



A Comparative Study of the Effect of Using Gamma Rays and Lantana Leaves Powder on the Quality of Cowpea Seeds During Storage

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Abstract

This study involved using gamma radiation and lantana leaf extract to preserve cowpea seeds for six months. The study aimed to determine the effect of gamma radiation and lantana leaf extract on certain quality factors of cowpea seeds, such as protein and carbohydrate content, moisture content, and weight loss during storage. This would allow for their use as preservation methods to protect stored seeds from spoilage in grain stores. Gamma radiation was used at doses of 5, 10, and 15 kGy, while lantana leaf extract powder was used at concentrations of 2, 4, and 6 g/250 g of cowpea seeds. The obtained results were concluded as follows: (a) The smallest decrease in protein percentage was in the sample irradiated at a dose of 5 kGy, which was approximately 24%. While, it was 26.2% at using 4 g of dried lantana leaf powder., (b) The lowest decrease in carbohydrate content was in the sample irradiated with a dose of 5 kG, which was approximately 12.6%. While, it was 14.5% at using 4 grams of dried lantana leaf powder., (c) The lowest weight loss was observed in the sample irradiated with a dose of 5 kGy, which was approximately 18.4%. While, it was observed in the sample with 4 g of dried lantana leaf powder about 9.6%., (d) The smallest decrease in moisture content was observed in the sample irradiated at a dose of 5 kGy, which was approximately 64.1%. While, it was in the sample to which 4 g of dried lantana leaf powder about 83.8%., and (e) Generally, it was concluded that a 5 kG irradiation dose can be used to irradiate cowpea seeds, or a quantity of dried lantana leaf powder at a rate of 4 g per 250 g of cowpea seeds can be used.

Keywords: Cowpea Seeds; Physico-Chemical Properties; Lantana Leaves Powder; Irradiation; Gamma; Quality and Storage

Introduction

Cowpea is the popular crop *Vigna unguiculata* (L.) The complete plant parts leaves, seeds, roots and pods consumed by humans and animals, Cowpeas possess a superior nutritional profile and provide a prolonged sense of satiety compared to other cereals and pulses. It has high content of proteins, fiber, carbohydrates, low cholesterol, minerals and vitamins. They can help lower cholesterol, support growth, supply iron to increase blood cells, improve gall bladder function, help keep the circulatory system healthy, increase insulin production, assist in weight loss, and provide strong antioxidant protection. Cowpeas also contribute to overall health and can help reduce the risk of both infectious and non-infectious diseases [1].

The cowpea plant is a nutritious legume that provides an excellent combination of carbohydrate and protein, nutrients that are vital for proper nutrition among humans. Each 100g serving of cowpea contains 61.8g of carbohydrates, 23.8g of protein, and 2.07g of fat [2]. According to FAO (2023) [3], Egypt's cowpea production in 2023 totaled 7,274.21 metric tonnes. This yield was harvested from an area of 4,776.5 feddans under cultivation.

The major threat to stable cowpea production, especially in storage is the cowpea weevil, *Callosobruchus maculatus*. This crop pest has been reported as a menace facilitating postharvest losses in cowpea grains causing at least 60% loss because of perforations on the grain seeds. Consequently, the seed quality was reduced and no longer suitable for either consumption or cultivation, thus lowering their market value [4].

Gamma irradiation, as low as 2 kGy, significantly modified all cowpea starch pasting and functional properties studied. Swelling index (SI) and Peak Gelatinisation Temperature (PGT) present significant correlations with most cowpea starch physicochemical properties [5].

Evaluated how gamma rays affected amino acids, thiamine, and oligosaccharides in cowpea beans, as well as the types and amounts of fungi and their toxins. the irradiation doses was 0.0, 0.5, 1.0, 2.5, 5.0 and 10.0 kGy the results showed Irradiation significantly reduced the presence of *Aspergillus*, *Penicilium*, *Rhizopus* and *Fusarium* fungi and was shown to be efficient in grain conservation for a storage time of 6 months [6].

