

## COMPARATIVE STUDY ON THE EFFECT OF EXPIRED AND NON-EXPIRED RANGLIM TABLET ON SOIL QUALITY

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### ABSTRACT

In pharmaceuticals, Antidiabetic drugs are one among the medicine used to treat diabetes Miletus. These pharmaceuticals enter into the environment through various routes like humans and animal excretion. The improper disposal of unused or expired tablets which may reach to the landfills along with the household wastes. During the present research, a pilot study has been conducted in order to know the impacts of expired and non-expired ranglim tablets on the soil quality. Organoleptic characterization and physical tests of both expired and non-expired ranglim tablets were conducted in order to know the various properties and its characteristics. During the present study, the powdered expired and non-expired ranglim tablets were added at the concentrations of 1g, 5g, and 10g to the landfill soil sample and kept for observations for 30 days. From both the treatments, the soil samples were collected and subjected to extraction and used for the analysis of various physico-chemical parameters. From the physical tests of both the tablets. It was found that, the hardness of expired ranglim tablet was 19.33g and non-expired was 6.9g. The percentage of friability of an expired ranglim was less (0.0008%) in comparison with the non-expired ranglim tablet (0.0117%). The disintegration of the expired ranglim was more than 15 hours and the non-expired tablet got disintegrated after 10 hours. The rate of dissolution of expired ranglim was 1.05% at 4 hours. Whereas, the dissolution of non-expired drug was 98.53% at 4 hours. From the experimental results, it was observed that, in majority of the parameters, the values were found to be higher than the normal range and control values in both the treatments. Similarly, among the obtained results, the values of the expired ranglim treatments were found to have greater effect than the non-expired ones. From the study, it can be concluded that, the dissolution of expired Antidiabetic tablets can alter the soil physico-chemical properties and reduce the overall soil quality. Proper management of pharmaceuticals has to be taken care while disposing along with domestic wastes.

**KEY WORDS :** Ranglim, Expired, Non-expired, Organoleptic properties, Soil Quality

### INTRODUCTION

Diabetes is one among the commonly found diseases that can be seen widely under various age groups. To cure irrespective of the types of diabetes, currently many pharmaceutical compounds are in practice. The commonly used pharmaceuticals to

cure diabetes across the globe are insulin, alpha-glucosidase inhibitors, biguanides, dopamine-2 agonist, dipeptidyl peptidase-4 (DPP-4) inhibitors, ranglim VG1, meglitinides, sodium-glucose transport protein inhibitors, sulfonylureas and thiazolidinediones. Among the above tablets ranglim is one among the combination of

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antidiabetic drug which is frequently used for the treatment of type II diabetes mellites in adults. Its composition includes the combination of three drugs such as metformin, glimepiride and voglibose. Metformin works by lowering the glucose production in the liver and improving insulin sensitivity. Glimepiride lowers the blood glucose levels by increasing the release of insulin from the pancreas. Voglibose is an alpha-glucosidase inhibitor which lowers the postprandial glucose levels in the body (Kadam, *et al.*, 2016). Many studies showed that, the release of these pharmaceuticals through domestic wastes will results in the contamination of water resources and the soil quality, once it reaches the external environment (Jaseem *et al.*, 2017).

Recent study from the Illinois Sustainable Technology (ISTC) showed that, the removal of various emerging pharmaceutical contaminants is not effectively managing as an impact, the pharmaceutical compounds can be seen in various products of wastewater treatment systems (Al-Farsi, *et al.*, 2017). Recently Zheng and his team conducted research and found that, the absorption of sitagliptin in the soil treated with wastewater application. In India, the use of diabetes medicines has reached to higher levels (Hao Cui and Peter Schroder, 2016). So, the entry of one or the other type of diabetes medicines will reach the external environment and contaminate the soil and water system. During the present investigation, it was observed that, the frequent disposal of expired and unexpired Ranglim VG1 tablet was observed in the study area. The study of antidiabetic medicines impact on environment was not concentrated much. But once it is deposited to the environment through various routes, its effects are not a matter of least concern (Eggen and Lillo, 2012). Based on the above concept, the present study has been undertaken to know the effect of Ranglim VG1 tablet on soil quality. In order to know the dissolution pattern of the Ranglim tablet in the environment, the experiments were conducted by using both expired and non-expired Ranglim VGI.

## MATERIALS AND METHODOLOGY

### Pharmaceutical Analysis of Ranglim VGI Tablet

#### Chemical composition of Ranglim tablet and its usage

Ranglim tablet is a combination of three drugs and its compositions are as follows: Metformin

hydrochloride is a crystalline compound with a molecular formula of  $C_4H_{11}N_5 \cdot HCl$ . The chemical composition of glimepiride is 1- [[p- [2-(3-ethyl-4-methyl-2-oxo-3-pyrroline-1 carboxamido) ethyl] phenyl] sulfonyl]-3-(trans-4-methylcyclohexyl) urea. Voglibose chemical composition is (1,3-dihydroxypropan-2-ylamino)-1 hydroxymethyl cyclohexane-1,2,3,4-tetrol.

