Tropentag 2012, Göttingen, Germany
September 19-21, 2012

Conference on Resilience of agricultural systems against crises organised by:
Georg-August Universität Göttingen and University of Kassel-Witzenhausen

Effect of gamma irradiation and storage on fungal growth, aflatoxin production and quality characteristics of groundnuts

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Abstract

This study was aimed to investigate the efficiency of gamma irradiation in extending the shelf life of stored products. The fungal growth, aflatoxin production and seed quality of two cultivars of ground nut (*Arachis hypogaea*) namely Sodari and Madani was determined after irradiation at dose levels 0, 1, 1.5 and 2 kGy followed by storage at room temperature. After two years storage at room temperature, the results revealed that the fungal growth was significantly ($P < 0.05$) lower in the irradiated seeds compare to the control one for both cultivars. Furthermore, gamma irradiation treatments significantly ($P < 0.05$) reduced the production of aflatoxin especially at the dose of 2 kGy, which was 5.50 and 4.50 ppb in the cultivar Sodari and Madani, respectively. Moreover, the results indicated that gamma irradiation followed by storage caused no significant effects on crude oil and crude protein contents for both cultivars. For the quality characteristics of extracted groundnut oil, the results proved that gamma irradiation treatments with storage caused significant ($P < 0.05$) reduction in the acid value, while the peroxide value of the oil was significantly increased as the dose was increased. The obtained results confirmed that application of gamma irradiation prevent the fungal growth as well as production of the aflatoxin effectively for a long period of time extending to two years without adverse damage in groundnut quality.

Key words: Gamma irradiation, Storage, Groundnut, Fungal growth, Aflatoxin

Introduction:

Ground nut (*Arachis hypogeae* L) is one of the most important oil crops producing edible oils and vegetable protein, vitamins and some minerals such as calcium, magnesium, potassium, iron and zinc (Ahmed and Young, 1982). Like other grains, during storage ground nut exposed to a damage resulting from infection by insects and fungi (Borwer and Tilton, 1972). For this reason, a lot of methods are used to control stored pest such as chemical fumigants, however, wide spread uses of these chemical have a negative impact on human health and the environment. So attention turned to explore non-chemical alternatives methods.

Gamma irradiation has been established as a safe and effective physical means for microbial decontamination, disinfestation, shelf-life extension and improvement of quality attributes of raw and processed agricultural commodities. Ionizing radiations have also been proved effective in improving the overall nutritional attributes, including some desired changes in functional properties of seed flours. However, application of this treatment may lead to change in the physical and chemical properties of grains (Dogbevi et al. 2000; Hassan et al., 2009). Therefore, the aim of this study was to determine the fungal growth, aflatoxin production, nutritive value and the quality characteristics of extracted oil of two groundnut (*Arachis hypogaea*) cultivars as affected of gamma irradiation at dose levels of 0, 1, 1.5 and 2 kGy followed by storage at room temperature.

Material and methods

Ground nut seeds were sealed in polythene bags of mass 500g before and during irradiation process. Irradiation was carried out at room temperature (25 °C) at Kaila irradiation processing unit, Sudanese Atomic Energy Corporation (SAEC). Samples were irradiated with a 3.89 KCi and ^{60}Co source at 0.5 and 1.0 kGy with dose rate 3.2 kGy/h. After the treatments the seeds were kept in glass jars and stored at the room temperature for two years. The fungal growth of treated and untreated samples was measured according to Hilmy et al., (1995). The aflatoxin content was determined by using the ELISA according to Hilal (2004). The crud protein and crude oil contents were estimated according to the AOAC (1990). The oil of treated and untreated samples was extracted by using petroleum ether and then the acid value was determined according to the AOAC (1990), while the peroxide value was measured according to AOCS (1972).

Results and discussion

Figure 1 (a & b) show the fungal growth and the aflatoxin content of control and irradiated seeds. The results indicated that after two years storage at the room temperature, the fungal growth was significantly ($P < 0.05$) lower in the irradiated seeds compare to the control one for both cultivars. Furthermore, gamma irradiation treatments significantly ($P < 0.05$) reduced the production of

aflatoxin especially at the dose of 2 kGy, which was 5.50 and 4.50 ppb in the cultivar Sodari and Madani, respectively.

