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The Relationship between Maximum Movement Velocity in Postural and Gait Measured by an Accelerometer

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ABSTRACT

In this work, an inertial measurement unit (IMU) was developed and employed to study the lower limb kinematic measures during the gait and sitting postures. The tasks consisted of isotonic maximum velocity test and gait with maximum speed test to achieve similar conditions in both tests. Acceleration data of the right leg were captured and six temporal and spectral features were extracted. The results showed a considerable correspondence of these tests, suggesting that kinematics measured by the IMU at postural conditions have the potential to be used to evaluate gait kinematics. These results can be leveraged to predict kinematics in non-ambulatory patients.
KEYWORDS: kinematic, isokinetic, accelerometer, ankle, gait

I. Introduction

Gait analysis involves evaluation of the walking patterns, and is typically conducted by capturing the position of individual body parts during walking in a straight line. The normal gait cycle consists of two phases: the stance phase, during which one leg and foot are bearing most or all of the body weight, and the swing phase, when one foot is not in contact with the ground and the body weight is borne by the other leg and foot. In both phases, kinematic parameters are important for movement assessments [1-4].

Isotonic test is a static test in the sitting posture with a voluntary muscle shortening (concentric) or lengthening (eccentric) [5, 6]. Isotonic test is one of the most common tests used in evaluation of neuromuscular impaired patients to evaluate kinetic and kinematic performance [6-8].

There is an increasing need to examine the movement parameters to evaluate the treatment progress, particularly, in patients with neurological disorders such as stroke, spinal cord injury, multiple sclerosis and cerebral palsy [9].

Previous studies on motion camera-based gait recognition have shown promising results [10]. Motion capture systems can accurately measure the gait parameters [11]; however, gait test is not applicable for many patients with severe balance instability and gait impairments, as they cannot walk. Furthermore, data acquisition using such systems is expensive for clinical and research applications. To address this challenge, a portable compact setup such as an inertial measurement unit (IMU) can be employed for gait analyses [12, 13], prognosis of gait impairment, and monitoring the progress of therapeutic interventions in improving the posture and locomotion. This setup can also be employed for isotonic analyses. The advantage of this method is the use of a single device for data acquisition in both tests, which allows performance comparison between these two conditions.

The objectives of this study was to develop an IMU that contains a three-axis accelerometer and employ it to measure lower limb kinematics at sitting posture and gait, and also, to determine the relationship between the measures obtained at these two conditions. This relationship can be used to predict the patient's kinematics of the gait position from posture data, and vice versa. This allows to measure the training improvement of patients that cannot perform one of these tests, based on the results of the other test.

II. Methods

A. Experiment Setup

Twelve healthy subjects; 8 male and 4 female (Table 1), aged 23 to 27 with no background of motor deficit and neurological disorders participated in this study. This study was approved by the ethics board of Tehran University of Medical Science. Before the experiment, all subjects provided written informed consent. All subjects performed both isotonic and gait tests.

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Table 1: Weight, Height and gender of the subjects

Subjects	Weight (Kg)	Height (Cm)	Gender
1	97	185	M
2	88	180	M
3	86	184	M
4	83	181	M
5	63	173	F
6	50	155	F
7	63	170	F
8	62	165	F
9	92	179	M
10	82	178	M
11	93	189	M
12	75	185	M

The IMU setup was designed to incorporate three sensors: ITG-3200 (MEMS triple-axis gyro), ADXL345 (triple-axis accelerometer), and HMC5883L (triple-axis magnetometer), resulting in a total of nine degrees of freedom. A 13 bit A/D converter was used for digitalize the data with 157Hz sampling rate. An Xbee wireless transmitter (Zigbee based) and a battery pack was also used in our data acquisition setup, as shown in Fig 2.

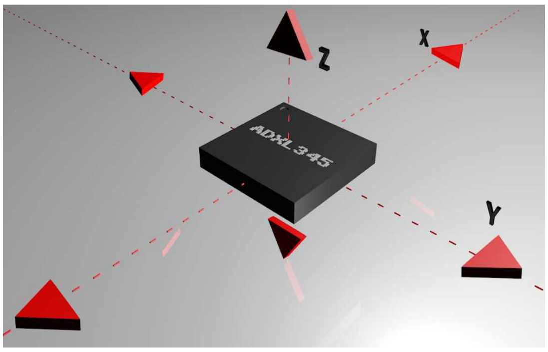


Figure 1: Axes of Acceleration Sensitivity.

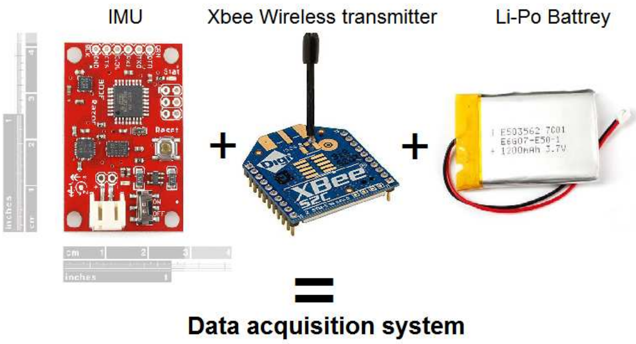


Figure 2: The data acquisition setup

1-. Gait patterns over a treadmill

The IMU setup was attached to the participants' right leg, on the lateral side of the fibula bone, above the ankle, as shown in Fig 3. The parameters extracted from the accelerometer measured data were maximum positive acceleration, maximum negative acceleration (deceleration), rise time, fall time, maximum frequency, and average frequency.

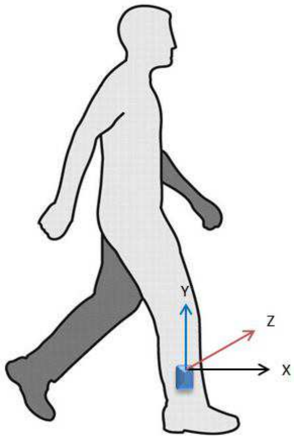


Figure 3: The IMU setup was attached to the participants' right leg, on the lateral side of the fibula bone, above the ankle.

The treadmill speed was increased gradually in order to help the subjects reach the standard gait patterns in a period of 3 minutes, for two reasons: (1) to allow the subjects to warm up for the standard treadmill walking, and (2) to allow the subjects adapt to walking on the treadmill and create a standard walking pattern [14]. The test speed was 4km/h during data acquisition and the subjects were blinded to the staring time of data acquisition to maintain their standard adapted gait pattern and also to avoid distraction [15]. The IMU data (including three axes of accelerometer, three axes of gyroscope and three axes of magnetometer) were recorded for one minute.

2. Postural position

The subjects were seated and secured in an adjustable chair with their foot strapped to the footplate. In order to minimize the contribution of other muscles, subject's thigh was supported by limb support pad which was placed under distal femur. A 90^{o} angle of the ankle joint was considered to be the neutral position (NP) and was defined as zero. All adjustments were completed precisely to facilitate alignment of the subject's axis of rotation (ankle joint) with the dynamometer shaft (Figure. 4).

In this test the IMU setup was attached and aligned to the footplate for measurement of the acceleration in its predefined three axes. An Isokinetic dynamometer (System 4, Biodex Medical Systems, Shirley, NY) was used to measure the subjects' velocity while performing foot rotation (in plantar-dorsi direction) in the postural position.

In order to let the subjects rotate their feet freely with minimum resistance from dynamometer, the system setup was adjusted so that no passive force was applied to the subjects' ankle.

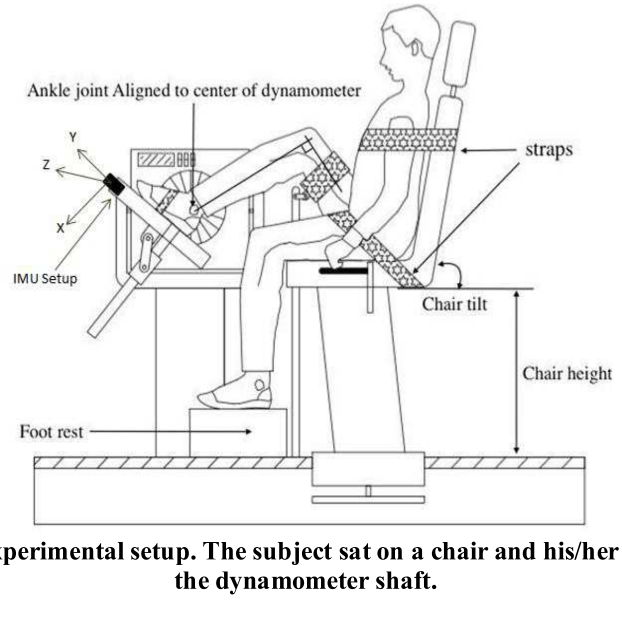
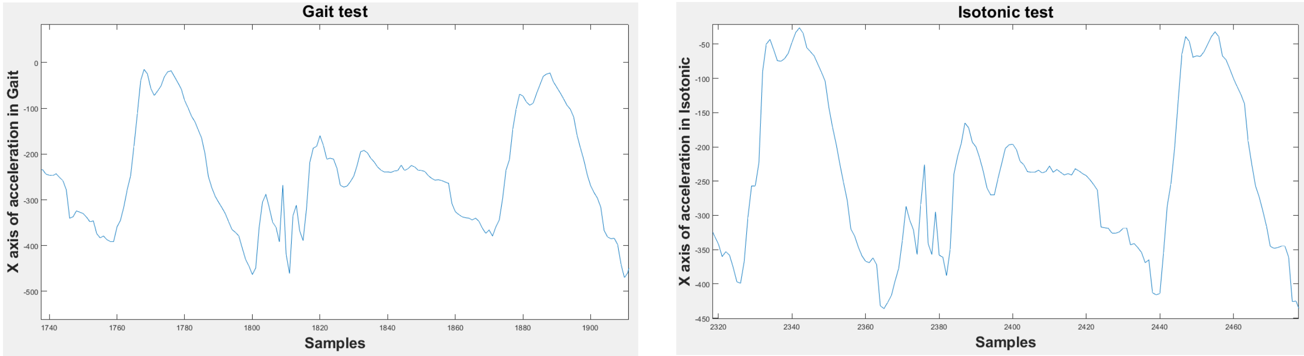


Figure 4: isotonic test experimental setup. The subject sat on a chair and his/her ankle was aligned with the dynamometer shaft.

