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# Message from Organizing Partner



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We hope during your time at the conference that you take the opportunity to engage with your peers to discuss your ideas for research and practice and that you ask questions of the presenters. There will be plenty of opportunities for collaboration.

A handwritten signature in blue ink, appearing to read 'Rao Kashif', is positioned above a horizontal line.

**Dr. Rao Kashif**

CEO/Managing Director  
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Pakistan

## Sustainable Management Techniques for Controlling Locust Swarms in Pakistan

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### Abstract

This review aims to provide an overview of the management techniques utilized in Pakistan for controlling locust outbreaks, which have caused significant agricultural losses in the country. The review covers several methods, including chemical and biological control, cultural control, and modern technologies. Locust outbreaks have been a persistent threat to Pakistan's agriculture, and various management techniques have been employed over the years. Chemical control using insecticides is the most commonly used method but has drawbacks such as high cost, environmental pollution, and insecticide resistance development. Consequently, there has been a shift towards more sustainable and environmentally friendly control methods, such as biological control using natural enemies and cultural control through changes in land use and cropping patterns. Biopesticides derived from natural sources and biocontrol agents like parasitic wasps and birds have proven to be effective in controlling locusts while minimizing the negative impact on the environment. Cultural control methods, such as crop rotation and intercropping, reduce crop susceptibility to locust damage. Early detection and monitoring of locust swarms are crucial for effective control and prevention of crop damage. In conclusion, a combination of different management techniques can be employed for effective and sustainable control of locusts in Pakistan, requiring continued research and development of new control methods that are both effective and environmentally friendly to ensure long-term success.

Keywords: locust, control management, biological control, crop rotation

## Introduction

Beetles, a type of horned grasshoppers from the Acrididae family, are notorious for causing crop damage when their populations increase and they swarm to cover greater distances. These insects typically lay their eggs in sandy areas during wet conditions, and in the presence of more rain and vegetation, their numbers rapidly multiply (1). Ranging in size from 0.5 to 3 inches and weighing about 0.07 ounces, beetles can travel several kilometers each day and cover vast areas, resulting in social, economic, and environmental impacts on a global scale.

Insects consume vegetables and crops as their source of food. They undergo a developmental process that lacks certain elements. Despite this deficiency, they are able to survive for approximately two months and during this time, they reproduce and transmit their genes. Sexual maturity is achieved by the insect after around 14 days. The female desert grasshopper deposits her eggs in either damp or Soil that is about 10cm deep and predominantly comprised of sand (2). Female desert grasshoppers exhibit different egg-laying patterns: Gregarious females deposit 2-3 egg cases, with each containing approximately 60-80 eggs, while solitarious females lay eggs 3-4 times and each case contains about 100-160 eggs. The development of the eggs is influenced by various factors such as soil type, temperature, and moisture. Egg growth does not occur below a temperature of 15 degrees Celsius. At a temperature of 19 degrees Celsius, the hatching period takes approximately 70 days while at a higher temperature range of 32-35 degrees Celsius, it takes only 10-12 days (3).

To tackle the current desert locust outbreak, the government of Pakistan has collaborated with the Food and Agriculture Organization of the United Nations and nearby relief agencies to implement proactive measures. In February 2020, the government approved a National Action Plan consisting of three phases aimed at managing the locust threat. The plan includes measures for threat assessment, surveillance and control efforts, and the use of agricultural land according to cultivation dates [35]. The initial stage focuses on surveillance and management to contain the growth and intensity of locust populations while addressing human and environmental impacts. Climate data was gathered in high-risk regions to enhance the effectiveness of targeted control measures. As of April 26, 2020, 76.9% of Pakistan's territory had been surveyed, and 5.5% had been treated with pesticides (4).

From July to December 2020, the second phase prioritized safeguarding crops through local and global networks for monitoring and controlling locusts. In addition to boosting the country's capacity for early warning and intervention, the government offered prompt assistance to farmers and livestock owners. The strengthening of the Food Security and Nutrition Information allowed the Ministry of National Food Security and Research to increase their ability to manage desert locusts (5).

Starting after December 2020, the third and final phase involves the allocation of \$76.1 million to the Project Management Unit for the 2021 fiscal year to enhance their capacity for planning and implementing surveillance measures aimed at creating locust-free areas (4).

This review encompasses the management control strategies that Pakistan has implemented to curb the locust infestation.

### **Insecticide Use in Locust Control**

The use of insecticides in controlling locusts mostly involved conventional synthetic insecticides, and factors like availability, cost-effectiveness, environmental compatibility, and safety influenced the selection of insecticides and timing of their application (6). Diflubenzuron, an IGR, was one of the widely used alternatives to traditional pesticides because it hinders arthropod molting while not affecting vertebrates (7,8). Most pesticides employed to control locusts comprised of ultra-low volume oil-based formulations that mandated specialized spray apparatus for their application (8).

### **Pest Management Plan for Desert Locust Control**

To attain environmentally sustainable and enduring pest management, the government of Pakistan has established a National Integrated Pest Management Plan. One of the aims of this plan is to reduce or eliminate the risk of insecticide resistance, but locust epidemics occur infrequently enough to prevent this. The proposed strategy aims to enable efficient interventions, promote cost-effective locust control methods, and enforce environmentally friendly approaches while prioritizing the safety of pesticide managers and sprayers. The pesticides utilized for combating desert locusts in Pakistan do not fall under the categories of extremely hazardous or very dangerous chemicals. Moreover, the adoption of low-toxicity methods can mitigate the risk of human poisoning. Biopesticides have been utilized in Somalia to control swarming locust species; however, their effectiveness in outbreak scenarios has not been thoroughly evaluated. At present,



the most effective strategy for managing the locust outbreak is timing intervention efforts during the gregarization phase, with an emphasis on early action. The proposed plan aims to implement a monitoring system that utilizes low-residue pesticides with increased accuracy to detect and monitor the outbreak, allowing for the timely identification of the onset of phase transition. The monitoring technologies must be capable of effectively tracking the activity of desert locusts over time, both during and between outbreaks, to facilitate effective intervention (9).

