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Gamma irradiation-induced morphological, yield and biochemical variation in taro (*Colocasia esculenta* (L.) Schott)

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Abstract

Colocasia esculenta is an important tropical tuber crop cultivated for its edible corms. The present investigation was undertaken to determine the effect of gamma irradiation on growth, yield and biochemical traits and to identify the optimum mutagenic dose for inducing genetic variability in taro. Mature, medium-sized corms were irradiated with gamma rays at doses of 2, 5, 10, 12, 14, 16, 18, 20, 40, 80 and 100 Gy, along with an untreated control and evaluated under field conditions. Gamma irradiation significantly influenced morphological, yield and biochemical characters. Increasing radiation dose caused a progressive decline in survival, vegetative growth and yield attributes. No plant survived at 20 Gy and above, while the LD50 was estimated at 13.56 Gy through probit analysis. Lower doses, particularly 2 Gy and 5 Gy, significantly enhanced plant height, number of suckers, leaf area, corm and cormel yield, sugar and protein contents, while reducing oxalate content compared with higher doses. Higher irradiation doses adversely affected all recorded traits owing to increased biological damage. The study demonstrated that gamma irradiation at lower doses (2-5 Gy) is effective for generating useful variability with minimal biological injury and can be utilized as a promising tool in mutation breeding programmes for the genetic improvement of taro.

Keywords: *Colocasia esculenta*, gamma irradiation, induced mutation, mutation breeding, yield traits

Introduction

Taro [*Colocasia esculenta* (L.) Schott] is an important tropical and subtropical tuber crop cultivated primarily for its edible corms, which are a major source of carbohydrates and dietary energy in many developing countries (Ivancic, 1992) [19]. The crop belongs to the monocotyledonous family Araceae, which comprises approximately 100 genera and about 1,500 species (Vinning, 2003) [41]. Taro is one of the few edible species of the genus *Colocasia* and is predominantly diploid ($2n = 2x = 28$), although triploid forms have also been reported. It is among the most widely cultivated root and tuber crops and contributes significantly to food and nutritional security (Rao *et al.*, 2010) [31]. In Andhra Pradesh, taro is cultivated over an area of 510 ha with an annual production of 6,630 tonnes (FAO, 2023) [11]. Taro corms are nutritionally rich, containing high levels of carbohydrates, dietary fibre, moderate amounts of protein and low-fat content (USDA, 2023). In addition to their nutritional value, taro corms contain bioactive compounds with reported medicinal properties, including anticancer potential (Kundu *et al.*, 2012). Its low glycemic index and comparatively low calcium oxalate content make taro a suitable alternative carbohydrate source to rice, thereby contributing to dietary diversification and human health (Bryan *et al.*, 2014) [6].

Genetic improvement of taro through conventional breeding is constrained by irregular flowering, poor flowering synchrony and predominant vegetative propagation through corms and cormels. Vegetative propagation requires large quantities of planting material and is frequently associated with seed corm rotting and viral diseases, resulting in reduced yield (Ooka, 1994) [30]. Under these constraints, mutation breeding has emerged as an effective approach for broadening genetic variability.

Among physical mutagens, gamma rays have been extensively used to induce genetic variability in vegetatively propagated crops.

Gamma irradiation induces mutations by causing DNA strand breaks, and subsequent repair processes may generate heritable genetic variation. This technique is rapid, economical and effective for improving specific traits while retaining the desirable genetic background of elite cultivars. The effectiveness of gamma irradiation in inducing useful mutations in taro has been reported previously (Vasudevan & Joseph, 1990) [40]. Therefore, the present study was undertaken to evaluate the effect of gamma irradiation on morphological, yield and biochemical traits and to determine the optimum irradiation dose for inducing useful genetic variability in taro.

