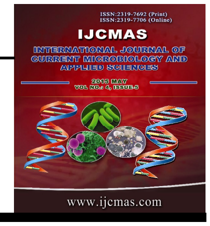

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Original Research Article

Evaluating of Functional Properties Orthesis, non Orthesis Bandages of Organs Wound with Chitoasallona and Gybschitoasallona

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A B S T R A C T

This research focuses on treatment of some orthesis and non-orthesis bandages of organs wounds, then comparing it what is currently available in hospitals and pharmacies. To improve the functional properties of these bandages they gauze fabrics treated by different concentrations of honey and chitosan mixture (Chitoasllona, CA), other samples of gauze fabrics with treated honey and chitosan mixture flowed by modifier medical gypsum (Gybschitoasallona, GCA) for treatment orthopedic organs wound, the treated fabrics curred microwave radiation. The results showed that when the concentration of honey and chitosan mixture increases the functional properties of the treated fabrics improved, namely, bactericidal activity. The finished fabrics were examined for morphological features and surface characteristics by making use of the SEM. Antibacterial activity of the treated and untreated fabric against *E. coli* (gram negative) and *Staphylococcus aureus* (gram positive) successfully examined. The results show excellent bactericidal activity in gauze fabrics. The SEM pictures reveal that honey, chitosan and modifier medical gypsum are deposited on the surface of fabric fibers and reduction of bacteria on the fabrics surfaces. The practice of this application proved fractures and wound healing speed for patients in the university hospital has increased by 12%, 17 % when using CA and GCA bandages with compared with the available presently bandages in hospitals and pharmacies.

Keywords

Medical Bandages, Wound, Chitoasllona, Gybschitoa-sallona, Gypsona

Introduction

Egypt now occupies the first place in the world in road accident with the asphalt consequent bleeding and the increase of the numbers of death and injuries which include fractures with some cutting injuries and other …..etc. Which requires intensive care in dealing with these wounds (Kim *et al.*, 2014; Park *et al.*, 2009)? Skin as the main part and the largest in the face of the body with the outside world, so it's possible that the skin injuries arises because of the direct penetration of microorganisms for proper skin (A wounds International publication, 2014) and increasingly so in the hot weather and high humidity which help the growth of bacteria and we use medical bandages which is available in pharmacies such as orthesis, non orthesis bandages of organs wound according to patient condition which requires that patient to keep it for a long period which must accompanied by some negative effects on the patient during the summer months when they multiply microorganisms quickly if moisture, oxygen, food and temperature are available (Orhue and Momoh, 2012; Mohamed *et al.*, 2012) and this affect the skin with hypersensitive effects. Bacteria turning urea that result from race to ammonia causing rashes, allergies and skin irritation (Elham Abdel Aziz, 2015) helping it to increase the nomination of the wound cells to some secretions in addition to sweating and accumulating of gypsum and body surface by unencumbered consists pus because the center will be suitable for the growth of bacteria that irritate the skin and given a sense of itching and allergies (Youbo Di1 *et al.*, 2012) and the patient may have to remove gypsona by himself or the doctors remove and clean the wound again then re-establish a new medical bandages. The resistant fabrics laces of bactria and microbes consider as an important property of this topic (Roland Hardman *et al.*, 2014). So the researches sought to overcome these problems by treatment orthesis and non-orthesis bandages of organs wounds using honey, Chitosan, CA and GCA bandages.

Fabrics antibacterial has been developed by inhibiting antibacterial activity and reached to improve the physical properties of cotton fabrics treated to increase the concentration of chitosan derivatives rates. Wounds bandaged was loaded with silver nano practices to act as an anti-bacterial. Another study has been able to produce chitosan and its use in medical textiles, and proved that it helps to increase absorption of cotton textiles of different dyes (Sanyakamdhorn *et al.*, 2013). Another study found that, the production of cotton fabrics anti-bacterial and UV using chitosan.

Khalid Al-Najjar *et al.* (2014) has been able to form the production of medical gauze to treat wound using capsules in the presence of UV ozone in the presence of ozone component of honey and chitosan concluded that it can successfully use these capsules in bandages injuries and it proved resistance to bacteria and speed wound healing (Xu *et al.*, 2010; Issa *et al.*, 2013). Lately they invent a bandage to the wounds of chitosan that is absorbed by the body, it uses a thin internal wounds and help heal wounds and don't use sensitivities (http//health.infoniac.com/ innovative-bandages), also noted by (Karin Heineman and ISTV Executive Producer, 2014) to the possibility of using sound waves to treat and clean various wounds and concluded that the wounds heal more with the sound waves from the normal treatment. Also they produce a smart bandage of medical adhesive plaster in color from yellow to magenta, change by the case of the wound, and help to examine the wound regularly from abroad without impeding the healing process (Zongxi Li *et al.*, 2014).

The aim of this stud to reach the suitable concentration of treatment material for orthesis and non-orthesis fabric bandages of organs wounds under research, which gives the best properties compared to what is available in hospitals and pharmacies.

Testing and analysis

Materials

Gauze fabrics (100% cotton, 1/1 plain, yarn number 20*20, density 38*38 and fabric width 90 cm). gauze fabrics treated by different concentrations of honey (20, 30 and 40 g/L), (5, 10 and 15 g/L) chitosan and modifier medical gypsum (20 g chitosan, 200 g CMC, 1 kg medical gypsum, Mountain honey of Saint Catherine in Southern Sinai, Egypt. Chitosan powder Poly-(1.4-B-D-glucopyranosamine).