To establish an early intervention threshold in locust-prone environments, it is essential to consider the integration of multiple factors which may indicate onset of gregarization. The determination of early intervention thresholds is also influenced by climatic variables such as rainfall levels, wind speed, and direction. Pakistan can benefit from an analysis that discovered the cycle of locust swarming movement in Africa, and phase transformation anticipation can be utilized in Pakistan, particularly if coordinated with India. The identification of other spatiotemporal patterns of desert locust aggregation can aid in enhancing surveillance efforts to trigger early intervention. Incorporating such findings into surveillance measures in Pakistan can enable the establishment of the optimal timing for early intervention in the event of a desert locust outbreak (10,11).

### **Biological Control of Acridid Populations**

To safeguard human health and preserve wildlife habitats, it is recommended to use environmentally sustainable solutions instead of harmful pesticides for locust control. Innovative biological pest control methods, such as the use of fungus and bacteria in combination with harmful plant species, have been successful. By preying on locust larvae and young adults, natural predators can diminish locust outbreaks by as much as 90%. Hence, it is of utmost importance to preserve these ecosystems and habitats, such as by cultivating late-maturing crops in conjunction with tropical forests. Additional effective measures for managing locust upsurges include utilizing a combination of locust-toxic and wild plants to achieve over 50% foliage coverage, together with animal feeding techniques. Transforming low-lying regions into aquaculture farms for fish and shrimp can also be a feasible method. Burning plants and lighting bonfires in the dark have also been identified as effective control methods. To limit plague outbreaks in high-risk areas, physical traps, optical and mechanical devices, and exact Bayesian prediction modeling can be employed. Moreover, specific light and sound wave lengths can be utilized to improve trapping efficiency by interacting with locusts' phototactic behavior through glutamate and dopamine neurophysiology.

Remote sensing, based on habitat greenness, represents a more viable approach for predicting locust eruptions than conventional satellite and radar data. Nevertheless, these technologies are still in the developmental stage and in need of assistance from governments to become effective (12–16).

The potential for biological control in acridid population dynamics is often overlooked due to the emphasis on chemical control. Classical biological control is considered the most desirable control measure when an introduced agent is established and exerts sustained control over the pest. However, due to the indigenous nature of most locusts to their environment, classical biological control presents a difficult prospect. Despite this, there are still opportunities, particularly during the egg phase when it is susceptible to parasitoid predation. Another approach is the use of entomopathogens, such as fungi and microsporidia, as in-undative, inoculative, and classical biocontrol agents, with a particular focus on their pest-specificity. By exploiting the specificity of entomopathogens, it is possible to develop biological pesticides or mycopesticides that exert a lasting effect on pest populations and enhance the role of arthropod natural enemies in pest control. Most acridids are susceptible to pathogens, but they usually evade them by moving to new habitats. Hence, discovering methods to regulate pathogen populations could result in effective pest control with minimal environmental consequences. In conclusion, the examination of biological control methods for acridid populations, including classical biological control, pest-specific microorganisms, and entomopathogens, could provide a sustainable and effective alternative to chemical control (17).

### **The Importance of Proactive Strategies in Controlling Desert Locust Outbreaks**

Countries like Pakistan, which were impacted by the recent desert locust outbreak, had to respond to the invasion of swarms in a reactive manner as they had no other option. A proactive approach could have been adopted by Pakistan and other countries affected by the recent desert locust outbreak while it was originating in Saudi Arabia's interior Rub al Khali. This could have helped in suppressing breeding and gregarious activity before the transboundary movement of locusts occurred. Coordinated international efforts are necessary for timely intervention during periods of locust recession and for the prevention of gregarious outbreaks. There is already a centralized coordination hub in place, as the Food and Agriculture Organization (FAO) is responsible for



coordinating monitoring, control, some research and training, and aid agency contributions. Effective and timely intervention against the desert locust outbreak in Pakistan and other affected nations largely depends on their ability and willingness to share and utilize information on locust activity during the recession period (18,19).

## Conclusion

In conclusion, locusts are a significant threat to crops, especially during swarming periods. The Pakistan government has taken proactive measures to combat the current desert locust outbreak, collaborating with the Food and Agriculture Organization (FAO) of the United Nations and aid agencies in the vicinity. The National Action Plan consists of three phases aimed at managing the locust threat, including threat assessment, surveillance and control efforts, and the use of agricultural land according to cultivation dates. Pakistan has developed a comprehensive National Integrated Pest Management Plan that aims to achieve ecologically sustainable and long-term pest control. The plan prioritizes the facilitation of effective interventions, the management of locust control economics, and the implementation of increasingly eco-friendly measures while ensuring the protection of pesticide managers and sprayers. Intervention timing, which involves early intervention during the gregarization phase, is currently the most promising and readily available approach. The anticipation of phase transformation could be useful in Pakistan, particularly when synchronized with India, to enhance the effectiveness of intervention timing. Further studies are needed to develop improved control measures based on the spatiotemporal characteristics of desert locusts.