Materials and Methods

The study on physical mutagenesis using gamma irradiation and LD₅₀ determination in taro (*Colocasia esculenta* cv. Godavari Chema) was conducted at the Regional Horticultural Research Station, Dr. Y. S. R. Horticultural University, Kovvur, Andhra Pradesh, during 2022-2024 under field conditions. Healthy, uniform-sized corms of cv. Godavari Chema were used as the experimental material. The corms were packed in corrugated fibreboard boxes with adequate ventilation and transported to Professor Jayashankar Telangana State Agricultural University (PJTSAU), Rajendranagar, Hyderabad, where they were exposed to gamma irradiation using a ⁶⁰Co gamma source. Eleven gamma irradiation doses (2, 5, 10, 12, 14, 16, 18, 20, 40, 80 and 100 Gy) together with an untreated control were evaluated.

After irradiation, the treated corms were disinfected by soaking separately in monocrotophos (2.5 mL L⁻¹) and copper oxychloride (3.0 g L⁻¹) for 10 min, shade-dried and planted immediately. The experiment was laid out in a randomized block design (RBD) with twelve treatments (including the control) and three replications.

Recommended agronomic practices, including fertilizer application, irrigation and weeding, were followed throughout the crop growth period.

Germination percentage was recorded 15 days after planting (DAP), and reduction over the control and the lethal dose (LD₅₀) were estimated in the mutagenized population (Farooq *et al.*, 2021) [12]. The experimental procedure adopted for gamma irradiation is presented in Plate 1. Morphological observations were recorded at appropriate growth stages, whereas corm and cormel characters were recorded at harvest. Representative corm samples (100 g) were oven-dried, powdered and used for biochemical analysis.

Table 1: Twelve doses of gamma irradiation treatments including control were given

Treatment	Dosage	Time of exposure
T ₁	0 Gy	0 sec
T ₂	2 Gy	10 sec
T ₃	5 Gy	23 sec
T ₄	10 Gy	46 sec
T ₅	12 Gy	54 sec
T ₆	14 Gy	1 min 4 sec
T ₇	16 Gy	1 min 12 sec
T ₈	18 Gy	1 min 25 sec
T ₉	20 Gy	1 min 53 sec
T ₁₀	40 Gy	3 min 6 sec
T ₁₁	80 Gy	6 min 13 sec
T ₁₂	100 Gy	8 min 6 sec

Statistical analysis

LD₅₀ value was estimated using probit analysis as described by Finney (1971). Analysis of variance (ANOVA) was performed using INDOSTAT software, and treatment means were compared at the 5% level of significance.

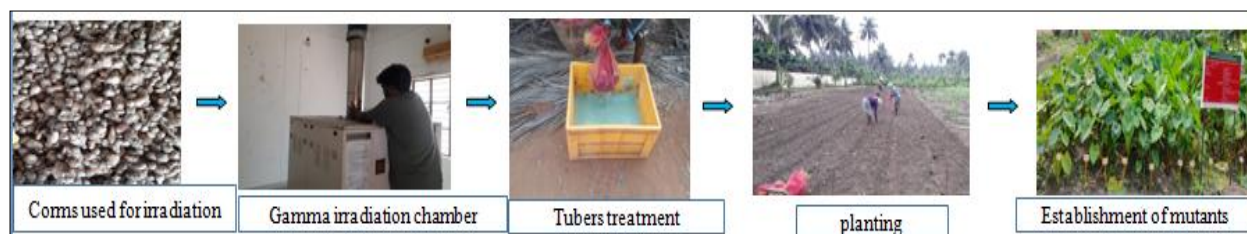


Plate 1: Steps involved in gamma irradiation treatment and establishment of mutants

Results and Discussion

Survival percentage and Lethal dose (LD₅₀)