Egyptian Medical Gypsum. Gyproc. Carboxy Methyl Cellulose Sodium Salt - (Medium Viscosity) (250–350 cps).

Perperation of gauze fabric

Gauze fabrics treated by different concentrations of chitosan (5, 10 and 15 g/L) and honey (20, 30 and 40 g/L). They treated fabrics finished with modifier medical gypsum (20 g chitosan, 200 g CMC, 1 kg medical gypsum). The finished fabrics dried at 80 °C for 4 min and cured in presence of microwave radiations at 510 Watt for 10 sec.

Testing

- Weight of meter square was measured as according to ASTM (1970).
- Tensile strength was measured as according to ASTEM (2003).
- Extension was measured as according ASTEM (2003).
- Stiffness was measured as according to ASTM (1975).
- Thickness was measured as according to EOS (2008).
- Water absorbance was measured as according to ASTEM, standards, D, 1682, 64.
- Anti bacterial was evaluated as according to AATCC test method 147, anti bacterial activity assessment of textile materials, parallel streak method, 1998.
- The SEM was assessment according to SU5000, nm 2800b, 2005.

Statistical analysis

To explore the effects of honey and chitosan concentrations on physical and antibacterial properties of the fabric samples, a 32 factorial design was performed. All data results were analyzed statistically for each measured response using SPSS statistical package. Two-way analysis of variance (two-way ANOVA) was used to determine whether a response was significantly influenced by the independent parameters at significance level $0.01 \leq \alpha \leq 0.05$. A regression analysis was executed to detect the relationship between each property of the fabric samples and the different levels of honey and chitosan concentrations. The nonlinear regression models are of the following form: Z= a + b x + c y + d x2 + e y2 + f xy

Where,

Z= fabric property, i.e. fabric weight, thickness, antibacterial properties, etc., X= chitosan concentration; % Y= honey concentration; % A= constant; b, c, d, e, and f = regression coefficients

These regression models can be used to predict each response for all fabric samples. The validation of these regression models was conducted using the coefficient of determination, R2 value. R2 value ranges between zero and one. Approaching this value from one means that the regression model fits the experimental data very well.

Results and Discussion

Fabric weight

The variation of fabric weight per square meter according to the variation of honey and chitosna concentrations for non-orthesis "CA" and orthesis "GCA" bandages of organs were illustrated in figures 1 and 2 respectively. The statistical analysis showed that both independent variables have a profound effect on fabric weigh for both types of bandages at 0.01 significant level. From both figures, an increasing trend was detected assuring that as the levels of both variables increases the weight of both bandages also increases.

The statistical analysis proved that increasing the honey concentration from 20% to 40% leads to an increase of weight per square meter by 28% and 3% for non-orthesis and orthesis bandages of organs respectively. With regard to the effect of chitosan, it was found that increasing its concentration increased the weight of non-orthesis "CA" and orthesis "GCA" bandages of organs by approximately 23% and 3% respectively.

The regression relationship which correlates honey and chitosan concentrations with the weight per square meter for both non-orthesis "CA" and orthesis "GCA" bandages of organs have the following non-linear form:

Weight (non- orthesis bandage), g/m2= 112.8 + 7.5 x + 3.2 y -0.19 x2 - 0.07 xy - 0.03y2

Weight (non-orthesis bandage), g/m2= 53.9 -0.4 x + 1.4 y - 0.07 x2 + 0.04 xy -0.008y2

Weight (orthesis bandage), g/m2= 365 – 1.1 x – 1.7 y + 0.04 x2 + 0.05 xy + 0.03y2

The coefficient of determination of these models equal to 0.88 and 0.93 respectively, which means that these models fit the data very well.

Regardless of the effects of honey and chitosan concentration, it was found a huge difference between non-orthesis "CA" and orthesis "GCA" bandages of organs with respect to their weights per square meters. The orthesis bandages of organs exhibited higher weight than non-orthesis ones. The average values of weight with gram per square meter for non-orthesis "CA" and orthesis "GCA" bandages of organs were 102 and 350 g/m2 respectively. This is due to treatment of orthesis bandages "CA" fabrics with modifier Medical Gypsum

Fabric tensile strength

Tensile strength has been accepted as one of the most important attributes of textile fabrics. The strength of a woven fabric depends not only on the strength of constituent yarns, but also on the yarn and fabric structure and the type of finishing and treatments.

The variation of tensile strength of woven fabrics according to different levels of chitosan and honey concentrations for orthesis "CA" and non- orthesis "GCA" bandages of organs was plotted in Figure 3 and 4 respectively. The statistical analysis proved that for orthesis bandages of organs, both honey and chitosan concentrations have no significant influence on their tensile strength. Whereas in the case of non-orthesis bandages of organs, the honey concentration was found to have a significant effect on fabric tensile strength at 0.01 significant level.

From these figures, an increasing trend was detected assuring that as the both factor levels increases the tensile strength react in the same manner for both types of bandages. It was found that increasing honey concentration from 20% to 40 % leads to an increase of bandage tensile strength by approximately 9% and 10% for non-orthesis and orthesis bandages respectively. Increasing the chitosan concentration from 5% to 15% causes the increase of non-orthesis bandage tensile strength by about 8.2%. The statistical analysis also showed that honey concentration accounted for 16% the variability in tensile strength and that chitosan accounted for 28% odf the non-orthesis bandages. In the case of orhesis bandages, the honey and chitosan concentrations accounted for 67% and 5% respectively the variability in the fabric tensile strength.

