

# A Study on the Development and Consumer Evaluation of Eco-Friendly Degreasing Kitchen Wipes

**Kathirol.K 1, Sudharshini.M 2, Joanofarc Rabekkal.J 3**

*Department of Fashion and Costume Designing*

*Holy Cross College (Autonomous)Trichy*

## ABSTRACT

This study focuses on the development of an eco-friendly kitchen cleaning wipe designed to remove grease while minimizing the use of harsh chemical cleaning agents. Conventional degreasing products often contain synthetic chemicals that may pose health and environmental risks. To address this issue, a biodegradable kitchen wipe was developed using natural textile materials and organic cleaning components. The wipe was constructed as a duplex material consisting of coir fibers and raveled cotton yarns. Natural acids extracted from lemon and tamarind were incorporated along with sodium bicarbonate to formulate a mild degreasing solution. The developed wipes were coated using a dip-and-dry technique and evaluated through laboratory testing and consumer feedback. Physical performance, antimicrobial activity, and tensile strength were examined to assess durability and hygiene properties. Additionally, a consumer evaluation survey was conducted to determine usability, cleaning efficiency, and user satisfaction. The results indicated that the developed wipes demonstrated effective grease removal, satisfactory mechanical strength, and positive user acceptance. The findings highlight the potential of combining natural fibers and plant-based cleaning agents to produce sustainable household cleaning products.

**Keywords:** Eco-friendly wipes, Natural degreasing agents, Coir fiber, Cotton yarn, Kitchen cleaning, Consumer evaluation

## INTRODUCTION

Textile materials have evolved beyond conventional clothing applications and are increasingly used in functional products designed for domestic and industrial purposes. Among the many branches of modern textile applications, home textiles represent an important sector that focuses on improving comfort, hygiene, and convenience in household environments. Kitchen cleaning materials such as wipes, scrubbers, and cloths are commonly used in daily household maintenance to remove grease, food residues, and dirt from surfaces.

Grease accumulation is a common issue in cooking environments because oils and food particles adhere to kitchen surfaces such as stoves, countertops, chimneys, and utensils. Most commercially available degreasing products rely on synthetic chemical formulations including alkaline detergents, solvents, and disinfectants. While these products are effective, continuous exposure to chemical cleaning agents may cause skin irritation, respiratory discomfort, and environmental pollution. This has encouraged researchers to explore sustainable alternatives that use natural ingredients and biodegradable materials.

Natural fibers and plant-derived acids have attracted considerable attention in sustainable product development. Coir fiber, obtained from coconut husk, possesses excellent durability, natural abrasiveness, and resistance to moisture, making it suitable for scrubbing applications. Cotton yarn, particularly recycled or raveled knitted yarns, exhibits high absorbency and flexibility, which allows it to effectively wipe residual grease and moisture. When combined into a duplex structure, these materials can perform both scrubbing and wiping functions.

Organic acids derived from natural sources can also act as mild cleaning agents. Citric acid obtained from lemon and tartaric acid from tamarind are known for their ability to break down grease and mineral deposits. Sodium bicarbonate further enhances cleaning efficiency due to its mild alkaline nature and abrasive properties. By integrating these natural cleaning agents with textile materials, it is possible to develop a multifunctional kitchen wipe that is both effective and environmentally friendly.

The present study aims to develop eco-friendly degreasing kitchen wipes using natural fibers and organic cleaning components. The performance of the developed wipes was examined through laboratory testing and user evaluation in order to determine their practicality as a sustainable household cleaning product.

## MATERIALS AND METHODS

The materials used for the development of eco-friendly degreasing kitchen wipes included coir fiber mats, raveled cotton knitted yarns, lemon, tamarind pulp, sodium bicarbonate, and adhesive for bonding. Coir fiber mats were selected because of their natural abrasive surface, which assists in removing stubborn grease from kitchen surfaces. Raveled cotton yarns obtained from knitted fabric waste were used as the absorbent layer to wipe off loosened dirt and moisture. The wipe was designed as a duplex structure consisting of two functional layers. The coir layer served as the scrubbing surface, while the cotton yarn layer functioned as the wiping surface. Adhesive bonding was used to combine the layers into a stable structure. The raveled yarns were arranged in multiple layers to achieve thickness comparable to the coir mat and to enhance durability during repeated washing.

