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Research Article

The Study of Chemical and Tensile Strength of Luffa Fruit's Fibers

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ABSTRACT:
Luffa cylindrica is a fruit belonging to family of cucurbitaceae. Many member of this family have been screened for their medical potential. Luffa have medical characteristics such as anti-inflammatory, antiallergic, antibacterial, stimulant for immune system and high strength which made researcher to think about it as a source for dental material specifically suture material. The objective of the present study is to determine the chemical components of methanolic, aqueous extract and its essence. In addition we aimed to investigate aimed at investigation the tensile strength of the luffa cylindrica (loofah) fibers. The extract were prepared and screened via GC MS for determination of the luffa's chemical component, which detected the chemicals according to their molecular weight, revealed the presence of alkaloids, carbohydrates, flavonoids and phenolics compound. The physicochemical parameters determined in the present work along with the texture analyzer CT3 profile showed that the luffa fibers have a high tensile strength. According to the texture analyzer's test, were done on 20 prepared single luffa fiber and statistically analyzed by SPSS, the mean value of tensile strength of the tested specimen were 2086 pascal.

Our study revealed that the luffa cylindrica's fiber by having named chemicals showed its high medical potential. High tensile strength of luffa fiber (8.363 newton) which is equal or even higher than of some suturing material like polyglycolic acid, polyglactin and polyglycolid-co-caprolactinto that are available and use now a days.

Luffa fiber by having all these characteristics would be use as dental material such as suturing material, dental floss or even bristle of dental brush if more research done on this fruits.

Keywords: Luffa Cylindrica, Chemical Components, Tensile Strength, Suture Material.

[I] INTRODUCTION

The main concern of the general public and science is in finding new natural and therapeutically active agents; scientist all over the glob have started screening plants for searching new phytochemicals (1). Luffa cylindrical (smooth luffa) belongs to the plant family of cucurbitaceae. it is a herbaceous plant and thrives commonly with twining tendrils (2). Luffa is also available in iran, it is an excellent fruit in nature containing all the essential constituents required for good health of human such as different types of vitamins and mineral (vitamine B, vitamin C, Niacin, Calcium, Phosphorus, Iron and etc…) (3). The valuable medicinal properties of this plant are antibacterial effect that made luffa as a best bath and dishes sponge source. Luffa's essential oil also have an anti-inflammatory, antiallergic, antihypertensive, antituisive effect and stimulant of immune system which made this plant as a traditional medicinal herbs. Luffa's fibers have a good elasticity, high strength, long storage liability and wound healing property in the body. it is reported to posses a good potential as a skin substitute in a laboratory rats, these are the similarities between luffa's fiber and the suturing materials such as; polyvinylidene fluoride, polylactic acid, polypropylene, polyglycolic acid and etc (4). The aim of the present study was to determine tensile strength and chemical components of luffa fibers separated from its fruits via the use of GC MS and Texture Analyzer CT3 screening to offer these fibers for more laboratory test in terms of cellular toxicity and its biocompatibility.

[II] MATERIALS AND METHODS

Plant material

In this research, researchers used 5 week luffa cylindrica's fruits that were obtained from luffa farm near noshahr city and confirmed by herbalist to undergo chemical and physical test specifically tensile strength test.

Preparation of extract

Methanolic extract, water extract and luffa essence: the fresh 5 week old luffa cylindrica obtained, dried in shade and coarsely pulverized using mortar and pestle. The powder was successively extracted with methanol followed by water. The methanol and aqueous extract were prepared by the maceration of methanol and distilled water for 72 hours stored at 27 degree Celsius in the incubator. In the other hand the luffa essence was prepared in a clevenger apparatus. The three specimen (methanol, water and essence) were injected to the GC MS apparatus for chemical screening.

Preparation of fiber for Tensile strength test

The tensile strength of luffa's fibers were measured by the use of texture analyzer CT3 (Brookfield-USA), in this test researchers separated, prepared 20 monofilament specimen from the named fruits. According to the program of texture analyzer we gave, it automatically separate 100mm of fiber and measured the tensile strength in terms of peak load (newton) and showed the deformation amount of fibers at peak load (mm).The amount of peak load measured were divided by the (0.45 mm) which is the mean value of fibers diameter, that was already measured by micrometer sylvoc S229, then presented based on newton .

