinamensis* L. (Saw-Toothed Grain Beetle), *Tribolium castaneum. Herbst* (Red Flour Beetle) and *Callosobruchus chinensis* L. (*Gram Dhora*). The results revealed that all of the tested materials had repellent and lethal effects against the tested pests as compared to untreated check. The extracts were mixed with grain 10mg/g of grains. Comparison of test plant extracts on *Oryzaephilus surinamensis* showed that Habulas extracts were the most effective causing 50.71% mortality. Datura showed maximum mortality of (21.43%) in *Tribolium castaneum* and when percentage mortality of different plants extracts on *Callosobruchus chinensis* was compared, it was seen that Habulas caused highest (63.94%) mortality. Present study also revealed that all the treatments significantly deterred / repelled the tested insects. Lemon grass showed maximum repellency of 39.75% against *Oryzaephilus surinamensis.* Habulas extract showed maximum repellency of 64.05% against *Tribolium castaneum* and Datura extract showed maximum (31.67%) repellency against *Callosobruchus chinensis.*

The results of thin layer chromatography (TLC) also showed that two components were detected in Lemon grass extract, four components in Mint extract and two components in Habulas extract. From Datura and Bakain, three components are detected respectively in the ethanol extractive.

Introduction

Callosobruchus chinensis L. (pulse beetle), *Tribolium castaneum* (Herbst) red flour beetle and *Oryzaephilus surinamensis* L. (Saw-Toothed grain beetle) are major and destructive stored grain pests of Pakistan. These are generally found in granaries, mills and warehouses. These pests not only cause economic loss, but are also responsible for 10% loss of world's cereal production (Wolpert, 1967). In Indo-Pak region, Farmers have inherited knowledge of mixing leaves, barks, seeds, roots and oils of some traditional plants with the stored grains for protection against insect pests during storage (Saxena *et al.*, 1988). Research reveals that extracts prepared from plants have a variety of properties including insecticidal activity, repellency to pests, antifeedant effects, insect growth regulation, toxicity to nematodes, mites and other agricultural pests, also antifungal, antiviral and antibacterial properties against pathogens (Prakash & Rao, 1997). Abubakr *et al*., (2000) also reported repellent and antifeedant properties of *Cyperus articulatus* against *T. castaneum.* Jilani *et al.*, (2003) tested neem seed oil from five localities of Pakistan against red flour beetle as growth inhibitor and found significant reduction in the progeny at 250 ppm or higher rate in all the samples. Khanam *et al.*, (2006) reported toxic and repellent properties of sugarcane bagasse-based lignin against some stored grain insect pests including *T. castaneum.* Kumar *et al.*, (2007) evaluated the long-term efficacy of the protein-enriched flour of pea (*Pisum sativum* L. var. Bonneville) in its toxicity, progeny reduction and organoleptic properties by combining it with wheat flour and testing the admixture against the red flour beetle, *Tribolium castaneum* Herbst. The toxicity and progeny-reducing effects of the wheat flour treated with protein-enriched pea flour were stable for a period of 5 months when stored at 28°C with 75% r.h.

Keeping in view the importance of plant extracts, the present study was carried out to test the efficacy of commonly used plant leaf extracts i.e., Bakain (*Melia azedarach*), Mint (*Mentha longifolia*), Habulas (*Myrtus communis*), Lemongrass (*Cymbopogon citratus*) and Datura (*Datura stramonium)* on three major insect pests of stored grains viz., *Oryzaephilus surinamensis*, *Tribolium castaneum* and *Callosobruchus chinensis*.

Materials and Methods

Experiments were conducted in the Entomology Research Laboratory, Department of Zoology, Lahore College for Women (LCW) University, Lahore.

Insects culture: Adults of *Tribolium castaneum*, *Callosobruchus chinensis* and *Oryzaephilus surinmensis* were drawn from laboratory mass cultures reared in glass jars at temperature 25±1°C without controlling conditions. The *Tribolium castaneum* and *Oryzaephilus surinmensis* used for experiment were about 2 months old (In very old age insect response to chemicals may not be normal) and reared on rice grain, while 2-3 days old *Callosobruchus chinensis* were used for experiment and fed on chickpea (channa).