Natural degreasing agents were prepared from lemon and tamarind. Citric acid was obtained from lemon peel through extraction and filtration, while tartaric acid was extracted from tamarind pulp using a precipitation process. The cleaning solution was prepared by mixing citric acid, tartaric acid, and sodium bicarbonate in appropriate proportions with water. The duplex wipes were immersed in the prepared solution using a dip-coating method and then dried at room temperature to allow the solution to impregnate the fibers.

The developed wipes were evaluated using both experimental and consumer research approaches. Tensile strength testing was conducted to determine the mechanical durability of the wipes. Antimicrobial activity was assessed using a disc diffusion method against common bacteria such as *Escherichia coli* and *Pseudomonas aeruginosa*. Additionally, a consumer survey was conducted in which participants used the product for several days and provided feedback regarding cleaning performance, absorbency, durability, and overall satisfaction.

## RESULTS AND DISCUSSION

The developed kitchen wipes demonstrated effective functionality due to the combination of abrasive and absorbent materials. The coir surface provided sufficient friction to remove grease deposits from cooking utensils, tiles, and stove surfaces. At the same time, the cotton yarn layer absorbed residual oil and moisture, leaving the cleaned surface relatively dry.

The natural degreasing solution containing citric acid, tartaric acid, and sodium bicarbonate contributed to grease removal by breaking down oily residues and improving cleaning efficiency. The mild acidity of the organic acids helped dissolve grease without causing damage to kitchen surfaces or skin irritation.

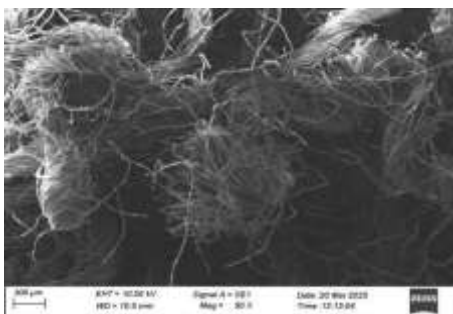
Tensile strength testing indicated that the duplex wipes possessed adequate mechanical strength to withstand normal household use and repeated washing cycles. The adhesive bonding method provided sufficient structural stability, preventing separation of the layers during cleaning operations.

Antimicrobial evaluation revealed a noticeable reduction in bacterial growth around the treated samples, indicating that the natural acid coating contributed to hygienic properties. Organic acids are known to inhibit microbial growth by lowering pH and disrupting bacterial cell processes.

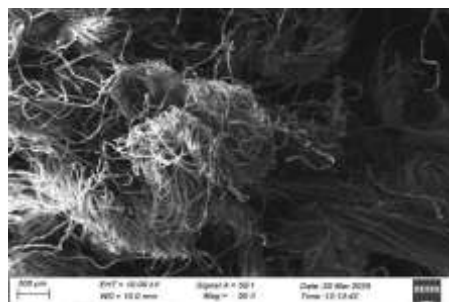
Consumer evaluation further supported the effectiveness of the developed wipes. Most participants reported satisfactory grease removal, good absorbency, and comfortable handling during cleaning tasks. The triangular shape of the wipes also allowed users to reach corners and narrow spaces in kitchen appliances. Overall, the feedback suggested that the eco-friendly wipes were a practical alternative to commercial kitchen scrubbers.

