NUTRITIONAL VALUE ASSESSMENT AND PROXIMATE COMPOSITION OF GAMMA IRRADIATED GRAPES

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ABSTRACT: Grapes (*Vitis vinifera* L.) belong to the family Vitaceae that are the best source of energy. The present research was focused to increase the shelf life and controlling the amount of fruit losses by optimizing the dose of gamma radiation and proximate analysis post gamma radiation. In the present study, grape samples were exposed to three doses of gamma radiation i.e. 0.5, 0.8 and 1 KGy. Nutritional value of grapes after gamma radiation was analyzed to determine the change in proximate composition. Through experimentation, it was observed that 0.8 KGy was optimized dose as the sensory properties remained unchanged and shelf life of grapes was increased up to 14 days. However the overall effect of gamma radiation enhanced the shelf life with a non-significant effect. Hence, gamma radiation is a promising technique in increasing country's economy.

Keywords: Grapes, Gamma radiation, shelf life and nutritional quality.

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INTRODUCTION

Grapes (*Vitis vinifera* L.) belong to family Vitaceae which is one of the most popular fruits in the world (This *et al.*, 2006). These are small oval berries mainly processed for making wine and are also consumed as both fresh and in dried form (Khair *et al.*, 2009). They have been admired in "The Holy Quran". The first grape varieties cultivated as far back as 6000 years ago (Babili, 2006).Worldwide, grape is the second most cultivated temperate fruit crop ranging between 61-66 million tons (Gallo *et al.*, 2014). In Pakistan, its cultivation is restricted to upland areas of Balochistan as it contributes to 97-99% of overall grape area and production (Aujla *et al.*, 2011). The average percentages of moisture, ash, crude protein and carbohydrates are 81.83%, 0.49%, 0.03% and 13.96% respectively (Luna-Vázquez *et al.*, 2013). Sterilization is defined as the process to kill all the living microorganisms. Gamma irradiation has become an effective tool for processing and preserving food products and an effective way of controlling food-borne pathogens (Raisi *et al*., 2015). Irradiation disrupts the DNA or RNA in the nuclei of cells (Smith and Pillai, 2004). It involves three types of ionizing radiation: X-rays, gamma radiation (^{60}C0 and ^{137}Cs) and electron-beams. Mainly gamma radiation sources are used in radiation processing applications now a days. A significant advantage of gamma radiation is that it does not affect the nutritional quality (Iqbal, 2016). The United States Food and Drug Administration (USDA) has approved radiation doses up to 1 KGy for preservation and disinfestation of fruits and vegetables (Follett, 2009). For irradiation effect on quality of grapes, it is found that the storage periods can be enhanced by 50% using the optimal doses, i.e. 0.5 to 1.0 KGy for Helwani and 1.5 to 2.0 KGy for Baladi (Al-Bachir, 1999). Other phytosanitory studies reveal that grapes were treated with 400, 600 and 800 Gy during three weeks of storage. Spoilage resulting from *Botrytis* spp. and *Rhizopus* spp. in grapes can be reduced by a dose of 2 KGy (Thomas *et al.*, 1995). Keeping in view the importance of gamma radiation the present study was conducted to optimize the dose of gamma radiation that can enhance the shelf life without any change in the sensory properties and nutritional components of grapes.

MATERIALS AND METHODS

During the present work grape samples were collected from the local market. The samples were packed in brown paper bags and radiated at 0.5, 0.8 and 1 KGy at Pakistan Radiation Services (PARAS). The control and radiated samples were compared for their nutritional components.

Moisture content: To determine the moisture content two grams of sample was taken in a pre-weighed crucible and dried at 70 °C for overnight (AOAC, 2007).

Ash content: Two to three grams of sample was taken into a pre-weighed crucible. Sample was first ignited and then placed in Muffle furnace at 500- 550°C temperature for 4 to 6 hours till the sample became ash (AOAC, 2007).

pH: The pH was monitored by using a digital pH meter. In order to determine the pH of sample, juice of grapes was prepared in a blender (Amerine and Ough, 1980).

Titrable Acidity: To determine titrable acidity, five mL of grape juice was taken in a 250mL flask and diluted with 50mL of distilled water. Three drops of 1% phenolphthalein were added. The juice was then slowly titrated with 0.1N NaOH (Horwitz, 1964).