**Organoleptic characterization of expired and Non-expired ranglim tablets:** In the present study, the general organoleptic properties were studied in order to ensure the quality and the efficacy of the expired tablet in comparison with the non-expired tablet. The organoleptic characterization of tablets involves evaluating the sensory properties, such as the appearance, odor, taste, and texture. In the present study, the layers of the tablets were examined cross-sectionally. The weight of the tablets was weighed individually in order to know average weight. The drug dosage and drug content of both the tablets were determined in order to know the concentration of the amount of the active pharmaceutical ingredient present in the tablets. The therapeutic classes of both the tablets were examined through the label of the tablets.

**Physical tests of expired and non-expired ranglim tablets:** In the present study, the physical tests of the expired and non-expired ranglim tablets were carried out. The physical tests conducted includes, hardness test, friability test, disintegration and dissolution test. In the present study, the hardness test of both the tablets were performed using Monsanto or Pfizer type testers. The friability test of both the tablets were evaluated in order to ensure the tablet's tendency to crumble or break when subjected to mechanical stress or abrasion. In the present research, the disintegration tests of both expired and non-expired tablet were carried out using a disintegration apparatus. The dissolution study was carried out in order to evaluate the rate and extent of drug release from the tablet over the time under standardized conditions. The test is performed using a dissolution apparatus. The results of the organoleptic and physical tests of both expired and non-expired tablets are presented.

### Analysis of soil sample

#### Collection of Soil Sample from the Landfill

In the present study, a survey was conducted in order to know the presence of expired or unused non-expired tablets discarded along with the

household solid wastes. It was found that ranglim was one among the tablets that was disposed along with the household wastes. After the survey, a composite soil samples were collected from the landfills. The soil samples were dried at room temperature, then grinded and passed through 2mm sieve. These soils were further used for the evaluation of physico-chemical analysis using standard procedures [Standard methodology of Arun Kumar Saha (2008), GKV manual (1999)].

### Pilot Study

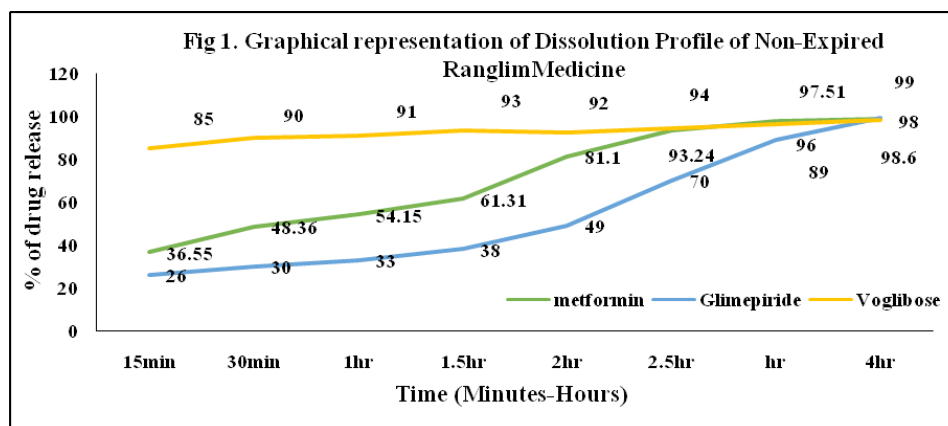
During the present investigation, a pilot study has been done. The collected expired and non-expired ranglim tablets were crushed in order to obtain a fine powder. Pots with 1kg capacity were used for the experimental set up and filled with processed landfill soil samples. The powdered expired and non-expired ranglim tablets were added to the landfill soil samples at different concentrations of 1g, 5g and 10g. For each concentration, 3 trials were maintained in order to get the accurate results. After the application of both the expired and non-expired tablets in powdered form, the soil samples were kept for observation for 30 days. Frequent application of tracer quantity of water was done to maintain the moisture level in all the treatments. At an interval of every 10 days, the soil samples were extracted from the experimental setup for the assessment of soil quality parameters.