In the present study, the survival percentage of taro was evaluated under different doses of gamma irradiation, with the untreated control recording 100% survival of corms. A progressive dose-dependent reduction in germination was observed with increasing gamma irradiation dose. The highest germination percentage was recorded at 2 Gy (96.67%), followed by 5 Gy (83.33%) and 10 Gy (70.00%). Germination declined sharply at higher doses, reaching 16.67% at 18 Gy (Table 2; Fig. 1), whereas no plants survived at 20 Gy and higher doses, indicating that these treatments were lethal. Correspondingly, mortality increased with increasing irradiation dose. Based on probit analysis, the LD₅₀ was estimated at 13.56 Gy, indicating that taro exhibited moderate sensitivity to gamma irradiation. Fadli *et al.* (2018) [10] reported that cobalt-60 gamma irradiation increased genetic variability in white taro (*Xanthosoma*

sagittifolium), with an LD₅₀ of 60 Gy under Gamma Cell-220 irradiation, which was considerably higher than that observed in the present investigation. This difference may be attributed to differences in species, genotype, irradiation source and experimental conditions. Similarly, Rawat *et al.* (2021) [32] reported that the median lethal dose (LD₅₀) of gladiolus genotypes ranged from 5.90 to 22.15 kR, indicating variation in radiosensitivity among cultivars. This range was considered suitable for inducing an optimum frequency of useful mutations and was consistent with the findings of the present study. Mabuchi and Kuwada (1975) [26] reported that the survival rate of chrysanthemum decreased progressively with increasing gamma irradiation dose. In the present investigation, probit analysis indicated that the LD₅₀ value lay between 12 and 14 Gy, with an estimated LD₅₀ of 13.56 Gy. Therefore, 14 Gy was considered the optimum LD₅₀ dose for gamma irradiation in *Colocasia* cv. Godavari Chema.

Qualitative variation in leaf characters of gamma irradiated taro

Qualitative characterization of gamma-irradiated taro plants revealed limited variation in leaf morphological traits as assessed using IPGRI descriptors. The majority of irradiated plants exhibited green leaf blade colour, undulate leaf margins, purple margin colour, a 'Y'-shaped vein

Table 2: Determination of LD₅₀ for Gamma irradiation in taro cv. Godavari Chema.

Dose/ concentration	Survival (%)	Mortality (%)	LD ₅₀ value
0 Gy (control)	100.00	0.00	13.56
2 Gy	96.67	3.33	
5 Gy	83.33	16.67	
10 Gy	70.00	30.00	
12 Gy	56.67	43.33	
14 Gy	43.33	56.67	
16 Gy	30.00	70.00	
18 Gy	16.67	83.33	
20 Gy	0.00	100.00	
40 Gy	0.00	100.00	
80 Gy	0.00	100.00	
100 Gy	0.00	100.00	

Pattern and light green petiole colour. Minor variations were observed in leaf blade colour, leaf margin and petiole junction colour. These variations may be attributed to gamma irradiation-induced genetic and physiological changes that alter cellular metabolism and gene expression, resulting in phenotypic variation, as reported by Nurul *et al.* (2018)^[29].

Days to sprouting varied significantly among the gamma irradiation treatments (Table 3). The longest time to sprouting was recorded at 18 Gy (10.07 days), whereas the earliest sprouting was observed at 5 Gy (8.20 days). The enhanced sprouting observed at lower irradiation doses may

be associated with the stimulatory effects of low-dose gamma irradiation on cellular metabolism, enzyme activity and endogenous growth regulators, particularly auxins, thereby promoting early sprout initiation. In contrast, higher irradiation doses are known to impair cell division and metabolic processes through radiation-induced DNA damage, resulting in delayed sprouting. These findings are consistent with those of Usha Nandini Devi and Chezhiyan (2007)^[39] in turmeric and are further supported by Gordon (1954)^[17], who described the influence of auxins on plant growth, and Wi *et al.* (2007)^[42], who reported that low-dose gamma irradiation enhances physiological activity, whereas higher doses adversely affect plant growth.