The result of physical test (tensile strength) were analyzed by SPSS software statistical analysis.

[III] RESULTS

Gas chromatography mass spectrum study of specific material is base on the ionization ability of the component and energy needed to break a molecular bond. The amount of energy needs to break a bond to make an ion is an ionization energy in this study the ionization energy were about 70ev. After injection of specimen to the GC MS each component were detected according to their molecular weight and their ionization liability. In each GC MS test aside from having a general graf; an individual graf for each molecular breakage was presented, which tells us about the molecular weight, time of breakage and the area that the specific component separated. As can be observed in table 1 and 2, the total chemical component from essence and methanolic extract were successively showed the luffa's chemical components.

The phytochemical screening conducted on fruit extracts of luffa acutangula L revealed the presence of oils, steroids, saponins, alkaloids, glycosides, phenol, tannins, flavonoids and resins (5).

Table 1:GC-MS analysis of essence of luffa cylindrical

Peak Number	Run time (Min)	Area	Name Molecular weight (M/Z)
1	3.642	198267506, %16.90	1.3-Dioxolane,4-ethyl-5-octy-2 57
2	16.577	12226485, %1.04	2-Decenal 70
3	19.949	6565012,%0.56	2-octenal 70
4	34.221	8023897,%0.68	1,2-benzenedicarboxylic acid 149
5	36.554	41138467,%3.51	n-hexadecanoic acid 73
6	40.578	141583610,%12.07	9-octadecenioc acid 55
7	41.064	15235468,%1.30	Octadecanioc acid 55
8	43.928	82713190,%7.05	Palmitic anhydride 98
9	44.093	15182270, %1.29	2-oxecanone,10-methyl 129
10	46.459	8025996,%0.68	9,12-octadecadienoic acid 67
11	46570	12517792,%1.07	9,12-octadecadien-1-ol 55
12	47.432	256214942,%21.84	9,12-octadecadienoic acid 67
13	47.543	526039004,%44.83	13-Tetradecenal 129
14	47.686	96271327,%8.21	Cyclopentadecanone,2-hydroxy 55
15	47.996	62537289,%5.33	Glycidol stearate 129
16	52.739	7436830,%0.63	Propanamide,N-(5,7-dimethyl) 173
17	56.464	58775613,%5.01	1,10-Hexadecanediol 173

18	68.948	21067183,%1.80	5,5'-(Tetrahydro-1H,3H-furo) 149

*Molecular weight (M/Z) measured based on weight and electron charge of the specific components.

Table 2:GC-MS analysis of methanolic extract of luffa cylindrica

Peak Number	Run time (Min)	Area	Name Molecular weight (M/Z)
1	3.664	65229077,%74.23	1H-indole-2-carboxylic acid,6 207
2	33.823	12916689,%1.47	9-octadecenoic acid 55
3	41.672	4015542,%0.46	2-Propanamine,N-(1-methylpropyl) 57
4	41.794	1308304,%0.15	Hexanoic acid,5,5-dimethyl 57.1
5	43.309	3167550,%0.36	4-fluoro-6-aminopyrimidine 113.1
6	45.387	3744269,%0.43	9,12-octadecadienoic acid 67.1
7	45.564	6427403,%0.73	Z,E-3,13-octadecadien-1-ol 55
8	46.338	4238097,%0.48	9-octadecenal,(Z) 55
9	46.537	35514146,%4.04	13-tetradece-11-yn-1-ol 67
10	46.692	71020828,%8.08	9-octadecenal 55
11	46.846	33390372,%3.80	13-tertadecen-1-ol acetate 55
12	47.377	6624736,%0.75	p-menthan-1,3,3-d3-2-ol 57
13	49.024	2193725,%0.25	Bicyclo[3.2.0]heptan-2-one, 97
14	50.959	5316557,%0.61	Cyclohexane,1-bromo-2-metyl 97.1
15	51.114	3436298,%0.39	3a,7a-Epoxy-1H-inden-4(5H) 97.1
16	51.202	7341986,%0.84	2-thiopheneacetic acid,2-methyl 97.1
17	51.722	2090823,%0.24	TERTIO-BUTYL- 4CYCLOHEXANOXIME 97
18	55.967	5794028,%0.66	Thiophen-2-methylamine 97.1
19	56.376	3810894,%0.43	Thiophen-2-methylamine 97
20	58.366	8361875,%0.95	Thiophen-2-methylamine 97.1
21	59.516	5684152,%0.65	2-butenamide,N,N-diethyl 97.1