Juice content: To determine the juice content five grams of sample was taken and squeezed to extract whole the juice with an extractor and filtered it (Nawaz *et al.*, 2008). The juice was recorded in mL with the help of a measuring cylinder

Vitamin C: To determine vitamin C content 5ml of grape juice was taken in 100mL measuring cylinder and after adding 50mL of 5% Trichloro acetic acid (TCA), it was diluted up to the mark with water (Nawaz *et al.*, 2008).

Antioxidant activity: The methodology of antioxidant activity determination was basically based on scavenging effects of 2,2-diphenyl-1-picrylhydrazyl, (DPPH). The sample was added in test tube in concentration of 100µL. Then added 900µL of methanol in test tube. About 1mL of DPPH was added in test tube. Sample was incubated for 30 minutes. After that, absorbance of the sample and control was determined at 517nm. Same method was repeated for each dose (Sanchez-Moreno *et al.*, 1999).

Protein determination: Protein in the sample was determined by Kjeldahl method (Barbano and Clark, 1990). The samples were digested by heating with concentrated sulphuric acid in the presence of digestion mixture. Then 0.1 N NaOH was added to make the mixture alkaline. Ammonium sulphate thus formed, released ammonia which was collected in 2% boric acid solution and titrated against standard HCl.

Statistical Analysis: The Standard deviation was calculated for the data of various tested parameters by using SPSS version 14.

RESULTS AND DISCUSSION

The effect of different doses of gamma radiation on grapes was recorded during the present work.

Organoleptic quality of grapes: Grapes irradiated at 1.0 and 0.8 KGy gamma rays retained their green color up to 21 days of storage whereas, grapes treated with gamma rays 0.5 KGy turned yellowish green on 12th day after treatment (Fig-1). It was also observed that gamma radiation reduced the percentage decay and resulted in enhancement of shelf life on grapes up to 25 days as compared to control grape sample which was spoiled after 15 days (Fig-1). It has been reported earlier that gamma radiation result in greater shelf life and reduce fruit losses (Al-Bachir, 1999)

Moisture content: The moisture content showed a slight decrease after exposing to gamma radiation. The best results were found at dose of 0.8 kGy which had the same moisture content as compared to control with a very little effect on sensory properties (Fig-2). It has been reported earlier that a slight decrease was observed in response to gamma radiation (Barros *et al.* 2013 and Kim *et al.*, 2014). The decrease in moisture content might be due to inhibition of metabolic activities and retardation of senescence

Ash contents: The effect of gamma radiation on ash content is shown in (Fig-3). The ash contents showed a non-significant decrease after exposing to gamma radiation. Bhat *et al.* (2008) also reported a dose-dependent decrease in the ash content.

pH: The effect of gamma radiation on pH is shown in Fig-4. The pH showed non-significant pattern on different dosage when exposing to gamma radiation. The best results found at dose of 0.8 kGy in terms of sensory evaluation. It was also observed that as storage time increased the pH also increased. Barros *et al.* (2013) also reported that the doses of gamma irradiation did not affect the pH of red grape juice. For beverages with white grapes juice showed slight decrease in pH when compared with the control sample.

Titrable acidity: The effect of gamma radiation on the titrable acidity of grape sample showed non-significant pattern on different dosage when exposed to gamma radiation (Fig-5). In the present study the titrable acidity decreased at 0.8 and 1kGy but increased at 0.5kGy after exposing to gamma radiation. At 0.8kGy dose of gamma radiation titrable acidity showed no considerable effect when compared to the control sample. Moreno *et al.* (2007) recorded similar results treatment up to 3.2 kGy did not have significant effect on the pH or acidity in blueberries. McDonald *et al.* (2012) reported that when peaches treated with 0.9 kGy dose of gamma radiation it resulted in a decrease in TA but the difference was negligible.

Juice content: During the study it showed that that there was a slight increase in juice contents when exposed to gamma radiation which was considered negligible (Fig-6). The mean value of juice contents of grape samples for control during four weeks was recorded to be 42.27g100mL^{-1}, 46.68 g100mL $^{-1}$, 52.71g100mL^{-1} which showed that juice content was decreased as storage time was increased. Kim *et al.* (2014) reported significant increase in juiciness of the Sugraone grapes with increase in irradiation. (McDonald *et al.*, 2012) reported that peaches treated with 0.69 or 0.9 kGy dose were found more juicy than control sample. It was also reported that the overall acceptability for flavor, texture, juiciness and overall liking of irradiated fruits were significantly higher as compared to control.