Plant height was significantly influenced by gamma irradiation (Table 3). The maximum plant height was recorded at 5 Gy (141.93 cm), which was statistically on par with 2 Gy (132.00 cm), whereas the minimum plant height was observed at 18 Gy. Plant height increased at lower irradiation doses but declined progressively with increasing radiation dose, and no plants survived beyond 18 Gy, indicating the detrimental effects of higher irradiation levels. The stimulatory effect of lower doses may be attributed to hormesis, whereby low-dose gamma irradiation enhances cellular metabolism, enzyme activity and endogenous growth regulators, leading to increased cell division and elongation. In contrast, higher irradiation doses are known to impair DNA integrity, disrupt mitotic activity and inhibit physiological processes, thereby reducing vegetative growth. The reduction in plant height at higher mutagenic doses has been associated with auxin degradation and inhibition of auxin biosynthesis, as reported by Gordon (1954)^[17]. Similar enhancement of plant height at lower irradiation doses has also been reported in gladiolus by Tiwari *et al.* (2010), supporting the beneficial effect of low-dose gamma irradiation on vegetative growth.

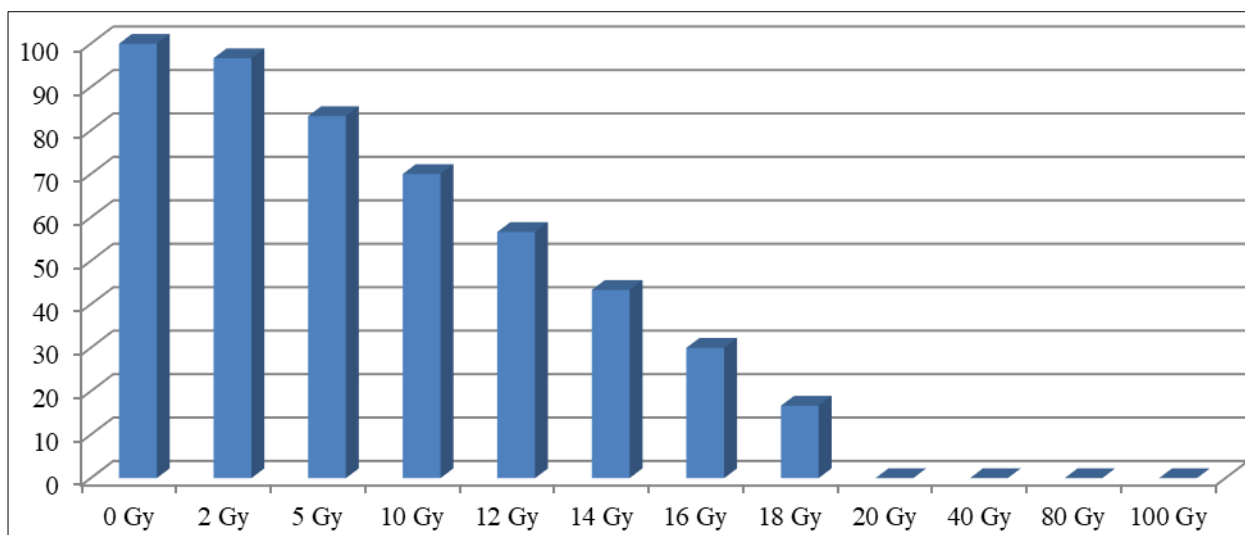


Fig 1: Influence of gamma rays on germination percentage in taro

Number of suckers was also significantly influenced by gamma irradiation (Table 3). The highest number of suckers was recorded at 5 Gy (3.93), followed by 2 Gy (3.20), whereas the lowest number was observed at 16 Gy. Lower doses of gamma irradiation promoted sucker production, whereas higher doses markedly reduced sucker formation. The increased sucker production at lower irradiation doses may be attributed to enhanced meristematic activity and

improved hormonal balance, particularly increased cytokinin-mediated bud initiation and auxin-cytokinin interaction, which stimulate the development of axillary buds. Conversely, higher doses of gamma irradiation may suppress meristematic activity through radiation-induced cellular damage, resulting in reduced vegetative propagation. These findings are in agreement with those of Giridharan (1984), who reported enhanced vegetative

growth at lower doses of gamma irradiation and growth inhibition at higher doses in ginger.

