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MICROBIAL STUDY OF MANGOES AND ITS CONTROL BY NON-THERMAL TREATMENTS

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A B S T R A C T

The mango (*Mangifera indica L.*) is an important staple food and an important source of carbohydrates, amino acids, vitamins, fatty acids, minerals, protein and organic acids. They however have shorter shelf life due to their high susceptibility to microbial contaminants. Several procedures are using to check microorganisms and enhance shelf life of fruits. This study focused on total viable count and isolation and identification of *Salmonella spp., Staphylococcus aureus, Escherichia coli* on the surface of mangoes. And effects of non-thermal treatments on microbial life and storage of mangoes. The samples were subjected to various irradiation doses (0.5, 1.0 and 1.5 KGy) and hot water 55ºC and stored for 60 days. Total viable count was estimated at 7 days interval throughout the storage duration. No *Salmonella spp., Staphylococcus aureus, Escherichia coli* were detected. Mangoes irradiated at the dose of 1.5 KGy have least bacterial viable count (2.9log cfu/g). So, irradiation is more effective in improving microbiological quality and extending shelf life of mangoes.

Keywords: Gamma Irradiations, Hot Water, Mango Fruit, Microbial load, UV-C.

INTRODUCTION

Generally, the mango (*Mangifera indica*L.) is an important staple food and an important source of carbohydrates, amino acids, vitamins, fatty acids, minerals, protein and organic acids.(Lamikanra et al.2002). "The king of fruits" mostly grown in tropical as well as subtropical regions of the world. It is popular in the world because of its attractive fragrance, excellent flavor, beautiful color, sweet taste and health giving properties (Salunkhe and Desai,1984). Asia produce 76.9% of mangoes worldwide. Among countries, Pakistan is at 5th number in mango production, producing 938000 tons every year and contributing a 7.6% share in the world market (Ravi *et al*., 2011).

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Mango is a short seasoned fruit and being highly perishable does not withstand even in cold storage due to presence of microorganisms (Hussain *et al*., 2003). It is highly susceptible to contamination with microorganisms including human pathogens and spoilage (European commission, 2002).

Several procedures are using to check microorganisms and enhance shelf life of fruits. Now days, the advanced biotechnologies revolving around spoilage of food by microorganisms to recapture the ecological balance loss. For acceptable hygienic quality of fruits Good Agriculture Practices (GAP) and Good Hygienic Practices (GHP) in combination with Hazard Analysis and Critical Control Point (HACCP) has been utilized. Different management practices such as moisture and temperature control, vacuum, irradiation and use of chemicals have been employed to control the microorganisms.

For microbiological safety of fruits, researchers have been investigated the efficiency of number of very

different methods for control of microbial decay of fruits (Jitareerat *et al*. 2005). For several years, a number of chemical compounds such as the chlorine based preservatives have also been used to minimize the contamination of mangoes (Gomez-Lopez *et al*., 2009). Despite of benefits, there some physical injuries due to fluctuation in temperature and also limitations such as mangoes contain many chemical residues. Studies consistently shows that irradiation effectively decrease the number of contaminants of fruits (Niemira and Fan, 2005). Low exposure of UV-C doses ranges between 190 to 280 nm in wavelength not only delayed senescence but also ripening process of mango fruits (Marquenie *et al*., 2003).

Scientific knowledge about irradiation technology help to meet many hygienic requirements (Fan, 2012). Food irradiation provide an excellent alternative against chemical and some other physical treatments. Food irradiation has been considered a safe and effective technology by World Health Organization (WHO), Food and Agriculture Organization (FAO) and International Atomic Energy Agency in Vienna. Irradiation of fruit can reduce post-harvest losses, increase shelf life, improve hygienic quality and inactivation pathogens of food (Thayer *et al*., 1996). Irradiation process is economical, safe and ensure the quality of mangoes in Pakistan. The main objective of study aimed to isolate and identify the microorganisms and gamma irradiation effect on microbial quality of mango fruit (cv kala Chunsa) during storage.