Vitamin C content of grapes: The effect of gamma radiation on vitamin C content is shown in Fig-7 below. The vitamin C contents showed a decrease after exposing to gamma radiation. The vitamin C content decreased after exposing to gamma radiation and this effect proved to be non-significant. These results were in line with the findings of Wilkinson (1985) who also who reported decrease in the total vitamin C levels.

Protein content of grapes: The graph below shows the effect of gamma radiation on protein content of grapes (Fig-8). The protein content showed a non-significant decrease after exposing to gamma radiation. In present study the protein content decreased after gamma radiation treatment and it also proved to be non-significant. At higher doses (above 10kGy) the protein degradation occurred hence degradation was a major cause of decrease in protein contents at higher dose which was similar to the results of Mehta and Nair (2011) who reported a decrease in protein content at higher dose.

Antioxidant activity of grapes: The antioxidant activity showed non-significant pattern on different dosage when exposed to gamma radiation Fig-9 Breitfellner *et al.*, (2002) also reported reduction in antioxidant activity due to the degradation of phenolic acids. This reduction in antioxidants is due to the formation of radiation-induced degradation products (Wong and Kitts, 2001 and Sajilata and Singhal, 2006).

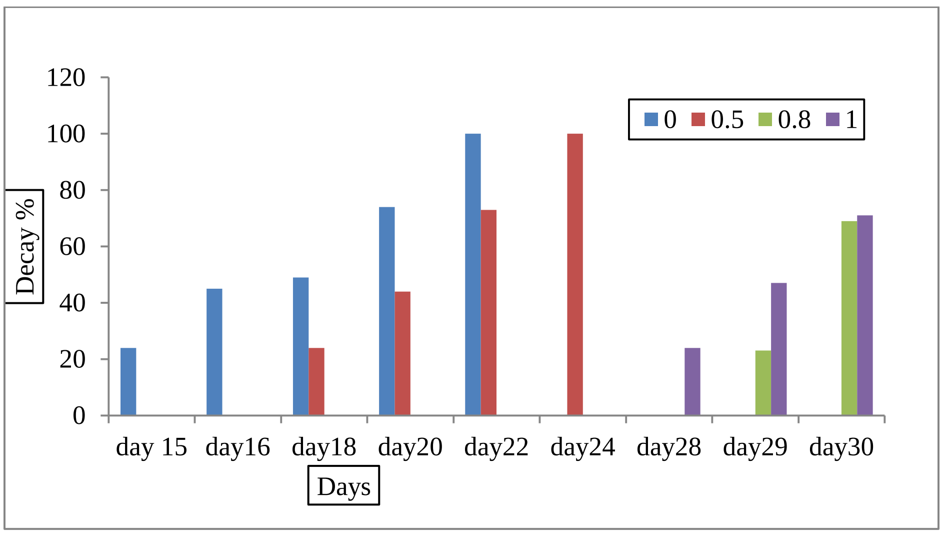

Figure-1: Effect of gamma radiation on decay percentage of grapeS
The control and irradiated grape samples were decayed hence not represented in the graph at day 21 Values having different letters in the same column are significantly different (P<0.05)