Table 3: Effect of different doses of gamma irradiation on morphological characters in *Colocasia* cultivar Godavari Chema

Treatments	Days to sprouting	Plant height (cm)	Number of suckers	Leaf area (cm ²)	Number of leaves
0 Gy	10.00	120.80	2.73	2567.12	8.47
2 Gy	8.87	132.00	3.20	2846.66	8.67
5 Gy	8.20	141.93	3.93	2835.44	9.47
10 Gy	9.33	110.13	2.73	2176.17	8.13
12 Gy	9.00	107.53	2.47	2214.71	7.27
14 Gy	9.53	98.07	1.33	2112.72	6.20
16 Gy	9.80	90.07	0.33	1384.10	5.20
18 Gy	10.07	68.93	0.00	1169.69	4.93
Mean	9.35	108.68	2.09	2163.33	7.29
S.Em ±	0.37	6.03	0.37	145.24	0.81
C.D (p=0.05)	1.11	18.29	1.12	440.55	2.47

Leaf area was significantly influenced by gamma irradiation (Table 3). The maximum leaf area was recorded at 2 Gy (2846.66 cm²), which was statistically on par with 5 Gy and the untreated control, whereas the minimum leaf area was observed at 18 Gy. Lower doses promoted leaf expansion, whereas higher doses reduced leaf area due to radiation-induced inhibition of cell division and vegetative growth. Similar reductions in leaf area at higher irradiation doses were reported by Songsri *et al.* (2019) and Salama and Hussien (2022). Ehrenberg (1955) attributed the reduction in vegetative growth to interference with normal mitosis and metabolic activity.

Number of leaves per plant was significantly influenced by gamma irradiation (Table 3). The highest number of leaves was recorded at 5 Gy (9.47), which was statistically on par with 2 Gy (8.67) and the untreated control (8.47), whereas

the lowest number was observed at 18 Gy (4.93). Lower doses enhanced leaf production, while higher doses reduced leaf number due to growth inhibition caused by gamma irradiation. Similar responses have been reported in gladiolus by Tiwari *et al.* (2010) [37] and Kiran Kumari and Kumar (2015) [21].

Qualitative evaluation of corm characters revealed limited variation among gamma-irradiated taro mutants. Most mutants produced cylindrical corms with a uniform fibrous skin surface, while minor variation was observed in corm flesh colour, with a few mutants exhibiting yellow flesh and the majority retaining white flesh. These variations indicate that gamma irradiation induced phenotypic variability in taro, which is in agreement with the findings of Ankush *et al.* (2017) [2] and Bhattacharjee *et al.* (2014) [5].

Table 4: Effect of different doses of gamma irradiation on corm characters in *Colocasia* cultivar Godavari Chema

Treatment	Corm length (cm)	Corm width (cm)	Corm weight (g)	Number of cormels	Cormel length (cm)	Cormel width (cm)	Yield of Cormels per plant (g)
0Gy	12.07	8.27	733.33	63.63	5.00	3.60	603.33
2Gy	12.27	8.47	756.67	68.40	5.73	3.70	756.67
5Gy	12.40	9.60	773.33	69.67	6.53	3.73	840.00
10Gy	8.20	7.67	520.00	61.73	4.87	3.40	266.67
12Gy	7.87	8.07	294.67	51.47	4.33	3.47	132.00
14Gy	7.67	7.47	268.67	15.93	3.47	3.47	76.67
16Gy	7.60	7.40	262.00	19.27	2.93	3.40	51.33
18Gy	7.07	6.33	44.00	9.60	3.53	2.47	28.67
Mean	9.39	7.91	456.58	44.96	4.55	3.40	344.42
S.Em ±	0.42	0.29	43.59	5.73	0.44	0.10	20.74
C.D (p=0.05)	1.29	0.89	133.50	17.39	1.34	0.30	63.52

Corm length was significantly influenced by gamma irradiation (Table 4). The maximum corm length was recorded at 5 Gy (12.40 cm), which was statistically on par with 2 Gy (12.27 cm) and the untreated control (12.07 cm), whereas the minimum corm length was observed at 18 Gy (7.07 cm). Lower doses promoted corm growth, while higher doses reduced corm length due to radiation-induced growth inhibition. Similar responses to gamma irradiation have been reported in gladiolus by Choudhary *et al.* (2023) [7] and Jerusalem artichoke by Songsri *et al.* (2019) [36].

