Pak. J. Phytopathol., Vol. 31 (02) 2019 – 217-220 DOI: 10.33866/phytopathol.031.02.0508

Official publication of Pakistan Phytopathological Society
Pakistan Journal of Phytopathology
ISSN: 1019-763X (Print), 2305-0284 (Online)
http://www.pakps.com

EFFECT OF GAMMA IRRADIATIONS ON FUNGAL GROWTH OF MANGO (*MANGIFERA INDICA*) TO ENHANCE THE SHELF LIFE

[a]Zia A. Chatha, [b]Muhammad Usman, [c]Fatima Faiyaz, [d]Ali Raza

[a] Department of Food Engineering, University of Agriculture Faisalabad Pakistan.
[b] Veterinary Officer, Livestock and Dairy Development Department, Govt. of Punjab, Pakistan.
[c] Institute of Horticultural Sciences, University of Agriculture Faisalabad, 38040, Pakistan
[d] National Institute of Food Science and Technology, University of Agriculture, Faisalabad, Pakistan.

ABSTRACT

The main objective of this research was to find the effect of Gamma irradiations and UV-C irradiations on the storability of mango fruit to check the prevention of fungal growth and the formation of skin scald. Gamma irradiations had showed the limited growth of microbes, delay of ripening and extension in the shelf life of mango fruit. From the surface of mango different thirteen fungal species were isolated. Different irradiation doses (0.50, 1.00 and 1.50 kGy) along with hot water were applied on the surface of mangoes and stored for 60 days. After treatment, the samples were collected and cultured on different media for growth and identification of fungi. Mangoes treated with gamma irradiation dose (1.5KGy) showed better shelf life than other treatments for controlling the decay of mangoes and enhancing the shelf life. Reduction in the disease incidence had been achieved with relatively high dose of gamma irradiations. However high dose of irradiations had adverse effects on texture and other qualities, but these effects can be reduced by using combined treatments of radiations plus low temperature. Several aflatoxin producing fungal species including *Aspergilus flavus, A. fumiigatus, A. niger, Penecillium chrysogenum, P. brevicompactum, P. verucosum, P. oxaliicum, Cladosporum cladosporoides* were isolated from mango surface and their isolation frequencies were observed. Gamma irradiations at 1.50 KGy showed best results to remove fungal isolates when it was applied on mango surface for two hours and fifteen minutes.

Keywords: Gamma Irradiations, Hot Water, Mango Fruit, Fungus frequency percentage, UV-C.

INTRODUCTION

Mango (*Mangifera indica*) is an important tropical fruits and known as the king of fruits (Usman *et al.*, 2003). It is grown all over the world with production of 45 million tons annually (FAO. 2017). In Pakistan, it is grown over an area of 1.3 million hectares with an annual production of 1.3 million tonnes (vegetables, fruits and condiments statistic of Pakistan 2015-16). It has become more popular throughout the world due to its attractive taste, specific and delicious flavour with high nutrition, and diuretic as well as therapeutic properties. It is most important source of various vitamins such as A and C and also contain a small quantity of vitamin B. the fruit contain 10-20% sugar content (Usman *et al*., 2003).

Pakistan is facing problems in the export of mangoes due to its competition with neighbour countries especially with India. Several factors such as lack of proper infrastructural facilities to handle, storage, process as well as marketing cause barrier mango export. The mango short life span has restricted its distribution to distant domestic as well as export markets. Different approaches have been used to extend post-harvest life span of mango but with little success (Thomas, 1986). The postharvest pathogens cause anthracnose, stem end rot and fruit rot disease etc (Prusky, 1996).

The contaminated mangoes due to toxigenic fungi under favourable condition may lead to accumulation infectious level of mycotoxins. To control the growth of fungi,

Submitted: June 14, 2019
Revised: December 04, 2019
Accepted for Publication: December 21, 2019
* Corresponding Author:
Email: zac143uaf@yahoo.com

mangoes are generally treated with chemicals (hypochlorous acid, sodium dichloroisocyanurate), hot water or their combinations. However, these techniques have some limitations such as chemical remains in the product as well as heat injuiry to mangoes due to inappropriate water temperature (Jitareerat *et al.*, 2005).