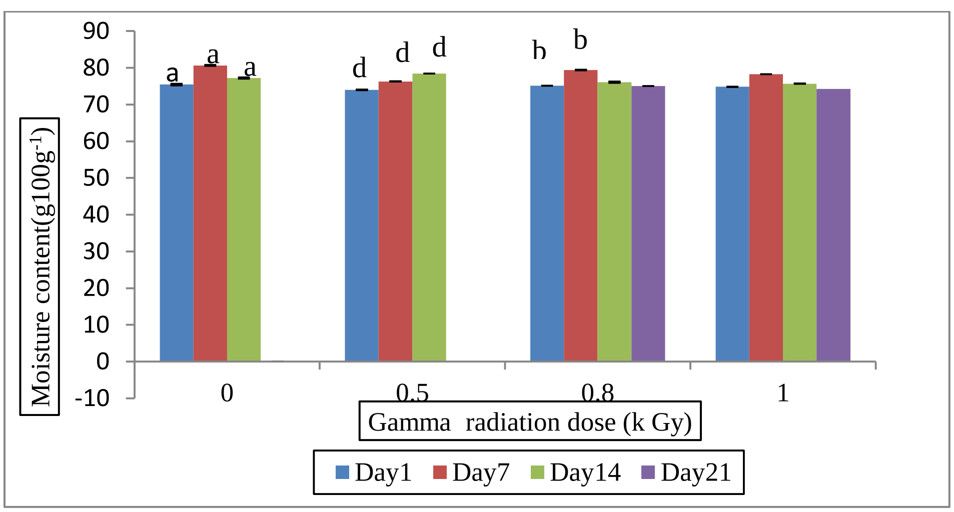

Figure-2: Effect of gamma radiation on moisture content of grapes
The control and irradiated grape samples were decayed hence not represented in the graph at day 21 Values having different letters in the same column are significantly different (P<0.05)

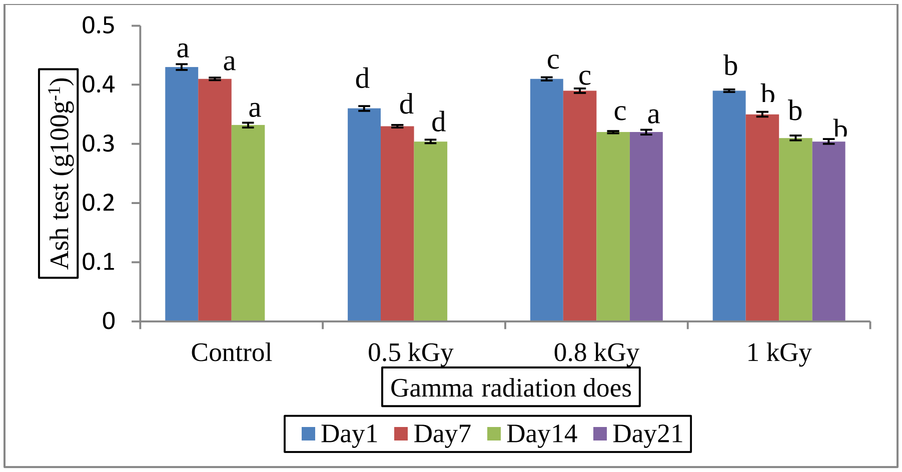

Figure-3: Effect of gamma radiation on ash content of grapes
The control and irradiated grape samples were decayed hence not represented in the graph at day 21 Values having different letters in the same column are significantly different (P<0.05)

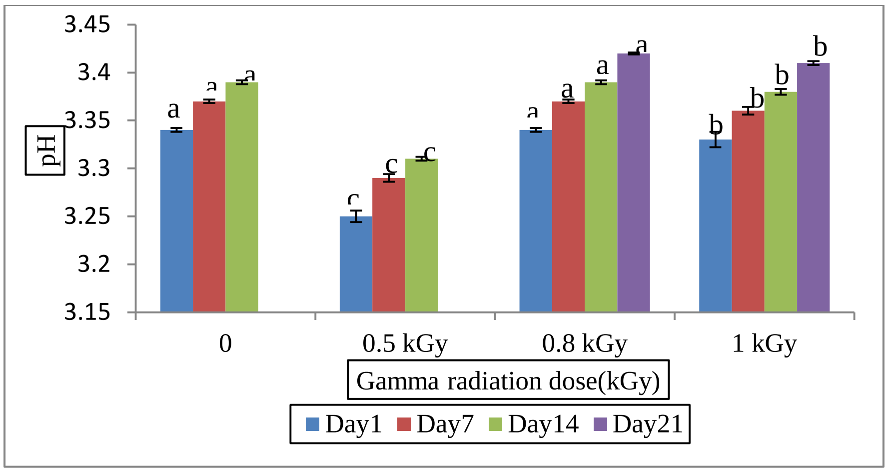

Figure-4: Effect of gamma radiation on pH of grape juice
The control and irradiated grape samples were decayed hence not represented in the graph at day 21 Values having different letters in the same column are significantly different (P<0.05)