### *Physical test analysis*

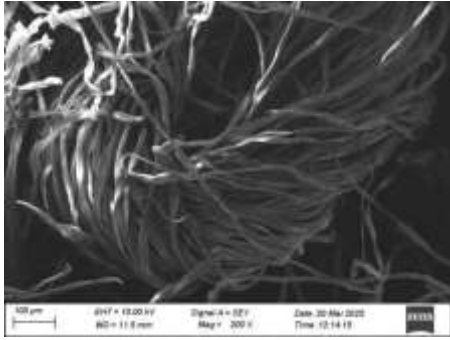
- SEM (Scanning Electron Microscope) analysis is taken for both the side of the scrubber to analyze the structure of scrubber and the penetration of the coating.



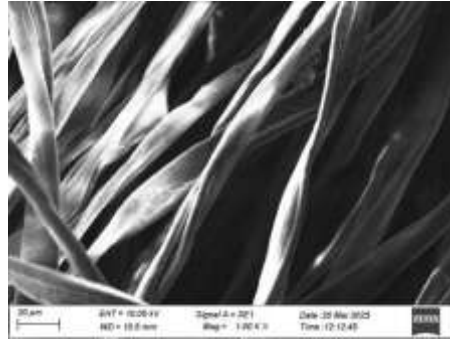
(a)



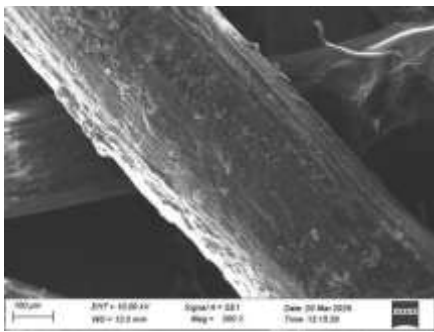
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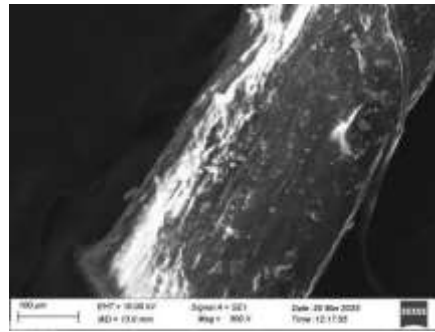
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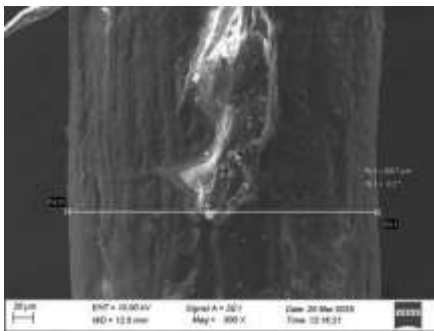
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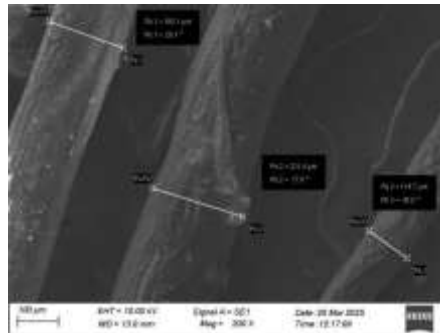
(e)



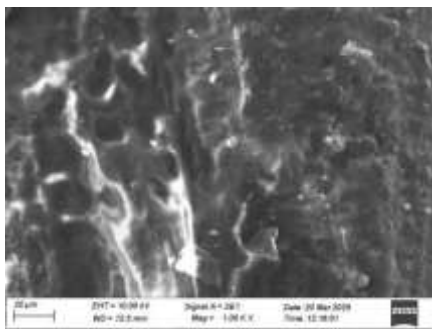
(f)



(g)



(h)



(i)

Plate 6 – (a) image of raveled knitted yarns in 50k magnitude, (b) image of raveled knitted yarns with crimp in 50k magnitude, (c) image of knitted raveled yarns in 200k magnitude,(d) image of knitted raveled yarns in 1.00k magnitude, (e) Image of coir in 200k magnitude,(f) image of coir in 300k magnitude, (g) image of coir fiber thickness in 500k magnitude, (h) image of coir fiber thickness of three different fibers, (i) image of coir fiber in 1.00k magnitude.

