

THE EFFECT OF WASHING OPERATIONS ON THE ANTIBACTERIAL TREATMENT OF IHRAM CLOTHING USED IN HAJJ AND UMRAH

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Abstract: The Ihram is worn in Hajj and Umrah. It's woven with soft different weights and properties, and it also consists of two pieces. Makkah has a hot humid climate, and pilgrims wear Ihrams for a long time, which leads to the accumulation of components of sweat and skin fat due to the impact of the sun's burning and high humidity and dust with the multitude of gatherings, which is a good environment for the bacteria and microorganisms to grow on the Ihram and this affects the public health of the individual and makes it more susceptible to diseases. This research aims to measure the effect of washing operations on the antibacterial treatment of Ihram garments. The results reached showed that treating the Ihram's fabric against bacteria through nanosilver does not negatively affect the feeling of comfort when wearing it, and the ihram's appearance is not affected by the treatment processes. In addition to that, it resists bacteria and types of fungi with a strong degree, but this decreases through the number of washes so that it can be wearable, but the anti-bacterial effect is weakened.

Keywords: washing operations, antibacterial treatment, Ihram clothing.

1 INTRODUCTION

Ihram clothing is popular in local markets throughout the year and achieves a high rate of sales as it is the legal dress for performing Hajj and Umrah rituals in Makkah. It is a soft woven cotton fabric (rings appear on one or both sides of the cloth), always white and consists of two unstitched white sheets. The first covers the lower part of the body (from the navel to the knee and is called Izar) and the second covers the upper part is called Ridaa [1]. Figure 1 shows the two parts of Ihram when it's wrapped up around the body.



Figure1 The upper and lower parts of Ihram clothing

1.1 How to wear Ihram

Ihram clothing is worn directly on the body without any other layers of clothing, so that it is wrapped up around the body and is fixed by a belt. Figure 2 shows the steps of wear the Ihram, three steps for wearing the upper part, and three steps for wearing the lower part.

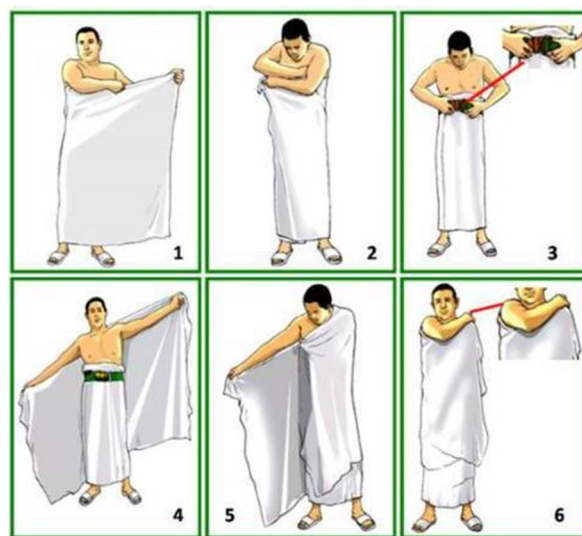


Figure2 How to wear Ihram around the body

If a Muslim wants to wear Ihram for Umrah or Hajj, he is obliged to do several things before that and among these things are his clothes' properties.

It is preferred that the Ihram is a white cotton and it must be free of decorations, manufacturing defects and any holes since it must be characterized by absorbing liquids and having the property of moisture, as they consist of two pieces, the dress and the buttons, of equal length and dimensions.

The Saudi Vision 2030 calls for the present vision of the future with 3 main divisions: a thriving economy, a vibrant society, and an ambitious nation. And its most prominent development goals are to increase the capacity to receive from 8 million to 30 million pilgrims and the Kingdom will work to empower more than 15 million pilgrims and Umrah performers annually [2].

Makkah Al-Mukarramah is located within the Tihama region to the west of the Arabian Peninsula which extends along the Red Sea, about 75 km from its coasts, in a site that is considered one of the most complex areas of geological formations and is dominated by the pattern of very hard rocks. The prevailing geography in this holy city imposed itself on the current climate. Its location in the tropical region, its low elevation above sea level, and its location relatively far from the Red Sea, making its climate a tropical desert in which there is a very hot summer and a warm winter.

1.2 Problems that faces Ihram

The climate of Makkah region, in the presence of massive numbers of pilgrims and Umrah performers, is a fertile climate for the growth of bacteria and fungi. The presence of microorganisms, such as bacteria and fungi, is everywhere around humans, in soil, water and air close to the surface of the earth. They are also found on natural fibers and their proliferation increases according to the surrounding conditions in terms of humidity, and the appropriate temperature for some species. Micro fungi, bacteria, tape bacteria and algae are distinguished by their ability to biodegrade (break down the fibers) and thus lead to the loss of some of the properties of these fibers such as tensile strength and elasticity, or color removal. It is good that, in some cases, the processing materials treated with the surface of the fibers may attack fungi and micro-organisms harmful to the fabric [3].