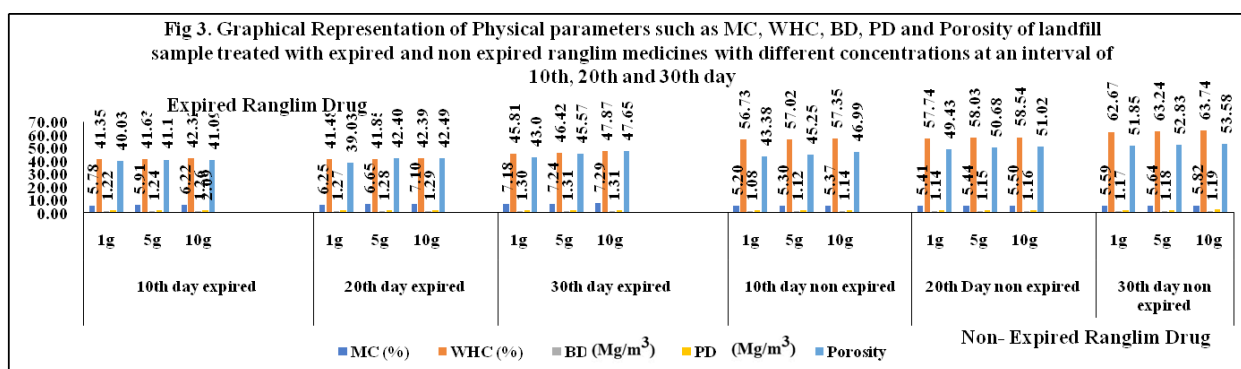
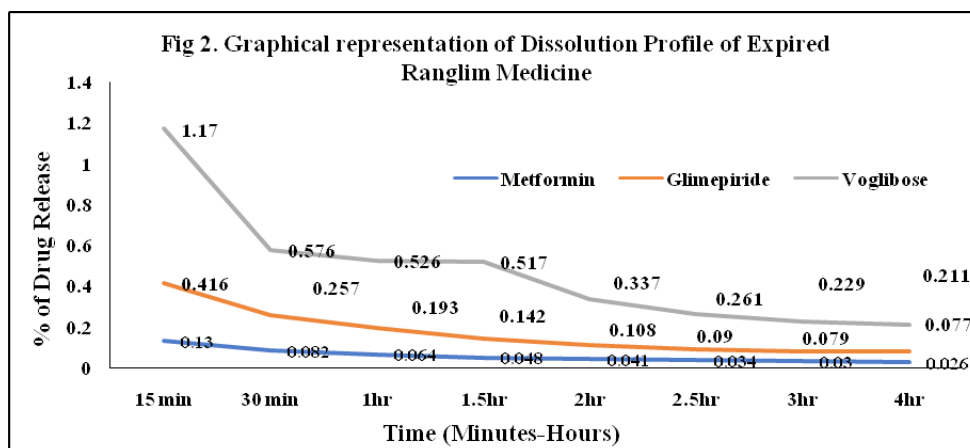
## RESULTS AND DISCUSSION

The organoleptic properties and physical tests of both expired and non-expired tablets are presented in Table 1. From the table, it is shown that, both the tablets are found to be uncoated, bilayer, embossed type of tablet. The colour of the tablet is 1/4<sup>th</sup> red

oxide of iron & 3/4<sup>th</sup> white. The taste of the tablets is very bitter. The size of the tablets is 12 mm in diameter. The shape of the tablet is caplet shape. Each expired tablet weighs for about 0.89g and non-expired tablet weighs for about 0.85g. The reduction in weight of the expired tablet is due the exposure of tablet to an environment which often absorbs moisture content. The tablets belong to the therapeutic class of Antidiabetic.

From the results of the physical tests of both the tablets, it was found that, the hardness of the expired tablet was found to be 19.33g and in the case of non-expired tablet, the hardness observed was 6.9g. This could be due the lack of moisture and transformation that occurs in tablet matrix over a period of time. The friability of the non-expired ranglim tablet showed 0.0117% and expired drug showed 0.0008%. The expired tablets may become more sensitive to crumbling as the time processed. The time taken by the expired tablet to disintegrate was found to be more than 15 hours and time for non-expired was 10 hours. Fig. 1 represents the dissolution profile of the chemical composition of the non-expired ranglim tablet. From the dissolution profile, it was observed that, the rate of the drug components release within 4hrs was 98.6% in metformin hydrochloride, 99% in glimepiride and 98% in voglibose. This shows the non-expired ranglim tablet has more effective in dissolution within a shorter duration of time. Figure 2, represents the dissolution profile of an expired ranglim tablet and it was observed that, the rate of the drug dissolution of metformin hydrochloride was 0.026%, glimepiride was 0.077% and voglibose was 0.211% at 4hours. From the dissolution study, it was observed that, the rate of drug content release of expired ranglim tablet was found to be decrease in the experimental duration, i.e. 4hrs. This indicates





even though the rate of dissolution is slow at 4hrs, extended duration will show greater rate of disintegration.

Based on the above organoleptic properties and the physical tests of both expired and non-expired ranglim tablet, it was observed that, the expired

tablet's quality and stability of the tablet was shown lesser disintegration and dissolution rate in comparison with the non-expired medicine. In order to study, its effectiveness in soil environment, these tablets were further used for pilot study. The results of the experimental studies are presented in the

**Table 1.** Organoleptic Characterization and Physical tests between non-expired and expired Ranglim VGI tablet

| Characteristics      | Non-Expired tablet                                            | Expired tablet                                                |
|----------------------|---------------------------------------------------------------|---------------------------------------------------------------|
| 1 Name of the tablet | Ranglim VG1                                                   | Ranglim VG1                                                   |
| 2 Layer              | Uncoated bilayer embossed                                     | Uncoated bilayer embossed                                     |
| 3 Drug content       | Metformin hydrochloride, voglibose, glimepiride               | Metformin hydrochloride, voglibose, glimepiride               |
| 4 Dosage             | 501.2mg                                                       | 501.2 mg                                                      |
| 5 Colour             | 1/4 <sup>th</sup> red oxide of iron & 3/4 <sup>th</sup> white | 1/4 <sup>th</sup> red oxide of iron & 3/4 <sup>th</sup> white |
| 6 Odour              | Blackberry scent odour                                        | Blackberry scent odour                                        |
| Taste                | Extremely bitter                                              | Extremely bitter                                              |
| 7 Size               | 12 mm in diameter                                             | 12 mm in diameter                                             |
| 8 Shape              | Caplet shape                                                  | Caplet shape                                                  |
| 9 Weight             | Each tablet contains 0.89g                                    | Each tablet contains 0.85g                                    |
| 10 Therapeutic class | Anti diabetic                                                 | Anti diabetic                                                 |
| 11 Hardness test     | 6.9g                                                          | 19.33g                                                        |
| 12 Friability        | 0.0117%                                                       | 0.0008%                                                       |
| 13 Disintegration    | 10 hours                                                      | More than 15hours                                             |
| 14 Dissolution       | Rate of dissolution of drug is 98.53% at 4 hours              | Rate of dissolution of drug is 1.05% at 4 hours               |