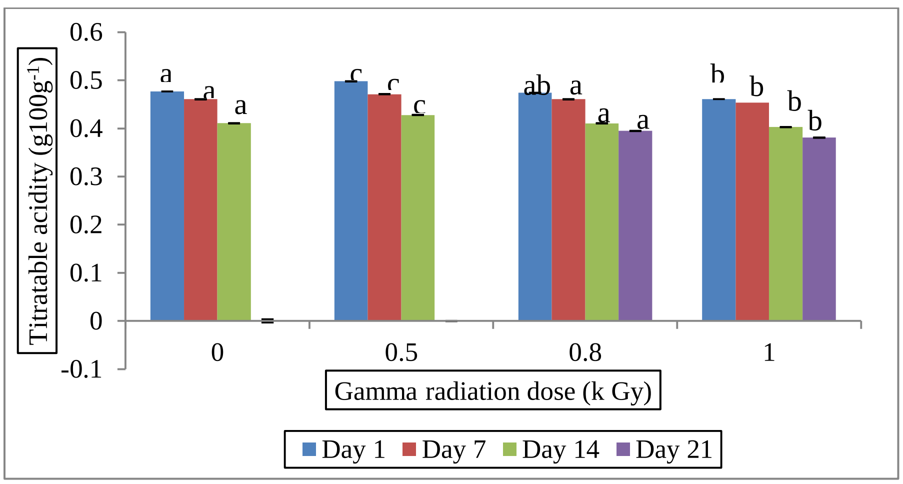

Figure-5: Effect of gamma radiation on titrable acidity of grape juice
The control and irradiated grape samples were decayed hence not represented in the graph at day 21 Values having different letters in the same column are significantly different (P<0.05)

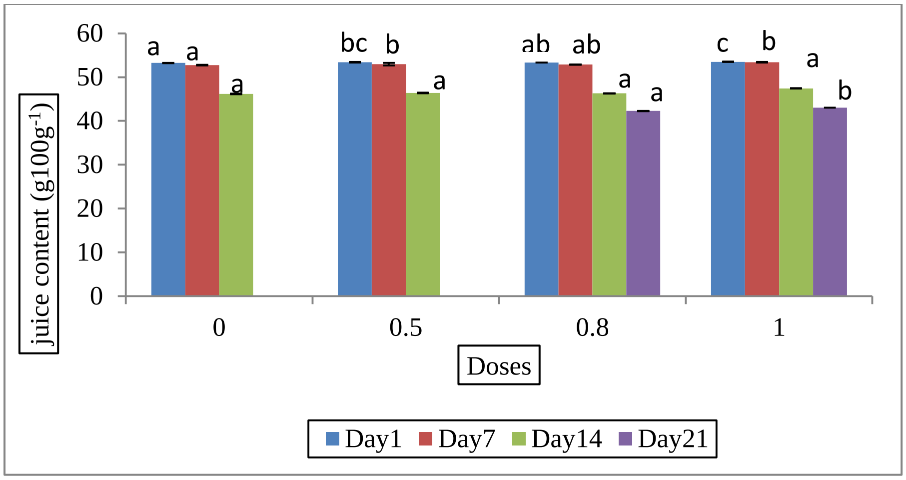

Figure-6: Effect of gamma radiation on juice content of grapes
The control and irradiated grape samples were decayed hence not represented in the graph at day 21 Values having different letters in the same column are significantly different (P<0.05)

