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Efficiency of some safe methods in controlling *Stegobium paniceum* on *Capsicum minimum* plant

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Abstract
Stegobium paniceum (L.) is a dangerous pest of stored products. It's the most common storage insect pest found in botanicals. The drugstore beetle infests various dried herbs and medicinal plants. Alternatives for control insect pests in grain handling and packing units are basic to keep up the characteristics of the product and decrease environmental impact. microwave heating efficacy was investigated as fumigation with phosphine or by applying protective organophosphate and parathyroid insecticides alternatives for controlling S. *paniceum.* Results indicated DNA damage in the whole body cells of both sexes of *S. paniceum* by microwave radiation exposure to LT_{50}. Also; results indicated the effect of microwave doses that caused 100 % mortality on chemical characteristics of hot pepper.

Keywords: *Stegobium paniceum*, microwave, comet, *Capsicum minimum*

1. Introduction
Botanicals are attacked in storage by many harmful insects. The most common pest found in botanicals is *Stegobium paniceum* (L.) (Abdelghany *et al*. 2010) [2]. This pest infests many dried foods such as flour, dried bread, biscuits, chocolate, grain and granular feed for pets as well as spices, drugs and pharmacological products (Hagstrum and Subramanyam, 2009) [19].
Capsicum minimum (hot pepper) fruit is one of the most important medicinal plants in Egypt because of its economic, nutritional and medicinal importance. Hot pepper is an excellent source for natural colors and antioxidant compounds such as ascorbic acid, carotenoids and phenolic compounds (Howard *et al*., 2000) [22]. The intake of these compounds in food is very important health-protecting factor as it prevent widespread of human diseases (Marin *et al*., 2004) [22].
Currently, most companies use chemical control methods, as methyl bromide or phosphine, for controlling insect infestation while storage. However, phosphine-resistant insect populations began to appear (Zettler and Keever 1994) [49]. So it became very important to use alternatives to insecticides such as Microwave heating as controlling agent, or using biological control agents (parasites, predators, and pathogens). (Zhanggui *et al*., 2003) [50].
Using heating of Microwave is based on the transformation of alternating electromagnetic field energy into thermal energy by the effect of polar molecules of a material. The main idea of pest control using microwaves for disinfestations is based on heating the insects to lethal temperature as result of high moisture content of insect body while leaving the product affected or a little warm (Vadivambal *et.al*. 2006).
The present examination detect the impact of microwave on DNA damage of *Stegobium paniceum*, using the single cell gel electrophoresis (SCGE) measure, normally called the comet assay (Tice *et al.*, 2000; Afify and Negm, 2018) [46, 14]. DNA damage considered as a biomarker of environmental mutagens. Genomic instability and cancer formation may be occurred as a result of defects in DNA damage response (Jehane *et al.*, 2017) [25]. During electrophoresis, the DNA fragments move out of single cells framing a tail toward the anode giving the harmed cells the comet shape. The remaining nucleus formed the head of the comet, whereas the tail is framed by the fragments. The damage intensity is closely related to the extension of the tail (Fairbairn *et al*., 1995) [17].
Consequently the present work intended to assess the genotoxic impact of using the alternative method (microwave) for the control of drug beetle and determined their effect on the chemical composition of *Capsicum minimum* (hot pepper) fruit.

2. Materials and methods
2.1 Test insects
Stegobium paniceum beetles used in ozone and microwave experiments were obtained from stored grain and product pests Department, Plant Protection Research Institute, whereas they were reared at 28 ±2 ^{0}C and 65 ±5 R.H. on red pepper for at least two months.

2.2 Samples and sampling
Hot peppers *(Capsicum minimum* L) fruits were obtained from Medicinal and Aromatic Plants Research Dept. The chemical analysis was done at the Central Laboratory of Horticulture Research Institute, Agricultural Research Center. Hot pepper was grinded in home grinder to be powder.

2.3 Exposure to Microwave radiation
2.3.1 Microwave
Microwave system (Model No: NN-C988W) made in Japan (220V-50HZ-900W-2450MHZ) was used.

2.3.2 Microwave treatment
10 g of hot pepper with and without insects were put in Petri dishes. Samples were exposed to microwave power level of low power (100watt), medium power (300watt) and high power (500watt) and different periods (10, 15, 20,30,40,50 and 60 seconds).

