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MUTAGENIC EFFECT OF ARGEMONE OIL IN WHEAT (*TRITICUM AESTIVUM* L.)[1]

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Abstract

An experiment was conducted on wheat seed to test the mutagenicity of Argemone oil which is often used to adulterate the edible oils. There were a marked reduction in seed germination, seedling height and survival in M_1 and an increase in chlorophyll mutation frequency in M_2 generation after treating the seeds with screwpressed oil. However, in combination treatments of Argemone oil with gamma rays, the reduction was more pronounced in the seedling parameters together with the high mutation frequency, as compared to the single treatments. The results clearly demonstrate that Argemone oil is a potent mutagen with serious implications for the genetic hygiene of human beings as it is used as an adulterant of mustard oil and other vegetable oils.

Key words: Mutagenicity; Argemone oil; wheat; chlorophyll mutation frequency; seed germination; seedling height; survival.

Introduction

Outbreaks of argemone poisoning due to adulteration of edible oils with Argemone oil are reported sporadically from several parts of the country. The seeds of *Argemone mexicana* L. yield a bitter, non-edible oil which is used as an illuminant lubricant and in medicine for external application in skin diseases. The oil is often used to adulterate mustard oil and other vegetable oils that are used as cooking media (Bhatnagar *et al.*, 1948). It has been well established that edible oils mixed with the Argemone oil cause epidemic dropsy (Patwardhan, 1952). Subramanyam *et al.* (1974) reported that screw-pressed oil was more effective in inducing chromosomal aberrations in *Allium cepa*. Reddy and Vaidyanath (1977) clearly indicated that Argemone oil is a potent mutagen which induced high frequency of mutations in rice. However, such studies on this crop are rare. Therefore, an experiment was undertaken to evaluate the mutagenicity of Argemone oil on wheat seeds.

[1] Dedicated to Dr. M. S. Swaminathan, Director General, International Rice Research Institute, Manila, on his 60th birthday.

Materials and Methods

For studying the mutagenic effect of Argemone oil on wheat seeds (*Triticum aestivum* L. var. Bansi), three different experiments were conducted. In the first experiment, a set of 250 seeds was pre-soaked in water for 12 h. The second and third set of 250 seeds each were soaked in water for 6 h and 2 h, respectively. In the second experiment, three sets of seeds were exposed to 40 kR ($1\ R = 2.58 \times 10^{-4}$ C/kg) of gamma rays. One set of treated seeds was soaked in water for 12 h. The other two sets were first soaked in water separately for 6 h and 2 h, before they were immersed in Argemone oil for 6 h and 10 h, respectively. In the last experiment, three sets were soaked in water and treated with Argemone oil and then irradiated with 40 kR of gamma rays. These experiments were repeated three times in identical conditions. After completion of the treatment, the excess of oil was removed from the seeds, which were then washed thoroughly in water for half an hour. A set of 150 seeds was sown in the field and the remaining 100 seeds were made to germinate in petridishes. The percentage of germination and the seedling growth was recorded after ten days. The M_2 generation was raised to record the data on chlorphyll mutation frequency.

Results and Discussion

The data presented in table 1 showed that the percentage of germination, the seedling height and the survival at maturity were less in the 10 h treatment of Argemone oil as compared to the 6 h, and the seeds soaked in water (Expt. 1). A similar trend was observed in the reduction of the seed germination and the seedling height in combination treatments of gamma rays and Argemone oil when compared to 40 kR+H_2O 12 h. However, plant survival showed a marked reduction in 40 kR+H_2O 6 h+oil 6 h treatment (Expt. 2). In the last experiment, a marked reduction in the seed germination, the seedling height and the survival was induced in the seeds pre-soaked in oil before irradiation. More drastic effects were revealed by the treatment of H_2O 2 h+oil 10 h+40 kR. However, the percentage of final survival was very low in all the treatments (Expt. 3). On the other hand, the chlorophyll mutation frequency was 00.00 to 12.9% (Expt. 1), 11.7% to 14.7% (Expt. 2) and 12.7% to 17.2% (Expt. 3), respectively. The high chlorophyll mutation frequency was observed in the treatments where irradiation was given after Argemone oil. The results obtained indicate that screw-pressed oil is a potent mutagen based on the M_1 seedling parameters and M_2 chlorophyll mutation frequency. The induction of mutations by Argemone oil in multicellular organisms has serious implications for the genetic hygiene of human beings, as it is being used for large scale adulteration of vegetable oils used as cooking media in India and elsewhere (Bhatnagar *et al.*, 1948). The oil extracted from mustard seeds, containing a sufficient

quantity of Argemone oil, is known to cause erythema, epidemic dropsy, gastro-intestinal disturbances, hepatitis, oedema, cardiac failure, abortion, glaucoma and even cancer (Shenolikar, 1971). The toxic effects of oil were attributed to an alkaloid, namely sanguinarine, present in it. Reddy and Vaidyanath (1977) reported that in treatment with screw-pressed oil, a marked reduction in seed germination and high chlorophyll mutation and mutant frequencies were observed. In the present study, the screw-pressed oil reduced the percentage of germination, the seedling height and the survival and on other hand it induced high frequency of chlorophyll mutations. Therefore, it has been proved that Argemone oil is a potent mutagen.

Table 1. *Germination, seedling height, survival at maturity in M_1 and frequency of chlorophyll mutations in M_2 generation.*

Treatments	Germination (%)	Seedling height (cm.)	Survival (%)	M_2 seedlings scored	Chlorophyll mutation frequency (%)
Expt. 1					
H_2O 12 h.	97.33	25.60	75.67	4410	—
H_2O 6 h.+oil 6 h.	81.67	22.40	71.00	4110	12.17
H_2O 2 h.+oil 10 h.	73.00	20.00	60.00	4006	12.85
Expt. 2					
40 kR+H_2O 12 h.	70.67	21.60	61.33	3832	11.74
40 kR+H_2O 6 h.+oil 6 h.	62.00	18.00	42.38	3911	13.17
40 kR+H_2O 2 h.+oil 10 h.	55.33	17.00	51.33	3161	14.71
Expt. 3					
H_2O 12 h.+40 kR	60.00	19.60	41.00	3611	12.74
H_2O 6 h.+oil 6 h.+40 kR	50.00	16.00	36.00	3610	14.96
H_2O 2 h.+oil 10 h.+40 kR	42.67	13.33	30.34	3004	17.21

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Argemone 油對小麥的誘變作用

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Argemone 油是一種經常被用來添加在食用油中的油，本實驗利用小麥種子來測試 Argemone 油的誘變性。以壓榨的 Argemone 油處理過的種子，其種子發芽、M_1 的幼苗高度及存活性均有顯著的減少，而 M_2 之葉綠素突變率提高。以 Argemone 油和 γ-ray 同時處理較單一個別處理其幼苗變數具有更明顯的變異率。結果中清楚的指出，一連串相關物質中，Argemone 油用爲芥子油和其他蔬菜油的添加物時，對人類遺傳生理上可能是一種有力的誘變物。