Plant material: The plants leaves used for extracts were *Melia azedarach* (bakain), *Myrtus communis* (habulas), *Mentha longifolia* (mint), *Cymbopogon citrates* (lemon grass), *Datura stamonium* (datura or jimson weed). The leaves were collected from surroundings of LCW University and from Bagh-e-Jinnah, Lahore. The leaves were dried in the shade and ground to coarse powder with an electric blender.

*Corresponding e-mail: ghazalanasim@hotmail.com

Preparation of extract: For the extraction, Soxhlet Apparatus was used, about 20g powder of each plant leaves was extracted with 300ml ethyl alcohol. The extraction of each plant sample was done in about 12 hrs. After soxhlet extraction, the material was run on rotary evaporator. The extracts were concentrated on rotary evaporator by removing the excess solvent under vacuum. After evaporation of solvent with rotary evaporator the remaining extracted material was kept on water bath for removing remaining solvent from the extracts. The extracts were stored at 4°C prior to application.

Apparatus used for experiment: Small plastic jars (capacity 50 ml) were used for the experiment, there was one set of two jars joined by clear plastic pipe of 1cm diameter at an angle of 180 degree for each replication. One jar of each set was provided with 10 g of grains given the name 'A' while the other jar was kept empty and given the name **'**B**'**. In jar 'A**'**, the grains treated with extracts were placed, while the jar B remained empty. The jars used for experiment were disinfected with alcohol.

Bioassays: The extract was diluted with Ethyl alcohol solvent (20mg/ml). The extracts were topically applied at doses of 10mg/g of grains (0.1gm of extract in 5ml of solvent).The solvent was allowed to evaporate at room temperature from treated grains. 10 adults of each species were released in the treated grain jars A. The jars used for experiment were covered with pieces of cloth size of jars with rubber band. For control no extract was applied on grains, only the solvent of respective extract was applied on the grains and allowed to evaporate. There were three replicates for each treatment and control.

Repellency and toxicity observation: The treated jars either repelled the insects and forced them to move from treated jars A to an empty jar B through the plastic pipe or killed them indicating the insecticidal properties in both the situations. The ones found in plastic pipe were considered repelled individuals. The mortality and repellency data i.e. dead (in treated and untreated jars) and alive (in empty or untreated jars) were recorded for 14 days at an interval of 24 hours for each observation.

Statistical analysis: The data were arranged in tabulated form and graph formats. The mortality (%) was corrected by Abbots's formula:

$$Pr = \frac{Po - Pc}{100 - Pc} \times 100$$

where, Po = Observed mortality, Pc = Control mortality

The data was analysed using a one way (ANOVA) test, using graph pad Prism Version 4 for Windows, Graph Pad Software, San Diego California USA, *(www.graphpad.com)*. Results with $p<0.05$ were considered Statistically Significant.

Preliminary components detection by thin layer chromatography (TLC): All the fine extractives were applied to precoated silica gel plate to perform TLC (Thin Layer Chromatography) with following mixture of solvents [distilled water, acetonitrile and ethanol (ratio 1:1:8)]. The aim of this procedure is to identify the number of components present in each extract. Components were detected with ultraviolet light. After the spots were visualized and labeled, their retention factor (Rf VALUE) were calculated. The Rf values were calculated according to the following formula:

$$\text{Rf value} = \frac{\text{Distance travelled from the original point to the spot}}{\text{Distance travelled by solvent from the original point to front line}}$$