To predict the tensile strength of orthesis "CA" and non orthesis "GCA" bandages, the following non-linear regression models can be used:

Tensile strength (non- orthesis bandage), Newton= 112.8 + 7.5 x + 3.2 y -0.19 x2 - 0.07 xy -0.03y2

Tensile strength (orthesis bandage), Newton= 183.7 + 4.7 x + 0.7 y - 0.13 x2 - 0.05 xy -0.02y2

The statistical analysis proved that the coefficient of determination for these models was 0.92 and 0.87, which means that these models fit the data very well.

Irrespective the levels of honey and chitosan concentrations, the orthesis and non-orthesis bandages of organs were found to differ significantly at 0.01 significant level in relation to their tensile strength. The statistical analysis showed that the tensile strength of orthesis bandages "CA" of organs surpasses the non-orthesis"GCA" ones by 10%.

Fabric breaking extension

Equally important to the fabric tensile strength is its ability to extend under load. When the fabric is subjected to tension in one direction, the extension takes place in two main phases. The first phase is decrimping or crimp removal in the direction of the load. The second phase is the extension of the yarn, during which the fabric becomes stiffer, the stiffness depending mainly on the character of the yarn. Breaking extension versus honey and chitosan concentrations for non-orthesis and orthesis bandages of organs were plotted in figures 5 and 6 respectively. The statistical analysis proved that chitosan concentration has a significant influence at 0.05 significant level on breaking extension of non-orthesis bandages, whereas honey concentration has a significant impact on breaking extension of non-orthesis bandages. From these figures an increasing trends were detected conforming that as the concentrations of chitosan and honey increase the breaking extension of both orthesis bandages increase.

Increasing the honey concentration from 20% to 40% leads to an increase of breaking extension for both types of orthesis organs by 17%. While increasing the chitosan concentration augmented the breaking extension of non-ortheis and orthesis bandages by about 37% and 10% respectively.

Irrespective of the type of treatment, the statistical analysis showed that there is no a significant difference between two types of bandages with respect to their breaking extension.

The regression relationship which correlates the levels of chitosan and honey concentrations to the breaking extension of orthesis and non-orthesis bandages of organs has the following non-linear forms:

Breaking extension (non-orthesis bandages), % = 11.6 + 0.5 x – 0.12 y -0.007 x2 + 0.005 xy +0.003y2

Breaking extension (orthesis bandages), % = 14.4 + 1.3 x – 0.4 y -0.03 x2 - 0.02 xy + 0.012y2

The statistical analysis proved that the coefficient of determination for both regression models equal 0.91 and 0.94 respectively, which means that these models fit the data very well.

Fabric thickness

Fabric thickness is important since it affects permeability and insulation characteristics of fabric. Also, thickness changing of the fabrics gives an idea about the bulkiness of the fabric under different pressures. The effects of honey and chitosan concentrations on thickness of non-orthesis and orthesis bandages of organs are depicted in figures 7 and 8 respectively.

The statistical analysis proved that both independent variables have a profound influence on thickness of both types of bandages at significant level 0.01. As shown in figures 7 and 8, both types of independent variables have a positive effect on bandage thickness. As the both variable levels increase the bandage thickness has the same trend.

It was found that increasing honey concentration from 20 to 40 % leads to an increase of bandage thickness by approximately 10% and 38% for non-orthesis and orthesis bandages of organs respectively. While increasing chitosan concentration from 5 to 15% leads to an increase of bandage thickness by about 7% and 17% for non – orthesis and orthesis bandage of organs.

The statistical analysis also showed that honey concentration accounted for 32% and 75% the variability in thickness of non-orthesis and orthesis bandages of organs, respectively. While chitosan concentration accounted for 32% and 14% the variability of thickness of non-orthesis and orthesis bandages of organs.

The regression relationship which correlates the honey and chitosan concentrations with the thickness of non-ortheis and orthesis bandage of organs are of the following form:
Thickness (non-orthesis bandages), mm = $0.5 + 0.002\ x - 0.004\ y - 0.001\ x2 + 0.0002\ xy$

Thickness (orthesis bandages), mm = $0.6 + 0.007\ x - 0.02\ y - 0.001\ x2 - 0.002\ xy + 0.005\ y2$

The statistical analysis proved that the coefficient of determination for both regression models equal 0.0.82 and 0.89 respectively, which means that these models fit the data very well.

Irrespective of the levels of honey and chitosan concentrations, it was found that thickness of orthesis bandage of organs exhibited higher values compared to the corresponding values of non-orthesis bandage of organs. The average thickness values of non-ortheis and orthesis bandage of organs were 0.5 mm and 0.6 mm respectively.

Fabric stiffness

Stiffness is one of the most widely used parameters to judge bending rigidity and fabric handling. Fabric stiffness and handling is an important decision factor for the end users. The degree of fabric stiffness is related to its properties such as fiber material, yarn and fabric structure. In this work, the effects honey and chitosan concentrations thickness of non-orthesis and ortheis bandages was investigated and depicted in figures 9 and 10. The statistical analysis proved that honey concentration has a significant influence on stiffness of both types of bandages. Whereas the chitosan concentration was found to have a significant effect on stiffness of orthesis bandage of organs only.

A shown in these figures, an increasing trend was detected assuring that as the levels of both variables increases, the stiffness of orthesis bandage also increases. Increasing honey concentration increased the stiffness of non-ortheis and orthesis bandages of organs by approximately 20% and 22% respectively. While increasing the chitosan concentration from 5% to 15% leads to an increase of stiffness by about 20% and 19% for non-orthesis and orthesis bandages of organs respectively.