***Molecular weight (M/Z) measured based on weight and electron charge of the specific components.**

Peak Number	Run time (Min)	Area	Name Molecular weigh (M/Z)
1	14.476	551062,%0.10	Dodecane 57
2	21.098	948551,%0.17	Tetradecane 57
3	27.079	1174555,%0.21	Hexadecane 57.1
4	46.846	40717217,%7.2310	Oxirane,tetradecyl 57
5	52.263	401662512,%71.37	3-cyclohexene-1-carboxylic acid 55
6	53.347	36132876,%6.42	Mesityl oxide semicarbazone 97
7	54.994	62076387,%11.03	N-methyl-cyclohexylamino 207
8	56.011	2954979,%0.53	Cyclotrisiloxane,hexamethyl 207
9	56.464	11280995,%2.00	Thiophen-2-methylamine 97
10	58.908	5319336,%0.95	Cyclotrisiloxane,hexamethyl 97.1

Table 3:GC-MS analysis of water extract of luffa cylindrical

***Molecular weight (M/Z) measured based on weight and electron charge of the specific components.**

All data came from texture analyzer CT3 is based on newton, which is presented in Table.4, The calculated tensile strength divided by the mean value of fiber’s diameter (0.45) measured by micrometer and presented based on pascal.

Table 4: Texture Analyzer data analysis of luffa cylindrica’s fiber

Specimen	Peak load (N)	Deformation at peak load (mm)
1	8.42	2.59
2	10.33	2.24
3	9.26	2.23
4	8.24	1.49
5	10.10	1.21
6	5.59	0.75
7	7.83	1.53
8	7.06	2.74
9	10.40	3.94
10	10.29	2.56
11	9.68	3.02
12	6.56	1.23
13	9.64	3.29
14	5.50	2.15
15	5.24	1.21
16	8.37	2.57
17	6.80	1.54
18	15.31	3.04

19	7.01	1.79
20	5.64	1.46

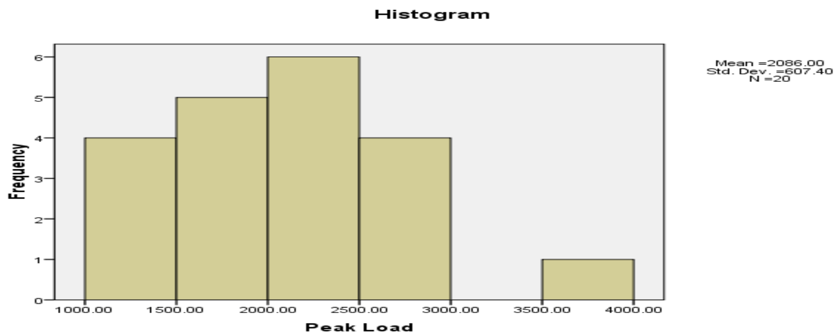
(N-newton),(mm-millimeter)

Based on the results the highest and the lowest peak load are 3827 and 1297 pascal, the mean and standard deviation is 2086 pascal and 607.4.

The highest, lowest and mean value for the deformation at peak load were 3.94 mm, 2.27mm, 2.17mm.

With all data gathered in these test, the researchers analyzed the data by the use of normality test (skewness and kurtosis).The kurtosis value for peak load and deformation at peak load was 2.15 and 0.54 and skewness for the named character was 1.03 and 0.48 which showed our data are in normal range and correctly calculated because (-2,2) is a normality range for kurtosis and skewness.

a.



b.