Table 2 and 3.

From the analysis of the physico-chemical parameters of landfill soil samples treated with different concentrations of expired and non-expired ranglim tablets the results are presented in the Tables 2 and 3. The experimental results were compared with the soil quality standards and control samples. The interpretation of the obtained experimental results is presented as follows.

In the present study, it was observed that, as the number of days increased, with the concentration of expired and non-expired ranglim tablet treatments, the percentage of moisture content (MC) in the landfill soil sample were also found to increase. In both the treatments, the MC values were found to be higher than the normal range and the control. The higher moisture content observed was 7.29 % in 10g concentration of expired ranglim at 30<sup>th</sup> day interval. In non-expired ranglim treatments, the highest moisture content observed was 5.82% in 10g concentration at 30<sup>th</sup> day interval. Expired medicines may undergo degradation when exposed to moisture, which could affect the soil's composition and potentially lead to leaching of harmful substances into the surrounding environment. From the study, one can conclude that, non-expired ranglim tablet can disintegrate and release the moisture slowly when compared to expired ones.

Water holding capacity (WHC) refers to the ability of the soil to retain water. From the experiment, it was observed that, in comparison with the control, among the ranglim tablet treatments, the highest water holding capacity was found in non-expired ranglim treatment with 63.74% in 10g concentration at 30<sup>th</sup> day interval.

Bulk density (BD) represents the compactness between the overall soil volume. From the study, it was observed that, as the number of days increases, in both the treatments the bulk density values are also found to increase. In comparison with the normal range, the bulk density values were found to be under normal range and slightly above the control value. From the results, it was observed that, high bulk density values observed was 1.31 Mg/m<sup>3</sup> in 10g concentration at 30<sup>th</sup> day interval in expired ranglim sample treatment.

The particle density (PD) of the soil indicates

**Table 2.** Physical Characterization of soil sample treated with expired and non-expired Ranglim medicines with different concentration (Average values of three trials of each concentration)

| Soil Physical Parameters |                        | Moisture Content (%) |             | Water Holding Capacity (%) |             | Bulk Density (Mg/m <sup>3</sup> ) |             | Particle Density (Mg/m <sup>3</sup> ) |             | Porosity (%) |             |
|--------------------------|------------------------|----------------------|-------------|----------------------------|-------------|-----------------------------------|-------------|---------------------------------------|-------------|--------------|-------------|
|                          |                        | Expired              | Non-expired | Expired                    | Non-expired | Expired                           | Non-expired | Expired                               | Non-expired | Expired      | Non-expired |
| Permissible Limit        |                        | 1-1.65               | 4.46        | -                          | 37.62       | 1-1.65                            | 2-2.65      | 30-65                                 |             |              |             |
| Control                  |                        |                      |             |                            |             | 1.182                             | 1.876       | 36.994                                |             |              |             |
| Days                     | Soil samples+ expired  |                      |             |                            |             |                                   |             |                                       |             |              |             |
|                          | and non-expired        |                      |             |                            |             |                                   |             |                                       |             |              |             |
|                          | Ranglim concentrations |                      |             |                            |             |                                   |             |                                       |             |              |             |
| 10 <sup>th</sup> Day     | 1g                     | 5.78                 | 5.20        | 41.35                      | 56.73       | 1.22                              | 1.99        | 1.08                                  | 1.97        | 37.36        | 43.38       |
|                          | 5g                     | 5.91                 | 5.30        | 41.63                      | 57.02       | 1.24                              | 2.08        | 1.12                                  | 2.08        | 40.01        | 45.25       |
|                          | 10g                    | 6.22                 | 5.37        | 42.32                      | 57.35       | 1.26                              | 2.09        | 1.14                                  | 2.13        | 41.09        | 46.99       |
| 20 <sup>th</sup> Day     | 1g                     | 6.25                 | 5.41        | 41.48                      | 57.74       | 1.27                              | 2.15        | 1.14                                  | 2.19        | 39.03        | 49.43       |
|                          | 5g                     | 6.65                 | 5.44        | 41.85                      | 58.03       | 1.28                              | 2.18        | 1.15                                  | 2.21        | 42.40        | 50.68       |
|                          | 10g                    | 7.10                 | 5.50        | 42.39                      | 58.54       | 1.29                              | 2.21        | 1.16                                  | 2.27        | 42.49        | 51.02       |
| 30 <sup>th</sup> Day     | 1g                     | 7.18                 | 5.59        | 45.81                      | 62.67       | 1.30                              | 2.26        | 1.17                                  | 2.35        | 43.0         | 51.85       |
|                          | 5g                     | 7.24                 | 5.64        | 46.42                      | 63.24       | 1.31                              | 2.38        | 1.18                                  | 2.39        | 45.57        | 52.83       |
|                          | 10g                    | 7.29                 | 5.82        | 47.87                      | 63.74       | 1.31                              | 2.40        | 1.19                                  | 2.44        | 47.65        | 53.58       |