2.3.3 Determination of toxicity of emerged progeny adults
The experiment was conducted with hot pepper samples. Batches of 15 pairs (0-2 days of *S. paniceum* adults) were put in Petri dishes containing 10gm hot pepper. After 24 hrs from treatment, the percentages of live and dead insects were counted. The samples with adult survivors were transferred to small glass jar; the jar was sealed with the muslin and placed under laboratory conditions. Number of adult's emergence was counted after 5-6weeks. Similar previous method was carried out without exposure to microwave for control treatment.

2.4 Sample Preparation for Alkaline Single Cell Gel (SCG) Assay
For each sample, the whole body cells of male and female adults of *S.paniceum* treated with LT_{50} were taken from five insects minced in 1 ml cold phosphate buffer solution (Ca^{+2} free).

2.4.1 Investigation of Damage of DNA by Alkaline SCG Assay
Alkaline SCG Assay used for investigating single strand breaks of DNA (incomplete excision repair sites and frank strand breaks), cross-linking and alkali-labile sites (Singh *et al*. 1988) [43]. The comet assay analyse DNA damage level in the whole body cells of *S.paniceum* to evaluate the genotoxic impacts of microwave radiation and ozone. Three replicates for each sample were prepared. The slides were analysed comets using barrier filter (605nm) and an excitation filter (524 nm) of Axio fluorescence microscope (Carl Zeiss, Germany).

2.4.2 Estimation of DNA damage
DNA damage was showed with ethidium bromide stain of DNA using a fluorescent microscope. The percentage of migrated DNA (DNA tail %) and the length of migrated DNA were measured (Tail length) (TL), and the product of both, called the tail moment (TM) using a Komet analysis software 4.0 developed by Kinetic Imaging, Ltd (Liverpool, U.K.) attached to a CCD camera. Each sample included 50-100 chosen cells (minimum of 25 cells/slide and 3 slides/treatment were estimated).

2.5 Studying effect of microwave heating on chemical characterization of hot pepper
2.5.0 Sample Preparation
For each sample, 50g of the hot pepper exposed to different tested microwave power and 4800ppm for 1 hour of ozone gas (O3) that caused 100% mortality for *S. paniceum*

2.5.1 Determination of Capsaicin
Measurement of capsaicin in samples of hot pepper fruit with HPLC technique, Merfort *et al.*, (1997) [31].

2.5.2 Alkaloids
The absorbance of the complex in chloroform was measured at 470 nm against blank prepared as above but without atropine (Shamsa, *et al.*, 2008) [40] by using JENWAY spectrophotometer model s6756-3P. Total alkaloids were determined as atropine from a calibration curve.

2.5.3 Total flavonoids
Total flavonoids were determined by using method of Woisky and Salation (1998) [48] using aluminum chloride; the absorbance was measured at 420 nm.

2.5.4 Total phenols compounds
Extraction of phenolic compounds was conducted according to the method described by Daniel and George (1972) [14].

2.5.5 Antioxidants
The antioxidant activity of the extracts was studied through the evaluation of the free radical scaving effect on the2, 2diphenyle 1-1picrylhydrazl (DPPH). The determination was assessed by using the procedure reported by Okonogi *et al.*, (2007) [34].

2.5.6 Ascorbic acid
Ascorbic acid was determined according to A.O.A.C., (2005) [1].

2.5.7 Acidity
Total acidity % was measured as mentioned in A.O.A.C (1990) [1]

2.5.8 Determination of total free amino acids (gm. /100gm dry weight)
Total free amino acids were determined according to Jayaraman (1985) [24].

2.5.9 Determination of total anthocyanin
It was determined by using mg/100gm dry weight according to Hsia *et al.*, (1965) [23].

2.5.10 Pigments content
(Chlorophyll a, b and carotenoids, mg./100g. d.w) were determined in capsicum fruit according to Saric *et al*., (1967) [39].

2.6 Data analysis
Probit analysis was used to estimate the LT50 and LT99 values (Abbott, 1925) [1]. Data were presented as mean ± SD and were statistically analysis of variance (ANOVA), ($P \leq 0.05$) using SPSS software (version 15; SPSS, Chicago, IL).