- By this SEM analysis it is evident that coating penetrated in the coir fibers

**Tensile Strength analysis**

Tensile strength is the physical test undertaken to know the maximum stress that the sample can withstand this can be identified by the following table.

S.NO	BREAKING FORCE	THICKNESS (inch)	WIDTH (inch)	AREA (mm <sup>2</sup> )	TENSILE STRENGTH (□)
1.	250	0.5	2.5	806.45	0.31N
2.	245	0.5	2.5	806.45	0.304N
3.	240	0.5	2.5	806.45	0.298N
4.	300	0.5	2.5	806.45	0.372N
5.	305	0.5	2.5	806.45	0.378N
6.	Average				0.332N

Table 3 Readings of tensile strength

From the readings the tensile strength of the duplex material is □ = 0.332 N or mm<sup>2</sup>

**Result of antibacterial test**

- The antibacterial activity of fabric samples treated with extracts was analysed against pathogens showed no growth observed against *Pseudomonas aeruginosa* and *Escherichia coli* at a concentration 100 µg/ml treated by Day 1 samples

Sample	Concentration (µg/ml)	Organisms/Zone of inhibition (mm)	
		<i>Pseudomonas aeruginosa</i>	<i>Escherichia coli</i>
Fabric sample coated with extracts	50 µl	No growth	No growth
	100 µl	No growth	No Growth

Table 4 – Antibacterial activity of Day 1 sample



Plate 7 – Day 1 *Pseudomonas aeruginosa*

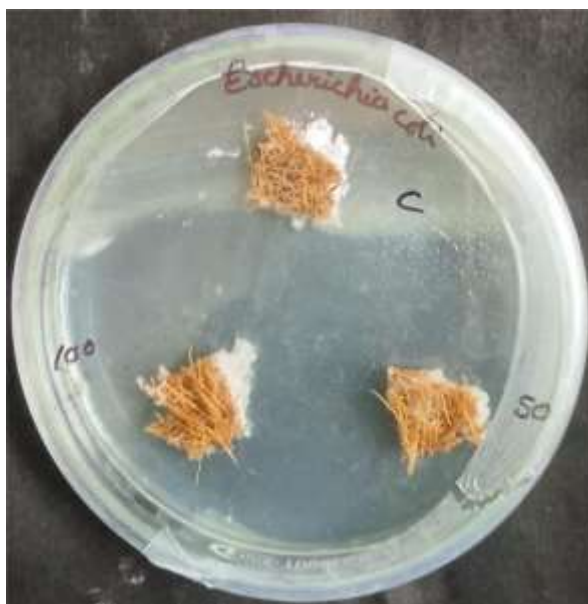


Plate 8 – Day 1 *Escherichia coli*

- The antibacterial activity of fabric samples treated with extracts was analysed against pathogens. No growth was observed against *Pseudomonas aeruginosa* and *Escherichia coli* at a concentration of 100 µg/ml treated by Day 2 samples.

Sample	Organisms/Zone of inhibition (mm)	
	<i>Pseudomonas aeruginosa</i>	<i>Escherichia coli</i>
Fabric sample coated with extracts	Slow growth	Slow growth
	Slow growth	Slow Growth

Table 5 – Antibacterial activity of Day 2 sample



**Plate 9 – Day 2 *Pseudomonas aeruginosa***



**Plate 10 – Day 2 *Escherichia coli***

- The antibacterial activity of fabric samples treated with extracts was analysed against pathogens. No growth was observed against *Pseudomonas aeruginosa* and *Escherichia coli* at a concentration of 100 µg/ml treated by Day 3 samples.

