Effect garlic (Allium sativum) powder as an antifungal for wheat crops

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- **Date of received 27 /9/2022 and accepted 12/12/2022.**

Abstract

Preserving the crops seeds is very important procedure to the farmers and breeders. Because it's reducing the contamination of these seeds with the aflatoxin during the post and pre harvest the crops. The Current study was carried out in October 2019, in the crop production department, Agricultural research center in Sulaymaniyah province. Fifteen Kg of local wheat (Slemani) was provided from the crop science department. Five levels of garlic powder was used (0, 2, 5, 10, 15)% to find suitable concentration during the storage seed. The samples were taken for in three times (1 day, 6 months, and 18 months) to test the seed contamination with toxins and calculate the seed germination. Our result show there is significant effect ($p<0.05$) of adding garlic powder with 15 concentrations on the T2 toxin. In conclusion its possible to use the garlic powder with 15% for reducing the effect of toxin in storage wheat seeds.

Key words: Garlic, mycotoxin, wheat, and crop**.**

تأثير أستخدام مسحوق الثوم (Allium sativum) كمضاد للفطريات لمحصول الحنطة

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- **تاريخ استلام البحث 2022/9/27 وتاريخ قبوله 2022/12/12 .**

الخلاصة

الحفاظ على بذور المحاصيل الحقلية هو إجراء مهم للغاية للمزارعين ومربين الحيوانات. لأنه يقلل من تلوث هذه البذور بالأفلاتوكسين خلال فترة ما بعد الحصاد وقبل الحصاد. أجريت الدراسة الحالية في تشرين الأول 2019 ، في قسم إنتاج المحاصيل ، مركز البحوث الزراعية بمحافظة السليمانية. تم توفير خمسة عشر كيلو جرام قمح محلي (السليماني) من قسم علوم المحاصيل. تم استخدام خمسة مستويات من مسحوق الثوم (0 ، 2 ، 5 ، 10 ، 15)٪ لإيجاد تركيز مناسب أثناء تخزين البذور لفترة طويلة. تم أخذ العينات ثلاث مرات (يوم واحد ، 6 شهور ، 18 شهر) لاختبار تلوث البذور بالسموم وحساب نسب إنبات البذور. أظهرت نتائج وجود تأثير معنوي ($p < 0.05$) لإضافة مسحوق الثوم بتركيز 15 على سموم الـ(T2). الاستنتاج يمكن استخدام مسحوق الثوم بنسبة 15٪ لتقليل تأثير السموم في تخزين بذور القمح.

الكلمات المفتاحية: الثوم، السموم الفطرية، الحنطة، المحاصيل

Introduction:

The process of preserving the seeds of field crops is a complex process of interest to farmers and breeders. The annual loss that affects crops across the world is estimated at least (125 million tons) every year (Fisher, et al., 2012). Wild & Hall, (2000) reported that crops would be contaminated by aflatoxin during post-harvest than pre-harvest conditions. Because of the great loss caused by the products of fungi and molds to those seeds (Bibani, et al., 2019), when the influencing factors of humidity and temperature are available (Fareed, et al., 2014; Nemati, et al., 2014; Ali, et al., 2017)

many attempts were done to solve this problem such as using essential oil (Abd El-Aziz, et al., 2015), (Brauer, et al., 2019; Davies, et al., 2021).

Mycotoxins are highly poisonous secondary metabolites produced by wide range of fungi principally molds. It's presence in poultry feeds result from the raw material used in their production (Khan et al., 2011). The important toxins are Aflatoxins, Zearalenone, Ochratoxin, Fumonisins, and T-2 that are affected on human and animals (Sokolovic, et al., 2008) by causing chronic diseases, reproductive confusion, immune extinction (Fujioka, et al., 2003; Dhanasekaran, et al., 2009) and decreased egg production and meat (Hussain, et al., 2010).

Several methods were used to control the Toxins inside the crops and animal feeds (Hussein, et al., 2017; Jolly, et al., 2018). These methods sometimes deal with chemical materials or plants, which contain active substances (Thanaboripat, 2011). Also Perello, et al. (2013 a) was used the garlic extracts to improve seed germination and seeding health in wheat. Lately the researches tend to use plant materials that contain active substances that stop or kill these causes, because it's safe to use and environmentally friendly. Our hypothesis is: using of some natural material or plant can reduce the growing of fungal in some crops that storage for use in animal feed and may be effect on percentage of mycotoxin in animal products.

Materials and methods:

1. Collecting samples:

The Current study was carried out in October 2019, in the crop production department, Agricultural research center in Sulaymaniyah province. Fifteen Kg of local wheat (Slemani) was provided from the crop science department. It was divided on five treatments, each treatment contains three replications, which kept in ventilated plastic containers. The samples were treated with garlic powder that was provided from local variety. The treatment one (T1) was control without any garlic powder additive, treatment two (T2) contain 2 g powder garlic per 100 g wheat, treatment three (T3) contain 5 g garlic powder per 100 g wheat, treatment four (T4) contain 10 g garlic powder per 100 g wheat, and treatment five (T5) contain 15 g garlic powder per 100 g wheat.

2. Toxic analysis procedure:

The samples were analysis by using (Biotek reader800Ts) for the three toxins kits (Neogen) (Aflatoxin, OCHRA toxin, and T2 toxin) in three periods 0 day, 6 months, and 18 months.

3. Data analysis:

General linear model (GLM) within SPSS v.18 program was used to analysis the differences between the treatments, Duncan (1955) multiple range test was used to test the differences among the means.

Results:

The concentrations of the Aflatoxin in the five treatments for three storage periods are shown in table 1. The result shown there are no significant differences between the treatments in the storage period 1, and 2. But the treatment 4, and 5 (0.23, 0.00) µg/Kg respectively were significantly ($P<0.001$) less then treatment 1, 2, and 3 in for the storage period 3.

