



Prevention of aflatoxins contamination in quinoa (*Chenopodium quinoa* Willd.) seeds by some organic acids

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ARTICLE INFO	ABSTRACT
<p>Research Article Received on September 15, 2023 Revised on September 24, 2023 Accepted on October 28, 2023 Published on November 06, 2023</p> <p>Article Authors Laxmi Gautam, Shyam Govind Singh</p> <p>Corresponding Author Email laxmigautam24@gmail.com</p>	<p>ABSTRACT Quinoa (<i>Chenopodium quinoa</i> Willd.) is one of the most important crops grown for its edible seeds. Quinoa is also used in foods to replace grains like wheat for people who need to avoid gluten. The seed samples of quinoa were found to be naturally contaminated with aflatoxin B₁, B₂ and G₁. Some organic acids lauric acid, propionic acid, benzoic acid and sorbic acid have been investigated to inhibit mould incidence and aflatoxin in quinoa seeds. The maximum inhibition of mould incidence and aflatoxin contamination was observed at 0.4 % concentration of propionic acid and the minimum inhibition of mould contamination was observed with lauric acid. The benzoic acid inhibited aflatoxin B₂ and G₁ at the concentration of 0.5 but aflatoxin B₁ could be inhibited only up to extent 97.72% at 0.5 concentrations and the mould was also completely suppressed at the concentration. More or less similar findings have been observed in other acids.</p>
PUBLICATION INFO	KEYWORDS
<p>International Journal of Agricultural Invention (IJAI) RNI: UPENG/2016/70091 ISSN: 2456-1797 (P) Vol.: 8, Issue: 2, Pages: 279-282 Journal Homepage URL http://agriinventionjournal.com/ DOI: 10.46492/IJAI/2023.8.2.21</p>	<p>KEYWORDS Aflatoxin, Quinoa Seeds, Organic Acids</p>

HOW TO CITE THIS ARTICLE

Gautam, L., Singh, S. G. (2023) Prevention of aflatoxins contamination in quinoa (*Chenopodium quinoa* Willd.) seeds by some organic acids, *International Journal of Agricultural Invention*, 8(2): 273-278. DOI: 10.46492/IJAI/2023.8.2.21

Quinoa (*Chenopodium quinoa* Willd.) seeds are the main edible part and gluten free grains, contain high quality of protein, essential amino acids minerals and proteins. Quinoa has been promoted as an alternative crop due to its characteristics nutrients and marketed as a superfood for its nutrition qualities (Mirinda, 2010). The seeds are mostly contaminated with fungi during storage condition. During storage most common species are *Aspergillus flavus*, *Fusarium*, *Alternaria*, *Penicillium* are commonly associated with its seeds.

Due to presence of fungal contamination cause decrease nutrition value, germination ability and weight. Sinha (1993) also produce highly toxic secondary metabolites. Aflatoxins are highly toxic metabolites produces by *Aspergillus flavus* and *A. parasiticus* (Payne, 1998). The aflatoxins are produces by certain strains of *Aspergillus flavus* and *A. parasiticus* spears. The commonly occurring aflatoxins are B₁, G₁, B₂ and G₂. (Hartley *et al.*, 1963). Among these toxins aflatoxin B₁ is the highly toxic mycotoxin and liver is the main part of that is effected by this toxic.

It is known to exert carcinogenic effects in many species of animal and human being (Purchase, 1974). In view, the concern about health hazards problem of aflatoxin present investigation was carried out to find the effect of some organic acids on species count and aflatoxin production by *Aspergillus flavus* on quinoa seeds.

Materials and Methods

In the present investigation, effect of some organic acids *viz.*, benzoic acid, propionic acid, sorbic acid, lauric acid and sodium benzoate was examined on the incidence of moulds and aflatoxins in quinoa seeds. For this purpose, seed samples quinoa were taken and treated with above mentioned organic acids and their derivatives at the rate of 0.1, 0.2, 0.3, 0.4 and 0.5% by weight. After adding the chemical, the seeds were shaken 15 minutes on an electric shaker in order to give uniform coating around the seeds, the treated seeds were then transferred to polythene bags, which were sealed and stored at room temperature for 6 months. After the storage period both treated and untreated seeds were observed the association of aflatoxin contamination.

The fungi associated with seeds were isolated by seed plating method following rules of ISTA (1966) using PDA medium for each sample 100 seeds were taken and plated at the rate of 10 seeds per plate on PDA medium and incubated at $28\pm 2^{\circ}\text{C}$ for 6 days in alternating cycle of 12 hours fluorescent light and 12 hours darkness. After incubation period the seeds were observed under stereo binocular microscope for the presence of fungi and finally fungi population were determined. Further, TLC (Thin layer chromatography) analyzed seed samples for presence of aflatoxin following method by (Jones, 1972).