**Table 3.** Chemical Characterization of Landfill Soil Sample Treated with Expired and Non-Expired Ranglim with different concentrations (Average values of three trials of each concentration)

| Soil Chemical Parameters | pH                                                                                         | EC (ds/m) | Ca <sup>2+</sup> (ppm) | Mg <sup>2+</sup> (ppm) | Cl <sup>-</sup> (%) | OC (%)   | AN (Kg/ha) | K <sup>+</sup> (Kg/ha) | AP (Kg/ha) | SO <sub>4</sub> <sup>2-</sup> (ppm) | Zn <sup>2+</sup> (ppm) | B <sup>2+</sup> (ppm) | Fe <sup>2+</sup> (ppm) | Mn <sup>2+</sup> (ppm) | Cu <sup>2+</sup> (ppm) |
|--------------------------|--------------------------------------------------------------------------------------------|-----------|------------------------|------------------------|---------------------|----------|------------|------------------------|------------|-------------------------------------|------------------------|-----------------------|------------------------|------------------------|------------------------|
| Permissible Limit        | 6.5-7.5                                                                                    | 1-2       | 700-36000              | 1200-150000            | 0.01-0.99           | 0.5-0.75 | 240-480    | 110-280                | 10-25      | 8-30                                | 0.6-1                  | 0.5-1                 | 4-9                    | 2-4                    | 0.2-0.3                |
| Control                  | 7.35                                                                                       | 1.41      | 84.16                  | 19.45                  | 0.532               | 0.66     | 163.0      | 251.40                 | 79.42      | 26.68                               | 2.94                   | 0.6                   | 46.61                  | 10.19                  | 3.35                   |
| Days                     | Soil Samples treated with different concentrations of expired & non-expired Ranglim Tablet |           |                        |                        |                     |          |            |                        |            |                                     |                        |                       |                        |                        |                        |
| 10 <sup>th</sup> Day     | Expired                                                                                    | 1g        | 285.6                  | 672.3                  | 1.09                | 0.68     | 174.5      | 1545                   | 157.2      | 51.43                               | 1.16                   | 0.52                  | 30.42                  | 11.31                  | 0.8                    |
|                          |                                                                                            | 5g        | 377.6                  | 707                    | 1.20                | 0.99     | 281.9      | 1855.6                 | 196.5      | 149.8                               | 1.79                   | 0.53                  | 32.30                  | 16.41                  | 0.89                   |
|                          |                                                                                            | 10g       | 437.6                  | 717.6                  | 1.26                | 1.11     | 464.6      | 1879                   | 199.4      | 176.2                               | 1.93                   | 0.57                  | 33.99                  | 17.68                  | 0.19                   |
|                          | Non-expired                                                                                | 1g        | 272.6                  | 31.0                   | 0.18                | 0.24     | 120.4      | 73.6                   | 1.2        | 0.47                                | 0                      | 0.03                  | 0.84                   | 4.78                   | 0.93                   |
|                          |                                                                                            | 5g        | 312.6                  | 37.3                   | 0.23                | 0.28     | 156.3      | 76.0                   | 2.4        | 3.81                                | 0                      | 0.06                  | 0.93                   | 5.70                   | 1.06                   |
|                          |                                                                                            | 10g       | 321.6                  | 39                     | 0.29                | 0.36     | 207.0      | 78.0                   | 3.6        | 6.00                                | 0                      | 0.08                  | 1.00                   | 11.92                  | 1.23                   |
| 20 <sup>th</sup> Day     | Expired                                                                                    | 1g        | 1955                   | 746                    | 1.31                | 1.12     | 569        | 1912.3                 | 243.6      | 190.9                               | 2.66                   | 0.65                  | 34.90                  | 26.61                  | 1.47                   |
|                          |                                                                                            | 5g        | 2196.6                 | 746.6                  | 1.36                | 1.24     | 595        | 2402.6                 | 267.5      | 669.6                               | 3.18                   | 0.76                  | 38.08                  | 31.48                  | 1.50                   |
|                          |                                                                                            | 10g       | 2200.3                 | 748.3                  | 1.41                | 1.32     | 632        | 2409.1                 | 293.1      | 767.2                               | 3.56                   | 0.81                  | 38.65                  | 31.59                  | 2.14                   |
|                          | Non-expired                                                                                | 1g        | 349.6                  | 42.3                   | 0.35                | 0.42     | 250.0      | 81                     | 4.8        | 7.90                                | 0.04                   | 0.09                  | 1.19                   | 19.72                  | 1.57                   |
|                          |                                                                                            | 5g        | 365.6                  | 45                     | 0.41                | 0.54     | 336.7      | 84.3                   | 4.8        | 9.33                                | 0.06                   | 0.103                 | 1.64                   | 19.94                  | 1.65                   |
|                          |                                                                                            | 10g       | 371.0                  | 46                     | 0.46                | 0.58     | 357.4      | 87.3                   | 6.0        | 10.19                               | 0.09                   | 0.12                  | 1.94                   | 20.02                  | 1.67                   |
| 30 <sup>th</sup> Day     | Expired                                                                                    | 1g        | 2547.6                 | 749.3                  | 1.53                | 1.33     | 1074.6     | 2755.3                 | 308.4      | 772                                 | 3.58                   | 0.89                  | 38.78                  | 38.29                  | 2.26                   |
|                          |                                                                                            | 5g        | 2591.3                 | 773                    | 1.64                | 1.35     | 1093.6     | 2820.6                 | 311.1      | 842.4                               | 3.85                   | 0.90                  | 39.23                  | 39.94                  | 3.13                   |
|                          |                                                                                            | 10g       | 3121                   | 805.6                  | 1.75                | 1.65     | 4366       | 3446                   | 317.7      | 862.9                               | 4.74                   | 0.97                  | 44.92                  | 48.43                  | 3.76                   |
|                          | Non-expired                                                                                | 1g        | 377.3                  | 46.6                   | 0.52                | 0.64     | 425.1      | 89.3                   | 6.0        | 13.81                               | 0.11                   | 0.15                  | 3.05                   | 20.17                  | 1.76                   |
|                          |                                                                                            | 5g        | 382.6                  | 48.6                   | 0.58                | 0.72     | 560.3      | 91                     | 7.2        | 23.24                               | 0.18                   | 0.18                  | 4.93                   | 20.20                  | 1.79                   |
|                          |                                                                                            | 10g       | 390.3                  | 49                     | 0.65                | 1.05     | 754.6      | 97                     | 9.6        | 49.81                               | 0.52                   | 0.31                  | 10.14                  | 20.45                  | 1.84                   |

