



Short Communication

Paracetamol and Ibuprofen effect on seed quality attributes of *Triticum aestivum* (Wheat)

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Abstract

Pharmaceutical industries are increasing day by day due to increase in demands and need of medicines. The wastewater generated from these industries has organic and inorganic chemical compounds that cause many hazards to environment and disturb the ecological niche of living organisms. A laboratory scale experiment was conducted to find out the effect of synthetic solutions of Paracetamol and Ibuprofen on wheat seeds under laboratory conditions. After seven days, different growth parameters like per cent seed germination, vigour index (VI), shoot and root length, chlorophyll (Chl) content and dry and fresh weight were analyzed. The research indicates that synthetic solution of both the pharmaceuticals i.e. Paracetamol and Ibuprofen has varying effect on different wheat seed growth parameters. It is therefore recommended that industrial effluents with such type of pharmaceuticals must be treated before being disposed into the environment.

Keywords: Germination%, Ibuprofen, Paracetamol, *Triticum aestivum*, Vigour index %.

Introduction

The rapid rate of urbanization and use of new technologies in agriculture, industries, and livestock contribute to water quality deterioration¹. Industries effluents are usually considered as the major pollutants containing inorganic and organic chemicals, alkalies, acids, suspended solids and other materials² and are responsible for water and soil pollution^{3,4}. Continual use of waste water in crops irrigation increases water repellency level, adversely affect soil properties and gradually make the soil infertile⁵. The quality of irrigation water is important in judging its suitability for irrigation⁶. Pharmaceutical effluents pose a big problem to dispose off because of having high biological oxygen demand, chemical oxygen demand, and total suspended solids, and pH varying from 1–11⁷. Pharmaceuticals compounds from of human and animal excreta may enter surface water bodies and groundwater through surface runoff and soil percolation, respectively⁸. Disposal of unused and outdated pharmaceuticals by patients, healthcare organizations, or industries and disposal of toxic wastes during their manufacturing are other sources of pharmaceuticals in water⁹. Because of growing public concern regarding possible health impacts of pharmaceuticals presence in different environmental component^{10,11}, it becomes essential to know and analyse different aspects of pharmaceutical exposures to common food plants. The present study investigated the effect of different concentration of Paracetamol and Ibuprofen on wheat seeds germination. Paracetamol or acetaminophen (C₈H₉NO₂) has a unique position among analgesic drugs and is extensively and increasingly being used as a common antipyretic and analgesic drug for the relief of headache, fever and other minor pains and

aches. Whereas, as an alternative of Aspirin, Ibuprofen was launched in 1969 as the first member of propionic acid and is widely used as an anti-inflammatory, analgesic, and antipyretic agent¹². Haryana state occupies the third place in wheat production among the states of India having maximum contributing districts are Hisar, Ambala, Jind, Rohtak, and Faridabad. Therefore, the experiment was designed with two commonly used analgesic and antipyretic drugs on wheat which is an important crop of Haryana.

Materials and methods

The five different concentrations of Paracetamol and Ibuprofen viz. 100%, 80%, 40%, 20%, 10% and 0% (distilled water and control) were prepared from the available medicine in the market. Healthy and uniformly weight seeds of *Triticum aestivum* were sanitized with HgCl₂ (0.1%) for 5 min and then thoroughly washed with distilled water. The wheat seeds were then kept to germinate for 24 hrs and afterwards germinated seeds were relocated in glass petriplates lined with Whatmann filter paper no.1. To moisten the filter paper 3 ml of the respective concentration of synthetic solutions were added in each petriplates at the 1st day of the experiment and then 2 ml of the respective concentration was poured repetitively for six days. Three sets of each concentration were maintained along with the control for comparison at 28°C in the incubator. On the seventh day, chlorophyll content and various growth parameters were investigated as follows:

Germination Percentage (Germination %) = Number of seeds germinated/ total number of seeds × 100¹³.

Root and shoot length: Root and shoot length of seedlings were calculated using the standard centimeter scale¹⁴.

Vigour index = Germination Percentage × (root length + shoot length) cm¹⁵.

Fresh and dry weight: Four seeds were randomly selected from each treatment and weighed to find out the fresh weight and then placed at 80°C in an oven for 24 hrs to obtain dry weight recorded in grams.

Chlorophyll estimation: Chlorophyll is extracted in acetone (80%) and readings were taken using spectrophotometer (Spectrosonic 20) at 663nm and 645nm. Using the absorption coefficients, the amount of chlorophyll is calculated as:
Chlorophyll (a) mg/g tissue = $12.7(A_{663}) - 2.69(A_{645}) \times V / 1000 \times W$
Chlorophyll (b) mg/g tissue = $22.9(A_{645}) - 4.68(A_{663}) \times V / 1000 \times W$
Total chlorophyll mg/g tissue = $20.2(A_{645}) + 8.02(A_{663}) \times V / 1000 \times W$ ¹⁶

Results and discussion

Wheat seed quality parameters as influenced by different concentrations of Paracetamol and Ibuprofen are mention in Table-1 and 2. The steady increase in concentration level of effluent from distilled water (blank/control) to higher concentration (100%) has shown significant changes in various seed quality parameters like root, shoot and total length, root/shoot ratio and on fresh and dry weight, and chlorophyll content both in case of Paracetamol and Ibuprofen.

