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Research Article

Effect of UV Radiation on Detoxifying Aflatoxin of Stored Rice

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1. Abstract

One of the most important consuming cereals in the world is rice and half of the world population was eating it daily. Contamination of cereal especially rice that has humid content with mycotoxin such as aflatoxin has the potential to very dangerous. Dominant species that product aflatoxin is aspergillus flavous and a parasitic us and certainly present in grains. Reducing the toxin levels is able crucially important.

Aflatoxin producing species was proceeding with special media culture and morphological study. Aflatoxin level was quantified by HPLC and Immunoaffinity column.

UV irradiation in 5,10,15,20,30 min on 20,40,60 cm and after 3,5,7,10,15,20,30 days after incubation on 25 °c showed most effective treatment is 30 min and 20 cm distance decrease 72 percent Aflatoxin level while 30 min and 40 cm cause to 39 percent decreasing [1]. According to Aflatoxin contamination in rice mostly between 5 to 15 ug/kg. Optimized treatment with the minimal negative effect is 20 min and 40 cm capable to control aflatoxin level to lower than maximum tolerated level. Our study shows that UV irradiation for 30 min has no negative effect on the flavor and taste of rice and no significant effect on amylose content as an important agent of rice length accretion. The design and production of an instrument able to irradiate UV during sorting and packaging for aflatoxin control is proffer meanwhile quality preservation 'safety of food product is assuring. Study of UV irradiation effect on aflatoxin of other food products that susceptible to mycotoxin contamination also the purpose.

2. Introduction

Rice is the most important food in Asian countries and especially in Iran. Rice as food is usually raped by fungi called Aspergillus flavous a parasitic us [2]. Aflatoxin B1 is a type of fungal toxins known as mycotoxins and causes of acute and chronic toxicity in humans as acute liver harm, cirrhosis, and cancer. The low dose of aflatoxin in a long period of consumption of contaminated food gets to chronic symptoms of liver disease.

As long as aflatoxin B1 is known as a liver toxin and carcinogen factor; scientists research effective procedures for detoxifying toxins. Recently a lot of different types of chemical [3], physical, and biological methods are developed to demolition aflatoxins in food and feedstuff.

As an efficient method to destroy the aflatoxin UV radiation is relevant and suitable for industrial food processing.

Researching mod systems for photo degradation of aflatoxin in foods are extended by Liu et al (2011).

According to researches UV radiation potentially could decrease the aflatoxin level, whereas setting up a practical operation that uses in the food industry. In this study, a photo degradation of aflatoxin in the rice matrix was evaluated and other physical-chemical characteristics like brightness flavor taste and amylose were measured for qualitative assessment [4-6].

Radiation time, the distance of UV source; after incubation of rice treated with Aspergillus flavous, and A. Parasitic us was studied. Some researches show UV irradiation is low risk or safe method for degradation of aflatoxins. The optimized condition of UV irradiation is the potential that could be used on a large scale for industrial food processing. According to the studies, UV irradiation could have a risk for food and nutrient.

One of the most important is the produce of peroxide of fatty acid that is not considered in rice because rice has very low level of fatty acid and lipids. Physicochemical properties like amylose percent and humidity of rice maybe change after irradiation but it's not remarkable [7]. Often reported UV consequence on lipids and this effect on rice isn't important as low lipid content. The other aspect of irradiation risk is free radical formation; changing in biochemical characteristics of rice and production of high energy compounds like H_2o_2 and accelerate oxidational reactions.

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In this research, we show how UV irradiation could effect on quality and flavor ability of rice while can decrease microbial loud and aflatoxin contamination.

3. Material and Methods

The samples were prepared from the most consuming rice in the official market. All chemical and reagent prepared on analytical grade and from Merck Germany Company.

3.1. UV treatment

Contaminated rice with aflatoxigenic aspergillus such as Aspergillus flavous , A parasitic us after incubation during 5, 10,20, and 30 days' time period was irradiated with 254nm wavelength UV light. A laboratory room designed for irradiation treatment with appropriate time and UV intensity that adjusts by UV source distance and shaking system for the shake of samples to ensure that the rice seeds are optimum expose of UV and avoids overlapping [8].

This type of irradiation could be achieving the best results for aflatoxin removal. UV irradiation system with 3 UV lamps is adjustable in different distances of samples. The irradiation treatment was carried in 5, 10, 20, 30 minutes, and the distance of UV source was aligned on 20, 40, 60 cm. the temperature was raised after irradiation, air condition system must be present to control the temperature. Irradiation time, the distance of UV lamp is variable and the UV wavelength was fixed in 254 nm as high energy and optimum efficiency and more influence. UV lamps with 254nm Philips company and 8.6 mw/cm2 intensity were used in 20, 40, 60 cm different intervals [9-12].