The statistical analysis showed that chitosan concentration accounted for 35% the variability of stiffness of both types of bandages. Whereas honey concentration accounted for 12% and 29% the variability of stiffness of non-orthesis and orthesis bandages of organs respectively.

The non-linear regression models which correlate the levels of chitosan and honey concentrations with stiffness of both types of bandages have the following form:

Stiffness (non-orthesis bandages), mg = 9.2 + 2.6 x + 0.7 y -0.03 x2 - 0.04 xy +0.002 y2

Stiffness (orthesis bandages), mg = 6.4 + 3.9 x + 1.02 y -0.08 x2 - 0.05 xy - 0.008 y2

It is also found that the average value of stiffness of orthesis bandage of organ is higher compared to the corresponding values for non-orthesis bandage of organs. The average values of stiffness of non-orthesis and orthesis bandage of organs were 42 and 52 mg respectively.

Fabric absorption

The absorbency of treated fabrics is measured by drop penetration method. The effects of chitosan and honey concentrations on absorption time for non-orthesis and orthesis bandages were illustrated in figures 11 and 12.

The statistical analysis proved that both independent variables have a significant influence on absorption time for non-orthesis bandages of organs only. It was found that there is no effect for these variables on absorbency on the other bandage type.

From these figures a decreasing trend was detected assuring that as the levels of both independent variables increases the absorbency of treated fabrics decreases.

Increasing honey concentration leads to a reduction of absorbency of non-orthesis bandage of organs by 25%, whereas the increase in chitosan concentration leads to a reduction of a absorbency by approximately 30%. This is due to cover some of fabrics porosity with modifier gedical gypsum.

The regression relationship which correlates the absorbency of non-orthesis and orthesis bandage of organs with the honey and chitosan concentration is as follows:

Absorption time (non-orthesis bandages), sec = 10.8 + 0.7 x - 0.6 y -0.03 x2 - 0.01 xy +0.01 y2

Absorption time (orthesis bandages), mg = 11.8 – 0.6 x – 0.3 y + 0.01 x2 - 0.01 xy + 0.003 y2

The coefficient of determination for these models equal to 0.83 and 0.79 respectively.

Antimicrobial properties

Following the physical and mechanical properties of non-orthesis and orthesis bandage of organs, additional testing was performed to determine the antimicrobial capabilities of these types of bandages.

The antimicrobial properties were conducted against Gram-positive bacterium (*S. aureus*) and Gram-negative (*E. coli*) respectively.

Antimicrobial properties against *E. coli*

Figure 13 and 14 show the response surface of the effect of honey and chitosan concentration on antimicrobial activity against *E. coli* for non-orthesis and orthesis bandages of organs. The statistical analysis proved that both independent variables have a profound effect on antimicrobial activity for both types of bandages.

From both figures an increasing trend was detected assuring that as the honey and chitosan concentration increases the antimicrobial activity against *E. coli* also increases for both types of bandages. Increasing honey concentration from 20% to 40% increases the antimicrobial activity by 31% and 40% for non orthesis and orthesis bandages of organs. While increasing chitosan concentration from 5% to 15% leads to an increase of antimicrobial activity for both types of bandages by approximately 45% and 41 % respectively.

The statistical analysis also proved that the effects of honey concentration accounted for 15% and 35% of the variability in antimicrobial activity for non-orthesis and orthesis bandages.

Whereas the concentration of chitosan accounted for 54% and 47% of the variability in antimicrobial activity for non – orthesis and orthesis bandages respectively. This is due to cover some of non – orthesis fabrics bandages porosity with modifier medical gypsum.

The regression relationship which correlates the concentration of chitosan and honey with the antimicrobial activity against *E. coli* was as follows:

Antimicrobial activity (non-orthesis bandages), mm = -4.8 + 1.2 x + 0.9 y -0.05 x^2 + 0.02 xy - 0.01 y2

Antimicrobial activity (orthesis bandages), mm = -7 +1.3 x +0.8 y - 0.02 xy - 0.005 y2

The coefficient of determination for these models is equal to 0.90 and 0.92 respectively, which means that these models fit the data very well.

Antimicrobial properties against *S. aureus*

The effects of chitosan and honey concentration against antimicrobial activity of *S. aureus* were presented in figures 15 and 16 for non-orthesis and orthesis bandages of organs. The statistical analysis showed a significant influence of both factors on the antimicrobial activity at 0.01 significant level.

From these figures an increasing trend was detected assuring that as the concentration of both independent variables increases the antimicrobial activity against *S. aureus* also increases for both types of bandages. Increasing honey concentration from 20% to 40% leads to an increasing of antimicrobial activity for non-orthesis and orthesis bandage by approximately 46% and 55% respectively. Whereas increasing the chitosan leads to an increase of antimicrobial activity for both types of bandages by 44% and 82% respectively.