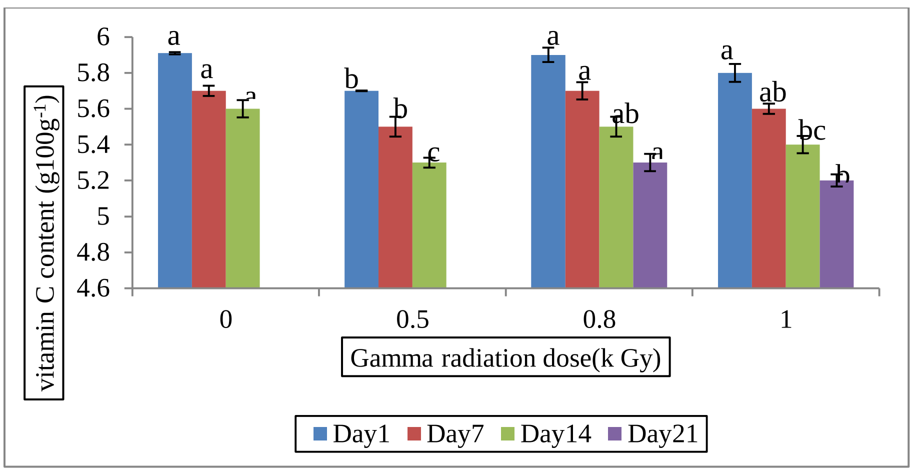

Figure-7: Effect of gamma radiation on Vitamin C content of grape juice
The control and irradiated grape samples were decayed hence not represented in the graph at day 21 Values having different letters in the same column are significantly different (P<0.05)

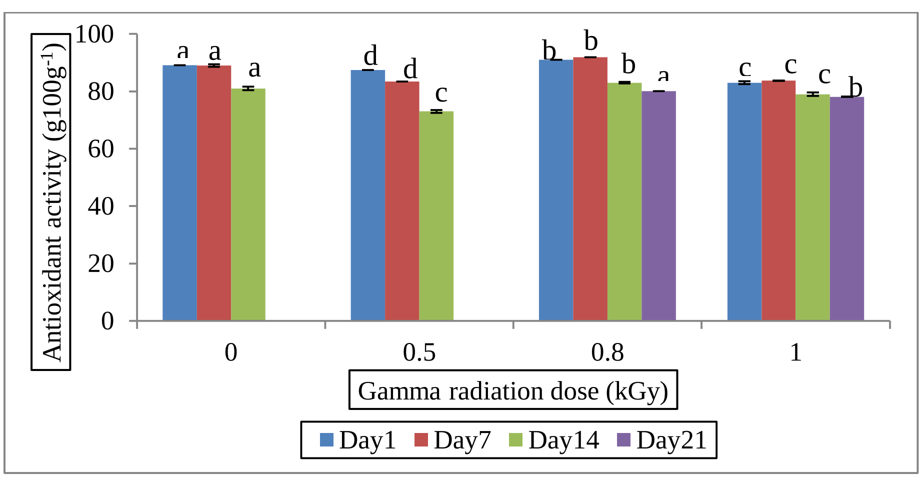

Figure-8: Effect of gamma radiation on antioxidant activity of grape juice
The control and irradiated grape samples were decayed hence not represented in the graph at day 21 Values having different letters in the same column are significantly different (P<0.05)

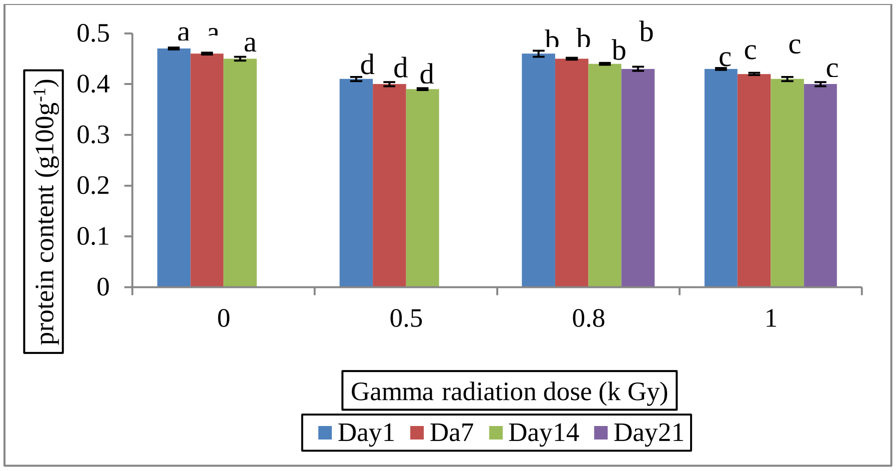

Figure-9: Effect of gamma radiation on protein content of grapes

The control and irradiated grape samples were decayed hence not represented in the graph at day 21 Values having different letters in the same column are significantly different ($P<0.05$).

Conclusion: It was concluded that 0.8 KGy is optimized dose to extend the shelf life of the fruit without having any adverse effects.

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