The consumer should be obliged to wash any material purchased from any sales centers, especially the kinds of cotton that confirmed that they contain a high fungal density which amounted to 1932 fungal colony/cm² [4].

Ministry of Health confirmed in its health article (Hajj 1436) that skin diseases are the most common diseases that affect arrivals for Hajj and Umrah due to the high temperature, high humidity and a large number of gatherings.

Preparation against biological activities (bacteria) is the treatment of textile products with substances

that prevent the accumulation of various, microorganisms such as bacteria and fungi [4]. It is indicated that recently there has been an increasing demand for textile products treated against bacteria and fungi because of their utmost importance on the health of the consumer, who has become interested in the different and important properties of fabrics.

Several advanced materials have been developed for the bacterial resistance of textiles, such as phenols, halogen, organic metals, quaternary ammonium salts, metal salts, organic mercury compounds, copper compounds, organic zinc and tin compounds, silver salts, each of which has its own properties, as well as the process of providing fibers with cyanide groups. The method of vaccination of acrylonitrile polymers works to prevent them from being attacked by mold bacteria, the need to treat textiles against bacteria as they are the first thing that comes into contact with the human body [5].

The properties of the Ihram fabrics are affected by the difference between the type of fibers used, the height of the pile, the shape, direction, and density of the pile, as well as the need to achieve the properties of comfort, durability, care, appearance, and protection [6]. The researcher saw the importance of measuring the effect of washing operations on the treatment's properties. In addition to the appearance of the Ihram clothing treated against bacteria in an attempt to improve the Hajj environment in response to the points related to Hajj and Umrah in the Kingdom's 2030 vision. Although some researches dealt with treating cotton fabrics against bacteria and that the Ihram clothes are made of cotton fabrics, this is one of the few studies that deals with the Ihram clothes that are worn under special climatic conditions in addition to their direct contact with the body, so there is no insulation between them and the body, and wearing it for a period up to several consecutive days during the Hajj, and one of the few studies that deals which measure the effect of washing on the treatment of Ihram clothes against bacteria

The research was based on the fabrics from which the Ihram garments are made, where the Ihram clothes were used most widely in the local market and treated against bacteria with nanosilver technology, which is accessible to all pilgrims and Umrah performers, and the main goal was to ensure that the treatment with nanofiber technology did not affect the appearance of the Ihram clothes and achieve comfort for pilgrims. In addition, the stability of bacteria resistance with repeated washing was measured.

2 EXPERIMENTAL

Research aims:

- Measuring the effect of antibacterial treatment on the comfort properties of Ihram garments.

- To measure the effect of anti-bacterial treatment on the appearance of Ihram garments.
- Measuring the effect of washing operations on the antibacterial treatment of Ihram garments.

Research importance:

- Linking scientific research with the Ministry of Hajj and serving pilgrims.
- Contribute to raising the efficiency of services provided to pilgrims and Umrah performers, and preserving their health and performance of rituals.
- Contributing to activating the policy of the tenth development plan, which stipulates "Upgrading the level of services for pilgrims, Umrah performers, and visitors."
- Response to the Kingdom of Saudi Arabia's 2030 Vision, which is concerned with serving pilgrims and Umrah performers.

Research methodology:

The research follows the semi-experimental approach in terms of its suitability to study the research's objectives, through used Ihram which is treated against bacteria and making laboratory tests to measure the stability of treatment with washing, as well as measuring the appearance and comfort of the treated fabrics.

Research tools:

- Questionnaire to evaluate the treated Ihram garments.
- Lab data registration form.