the mass of a soil per unit volume. In the present study, it was observed that, as the concentration of the tablet increases, there was a slight increase in the particle density values in both the treatments. In comparison with the normal range and control, in both the treatments, the particle density values were found to be within the normal range and slightly above the values of control. The highest particle density was found to be 2.44 Mg/m<sup>3</sup> in 10g of non-expired tablet concentration at 30<sup>th</sup> day interval.

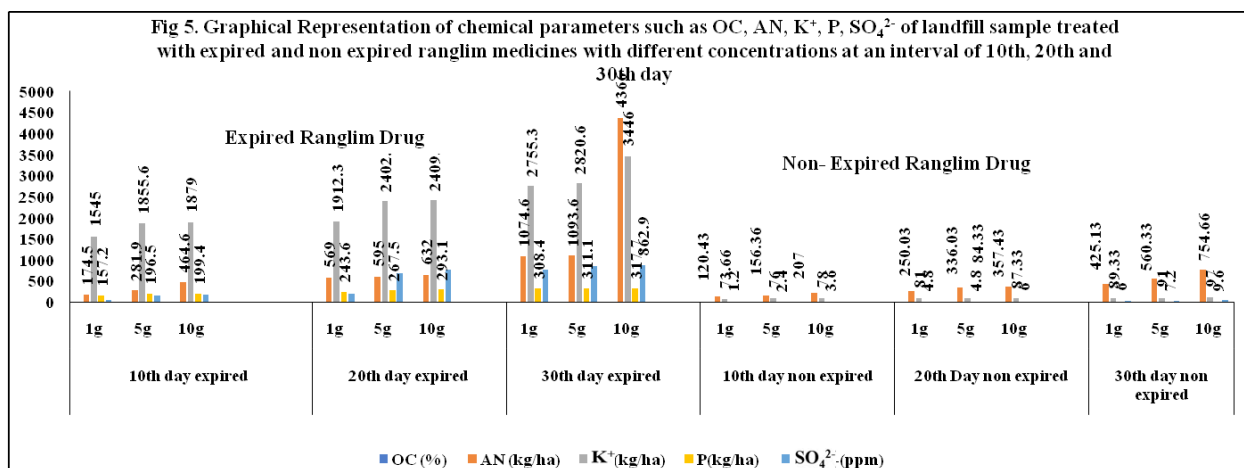
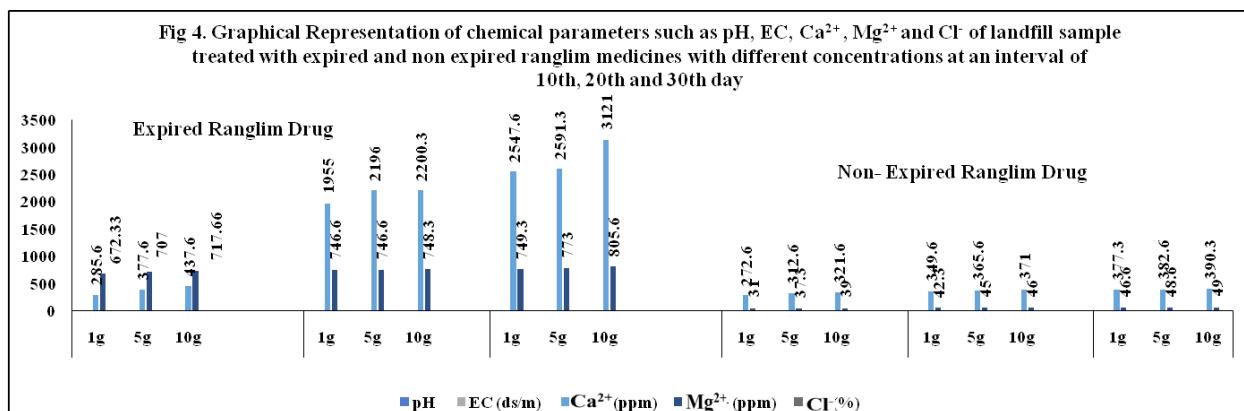
The soil porosity is the percentage of the total volume of the soil occupied by the pore space. The porosity value in both the treatments were found to be within the normal range. From the results, it was found that, the highest porosity was found to be 53.58% in 10g concentration of non-expired ranglim sample at 30<sup>th</sup> day interval. In comparison with the control, the particle density value was found to be higher in non-expired treatment.