Results and Discussion

The different concentration of all the organic acids decreased the mould count and aflatoxin contamination to varying extent. However at the concentration of 0.4% of propionic acid completely inhibited aflatoxin B₁, B₂ and G₁ production and mould count concentration of 0.5 fungal incidence and aflatoxin (B₁ and B₂) production are totally inhibited but aflatoxin G₁ has been totally inhibited even at 0.1 concentration of this acid.

However, aflatoxin B₂ and G₁ count not be inhibited at 0.1 concentration, only aflatoxin B₁ concern at 0.3% of propionic acid was inhibited up to 90.15% even at 0.4 concentration. Benzoic acid was found to be the next effective acid in preventing aflatoxin B₂ and G₁ at 0.4 concentrations, but aflatoxin B₁ could inhibited up to extent of 97.72% at 0.5 concentrations.

Further, in case of lauric acid, sodium benzoate and sorbic acid more or less similar finding have been observed. Sorbic acid and lauric acid both have totally preventing aflatoxin B₂ and G₁ at 0.4 concentrations, whereas G₁ was totally inhibited B₂ and G₁ at 0.4 concentrations. While aflatoxin B₁ could not be inhibited completely at 0.5 concentration of this organic acid. Thus, it can be concluded that propionic acid is the best organic acid for elimination for mould and aflatoxin contamination 0.4% concentration, other organic acid like benzoic acid, sorbic acid, lauric acid to the extent of 97.72%, 96.15% and 95.70% respectively at 0.5 concentrations.

Dixit (1988) have reported inhibitory effect of organic acid on aflatoxin production by *Aspergillus flavus*. The maximum inhibition was initiated by propionic acid. Moon (2018) reported the inhibitory effect of organic acid on aflatoxin formation, which was inhibition growth of *Aspergillus flavus*. Jubeen (2020) observed the propionic acid at 0.9 concentrations significantly reduced aflatoxin. Therefore, it is clearly that some organic acids show inhibitory effect for mould incidence and aflatoxin during the storage of seeds.

Acknowledgments

Authors are thankful to the Principal, Agra College, Agra (Dr. Anurag Shukla) and the head of the Botany Department (Dr. P. B. Jha) for providing facilities and to Dr. Surendra Singh for his critical suggestions.

Table 1. Efficacy of some organic acids against aflatoxin contamination in quinoa seeds

S. N.	Organic Acid	Concentration of Organic Acid (%)	No. of Moulds	Amount of Aflatoxin (in ppb)				% Inhibition in Aflatoxin Production			
				B ₁	B ₂	G ₁	G ₂	B ₁	B ₂	G ₁	G ₂
1.	Control	-	25	2490	650	550	-	-	-	-	-
2.	Propionic Acid	0.1	21	850	120	-	-	64.01	83.15	100.00	-
		0.2	15	650	-	-	-	72.70	100	100.00	-
		0.3	7	180	-	-	-	90.15	100	100.00	-
		0.4	02	-	-	-	-	100	100	100.00	-
		0.5	-	-	-	-	-	100	100	100.00	-
3.	Benzoic Acid	0.1	22	900	120	-	-	63.05	71.82	100.00	-
		0.2	17	750	80	-	-	64.70	83.14	100.00	-
		0.3	12	720	50	-	-	68.19	92.13	100.00	-
		0.4	07	300	-	-	-	85.31	100.00	100.00	-
		0.5	-	100	-	-	-	97.72	100.00	100.00	-
4.	Sorbic Acid	0.1	23	900	250	150	-	55.02	51.00	63.00	-
		0.2	18	830	110	80	-	65.20	79.94	85.20	-
		0.3	14	750	80	-	-	66.25	87.54	100.00	-
		0.4	04	400	-	-	-	81.24	100.00	100.00	-
		0.5	02	130	-	-	-	96.15	100.00	100.00	-
5.	Lauric Acid	0.1	23	1110	350	250	-	51.25	46.60	50.00	-
		0.2	15	850	200	120	-	63.20	53.00	76.00	-
		0.3	11	760	80	-	-	68.10	86.19	100.00	-
		0.4	02	400	-	-	-	81.46	100.00	100.00	-
		0.5	-	130	-	-	-	95.70	100.00	100.00	-
6.	Sodic Benzoate	0.1	22	1100	420	310	-	52.13	41.00	43.00	-
		0.2	15	850	200	160	-	59.12	51.00	72.00	-
		0.3	11	800	90	50	-	68.00	83.17	82.00	-
		0.4	03	600	-	-	-	75.65	100.00	100.00	-
		0.5	01	120	-	-	-	94.95	100.00	100.00	-

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