Results

The percent repellency of *Oryzaephilus surinamensis* (Sawtoothed Grain Beetle) against different plant extracts is shown in Table 1. It was obvious from the Table that the tested plant extracts exhibited significant repellency on the target species by forcing it to move from treated jar to untreated jar through plastic pipe. Mean repellency for Bakain was 30.23%, Mint 26.96%, Habulas 26.66%, Lemon grass 39.75%, Datura 33.09% and control 2.85%. After 14^{th} day of treatment, the maximum number (39.76±13.26) of repelled alive insects were recorded in Lemon grass. Analysis of variance revealed that all the plant extracts differed significantly (F., 8.686; d.f., 5; $p<0.0001$) from that of control. The percent Repellency of *Tribolium castaneum* (Red Flour Beetle) against different plant extracts is given in Table 2. *Tribolium castaneum* was significantly repelled from the applied plants extracts. Mean repellency for Bakain was 55.24 %, Mint 59.52%, Habulas 64.05%, Lemon grass 33.57%, Datura 48.33 and control 0.95%. Maximum number of repelled alive insects were recorded in Habulas leaves extract (64.05±13.47). Lemon grass extract was found comparatively least effective but was quite effective at the start of experiment i.e., 56.66% repellency on D1 and 20% on D14 of experiment.

The percent repellency of different plant extracts on *Collosobrucus chinensis* is given in Table 3.Total mean repellency for Bakain was 20.24%, Mint 29.69%, Habulas 25.71%, Lemon grass 27.00%, Datura 31.67% and control 3.33%. The maximum repellency was exhibited by Datura on D1 i.e., 70.00% and decreased after D4 (36.66%), after D7 the repellency was not observed. The total mean repellency was recorded as 31.67%. Bakain showed the least repellent effect as compared to other extracts. The maximum repelled individuals on D1 were 46.66%, the repellency was observed till 7^{th} day. The mean repellency was 20.42% against *Collosobrucus chinensis.* The plant extracts showed maximum repellency against *C. chinensis* in the following ascending order of preference Datura > mint > lemon grass> habulas > bakain. Data with respect to percent mortality of *Oryzaephilus surinamensis* observed on different days (D) in plastic pipes, treated and untreated empty jars are shown in Table 4. It is evident that the total mean% Mortality of *Oryzaephilus surinamensis* for treatments, Bakain was 25.61%, Mint

48.30%, Habulas 50.71%, Lemon grass 28.81% and Datura 36.98% and control 0.71%. Maximum mortality was recorded for Habulas (50.7), while minimum for Bakain (25.61). Data table also revealed that Bakain and Datura had no effect on first day of treatment but as number of days increased, the % mortality also increased. Analysis of variance also revealed that these plants extracts were found significantly effective against *O. surinamensis* compared to control. The means were further separated by LSD (Tukey's Multiple Comparison Test) at 5% level of significance. The data with respect to percent mortality of *Tribolium castaneum* observed on different days (D) in plastic pipes, treated and untreated empty jars is shown in Table 5. From the table it is evident that the total average percentage mortality of *Tribolium castaneum* against extract of Bakain was 16.66%, Mint 15.95%, Habulas 20.24%, Lemon grass 19.28% Datura 21.43% and control 0.00%. Maximum mortality was recorded for Datura (21.43+14.83), while minimum for Mint (15.95 +11.34). Table also reveals that the plants extracts have no effect on first day of treatment but as number of days increased the % mortality also slightly increased. Datura and Habulas showed mortality after 48 hrs of treatment. Analysis of variance revealed that these plants extracts were not found significantly different from each other but significantly different from control. The means were further separated by LSD (Tukey's Multiple Comparison Test) at 5 % level of significance (Table 5).

Table 1. Repelling effects of five different plants extracts on *Oryzaephilus surinamensis* L. (Sawtoothed Grain Beetle).