The thickness of rice seed was considered for samples and shaking the plates prevents from overlaying. Shaking was operating with an IKA shaker in fixed 60 rpm for all time of UV treatment. The untreated samples were used as control.

The brightness of rice was determined by DRK 1000 instrument with standard material for white and black (0-100). Rice samples place in a standard 8cm diameter plate and related brightness after irradiation was measured.

3.2. Amylose Level

Rice samples after grounding by mill grounder IKA type in 2 min in the high rotation is prepared for amylose test.

0.1g of milled rice samples were scaled and then 1ml acetic acid, 9ml NaOH was added. Placed in boiling water for 15 min, after reached the ambient temperature diluted to 100 ml with distilled water [13]. 0.5 ml of this solution mixed with 5 ml distilled water, 0.1 ml acetic acid, and 0.2 ml of 10% iodine solution.

The absorbance was measured at 388 nm wavelength. The calibration curve of amylose with working standard in 4 levels was prepared (5, 15, 20, 30 percent amylose content).

3.3. Aflatoxin HPLC Detection

Aflatoxin is dissolved in Methanol: H_2O (8:2) mix with a Warring blender at a high rate of 10000 rpm for 3 minutes. After blending, filter the extracting solvent and then dilute with phosphate buffer saline. Pass the diluted extract solution through the immune affinity column with a monoclonal antibody against aflatoxins. Aflatoxins were trapped in the column and elute and collect in the vial with HPLC grade methanol as eluant. This solvent was filtered with 0.45-micron filters if it was necessary and ready to inject it to HPLC.

Working standards in 0.4, 1.2, 2, 2.8, 3.6, 5.6, 7.2 ugr/lit concentrations is prepared and a blank sample is spiked in 5 ppb level with aflatoxin primary standard stock solution (1000ugr/lit) for recovery calculation. HPLC system is equipped with a fluorescent detector and Kobra cell post-column derivatization for brominating and increase the fluorescence absorbance of aflatoxin B1, G1 [14]. Aflatoxin mobile phase is made of Methanol: Acetonitrile: H_2O (3:2:6) with HNo_3 (4mol) and 0.12gr KBr for 1000 ml mobile phase.

3.4. Taste and Organoleptic Test

Taste, flavor, and quality after cooking were evaluated before and after UV irradiation.

3 samples got in different conditions of UV irradiation and blank sample without any treatment.

4. Result and Discussion

Organoleptic properties of rice after irradiation have not more sensible change instead of a blank sample. The brightness of rice after and before irradiation was shown in (Table 1)

Changes in color and brightness of rice after UV irradiation are not significant ($P< 0.05$).

Rice also doesn't have natural pigment like anthocyanin, is not affected by UV. Oxidation and produce free radicals in rice samples after radiation were not remarkable.

Table 1: Brightness of rice samples after UV irradiation

UV time (min)	Brightness repeat 1	Brightness repeat 2	Brightness repeat 3	Mean	Standard Deviation	Difference
10	80.1	80.02	80.05	80.05	0.032998	Not significant
20	79.9	80.1	79.9	79.96	0.094281	Not significant
30	79.8	79.9	79.85	79.85	0.040825	Not significant
Blank	80.6	80.7	80.9	80.73	0.124722	-----

4.1. Amylose Percent as a Quality Index

After UV irradiation, the Amylose content of samples was measured for this purpose in blank and treated rice. Rice samples in tree levels of amylose such as high, medium, and low were select, quantified, and categorized.

Any significant change has not been seen in samples and any correlation between UV irradiation time and amylose level has not been achieved.

4.2. Aflatoxin Detoxification

UV irradiation can decrease aflatoxin content in rice samples results show 10, 20, 30 min UV irradiation in rice samples. The best treatment with high performance is 30 min and 20 cm distance to the UV source. According to the safety of UV treatment and that irradiation has not any remarkable risk and did not change acceptability flavor, taste, and amylose content; UV irradiation could be used as a safe, cost-effective, and efficient method to detoxifying aflatoxin in grains and cereals at industrial cases. Irradiation in30 min and 20 cm distance (most intensity) can control aflatoxin production and decrease the aflatoxin level in comparison with the blank test that has any treatment. In graph 2 blank samples and different treatments have been shown.

In the 5 and 7 days after incubation of samples in 25c that inoculated with the spore of Aspergillus flavous and A. parasitic us; the growth was seen but aflatoxin produced few little much.