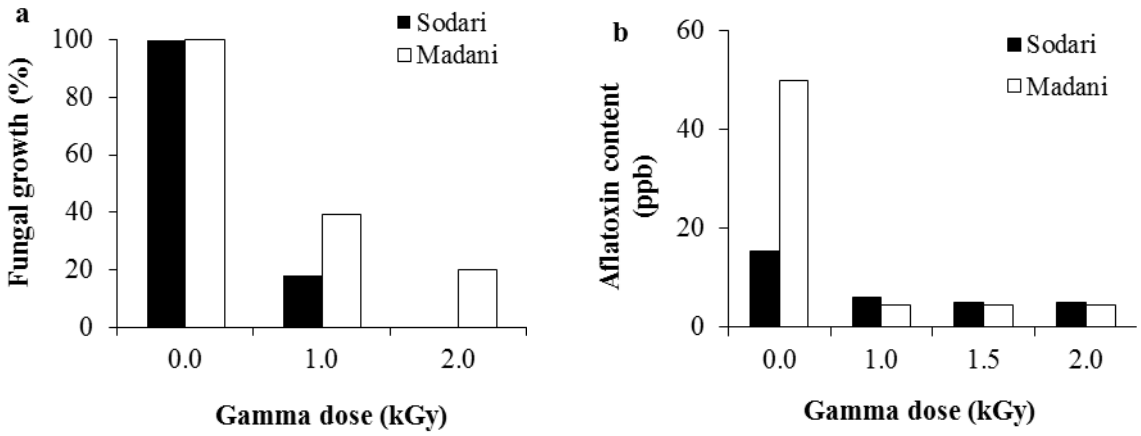

Figure 1 Fungal growth and aflatoxin content of gamma irradiated seeds

Figure 2 (a & b) illustrate the crude protein and oil contents of controlled and treated seeds after two years storage. For the both cultivars, the results indicated that there was no significant changes in the crude protein and oil were observed in the both cultivar.

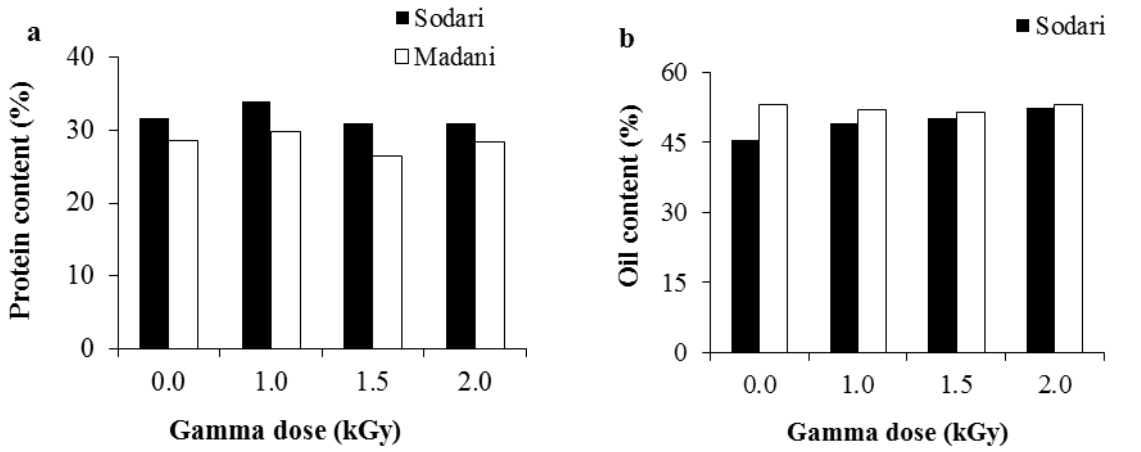

Figure 2 Protein & oil contents of gamma irradiated seeds

For the quality characteristics of extracted groundnut oil, figure 3(a & b) show the results of acid and peroxide value of the oil extracted from the treated and controlled samples after storage for a period of two years. The results showed that radiation treatment after storage lead to a substantial decrease in acid value of the two cultivars. On the other hand, figure 3b describes that the peroxide value of the extracted oil from the two cultivars increased as the dose was increased. These findings are consistent with those cited by some researchers that gamma irradiation reduces the acid value and increases the number of peroxide (Zeb, and Ahmad, 2004).

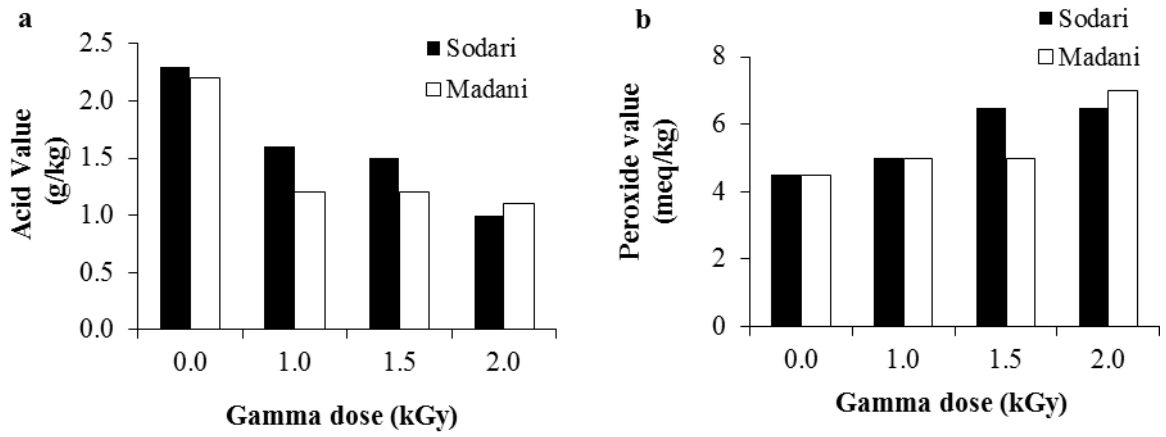

Figure 3 Acid & peroxide values of gamma irradiated seeds

Conclusion

The study concluded that gamma irradiation the fungal growth as well as production of the aflatoxin effectively for a long period of time extending to two years without adverse damage in groundnut quality.

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