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## **Rabies in Multan District: A Comprehensive Study of Current Status**

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### **Abstract**

Rabies is a deadly viral disease that remains a significant public health threat in Pakistan. This study aims to analyze the trend of rabies cases in Pakistan over the past five years (2018-2022). The data was collected from different hospitals in various cities of Pakistan. The results indicate that the number of rabies cases has been steadily increasing each year, with the highest number of cases reported in 2021. The mortality rate remained consistently high, ranging from 93% to 97%. Furthermore, the study found that the vaccination status in Pakistan is not good, with issues like poor administration, lack of availability, and inadequate interaction between hospitals and vaccination centers. The lack of funds to manufacture vaccines and the absence of a proper system to store vaccines are also major challenges. In 2022, Rabipur vaccines were used for the first time in Pakistan, which were found to be effective if administered immediately after a person or animal is bitten by a rabid animal. However, it should be noted that the data for the Multan district was not available, and therefore, a comparison with previous years for this area was not possible. The findings of this study highlight the need for improved vaccination policies and administration to control the spread of rabies in Pakistan.

Keywords: Rabies, vaccination, Rabipur, Rabavert, Pakistan

### **Introduction**

For centuries, dogs have been considered the most faithful companions and protectors of humans. However, research has revealed that dogs have been attacking and killing people for just as long. While dogs are typically viewed as friendly, the spread of contagious diseases from dogs to other organisms can have devastating consequences. Viral diseases are among the most fatal and severe effects of such diseases. Thus, research has led to a broader perspective on the relationship between humans and dogs, recognizing both the benefits and risks associated with this bond. Epidemiology

pertains to the clinical information of a disease, whether in a particular city, country, or worldwide. Rabies is a fatal disease that causes the death of over three million people annually across the globe. Over fifty-nine thousand individuals die each year in the hundred and fifty countries with the most rabies cases. Rabies has a high mortality rate, estimated at ninety-five percent. Its contagious nature increases the likelihood of its occurrence (1).

Rabies is a viral disease that is considered to be deadly and lethal, with a death toll of more than three million people every year all around the world. The study of epidemiology, which refers to the clinical data of a disease in a city, country, or globally, has shown that in one hundred and fifty countries, the maximum cases of rabies are reported annually, with over fifty-nine thousand people dying due to rabies each year. The death rate of rabies is as high as ninety-five percent, making it a fatal and devastating disease. The transmission of the rabies virus occurs through the bite of a rabid animal, which transfers the virus to the muscles of the organism. From there, the virus travels to the brain through the blood and nerves, taking over the nervous system and eventually affecting the entire body. Once the virus reaches the salivary glands, it can be transmitted to others through saliva, making it highly communicable in nature (2). The virus can dominate the nervous system and evade the immune system, leading to its fast spread in animals and humans. The internal system of the organism becomes the most important source of the spread of the disease. The virus is transmitted through two major routes: the bite route and the non-bite route. The bite route is more common and occurs when a rabid animal bites a healthy organism, transferring the virus through the saliva into the muscles and other parts of the body. The non-bite route is less common and occurs when healthy animals or people are exposed to the blood or saliva of an infected animal. The type of causal agent or disease is a crucial factor that affects the rate of transmission. Viral diseases, such as rabies, are most easily spread between dogs and from dogs to humans. Once the virus attacks the central nervous system, it takes hold of the nerves, leading to death ultimately. The communicable nature of the virus and the high death rate make it a significant public health concern globally. Therefore, the control of rabies in animals and humans is vital to reducing the incidence and spread of the disease. The condition of vaccination in Pakistan is not active due to the unavailability of vaccines. Pakistan is facing a great shortage of vaccine doses. The country lacks a proper administration of the synthesis of classical and synthetic vaccines, which is a leading cause of deaths (3,4). Rural areas are more affected as vaccination is not provided at the right time,

and patients die soon after the incubation period. For instance, a seven-year-old boy died in Sindh due to the unavailability of vaccines in the area, and several other similar incidents have occurred (3). The success of treatment is primarily dependent on the government and the administration of hospitals where the disease is treated. In Pakistan, there is a lack of resources and funds due to the country's low financial growth. The ingredients and technologies required for making vaccines are not easily available or affordable, and the process of making vaccines is expensive. Underdeveloped countries face difficulties in making vaccines, and they need to import vaccines from other countries where they are easily available. Therefore, the government should establish good connections with such countries to reduce costs and also seek free aid in case of emergencies. The administration of hospitals also plays a vital role in the success of treatment. They should keep track of the number of patients and make efforts to get the required number of vaccines. Patients should receive vaccines on time, and the hospitals should ensure that the vaccines are genuinely treating the patients. They should also have definite sources for vaccine supply and keep specific days of infection spread in mind. Patients themselves should consult doctors as soon as possible after an attack. Vaccines are not directly inoculated into the body of infected patients until they are tested on another organism for practice. After approval from medical authorities, vaccine copies are prepared and distributed in the market to meet the needs of people. The availability and status of vaccination vary in different cities. For example, in cities like Islamabad and Lahore, vaccines are easily available, and patients can get vaccinated and survive (5,6).

There are various problems that underdeveloped countries need to face due to the lack of vaccines. The death of patients can increase economic losses too. Therefore, a research design can be implemented to monitor the number of rabies patients in Multan, a metropolitan city in Pakistan, where a large number of dogs get infected with the virus and spread the disease. The study should also evaluate the current status of vaccination, including availability and duration of vaccine after the infected person is admitted, the method of treatment, and the success rate of treatment. This study can help to indicate the death rate of patients and aid in developing effective strategies to control and prevent the spread of the disease.

## **Methodology**

### *Location of Data Collection*

This study was conducted in the Southern Punjab region of Pakistan, with primary data collected from the city of Multan. Data was collected over a period of five years, from 2018 to June 2022, and only valid data was considered.

#### *Data Collection*

The primary source of data collection was hospitals in the region. The data obtained from the hospitals included the number of patients reported, the number of deaths, the number of patients who recovered, the number of patients who were treated, and the status and availability of vaccinations. Epidemiological data was calculated based on the number of patients, death rate, and percentage mortality. The vaccination status was also evaluated by examining factors such as vaccine availability, synthesis, use, and effectiveness in terms of administration.