3. Results
3.1 Microwave treatment results
3.1.1 The Effect of different power of microwave on *S.paniceum*
The results presented in Table (1) indicate that adult mortality was caused at different exposure powers (low, medium &high) increase by increasing of exposure time (10, 20, 30, 40, 50&60 seconds), respectively. The correct mortality rate of adult at different periods was (2.5, 5, 31.67, 43.33, 80.83 &100) (6.67, 35.83, 61.67, 92.5, 100&100) and (19.17, 47.5, 70.83, 100, 100&100), respectively for the three different powers of exposure. There were significant different between low, medium and high power. Meanwhile emerged adults were significantly decreased with increasing of microwave exposure times at the three exposure powers. The most effective exposure periods were (60, 50&40sec),

respectively which evidenced by 100% mortality for adult.
Data given in Table (1) indicate that reduction % in adult emergence was gradually increased with the increase of time at different powers. The reduction rate of emerged adult after 4-5 weeks of treatment to different exposure time (10, 20, 30, 40, 50&60 seconds) were (27.77,61.11, 62.96,66.66,72.22&100)(51.85,64.81,66.67,88.89,100&100) (98.14,100,100,100,100&100) at different tested powers. There was significant difference in the mean number of emerged adult between different exposure times. The reduction % was significantly increased with increase of exposure time. Adult emergence was completely inhibited at 60sec exposure time at low power 50&60sec exposure time at medium power and at 20, 30, 40, 50&60sec exposure time at high power.
The $LT_{50}$and LT_{90}values of microwave effect against egg and adult of *S. paniceum* are shown in Table (2). The data indicated that the egg was more tolerant than adult when exposed to various microwave power. The data showed that when eggs were exposed to various microwave power, the lethal time values were significantly decreased by increasing microwave power. LT_{50} values at low and medium power were 39.47and 25.82 seconds for eggs and 38.05 and 23.06 seconds for adult. The results showed that mortality rate had direct relation with microwave power and exposure time, by increasing the microwave power to high; the mortality reached 100% for two stages at different exposure time.

3.1.2 Comet assay; Single-cell gel electrophoresis

Results indicated damage of DNA in the cells of the boy of adults (male and female) of *S. paniceum* using microwave power. Microwave exposure in adults (male and female) of *S. paniceum* caused a critical increment in DNA damage at the various powers of microwave (low, medium and high intensity of microwave) for LT_{50} s intervals as demonstrated by a high migration of DNA pieces on the agarose gel (Fig. 1A-H).
The effect of intensity response was noticed on DNA damage, showing that as increasing microwave dose as increasing DNA damage occurs brought about a significant variety in % of tailed cells compared to intact cells at 50 s after microwave exposure. The comet assay results showed a significance increment in the mean of different comet assay data (% T, TL and TM) at high power of microwave for LT_{50} (Table 3). The results also indicated that there is no significance increment in means of different DNA damage measurements (TL, %T and TM) between microwaves treated male and female adults (Table 3).