Thus irradiation after 5, 7 days is not more effective because of very low-level aflatoxin as a substrate for UV degradation. In the blank sample after 5, 7 days incubation Aspergillus flavous A parasitic us recently begin aflatoxin biosynthesis and the aflatoxin level is very low. After that biosynthesis is uprising and aflatoxin level is high and more than the maximum tolerated level in food [15-17].

Aflatoxin reduce percent in comparison with the blank sample was showed in (Table 2) that demonstrates the most effective treatment for UV degradation is 30 min and 20 min could eliminate aflatoxin 45 percent. This type of irradiation can improve and commercialized for developing the safety of rice and other grains on industrial scales.

Low risk of irradiation in grains instead of oilseeds and their oils like peanut oil and very few and no significant changes in flavor, moisture, and brightness of rice can be developing this method to reduce the microbial loud and aflatoxin contamination.

Table 2: Amylose level of rice samples after UV irradiation

UV time (min)	Amylose Low level	Amylose Medium level	Amylose High level
10	17	21.7	24.7
20	17.5	22	24.9
30	16.9	20.8	25.1
BlankWithout UV irradiation	17	21.5	25
Mean	17.1	21.5	24.92
Difference	Not significant	Not significant	Not significant

References

1. Carvajal-Campos A, Manizan AL, Tadrist S, Akaki DK, Koffi-Nevry R, Moore GG et al. Aspergillus korhogoensis, a Novel Aflatoxin Producing Species from the Côte d'Ivoire. Toxins. 2017; 9: 353.
2. Choudhary R, Bandla S. Ultraviolet pasteurization for food industry. International Journal of Food Science and Nutrition Engineering. 2012; 2: 12-5.
3. CEN(Commission European Norm). Aflatoxin Protocol Sampling and testing of feed material. GMP International.sep edition. 2016; 1-10.
4. Amornsin A. Properties of waxy rice starch and rice grain: process development for an instant waxy rice product (Doctoral dissertation, University of Georgia). 2003.
5. Atalla MM, Hassanein NM, El-Beih AA, Youssef YA. Effect of fluorescent and UV light on mycotoxin production under different relative humidities in wheat grains. International Journal of Agriculture and Biology. 2004; 6: 1006-12.
6. Campbell BC, Molyneux RJ, Schatzki TF. Current research on reducing pre-and post-harvest aflatoxin contamination of US almond, pistachio, and walnut. Journal of Toxicology: Toxin Reviews. 2003; 22: 225-66.
7. Eslami M, Mashak Z, Heshmati A, Shokrzadeh M, MozaffariNejad AS. Determination of aflatoxin B1 levels in Iranian rice by ELISA method. Toxin Reviews. 2015; 34: 125-8.
8. Fouzia Begum N. Samajpati. Mycotoxin production on rice, pulses and oilseeds. Springer Naturwissenschaften. 2000; 87: 275-7.
9. Gawade SP. Photodynamic studies on aflatoxin B1 using UV radiation in the presence of methylene blue. Indian Journal of Pharmaceutical Education and Research. 2010; 44; 142-7.
10. Hayashi N, Yagyu Y, Yonesu A, Shiratani M. Sterilization characteristics of the surfaces of agricultural products using active oxygen species generated by atmospheric plasma and UV light. Japanese Journal of Applied Physics. 2014; 53: 05FR03.
11. Hedayati MT, Omran SM, Soleymani A, Armaki MT. Aflatoxins in food products in Iran: A review of the literature. Jundishapur journal of microbiology. 2016; 9: e33235.
12. Reddy KRN, Reddy CS, Muralidharan K. Potential of botanicals and biocontrol agents on growth and aflatoxin production by Aspergillus flavus infecting rice grains Food Control. 2009; 20: 173-8.
13. Lai X, Liu R, Ruan C, Zhang H, Liu C. Occurrence of aflatoxins and ochratoxin A in rice samples from six provinces in China. Food Control. 2015; 50: 401-4.
14. Lai X, Zhang H, Liu R, Liu C. Potential for aflatoxin B1 and B2 production by Aspergillus flavus strains isolated from rice samples. Saudi journal of biological sciences. 2015; 22: 176-80.
15. Mao J, He B, Zhang L, Li P, Zhang Q, Ding X, Zhang, W. A structure identification and toxicity assessment of the degradation products of aflatoxin B1 in peanut oil under UV irradiation. Toxins. 2016; 8: 332.
16. Osman NA, Abdelgadir AM, Moss MO, Bener A. Aflatoxin contamination of rice in the United Arab Emirates ,Mycotoxin Research. 1999; 15: 39-44.
17. Shen XZ, Diao EJ, Zhang Z, Ji N, Ma WW. Effects of UV-irradiation detoxification in a photodegradation reactor on quality of peanut oil. International Food Research Journal. 2014; 21: 2311-4.