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# **CHAPTER FOUR (4)**

## **4.0 RESULTS**

### 4.1 Isolation and identification of bacteria

#### 4.1.1 Relative abundance of bacteria in the shops

The figure below presents the data on the relative abundance of different bacterial genera observed in the shops. Staphylococcus, Diplococcus, and Bacillus each have the highest relative abundance, with a count of 6. E. coli follows closely with a relative abundance of 5. In contrast, Streptococcus, Actinomyces, and Streptobacillus have the lowest relative abundance, each recorded at 1. This indicates that Staphylococcus, Diplococcus, and Bacillus are the most prevalent bacterial genera in the shops, while Streptococcus, Actinomyces, and Streptobacillus are significantly less common.

Figure 1: RELATIVE ABUNDANCE OF BACTERIA IN THE SHOPS

#### 4.1.2 Comparing the bacterial load in the shops

The ANOVA (Analysis of Variance) table provides a statistical analysis of the log-transformed bacterial counts across different shops, examining three specific metrics: the log of bacterial plate count, the log of fecal coliforms, and the log of EMBA (Eosin Methylene Blue Agar) of E. coli. For the log of bacterial plate count, the sum of squares between groups is 1.273 with 4 degrees of freedom (df), resulting in a mean square of 0.318. The F-value is 0.999, and the significance level (Sig.) is 0.522, indicating no statistically significant difference in bacterial counts between shops at the 5% significance level. Within groups, the sum of squares is 0.956 with 3 degrees of freedom, yielding a mean square of 0.319, leading to a total sum of squares of 2.229 with 7 degrees of freedom.

For the log of fecal coliforms, the sum of squares between groups is 1.272 with 2 degrees of freedom, resulting in a mean square of 0.636. The F-value is 4.983, and the significance level is 0.302. Within groups, the sum of squares is 0.128 with 1 degree of freedom, yielding a mean square of 0.128, leading to a total sum of squares of 1.399 with 3 degrees of freedom. Similarly, this result suggests no significant differences between shops for fecal coliform counts.

For the log of EMBA of E. coli, the sum of squares between groups is 2.226 with 2 degrees of freedom, resulting in a mean square of 1.113. The F-value is 3.149, and the significance level is 0.241. Within groups, the sum of squares is 0.707 with 2 degrees of freedom, yielding a mean square of 0.354, leading to a total sum of squares of 2.933 with 4 degrees of freedom. These results indicate no statistically significant differences in E. coli counts between the shops.

Overall, the ANOVA results across all three metrics—log of bacterial plate count, log of fecal coliforms, and log of EMBA of E. coli—suggest that there are no significant differences in the bacterial counts between the different shops. The F-values are not high enough to indicate statistical significance, and the significance levels are well above the conventional threshold of 0.05. Therefore, it can be concluded that the variation in bacterial counts observed in the shops is not statistically significant, implying a relatively uniform distribution of bacterial presence across the different locations studied.

Table 1: ANOVA TABLE OF BACTERIA COUNT

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **ANOVA Table** | | | | | | | |
|  | | | Sum of Squares | df | Mean Square | F | Sig. |
| Log of Bacterial Plate Count \* Shop | Between Groups | (Combined) | 1.273 | 4 | 0.318 | 0.999 | 0.522 |
| Within Groups | | 0.956 | 3 | 0.319 |  |  |
| Total | | 2.229 | 7 |  |  |  |
| Log of Fecal Coliforms \* Shop | Between Groups | (Combined) | 1.272 | 2 | 0.636 | 4.983 | 0.302 |
| Within Groups | | 0.128 | 1 | 0.128 |  |  |
| Total | | 1.399 | 3 |  |  |  |
| Log of EMBA of E. coli \* Shop | Between Groups | (Combined) | 2.226 | 2 | 1.113 | 3.149 | 0.241 |
| Within Groups | | 0.707 | 2 | 0.354 |  |  |
| Total | | 2.933 | 4 |  |  |  |

### 4.2 Isolation and identification of fungi

#### 4.2.1 Relative abundance of fungi in the shops

The figure below displays the data on the relative abundance of various fungal species found in the shops. Aspergillus fumigatus has the highest relative abundance at 30, followed by Aspergillus niger with an abundance of 21. Rhizopus has a relative abundance of 8, while both Aspergillus flavus and Penicillium have a relative abundance of 7. Colletotrichum gloeosporioides has the lowest relative abundance among the species listed, with a count of 3. This indicates a varying distribution of fungal species in the shops, with Aspergillus species being the most prevalent.