3.1.3 Effect of microwave treatments on chemical properties of hot pepper

Different microwave powers treatment which caused 100% mortality for *S. paniceum* on hot pepper was shown in Table (4).
Capsaicin extracts from *Capsicum minimum* data were presented in Table (4) which obtained as a result of using different microwave powers. The capsaicin content values were (0.332, 0.303&0.266mg/100g),respectively for the different tested powers of microwave treatments against 0.207 mg/100g for control. The best results were at the powers of lowfor60 seconds and medium for 50 seconds but the capsicum content decreased with high microwave power.
Data showed that Alkaloids significant differences were found between different treatments of microwave powers (0.702, 0.661&0.611 mg/100g) for low, medium& high, respectively and control (0.335mg/100g).
Total flavonoids contents of hot pepper extract were insignificantly increased with low microwave powers. While increased significantly at medium and high microwave power (0.609&0.636mg/100g) respectively and was 0.582mg/100 g for control.
While for total phenols content there were insignificant increase between different treatments of microwave powers and control, there were increase from 0.144 mg/ g (control) to (0.167, 0.203, &0.208 mg/ g) at low, medium& high microwave powers, respectively in *Capsicum minimum*.
Thermal microwave caused more significant changes of antioxidants activity than untreated samples. It significantly decreased from 60% for control samples to 52.1, 49.5 & 42.3%, at low, medium& high microwave powers, respectively for different tested powers.
Data demonstrated that ascorbic acid (AsA) of *Capsicum minimum* content decreased by increasing the microwave energy (8.6, 8.2&8mg/100g), respectively against 9.2mg/100g for control. The statistical analysis revealed that there was significant influence of the drying conditions on the degradation of AsA.
The acidity value after microwave treatments was found (0.042, 0.042& 0.043) against 0.041 for control. There was no significant differences between the untreated and MW treated groups.
Data show significant increase in total free amino acid content for the medium and high microwave power.
Data indicated that the anthocyanin yields significantly increased with extraction microwave power. It increased from 0.132mg/100g for control to (0.136, 0.144&0.147mg/100g) for low, medium and high microwave power.
Results presented in table (4) showed that there was significant decrease in chlorophyll A content with different microwave power except for low microwave power. That chlorophyll A content the highest value was recorded by control (0.26 mg/g) compared to treatments microwave It recorded (0.24, 0.19, 0.17mg/g), respectively for different treatments microwave. Also there is significant decrease in chlorophyll B content for different microwave power.
The color values were also compared after microwave treatments as shown in Table (4). The total carotene in hot pepper significantly decreased due to treatment with medium and high power of microwave (25.32&24.66mg/g), respectively but in low power there is insignificantly decrease against control group (28.68mg/g).

4. Discussion

4.1 The Effect of different power of microwave on *S.paniceum*

According to the obtained results, different powers of microwave and ozone had proven to be successful against the eggs and *S. paniceum* adult stage. At different microwave power (low, medium &high) the effectiveness on adult mortality reached 100% at unlike exposure periods (60, 50&40sec), respectively. Also, percentages of emergence were much decreased with increasing of microwave exposure times at different powers. It achieved to zero percent at 60, 50 and 20 sec respectively, for low, medium and high microwave power. The results are to some extent consistent with that reported by Abdullah Ahmady *et al.*, (2016), who studied the microwave radiations effect on

Tribolium confusum and *Callosobruchus maculatus* at 400watts and found that complete mortality of *T. confusum* adults was obtained at 25 sec, whereas 98.8% mortality percentage was obtained at the same exposure time for *C. maculatus* adults. Also, Azizoglu *et al.*, (2011) [10] stated that complete mortality of eggs of (24 hr) *Ephestia kuehniella* took place by the result of the power of 150 W and the maximum exposure time (300 sec). Very similar result was obtained at the highest dose (600 W) and the shortest exposure time (10sec). Shayesteh and Barthakur (1996) [41] investigated mortality of the stored-product pests such as *Tribolium confisum* and *Plodia interpunctella* that exposed irregularly or continuously to microwave radiation (2450 MHz). Irregular exposure at 1 or 5 min was more effective to kill insects of both pests than continuous one. Microwave could cause physical injuries and reduced rates of reproduction in insects exposed for its waves (Nelson 1996) [33].

Östling and Johanson (1984) [35] noticed that radiation dose leads to DNA fragment migration. So DNA changes induced by radiation might be utilized as the reason for irradiation method investigation in insects and nourishment (Pandır and Güven, 2014) [36].

DNA comet assay considered as a legitimate assessment for recognizing the historical backdrop of pests which irradiated (FAO, 2009) [18] like the cigarette beetle, *Lasioderma serricorne* when the treatment time became 50 seconds (Kameya *et al*., 2012) [26]. In the ongoing examination, comet test examination was utilized as the most touchy, quick, simple and and cheap methods to test microwave radiation genotoxicity of adults (male and female) of *S. paniceum*.