Applied study:

The applied study went through steps that help in achieving the research objectives, as follows:

- I. Used Ihram clothes, which are made of 100% cotton towelling "terry", and already treated against bacteria. The material used is a common material purchased on the Saudi market and that the antibacterial treatment was performed by the producer.
- II. Conducting laboratory tests to measure the effect of washing operations on the treated Ihram clothes according to the household washing specification, this process done in "Bureau Veritas Saudi Arabia Testing Services - Textile" in Jeddah, Saudi Arabia using Standard specification for Dimensional Stability in Washing and Drying (ISO 5077 / BS EN ISO 6330 / ISO 3759 / AATCC 135 / AATCC 150).
- III. Comparison between Ihram clothing resistance to bacteria (*Escherichia coli*, *Staphylococcus aureus*) and resistance to fungi (*Candida albicans*, *Aspergillus flavus*), before and after the washing process. The tests were done in Microanalytical Center, Faculty of Science, Cairo University, Egypt.
- IV. Designing a questionnaire for users of Ihram clothing to evaluate the comfort and appearance of fabrics treated with nano-silver technology

that resists bacteria. The questionnaire consisted of two axes; one of them, which was the comfort of the Ihram clothing, consisted of 8 items, as shown in Figure 3 and the other axis was about the appearance of the Ihram clothing and consisted of 7 items as shown in Figure 4. The questionnaire targets men during the Hajj and Umrah season. The questionnaire consists of three options and they are: yes, maybe, no. The questionnaire was distributed to 70 individuals through Hajj and Umrah trips in the Kingdom of Saudi Arabia in the Jeddah region.

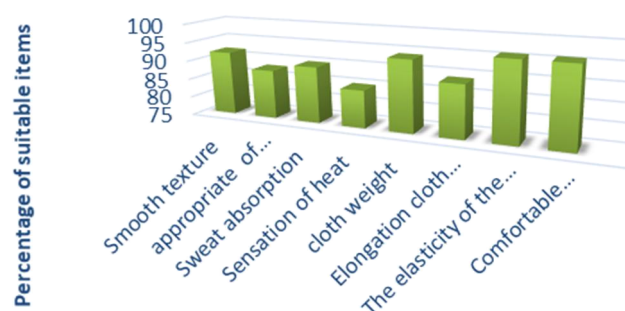
3 RESEARCH RESULTS

Through the research tools and applied study steps, a set of results was reached:

3.1 Results related to the effect of treating fabrics with nanosilver technology (anti-bacterial treatment) on Ihram garments

A: The effect of treating fabrics with anti-bacteria on the comfort of the body

The following figure shows the opinions of the target group regarding the suitability of the treated fabrics during use, and the degree of feeling the requirements of comfort and function for the wearers of the Ihram clothing. Figure 3 shows the effect of treating fabrics with anti-bacteria on the comfort of body during wearing the Ihram in Umrah.



Evaluate the comfort of fabrics treatment

Figure 3 The effect of treating fabric with anti-bacteria on the body comfort

The previous figure shows that all of the percentages were concentrated between 85% and 96%, which indicates the high results of the items related to the feeling of the research sample of pilgrims and Umrah performers with the degree of comfort of the Ihram clothing after being treated with nano-silver technology (treatment against bacteria) so that the last item, which is the feeling of comfort, is generally 96%, which is satisfactory. No negative remarks were recorded on the part of the research sample as well.

B: The effect of antibacterial fabric treatment on the appearance of Ihram clothing fabrics

The treatment procedure may affect the appearance of the fabrics as a result of the effect of the materials involved in the treatment. So the appearance of the fabrics was evaluated by specialists in the field of clothing and textiles, after completing their treatment with nano-silver technology (anti-bacterial treatment), and the following figure shows the results of the evaluation. Figure 4 shows the effect of treating fabrics with anti-bacteria on the fabric's appearance related to consumer opinion during Umrah.

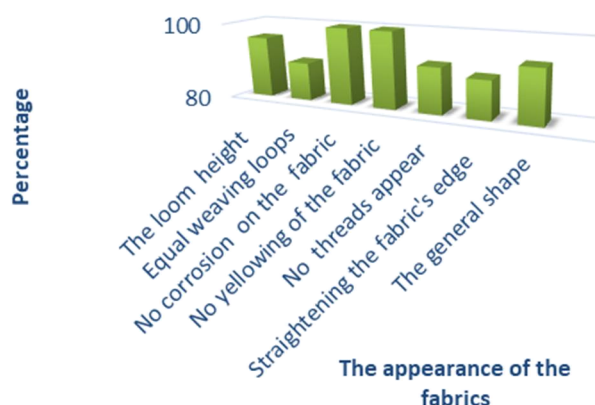


Figure 4 The effect of treating fabric with anti-bacteria on the fabric appearance

The previous figure shows that all of the percentages were concentrated between 90% and 100%, which indicates high results of the items related to the appearance of the fabrics after treating them with nano-silver technology (treated against bacteria), so that the last item, the general form, reached 94%, which is a satisfactory rate. No negative remarks were recorded on the part of the research sample.

Through the previous results related to the comfort and the appearance of the treated fabrics against bacteria, the suitability of the treated fabric was reached and there were no negative results related to the use.