The regression relationship which correlates the concentration of chitosan and honey with the antimicrobial activity against *S. aureus* was as follows:

Antimicrobial activity (non-orthesis bandages), mm = 12.8 – 0.08 x - 0.2 y + 0.03 xy + 0.005 y2

Table.1 Bandages specifications

No	Gauze Fabrics	Bandages type	Creator Name Bandages	treatment materials	Concentration of treatment Materials g/g/L	Concentration of modifier Gypsum medical	Microwave Energy W/sec
1	Gauze thick	Non Orthesis Bandages of organs	Gauze	–	-	-	-
2			Asallona	Honey	20		510/10
3			Chitosona	Chitosan	5		
4			CA	Honey/ Chitosan	20/5		
5					20/10		
6					20/15		
7					30/5		
8					30/10		
9					30/15		
10					40/5		
11					40/10		
12					40/15		
13		Orthesis Bandages of Organs	Gypsona	-	-	-	-
14			Gauze	–	-	–	510/10
15			Gybs Asallona	Honey	20	20g Chitosan /200g CMC /1Kg Medical Gypsum	
16			Gybs Chitosona	Chitosan	5		
17			GCA	Honey / Chitosan	20/5		
18					20/10		
19					20/15		
20					30/5		
21					30/10		
22					30/15		
23					40/5		
24					40/10		
25					40/15		

Figure.1 Response surface of the effects of honey and chitosan concentration on weight per square meter of non-orthesis bandages"GCA" of organs

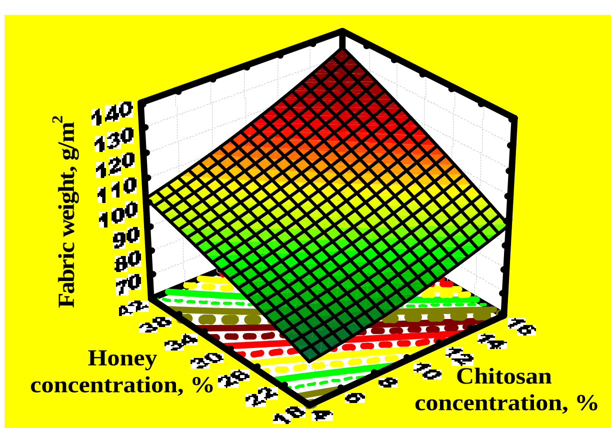


Table.2 Experimental results

No	weight g	Tensile strength kg	Extension cm	Stiffness %	Thickness mm	Absorption sec	resistance (*E.coli*) mm	resistance (Staph---) mm
1	66	22	20	27	0.48	3	3	2
2	72	22	20	30	0.49	4	18	14
3	76	22.5	16	47.1	0.5	6	18	13
4	80	186	14	33	0.44	8	15	13
5	92	215	15	38	0.45	7	16	15
6	96	215	18	43	0.46	5	20	17
7	92	215	14	35	0.45	6	16	15
8	100	215	16	44	0.46	6	23	17
9	116	221	20	46	0.48	5	24	22
10	104	215	15	45	0.46	6	17	17
11	111	225	20	45	0.5	5	24	23
12	128	230	20	47	0.51	4	26	26
13	378	15	15	49.1	0.65	2	2	1
14	332	225	16	48.3	0.60	2	11	9
15	336	230	18	49	0.70	5	20	22
16	339	235	18	59.7	0.70	7	10	17
17	343	186	15	39.2	0.49	5	12	10
18	346	215	18	48.9	0.5	3	16	13
19	348	215	18	52.1	0.55	3	20	17
20	342	215	16	45.5	0.49	3	16	11
21	347	215	18	53.7	0.6	3	19	16
22	355	221	18	56.1	0.65	3	24	22
23	350	215	20	55	0.7	3	20	14
24	355	225	20	56.5	0.75	3	23	23
25	364	230	20	58.4	0.8	3	24	25

Figure.2 Response surface of the effects of honey and chitosan concentration on weight per square meter of orthesis bandages of organs "CA"

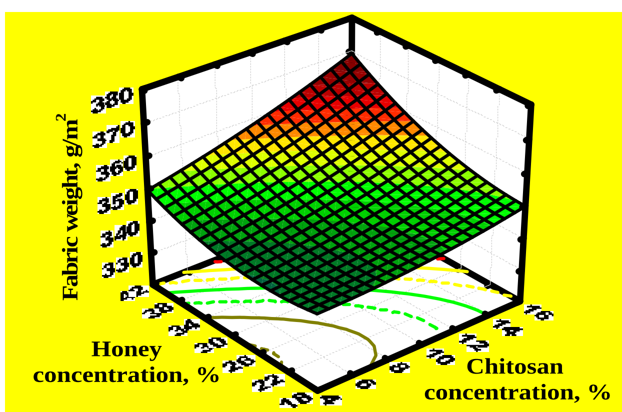


Figure.3 Response surface of the effects of honey and chitosan concentration on tensile strength of non-orthesis bandages of organs "GCA"

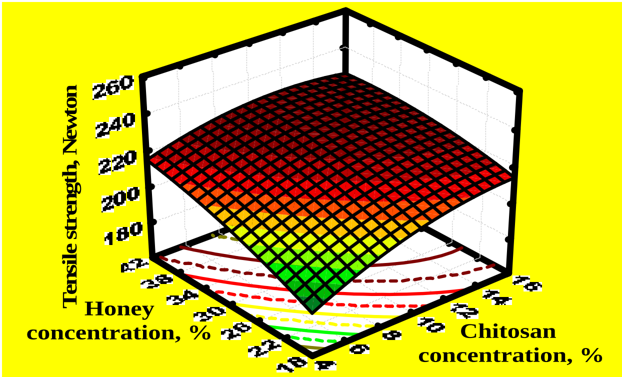


Figure.4 Response surface of the effects of honey and chitosan concentration on tensile strength of orthesis bandages of organs "CA"