The pH of the soil sample in any geographical condition varies due to the influence of microbial activity under various environmental conditions. Particularly, in waste dumping sites, various categories of waste and its disintegration in various

environmental conditions will influence over the variation of pH. In comparison with the normal range and control, in all the treatments, the pH values were found to be higher. The highest pH value observed was 8.66 in 10g concentration of expired ranglim at 30<sup>th</sup> day interval.

The electrical conductivity (EC) is a vital indicator of the ionic concentration in any soil. From the experiment, it was observed that, as the number of days increase with the increase in concentration in both ranglim treatments, the EC values were found to increase. The highest EC value was found to be 7.16 ds/m in 10g concentration of expired tablet at 30<sup>th</sup> day interval. In comparison with the soil quality standards and the control, the EC observed in expired drug sample was very much higher. In case of non-expired treatments, the highest values recorded were 2.26 ds/m in 10g concentration of expired tablet at 30<sup>th</sup> day interval. This indicates even though non-expired ranglim tablet has impact on the EC values, the expired tablet with increase concentration will have greater impact on the overall soil quality.

The calcium (Ca<sup>2+</sup>) is one among the major



content that helps for the regulation of the overall pH condition in the soil. During the present study, the calcium values in both the treatments, the were found to be less in 10<sup>th</sup> day expired ranglim treatment. further as the number of days increases in calcium values was found to be higher. In comparison with the control, the calcium values were found to be higher and lesser than the normal range.

In the present study, the magnesium ( $Mg^{2+}$ ) values in both the treatments, were found to be less in comparison with the normal range and higher than the control values. From the results, it was concluded that, in expired ranglim treatments, higher magnesium values were observed compared to non-expired one.

Chloride ( $Cl^-$ ) is one among the anions that is responsible for the increase in the soil salinity and has negative impacts on soil quality. From the study, it was concluded that, in comparison with the normal range and control, in all the treatments, the chloride values were found to be higher. High chloride values were observed in 10g concentration of expired ranglim treatments at 30<sup>th</sup> day interval.

Organic carbon (OC) is a major component of organic matter, which decomposes to release essential nutrients in order to enhance soil fertility. In the present study, the percent of organic carbon of expired ranglim sample was found to be more when compared to the control. In the expired ranglim treatment, the highest organic carbon content i.e., 1.65%, was observed in 10g concentration at the 30<sup>th</sup> day interval and in non-expired ranglim the highest OC was found to be 1.05% in at 30<sup>th</sup> day interval and at 10<sup>th</sup> day of non-expired ranglim treatments, in all the concentrations, the organic carbon values were

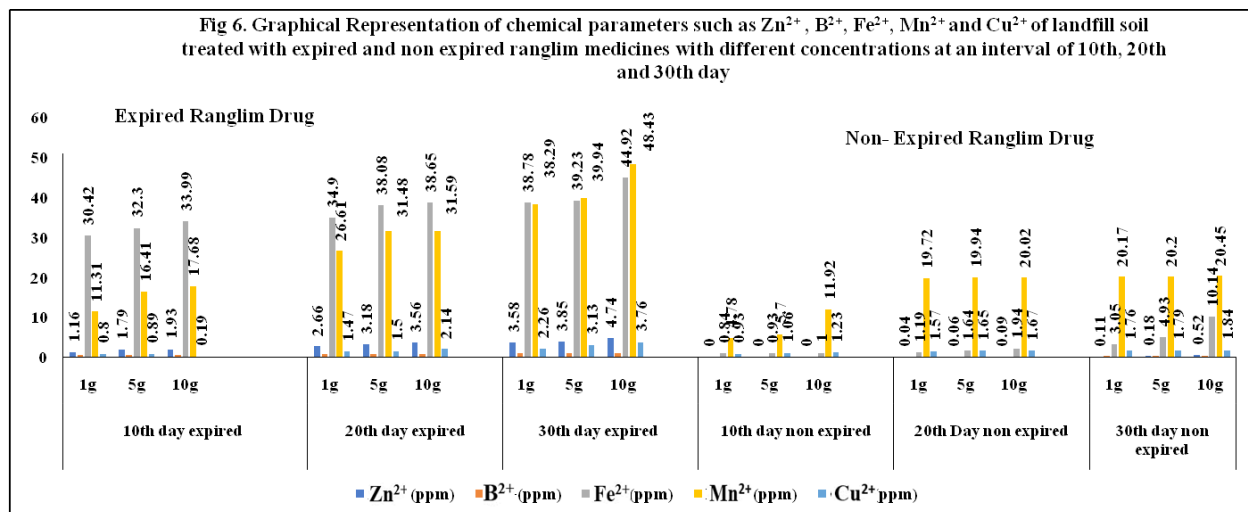
found to be below the normal range.