The results showed that as expanding radiation portion as increasing DNA damage happens and these results agreed with the results of (Marín-Huachaca *et al.,* 2005) [29] study, they found that expanding radiation portion more DNA fragmentation happens and these fragments relocate further during the electrophoresis. Therefore, there is extension increment of DNA started to move from the core into the anode in irradiated cells forming comet shape, whereas control cells will show up about round or with just slight tails. Also, it was recommended that the % of tailed cells in comet scoring compared to intact cells could be calculated to verify the genotoxicity (Jehan *et al*., 2017) [25]. After the treatment with microwave, a huge increment in mean tail length, % tail DNA and tail moment at high power of microwave radiation for 50 seconds in comparison to control. These results agreed with the results of (Pandır and Güven, 2014) [36] study in which *E. kuehniella* larvae treated with different microwave strengths and the significant increment was in mean comet tail length at just 600 W for 50 s in contrast with control and other treatment groups were noticed.

Modern methods like microwave facilitate efficient extraction due to fast removal of cuticular superficial waxes from plant material and the cell membrane is regularly enhanced when the temperature increases, and the best extraction for products can be obtained Arianne *et al.* (2008) [9] & Alberto *et al*., (2013) [5]. Modern data indicated that capsaicin content increases when the temperature of extraction increases and that is in harmony with Haiyan *et al.,* (2013) [20] that investigated the capsaicin extraction from chili pepper powder by microwave technique and stated that with the increase of temperature extraction range from 60˚C to 150˚C, the capsaicin extraction increased.

Alkaloids contents was significantly increased and this in agreement with Christine *et al.* (2014) [12] who evaluated the nutritional, photochemical and microbiological quality of three pepper varieties.

Secondary plant metabolites, that called Flavonoids present in all growing parts of the plants. They have been reported to be the most amount of plant pigment together with chlorophyll and carotenoids (Stalikas, 2007) [45]. Shotorbani *et al*. (2012) [42] observed the antioxidants activities of Gijlar pepper and red pepper. the total flavonoids contents of the two sweet peppers was significantly increased after thermal treatment. these data is in agreement with Piovesan *et al.* (2017) [37] also who used microwave to extract of bioactive compounds of blue berry and found that the flavonoids showed no significant difference in terms of the extraction temperature.

These findings are in harmony with that of Horvathova *et al.,* (2007) who evaluated the result of thermal treatment on antioxidants activity of some spices. They founded that thermal treatment significant increase the phenoilc compounds (26%) in case of black pepper and caused significant decrease for the phenoilc compounds at allspice (9%) and oregano (5%). In contrast with those obtained by Dorantes-Alvarez *et.al*. (2011) [16] that considered the effectiveness of microwave on blanching peppers and reached to that the treatment reduced the amount of phenolic compounds from 9.6 to 7.6 mg/ g peppers (dry weight basis). Horvathova *et.al.* (2007) studied the result of thermal treatment on antioxidants activity of a number of spices. They founded that thermal treatment significant decrease of the content of oxidative reaction substances. According the results found, we can state that thermal treatment caused significant decrease of antiradical activity, reducing power, content of oxidative substances due to the formation of some early Maillard reaction products, arisen during the short heat treatment between reducing saccharides and amino acids or proteins produced strong reducing materials such as amino reluctant Anese *et.al*.(1999) [6].

Ascorbic acid (ASA) is a vitamin that soluble in water, and the (ASA) content is broadly used as a sign for the alteration of food quality during vegetable and fruit processing (Chuah *et al*. 2008) [13]. These values are equivalent to those previously reported by (Man *et al.* 2014) [28]. For the green bell pepper the activation energies are i.e.,0.043,0.062&0.123mg/100gm at different temperatures (40, 50&60 º C).

Similar to our results Bozkir *et.al*. (2018) who studied the effectives of microwave hotness on the yield and quality of red bell pepper puree and found that the acidity value after treatment 3.16-3.43% and there is no significant effect between MWH group and control.

These radicals can damage or modify important components of plant cells and have been reported to affect differentially the morphology, anatomy, biochemistry and physiology of plants depending on the irradiation level (Wi *et al*., 2005).