To allow the full-range of motion, the predefined range of motion was set to the maximum passive range of motion for each subject. Once the setup was ready, the subjects were asked to perform dorsi and plantar flexion with their maximum speed and maximum range of motion for five trials where each trial lasted 120s. Figure 5 shows the amplitude of acceleration in X-axis versus time for a representative subject during the gait test and isotonic tests.



(a) **(b)**

Figure 5: The amplitude of acceleration in X-axis during (a) gait and (b) isotonic tests is plotted for a representative subject.

B. Data Processing

Data processing was performed using Matlab 2016b. The raw data were bandpass filtered between 0.25-20 Hz using a 6th order Butterwroth filter, to remove the baseline and high-frequency noises.

The total acceleration was calculated using acceleration of the moving directions (sensors X and Y) using the following equation (the acceleration in z direction was negligible and thus removed from the equation).

$$\text{Total Acceleration} = \sqrt{\text{ACCX}^2 + \text{ACCY}^2} \qquad (1)$$

where ACCX and ACCY were the measured accelerations in X and Y directions.

Different features were examined to identify those that can better discriminate the task performance.. Consequently, six features were selected including: acceleration rise time and fall time ,maximum positive and negative acceleration, and maximum and mean frequency. These features were calculated and averaged during the test period [16]. For this purpose, first, peaks and zerocorssings of the smoothed signal were identified to determine the maximum and negative acceleration, and rise time and fall time. Figure 6 shows the result of this algorithm for the entire acceleration data of a representative subject.

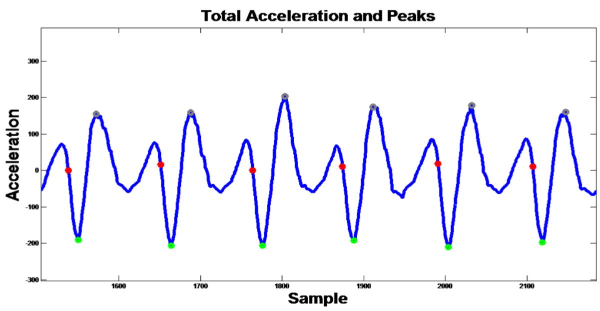


Figure 6: The peak detection results in the Acceleration data of a representative subject; green dots show maximum deceleration, red dots show zero crossing and gray dots show maximum acceleration.

Also the maximum and mean frequency were computed from the Fourier transform of the acceleration signal (Fig. 7).

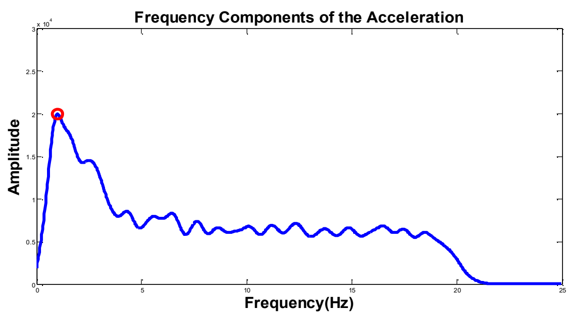


Figure 7: Frequency response of the acceleration signal. The red dot shows the maximum frequency.

IV. RESULTS

Table 2 summarizes the measured features in both tests, averaged across the subjects.

Table 2 : The features extracted during gait and isotonic tests, averaged across the subjects. The standard devition is also shown.

Feature	Isotonic	Gate(Fast walk)
Maximum Acc positive	1081.4 ± 7.9	427.5829 ± 4.3
Maximum Acc negative	-493.9466 ± 12.1	-242.5521 ± 9.6
Rise time	0.2510 ± 0.9	0.248 ± 0.8
Fall time	0.2329 ± 0.3	0.2344 ± 0.4
Maximum frequency	1.0339 ± 1.7	0.9154 ± 1.5
Mean frequency	4061.6 ± 23.2	4852.6 ± 37.8

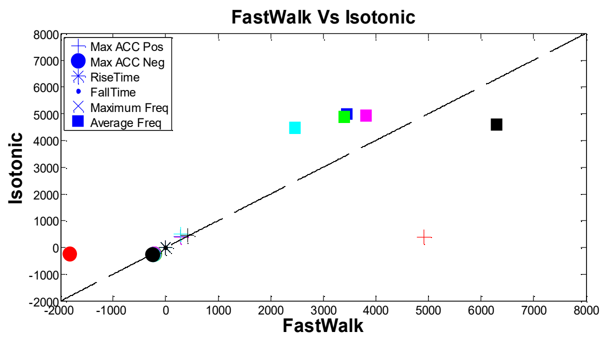


Figure 8: Group average results of main features extracted from isotonic data versus gait data

Figure 8 shows the features extracted in the isotonic test versus those extracted in the gait test.

The results show that there is a nearly linear relationship between the parameters of these two tests and Figure 9 shows the features correlation between the Isotonic and Gait test.

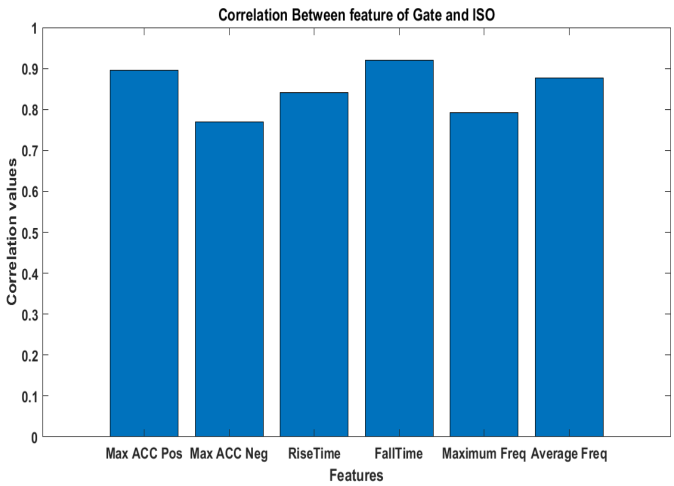


Figure 9: Correlation of features between the gate and isotonic tests.

V. DISCUSSION AND CONCLUSIONS

In this study an IMU was developed and utilized to determine the relationship between kinematic measures of isotonic posture and gait tests.

The results show a strong correlation between the acceleration data of the gait and isotonic tests. This resulted in a high correlation of the acceleration features between these two tests. This suggests the possibility of estimating gait kinematic features from the postural isotonic test. These findings have clinical significance as they show that it is possible to predict gait impairments for patients who cannot possibly participate in gait assessment because of their impairment severity. Furthermore, the analysis of gait requires gait lab facilities, which is expensive. Thus, by using a portable IMU, the cost and efforts can be substantially reduced. The results of this work, should be confirmed by further studies on a larger sample size as well as on patients with walking impairment.

The major limitation of this study was that numerical integration of the measured signal to compute velocity and position, was not possible, because the initial velocity and position were not available.