Gamma rays were used to irradiated Cowpea seeds by the doses were 200 Gy, 300 Gy, 400 Gy, and 500 Gy and stored for four months. Notably, 500 Gy exhibited the least weight loss among irradiated samples, highlighting a dose-dependent effect of gamma irradiation on weight loss and its potential impact on shelf life, and can effectively preserve the nutritional components and extend the shelf life of cowpea, offering an alternative to chemical preservation methods [7].

The effect of using gamma rays enhancing storage life of grain cowpea. By using six treatments (100, 200, 300, 400, 500 Gy, and control) with different doses of gamma rays. All the treatments were effective in control of pulse beetle infestation without any seed damage and consequently no weight loss. Meanwhile, Gamma radiation at 200 Gy registered a higher value for seed germination parameters and was highly effective in controlling pulse beetle infestation. Though, gamma doses above 200 Gy were effective in controlling pulse beetle, it showed reduction in germination parameters and morphological traits [8].

A natural and cost effective method for reducing fungal growth in stored cowpeas is using the essential oil from *Lantana camara*. Tests show that, at a concentration of 20 micrograms (thousandth of a gram) per millimetre, the essential oil was effective at managing fungal contamination [9].

A study into the evaluation of *lantana (Lantana camara)* leaves and roots for the control of cowpea insect pests. The treatments comprised of *lantana* leaves and roots at 50g/l, and 75g/l each, an uncontrolled treatment and Dimethoate 40 EC at 2.5 ml/l. Effects of these treatments on aphids (*Aphis craccivora*), pod borer (*Maruca vitrata*) and foliage beetle (*Ootheca mutabilis*) counts and damage and grain yield were determined. The results of the study showed that *lantana* leaf and root extracts significantly reduced *A. craccivora*, *O. mutabilis*, and *M. vitrata* populations at 75g/l [10].

Study the Effect of *Lantana camara* on controlling insect pests on storage of pea seeds. When *L. camara* was mixed with pea seeds in a ratio of 1Kg pea seeds to 150g *L. camara* or more, the seeds were not damaged by insects. In contrast, all the seeds were damaged by insect pests [11].

The main objective was to study the comparative effect of gamma rays and *lantana* powder on the some physical and chemical properties of cowpea seeds during storage.

Materials and Methods

Cowpea Seeds (*Vigna unguiculata L.*) Cultivar Black-Eyed (Qaha 1 variety), sourced from the Field Crops Research Institute in Egypt, was acquired. A seed rate of was 3 kg for each treatment that applied throughout the 2025 growing season.

Seeds were subjected to gamma irradiation at doses of 0 (control), 5, 10, and 15 kGy using Indian gamma cell (^{60}Co source) at the National Center for Radiation Research and Technology, Nasr City, Cairo, Egypt. Following irradiation, four subsamples (250 g each, including one from the control) were drawn from each treatment, placed in plastic bags, and stored at room temperature for six months.

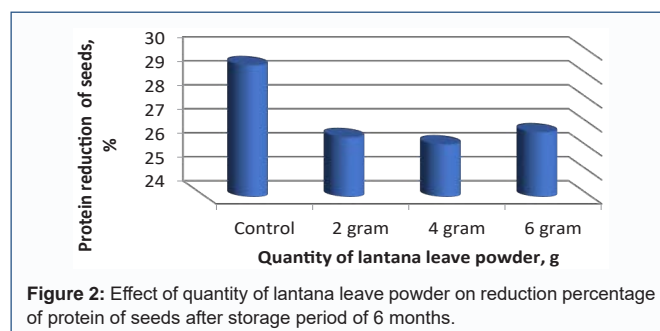
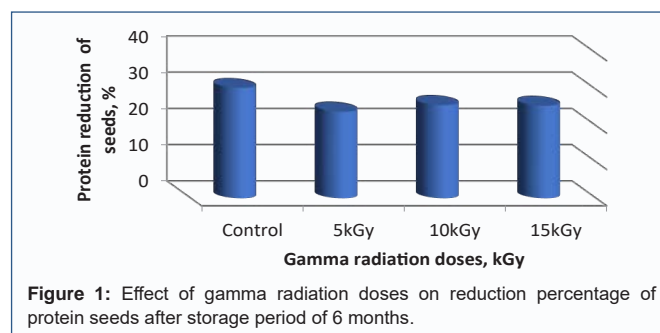
The efficacy of *Lantana camara* leaf powder extracts was assessed against *Callosobruchus maculatus* in laboratory conditions. The seeds were treated with *lantana* leaves powder three different concentrations of *L. camara* leaf powder (2, 4, and 6 grams per treatment; with three replicates for each), the powder was extract by sun draying then milled by laboratory mill. Meanwhile there were Seeds that not treated (control group). After mixing the powder with the seeds, three samples (each one 250 g), and the control treatment were placed in plastic bags, and stored at room temperature for six months.