Figure 2: RELATIVE ABUNDANCE OF FUNGI IN THE SHOPS

#### 4.2.2 Comparing the fungal load in the shops

##### 4.2.2.1 Mean and standard deviation

The table provides the mean and standard deviation for the relative abundance of six fungal species across ten samples (S01 to S10). The fungal species include Aspergillus niger, Aspergillus fumigatus, Aspergillus flavus, Penicillium, Colletotrichum gloeosporioides, and Rhizopus.

For Aspergillus niger, the mean values range from 1.00 to 2.00 across the samples, with standard deviations ranging from 0.000 to 0.577. The total mean for Aspergillus niger is 1.53 with a standard deviation of 0.506. Aspergillus fumigatus has mean values consistently around 1.00 to 2.00, with standard deviations ranging from 0.000 to 0.577. The total mean for Aspergillus fumigatus is 1.75 with a standard deviation of 0.439.

For Aspergillus flavus, the mean values range from 1.00 to 1.75, and the standard deviations are between 0.000 and 0.500. The total mean for Aspergillus flavus is 1.17 with a standard deviation of 0.385. Penicillium shows mean values between 1.00 and 1.75, with standard deviations from 0.000 to 0.577. The total mean for Penicillium is 1.18 with a standard deviation of 0.385.

For Colletotrichum gloeosporioides, the mean values are consistently 1.00 across most samples, with a few samples showing slightly higher means, resulting in a total mean of 1.08 with a standard deviation of 0.267. Rhizopus has mean values ranging from 1.00 to 1.75, with standard deviations between 0.000 and 0.577. The total mean for Rhizopus is 1.20 with a standard deviation of 0.405.

Overall, the total mean values indicate that Aspergillus fumigatus has the highest average relative abundance across the samples, followed by Aspergillus niger. Aspergillus flavus, Penicillium, Colletotrichum gloeosporioides, and Rhizopus have relatively lower mean values, indicating lesser abundance. The standard deviations suggest some variation within the samples, but the overall distribution of fungal species is relatively consistent.

Table 2: MEAN AND SD OF FUNGAL COUNTS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **MEAN** | | | | | | | |
| Sample | | A. niger | A. fumigatus | A. flavus | Penicillin | C. gloeosporioides | Rhizopus |
| S01 | Mean | 1.25 | 2.00 | 1.25 | 1.00 | 1.00 | 1.00 |
| Std. Deviation | 0.500 | 0.000 | 0.500 | 0.000 | 0.000 | 0.000 |
| S02 | Mean | 1.50 | 2.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Std. Deviation | 0.577 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| S03 | Mean | 1.00 | 1.00 | 1.00 | 1.50 | 1.00 | 1.00 |
| Std. Deviation | 0.000 | 0.000 | 0.000 | 0.577 | 0.000 | 0.000 |
| S04 | Mean | 1.75 | 1.50 | 1.25 | 1.75 | 1.00 | 1.00 |
| Std. Deviation | 0.500 | 0.577 | 0.500 | 0.500 | 0.000 | 0.000 |
| S05 | Mean | 1.00 | 1.75 | 1.00 | 1.00 | 1.00 | 1.00 |
| Std. Deviation | 0.000 | 0.500 | 0.000 | 0.000 | 0.000 | 0.000 |
| S06 | Mean | 2.00 | 1.50 | 1.25 | 1.25 | 1.00 | 1.50 |
| Std. Deviation | 0.000 | 0.577 | 0.500 | 0.500 | 0.000 | 0.577 |
| S07 | Mean | 1.25 | 2.00 | 1.00 | 1.00 | 1.25 | 1.00 |
| Std. Deviation | 0.500 | 0.000 | 0.000 | 0.000 | 0.500 | 0.000 |
| S08 | Mean | 2.00 | 2.00 | 1.25 | 1.00 | 1.00 | 1.75 |
| Std. Deviation | 0.000 | 0.000 | 0.500 | 0.000 | 0.000 | 0.500 |
| S09 | Mean | 2.00 | 2.00 | 1.75 | 1.00 | 1.00 | 1.75 |
| Std. Deviation | 0.000 | 0.000 | 0.500 | 0.000 | 0.000 | 0.500 |
| S10 | Mean | 1.50 | 1.75 | 1.00 | 1.25 | 1.50 | 1.00 |
| Std. Deviation | 0.577 | 0.500 | 0.000 | 0.500 | 0.577 | 0.000 |
| Total | Mean | 1.53 | 1.75 | 1.17 | 1.18 | 1.08 | 1.20 |
| Std. Deviation | 0.506 | 0.439 | 0.385 | 0.385 | 0.267 | 0.405 |

##### 4.2.2.1 ANOVA

The ANOVA table below presents the statistical analysis of the relative abundance of six fungal species across ten samples, detailing the sum of squares, degrees of freedom (df), mean square, F-value, and significance level (Sig.) for each species.