ACKNOWLEDGMENT

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The Perception of Students Feedback with Hostel Services: Case Study of Mehran UET, Pakistan

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ABSTRACT

In the modern era, hostel life considered as a necessity for students. Although, some of them struggling for the better placement. For the sake, the couple of year's student's feedback of Mehran University of Engineering and Technology, Jamshoro hostels has analyzed and the data provided through the Director Management Information System (MIS). For the afford mention subject has analyzed using statistical package for social sciences (SPSS). The results imply that there is a strong relationship between the results of the parameters (working condition of electric fans and lights in the rooms, canteen facility, hygienic condition of canteen, security at the hostel and dispensary) and the null hypothesis is accepted only the above mentioned parameters and rejected for the other alternative parameters. The results also illustrated that the boy's hostels are better than the girls hostels regarding the basic services provided in the hostels.
KEYWORDS: Students Feedback, Hostel Life, Parameters, Significance, Trend

1.0 INTRODUCTION

Currently, universities are determined to plethora students to their own programs and replacing of adopting different schemes to sustain their own students. Previous research has presented how university accommodation compromises significance of student's choice Oppewal et al. (2005). The impact of the atmosphere and accommodation on the satisfaction level of students is a prevalent study topic and is surely of interest to the universities (Khozaei et al. 2010). Satisfaction with one's housing condition arises from comparison between real and wanted situations. If this consensus is not happened, dissatisfaction could be experienced (Vera-Toscano and Ateeca-Amestoy, 2008). Omole (2001) acquiesced that as a unit of the atmosphere, housing has huge impact on the health, effectiveness and social welfare of the community. In the academic situation, housing has proven to be a main requirement, especially in tertiary institutions where students move from far distance to achieve academic attainments. Mahama et al. (2016) discovered that security issues of the hostel, availability of water facilities, availability of electricity, calm and piece environment and availability of toilet facilities are some of the essential factors that can determine students desire to stay in hostels. M. Memon (2018) revealed the study about the parameters food quality, cleanliness in the hostel, water supply and first aid facilities and suggested for some improvement in water supply and first aid facilities in some hostels and also there is strong evidence of significant relationship between the results. However, a lot of factors which affect the satisfaction with hostel facilities. Most of the students to take up residence in hostels, as long as they are furnished with appropriate residence and satisfactory services at a lower rate. Unlike the effort has made to investigate influencing residents' satisfaction with hostel. The lack of inquiry into students' satisfaction with their university housing seems to suggest more investigation (Amole, 2009). Students face a lot of problems such as Students share their rooms with roommates, ethical problems, food issues, family stress, security problems, proper lighting, geyser facility in the winter season, dispensary etc. To resolve these issues, this paper is presented. Analysis of students' views of the residence hall, living atmosphere at MUET Jamshoro, presented how students' perception might be troubled by gender, nationality and the period of residency. The differences were established between male and female students' responses on the way they observed during living condition at the hostel but no difference were found based on their nationalities. During hostel stay, students are learned very important things about life such as adjustment with any unknown personality

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improve depression, how to talk with legends, life style with different cultures etc. To find these issues, we were conduct a research in the hostels Of Mehran University Of Engineering & Technology (MUET), Jamshoro on the parameters: proper lighting (illumination) in the rooms, working condition of electric fans and lights in the room, hygienic conditions of bath rooms/wash rooms, canteen facility, hygienic condition of canteen, security at the hostel, water cooler facility, geyser facility in the winter season, dispensary and maintenance of the hostel.

MATERIALS AND METHODS

This study were consists the feedback of the nine (7 Male and 2 Female) hostels of Mehran University Of Engineering and Technology (MUET), Jamshoro regarding the parameters proper lighting (illumination) in the rooms, working condition of electric fans and lights in the rooms, hygienic conditions of bath rooms/wash rooms, canteen facility, hygienic condition of canteen, security at the hostel, water cooler facility, geyser facility in the winter season, dispensary and maintenance of the hostel. The sample of 50 students from each hostel was taken. The data were interpreted through the statistical tools like correlation, regression line. To check the significance between the results, the independent z-test were applied.
The basic formula's is:

$$r = \frac{n\sum XY - \sum X \sum Y}{\sqrt{[n\sum X^2 - (\sum X)^2][n\sum Y^2 - (\sum Y)^2]}}$$

The equation of regression line is: $Y = a + bX$

The intercept of the regression line is:

$$b = \frac{n\sum XY - \sum X \sum Y}{n\sum X^2 - (\sum X)^2}$$

And the slop of regression line is:

$$a = \bar{Y} - b\bar{X}$$

The formula for z-test is:

$$S_e = \sqrt{\frac{\sum y_i^2 - a\sum y_i - b\sum x_i y_i}{(n-2)}},\ S_b = \frac{S_e}{\sqrt{\sum x_i^2 - \frac{(\sum x_i)^2}{n}}} \text{ and } z - statistic = \frac{b}{S_b}$$

Null hypothesis is set to test the significance of the results with 95% confidence interval.
The hypothesis is:
$H_0 =$ There is significance relationship between the results.
$H_1 =$ There is no significance relationship between the results.

RESULTS AND DISCUSSIONS

(Table 1.1) showing the Maximum and Minimum Mean and Coefficient of Variation of the ten parameters in nine hostels. The Maximum Mean is 3.66 with coefficient of variation of 18.80841 in the Bakhtawar hostel regarding the parameters proper lighting (illumination) in the rooms and working conditions of electric fans and lights in the room. This means that the data of the above parameters are more reliable than the other parameters. The minimum mean is 1.78 with coefficient of variation 60.36892 in the beenazir hostel regarding the parameter dispensary. It shows that the data is not reliable than the other parameters.
(Table 1.2) showing the regression lines with their trend, correlation and hypothesis of z-test of the parameter (proper lighting illumination in the rooms) for the nine hostels. The trend of regression lines of the hostels G.M.Syed, Shah Abdul Latif, Sachal Sarmast and Bakhtawar is decreasing. This shows that it is not a best fitting line. The maximum coefficient of correlation is 0.9242 in the Sachal Sarmast hostel, which shows the strong correlation. This table also shown that the null hypothesis is rejected for only beenazir hostel and accepted for the other hostels.
(Table 1.3) showing the regression lines with their trend, correlation and hypothesis of z-test of the parameter (working condition of electric fans and lights in the rooms) for the nine hostels. The decreasing trend of the regression lines is in the hostels Abdul Qadeer Khan Afghan, Sachal Sarmast and Bakhtawar, which shows that it is not best fitting line. The strong correlation is in the Sachal Sarmast hostel because the coefficient of correlation is 0.9481. This table also presented that the null hypothesis is rejected for only Shaikh Abdul Majeed Sindhi hostel.
(Table 1.4) showing the regression lines with their trend, correlation and hypothesis of z-test of the parameter (hygienic condition of bath rooms/wash rooms) for the nine hostels. The trend of the regression

lines is both increasing and decreasing. The maximum coefficient of correlation is 0.9498, which is in the Shaikh Abdul Majeed Sindhi hostel and shows that the data of this hostel is strongly correlated. The null hypothesis is accepted for all hostels except Shaikh Abdul Majeed Sindhi Hostel.

(Table 1.5) showing the regression lines with their trend, correlation and hypothesis of z-test of the parameter (canteen facility) for the hostels. This table shows that the trend of regression lines is mostly decreasing. The maximum Coefficient of Correlation occurs in the Bakhtawar hostel, i.e. 0.8174. It is also seen that the null hypothesis is accepted for all nine hostels.

(Table 1.6-1.7) showing the regression lines with their trend, correlation and hypothesis of z-test of the parameter (hygienic condition of canteen and security at the hostel) for the nine hostels. The trend of lines is mostly decreasing in both tables and the maximum coefficient of correlation in table 1.6 is 0.9234 for the Shaikh Abdul Majeed Sindhi hostel and in table 1.7 is 0.8944 for the Hyder Bux Jatoi hostel. The null hypothesis is accepted for all nine hostels in both parameters table.

(Table 1.8) showing the regression lines with their trend, correlation and hypothesis of z-test of the parameter (water cooler facility) in the hostels. The trend of the lines is decreasing except two hostels Shah Abdul Latif and Beenazir. This table illustrated that the null hypothesis is rejected for only Shah Abdul Latif hostel.

(Table 1.9) showing the regression lines with their trend, correlation and hypothesis of z-test of the parameter (geyser facility in the winter season) in the hostels. The trend of regression lines is mostly decreasing. The null hypothesis is accepted for all hostels except Abdul Qadeer Khan Afghan and Shah Abdul Latif hostel.

(Table 1.10) showing the regression lines with their trend, correlation and hypothesis of z-test of the parameter (dispensary) in the hostels. The regression lines trend is mostly increasing except for three hostels which shows the significance of the slope of the regression line. The maximum coefficient of correlation is 0.9328 for rashidi hostel. The null hypothesis for the significance of r is accepted for all hostels.

(Table 1.11) showing the regression lines with their trend, correlation and hypothesis of z-test of the parameter (maintenance of the hostel). The table represented that the trend of the lines is mostly increasing. The maximum coefficient of correlation 0.9694, that occurs in the Abdul Qadeer Khan Afghan hostel. The null hypothesis is rejected for only Abdul Qadeer Khan Afghan hostel.