Time after treatment (days)	Alive repelled organisms (%)					
	Bakain	Mint	Habulas	Lemon grass	Datura	Control
1	53.33a	50.00a	46.66a	56.66a	60.00a	0.00b
2	63.33a	53.33a	56.66a	70.00b	56.66a	0.00c
3	46.66a	46.66a	50.00a	53.33a	56.66a	0.00b
4	36.66a	36.66a	40.00a	46.66a	50.00b	3.33c
5	36.66a	36.66a	36.67a	43.33a	46.66a	3.33b
6	33.33a	33.33a	30.00a	43.33a	43.33a	0.00b
7	26.66a	30.00a	26.66a	33.33a	33.33a	0.00b
8	23.33a	23.33a	10.00b	36.67c	30.00c	6.66d
9	30.00a	16.66b	10.00b	40.00c	26.66a	6.66d
10	20.00a	3.33b	6.66c	30.00d	20.00e	3.33f
11	16.66a	3.33b	3.33b	30.00c	13.33d	3.33e
12	13.33a	0.00b	3.33c	26.66d	13.33e	3.33c
13	13.33a	0.00b	0.00b	23.33c	6.67d	6.66d
14	10.00a	0.00b	0.00b	23.33c	6.67d	3.33e

(F.,8.686 ; d.f.,5 ; p<0.0001)

Table 2. Repelling effects of five different plants extracts on *Tribolium castaneum* (Red Flour Beetle).

Time after treatment (days)	Alive repelled organisms (%)					
	Bakain	Mint	Habulas	Lemon grass	Datura	Control
1	56.66a	76.66b	73.33b	56.66a	73.33b	0.00c
2	60.00a	86.66b	86.66b	46.66c	73.33d	0.00e
3	63.33a	73.33a	90.00b	46.66c	63.33a	3.33d
4	66.66a	63.33a	80.00b	36.66c	53.33d	0.00
5	73.33	60.00	63.33	40.00	50.00	0.00e
6	60.00a	63.33b	56.66c	40.00d	50.00e	0.00f
7	46.66a	63.33b	60.00b	36.66c	53.33d	0.00e
8	50.00a	60.00b	60.00b	33.33c	50.00a	0.00d
9	60.00a	60.00a	50.00b	26.66c	40.00d	0.00e
10	53.33a	53.33a	60.00a	23.33b	36.66c	3.33d
11	53.33a	53.33a	60.00b	23.33c	36.66d	0.00e
12	40.00a	43.33a	60.00b	20.00c	36.66a	0.00d
13	46.66a	43.33a	46.66a	20.00b	30.00c	6.66d
14	43.33a	33.33b	50.00c	20.00d	30.00b	0.00e

(F.,56.71 ; d.f.,5 ; p<0.0001)

Table 3. Repelling effects of five different plants extracts on *Callosobruchus chinensis* (Gram dhora).

Time after treatment (days)	Alive repelled organisms (%)					
	Bakain	**Mint**	**Habulas**	**Lemon grass**	**Datura**	**Control**
1	46.67a	66.66b	53.33c	50.00c	70.00b	0.00d
2	33.33a	56.66b	43.33c	53.33b	60.00b	0.00d
3	30.00a	43.33b	36.66a	43.33b	46.66b	0.00c
4	20.00a	43.33b	26.66a	33.33c	36.66c	6.67d
5	16.7a	33.33b	10.00a	26.67c	16.67a	3.333d
6	13.33a	30.00b	10.00a	23.33b	16.67a	6.67c
7	3.33a	23.33b	0.00a	20.00b	6.66a	10.00c
8	0.00a	13.33b	0.00a	13.33b	0.00a	6.67a
9	0.00a	10.00b	0.00a	6.67b	0.00a	6.67b
10	0.00a	6.66a	0.00a	0.00a	0.00a	3.333a
11	0.00a	0.00a	0.00a	0.00a	0.00a	3.33aa
12	0.00a	0.00a	0.00a	0.00a	0.00a	0.00a
13	0.00a	0.00a	0.00a	0.00a	0.00a	0.00a
14	0.00a	0.00a	0.00a	0.00a	0.00a	0.00a

(F.: 4.215 ; d.f: 5 ; p<0.0001)

Table 4. Effect of five different plants extracts on percentage mortality of *Oryzaephilus surinamensis L.* (Sawtoothed Grain Beetle).