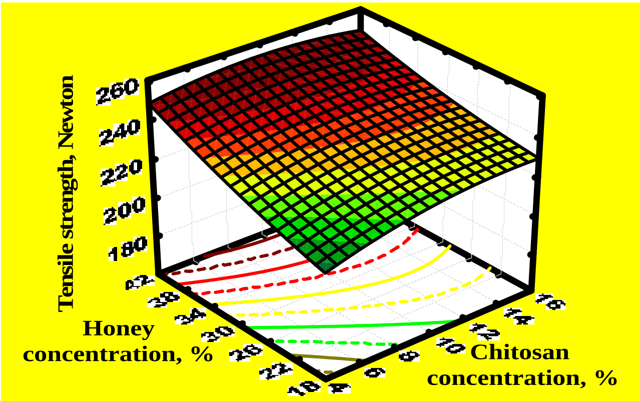


Figure.5 Response surface of the effects of honey and chitosan concentration on breaking extension of non-orthesis bandages of organs "GCA"

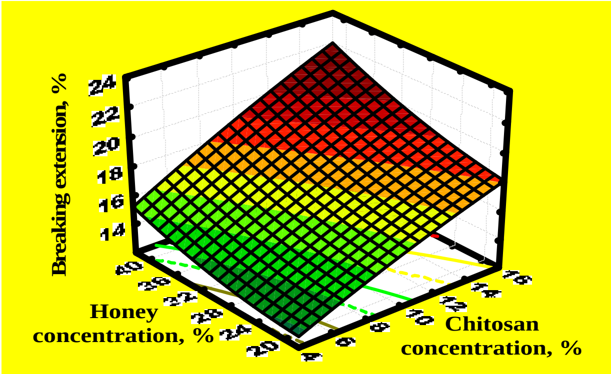


Figure.6 Response surface of the effects of honey and chitosan concentration on breaking extension of orthesis bandages of organs "CA"

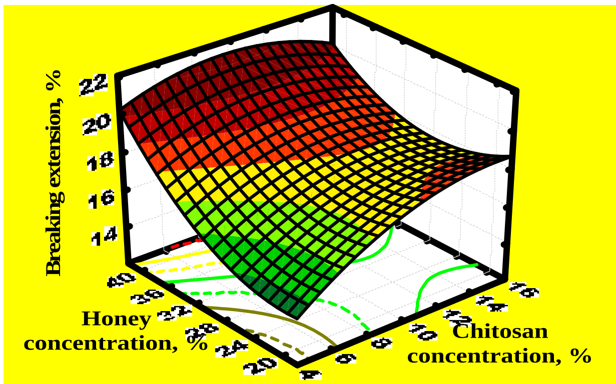


Figure.7 Response surface of the effects of honey and chitosan concentration on thickness of non-orthesis bandages of organs "GCA"

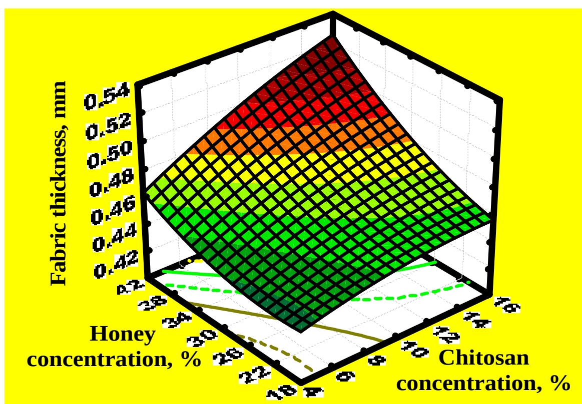


Figure.8 Response surface of the effects of honey and chitosan concentration on thickness of orthesis bandages of organs "CA"

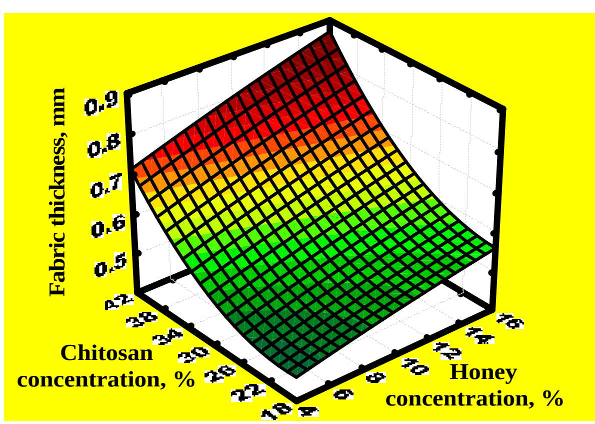


Figure.9 Response surface of the effects of honey and chitosan concentration on stiffness of non-orthesis bandages of organs "GCA"

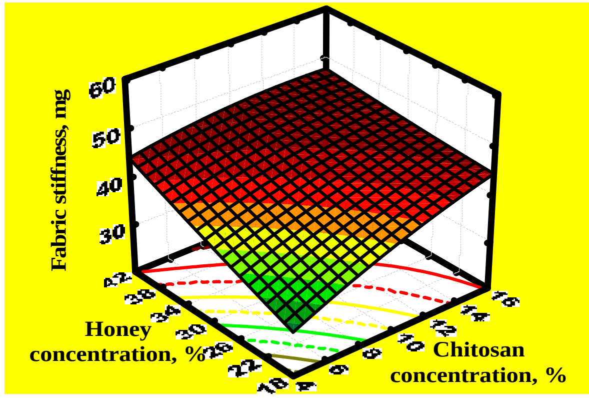


Figure.10 Response surface of the effects of honey and chitosan concentration on stiffness of or thesis bandages of organs " CA"