Table 1.1: Maximum and Minimum Mean and Coefficient of Variation of the hostels

Maximum Mean	**Parameter and Hostel**
3.66	Proper lighting (illumination) in the rooms Working condition of electric fans and lights in the rooms (Bakhtawar Hostel)
Minimum Mean	**Parameter and Hostel**
1.78	Dispensary (Beenazir Hostel)
Maximum Coefficient of Variation	**Parameter and Hostel**
60.36892	Dispensary (Beenazir)
Minimum Coefficient of Variation	**Parameter and Hostel**
14.42075	Maintenance of the Hostel (Abdul Qadeer Khan Afghan Hostel)

Table 1.2: Regression Lines with their trend, correlation and hypothesis of z-test of the parameter (proper lighting illumination in the rooms)

Hostel	Regression Line	Coefficient Of Correlation	Trend	Standard error of B	Test-Statistic	Hypothesis ($Z\pm1.96$)
Abdul Qadeer Khan Afghan	0.05x+2.82	0.6466	Increasing	0.093274	0.5360	ACCEPT
G.M.Syed	-0.05x+2.93	0.3056	Decreasing	0.246374	-0.2029	ACCEPT
Hyder Bux Jatoi	0.026x+3.18	0.2161	Increasing	0.185634	0.1401	ACCEPT
Rashidi	0.006x+2.76	0.0489	Increasing	0.193028	0.0311	ACCEPT
Shah Abdul Latif	-0.096x+3.27	0.2863	Decreasing	0.507898	-0.1890	ACCEPT
Shaikh Abdul Majeed Sindhi	0.124x+2.68	0.7257	Increasing	0.185903	0.6670	ACCEPT
Sachal Sarmast	-0.168x+3.53	0.9242	Decreasing	0.109727	-1.5311	ACCEPT
Bakhtawar	-0.36x+4.02	0.6949	Decreasing	0.588897	-0.6112	ACCEPT
Beenazir	0.163x+2.635	0.9909	Increasing	0.034857	4.6762	**REJECT**

Table 1.3: Regression Lines with their trend, correlation and hypothesis of z-test of the parameter (working condition of electric fans and lights in the room)

Hostel	Regression Line	Coefficient Of Correlation	Trend	Standard error of B	Test-Statistic	Hypothesis ($Z \pm 1.96$)
Abdul Qadeer Khan Afghan	0.072x+2.84	0.6033	Increasing	0.150466	0.4785	ACCEPT
G.M.Syed	-0.002x+2.91	0.0245	Decreasing	0.131681	-0.0152	ACCEPT
Hyder Bux Jatoi	0.046x+3.07	0.2927	Increasing	0.237613	0.1936	ACCEPT
Rashidi	-0.066x+3.16	0.8315	Decreasing	0.069714	-0.9467	ACCEPT
Shah Abdul Latif	-0.008x+3.18	0.0360	Decreasing	0.350771	-0.2280	ACCEPT
Shaikh Abdul Majeed Sindhi	0.048x+2.91	0.8381	Increasing	0.049396	0.9717	ACCEPT
Sachal Sarmast	-0.214x+3.6	0.9481	Decreasing	0.113402	-1.8871	ACCEPT
Bakhtawar	-0.206x+3.75	0.6801	Decreasing	0.351084	-0.5867	ACCEPT
Beenazir	0.166x+2.62	0.9225	Increasing	0.109818	1.5115	ACCEPT

Table 1.4: Regression Lines with their trend, correlation and hypothesis of z-test of the parameter (hygienic condition of bath rooms/wash rooms)

Hostel	Regression Line	Coefficient Of Correlation	Trend	Standard error of B	Test-Statistic	Hypothesis ($Z \pm 1.96$)
Abdul Qadeer Khan Afghan	-0.008x+2.81	0.0948	Decreasing	0.132816	-0.0602	ACCEPT
G.M.Syed	0.1825x+2.3175	0.7073	Increasing	0.28839	0.6328	ACCEPT
Hyder Bux Jatoi	0.174x+2.39	0.7833	Increasing	0.218312	0.7970	ACCEPT
Rashidi	0.12x+2.41	0.4968	Increasing	0.331361	0.3621	ACCEPT
Shah Abdul Latif	0.166x+2.4	0.7413	Increasing	0.237613	0.6986	ACCEPT
Shaikh Abdul Majeed Sindhi	0.254x+1.94	0.9498	Increasing	0.035496	7.1557	**REJECT**
Sachal Sarmast	-0.068x+3.17	0.4771	Decreasing	0.198091	-0.3433	ACCEPT
Bakhtawar	-0.04x+3	0.2326	Decreasing	0.264575	-0.1512	ACCEPT
Beenazir	0.232x+2.07	0.9305	Increasing	0.144361	1.6071	ACCEPT

Table 1.5: Regression Lines with their trend, correlation and hypothesis of z-test of the parameter (canteen facility)

Hostel	Regression Line	Coefficient Of Correlation	Trend	Standard error of B	Test-Statistic	Hypothesis ($Z \pm 1.96$)
Abdul Qadeer Khan Afghan	-0.032x+2.83	0.2181	Decreasing	0.226363	-0.1414	ACCEPT
G.M.Syed	0.102x+2.41	0.5301	Increasing	0.257353	0.3954	ACCEPT
Hyder Bux Jatoi	0.1x+2.6	0.5462	Increasing	0.242487	0.4124	ACCEPT
Rashidi	-0.07x+3.11	0.5854	Decreasing	0.153297	-0.4566	ACCEPT
Shah Abdul Latif	0.128x+2.38	0.7738	Increasing	0.16565	0.7727	ACCEPT
Shaikh Abdul Majeed Sindhi	0.052x+2.77	0.7156	Increasing	0.08025	0.6479	ACCEPT
Sachal Sarmast	-0.052x+3.13	0.4625	Decreasing	0.157607	-0.3299	ACCEPT
Bakhtawar	-0.18x+3.53	0.8174	Decreasing	0.200499	-0.8978	ACCEPT
Beenazir	-0.026x+3.12	0.2841	Decreasing	0.13878	-0.1873	ACCEPT

Table 1.6: Regression Lines with their trend, correlation and hypothesis of z-test of the parameter (hygienic condition of canteen)

Hostel	Regression Line	Coefficient Of Correlation	Trend	Standard error of B	Test-Statistic	Hypothesis ($Z \pm 1.96$)
Abdul Qadeer Khan Afghan	-0.068x+2.87	0.4495	Decreasing	0.213635	-0.3183	ACCEPT
G.M.Syed	0.076x+2.46	0.3715	Increasing	0.300267	0.2531	ACCEPT
Hyder Bux Jatoi	0.058x+2.63	0.2586	Increasing	0.342549	0.1693	ACCEPT
Rashidi	-0.056x+2.96	0.4830	Decreasing	0.160499	-0.3489	ACCEPT
Shah Abdul Latif	0.148x+2.26	0.8882	Increasing	0.120996	1.2232	ACCEPT
Shaikh Abdul Majeed Sindhi	0.054x+2.74	0.9234	Increasing	0.035496	1.4649	ACCEPT
Sachal Sarmast	-0.078x+3.14	0.4517	Decreasing	0.243598	-0.3202	ACCEPT
Bakhtawar	-0.178x+3.49	0.7887	Decreasing	0.219408	-0.8113	ACCEPT
Beenazir	-0.008x+3	0.1039	Decreasing	0.120996	-0.0661	ACCEPT

Table 1.7: Regression Lines with their trend, correlation and hypothesis of z-test of the parameter (security)

Hostel	Regression Line	Coefficient Of Correlation	Trend	Standard error of B	Test-Statistic	Hypothesis ($Z\pm1.96$)
Abdul Qadeer Khan Afghan	-0.046x+2.89	0.2872	Decreasing	0.242611	-0.1896	ACCEPT
G.M.Syed	-0.054x+2.85	0.3711	Increasing	0.213682	-0.2527	ACCEPT
Hyder Bux Jatoi	-0.168x+3.25	0.8944	Increasing	0.132816	-1.2649	ACCEPT
Rashidi	-0.142x+3.15	0.8335	Decreasing	0.148795	-0.9543	ACCEPT
Shah Abdul Latif	0.026x+2.79	0.1939	Increasing	0.20799	0.1250	ACCEPT
Shaikh Abdul Majeed Sindhi	-0.074x+3.01	0.97	Increasing	0.029326	1.8414	ACCEPT
Sachal Sarmast	-0.142x+3.25	0.6393	Decreasing	0.270074	-0.5258	ACCEPT
Bakhtawar	-0.142x+3.39	0.5380	Decreasing	0.351767	-0.4037	ACCEPT
Beenazir	-0.03x+3.01	0.6742	Decreasing	0.051962	-0.5773	ACCEPT

Table 1.8: Regression Lines with their trend, correlation and hypothesis of z-test of the parameter (water cooler facility)

Hostel	Regression Line	Coefficient Of Correlation	Trend	Standard error of B	Test-Statistic	Hypothesis ($Z\pm1.96$)
Abdul Qadeer Khan Afghan	-0.186x+3.39	0.8614	Decreasing	0.173378	-1.0728	ACCEPT
G.M.Syed	-0.07x+3.05	0.6742	Decreasing	0.121244	-0.5773	ACCEPT
Hyder Bux Jatoi	-0.156x+3.51	0.8742	Decreasing	0.136967	-1.1389	ACCEPT
Rashidi	-0.2x+3.41	0.8421	Decreasing	0.202485	-0.9877	ACCEPT
Shah Abdul Latif	-0.116x+3.36	0.9860	Increasing	0.030984	-3.7439	**REJECT**
Shaikh Abdul Majeed Sindhi	-0.064x+3.27	0.5440	Decreasing	0.156077	-0.4742	ACCEPT
Sachal Sarmast	-0.034x+3.15	0.2078	Decreasing	0.253101	-0.1343	ACCEPT
Bakhtawar	-0.104x+3.31	0.5640	Decreasing	0.240749	-0.4319	ACCEPT
Beenazir	0.03x+2.92	0.1091	Increasing	0.431625	0.0695	ACCEPT