MATERIALS AND METHODS

Preparation of Sample: The fresh mature mango fruits (cv kala Chunsa) were purchase from the farmers of Multan, Pakistan at the same day of harvesting. The mangoes were prevented from exposing to excessive field heat by keeping harvesting time early in the morning, avoiding high temperature above 27 ^{o}C. The sorting and grading of mangoes were done according to size and weight. The sample were washed in 10% sodium hypo-chlorite solution and rinsed in sterile distilled water and placed in specially designed boxes which allow air circulation. Then, stored at temperature of 11ºC in the reefer container and transported to cold storage of Post Harvest Research Center in AARI, Faisalabad, Punjab, Pakistan. Application of postharvest treatments applied randomly on different groups of mango.

Irradiation and Microbiological Analysis of Samples: The gamma irradiation and hot water treatment plan for effect on microorganisms and storage is presented here.

Treatments: Mangoes were irradiated with total seven treatments in which T1 consider as control, T2 with 0.5KGy for 45 minutes, T3 with 1KGy for 1 hour and 30 minutes, T4 was irradiated with 1.5 KGy for 2 hours and 15 minutes and T5 and T6 with UV-C for about 30 minutes and 60 minutes respectively and the last treatment T7 using hot water at 55º for 5 minutes.

Mangoes were irradiated with 0.5KGy, 1KGy , and 1.5 KGy of 137 Cs-generated gamma rays using a Gamma-cell Elan3000 (Elitemodel D, Nordion International, Inc., Ottawa, Canada). After irradiation, samples were stored at 11°C in cold storage room. The mangoes were analyzed for total viable count and isolation and identification of *Salmonella spp., Staphylococcus aureus, Escherichia coli.* For viable count, for each sample took 1.0 gm of sample and mixed into 9 ml peptone water and stirred on mechanical shaker for 30 minutes and prepared serial 10 fold diluted upto 10^{-10}.Took 1 ml of 10^{-1}dilution and spread over nutrient agar plate and done the same upto 10^{-10}. All samples were incubated at 37 °C for 24 hours. Petri plates that had colonies between 30-300 were selected for determining cfu/gm. The no. of cfu/gmwas calculated by multiplying average number of colonies by dilution factor (Awan and Rahman, 2002). For isolation and identification of *Staphylococcus aureus*an and *Escherichia coli,* nutrient broth used as general purpose media and Staph 110 and MacConkey's agar selective media respectively. For *Salmonella spp.,* tetrathionate broth used as enrich media and Salmonella-sheigella agar as selective media. Colonies on selective media were identified on the basis of morphological, cultural and biochemical characteristics. Each experiment was repeated for three times.

DATA ANALYSIS

The total viable cells mean count were calculated and transformed into logarithms (log10x).