Table (1): Mean, standard deviation of the Aflatoxin (µg/Kg) of the wheat seed for the five treatments in three storage periods

Treatments (Garlic concentration)	Periods			P-Value	Sig
	0 day	6 months	18 months		
0 %	0.31 ± 0.15 **b**	1.43 ± 0.40 **a**	1.60 ± 0.52 **a**	9.934	0.012
2 %	0.31 ± 0.15 **b**	1.43 ± 0.25 **a**	1.40 ± 0.57 **a**	39.100	0.000
5 %	0.31 ± 0.15 **b**	0.87 ± 0.15 **a**	0.53 ± 0.15 **a**	14.730	0.005
10 %	0.32 ± 0.02 **b**	0.83 ± 0.20 **a**	0.23 ± 0.25 **b**	8.798	0.016
15 %	0.31 ± 0.01 **b**	0.53 ± 0.25 **a**	0.00 ± 0.00 **c**	14.230	0.005

Means with different superscript in the same raw differs significantly ($P<0.05$)

The concentrations of the Ochratoxin in the five treatments for three storage periods are shown in table 2. No significant differences between the treatments within the storage periods. But there were significant differences between the three storage periods in the treatment 1, and 2 ($P<0.05$). The Ochratoxin was increase in treatment one from (0.00) µg/Kg in storage period 1 to (0.47) µg/Kg in storage period. As well as treatment 2, which increase from (0.00) µg/Kg in storage period 1 to (0.16) µg/Kg in storage.

Table (2): Mean, standard deviation of the Ochratoxin (µg/Kg) of the wheat seed for the five treatments in three storage periods

Treatments (Garlic concentration)	Periods			P-Value	Sig
	0 day	6 months	18 months		
0 %	0.00 ± 0.00 **b**	0.17 ± 0.15 **b**	0.47 ± 0.11 **a**	13.727	0.006
2 %	0.00 ± 0.00 **b**	0.00 ± 0.00 **b**	0.16 ± 0.11 **a**	6.250	0.034
5 %	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	-	-
10 %	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	-	-
15 %	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	-	-

Means with different superscript in the same raw differs significantly (P<0.05)

The concentrations of the T2 toxin in the five treatments for three storage periods are shown in table 3. No significant differences were found (p<0.05) between the five treatments in storage period 1. But the concentration of T2 toxin was decreased from storage period one to three for the treatment 5 (0.31, 0.06) µg/Kg respectively.

Table (3): Mean, standard deviation of the T2 toxin (µg/Kg) of the wheat seed for the five treatments in three storage periods

Treatments (Garlic concentration)	Periods			P-Value	Sig
	0 day	6 months	18 months		
0 %	0.31 ± 0.01 **b**	3.67 ± 0.35 **a**	4.23 ± 0.35 **a**	164.006	0.000
2 %	0.31 ± 0.23 **b**	1.80 ± 0.20 **a**	2.00 ± 0.10 **a**	151.237	0.000
5 %	0.31 ± 0.06 **b**	1.97 ± 0.15 **a**	1.83 ± 0.11 **a**	208.614	0.000
10 %	0.32 ± 0.27 **b**	1.37 ± 0.15 **b**	0.43 ± 0.38 **a**	17.741	0.003
15 %	0.31 ± 0.01 **b**	1.23 ± 0.15 **c**	0.06 ± 0.11 **a**	92.830	0.000

Means with different superscript in the same raw differs significantly (P<0.05)

Mean, standard deviation, maximum and minimum of the germination percentage of the wheat seed for the five treatments in three storage periods was shown in the table 4. As it displays the

germination percentage was significantly affected between the treatments in each storage period ($P<0.05$).

Table (4): Mean, standard deviation, maximum and minimum of the germination percentage of the wheat seed for the five treatments in three storage periods

Period	0 day			6 months			18 months		
Treatments (Garlic concentration)	Mean ±SD	Max	Min	Mean ±SD	Max	Min	Mean ±SD	Max	Min
0 %	81.33±6.11	88	76	92.00±6.93	100	88	82.67±6.43	90	78
2 %	94.67±6.11	100	88	92.00±6.93	100	88	84.00±7.21	92	78
5 %	97.33±2.31	100	96	96.00±6.93	100	88	84.67±6.11	90	78
10 %	92.00±4.00	96	88	90.67±8.33	100	84	80.67±9.02	90	72
15 %	92.00±8.00	100	84	94.67±4.62	100	92	81.33±5.03	86	76
P-Value	3.467			0.307			0.183		
Sig.	0.050			0.867			0.942		

Discussion:

Several studies were demonstrated to study the effect of garlic as antifungal for wheat seeds. Adding the garlic powder in 15% concentration was reducing the T2 toxin (Table3). And the germination was not significantly affected by the five concentrations during the experiment duration. Perello et al., (2013 a) was reported that the wheat seeds treated with garlic extract was affected germination of spores and induce inhibition of the fungal growth. Also Perello et al., (2013 b) confirmed that the effect of garlic extract could be depending on the wheat cultivar. Moreover Masum et al., (2009) Find that treated sorghum seed with garlic significantly affected on the fungal spores and increase the germination of sorghum. Al-Mayah, (2005) considered by using garlic powder in the chicken feed as additive to protect as well as relieve the chicken from fungal infection.

Conclusion:

Our result suggested that garlic powder in 15% concentration was affected the growth of fungal especially with T2 toxin. And we suggest to increasing the required concentrations in the future studies to find out the effects on the other toxins.

Acknowledgments:

The authors acknowledge the assistance provided by the Razga Company in Sulaymaniyah province for the execution of this investigation.

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