Table 1.9: Regression Lines with their trend, correlation and hypothesis of z-test of the parameter (geyser facility in winter season)

Hostel	Regression Line	Coefficient Of Correlation	Trend	Standard error of B	Test-Statistic	Hypothesis ($Z\pm1.96$)
Abdul Qadeer Khan Afghan	-0.176x+3.38	0.9938	Decreasing	0.030984	-5.6803	**REJECT**
G.M.Syed	0.032x+2.69	0.4187	Increasing	0.109727	0.2916	ACCEPT
Hyder Bux Jatoi	-0.036x+3.14	0.2509	Decreasing	0.219454	-0.1640	ACCEPT
Rashidi	-0.03x+2.94	0.3445	Decreasing	0.129228	-0.2321	ACCEPT
Shah Abdul Latif	-0.046x+3.2	0.9592	Decreasing	0.021448	-2.1447	**REJECT**
Shaikh Abdul Majeed Sindhi	0.05x+2.8	0.2627	Increasing	0.290345	0.1722	ACCEPT
Sachal Sarmast	-0.03x+3.19	0.1849	Decreasing	0.251992	-0.1150	ACCEPT
Bakhtawar	-0.088x+3.28	0.7546	Decreasing	0.120996	-0.7273	ACCEPT
Beenazir	0.244x+2.29	0.8203	Increasing	0.268998	0.9071	ACCEPT

Table 1.10: Regression Lines with their trend, correlation and hypothesis of z-test of the parameter (dispensary)

Hostel	Regression Line	Coefficient Of Correlation	Trend	Standard error of B	Test-Statistic	Hypothesis ($Z\pm1.96$)
Abdul Qadeer Khan Afghan	-0.224x+3.71	0.9485	Decreasing	0.121491	-1.8437	ACCEPT
G.M.Syed	0.204x+2.24	0.7404	Increasing	0.292848	0.6966	ACCEPT
Hyder Bux Jatoi	0.238x+2.42	0.8639	Increasing	0.219408	1.0847	ACCEPT
Rashidi	0.13x+2.47	0.9328	Increasing	0.079373	1.6378	ACCEPT
Shah Abdul Latif	0.026x+2.77	0.3409	Increasing	0.113402	0.2293	ACCEPT
Shaikh Abdul Majeed Sindhi	0.34x+1.8	0.7235	Increasing	0.51303	0.6627	ACCEPT
Sachal Sarmast	-0.042x+3.16	0.1516	Decreasing	0.43329	-0.0969	ACCEPT
Bakhtawar	-0.047x+3.15	0.5693	Decreasing	0.107308	-0.4379	ACCEPT
Beenazir	0.482x+1.56	0.8637	Increasing	0.44468	1.0839	ACCEPT

Table 1.11: Regression Lines with their trend, correlation and hypothesis of z-test of the parameter (maintenance of the hostel)

Hostel	Regression Line	Coefficient Of Correlation	Trend	Standard error of B	Test-Statistic	Hypothesis ($Z\pm1.96$)
Abdul Qadeer Khan Afghan	-0.202x+3.75	0.9694	Decreasing	0.08087	-2.4978	**REJECT**
G.M.Syed	0.016x+2.96	0.1356	Increasing	0.184824	0.0856	ACCEPT
Hyder Bux Jatoi	0.066x+3.27	0.2542	Increasing	0.397064	0.1662	ACCEPT
Rashidi	0.074x+2.81	0.9444	Increasing	0.040743	1.8163	ACCEPT
Shah Abdul Latif	-0.052x+3.23	0.7634	Decreasing	0.06957	-0.7474	ACCEPT
Shaikh Abdul Majeed Sindhi	0.226x+2.39	0.6404	Increasing	0.428556	0.5273	ACCEPT
Sachal Sarmast	-0.104x+3.4	0.4127	Decreasing	0.362988	-0.2865	ACCEPT
Bakhtawar	-0.134x+3.66	0.8639	Decreasing	0.123531	-1.0847	ACCEPT
Beenazir	0.224x+2.6	0.8338	Increasing	0.234435	0.9555	ACCEPT

CONCLUSION

The above research study is based on to testing the student's feedback of the ten parameters in the hostels for two years data at MUET, Jamshoro. It is concluded from the tables (1.3, 1.5, 1.6, 1.7, 1.10) that there is strong relationship between the results of the parameters (working condition of electric fans and lights in the rooms, canteen facility, hygienic condition of canteen, security at the hostel and dispensary) in all the hostels and accepted the null hypothesis for the above said parameters and rejected the null hypothesis for the parameters proper lighting in the rooms in beenazir hostel, hygienic condition of bath rooms/wash rooms in shaikh abdul majeed sindhi hostel, water cooler facility in shah abdul latif hostel, geyser facility in the winter season in abdul qadeer khan afghan, shah abdul latif hostel and maintenance of the hostel in abdul qadeer khan afghan hostel. It is also illustrated in the results that the averages of the parameters in the boy's hostels are greater than the averages of the parameters in the girl's hostels. So it can be said that the boy's hostels are better than the girl's hostels. It is also concluded that the services provided in the hostels are satisfactory only the proper lighting (illumination) in the rooms, hygienic condition of bath rooms/wash rooms, geyser facility in the winter season and maintenance of the hostel require some improvement in the above said hostels. It is advised to higher authorities to must provide some eminence facilities.

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Improving the Functional Properties of the Arabian Women Headscarves by Plasma Treatment

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ABSTRACT

The basic requirements for good headscarves are no longer only aesthetically pleasing, but also related to the functional requirements that the head scarf should provide for the woman wearing it. Therefore, the study of the functional requirements of the head coverings of women in the Arab climate, which combines the heat in summer and cold winter is important to different dimensions in terms of selection of raw materials suitable for the manufacture of head covers and treatments to improve the head scarf to give a sense of comfort with the aesthetic appearance. The synthetic headscarf prevents the extraction of sweat and prevents air permeability, which causes many problems for women who wear it. In this study, polyester head scarf fabric will be treated with atmospheric pressure plasma to improve functional properties such as wettability, tensile strength, elongation, UV protection and protection from harmful bacteria to woman skin. The effectiveness of the treatment is assessed by using standard tests methods; first, the UPF test, second, the Antimicrobial test, finally, Infrared spectroscopy Analysis.

KEYWORDS: Headscarves, Plasma surface treatment; UV protection, Infrared spectroscopy Analysis, Scanning Electron Microscopy

1. INTRODUCTION

The head cover is one of the most effective clothing supplements that can be used in many styles. It is one of the easiest ways to add a distinctive touch to clothes and give them a hint of renewal and diversity. The headdress has the ability to change the shape of old clothes and to avoid looking at the body defects when placed near aesthetic areas in the woman's body. It is also used as a function of heating in the winter season.

Scarves come in different sizes, fabrics and shapes. A scarf's fabric defines its appearance, texture, and weather-suitability. Women are among the most affected by the danger of solar radiation, especially UV radiation so women should always pay attention to fabric when they're shopping for scarves. A lot of Headscarves made from different materials in the markets, some may be inappropriate in the way wear on the head or uncomfortable or inappropriate for use; so the study of the functional requirements of the fabrics used in the Headscarves manufacturing and attention to the requirements of the society is very important.(3)

There are at least 70% of women in Egypt, Arab countries and North Africa wear headscarves for social, religious and protective reasons and sometimes for other reasons such as decorating or protection from heat and solar radiation, which increases the need to provide fabrics with high protective properties against the thermal and radiation effects of (Ultraviolet - visual - infrared) radiation, where most women suffer in these areas of damage and skin diseases such as increase the secretion of sweat and inflammation of the scalp and hair loss and lack of vitamin D and so on, causing a real problem for Arab women and psychological and moral diseases. (3)

Synthetic fibers have become an integral part of the current textile industry. Polyester fiber has been most widely used for textile materials because of high mechanical strength, good stretchability, heat-setability, rapid drying, and wrinkle resistance. The main drawback of some synthetic fibers is the low surface energy that causes a weak sensitivity to moisture and dyeability. (6)

It is known that polyester fiber has an inherent hydrophobic nature and thus polyester products are lacking in stain-release, anti-soil redeposition, water and moisture wicking and anti-electricity in textile end-use. The hydrophobicity can also be a disadvantage for certain applications like dyeing and finishing. Chemicals treatments are often used to improve the hydrophilic nature of the polyester headscarves surface; however, the usage of chemicals is accompanied by a decrease in fiber strength and leads to environmental pollution. Therefore, we used plasma treatment to enhance comfort properties and mechanical properties. (6)

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Plasma technology is based on a simple physical principle. Matter changes its state when energy is supplied to it: solids become liquid, and liquids become gaseous. If even more energy is supplied to a gas, it is ionized and goes into the energy-rich plasma state, the fourth state of matter. (2)

Plasma treatment of textile is one of the most popular methods used for textile surface treatment; it is dry, pure and used lower energy consuming than valet ordinary treating. Plasma processing of polymers was used to get desired surface properties without interfering with material properties. Non-thermal plasma techniques were developed in the atmosphere to meet the need for the textile industry. (1)

Plasma treatment causes a desirable and exactly adjustable increase in the adhesiveness and wettability of surfaces. This makes it possible to use completely new materials and environmentally-friendly, solvent-free paints and adhesives industrially. Many chemical surface treatment processes can be replaced with plasma treatment. (2)

The significance of this paper is to discussion the influence of atmospheric pressure plasma modification on women headscarves. Comfort properties, UV protection and protection from harmful bacteria to woman skin have been investigated; Methodology was undertaken using a headscarves material, with fiber content of polyester.