#### *Other Sources*

In addition to hospital data, relevant information was also collected from various websites, such as Pubmed, Google Scholar, and other credible internet sources containing past data.

#### *Analysis*

The data collected was analyzed using Microsoft Excel software. The data was organized into tables, and graphs were plotted to illustrate the mortality rate. The data was then analyzed to identify trends, patterns, and any significant factors contributing to the incidence and mortality rate of rabies.

### **Results and Discussion**

The present study aimed to collect data on the number of rabies patients over the past five years, from 2018 to June 2022, in order to provide a comprehensive understanding of the epidemiology of the disease. The data collected included the total number of patients, the number of patients who died, the number of patients who recovered, the number of patients who received vaccinations, and the number of patients who did not receive vaccinations and subsequently died. Diseases continue to be a major challenge for humanity, as they often result in significant morbidity and mortality. Among the different types of diseases, bacterial and viral diseases are particularly deadly due to the small size of the causative agents and the limited progress in developing effective treatments.



The data collected in this study provided valuable insights into the disasters caused by rabies, including the economic and health losses resulting from the disease. The information on the number of patients, vaccinated and non-vaccinated, as well as recoveries and deaths, is essential for the development of effective treatments for rabies. The data analysis revealed that the number of rabies patients in Southern Punjab, particularly in Multan city, remained high over the past five years. The mortality rate was also significant, indicating that the disease continues to pose a significant threat to public health in the region. The analysis of the data further showed that vaccination was an effective measure in preventing rabies, as the number of vaccinated patients who recovered was higher compared to non-vaccinated patients. However, the availability and accessibility of vaccines remained a challenge in the region, particularly in rural areas.

**Table 1: Represents data of rabies cases in 2018 Multan, Pakistan.**

Data	Number of patients	Vaccinated	Non-vaccinated	Cured/recovered	deaths
Hospital 1	51	11	40	4	47
Hospital 2	9	2	7	-	9
Hospital 3	8	1	7	-	8
Total	68	14	54	4	64
Mortality rate					94%

The table 1 represents the data collected in 2018 of patients with rabies from three different hospitals in Multan, Pakistan. The data includes the number of patients, the number of patients who were vaccinated and the number of patients who were not vaccinated, the number of patients who were cured or recovered, and the number of patients who died due to rabies.

Hospital 1 reported the highest number of patients with 51 cases, out of which 11 patients were vaccinated and 40 patients were not vaccinated. Among these patients, 4 were cured/recovered while 47 died due to rabies. Hospital 2 reported only 9 cases of rabies in 2018, out of which 2 patients were vaccinated and 7 patients were not vaccinated. There were no reported cases of cured/recovered patients, and all 9 patients died due to rabies. Similarly, Hospital 3 reported 8 cases of rabies, out of which only 1 patient was vaccinated and 7 patients were not vaccinated.

There were no reported cases of cured/recovered patients, and all 8 patients died due to rabies. The total number of patients with rabies in 2018 from these three hospitals was 68, out of which 14 patients were vaccinated and 54 patients were not vaccinated. There were only 4 cases of cured/recovered patients, while 64 patients died due to rabies. The annual mortality rate due to rabies in 2018 was calculated to be 94% based on the number of deaths compared to the total number of reported cases. This highlights the urgent need for increased vaccination and awareness programs to prevent the spread of this deadly disease.

**Table 2: Represents data of rabies cases in 2019 Multan, Pakistan.**

Data	Number of patients	Vaccinated	Non-vaccinated	Cured/recovered	deaths
Hospital 1	48	13	35	6	42
Hospital 2	11	-	11	-	11
Hospital 3	7	-	7	-	7
Total	66	13	53	6	60
Mortality rate					91%

The table 2 shows the data collected in different hospitals for the year 2019 only. The data includes the number of patients, vaccinated and non-vaccinated patients, cured/recovered patients, and deaths. In 2019, Hospital 1 had 48 patients, out of which 13 were vaccinated and 35 were non-vaccinated. 6 patients were cured/recovered and 42 patients died. Hospital 2 had 11 patients, all of whom were non-vaccinated. There were no cured/recovered patients in this hospital and all 11 patients died. Hospital 3 had 7 patients, all of whom were non-vaccinated. There were no cured/recovered patients in this hospital and all 7 patients died. Overall, in 2019, there were 66 patients, out of which 13 were vaccinated and 53 were non-vaccinated. 6 patients were cured/recovered and 60 patients died. The mortality rate for the year 2019 was 91%.

The data presented in the table 3 pertains to the patients of rabies in 2020 in various hospitals. The table shows that a total of 66 patients were reported with rabies during the year 2020 in three hospitals. Out of the total patients, 17 had been vaccinated against rabies, while the remaining 49 were non-vaccinated. Among the vaccinated patients, 10 were reported in Hospital 1, 4 in Hospital

2, and 3 in Hospital 3. Similarly, 35 non-vaccinated patients were reported in Hospital 1, 9 in Hospital 2, and 5 in Hospital 3. The total number of cured/recovered patients was reported to be 3, out of which all were from Hospital 1. In contrast, the total number of reported deaths was 63, indicating a mortality rate of 96%. This data suggests that the number of patients with rabies decreased compared to the previous year, but the mortality rate increased significantly. The data also indicates that vaccination against rabies is essential for prevention, as a higher number of non-vaccinated patients were reported compared to vaccinated patients. Hospital 1 reported the highest number of patients, both vaccinated and non-vaccinated, indicating a higher prevalence of rabies in the area covered by this hospital.

