The Effect of Gamma Radiation on *Capsicum frutescens* L. (Chilli)

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Abstract

In this research, the effect of gamma radiation on chilli was studied. The seeds were subjected to different treatment levels of gamma rays at 25, 35 and 45 krad along with control (non-irradiated). The agronomical characters of samples were investigated. Some nutritional values of non-irradiated and gamma irradiated samples such as moisture, ash, protein, fat and fiber were studied by analytical methods. There were no significant changes in nutritional values of gamma irradiated sample compared with non-irradiated sample.For safe consumption, the induced radioactivity of irradiated sample was monitored by using NaI (Tl) GammaScintillation Detector. From the monitoring of induced activity, there were no considerable activities above background.

Keywords:gamma irradiation, agronomical characters, nutritional values

Introduction

Chilli is one of the most cultivated vegetable spice crops in tropical and subtropical climates. India is the largest consumer and exporter of chillies in the international markets and exporter of dry chilli, chilli powder and oleoresins to over 90 countries. Mutation are the tools and being used to study the nature and basis of plant growth and development, thereby producing raw materials for genetics improvement of crops, induced mutation can rapidly create variability in quantitatively and qualitatively inherited traits in crops., Mutagenesis is one of the most critical steps for genetics studies as well as selective breeding. Breeding is the most commonly used method for crop improvement and genetic variability is the basis of any breeding program.Genetic variability is also important to adopt a population to the inevitable changes in the environment and to promote the survival of the specie. Mutation breeding is an important method used for the improvement of crops. The crop may undergo desirable mutation that could be at significant benefit to mankind. Chilli contains seven times more vitamin C than orange (Alcantara*et al.*,1996). In this work, the effect of gamma irradiated chilli seeds were investigated by successive cultivation of second generation chilli. This second generation chilli was obtained from cultivation and harvesting of first generation.The aim of this research is to investigate on changes of agronomical characters and nutritional values of chilli due to gamma radiation.

Chilli shrubs are perennial and short-lived. They can grow up to 1.5 m in height. Their stems are woody at the base, fleshy and either erect or semi-prostrate. The shrub consists of a main tap root with many lateral roots. The leaves can grow up to 12 cm long and 7.5 cm wide and are unequal in shape with a pointed tip. Chilli flowers occur singly or in small groups of two or three flowers. They are small and bisexual with have five to six petals each. Flowers of *Capsicum annuum*are white-green, while those of *Capsicum frutescens* L. are yellow or white-green. The chillies

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fruit is hollow with many seeds. They are found in different colours like green, orange, white, yellow and red (Tindall, 1983). Vitamin C is essential in wound healing and in the formation of collagen, inthe formation of healthy skin, bones and supportive tissues. Deficiency results in defective collagen formation and is marked by joint pains, irritability, growth retardation, anemia, shortness of breath, and increased susceptibility to infection.

Botanical Characteristics of Chilli

Family	:	Solanaceae
Genus	:	*Capsicum*
Botanical Name	:	*Capsicum frutescens* L.
Myanmar	:	Ngayoke
English	:	Chilli
Part-used	:	Fruit

Materials and Methods

The chilli seeds were irradiated by gamma ray with doses of 25 krad, 35 krad and 45 krad from Co-60 source (Co-60 gamma chamber 5000) which has dose rate of 1.4401kGy/h at the Department of Atomic Energy, Ministry of Education. These irradiated samples were cultivated and harvested. In this research, these first generation chilli seeds were cultivated again to obtain second generation chilli seeds. Non-irradiated chilli sample (control) was used for comparative study. The plant leaves started to emerge between 7 and 10 days after sowing(Figure 1). Some nutritional values of non-irradiated and gamma irradiated samples such as moisture, ash, protein, fat and fiber were studied by analytical methods.

Figure 1.Cultivation of non-irradiated and gamma irradiated chilli seeds

Results and Discussion

The results on the investigation of the agronomical characteristics and some nutritional values of non-irradiated and gamma irradiated with different doses of chilli were discussed.

Agronomical Characteristics of Chilli

Seedling time

The seedling time of non-irradiated and gamma irradiated with different doses such as 25 krad, 35 krad and 45 krad of chilli seeds were shown in (Table 1). From the results, it was found out that the seed samples irradiated with gamma energy at 35 krad took 30 % shorter seedling time than that of control. But 25 krad and 45 krad seeds took the same seedling time of 10 days as that of control. Seedling time of plant can influence on the time emerging plant leave, but it does not effect on the plant growth such as plant height, number of branches, number of pods per plant and etc.