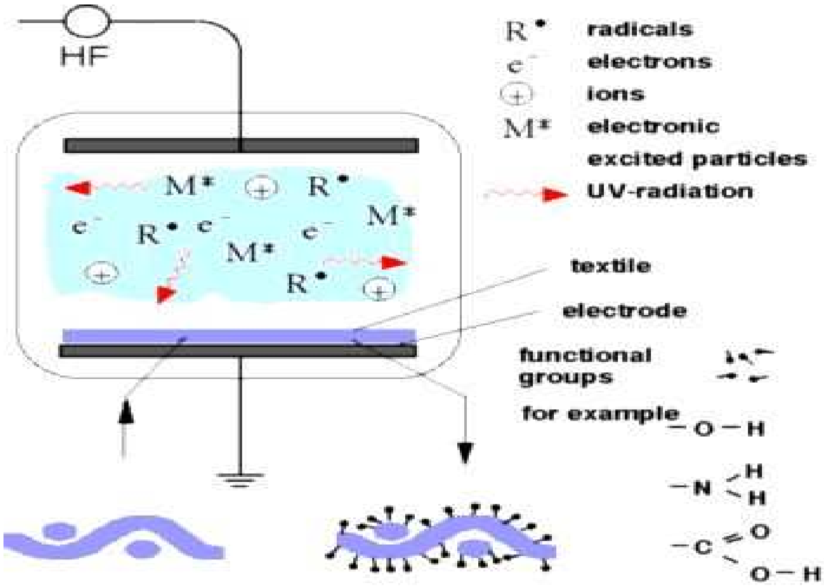


Figure (1) Working principle of plasma treatment (5)

2. MATERIALS AND METHODS

2.1 Fabrics:

Specifications of fabrics are given in table 1. Headscarves fabrics were procured from Tie shop.
Thickness obtained using thickness tester according to (ASTM D1777-96-2003).
Fabric weight obtained using digital sensitive scale according to (ASTM D3776-96-2003).

Table1
Specifications of fabric before treatment

Fabric structure	Fiber type	Warp/cm	Weft/cm	Weight (gm/m^2)	Thickness (mm)
Chiffon1/1	polyester	32	32	90	0.2

2.2. Experimental Methods

Application of atmospheric pressure plasma treatment of polyester fabric for improvement of headscarves specific properties:

The discharge can be produced between two electrodes one of them covered by two different dielectric material cement and glass, cell shown in Fig.2 consists of two metallic parallel square electrodes of 25x25 cm^2, 2mm gap space, separated by glass sheet through an O ring. The ground electrode stands on Acrylic sheet with inlet and out let opening for gas insertion and exhaustion. High voltage AC transformer (0-10kV) generates a 50 Hz sinusoidal voltage was used as a power source for driving discharge. (7)The live electrode is stain steel has radius 15 cm and the other electrode is covered by porous material as a dielectric with thickness 1 mm. (6)
The discharge situation should be adapted to being in the glow mode through setting the used voltage and current.

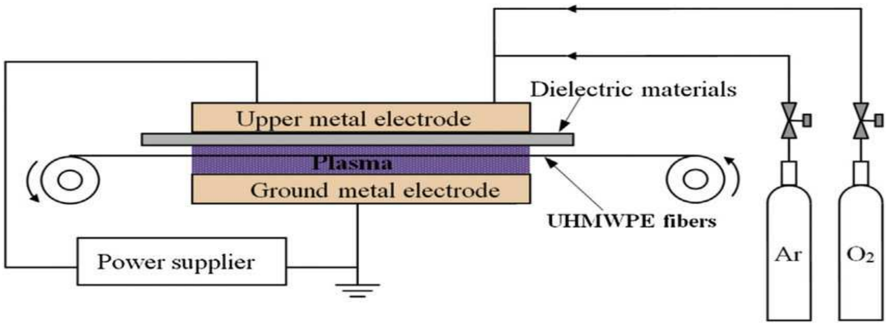


Fig. (2): The diagram of DBD discharge treatment

Polyester fabric was exposed to atmospheric pressure glow discharge plasma (APGD) at different currents and times with different gases Oxygen, nitrogen and air. Exposing time variables were 5 min, while discharge current variables were 3, 5, 7 and 10 mA.

The headscarf fabric was cut and then scoured with acetone for 10minutes to remove contaminants on the fabrics surface. After that, the headscarf fabric was rinsed with deionized water for 5minutes. Water was extracted from fabrics in a hydro extractor for 3 minutes. Lastly, the fabrics were dried in an oven at 60°C for 10minutes.

After scouring the fabrics, the fabrics were conditioned under the standard atmospheric pressure at 65% +/- 5% relative humidity and 21°C+/- 1°C for at least 24 hours before other procedure processed.

The investigation involves the application of different gases oxygen; nitrogen and air to polyester headscarf in order to improve the fabric physical properties such as wettability, tensile strength, elongation, IR- spectroscopy Analysis as well as surface morphology were also investigated.

The tensile strength test and the water drop test were applied.

The duration required for the drop of water to be absorbed into the fabric is pointed to as absorbency amount. In order to determine the changes in the chemical structure of polyester headscarf fiber as a result of plasma treatment, the untreated and plasma treated samples were studied by IR- spectroscopy Analysis.

The scanning electron microscope photomicrograph was registered to study the changes in the surface morphology of plasma treated fabrics.

3. RESULTS AND DISCUSSION

Effect of atmospheric pressure plasma on the physical and mechanical properties of polyester headscarf fabric, Time exposure 5 min:

3.1. Infrared spectroscopy Analysis:

The results are illustrated in figures (3, 4, 5 and 6). In the spectrum of the nitrogen plasma- treated fabric fig. (4), some new peaks were observed compared with untreated sample spectrum :2443.06cm characteristic of NH_2 groups, 1378.36 cm^{-1} characteristic of C-N aromatic amine , 1234.64cm characteristic of secondary amine C-N stretch , 1227.57 characteristic of C-N aliphatic amine and 1455.18 cm^{-1} characteristic of aromatic tertiary amine C-N stretch, As well some other peaks with intensity at 3368.64 cm^{-1} , 3357.85 cm^{-1}, 3053.9 cm^{-1} characteristic of hydroxyl group H-bonded OH stretch were also observed.
Fig. (5) Shows that a new absorption band with peak intensity at 1462.86 cm^{-1}, characteristic of carboxylate groups was observed.
In addition, the intensity of the hydroxyl group (-OH) peaks like 3648.27 cm^{-1} and 3231.15 cm^{-1} were outstandingly higher than that in figure (3) this increase in the absorption intensity indicates the introduction of more hydroxyl

groups as a result of oxygen plasma treatment, also it can be observed the absorption peak at 2032.58 cm^{-1} characteristic of carbonyl compound groups (C=O).

The rate of the oxygen containing groups such as –COOH, -C-OH and C=O increased on the surface of the treated fabric. This effect may be referring to the fact that some of the C-C bonds in the polyester fabric surface could be broken by the oxygen plasma treatment. Then the carbon radicals, formed by the removal of hydrogen atoms from the polyester chain

The introduction of these polar groups converts the nature of the fabric from hydrophobic to hydrophilic, as shown in figure (6), some new absorption band with peak intensity at 3298 .64 cm^{-1} characteristic of hydroxyl group H-bonded OH stretch was observed. Furthermore the intensity of the carboxylic acid salt group (-COOH) peaks like 1302.68 cm^{-1} 1403.92 cm^{-1} and 1834.46 cm^{-1} were higher than that in untreated sample spectra. Also, the intensity of the amine group ($-NH_2$) peaks like 2358.81 cm^{-1}, 2223.82 cm^{-1} 2406.63 cm^{-1} were also higher than that in untreated sample spectrum, which means additional functional groups induce to the fabric surface as a result of air plasma treatment.