The presence of high nitrogen levels in landfill soil can lead to nutrient imbalances, soil acidification and increased microbial activity. In the present study, the highest available nitrogen (AN) value observed was 4366 Kg/ha at 30<sup>th</sup> day in 10g concentration of expired ranglim. In non-expired tablet, the, available nitrogen values were found to be very less and increasing trend after 20<sup>th</sup> day in non-expired ranglim treatments.

From the experimental analysis, the potassium ( $K^+$ ) levels in the expired ranglim treatments were observed in the range of 1545 kg/ha to 3446 Kg/ha. The lower values were observed in the non-expired ranglim treatments. In comparison with the normal range and control values, the potassium values observed was lower in non-expired and gradual increase trend in potassium values were observed in expired ranglim treatments. Generally, organic materials in landfills can contribute to higher levels of potassium due to the decomposition of plant and food waste, which release high potassium content (Khoshgoftarmanesh and Kalbasi, 2011).

In the present study, the higher available phosphorus (AP) values observed in expired ranglim treatments, was 317.7 Kg/ha at the 30<sup>th</sup> day interval 10g of treatment. In comparison with the normal range and the control, in expired ranglim treatments, the phosphorus values were found to be very much higher and in non- expired ranglim treatments, the available phosphorous values were found to be less.

The experimental results show that, the values of sulphate ( $SO_4^{2-}$ ) showed lesser than the normal range and the control values in non-expired ranglim treatments and higher in expired ranglim



treatments. Among the treatments, the highest sulphate value was found to be 862.9ppm in 10g expired ranglim treatment at 30<sup>th</sup> day interval.

### Heavy Metals

The normal sources of Zinc ( $Zn^{2+}$ ) can be seen in domestic waste disposal and also chemicals fertilizers and from e-wastes such as used batteries and galvanized metals. The highest zinc observed was 4.74 ppm in 10g concentration of expired ranglim treatment at 30<sup>th</sup> day interval. In comparison with the normal range and control, the zinc values were found to be higher in expired ranglim treatment. Whereas in non-expired ranglim treatment, the zinc values were found to be within the normal range. From the experimental results, the boron values in both the treatments were found to be lesser than the normal range. In comparison with the control, the highest boron values were found in expired ranglim sample.

Iron ( $Fe^{2+}$ ), Manganese ( $Mn^{2+}$ ), and Copper ( $Cu^{2+}$ ) metals may originate from various sources, including the degradation of metallic items within the waste, and industrial or household wastes disposed of in the landfill. In the present work, these metals have observed to be higher after the addition of expired ranglim medicine to the soil sample. The highest iron observed was 44.92 ppm, manganese was 48.43 ppm and copper were 3.76 ppm at 30<sup>th</sup> day interval in 10g concentration of expired ranglim. In comparison with the non-expired ranglim treatment, all the metals are observed to be lower. These metals may disrupt soil environment and potentially leading to the long-term ecological impacts [8].

### SUMMARY AND CONCLUSION

The effect of expired antidiabetic medicine on the soil depends on chemical composition of drug with their degradation products and soil's characteristics. Based on the research conducted with the addition of expired and non-expired ranglim medicine into the landfill soil sample, it was concluded that, in comparison with the normal range and the control values, in both the ranglim treatments, all the parameters were found to be in higher. From the experimental values of physical parameters of both the ranglim treatments, one can conclude that, the expired ranglim drug has greater potential to cause negative impact on soil quality. From the results obtained by the chemical characterization of both

the ranglim treatments, it was found that, the parameters such pH, electrical conductivity, organic carbon, chloride, available nitrogen, potassium, phosphorus, sulphate was found to be higher than the normal range, control and non-expired treatments. This indicates the greater tendency of expired ranglim tablet to alter the cationic and anionic concentrations in both the treatments. From the heavy metal analysis, the values of zinc, boron, manganese, copper and iron showed, higher concentration than the normal range, control and non-expired values. From the present research, it can be concluded that, care has to be taken regarding the proper disposal options to prevent the entry to household wastes. The persistence and accumulation of unused non-expired and expired ranglim tablets can cause environmental and public health problems. This can be minimized by implementing medicine disposal policy, specialized pharmaceutical waste treatment facilities, guidelines and improving awareness of the public on appropriate medicine disposal methods and practices will help to prevent environmental contamination.

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**Conflict of Interest - None**

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