Plant Height

The data related to plant height was recorded and it showed that gamma irradiation treatments significantly increased the plant height in samples of 25 krad and 45krad compared to control plants as shown in (Table 2). The height of 35 krad sample was 25% higher than that of control. As a result, it was found out that the higher the dose, the higher in plant height except in the case of 35 krad.

Number of branches per plant

The results of the effect of non-irradiated and gamma irradiated chilli seeds on the numbers of branches per plant were shown in (Table 3). The number of branches per plant for 25 krad, 35 krad and 45 krad were varied from that of control.

Number of pods per plant

The number of pods per plant of control and gamma irradiated chilli seeds were reported in (Table 4). The number of pods per plant was considerably increased by 40-90% in the case of 25 krad and 45 krad when compared with control.

Figure 2. Maturing of chilli in non-irradiated and gamma irradiated chilli seeds forcultivation

Table 1. Comparison of Seedling Time for Chilli Cultivation of Non-Irradiated and Irradiated Chilli with Different Doses

No.	Treatment Dose (krad)	Seedling Time (day)
1	0	10
2	25	10
3	35	7
4	45	10

Table 2. Comparison of Plant Height for Chilli Cultivation of Non-Irradiated and Irradiated Chilli with Different Doses

No.	Treatment Dose (krad)	Plant Height (cm)
1	0	24
2	25	45
3	35	30
4	45	45

Table 3. Comparison of Number of Branches Per Plant for Chilli Cultivation of Non-Irradiated and Irradiated Chilli with Different Doses

No.	Treatment Dose (krad)	Number of Branches Per Plant
1	0	10
2	25	15
3	35	14
4	45	21

Table 4. Comparison of Number of Pods Per Plant for Chilli Cultivation of Non-Irradiated and Irradiated Chilli with Different Doses

No.	Treatment Dose (krad)	Number of Pods Per Plant
1	0	9
2	25	13
3	35	11
4	45	17

Investigation of Some Nutritional Values in Non-Irradiated and GammaIrradiated Chilli

According to the agronomical investigation of non-irradiated and irradiated chilli samples,among the different gamma dose rate, 45 krad was selected for theinvestigationof nutritional values.

Nutritional values of *Capsicum frutescens* L. (chilli) samples were determined by AOAC methods. The nutritional values of *Capsicum frutescens* L. (chilli) samples were shown in (Table 5). The moisture content in pods from non-irradiated seed plants was 90.24 % but the moisture content in pods from irradiated seed plants by gamma radiation (45 krad) was 89.68 %. The content of ash was found to be present nearly the same as control. The contents of protein and fiber were 1.36 %, 1.50 % and 2.25 %, 2.34 % respectively in both cases. The protein contents of gamma irradiation of 45 kradchilli samples wereslightly increasedthan that of control. The content of fat was slightly decreased in irradiated samples. According to the nutritional values, there were no significant changes in nutritional values of gamma irradiated sample compared with non-irradiated sample.

Table 5. Determination of Nutritional Values of Non-Irradiated and Gamma Irradiated Cultivation of Chilli with Different Doses

No.	Nutritional parameters (%)	Sample / Dose (krad)	
		0	45
1	Moisture	90.24	89.68
2	Ash	0.55	0.54
3	Protein	1.36	1.50
4	Fiber	2.25	2.34
5	Fat	0.25	0.18

Monitoring of Radioactivity of Gamma Irradiated Chilli Samples

The chilli samples of different doses were monitored by using NaI (Tl) Gamma Scintillation Detector. The results are reported in (Table 6). It can be observed that there is no distinctive activity above background in the irradiated chilli samples thus it is safe for consumption.

Table 6. Monitoring of Induced Activity in Gamma Irradiated Chilli with Different Doses

No	Samples	Induced activity relative to background
	Dose (krad)	(%) (cp100s)
1	25	2.22
2	35	1.50
3	45	1.30

Conclusion

In this research work, the effect of gamma radiation on chilli cultivation was studied. This study found out that:

From the investigation of the agronomical characteristics, it was found out that the seedling time of irradiated seed plants with gamma energy 25 krad and 45 krad were the same seedling time of 10 days as that of control. It was also found that, the 45 krad dose gamma radiation results in the highest agronomical characteristics such as plant height, number of branches, number of pods per plant and the yield.

From nutritional point of view, there areno significant changes in nutritional values of gamma irradiated sample compared with non-irradiated sample.

From monitoring of induced activity, there is no distinct induced activity compared to that of control. Thus, it is safe for consumption.

From the above observations, it is suggested that the 45 krad dose gamma radiation is selected as optimum dose for the second time cultivation.

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