Using (A.O.A.C., 2000) [12] procedure, the quality of cowpea seeds was evaluated throughout storage every three month by measuring the amount of moisture, protein, carbohydrates, and weight losses of all samples from each treatment. While about 100 seeds were measured the mass by digital balance for the control and the irradiated treatments and the treated seed with *lantana* leaves powder.

Results and Discussions

Protein percentage

Regarding the effect of using gamma radiation on cowpea seeds during six months of storage. Figure 1 shows the protein percentage decreased by 24.0%, 25.8%, and 25.6% for seeds irradiated at doses of 5, 10, and 15 kGy, compared to the unirradiated (control) seeds, where the decrease was approximately 30.5%. It is clear from the above that the smallest decrease in protein percentage was in the sample irradiated at a dose of 5 kGy, which was approximately 24%. While, for the effect of using dried *lantana* leaf powder in preserving cowpea seeds during six months of storage. Figure 2 shows the protein percentage decreased by 26.5%, 26.2%, and 27.2% for seeds preserved



with dried lantana leaf powder at doses of 2, 4, and 6 grams per 250 grams of cowpea seeds, compared to the untreated (control) seeds, where the decrease was approximately 30.5%. Approximately 29.5%. It is clear from the above that the lowest decrease in protein content was in the sample to which 4 g of dried lantana leaf powder was added per 250 g of seeds, which was approximately 26.2%.

Carbohydrate content

According to the effect of using gamma rays on cowpea seeds during six months of storage: Figure 3 illustrate that the carbohydrate content decreased by 12.6%, 14.2%, and 15.7% for seeds irradiated with doses of 5, 10, and 15 kG, respectively, compared to the un-irradiated seeds (control), where the decrease was approximately 21.8%. It is clear from the above that the lowest decrease in carbohydrate content was in the sample irradiated with a dose of 5 kG, which was approximately 12.6%. While, for the effect of using dried lantana leaf powder on preserving cowpea seeds during six months of storage. Figure 4 it showed that the carbohydrate content decreased by 15.6%, 14.5%, and 19.1% for seeds preserved with 2, 4, and 6 grams of dried lantana leaf powder per 250 grams of cowpea seeds, compared to untreated seeds (control), where the decrease was approximately 21.1%. It is clear from the above that the lowest decrease in carbohydrate content was in the sample to which 4 grams of dried lantana leaf powder per 250 grams of seeds were added, which was approximately 14.5%.

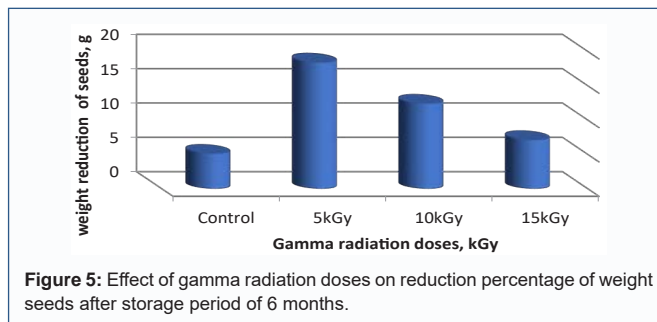


Figure 5: Effect of gamma radiation doses on reduction percentage of weight seeds after storage period of 6 months.