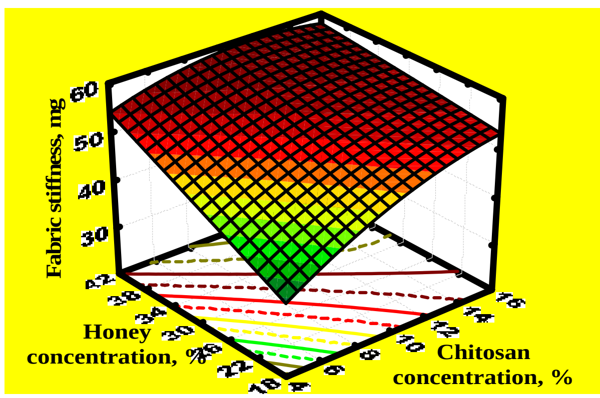


Figure.11 Response surface of the effects of honey and chitosan concentration on absorbency of non-orthesis bandages of organs "GCA"

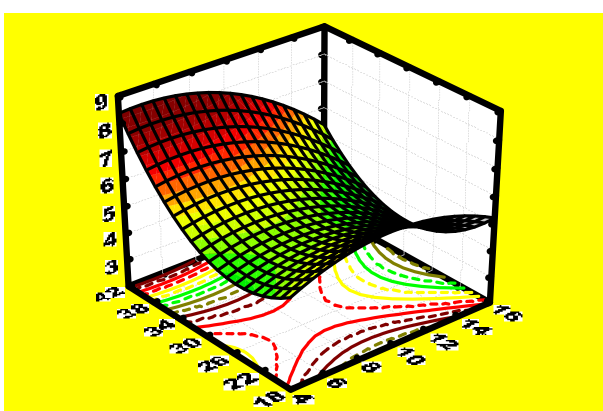


Figure.12 Response surface of the effects of honey and chitosan concentration on absorbency of orthesis " CA" bandages of organs

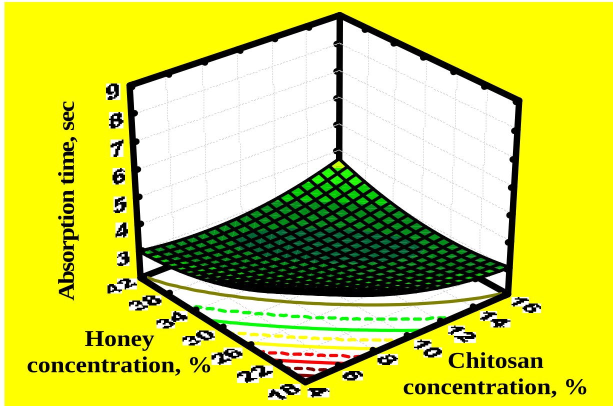


Figure.13 Response surface of the effects of honey and chitosan concentration on antimicrobial activity against *E. coli* for non-orthesis bandages of organs "GCA"

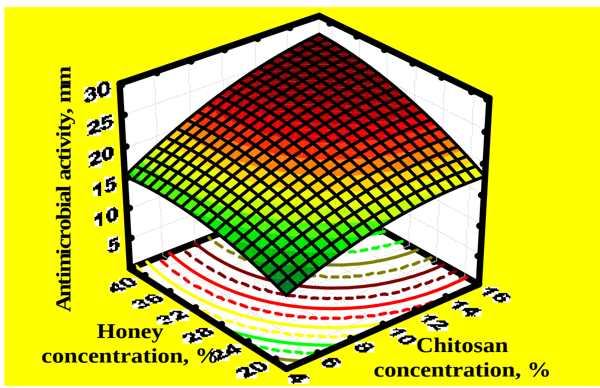


Figure.14 Response surface of the effects of honey and chitosan concentration on antimicrobial activity against *E. coli* for orthesis "CA" bandages of organs

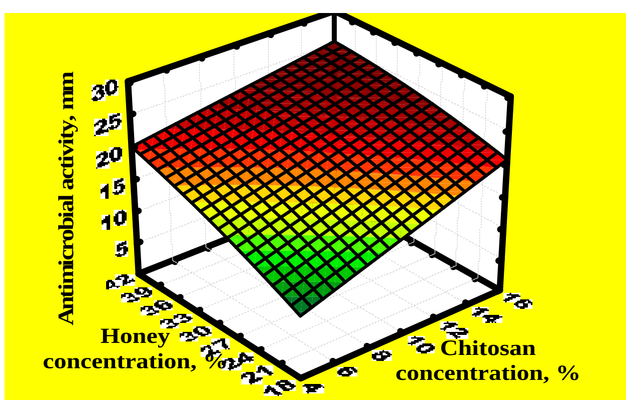


Figure.15 Response surface of the effects of honey and chitosan concentration on antimicrobial activity against *S. aureus* for non-orthesis bandages of organs "GCA"

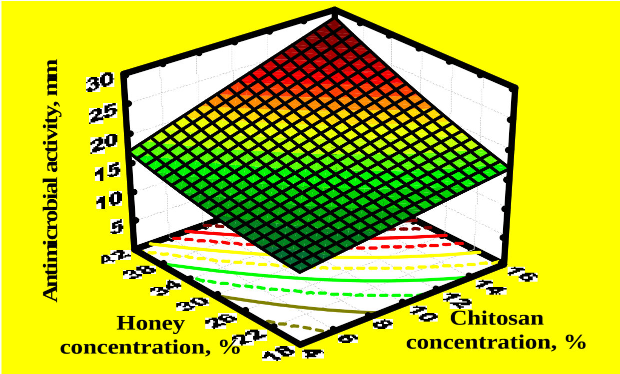


Figure.16 Response surface of the effects of honey and chitosan concentration on antimicrobial activity against *S. aureus* for orthesis "CA" bandages of organs