*Table 6 – Antibacterial activity of Day 3 sample*

Sample	Organisms/Zone of inhibition (mm)	
	<i>Pseudomonas aeruginosa</i>	<i>Escherichia coli</i>
Fabric coated with extracts	Moderate growth	Moderate growth
	Moderate growth	Moderate Growth



Plate 11 – Day 3 *Pseudomonas aeruginosa*



Plate 12 – Day 3 *Escherichia coli*

- The antibacterial activity of fabric samples treated with extracts was analysed against pathogens. No growth was observed against *Pseudomonas aeruginosa* and *Escherichia coli* at a concentration of 100 µg/ml treated by Day 4 samples.

Sample	Organisms/Zone of inhibition (mm)	
	<i>Pseudomonas aeruginosa</i>	<i>Escherichia coli</i>
Fabric sample coated with extracts	Partial growth	Partial growth
	Partial growth	Partial Growth

Table 7 – Antibacterial activity of Day 4 sample



Plate 13 – Day 4 *Pseudomonas aeruginosa*



Plate 14 – Day 4 *Escherichia coli*

#### 4.1. User Feedback and product evaluation

Performance of the kitchen wipes is analyzed by using survey form which is collected from 25 different peoples with 10 different questions, collected information are tabulate as

RESPONDENT	Q1 Appliance	Q2 Removal Of greasy areas	Q3 No. of Washes/ No. of Days	Q4 Coir Function	Q5 Raveled yarns – absorption	Q6 Rating	Q7 Future use	Q8 Price	Q9 Recommends for friends	Q10 Suggestion
1	Kitchen table top	Yes	10/5	Yes	Yes	Good	Yes	Rs.2 0	Yes	Need grab band
2	Mixer Grinder	Moderate	10/10	Yes	Yes	Good	Yes	Rs.2 0	Yes	Improve Adhesive bonding
3	Chimney	Yes	5/3	Yes	Yes	Better	Yes	Rs.2 0	Yes	Good
4	Silver Utensils	Yes	15/15	Moderate	Moderate	Good	Yes	Rs.2 0	Yes	Knitted yarns are raveling slightly
5	Stove	Yes	10/5	Yes	Yes	Good	Yes	Rs.2 0	Yes	-
6	Vessels	Yes	14/5	Yes	Yes	Better	Yes	Rs.2 0	Yes	Add Handle
7	Stove	Yes	10/4	Yes	Yes	Better	Yes	Rs.2 0	Yes	Add Handle

8	Chimney	Yes	10/9	Yes	Yes	Good	Yes	Rs.2 0	Yes	Improve extraction
9	Stove	Yes	12/6	Yes	Yes	Better	Yes	Rs.1 0	Yes	-

10	Table top	Yes	4/4	Yes	Yes	Good	Yes	Rs.20	Yes	-
11	Chimney	Yes	1/5	Yes	Yes	Good	Yes	Rs.15	Yes	Good
12	Gas Stove	Yes	3/3	Yes	Yes	Better	Yes	Rs.25	Yes	Improve coating
13	Kitchen shelf	Yes	7/7	Yes	Yes	Good	Yes	Rs.20	Yes	Good absorbency, need to improve cotton side
14	Mixi, Gas stove	Yes	7/7	Yes	Yes	Good	Yes	Rs.25	Yes	Improve knitted side
15	Gas stove, Kitchen tiles	Yes	8/8	Yes	Yes	Better	Yes	Rs.20	Yes	Suits for tile cleaning, need different shapes
16	Gas stove	Yes	5/7	Yes	Yes	Better	Yes	Rs.20	Yes	Coir is raveled