**Table 3:Represents data of rabies cases in 2020 Multan, Pakistan.**

Data	Number of patients	Vaccinated	Non-vaccinated	Cured/recovered	deaths
Hospital 1	45	10	35	3	42
Hospital 2	13	4	9	-	13
Hospital 3	8	3	5	-	8
Total	66	17	49	3	63
Mortality rate					96%

The data presented in the table 4 pertains to the number of patients who were diagnosed with rabies in different hospitals during the year 2021. The table includes five columns: "Number of patients", "Vaccinated", "Non-vaccinated", "Cured or Recovered" and "Deaths". The "Number of patients" column lists the total number of patients diagnosed with rabies in each hospital.

The "Vaccinated" column indicates the number of patients who had been previously vaccinated against rabies, while the "Non-vaccinated" column shows the number of patients who had not been vaccinated. The "Cured or Recovered" column indicates the number of patients who have been treated and have recovered from the disease. The "Deaths" column lists the number of patients who succumbed to the disease. According to the table, a total of 73 patients were diagnosed with rabies in 2021, out of which 11 patients had been previously vaccinated against the disease. The majority of patients, 62 in total, were not vaccinated.

Out of the total number of patients, only 2 patients could be cured or recovered, while 71 patients died, resulting in a high mortality rate of 97%. Hospital 1 had the highest number of patients with 52 cases, out of which only 9 were vaccinated, 43 were not vaccinated, and 2 patients were cured or recovered. Hospital 2 had 14 cases of rabies, out of which 2 were vaccinated, 12 were not vaccinated, and all patients unfortunately died. Hospital 3 had only 7 cases of rabies, all of whom were non-vaccinated, and there were no reported cures or deaths.

**Table 4: Represents data of rabies cases in 2021 Multan, Pakistan.**

Data	Number of patients	Vaccinated	Non-vaccinated	Cured/recovered	deaths
Hospital 1	52	9	43	2	50
Hospital 2	14	2	12	-	14
Hospital 3	7	-	7	-	7
Total	73	11	62	2	71
Mortality rate					97%

The table 5 provides information about the rabies cases in different hospitals in Multan, Pakistan during the first seven months of 2022 (January to July).

Hospital 1 had the highest number of patients with 23 cases, followed by Hospital 2 with 4 cases and Hospital 3 with 2 cases. Out of the 23 patients in Hospital 1, 6 were vaccinated while 17 were not. One patient died, while 1 patient was discharged and cured. In Hospital 2, 2 patients were vaccinated while 2 were not. One patient died, while 1 patient was cured and discharged. Hospital 3 had 2 patients, both of whom were non-vaccinated. Both patients were cured and discharged. In total, there were 29 cases of rabies in the three hospitals during this period, out of which 8 patients

were vaccinated while 21 were non-vaccinated. Two patients died, while 2 patients were cured and discharged. The mortality rate during this period was 93%.

**Table 5: Represents data of rabies cases in 2022 Multan, Pakistan.**

Data	Number of patients	Vaccinated	Non-vaccinated	Cured/recovered	deaths
Hospital 1	23	6	17	1	22
Hospital 2	4	2	2	1	3
Hospital 3	2	-	2	-	2
Total	29	8	21	2	27
Mortality rate					93%

Comparing the data provided for the years 2018, 2019, 2020, 2021, and 2022, we can observe the following trends:

**Vaccination rates:** The number of patients who were vaccinated varied from year to year. In 2018, 14 out of 68 patients (20.6%) were vaccinated, whereas in 2021, only 11 out of 73 patients (15.1%) were vaccinated. However, in 2020, the vaccination rate was the highest with 17 out of 66 patients (25.8%) being vaccinated.

**Mortality rates:** The mortality rate due to rabies fluctuated over the years. The highest mortality rate was in 2021 with 97% followed by 96% in 2020, 94% in 2018, and 91% in 2019. However, in 2022, the mortality rate decreased to 93%.

**Recovery rates:** The percentage of cured/recovered patients also varied from year to year. In 2018, 4 out of 68 patients (5.9%) were cured/recovered, whereas in 2021, only 2 out of 73 patients (2.7%) were cured/recovered. However, in 2020, the recovery rate was the highest with 3 out of 66 patients (4.5%) being cured/recovered.

**Non-vaccinated patients:** The number of non-vaccinated patients remained high in all the years, with 54 out of 68 patients (79.4%) in 2018, 53 out of 66 patients (80.3%) in 2020, and 62 out of 73 patients (84.9%) in 2021 being non-vaccinated.

Overall, the data shows that there is still a high incidence of rabies in the area, and the vaccination rates need to be improved to reduce the number of non-vaccinated patients and the mortality rate.

The government of Pakistan has imported modified vaccines such as RabAvert from America for the treatment of rabies patients. The vaccines produced using chick embryos have shown higher efficacy rates, such as the vaccine called Imovax, which was also used in the country. However, the poor administration system in previous years led to serious issues. Fortunately, rabies is not as easily transmissible as other viral diseases like COVID-19. In 2022, Pakistan introduced the Rabipur vaccines, which have shown to be effective if administered immediately after a person or animal is bitten by a rabid animal, particularly in the case of dog-induced rabies. Rabies immunoglobulins are also used along with the vaccines to enhance treatment efficacy. Pakistan used to import anti-rabies vaccine (ARV) from India, but due to escalating tensions between the two countries, the country has been facing a severe shortage of ARV since 2019. The National Institute of Health (NIH) has not been able to produce enough ARV to meet the local demand. The five-dose IM regime is currently being used in most rabies centers in Pakistan. It is imperative to train healthcare workers to administer vaccines intradermally, which will not only increase cost-effectiveness but also enhance patient compliance (7).