Time after treatment (days)	Mortality (%)					
	Bakain	**Mint**	**Habulas**	**Lemon grass**	**Datura**	**Control**
1	0.00a	3.33a	13.33b	3.33a	0.00a	0.00a
2	3.33a	6.66a	16.66b	10.00b	0.00a	0.00a
3	6.667a	13.33b	23.33c	10.00b	13.33b	0.00d
4	13.33a	23.33b	33.33c	13.33a	16.66a	0.00d
5	23.33a	36.66b	36.66b	26.66a	26.66a	0.00c
6	23.33a	43.33b	40.00b	26.66a	26.66a	0.00c
7	26.67a	46.66b	53.33c	30.00a	33.33a	0.00d
8	33.33a	53.33b	60.00b	33.33a	43.33c	0.00d
9	31.03a	56.66b	60.00b	33.33a	46.66c	0.00d
10	32.14a	66.66b	66.67b	36.66a	53.33c	0.00d
11	35.71a	76.66b	70.00b	36.66c	60.00d	0.00e
12	37.03a	82.75b	70.00c	46.66d	62.06e	3.33f
13	40.74a	83.44b	83.33b	46.66a	67.85c	3.33d
14	51.85a	83.44b	83.33b	50.00a	67.85c	3.33d

(F.,11.72 ; d.f.,5 ; p<0.0001)

Table 5. Effect of five different plants extracts on percentage mortality of *Tribolium castaneum* (Red Flour Beetle).

Time after treatment (days)	Mortality (%)					
	Bakain	**Mint**	**Habulas**	**Lemon grass**	**Datura**	**Control**
1	0.00a	0.00a	0.00a	0.00a	0.00a	0.00a
2	0.00a	0.00a	6.66a	0.00a	6.67a	0.00a
3	3.33a	0.00a	6.67a	3.33a	6.67a	0.00a
4	6.67a	6.66a	13.33b	3.33a	6.67a	0.00a
5	13.33a	10.00a	13.33a	13.33a	13.33a	0.00b
6	13.33a	10.00a	20.00b	16.66a	16.66a	0.00c
7	16.67a	16.66a	20.00a	20.00a	20.00a	0.00b
8	20.00a	20.00a	20.00a	26.66a	20.00a	0.00b
9	23.33a	23.33a	23.33a	26.66a	23.33a	0.00b
10	23.33a	23.33a	26.66a	26.66a	26.66a	0.00b
11	26.67a	26.66a	30.00a	26.66a	26.66a	0.00b
12	26.67a	26.66a	30.00a	33.33a	43.33b	0.00c
13	26.67a	30.00a	36.66b	36.66b	43.33c	0.00d
14	33.33a	30.00a	36.66a	36.66a	46.66b	0.00c

(F.,6.827; d.f.,5 ; p<0.0001)

The data given in Table 6 indicates that the tested extracts had profound effect on mortality of *Callosobruchus chinensis*. The 100% mortality was obtained before termination of experiment. The total mean % mortality observed for *Callosobruchus chinensis* was Bakain 44.06%, Mint 48.76%, Habulas 63.94%, Lemon grass 50.04%, Datura 55.15% and control 18.33%. Habulas leave extract gave maximum mortality ranging from 13.33% on D1 to 100% on D8 of observation. Minimum mortality was recorded for Bakain (44.06%). It also revealed that Bakain and Mint had no initial effect but as number of days increased the % mortality also increased. Analysis of variance revealed that these plants extracts were found significantly effective against *Callosobruchus chinensis* as compared to control. The means were further separated by LSD (Tukey's Multiple Comparison Test) at 5% level of significance.

Table 6. Effect of five different plants extracts on percentage mortality of *Callosobruchus chinensis* (Gram dhora).