Various dosage of gamma irradiation significantly influenced the corm width during the period of investigation and was presented in the table 4. The results were found significant and showed that highest corm width was observed in corms treated with 5 Gy (9.60 cm) followed by corms treated with 2 Gy (8.47 cm). The lowest corm width was observed in corms treated with 18 Gy (6.33 cm).

Lower doses promoted corm development, whereas higher doses adversely affected corm size. Similar reductions have been reported in gladiolus by Rawat *et al.* (2021) [32] and Choudhary *et al.* (2023) [7].

A reduction in corm length at higher doses was also reported by Kumari *et al.* (2018) [23] in gladiolus, where the decrease in vegetative growth at higher doses (70 Gy) was attributed to the failure of translocation of photosynthates to the storage organ. Higher doses of gamma irradiation were found to have a more pronounced effect, which resulted in smaller corm width and reduced corm size. This effect was attributed to a reduction in plant growth. The stimulatory effects observed were considered to be due to acceleration in the release of certain enzymes or biological compounds from their bound form to scavenge free radicals, or due to enhanced biosynthesis of ascorbic acid and sulphhydryl compounds (Flaig and Schmid, 1966) [14]. Such changes

were suggested to occur as a result of physiological disturbances caused by reshuffling of histogen layers given by (Banerji and Datta, 2002)^[3] in chrysanthemum.

Corm weight was significantly influenced by gamma irradiation (Table 4; Fig. 2). The maximum corm weight was recorded at 5 Gy (773.33 g), which was statistically on par with 2 Gy and the untreated control, whereas the minimum corm weight was observed at 18 Gy (44.00 g). Lower irradiation doses enhanced corm weight, whereas higher doses markedly reduced corm development. The increase at lower doses may be attributed to enhanced photosynthetic activity and efficient translocation of assimilates to the storage organ, while higher doses likely disrupted hormonal balance and enzyme activity, resulting in growth inhibition. Similar findings were reported by Salama and Hussien (2022)^[34] in Jerusalem artichoke and Kumar (2012)^[22] in gladiolus.

Number of cormels per plant varied significantly with gamma irradiation, with the maximum recorded at 5 Gy (69.67), which was on par with 2 Gy (68.40) and 10 Gy (61.73), while the minimum was observed at 18 Gy (9.60) (Table 4). The stimulatory effect at lower doses and inhibitory effect at higher doses may be attributed to enhanced photosynthetic efficiency at low irradiation levels and physiological disturbances at higher doses, as reported by Choudhary *et al.* (2023)^[7] in gladiolus. It was stated by these authors that the changes in the number of cormels per plant might have been caused by the disturbance of plant physiology at higher doses due to irradiation treatment, which affected photosynthesis and the root system, resulting in improper plant growth by hampering root activity (Grabowska and Mynett, 1970)^[18] in gladiolus, and thereby adversely affecting the cormel number.