For Aspergillus niger, the sum of squares between groups is 5.725 with 9 degrees of freedom, yielding a mean square of 0.636. The F-value is 4.490 with a significance level of 0.001, indicating a statistically significant difference in the abundance of Aspergillus niger across the samples. Within groups, the sum of squares is 4.250 with 30 degrees of freedom, resulting in a mean square of 0.142. The total sum of squares is 9.975 with 39 degrees of freedom.

For Aspergillus fumigatus, the sum of squares between groups is 4.000 with 9 degrees of freedom, resulting in a mean square of 0.444. The F-value is 3.810 with a significance level of 0.003, indicating a statistically significant difference in the abundance of Aspergillus fumigatus across the samples. Within groups, the sum of squares is 3.500 with 30 degrees of freedom, yielding a mean square of 0.117. The total sum of squares is 7.500 with 39 degrees of freedom.

For Aspergillus flavus, the sum of squares between groups is 2.025 with 9 degrees of freedom, resulting in a mean square of 0.225. The F-value is 1.800 with a significance level of 0.110, indicating no statistically significant difference in the abundance of Aspergillus flavus across the samples. Within groups, the sum of squares is 3.750 with 30 degrees of freedom, yielding a mean square of 0.125. The total sum of squares is 5.775 with 39 degrees of freedom.

For Penicillium, the sum of squares between groups is 2.525 with 9 degrees of freedom, resulting in a mean square of 0.281. The F-value is 2.590 with a significance level of 0.024, indicating a statistically significant difference in the abundance of Penicillium across the samples. Within groups, the sum of squares is 3.250 with 30 degrees of freedom, yielding a mean square of 0.108. The total sum of squares is 5.775 with 39 degrees of freedom.

For Colletotrichum gloeosporioides, the sum of squares between groups is 1.025 with 9 degrees of freedom, resulting in a mean square of 0.114. The F-value is 1.952 with a significance level of 0.082, indicating no statistically significant difference in the abundance of Colletotrichum gloeosporioides across the samples. Within groups, the sum of squares is 1.750 with 30 degrees of freedom, yielding a mean square of 0.058. The total sum of squares is 2.775 with 39 degrees of freedom.

For Rhizopus, the sum of squares between groups is 3.900 with 9 degrees of freedom, resulting in a mean square of 0.433. The F-value is 5.200 with a significance level of 0.000, indicating a statistically significant difference in the abundance of Rhizopus across the samples. Within groups, the sum of squares is 2.500 with 30 degrees of freedom, yielding a mean square of 0.083. The total sum of squares is 6.400 with 39 degrees of freedom.

In summary, the ANOVA results indicate that there are statistically significant differences in the abundance of Aspergillus niger, Aspergillus fumigatus, Penicillium, and Rhizopus across the samples, with significance levels below the 0.05 threshold. However, no statistically significant differences were found for Aspergillus flavus and Colletotrichum gloeosporioides, as their significance levels are above 0.05. This analysis highlights the varying distribution and prevalence of different fungal species in the samples studied.

Table 3: ANOVA table

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **ANOVA Table** | | | | | | | |
|  | | | Sum of Squares | df | Mean Square | F | Sig. |
| A. niger \* Sample | Between Groups | (Combined) | 5.725 | 9 | .636 | 4.490 | 0.001 |
| Within Groups | | 4.250 | 30 | 0.142 |  |  |
| Total | | 9.975 | 39 |  |  |  |
| A. fumigatus \* Sample | Between Groups | (Combined) | 4.000 | 9 | 0.444 | 3.810 | 0.003 |
| Within Groups | | 3.500 | 30 | 0.117 |  |  |
| Total | | 7.500 | 39 |  |  |  |
| A. flavus \* Sample | Between Groups | (Combined) | 2.025 | 9 | 0.225 | 1.800 | 0.110 |
| Within Groups | | 3.750 | 30 | 0.125 |  |  |
| Total | | 5.775 | 39 |  |  |  |
| Penicillin \* Sample | Between Groups | (Combined) | 2.525 | 9 | 0.281 | 2.590 | 0.024 |
| Within Groups | | 3.250 | 30 | 0.108 |  |  |
| Total | | 5.775 | 39 |  |  |  |
| C. gloeosporioides \* Sample | Between Groups | (Combined) | 1.025 | 9 | 0.114 | 1.952 | 0.082 |
| Within Groups | | 1.750 | 30 | 0.058 |  |  |
| Total | | 2.775 | 39 |  |  |  |
| Rhizopus \* Sample | Between Groups | (Combined) | 3.900 | 9 | 0.433 | 5.200 | 0.000 |
| Within Groups | | 2.500 | 30 | 0.083 |  |  |
| Total | | 6.400 | 39 |  |  |  |