Time after treatment (days)	Mortality (%)					
	Bakain	Mint	Habulas	Lemon grass	Datura	Control
1	0.00a	0.00a	13.33b	3.33a	3.33a	0.00a
2	3.33a	3.33a	30.00b	13.33c	16.66c	0.00d
3	13.33a	17.24a	48.27b	20.68c	27.58c	0.00d
4	23.41a	20.68a	62.06b	31.03a	48.27c	3.33d
5	39.27a	41.37a	75.85b	34.48a	58.62c	6.667d
6	61.54a	42.85b	85.69c	46.42b	64.28a	13.33d
7	63.99a	55.55b	96.28c	55.55b	81.47d	16.67e
8	91.66a	61.53b	100.00c	69.22b	96.14c	20.00d
9	100.00a	73.07b	0.00c	80.76d	100.00a	20.00e
10	0.00a	78.25b	0.00a	95.65c	0.00a	23.33d
11	0.00a	91.3b	0.00a	100.00b	0.00a	33.33c
12	0.00a	100.00b	0.00a	0.00a	0.00a	33.33c
13	0.00a	0.00a	0.00a	0.00a	0.00a	40.00b
14	0.00a	0.00a	0.00a	0.00a	0.00a	46.67b

(F., 2.997; d.f., 5; $p<0.018$). Means within a row followed by the same letter are not significantly different (Tukey's Multiple Comparison Test, $p<0.05$)

Detection of components: Every extractive was dissolved in methanol and applied to 1B2-F silica gel plate. The results of thin layer chromatography (TLC) showed that two components are identified from Habulas, two components are detected from Lemon grass extractives while Mint extractive contains four components. From Datura and Bakain, three components from each were detected respectively in the ethanol extractive. Rf values for each components were calculated and given in Table 7.

Table 7. Components detected in plants extracts.

Plants extracts	No. of components	Rf Values of components detected
Bakain	1-A	0.96
	2-B	0.92
	3-C	0.78
Mint	1-A	0.97
	2-B	0.88
	3-C	0.78
	4-C	0.72
Habulas	1-A	0.94
	2-B	0.73
Lemon Grass	1-A	0.932
	2-B	0.734
Datura	1-A	0.88
	2-B	0.92
	3-C	0.95

Discussion

Researchers in different parts of world have been using plants for controlling pests including stored grain pests. Previous studies revealed that different plant compounds were used in controlling pest and they proved effective and eco-friendly. Many researchers investigated the compounds in plants that have a variety of properties including insecticidal activity, repellence to pests, antifeedant effects, insect growth regulation, toxicity to nematodes, mites and other agricultural pests, also antifungal, antiviral and antibacterial properties against pathogens. Lawati *et al.*, (2002) reported the extracts of eight plants local to Oman, viz., Qarat *(Acacia nilotica),* Mustafal *(Annona squamosa),* Shereesh *(Azadirachta indica),* Luban (*Boswellia sacra),* Kheshkhash *(Crotalaria juncea),* Zebrot (*Jatropha dhofarica),* Yas, (*Myrtus communis)* and Suwwad (*Suaeda aegyptiaca)* in water and solvent (methanol or ethanol) were repellent and toxic causing mortality to *Callosobruchus chinensis.* They reported that high mortality was achieved from *A. nilotica, C. juncea, M. communis* and *S. aegyptiaca* in methanol and *B. sacra, J. dhofarica, S. aegyptiaca* and commercial neem in ethanol. Extracts of *M. communis* in methanol were highly repellent to the beetles compared to other extracts. Khan & Marwat (2004) evaluated the leaves, bark and seeds of bakain (*Melia azadarach*) and Ak (*Calotropis procera*) powder against lesser grain borer (*R. dominica*). They tested that insect (*R. dominica*) was repelled from bakain's bark powder with 98.25% repellency followed by powder of Ak (*Calotropis procera*). Kundu *et al*., (2007) evaluated the

toxicity, repellent and residual effects of Bishkatali plant extracts in chloroform and ethyl alcohol solvents against the red flour beetle. It was reported that Bishkatali plant extracts in both chloroform and ethyl alcohol had remarkable residual effects on *T. castaneum* by reducing the production of F1 progeny and/or by increasing the population mortality

Moreira *et al.*, (2007) screened plants with insecticidal activity, in order to isolate, identify and assess the bioactivity of insecticide compounds present in plants, basil (*Ocimum selloi Benth.*), rue (*Ruta graveolens* L.), lion's ear (*Leonotis nepetifolia* (L.) R.Br.), jimson weed (*Datura stramonium* L.), baleeira herb (*Cordia verbenacea* L.), mint (*Mentha piperita* L.), wild balsam apple (*Mormodica charantia* L.), and billy goat weed or mentrasto (*Ageratum conyzoides* L.) against Coleoptera pests of stored products: *Oryzaephilus surinamensis* L. (Silvanidae), *Rhyzopertha dominica* F.