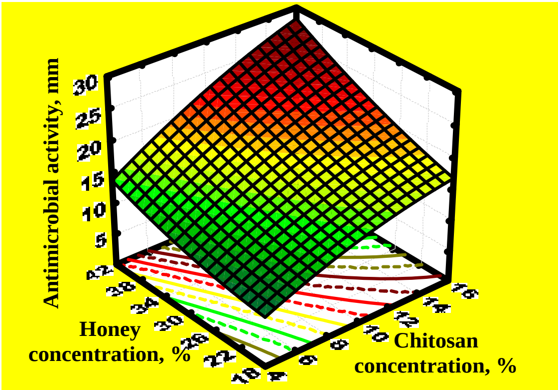


Fig.17 gauze fabric resistance *E. coli*

Fig.18 gauze fabric resistance *E. coli*

Fig.19 gauze fabric resistance *Staph*

Fig.20 gauze fabric resistance *E. coli*

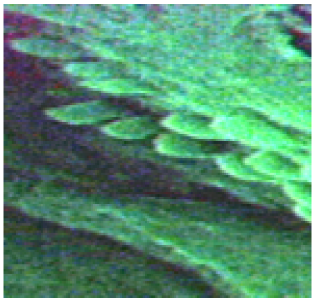


Fig.21 SEM of untreated gauze fabric " Gypsona "

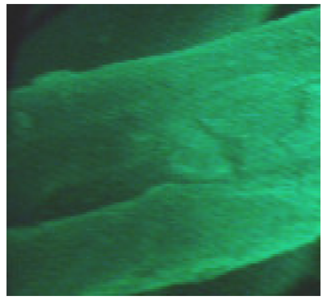


Fig.22 SEM of treated fabric "GCA"

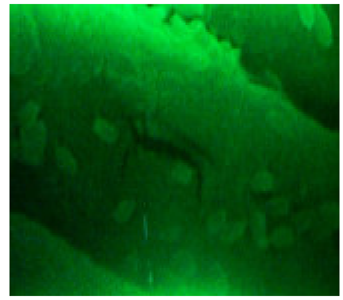
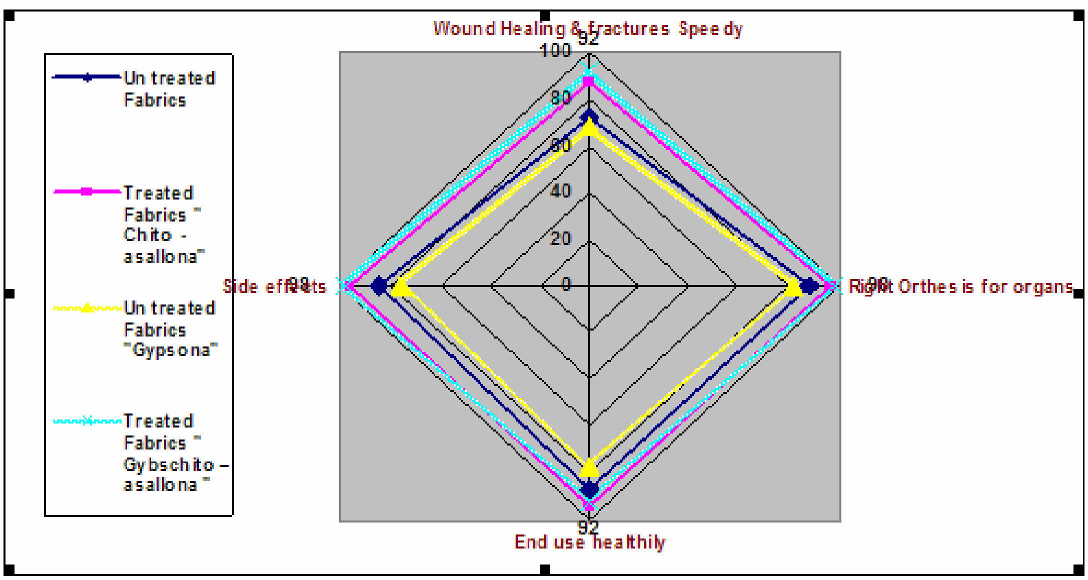


Fig.23 SEM of treated fabric " CA"

Fig.24 Chitosallona "CA" and Gybschitoasallona "GCA" compared with available in hospitals and medical pharmacies



Antimicrobial activity (orthesis bandages), mm = 4.9 +1.03 x - 0.23 y – 0.03 x2 + 0.02 xy + 0.007 y2

The coefficient of determination for these models is equal to 0.90 and 0.92 respectively, which means that these models fit the data very well. Antibacterial activity of the treated and untreated fabric Against *E. coli* (gram negative) and *Staphylococcus aureus* (gram positive)

Figures 19 and 20 appeared antibacterial activity diagonal of the treated and untreated fabric Against *E. coli* and *Staphylococcus aureus*.

Figures 21 and 22 appeared high growth of bacteria on untreated gauze fabric with Chitosan & honey, while the surface of gauze fabric treated gave resistant bacteria. Figure 23 Showed Chitosan & honey of fabric surface.

Figure 24 shows that Practice of this application proved fractures and wound healing speed of patients in the university hospital increased by 12%, 17 % when using CA and GCA bandages with compared with available presently bandages in hospitals and pharmacies.

The results showed that when the concentration rate of honey, chitosan mixture and honey, chitosan mixture, modifier medical gypsum are increased the measured functional properties improved, and appears excellent bactericidal activity in CA and GCA fabrics. The SEM pictures reveal that honey, chitosan and modifier medical gypsum are deposited on the surface of fabric fibers and reduction of bacteria on the fabrics surfaces.

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