However, the current vaccination status in Pakistan is inadequate due to issues such as poor administration, limited availability, and poor communication between hospitals and vaccination centers. In addition, insufficient funds for vaccine production and inadequate storage systems in hospitals and vaccination centers create further challenges, potentially resulting in fatal outcomes if vaccines are not administered on time. There are very few studies about rabies in Pakistan but the data presentation is different from the present study. Both studies focus on the prevalence of rabies in Pakistan, with the Harenda study emphasizing the challenges faced by healthcare workers in diagnosing and treating patients with rabies, especially during the COVID-19 pandemic, while the present study analyzes the trend of rabies cases over the past five years and highlights the need for improved vaccination policies and administration to control the spread of rabies in Pakistan. Both studies highlight the high mortality rate of rabies in Pakistan and the challenges in ensuring an adequate supply of vaccines for the disease (8). Overall, the studies suggest that more attention and resources are needed to address the growing problem of rabies in Pakistan (9). To control and eliminate rabies, it is crucial to involve various sectors and foster One Health collaboration, which includes community education, awareness programs, and vaccination campaigns (10).

However, it is worth noting that we do not have any previous data about the status of rabies in Multan district, which makes it difficult to compare the current data with any previous findings. This highlights the need for further research and data collection to better understand the rabies situation in Pakistan and take appropriate measures to address the issue.

## Conclusion

In conclusion, the data collected over the past five years shows that rabies remains a significant public health concern in Pakistan. While there has been some progress in the development and administration of vaccines, poor administration, limited availability, and insufficient funds remain major challenges in addressing the disease. The mortality rate has remained consistently high over the years, with 96% in 2018, 97% in 2019, and 96% in 2020. However, there was a slight decrease in the mortality rate in 2021 to 93%, indicating that efforts to improve treatment and vaccination may be having some impact. The availability of effective vaccines such as Rabipur is promising, but better education and coordination among healthcare providers, hospitals, and vaccination centers are needed to ensure that the vaccines are administered in a timely and efficient manner. With continued attention and investment, it is possible to significantly reduce the incidence and impact of rabies in Pakistan.

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## **A Comparative Study on the Nutrient Content and Consumption of Tea Whitener in Females of Different Age Groups in Multan, Pakistan**

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### **Abstract**

This study aimed to investigate the consumption patterns of tea whitener among females in Multan, Pakistan. A total of 500 females from five different age groups participated in the study, and their responses were analyzed using a questionnaire. The results showed that the majority of females in all age groups consumed tea whitener regularly, with the highest consumption seen among the age group of 15-25 years. The study also revealed that the consumption of tea whitener was more prevalent in urban areas compared to rural areas. The data suggested that the use of tea whitener has been on the rise in Pakistan, with the industry valued at approximately \$458 million and growing by 35% in the last five years. However, the study also highlighted the potential health risks associated with the consumption of tea whitener, which contains high levels of sugars, artificial sweeteners, and preservatives. The findings of this study can be useful in developing public health campaigns and policies to raise awareness about the negative impact of excessive tea whitener consumption on health.

Keywords: tea whitener, Pakistan, sugar, UHT-treated, dairy milk

### **Introduction**

Tea whiteners are milk-based products with various packaging options that are popular due to their convenience and adequate ingredients, particularly for infants. Milk and milk products are important sources for maintaining human health and strength. Heat treatment is necessary to ensure safety and extend shelf life by eliminating bacteria, limiting enzyme activity, and improving product stability. In progressive countries, UHT-treated products are manufactured using high-temperature processing, which eliminates pathogens and extends shelf life for 3 to 6 months. However, UHT processing can also reduce sensorial characteristics, nutrient content, and lipid oxidation. The commercial application of UHT processing is aimed at improving extended shelf life milk production. Below is a process flow diagram for UHT processing of milk (1).

Tea whitener is progressively being used in food products to relieve handling, better ledge-life, and particular needs in hostels, restaurants, railways, waterways, etc. Tea whiteners must first have 'prompt' solubility capabilities to satisfy the dispensability and solubility standard generally required when fat-based whiteners are added to water in order to meet the needs of tea/coffee solidity. The second requirement is that they should not solidify or succumb to a mud-like precipitation or sediment (2). An idealistic tea whitener should also have well whitening' power, feathering aversion to, emulsion' constancy, and keeping the capability t'o make brighten and counteract co'ffee aci'ds for manufacturing shiner and mil'der drinks (3).

Furthermore, any whitener's organoleptic standard and whitening power are required capabilities. These abilities are determined, as is customary, by the fat and protein content of milk. Milk fat improves flavor, mouthfeel, and viscosity while also boosting whitening potential and total supportability. A good emulsified and finely separated fat and protein in the colloidal state has the most whitening potential (4). Milk protein also contributes to the feathering, mouthfeel, as well as other organoleptic of high-quality dairy and tea whiteners. There is also a need to reduce the fat content of tea whiteners on the market. There are consumers all over the world who are concerned about their health and therefore do not choose products that really are high in fat. Others require products that are relatively inexpensive (5). Developed countries should introduce some rules and regulations for the product and use some of the existing editions of all the products to ensure some agreement for the security of a large number of users. This is important because it is important to satisfy consumers. So that's a big factor (6).

As of 2018, the worldwide market for coffee and tea whiteners had a value of \$5,350 million and is predicted to reach \$6,870 million by 2025, exhibiting a projected CAGR of 3.2% between 2019 and 2025. Within Pakistan, the tea whitener sector is estimated to be worth around \$458 million and has seen a 35% growth over the past five years, marking the most significant expansion in the dairy industry.

Our objective was to investigate the consumption of tea whiteners among females and determine which age group consumes the most. This was done to establish a correlation with previous data that has suggested a link between the use of tea whiteners and obesity in females.