6. Tables and Figures

Table 1: Effect of Microwave radiation on mortality & adult emergence of *Stegobium paniceum* at different exposure powers

Exposure time (sec.)	Correct Mortality % of adults ±SD			REDucation % of Adults±SD		
	Low power	Medium power	High power	Low power	Medium power	High power
10	2.5±1.59^{e}	6.67±1.36^{e}	19.17±0.83^{d}	27.77±0.48^{d}	51.85±1.63^{d}	98.14±0.25^{a}
20	5±0.96^{e}	35.83±1.59^{e}	47.5±2.85^{c}	61.11±0.25^{c}	64.81±0.96^{c}	100±0.0^{a}
30	31.67±2.15^{d}	61.67±5.18^{c}	70.83±2.85^{b}	62.96±0.41^{bc}	66.67±0.29^{c}	100±0.0^{a}
40	43.33±2.36^{c}	92.5±1.59^{b}	100±0.0^{a}	66.66±0.65^{bc}	88.89±0.58^{b}	100±0.0^{a}
50	80.83±2.85^{b}	100±0.0^{a}	100±0.0^{a}	72.22±0.48^{b}	100±0.0^{a}	100±0.0^{a}
60	100±0.0^{a}	100±0.0^{a}	100±0.0^{a}	100±0.0^{a}	100±0.0^{a}	100±0.0^{a}

Means within a column followed by the same lower case letter are not significantly different (P<0.05)

Table 2: Lethal time values and parameters of mortality regression line for the various stages of *Stegobium paniceum* exposed to different microwave power.

Microwave Power(w)	Stage	LT_{50}(sec.)	LT_{99}(sec.)	Confidence limits(sec.)				Slope± SE	R
				LT_{50}		LT_{99}			
				Lower	upper	lower	upper		
Low	Egg	39.47	71.38	24.18	49.55	65.71	92.69	1.70±0.58	0.69
	adult	38.05	59.68	31.99	45.26	49.60	72.62	5.90±0.16	0.95
Medium	Egg	25.82	62.66	20.82	27.88	52.55	64.48	2.09±0.47	0.78
	adult	23.06	47.75	18.89	28.15	45.50	62.70	5.06±0.19	0.94
High	Egg	*	*	*	*	*	*	*	*
	adult	20.28	34.75	15.20	27.07	31.03	53.07	2.97±0.33	0.99

R = Correlation coefficient. S.E = Standard error of regression line.

Table 3: DNA damaging activity of microwave power in male and female adults of *S. paniceum*. Microwave power (W) Mean tail length (TL) (µm), Mean tail DNA (% T) and Mean tail moment (TM).

Treatment	TL(µm)		%T		TM	
	Male	Female	Male	Female	Male	Female
Control	2.3±0.31^{a}	2.3±0.04^{a}	2.97±0.16^{a}	5.4±2.5^{a}	0.07±0.016^{a}	0.12±0.05^{a}
Low power	4.3±0.59^{b}	3.8±0.2^{b}	6.9±0.46^{b}	6.9±0.5^{a}	0.32±0.065^{ab}	0.27±0.03^{a}
Medium power	4.4±0.26^{b}	3.6±0.12^{ab}	7.7±1.8^{b}	6.9±0.7^{a}	0.50±0.1^{ab}	0.3±0.04^{a}
High power	5.5±0.9^{b}	4.4±0.76^{b}	9.5±0.85^{b}	5.9±1.44^{b}	0.6±0.22^{b}	0.3±0.1^{a}

Means within a column followed by the same lower case letter are not significantly different (P<0.05)

Table 4: The effect of microwave power on chemical properties hot pepper

Power	Capsaicin(mg/100g)	Alkaloids (mg/100g)	Flavonds (mg/100g)	Total phenols (mg/g)	Antioxidant (%)	Ascorbic acid (AsA)	Acidity (%)	Total free amino acids (g/100g)	Total anthocyanin (mg/100g)	ChlorophyllA (mg/g)	ChlorophyllB (mg/g)	Caroten (mg/g)
Control	0.207±0.0^{a}	0.335±0.02^{a}	0.582±0.00^{a}	0.144±0.00^{a}	60±0.01^{a}	9.2±0.00^{a}	0.041±0.00^{a}	0.070±0.00^{a}	0.132±0.001^{a}	0.26±0.00^{a}	0.44±0.00^{a}	28.68±0.0^{a}
Low60	0.332±0.0^{b}	0.702±0.01^{b}	0.592±0.00^{a}	0.167±0.00^{b}	52.1±0.82^{c}	8.6±0.00^{b}	0.042±0.00^{a}	0.073±0.0^{a}	0.136±0.00^{b}	0.24±0.00^{a}	0.27±0.00^{b}	27.04±0.0^{a}
Medium50	0.303±0.0^{b}	0.661±0.01^{c}	0.609±0.00^{b}	0.202±0.00^{c}	49.5±0.04^{b}	8.2±0.00^{c}	0.042±0.00^{a}	0.121±0.00^{b}	0.144±0.003^{c}	0.19±0.00^{b}	0.17±0.00^{c}	25.32±0.0^{b}
High40	0.266±0.0^{c}	0.611±0.01^{d}	0.636±0.02^{c}	0.208±0.00^{c}	42.3±0.08^{d}	8±0.00^{d}	0.043±0.00^{a}	0.133±0.00^{c}	0.147±0.001^{d}	0.17±0.00^{bc}	0.15±0.0^{d}	24.66±0.0^{c}