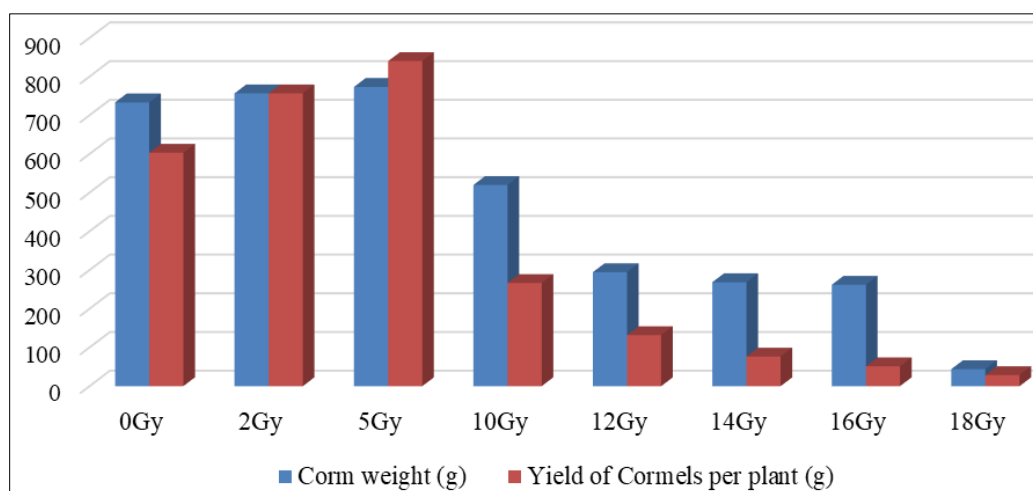


Fig 2: Effect of gamma irradiation on yield attributes of taro

The maximum cormel length was recorded in corms treated with 5 Gy (6.53 cm), which was found to be on par with corms treated with 2 Gy (5.73 cm). In contrast, the minimum cormel length was observed in corms treated with gamma irradiation of 16 Gy (2.93 cm). It was observed that the highest cormel width was recorded in corms treated with 5 Gy (3.73 cm) which was on par with corms treated with 2 Gy (3.70 cm), control (3.60 cm), 12 Gy (3.47 cm), and 14 Gy (3.47 cm). The minimum cormel width was recorded in corms treated with 18 Gy (2.47 cm).

It was reported through experimental studies that enlargement and improvement in the size of cormlets due to the application of gamma irradiation were observed by Jun *et al.* (2007)^[20] in saffron. They found that photosynthetic activity in the treated plants was higher at lower dosages than in untreated corms. A reduction in cormel diameter after irradiation was also reported by Bhajantri and Patil (2013)^[4] in gladiolus cultivars when exposed to gamma radiation. The decrease in cormel size was attributed to the reduction in leaf number and weight, as well as the hampered growth of roots due to the pronounced effect of higher doses.

Results related to yield of cormels in *Colocasia* cv. Godavari chema as affected by different mutagenic treatments are presented in table 4 (fig. 2). It was observed that the maximum cormel yield was recorded in treatment 5 Gy (840 g) followed by corms treated with 2 Gy (756.67 g).

Whereas the minimum cormel weight was observed in corms treated with highest gamma irradiation dosage *i.e.*, 18 Gy (28.67 g).

Reduction in cormel yield at higher gamma irradiation doses might have occurred due to characteristic nature of mutation which led to alterations in chromosomes in one or few genes governing the trait. A decrease in the yield of the cormels was attributed to the reduction in vegetative growth caused by higher doses of gamma irradiation, as the translocation of photosynthates to the cormels was reported to be restricted (Kiran Kumari and Santosh Kumar, 2015)^[21] in gladiolus. Gharib (2021)^[15] in taro investigated the effects of gamma irradiation on taro and found that a lower doses of gamma irradiation resulting in increased cormel weight and yield.

Dry matter percentage and starch percentage showed no significant variation among gamma irradiation treatments indicating these were largely unaffected by gamma irradiation.

Sugar percentage was significantly influenced by gamma irradiation, with the highest values recorded at 2 Gy and 5 Gy (2.98%), which were on par with the control (2.42%), while the lowest sugar content was observed at 18 Gy (1.25%) (Table 5). It was reported in banana that the increase in sugar content might have been due to the degradation of polysaccharides into monosaccharides. It was also suggested that the breakdown of starch into non-reducing sugars,

Table 5: Effect of different doses of gamma irradiation on biochemical characters of *Colocasia* cv. Godavari chema.