3.2 Results related to the effect of washing operations on the antibacterial treatment of Ihram garment

Biological activity (Sensitivity tests): The antimicrobial activity of the tested samples was determined using a modified Kirby-Bauer disc diffusion method [7]. Isolated colonies of the organisms were tested using disc diffusion method. For the disc diffusion, the zone diameters were measured with the National Committee for Clinical Laboratory Standards [8]. Agar-based methods are simpler and faster than broth-based methods so they can be a good alternative [9, 10]. The tests were carried out before the washing process and after completing 5 washes,

and the tests included a group of organisms. Table 1, shows the strains of microorganisms that tested its effect by the washing process, its divide in to two kinds of bacteria and two kinds of fungus.

Table 1 The strain type of microorganisms

Name	Gram reaction	ATCC
<i>Escherichia coli</i>	G-	11775
<i>Staphylococcus aureus</i>	G+	12600
<i>Candida albicans</i>	Fungus	7102
<i>Aspergillus flavus</i>	Fungus	9643

The laboratory results appeared as shown in the following Figures 5-8. The number (1) represents the resistance of the sample against the organism before washing and the number (2) represents the resistance of the sample to the organism after five washes. Figure 5 shows the resistance of the sample against *Aspergillus flavus* (fungus) before washing and after five washes. It was found that the resistance decrease after the fabric washing.



Figure5 The effect of washing on *Aspergillus flavus*

Figure 6 shows the resistance of the sample against *Candida albicans* (fungus) before washing and after five washes. It was found that the fabric still have resistance after the fabric washing.

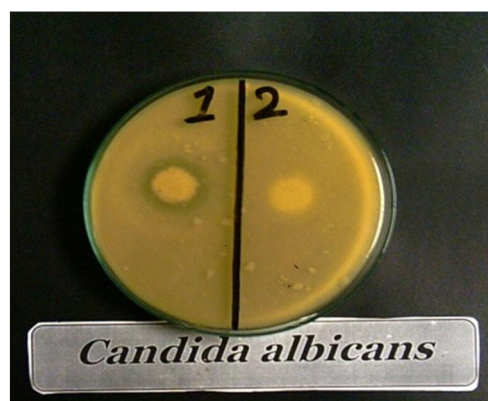


Figure6 The effect of washing on *Candida albicans*

Figure 7 shows the resistance of the sample against *Staphylococcus aureus* (bacteria) before washing and after five washes. It was found that the fabric still have resistance after the fabric washing but less than sample no. (1) – fabric before washing.

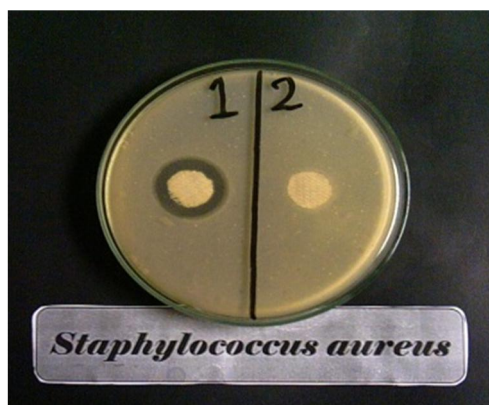


Figure7 The effect of washing on *Staphylococcus aureus*

Figure 8 shows the resistance of the sample against *Escherichia coli* (bacteria) before washing and after five washes. It was found that the fabric still have resistance after the fabric washing but less than sample no.(1) - fabric before washing.

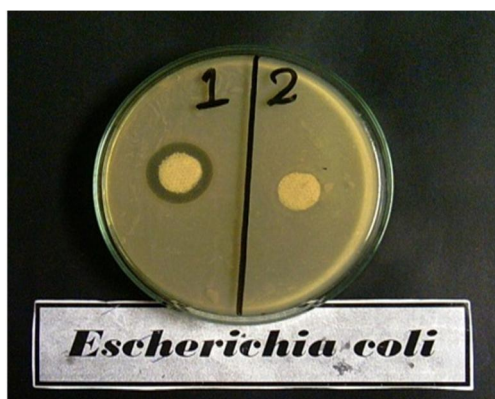


Figure 8 The effect of washing on *Escherichia coli*

Table 2, shows the results of the microbiological analyzes of the resistance of the treated fabric samples against bacteria before washing and after five washes, and the number (1) refers to the samples before washing, while the number (2) refers to the samples after five washes.