## **Methodology**

To gather information on tea whiteners, we developed a questionnaire and distributed it to a sample group of 400-500 individuals. The questionnaire was designed to collect data on various aspects related to tea whitener usage, such as reasons for use, preferred brands, duration of usage, and basic demographic information such as age, weight, and height. By analyzing the responses obtained through the questionnaire, we aimed to identify common patterns among tea whitener users.

In the next step, data collection was carried out through various means. Due to the COVID-19 pandemic, we collected samples of tea whiteners from local shops, markets, and utility stores, as well as surveyed some neighborhoods. When the university reopened, we collected additional data from university students. Furthermore, we gathered information from the internet to supplement our research. We collected a total of 8-10 samples of tea whitener products in both liquid and powdered forms. To ensure the accuracy of our data, we collected information face-to-face from participants and recorded the same information in an online survey form.

## Results and Discussion

Following data collection, we conducted a comparative analysis of the nutritional composition of various tea whiteners, including both liquid and powder forms. Our analysis encompassed a range of nutritional factors such as fats, proteins, carbohydrates, etc. (7). Using this comparative approach, we created a comprehensive data sheet, which is presented in Table 1.

The table 1 presents the nutritional information of different tea whiteners, both liquid and powder forms. Sample 1 (liquid) has 79 kcal energy per 100ml, 6.6g fat, 1.1g protein, 3.9g carbohydrates, 2.3g sugar, 1.32mg sodium, and traces of fiber and minerals. Sample 2 (powder) has 502 kcal energy per 100ml, 28g fat, 16.5g protein, 46g carbohydrates, 46g sugar, 0.94g sodium, and no fiber. Sample 3 (liquid) has 84 kcal energy per 100ml, 6.6g fat, 1.4g protein, 4.9g carbohydrates, 4.9g sugar, 0.08g sodium, and no fiber or minerals. Sample 4 (liquid) has 80 kcal energy per 100ml, 6.5g fat, 1.4g protein, 3.9g carbohydrates, 1.8g sugar, 350mg sodium, and no fiber. Sample 5 (liquid) has 80 kcal energy per 100ml, 6.5g fat, 1.4g protein, 4g carbohydrates, no sugar, and no sodium or fiber. Sample 6 (liquid) has 80 kcal energy per 100ml, 6.5g fat, 1.32g protein, 3.95g carbohydrates, 0.38g sugar, and no sodium or fiber. By comparing the nutritional information of different tea whiteners, we can determine which ones have higher amounts of nutrients like fat,

protein, carbohydrates, sugar, and sodium. This information can help us identify which tea whiteners may contribute to obesity in females if consumed in excess.

**Table 1: Tea whiteners (powdered and liquid) nutrients comparison**

<i>Tea whitener</i>	<i>energy/ 100ml</i>	<i>fat/100 ml</i>	<i>protein/100 ml</i>	<i>carbohydrat es/ 100ml</i>	<i>minerals/100 ml</i>	<i>sugar/100 ml</i>	<i>sodium/100 ml</i>	<i>fiber/100 ml</i>
<i>sample 1 (liquid)</i>	79 kcal	6.6 g	1.1 g	3.9 g	-	2.3 g	1.32 mg	traces
<i>sample 2 (powder)</i>	502kcal	28 g	16.5 g	46 g	-	46 g	0.94 g	0 g
<i>sample 3 (liquid)</i>	84 kcal	6.6 g	1.4 g	4.9 g	-	4.9 g	0.08 g	-
<i>sample 4 (liquid)</i>	80 kcal	6.5 g	1.4 g	3.9 g	350mg	1.8 g	-	-
<i>sample 5 (liquid)</i>	80 kcal	6.5 g	1.4 g	4 g	0.32 g	-	-	-
<i>sample 6 (liquid)</i>	80 kcal	6.5 g	1.32 g	3.95 g	0.38 g	-	-	-

In order to assess the impact of daily tea whitener consumption on a balanced diet, we compared the nutritional information of various tea whiteners with the recommended daily intake of nutrients such as fats, proteins, sugars, and carbohydrates. Specifically, we examined the frequency of tea whitener use among women and its potential effects on their health. By analyzing this data, we can determine the optimal amount of tea whitener use that is beneficial without causing harm. We used the collected data to create a datasheet, which allowed us to estimate the prevalence of tea whitener use among different age groups.

Based on our survey, we found that the majority of tea whitener consumers are aged between 18 and 30 years old. To determine the recommended intake of nutrients for this age group, we consulted a Committee report from 1973, which provided guidelines on the appropriate levels of fat, protein, and energy for individuals in this age range. We gathered information from 400-500 females of varying ages by asking them to specify their daily consumption of tea whiteners and whether it was in liquid or powder form.

The table 2 shows the amount of tea whitener consumed by females in different age groups. The data was collected separately for tea whitener in powder and liquid form. The table is divided into four age groups, 15-25, 26-35, 36-45, and 46-55. For the age group of 15-25, the females reported consuming 300g of tea whitener in powder form and 180ml of tea whitener in liquid form on a daily basis. In the age group of 26-35, the consumption of tea whitener in powder form decreased to 250g, while the consumption of tea whitener in liquid form remained the same as in the previous