Effect of Paracetamol: Table-1 and 3 is showing the results of seed quality parameters by Paracetamol treatment. On increasing the concentration from blank to 10%, the gradual decrease in various seed quality parameters was observed. The growth of the plants was significantly increased in the blank (0%). Germination % in untreated (blank, 0%) seedlings of *Triticum aestivum* was 93.33%, while the germination % of seedlings treated with 10%, 20%, 40%, 80% and 100% concentration were 45.71, 80.95, 63.80, 63.80 and 96.16%, respectively. The maximum reduction of 45.71% was found at 10% concentration.

The root and shoot length showed significant ($p < 0.05$) reduction in growth with an increase in the concentration of Paracetamol from 0–10%. There was no significant change in the fresh weight but the dry weight showed the significant change in its values as showed in Table-3. Significant reduction of photosynthetic pigments (chlorophyll a and b) has been observed at the lowest concentration (10% Paracetamol). Total chlorophyll content in the experiments in untreated seedlings was significant but as concentrations increased from 10–100%, the values showed significant reduction in the content. The result of present study revealed that vigour index and total chlorophyll content remained lowered at all the treatments over control. However, other studied parameters like per cent germination, root and shoot length, and fresh and dry weight did not show any definite trend when irrigated with different concentrations. Values of fresh and dry weight and chl-a were remained minimum at 80% concentration while total chl. remained at lowest level at 100%. Scientists earlier reported that pharma effluents treatment had neither growth promoting effect nor growth inhibiting effect on wheat¹⁷.

Table-1: Effect of different concentration of Paracetamol on various parameters in *Triticum aestivum* (Wheat).

Parameters	Concentration (%)					
	DW*	10%	20%	40%	80%	100%
Germination (%)	93.33±3.25	45.71±4.59	80.95±4.59	63.80±3.55	63.80±8.48	96.19±7.55
Vigour index	1721.93±324.1	899.11±68.31	1390.72±311.2	805.79±156.5	1159.21±204.2	1514.03±431.6
Root length (cm)	6.82±1.69	6.0±2.9	5.94±3.8	2.9±1.3	6.95±1.5	4.8±1.9
Shoot length (cm)	11.63±3.24	13.6±4.5	11.24±2.12	9.73±3.5	11.22±2.1	10.94±3.7
Fresh weight (g)	0.121±0.04	0.107±0.04	0.120±0.06	0.123±0.05	0.096±0.01	0.106±0.03
Dry weight (g)	0.006±0.001	0.004±0.00	0.007±0.001	0.005±0.002	0.002±0.00	0.002±0.00
Total Chl (mg/g)	0.018±0.003	0.014±0.002	0.017±0.001	0.007±0.001	0.012±0.01	0.01±0.00
Chl a (mg/g)	0.003±0.001	0.002±0.001	0.003±0.001	0.001±0.002	0.001±0.0001	0.003±0.001
Chl b (mg/g)	0.015±0.004	0.011±0.001	0.014±0.002	0.006±0.001	0.011±0.001	0.007±0.001

*DW- distilled water i.e. 0% Paracetamol.

Table-2: Effect of different concentration of Ibuprofen on various parameters in *Triticum aestivum* (Wheat).

Parameters	Concentration (%)					
	DW*	10%	20%	40%	80%	100%
Germination %	98.09±5.04	77.1±6.48	93.3	55.03±7.03	43.77±3.52	51.38±3.6
Vigour index	1404.76±204.1	1364.97±159.0	856.26±86.23	735.33±96.4	961.83±165.4	1559.6±122.4
Root length (cm)	4.3±1.60	8.88±4.93	4.37±1.72	5.21±2.46	5.35±3.22	7.07±3.16
Shoot length (cm)	11.6±1.53	9.34±3.50	10.26±2.79	10.35±1.74	11.45±1.34	11.65±2.03
Fresh weight (g)	0.65±0.06	0.173±0.03	0.158±0.06	0.171±0.02	0.297±0.02	0.261±0.05
Dry weight. (g)	0.028±0.01	0.011±0.002	0.010±0.002	0.011±0.001	0.010±0.002	0.013±0.004
Total Chl (mg/g)	0.023±0.01	0.022±0.00	0.013±0.00	0.014±0.00	0.009±0.00	0.016±0.01
Chl a (mg/g)	0.005±0.00	0.007±0.00	0.002±0.00	0.004±0.00	0.001±0.00	0.003±0.00
Chl b (mg/g)	0.017±0.00	0.014±0.00	0.011±0.00	0.009±0.00	0.007±0.00	0.012±0.00

*DW- distilled water i.e. 0% Ibuprofen.