Treatment	Dry matter percentage	Starch percentage	Sugar percentage	Protein percentage	Oxalates percentage
0 Gy	29.41	8.61	2.42	1.33	0.047
2 Gy	29.68	8.66	2.98	1.50	0.043
5 Gy	32.27	10.28	2.98	1.73	0.053
10 Gy	29.06	8.56	2.29	1.30	0.050
12 Gy	29.06	8.51	1.91	1.37	0.053
14Gy	27.84	8.20	1.49	1.23	0.063
16Gy	28.41	8.08	1.45	1.27	0.067
18Gy	27.23	7.33	1.25	1.17	0.070
Mean	29.12	8.53	2.10	1.36	0.056
S.Em ±	1.67	1.17	0.21	0.11	0.006
C.D (p=0.05)	NS	NS	0.62	0.33	0.017

Which were subsequently converted into reducing sugars, resulted in a gradual increase in non-reducing sugar. It was further reported by Rezaee *et al.* (2013)^[33] in potato that the reducing sugar content was significantly increased with lower doses, while the non-reducing sugars were decreased with higher doses. A similar finding was observed by Dhulgande *et al.* (2011)^[8] in pea.

Protein content in taro corms varied significantly with gamma irradiation, with the highest value recorded at 5 Gy (1.73%), which was on par with 2 Gy (1.50%), while the lowest protein content was observed at 18 Gy (1.17%) (Table 5). Higher protein content at lower doses and reduction at higher doses may be due to stimulation of metabolic activity at low irradiation levels and disruption of protein synthesis under high radiation stress (Gharib 2021, Nurilmala *et al.*, 2017 in taro)^[15, 28].

The data presented in table 5 indicated that the various doses exhibited significant differences in oxalate percentage during the experiment. The lowest oxalate percentage was recorded in the treatment 2 Gy (0.043%). The highest oxalate percent was recorded at the higher dosages of gamma irradiation, i.e., 18 Gy (0.070%) and 16 Gy (0.067%), which were on par with treatments 5 Gy (0.053%), 10 Gy (0.050%) and 12 Gy (0.053%).

Gamma irradiation was reported to have induced radiolysis and the absorbed radiation was stated to have generated free radicals that altered physiological and biochemical processes, including calcium oxalate formation given by Ahuja *et al.* (2014) in maize. Furthermore, the synthesis of ascorbic acid associated with oxalate production was suggested to have been modified and low gamma irradiation was reported to have enhanced plant nutrition, though the quality of grains related to micronutrients was not improved referred by Singh and Datta (2010)^[35] in wheat. Similar observations regarding differences in oxalate content in pea was reported by Lolas and Markakis (1975)^[25], wherein lower doses were considered to have resulted in reduced oxalate percentages due to dilution of antinutritional factors in plant tissues by increased growth.

Conclusion

Germination and survival were found to decline progressively with increasing gamma irradiation, and no plant survival was recorded beyond 20 Gy, which was therefore considered lethal. Probit analysis estimated the LD₅₀ value at 13.56 Gy, indicating moderate radiosensitivity of taro to gamma rays. Lower doses of gamma irradiation, particularly 2 and 5 Gy, were observed to enhance morphological, yield, and biochemical traits, whereas higher doses resulted in pronounced growth and yield suppression. Yield and yield contributing characters were maximally

improved at 5 Gy, while qualitative morphological traits remained largely stable across treatments, indicating limited phenotypic disruption due to irradiation.

Biochemical traits exhibited variable responses, with sugar and protein contents being enhanced at lower doses and reduced at higher doses. Oxalate content was lowest at 2 Gy and increased with increasing radiation dose, indicating an additional nutritional advantage at lower irradiation levels. Overall, the results demonstrated that low doses of gamma irradiation (2Gy and 5 Gy) were optimal for inducing useful variability with minimal biological damage, whereas higher doses were detrimental. Therefore, gamma irradiation in the range of 2Gy and 5 Gy was considered suitable for use in mutation breeding programmes of taro for improving growth, yield, and quality traits, and the estimated LD₅₀ value may serve as a useful reference for future mutation breeding studies in this crop.

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