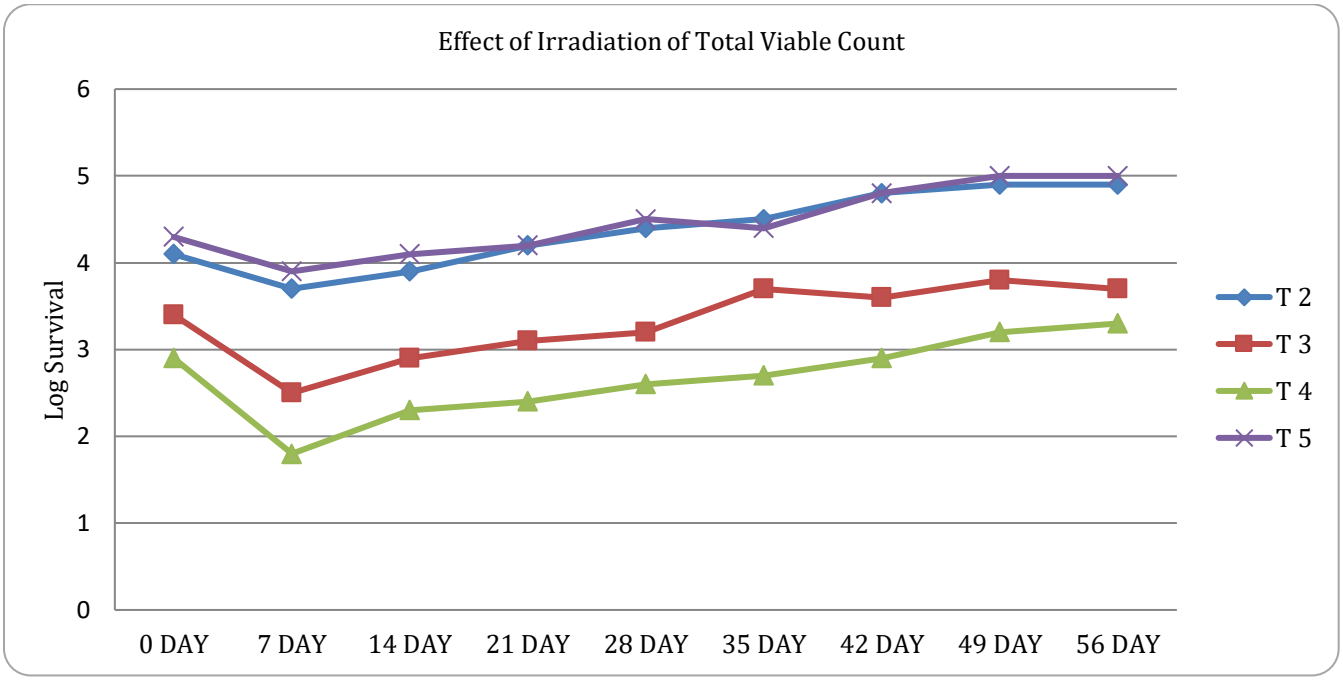
RESULTS AND DISCUSSIONS

No microorganism were isolated inside the mango fruit at time zero. All data represents the microbial population on the surface of the peel. The initial total viable of un-irradiated mango was 9.9log cfu/g, which decrease significantly after irradiation with highest dose of the plan1.5 KGy gamma irradiation as shown in Table 1.

Table 1. Effect of irradiation on total viable cells

Treatments	Day 0 (logcfu/g)	Day 7 (logcfu/g)	Day 14 (logcfu/g)	Day 21 (logcfu/g)	Day28 (logcfu/g)	Day 35 (logcfu/g)	Day 42 (logcfu/g)	Day 49 (logcfu/g)	Day 56 (logcfu/g)
T1	9.9	8.7	10.2	-	-	-	-	-	-
T2	4.1	3.7	3.9	4.2	4.4	4.5	4.8	4.9	4.9
T3	3.4	2.5	2.9	3.1	3.2	3.7	3.6	3.8	3.7
T4	2.9	1.8	2.3	2.4	2.6	2.	2.9	3.2	3.3
T5	4.3	3.9	4.1	4.2	4.5	4.4	4.8	5.0	5.0

The population of micro organisms was inversely proportional to the intensity of irradiation dose. The reduction in total viable count on the peel of mangoes was similar the results shown by Farkas *et al*., 1972.During storage up to 56 day, there was incredible increase in total viable count. The least rate of increase was seen in 1.5 KGy gamma irradiation, then 1.0 and 0.5KGy gamma irradiation respectively as shown in Graph 1.