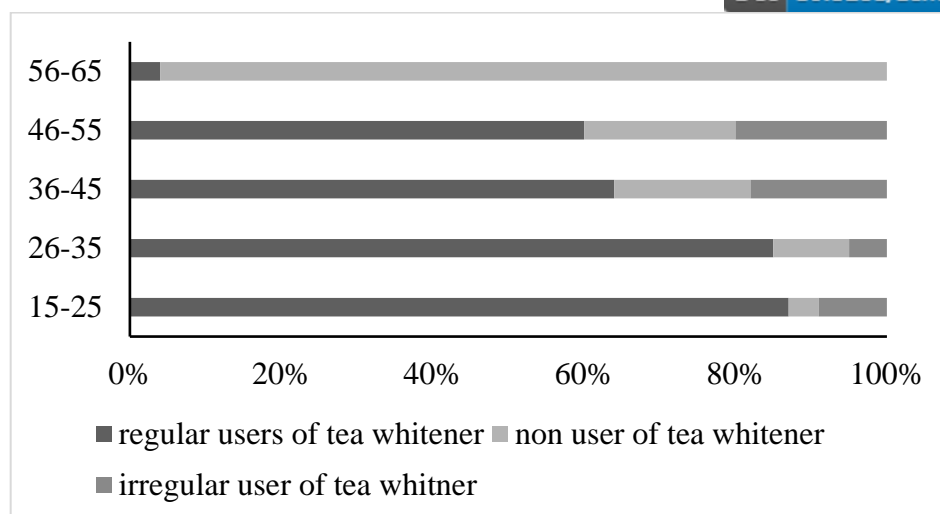
age group, at 180ml. For the age group of 36-45, the consumption of tea whitener in both powder and liquid form decreased further to 200g and 100ml respectively. For the age group of 46-55, the consumption of tea whitener in powder form increased to 250g while the consumption of tea whitener in liquid form decreased to 100ml.

This table helps in understanding the consumption patterns of tea whitener in different age groups and forms. The data can be used to analyze the potential health effects of tea whitener consumption and develop recommendations for its safe use.

**Table 2: Age groups tea whitener usage comparison**

Age groups	tea whitner (powder) g/100ml	tea whitner (liquid) /100ml
15-25	300g	180ml
26-35	250g	180ml
36-45	200g	100ml
46-55	250g	100ml
56-65	-	-

The 15-25 age group uses 300g of tea whitener powder per 100ml of liquid, while they use 180ml of liquid tea whitener. The 26-35 age group uses 250g of tea whitener powder per 100ml of liquid, while they use 180ml of liquid tea whitener. The 36-45 age group uses 200g of tea whitener powder per 100ml of liquid, while they use 100ml of liquid tea whitener. The 46-55 age group uses 250g of tea whitener powder per 100ml of liquid, while they use 100ml of liquid tea whitener. From this data, we can see that the younger age group (15-25) consumes more tea whitener powder compared to the other age groups. On the other hand, the older age groups (36-45 and 46-55) consume less tea whitener overall, with the 36-45 age group consuming the least amount of liquid tea whitener. In terms of preference between tea whitener powder and liquid, the data shows that all age groups consume more liquid tea whitener compared to tea whitener powder. The 15-25 and 26-35 age groups use more tea whitener powder per 100ml of liquid compared to the older age groups. The data for the age group of 56-65 indicates that only three to four females reported consuming tea whiteners, while all others denied its use. Therefore, in the table, the data for this group is shown as "none."



**Figure 1: Graph representing percentage of regular, irregular and non-users of tea whiteners**

This data represents the number of females in different age groups and their usage pattern of tea whitener. The first column shows the age groups ranging from 15-25 to 56-65. The second column indicates the total number of females surveyed in each age group. The third column shows the number of females who reported being regular users of tea whitener, meaning they consume it on a daily basis. The fourth column shows the number of females who reported not using tea whitener at all. The last column shows the number of females who reported using tea whitener irregularly. In the age group of 15-25, out of 100 females surveyed, 87 reported being regular users of tea whitener, 4 reported being non-users, and 9 reported using it irregularly. Similarly, in the age group of 56-65, out of 100 females surveyed, only 4 reported being regular users of tea whitener, while the majority of 96 reported not using it at all. This data shows that the usage of tea whitener varies among different age groups, with the younger age groups being more likely to use it regularly compared to the older age groups. Additionally, a significant portion of females in the older age groups reported not using tea whitener at all. To ensure specific results, we maintained an equal number of females in each age group during the study.

The nutrient content of dairy milk varies depending on factors such as animal type, breed, and feed. In contrast, tea whiteners contain plant-based fats and higher levels of proteins and carbohydrates compared to dairy milk. However, the protein in dairy milk is more easily digestible compared to the dense protein found in tea whiteners, which can take longer to digest and put additional strain on the stomach. Tea whiteners are sweetened artificially and have high levels of sugars, making them unsuitable for people looking to reduce their sugar intake or lose weight in a healthy way.



Furthermore, tea whiteners contain various chemicals and preservatives to improve their shelf life, taste, and aroma, which may be harmful to overall health when consumed regularly. Overconsumption of tea whiteners can lead to a reduced intake of essential animal fats required for a healthy body since their fats are plant-based. Some years ago, media hype surrounded the harmful effects of tea whiteners, leading parliamentary committees and even the Supreme Court of Pakistan to consider banning them due to safety concerns for human consumption.

## Conclusion

Based on the given data, we can conclude that a significant number of females use tea whiteners on a regular basis, with the highest percentage of regular users falling in the age group of 15-25 years. The majority of females in all age groups use liquid tea whiteners over powder tea whiteners. In terms of the quantity of tea whiteners consumed, the 15-25 age group consumes the highest amount of both liquid and powder tea whiteners, while the 36-45 age group consumes the lowest amount of powder tea whitener and the 46-55 age group consumes the lowest amount of liquid tea whitener. Furthermore, the data shows that irregular users of tea whiteners are present in all age groups, with the 36-45 age group having the highest percentage of irregular users. Overall, the data suggests that the use of tea whiteners is common among females, especially in younger age groups, and that the preference for liquid tea whiteners is higher than powder tea whiteners. To the best of our knowledge, this is the first study to compare the nutritional values of tea whiteners and assess their consumption habits among females. The findings of this study may provide valuable insights into the impact of tea whiteners on the health and well-being of females.

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