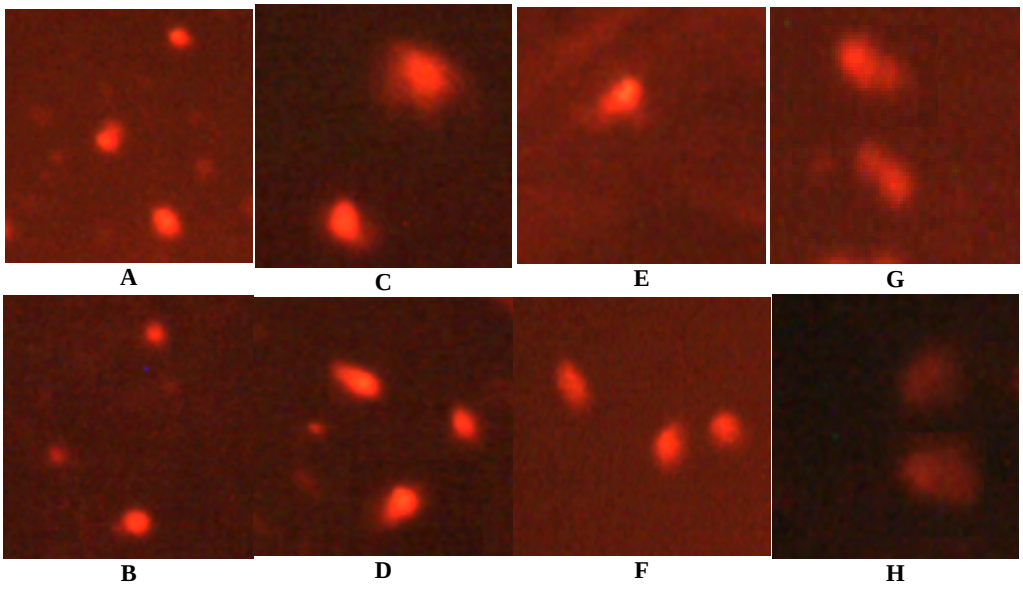

Fig 1: Effect of microwave power (A, B-Control male and female respectively, C,D- low power male and female respectively, E,F- Medium power male and female respectively, G,H- High power male and female respectively) on DNA damage of whole body cells of male and female adults of *S. paniceum.*

Similar to Man *et.al.* (2014) [28] that studied the result of dissimilar drying methods on chemical and physical characters of blanched green bell pepper and demonstrated that drying conditions by microwave affected the loss of total chlorophyll. Obtained data agree with Samia (2013) who evaluated the effect of microwave treatment for 180 and 120 seconds on spearmint leaves and stated that chlorophyll- A and B content had the lowest value in spearmint leaves.

Degradation of carotene can be obtained as a result of Drying of chilli pepper Dermiray *et.al.* (2013). The study postulated that microwave different powers caused decrease in carotene content and this agree with Maurya *et.al.* (2018) [30] who investigated the outcome of different drying ways on chemical, physical and nutritional characters of five pepper cultivars.

5. Conclusion

The microwave low power is suitable for controlling adult *S. paniceum* and considered one of the alternatives to pesticides. The microwave low power (60 sec.) had proven to be not effect on the chemical properties of hot pepper.

7. References

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