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EVALUATION OF THE EFFECT OF CHRONIC GAMMA IRRADIATION ON TARO (*Colocasia esculenta* L. cv Wangi) FOR AGRONOMIC, GENOMIC, ANTIOXIDANT AND OXALATE CONTENT CHARACTERISTICS

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ABSTRACT

Taro (*Colocasia esculenta* L.) is an important staple food crop in developing countries which has a great potential in terms of high-quality food and has a higher nutritive value. Mutation breeding can be used for selection and improvement of desirable morphological traits of taro. This study was attempted to induce mutation on taro in order to determine the effect of gamma irradiation on morphological traits of taro *cv* "Wangi". Suckers of taro *cv* "Wangi" that had previously been exposed with seven doses (0 Gy, 12.01 Gy, 16.02 Gy, 28.03 Gy, 44.05 Gy, 68.07 Gy, 120.12 Gy and 268.28 Gy) under chronic gamma ray radiation were propagated until M_1V_4 generations. The genetic diversity of taro mutant lines was analyzed among irradiated taro based on the genetic analysis by using Simple Sequence Repeat (SSR) molecular markers. It was observed that chronic gamma irradiation had tremendously affected the growth performance of taro plant. In M_1V_1 generation, a decreasing trend in the plant height, leaf width, number of suckers per plant and corm weight characters was observed in all the treatments when compared to unirradiated plant (control). In M_1V_2, M_1V_3 and M_1V_4 generation, all the trait studied exhibited significantly better performance in mutant taro as compared to the control. Moreover, those generations also exhibited wide spectrum of viable mutants including shape of laminar, laminar orientation, colour of laminar, vein colour, shape of leaf vein and laminar variegation and corm shape. Correlation analysis revealed the strong and positive correlation between corm weight with corm diameter. Heritability analysis showed the phenotypic coefficients of variation in general for all the characters were higher than genotypic coefficients of variation indicating the influence of environmental factors on these traits. Highest level of heritability was observed in 16.02 Gy for trait number of suckers, number of leaves per plant, corm weight and diameter of corm meanwhile taro mutant at 44.05 Gy, 67.05 Gy and 120.02 Gy recorded highest heritability for trait plant height, leaves length, number of stolon and corm length. The total phenolic content (TPC), total flavonoid content (TFC) and radical scavenging activity showed a significant difference ($p<0.05$) on different irradiation doses which plant exposed in12.01 Gy showed the highest in TPC and TFC with 299.37 ± 8.87 mg GAE/ 100g and 1680.75± 64.69 mg GAE/ 100g respectively while the highest radical scavenging percentage was recorded in plant treated with 268.28 Gy in both methanol and aqueous extract. The highest oxalate content was recorded in plant exposed with 120.12 Gy (13686.06 ± 356.32 mg/100g) and the lowest was found in plant treated at 12.01 Gy (6092.78 ± 344.54 mg/100g). The PCR-based SSR analysis showed that out of 10 SSR primers tested, 7 primers successfully amplified a total number of 42 amplicons. The polymorphism information content (PIC) values of SSR markers ranged from 0.20 to 0.80. Cluster analysis classified taro into 3 subgroups as mutant and parent genotypes. The results clearly showed that SSR markers are important tools to distinguish mutant genotypes and confirmed their usefulness for phylogenetic studies. Findings in this study suggested that the mutation induction approach is recommended for taro genotype improvement with lower doses of chronic gamma irradiation produced high antioxidant activity and low oxalate content of taro genotype. Potential taro genotypes develop in this study was considered as potential genotype for future taro breeding program.

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CHAPTER ONE
INTRODUCTION

1.1 Research Background

Climate change and increasing population is proven to have had impacted the agricultural productivity of staple crops and food security everywhere in the world. Health issues such as obesity and diabetes contribute to the major challenges due to the globalization and intake patterns which necessitates the search for nutritious foods. The efforts on food security are aimed at supplying nutritious food from local resources that can be cultivated in various agro- ecological areas of tropical climate countries. Hence, underutilized or neglected root crops have roles in the improvement of food security.

Root crops are major sources of carbohydrates which consists of 40-50% energy source comprising of minerals, calcium, iron, fibre and vitamins (Nanbol and Namo, 2019; Bhardwaj *et al.,* 2021). Among them, taro (*Colocasia esculenta* (L.) *Schott*) is one of the world's oldest crops that belongs to *Araceae* family which is widely cultivated in tropical and sub-tropical regions of many countries (Juang *et al.*, 2021; Nipa, 2021). Taro is primarily grown for its starchy corm but the leaves, petioles and inflorescences are also edible. It has low content of fat, fibre and ash but high in vitamin and mineral which useful for the elderly, children with allergies, person with diabetics and other problems related to intestinal (Fufa *et al.,* 2021). Phytochemicals compounds from all plant portions of taro have various domestic and therapeutic properties. The antioxidants such as vitamin C, phenols and carotenoids have been shown to be related with reducing rates of mortality due to heart disease and other degenerative diseases (Guchhait *et al.*, 2008). Besides, taro leaves and corms contain significantly more calcium, magnesium, and potassium than other tuber crops and have the highest concentrations of manganese, copper, zinc (Kapoor *et al.,* 2021) and bioactive compounds such as flavonoids, steroids, β-sitosterol and triterpenoids that are mainly found in taro leaves (Sharma *et al.,* 2020).

Regardless of many nutritional values, taro also have anti nutritional such as phytates and oxalates capable of affecting the availability of desirable nutrients. Oxalates form by oxalic acid is the needle-like calcium oxalate crystals as raphides where it can penetrate soft skin. Consumption consistently of taro in large amounts with