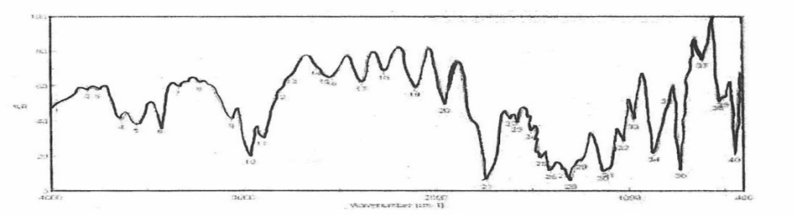


Fig. (3) IR analysis chart of untreated polyester headscarf fabric

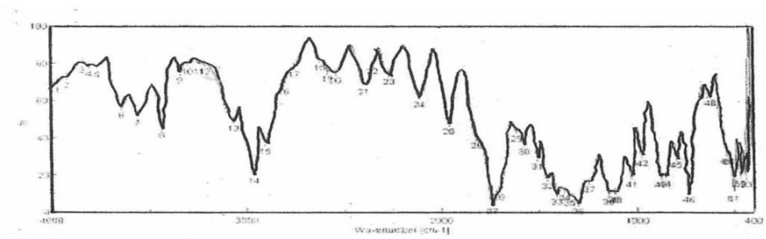


Fig. (4) IR analysis chart of treated polyester headscarf fabric with nitrogen plasma

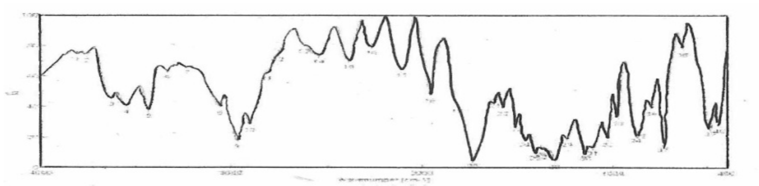


Fig. (5) IR analysis chart of treated polyester headscarf fabric with oxygen plasma

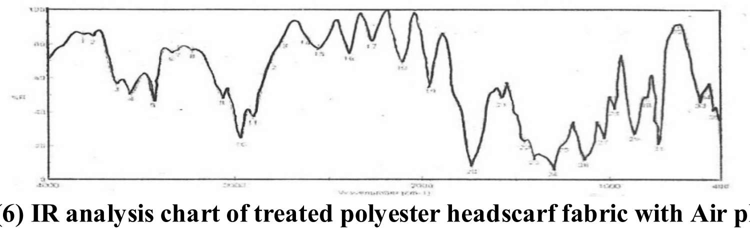


Fig. (6) IR analysis chart of treated polyester headscarf fabric with Air plasma

3.2. Wettability

Wettability expressed as wetting time of untreated and treated fabrics was measured; table (2) shows the wetting times of the polyester headscarf fabric modified by different gases under different discharge current.

Table (2):
Wetting time of polyester fabric modified with different Glow discharge gases:

Discharge current (MA)	Untreated sample	Wetting time (sec.)		
0	3.07	Air	O2	N2
3		0.72	0.82	1.02
5		0.68	0.71	0.85
7		0.61	0.65	0.79
10		0.58	0.61	0.72

It can be easily observed that the plasma treated fabrics exhibited a significant enhancement in the hydrophilicily and water absorption irrespective of gas types used under the study.
The improved wettability of polyester fabric as a result of plasma treatment is in good agreement with the results of IR analysis. It could be concluded from table (2) that increase the discharge current is accompanied with decrease in the wetting time for plasma treated samples.

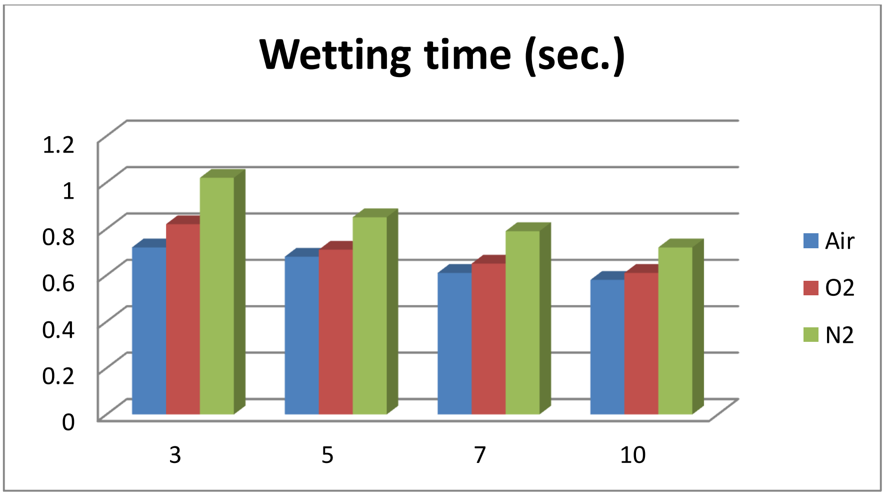


Fig. (7) Wetting time chart of treated polyester headscarf fabric

The improved wettability of polyester treated fabrics can be attributed to the increase in ion bombardment on the fabric surface which leads to formation of surface- free radicals, increasing the amount of active species formed on oxidation, besides increasing surface and increasing surface roughness according to the kind of gas used in glow treatment.
The wettability of plasma treated polyester fabric increases in the order of Air> O2 >N2.
this increase in the surface wettability is due to formation of several hydrophilic groups (e.g.,-NH,-CN,-N:N,-C=O,-COOH,-C-OH,-CHO) Beside chain scission, etching, and increasing surface roughness.

Plasma treatment resulted in improvement in hydrophilicity of polyester film which was treated along with polyester fabric in air DBD.
As seen in Figure 8, an apparent decrease in water contact angle took place after 15 min plasma treatment, which suggest that a strong increase in wettability of the polyester headscarf fabric surface induced by DBD. Water contact angle was reduced from 85.7° for untreated to 29.5°, which indicate the formation of polar groups such as CO, COO, OH, etc as consequences of plasma treatment which make polyester surface more hydrophilic. (8)

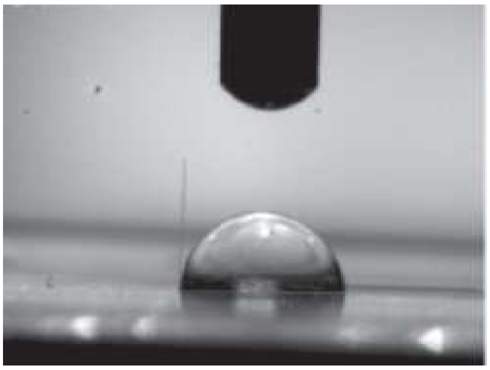


Fig. (8) Contact angle of untreated polyester Headscarf fabric

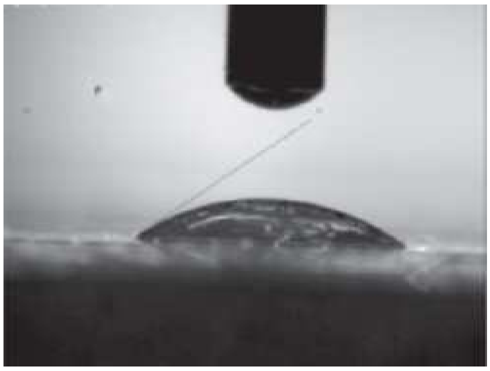
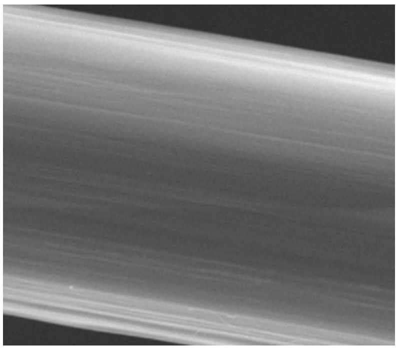


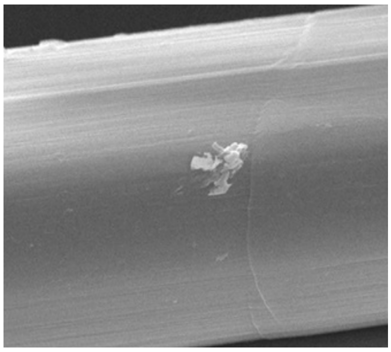
fig. (9) Contact angle of treated polyester headscarf fabric

3.3. Scanning electron microscopy (SEM):

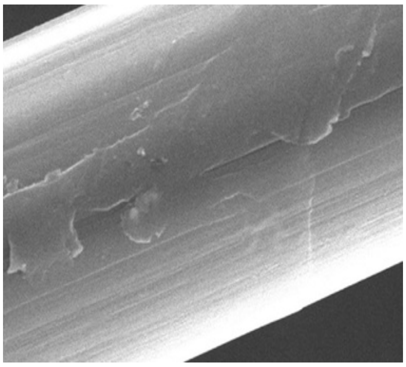
SEM Measurements Figures 10, 11, 12 and 13 show the SEM micrographs of the plasma treated polyester fabric and the untreated fabric. Surface morphology changes significantly after plasma treatment. It can be showed from Figures 10 that the untreated polyester fibers look distinct and very smooth, however Figures 11, 12 and 13 show several grooves on the surface of the fibers, with the existence of some pores and voids. These results may be due to the removal of some material by etching and roughening effect caused by the bombardment of ions/ electrons in the plasma on the fabric surface, causing surface roughness.