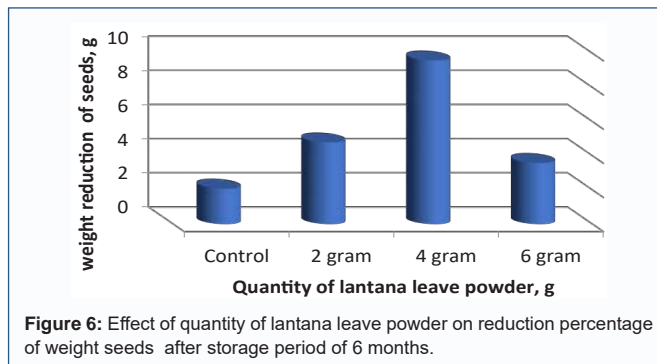


Figure 6: Effect of quantity of lantana leaf powder on reduction percentage of weight seeds after storage period of 6 months.

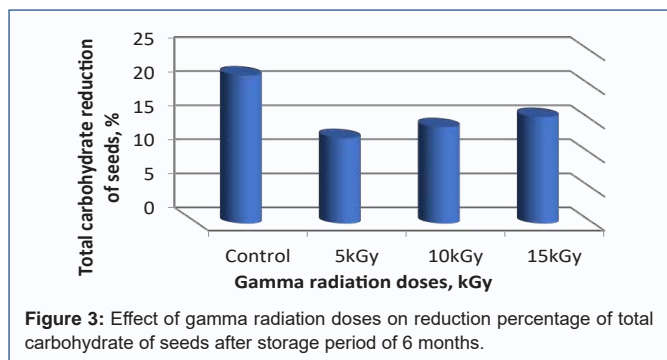


Figure 3: Effect of gamma radiation doses on reduction percentage of total carbohydrate of seeds after storage period of 6 months.

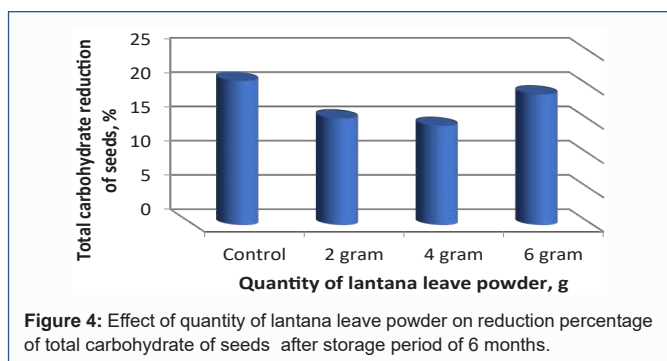


Figure 4: Effect of quantity of lantana leaf powder on reduction percentage of total carbohydrate of seeds after storage period of 6 months.

Weight loss percentage

Regarding the effect of using gamma rays on cowpea seeds during six months of storage. Figure 5 found that the weight loss percentage decreased by 18.4%, 12.4%, and 7.1% for seeds irradiated with doses of 5, 10 and 15 kGy compared to the un-irradiated (control) seeds, where the weight loss was approximately 5.1%. It is clear from the above that the lowest weight loss was observed in the sample irradiated with a dose of 5 kGy, which was approximately 18.4%. While, for the effect of using dried lantana leaf powder on preserving cowpea seeds

during six months of storage. Figure 6 It was found that the weight loss decreased by 4.8%, 9.6%, and 3.6% for the seeds preserved with 2, 4, and 6 grams of dried lantana leaf powder per 250 grams of cowpea seeds, respectively, compared to the untreated (control) seeds, where the weight loss was approximately 2.1%. It is clear from the above that the lowest weight loss was observed in the sample with 4 grams of dried lantana leaf powder per 250 grams of seeds. 9.6%.