Fruit disinfection is done by various methods like, hot water treatment, use of chemicals (fumigants) and irradiations. Irradiation can be used as an effective method of disinfection. The effects of different doses of gamma rays have been observed on fungal growth in comparison with UV-C. World Health Organization (WHO) has considered it as as environmentally safe and effective technology. It has also been proved safe by Food and Agriculture Organization (FAO, 2010) and the International Atomic Energy Agency (IAEA) in vienna. Ionizing irradiation has adverse effect on DNA structure of microorganism and alter the growth and proliferation of cells leading to cell death (Smith and Pillai, 2004). In comparison to above statement, the present study was aimed on the effect of various doses of irradiations on growth of fungal pathogens.

MATERIALS AND METHODS

Fully matured, mangoes (Safaid Chunsa 550g, Kala chunsa 370g) were purchased from Multan. After cleaning with tap water, mangoes were stocked in plastic boxes and stored at optimum temperature 11ºC in transoport van. The mangoes were transported to Post Harvest Research Center in AARI, Faisalabad. The mangoes were classified into various groups usually for the post-harvest treatments (T1- T7) and were transferred to cold storage room at 11ºC. As detail below

Treatments: Treatment T1 was kept control and T2, T3 and T4 were gamma rays with doses 0.5 KGy per hour, 1KGy per hour, 1.5KGy per hour respectively. In comparison to these, other inhibition treatments were T5, T6 and T7 with doses UV-C for 32 minutes, UV-C for 61 minutes, and hot water 55_0C for 5 minutes respectively.

The experiment was conducted in three replications with 5 mangoes in each treatment. Seven treatments with five days interval were taken.

Isolation and Identification of Fungi: Mango (*Mangifera indica*) samples were cultured on the medium of potato dextrose agar for growth of fungus (Samson *et al*., 2004). After the growth, the fungus was subcultured on Czepek dox agar media and yeast extract sucrose. These petri plates were incubated at a temperature of 28ºC for 7-10 days. After incubation period, the isolated fungi were identified for the colony morphology and characteristics of slide culture on various culture media (Singh *et al.,* 1991; Klich and Pitt, 1988). The isolation frequency (Fr) of the species were calculated according to Gonzalez *et al.,* (1995) as follow:

$$\text{Fr}\ (\%) = \frac{\text{No. of samples with a species or genus}}{\text{Total No. of samples}} \times 100$$

RESULTS AND DISCUSSION

In this experiment, eight hundred and forty samples of mangoes were tested against various treatments including Gama irradiation. Out of these samples only 41 percent (345) of samples showed fungal isolates on their surface. From the surface of these mango different thirteen fungal species were isolated. Moreover, different thirteen fungal species including *Aspergilus flavus, A. niger, A. fumigantus, A. oryzae, A. tereus, A. paraseticus, Pencilium chrysogenam, P. brevicompactum, P. oxaliicum, P. verucosum, C. cladosporides, F. oxysporum* and *S. breviicaulis* were isolated from the surface of mangoes and their isolation frequency in percentage was 16.53, 20.58, 0.88, 6.66, 7.55, 1.44, 6.12, 5.19, 3.80, 2.59, 14.80, 6.09 and 7.79 respectively (Table 1).

Table 1. Frequency of Isolated Fungi (%).

Isolated Fungi	Number of isolates	Frequency(%)
A. flavus	57	16.533
A. niger	71	20.58
A. fumigates	03	0.88
A. oryzae	23	6.66
A. terreus	26	7.55
A. parasitcus	05	1.44
P. chrysognum	21	6.12
P. brevicmpactum	18	5.19
P. oxalicum	13	3.80
P. verucosum	09	2.59
C. cladosporides	51	14.80
F. oxysporm	21	6.09
S. brevicaulis	27	7.79
Total	345	

Fungi varied in their resistance to different treatments. (Table 2) showed the total number of fungal isolates from mangoes which were subjected to various treatment including gamma irradiations.

Table 2. Fungal load on mangoes.