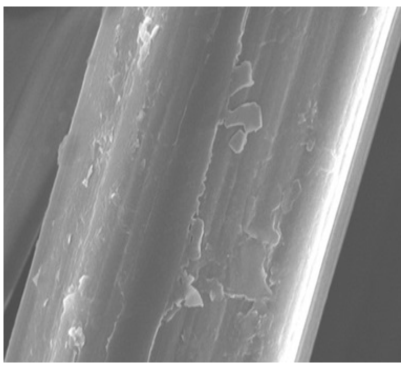
(a)



(b)



(c)



(D)

Fig. (10): SEM micrographs of the polyester headscarf fabric (a) untreated, (b) Oxygen plasma, (c) air plasma, (d) nitrogen plasma.

3.4. Tensile strength

Treated and untreated samples were subjected to measurement of tensile strength. The results are illustrated in table (3).

Table (3):
Effect of plasma glow discharge current on the tensile strength of Polyester headscarf fabric:

tensile strength			
untreated sample	68		
Discharge current (mA)	Air	O2	N2
(3)mA	68	61	67
(5)mA	66	63	64
(7)mA	65	58.5	62.5
(10)mA	64.5	57.5	63

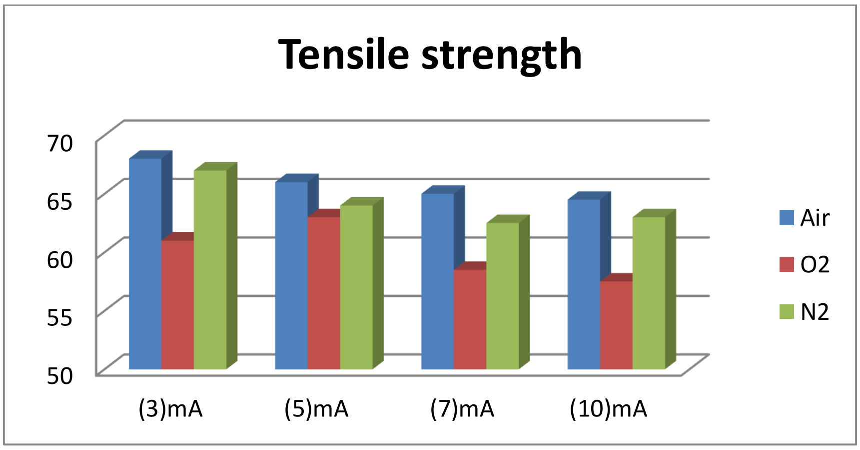


Fig. 12: Effect of plasma glow discharge current on the tensile strength of polyester headscarf fabric

Table3 and figure (12) Shows that the treatment of plasma caused a little reduce in the rate of the tensile strength in comparison with the untreated fabrics.

Long plasma treating produced deep cracks on the samples, on the other hand, higher discharge current or longer treatment time during plasma treatment may caused lose in tensile strength properties.

3.5. Ultraviolet protection factor:

it was determined using UV-VIS double beam spectrophotometer according to the standard (ASTM D6604-2000) and AATCC test method [AATCC 183-2000]. And the results showed in table 4:

Table (4):
Effect of plasma glow discharge current on the Ultraviolet protection factor Of polyester fabric:

Ultraviolet protection factor			
untreated sample	75.2		
Discharge current (mA)	Air	O_2	N_2
(3)	121.6	158.9	195.4
(5)	151.2	173.3	213.4
(7)	163.4	181.2	226.2
(10)	172.3	198.3	241.7

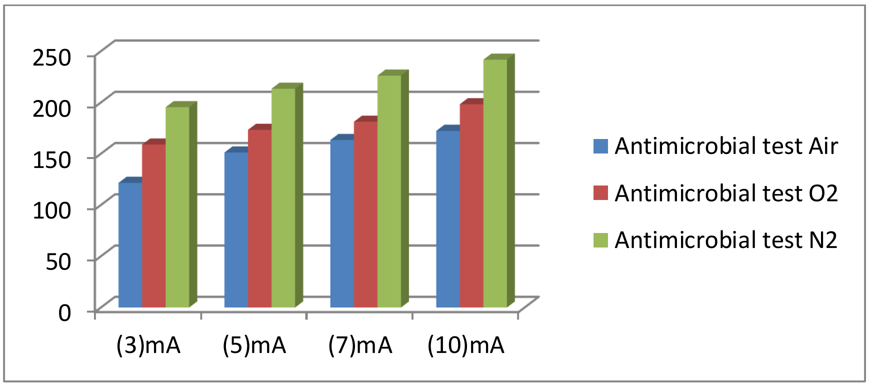


Fig. 13: Effect of plasma glow discharge current on the Ultraviolet protection factor of polyester headscarf fabric

It's clear that after the treatment of the polyester fabrics with plasma glow discharge current the Ultraviolet protection factor values increased significantly. This improvement is preferable in the woman scarves. It gives sufficient protection for women skin against UV protection.

3.6. Antimicrobial test:

The examination was done by using a modified Kirby-Bauer disc diffusion method, and the results are illustrated in table 5:

Table 5:
Results for antimicrobial activity Disc diffusion method

Antimicrobial test Escherichia coli (G¯)				
Untreated	0			
Inhibition zone diameter (mm / 1 cm Sample) Escherichia coli (G¯)	Discharge current (mA)	Air	O_2	N_2
	(3)	6	12	18
	(5)	7	12	16
	(7)	7	15	19
	(10)	9	17	19

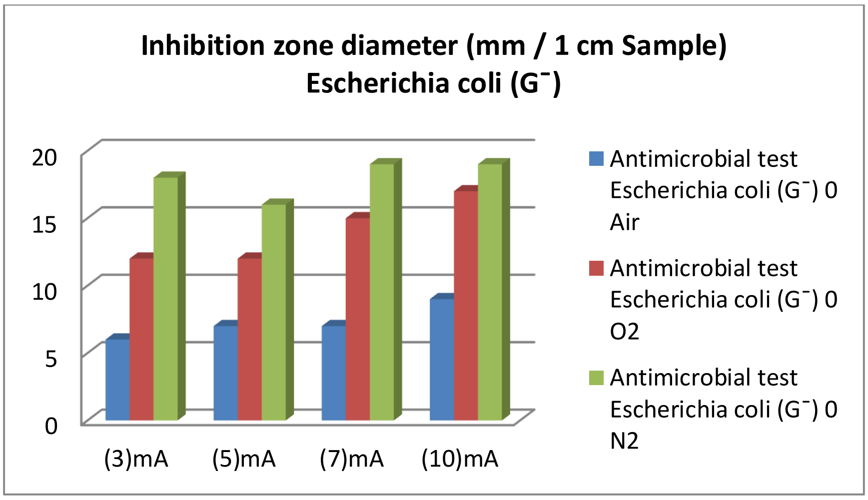


Fig. 14: Antimicrobial test Escherichia coli (G¯)

Antimicrobial test Staphylococcus aureus (G^+)				
Untreated	0			
Inhibition zone diameter (mm / 1 cm Sample) Staphylococcus aureus (G^+)	Discharge current (mA)	Air	O_2	N_2
	(3)	8	12	12
	(5)	11	14	16
	(7)	12	15	16
	(10)	12	15	18

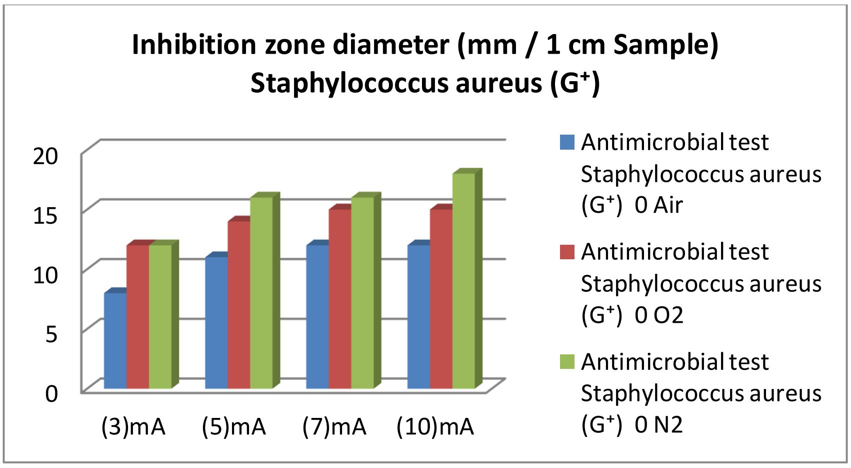


Fig. 15: Antimicrobial test Staphylococcus aureus (G^+)

As shown from the results for the untreated sample, it doesn't have any influence on the antimicrobial effectiveness, however for the treated Samples, It's obvious that the diameters of the inhibition zones determined in millimeters were ranging from 6 – 19 millimeters refers to the improvement in antimicrobial efficiency for the polyester women head scarf.

CONCLUSION

Treating polyester women head scarf with atmospheric pressure glow discharge plasma (APGD) has a significant effect on performance and functional properties.N2 treatment at low current, 3mA with 5min duration, showed a better resultant data, for polyester women head scarf. Plasma treatment caused formation of some new functional groups like, OH, COOH, CO, NH2 these additional groups were detected by Infrared analysis. The UV blocking and anti microbial properties has successfully achieved after treatment. The plasma treated fabrics exhibited a significant enhancement in the hydrophilicily and water absorption irrespective of gas types used under the study.

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