In the present work repellent property was well depicted by all the treatments soon after their application. The results showed that maximum repellency against *Oryzaephilus surinmensis*, was found in extract of lemongrass after 48 hrs., i.e., 70.00% (Table 1) The results indicated that the least effective repellency was observed in Habulas plant extract only for 11th day of treatment. It was also seen that the tested insect *Tribolium castaneum* strongly repelled from all the extracts till the termination of experiment. Habulas showed maximum repellency i.e., 90.00% after 72 hrs of treatment but slightly decreased after passage of time and mean percent repellency was 64.05% (Table 2). Lemon grass proved least effective repellent as compared to other extracts with an average of 33.57% repellency. To test the repellent effect against *Callosobruchus chinensis*, the repellency was observed only for some days after treatment. The maximum repellency was found in the extract of Datura and was observed till 7th day, the mean recorded repellency was 31.67% and Bakain gave minimum repellency with mean repellency of 20.24% (Table 3).

The results also showed that the tested plants extracts proved to be effective in mortality of *Oryzaephilus surinmensis*. In case of lethal effects, the habulas gave maximum mortality (83.33%) and mean percent mortality was 50.71% (Table 4). In the present study the data indicated that Mint extract also exhibited the significant toxicity against *O. surinmensis*, the recorded mean % mortality was 48.30, while Bakain showed minimum toxicity 25.61% (Table 4).

The results showed that the *Tribolium castaneum* (red flour beetle) was a tolerant species. The tested plant extracts showed slight toxicity against *T. castaneum*. The most effective mortality was observed in extract of Datura followed by Habulas. The average mortality was 21.43% and 20.24% found in Datura and Habulas respectively. Mint extracts was least effective to cause mortality of *T. castaneum* with average of 15.95% (Table 5.

The results revealed that the *Callosobruchus chinensis* (gram dhora) was most susceptible to the tested plants extracts. *Callosobruchus chinensis* (gram dhora) is the destructive pest with short life span. Again, Habulas plant extracts resulted in maximum mortality i.e., 63.94% of *C. chinensis*. Datura yielded 55.51%, lemon grass with 50.04%, mint with 48.76% and lastly minimum mortality was obtained in the case of bakain with averaged of 44.06% (Table 6). The findings of present study are somewhat in conformity with those reported by the Saljoqi *et al.,* (2006) that the effect of ethanolic extracts of bakain drupes (*Melia azdarach*), habulas leaves (*Myrtus communis*), mint leaves (*Mentha longifolia*), bakain leaves, harmal shoots and seeds (*Pegnum harmala*) and lemon grass roots (*Cymbopogon citratus*) had repellent and lethal effects against rice weevil, *Sitophilus oryzae* L. The difference in this regard with the present study may be due to difference in pest species, dose of the treatment, methodology of research, varietal and commodity variations, laboratory and environmental differences. The plants used in this study proved effective repellent and toxicant for the targeted post harvest grain pests. These plants have a range of chemicals which can be isolated and used for pest control. The test plants being medicinal would yield environmentally sound chemicals having no harmful effects on the non target organisms.

From the present study, it is concluded that the ethanolic extracts of plants materials i.e., Bakain leaves (*Melia azdarach*), Mint leaves (*Mentha longifolia*), Habulas leaves (*Myrtus communis*), Lemongrass leaves (*Cymbopogon citratus*) and Datura leaves (*Datura stramonium)* possess toxic principles with significant insecticidal effects and could be a potential grain protectant against *Oryzaephilus surinamensis* (Saw-Toothed Grain Beetle), *Tribolium castaneum* Herbst (Red Flour Beetle) and *Callosobruchus chinensis* L. (Gram Dhora).

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