Treatments	Number of Fungal Isolates	Fungal isolate (%)in comparison with control (T1)
T_1	195	56.52%
T_2	28	8.12%
T_3	21	6.1%
T_4	4	1.16%
T_5	30	8.69%
T_6	17	4.93%
T_7	50	14.5%
Total	345	

T4 treatment showed best results for the suppression of fungal isolates and recorded as most effective treatment. High dose of gamma irradiation showed reduced fungal development with no detrimental effects on quality parameters. All the treatments had significant effects on disinfection of fungal growth and no effect on the skin colour and texture was observed. These results were similar to the findings of Smith and Pillai (2004). They revealed inhibition of spore germination by destruction of DNA of cells attributed to the direct as well as indirect radiation effects. As compared to other treatments T6 (UV-C for 60 minutes), T3 (1.00 KGy / one hour and thirty minutes) and T2 (0.50 KGy / forty five Minutes) also effective to reduce the population of fungi.

These studies described that increase in irradiation doses had led to higher suppression of fungal growth. Beraha (1964) reported that higher rates of irradiation increased the efficasy of radiation. Fungal species differe widely in the resistant to irradiation, multicellular as well as bicellular spores are more resistant as compared to the gamma radiation than unicellular spores (Sommer *et al*., 1964).

The result of this study revealed that mangoes irradiated with gamma rays with high doses increase the shelf life and made them resistant for growth of fungi. Jitareerat *et al*. (2005) conducted a research and concluded that the fungal growth significantly decreased by the treatment of gamma irradiation. To increase the shelf life of mangoes and inhibit the fungal growth, application of gamma rays at 1.5 KGy for two hour and fifteen minutes showed excellent results.

REFERENCES

Beraha, L. 1964. Influence of gamma radiation dose rate on decay of citrus, pears, peaches, and on penicillium and *Botrytis cinerea* in vitro. Phytopathology (US), 54.

FAO STAT. FAO Statistics. 2012. Food and Agriculture Organization of the United Nations, Rome, Italy.

Jitareerat, P., W. Kriratikron, S. Phochanachai and A. Uthiratanakij. 2005. Effects of gamma irradiation on fungal growths and their pathogenesis on banana cv.'Kluai Kai'. International Symposium "New Frontier of Irradiated Food and Non-Food Products. pp. 22-23.

Meier, G. W. 1964. Early Behavioral Analysis of Low-Dose-Rate, High-Dose Gamma-Irradiation Effects. Radiation Research, 22: 398.

GOP., 2007. Fruit, vegetables and condiments statistics of Pakistan. Ministry of Food, Agriculture and Livestock, Food and Agriculture Division.

Pitt, J. I. and A. D. Hocking. 1997. Fungi and Food Spoilage. Springer US.

Prusky, D. 1996. Pathogen quiescence in postharvest diseases. Annual Review of Phytopathology, 34: 413-434.

Samson, R. A., E. S. Hoekstra and J. C. Frisvad. 2004. Introduction to food-and airborne fungi. Centraalbureau voor Schimmelcultures (CBS).

Smith, J. S. and S. Pillai. 2004. Irradiation and food safety. Food technology, 58: 48-55.

Sommer, N. F., E. C. Maxie and R. J. Fortlage. 1964. Quantitative dose-response of Prunus fruit decay fungi to gamma irradiation. Radiation Botany, 4: 309-316.

Thomas, P. and J. H. Moy. 1986. Radiation

preservation of foods of plant origin. III. Tropical fruits: Bananas, mangoes, and papayas. C R C Critical Reviews in Food Science and Nutrition, 23: 147-205.

Usman, M., B. Fatima, M. M. Khan and M. I. Chaudhry. 2003. Mango in Pakistan: A chronological review. Pakistan Journal of Agricultural Sciences, 40: 151-154.

Contribution of Authors:

Zia A. Chatha	:	Design and conduct experiment, Manuscript write-up.
Muhammad Usman	:	Help in write up of article.
Fatima Faiyaz	:	Help in English editing.
Ali Raza	:	Help in correction and typing of article.