17	Oven	Yes	6/6	Yes	Yes	Good	Yes	Rs.15	Yes	Easy to handle
18	Kitchen shelf	Yes	9/5	Yes	Yes	Good	Yes	Rs.20	Yes	Need more sizes
19	Stove top, kitchen slab	Yes	7/7	Yes	Yes	Good	Yes	Rs.25	Yes	Need separate degreasing solution for future need
20	Chimney, stove	Yes	6/12	Yes	Yes	Better	Yes	Rs.15	Yes	Need coloured yarns.
21	Kitchen table top	Yes	5/5	Yes	Yes	Better	Yes	Rs.15	Yes	Good
22	Chimney	Yes	7/6	Yes	Yes	Good	Yes	Rs.20	Yes	Good
23	Stove	Yes	6/5	Yes	Yes	Good	Yes	Rs.15	Yes	Need more sizes
24	Stove, Chimney	Yes	12/10	Yes	Yes	Better	Yes	Rs.20	Yes	Raveling of coir
25	Stove	Yes	3/10	Yes	Yes	Good	Yes	Rs.20	Yes	Improve design

Table 8 – data collected from survey form

From the above collected data, the following are the graphs to analyze the data

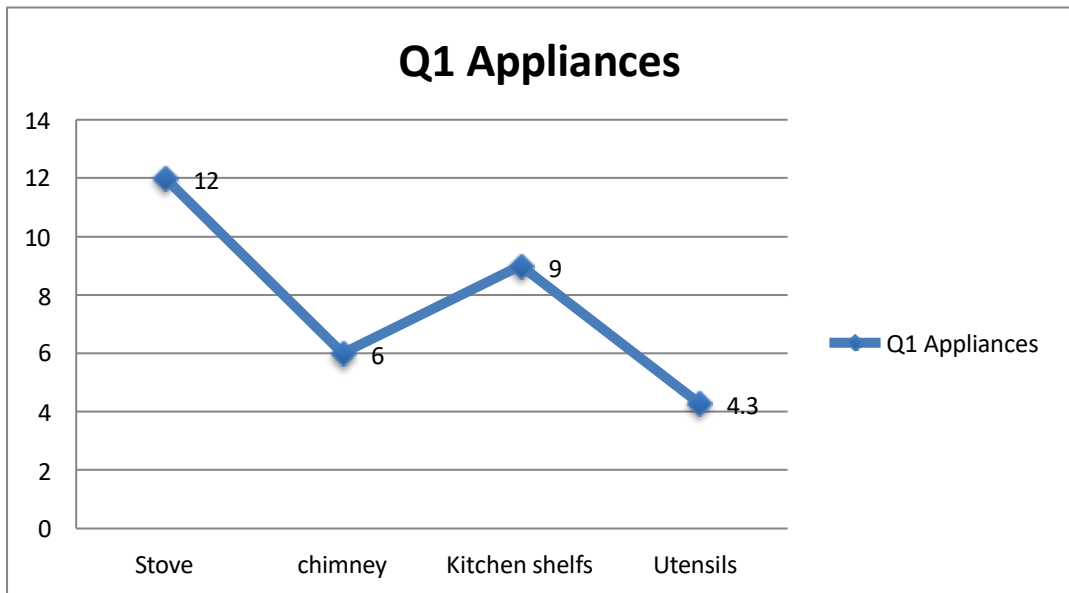


Fig.1 – Graph for which appliances are used for cleaning

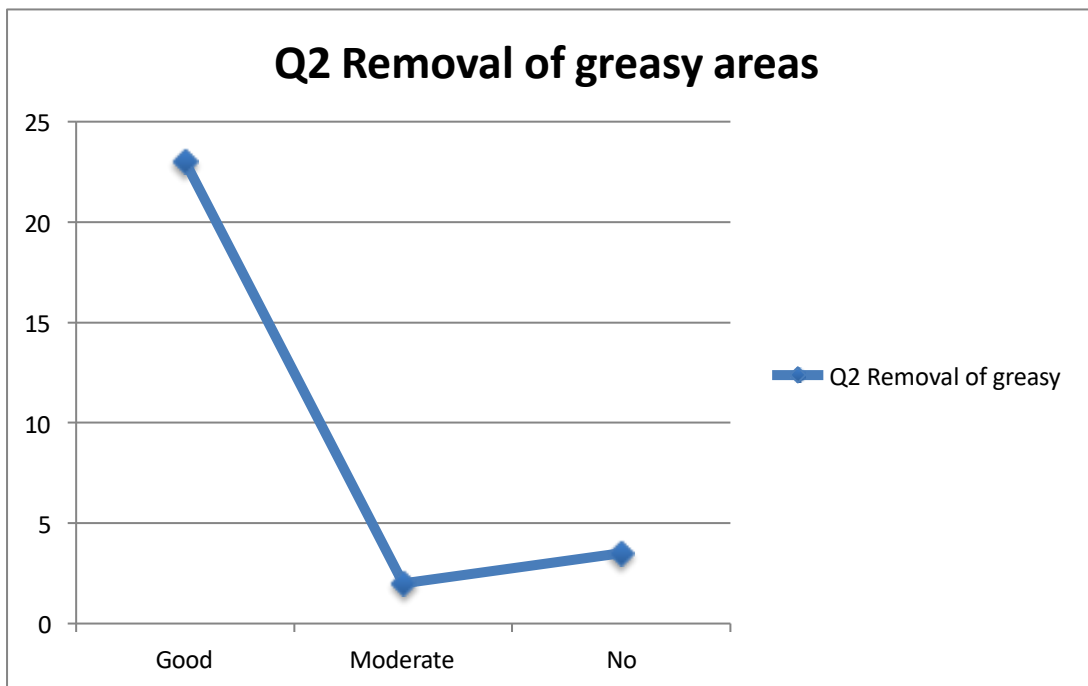


Fig.2 – Graph for performance of the wipes

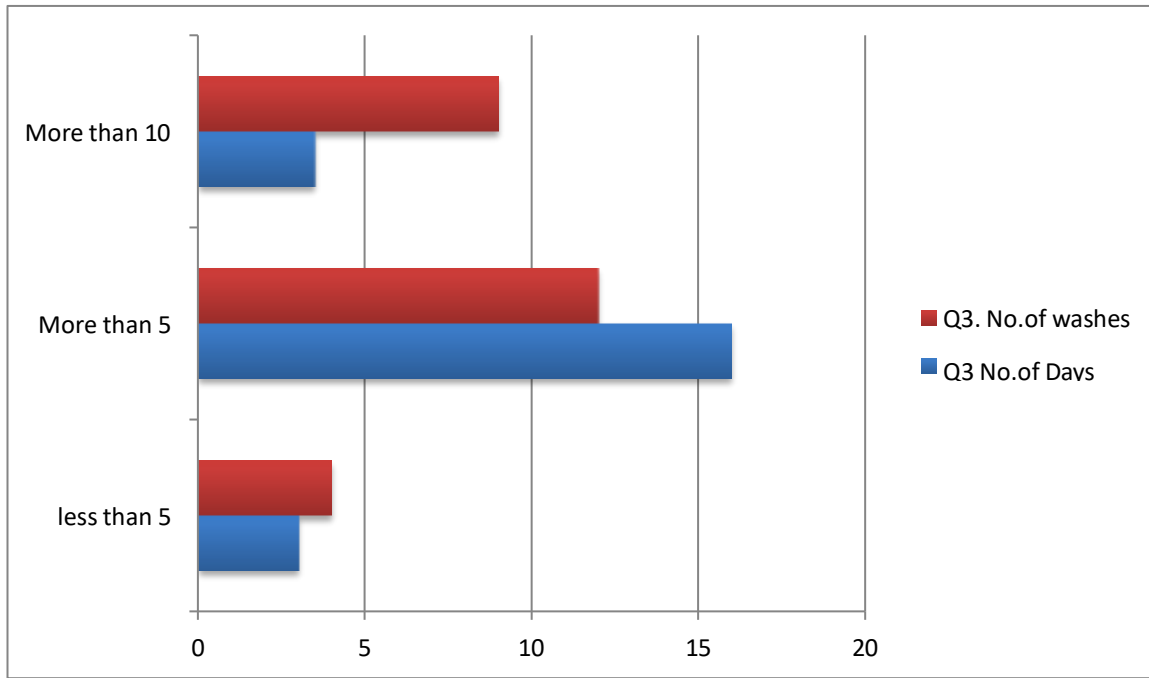


Fig.3 – Graph for no. of days used and no. of washes

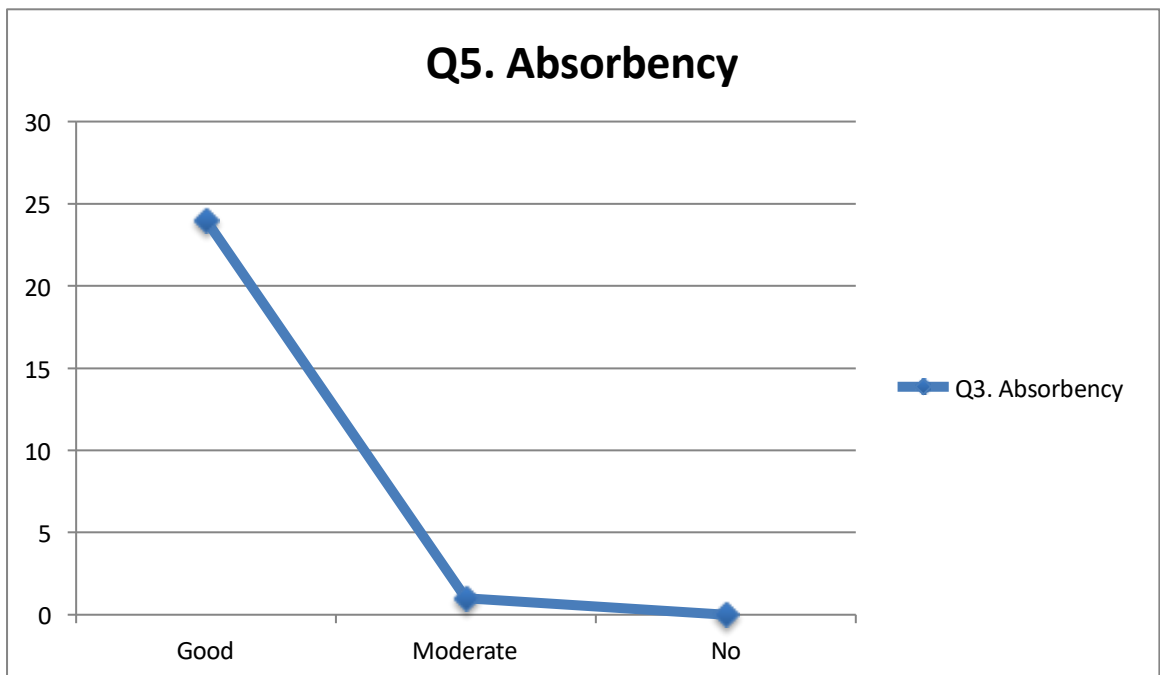


Fig.4 – Graph for absorbency capacity

**CONCLUSION**

The present study successfully developed an eco-friendly degreasing kitchen wipe using natural textile materials and plant-based cleaning agents. The combination of coir fiber and raveled cotton yarns created a functional duplex structure capable of both scrubbing and wiping actions. The use of natural acids derived from lemon and tamarind, along with sodium bicarbonate, provided an effective yet mild degreasing solution.

Laboratory tests confirmed that the developed wipes possessed acceptable mechanical strength and demonstrated antimicrobial potential. Consumer feedback indicated positive acceptance of the product in terms of cleaning performance and usability. The findings suggest that eco-friendly kitchen wipes made from natural fibers and organic

cleaning agents can serve as a sustainable alternative to synthetic cleaning products. Further research may focus on improving durability, optimizing coating formulations, and scaling up production for commercial applications.

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