4 CONCLUSION

Both tested samples have a resistant and anti-bacterial effect, but the sample (1) before washing is much better than the sample (2) as it has a stronger effect on the types of Gram-positive and Gram-negative bacteria in addition to having a resistive effect against the yeast type *Candida albicans*. For sample 2, which is the fabric after five washes, it was found that it has an anti-bacterial effect, but at a weak rate, and it does not affect the types of fungi or yeasts tested.

The treating the Ihram fabrics against bacteria through nanosilver do not have a negative effect on the feeling of comfort when wearing, and its appearance is not affected by the treatment processes. In addition to that, it resists bacteria and types of fungi with a strong degree, but this has become less through the number of washes so that it can be wearable, but the anti-bacterial effect is weakened

4.1 Recommendations:

- Treating fabrics used in Ihram clothing against other types of microorganisms that didn't exist in this research.
- Increasing areas of use anti-bacterial treatments in fabrics especially in functional clothes.
- Conducting more scientific research that is interested in the fabrics of Ihram clothing and their effect on direct sunlight and high temperatures.

ACKNOWLEDGEMENT: This Project Was funded by the Deanship of Scientific Research (DSR) at King Abdulaziz University, Jeddah, under grant no. (G: 352-253-1441). The author, therefore, acknowledge with thanks DSR for technical and financial support.

Table 2 Microbiological analyzes of samples treated against bacteria

Sample	Inhibition zone diameter [mm/1 cm of sample]			
	Bacteria		Fungi	
	<i>Staphylococcus aureus</i> (G+)	<i>Escherichia coli</i> (G-)	<i>Candida albicans</i> (fungus)	<i>Aspergillus flavus</i> (fungus)
1 - before washing	29	27	17	0.0
2 - after five washes	12	13	0.0	0.0

5 REFERENCES

1. Abd al-Fattah L.: The possibility of implementing some of the men's Ihram fabrics to match the functional performance, Home Economics, Faculty of Specific Education, Tanta University, 2015 (in Arabic)
2. Ministry of Hajj and Umrah,
<https://www.haj.gov.sa/ar/News/Details/12374>
3. Abu-Nasif G.: Treating the carpets of the Two Holy Mosques to resist dirt and microorganisms and their effect on some properties, PhD thesis, Faculty of Home Economics, King Abdulaziz University, Jeddah, 2011 (in Arabic)
4. Al-Shehri F.: Studies on the fungal flora associated with some textiles in Jeddah, Master thesis, Faculty of Science, King Abdulaziz University, Jeddah, 2004
5. Boryo D.E.A.: The effect of microbes on textile material: A review on the way-out so far, The International Journal of Engineering and Science (IJES) 2(8), 2013, pp. 9-13
6. Al-Andijani N., Eid Y.: Determining the standard for ihram fabrics in light of modern technological variables, published in the Eighteenth Scientific Forum, Faculty of Designs, Umm Al-Qura University, 1439 AH (in Arabic)
7. Bauer A., Kirby W., Sherris C., Turck M.: Antibiotic susceptibility testing by a standardized single disk method, American Journal of Clinical Pathology 45(4), 1966, pp. 493-496
8. Clinical and Laboratory Standards Institute: M07-A9 Methods for dilution antimicrobial susceptibility tests for bacteria that grow aerobically. Approved standard – 9th ed., Clinical and Laboratory Standards Institute, Vol. 32 No. 2, 2012, ISSN 2162-2914 (Electronic)
9. Liebowitz L., Ashbee H., Evans E., Chong Y., Mallatova N., Zaidi M., Gibbs D.: A two year global evaluation of the susceptibility of *Candida species* to fluconazole by disk diffusion, Diagnostic Microbiology and Infectious Disease 40(1-2), 2001, pp. 27-33,
[https://doi.org/10.1016/S0732-8893\(01\)00243-7](https://doi.org/10.1016/S0732-8893(01)00243-7)
10. Matar MJ., Ostrosky-Zeichner L., Paetznick V.L., Rodriguez J.R., Chen E., Rex J.H.: Correlation between E-test, disk diffusion, and microdilution methods for antifungal susceptibility testing of fluconazole and voriconazole, Antimicrobial Agents and Chemotherapy 47(5), 2003, pp. 1647-1651,
<https://doi.org/10.1128/AAC.47.5.1647-1651.2003>

6 ILLUSTRATIONS

Figure 1: The upper and lower parts of Ihram clothing,
<https://www.kanbkam.com/sa/en/religion-ihram-clothing-for-men-36872661>

Figure 2: How to wear Ihram around the body,
<http://travelforumrah.co.uk/blog/wp-content/uploads/2017/07/How-Men-Wear-Ihram.jpg>