Table-3: Correlation coefficient (p) for effect of Paracetamol concentration on different seed quality attributes during germination of *Triticum aestivum* (wheat).

Parameters	Germination (%)	Vigour index	Root length (cm)	Shoot length (cm)	Fresh weight (g)	Dry weight (g)	Total Chl (mg/g)	Chl a (mg/g)	Chl b (mg/g)
Germination (%)	1								
Vigour index	0.892	1							
Root length (cm)	0.071	0.496	1						
Shoot length (cm)	-0.406	-0.021	0.599	1					
Fresh weight (g)	0.272	0.109	-0.424	-0.336	1				
Dry weight (g)	0.125	0.156	-0.017	-0.030	0.866	1			
Total Chl (mg/g)	0.245	0.603	0.788	0.540	0.176	0.553	1		
Chl a (mg/g)	0.714	0.802	0.287	0.236	0.298	0.361	0.630	1	
Chl b (mg/g)	0.170	0.536	0.821	0.465	0.150	0.553	0.975	0.468	1

Values are Significant if, $p < 0.05$, Values are very significant if, $p < 0.01$ and not significant $p > 0.05$.

Effect of Ibuprofen: The results of seed quality attributes treated with Ibuprofen are depicted in Table-2 and 4. Five out of nine studied parameters viz. % germination, fresh and dry weight, total chl. and chl.-b showed their maximum results at control i.e. with distilled water whereas minimum values of five studied parameters were investigated at 80% concentration. The values of % germination and dry weight and concentration of chl.-a, chl.-b and total chl. remained at lowest level with 80% Ibuprofen concentration. Same as in accordance with Paracetamol, no definite pattern was observed on growth parameters on treatment with different concentrations of Ibuprofen. However, on increasing Ibuprofen concentration up to 80%, the seed quality parameters showed significant reduction but at 100% concentration the results showed somewhat opposite trend. In case of effluent treatment, the percent germination might be increased due to the decrease concentration of toxic metabolites by dilution and nutrients^{18,19}. The root length of wheat seedlings was significantly increased from 4.3 to 8.8 cm as the concentration of Ibuprofen was increased from 10–100%. Root elongation is often considered as a primary effect measure for plant toxicity tests as they are the contact point with exposure medium and contaminants may gain entry through plant roots²⁰. In case of *Vigna radiate* (green gram) seeds 100% solution of Ibuprofen maximum affected the vigour index, fresh and dry weight, total chl, chl-a and chl-b contents²¹. The growth and germination of five varieties of groundnut (*Arachis hypogea L.*) shows an inhibitory effect on seed growth and germination after treatment with pharmaceutical factory effluent¹. Irrigation with effluents directly changes the physical, biological and chemical characteristics of soils and was responsible for reduced rate in seeds germination but the early study have verified that appropriately diluted effluents can be used for irrigation²².

Conclusion

The study demonstrates the effect of both antibiotics on growth parameters of *Triticum aestivum* seeds. However, no definite pattern was observed on growth parameters on treatment with different concentrations of Paracetamol and Ibuprofen. Overall the different concentrations of antibiotics supported the seedling growth. Many researchers across the world also observed similar trend from the impact of pharmaceutical effluents from various industries on different crops, depending on crop species and type of effluent used.

Therefore, increase in concentration of antibiotics like Paracetamol and Ibuprofen, did not affect seeds germination and also favours seedlings growth. Some morphological parameters like dry weight and the biochemical parameters like chlorophyll content are affected by higher concentration of antibiotics. Though, it is suggested that introduction of pharmaceuticals in any form should be avoided to be added to soil or water because it will affect the leaf growth and chlorophyll content of the seedlings which is necessary part for food preparation (photosynthesis) in plants.

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Table-4: Correlation coefficient for effect of Ibuprofen concentration on different seed quality attributes during germination of *Triticum aestivum* (wheat).

Parameters	Germination %	Vigour index	Root length (cm)	Shoot length (cm)	Fresh weight (g)	Dry weight. (g)	Total Chl (mg/g)	Chl a (mg/g)	Chl b (mg/g)
Germination %	1								
Vigour index	0.137	1							
Root length (cm)	-0.275	0.513	1						
Shoot length (cm)	-0.247	0.289	-0.461	1					
Fresh weight (g)	0.387	0.445	-0.406	0.639	1				
Dry weight. (g)	0.553	0.477	-0.353	0.473	0.952	1			
Total Chl (mg/g)	0.618	0.672	0.343	-0.199	0.477	0.663	1		
Chl a (mg/g)	0.401	0.447	0.560	-0.527	0.133	0.338	0.890	1	
Chl b (mg/g)	0.750	0.693	0.133	-0.019	0.602	0.773	0.949	0.711	1

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