No microbial isolates were positive for *Salmonella spp., Staphylococcus aureus, Escherichia coli* in irradiated mangoes. During the early days of storage, there was decrease in total viable count which increase gradually with as storage prolong. No potential pathogen were found which enhance the acceptability of irradiated mangoes. The study shows that microbiological quality and storage of mangoes can be improved by treatment with ionizing radiation at dose 1.5 KGy. This agrees with researchers Patterson and Stewart, 2003 and Farkas *et al*., 2003. In a related study on apples and pear jam, Mossel, 1985 and Abadias *et al*., 2008 reported decrease in microbial load by irradiation. This result indicating the efficacy of high dose of gamma irradiation increase the mean life and in retarding the growth of microorganisms.

In summary, we found that 1.5KGy irradiation) is useful to lower bacterial count and for prolonging the shelf life of mangoes.

REFERENCES

Abadias, M., J. Usall, M. Oliveira, I. Alegre and I. Viñas. 2008. Efficacy of neutral electrolyzed water (NEW) for reducing microbial contamination on minimally-processed vegetables. International Journal of Food Microbiology, 123: 151-158.

Awan, J. A. and S. U. Rahman. 2005. Microbiology Manual, Unitech Communications, Faisalabad. pp. 49-51.

commission, E. 2002. Risk profile on the microbiological contamination of fruits and vegetables. Report of the scientific committee on food.

Fan, X. 2012. Ionizing Radiation. Decontamination of Fresh and Minimally Processed Produce. Wiley-Blackwell, pp. 379-405.

Farkas, J., S. Dharkar and A. Sreenivasan. 1972. Transportation and storage studies on irradiated Alphonso mangoes. Acta Alimentaria Academiae Scientiarum Hungaricae, 1: 401-410.

Farkas, J., K. Polyák-Fehér, C. MOHÁCSI-FARKAS, L. Mészáros, E. Andrássy and T. Sáray. 2003. Studies on irradiation of pre-packaged prepared vegetables and improvement of microbiological safety of some sous-vide meals by gamma radiation. Radiation Processing for Safe, Shelf-stable and Ready-to-eat Food, IAEA-TECDOC-1337, IAEA, Vienna: 27-46.

Gómez-López, V. M., A. Rajkovic, P. Ragaert, N. Smigic and F. Devlieghere. 2009. Chlorine dioxide for minimally processed produce preservation: a review. Trends in Food Science & Technology, 20: 17-26.

Hussain, S., S. Rehman, M. Randhawa and M. Iqbal. 2003. Studies on Physico-chemical, microbiological and sensory evaluation of mango pulp storage with chemical preservatives. Journal of Research in Science Teaching**.** BZ Uni., Multan, Pak, 14: 01-09.

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.

Lamikanra, O. 2002 Preface.In Lamikanra.Oeds, Fresh-cut fruit and vegetables. Science and technology and market Boca Raton. CRC Press.

Marquenie, D., C. W. Michiels, J. F. Van Impe, E. Schrevens and B. N. Nicolaï. 2003. Pulsed white light in combination with UV-C and heat to reduce storage rot of strawberry. Postharvest Biology and Technology, 28: 455-461.

Niemira, B. A. and X. Fan. Low-Dose Irradiation of Fresh and Fresh-Cut Produce: Safety, Sensory, and Shelf Life. Food Irradiation Research and Technology. Blackwell Publishing, pp. 169-184.

Patterson, M. and E. Stewart. 2003. Effect of gamma irradiation on the shelf-life and nutritional quality of ready made meals. Radiation Processing for Safe, Shelf-stable and Ready-to-eat Food, IAEA-TECDOC-1337, IAEA, Vienna: 47-61.

Ravi, V., M. Prabhu and D. Subramanyam. 2011. Isolation of bacteriocin producing bacteria from mango pulp and its antimicrobial activity. Journal of Microbiology and Biotechnology Research 1: 54-63.

Salunkhe, D. K. and S. Kadam. 1995. Handbook of fruit science and technology: production, composition, storage, and processing. CRC press.

Thayer, D. W., E. S. Josephson, A. Brynjolfsson and G. Giddings. 1996. Radiation pasteurization of food. Council for Agricultural Science and Technology, 7: 1-10.

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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.