Moisture content

Regarding the effect of gamma radiation on cowpea seeds during six months of storage. Figure (7) illustrate the moisture content of seeds, which was decreased by 64.1%, 63.1%, and 63.2%, respectively, for seeds irradiated at doses of 5, 10, and 15 kGy, compared to the un-irradiated (control) seeds, which saw a decrease of approximately 60.1%. It is clear from the above that the smallest decrease in moisture content was observed in the sample irradiated at a dose of 5 kGy, which was approximately 64.1%. While, according to the effect of using dried lantana leaf powder on preserving cowpea seeds during six months of storage. Figure 8 showed that the moisture content decreased by 79.2%, 83.8%, and 77.9%, respectively, for seeds preserved with 2, 4, and 6 grams of dried lantana leaf powder per 250 grams of cowpea seeds, compared to untreated seeds. (Control) The decrease was approximately 68.7%. It is clear from the above that the lowest decrease in moisture content was in the sample to which 4 g

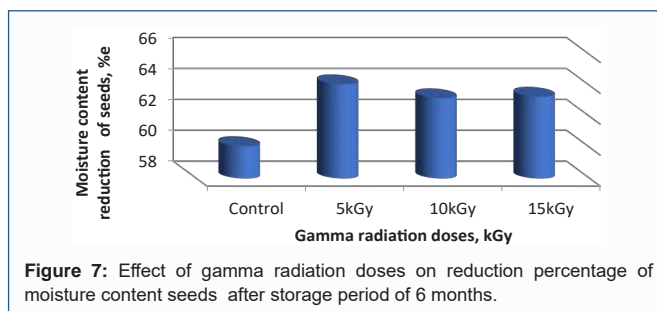
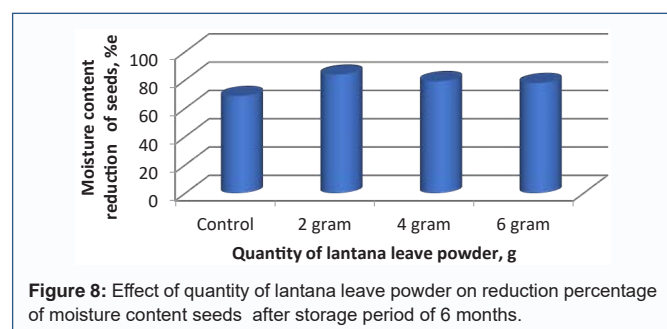


Figure 7: Effect of gamma radiation doses on reduction percentage of moisture content seeds after storage period of 6 months.



of dried lantana leaf powder / 250 g of seeds were added, which was approximately 83.8%.

From the above results, we conclude that a 5 kG irradiation dose can be used to irradiate cowpea seeds, or a quantity of dried lantana leaf powder at a rate of 4 g per 250 g of cowpea seeds can be used.

Conclusions

This experiment was carried out to comparative between quality of cowpea seeds at using gamma radiation and lantana leaves powder as a different method to save seeds during storage, the results were concluded as follows:

- The smallest decrease in protein percentage was in the sample irradiated at a dose of 5 kGy, which was approximately 24%. While, it was 26.2% at using 4 g of dried lantana leaf powder.
- The lowest decrease in carbohydrate content was in the sample irradiated with a dose of 5 kG, which was approximately 12.6%. While, it was 14.5% at using 4 grams of dried lantana leaf powder.
- The lowest weight loss was observed in the sample irradiated with a dose of 5 kGy, which was approximately 18.4%. While, it was observed in the sample with 4 g of dried lantana leaf powder about 9.6%.
- The smallest decrease in moisture content was observed in the sample irradiated at a dose of 5 kGy, which was approximately 64.1%. While, it was in the sample to which 4 g of dried lantana leaf powder about 83.8%.
- Generally, it was conclude that a 5 kG irradiation dose can be used to irradiate cowpea seeds, or a quantity of dried lantana leaf powder at a rate of 4 g per 250 g of cowpea seeds can be used.

Fund

The manuscript not has any fund.

Conflict of Interest

Authors declare not has any conflict interest with others.

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