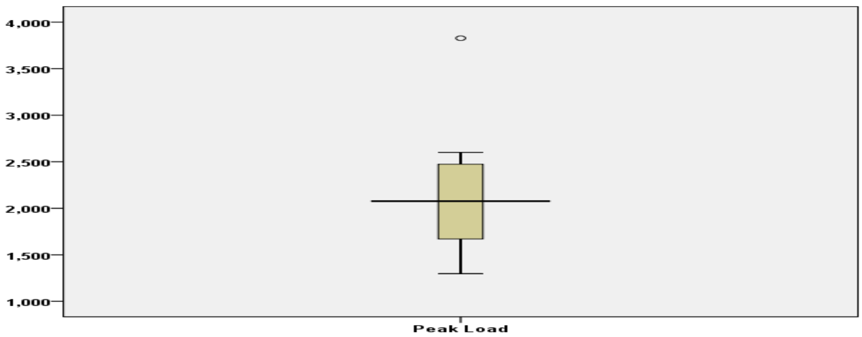
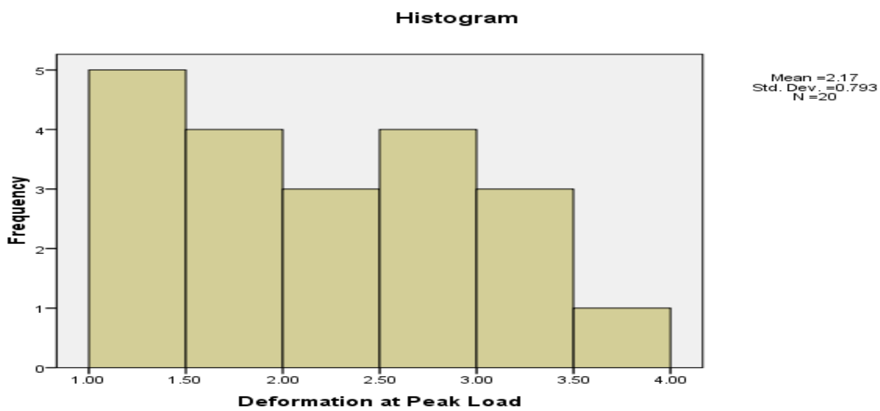


Fig1: a-histogram of the tensile strength base on peak load (pascal) and frequency(numbers).b-histogram of the standard deviation of the tensile strength base on the peak load (pascal) and frequency(numbers).

a.



b.

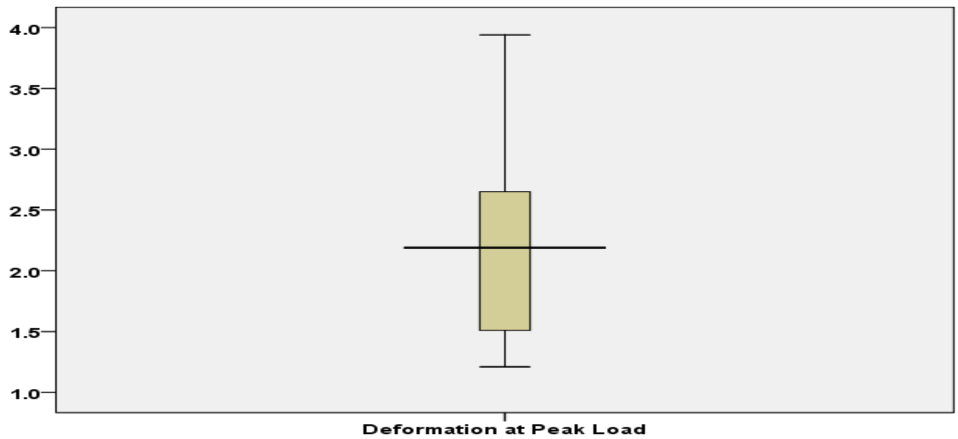


Fig2: a-histogram of the deformation of fiber at peak load (millimiter) and frequency (numbers) and millimeter. b-histogram of the standard deviation of the deformation at the peak load base on (millimeter).

Table 5: Regression analysis for the correlation between peak load and deformation at peak load of luffa cylindrical fibers

Cubic Equation	df	Mean Square	R Square	Constant	b1	b2	b3
Regression	3	1002483.6	0.429**	5.257 E3	- 5.423 E3	2.522 E3	- 334.263
Residual	16	250143.9					

As presented at table 5, which describe the correlation between peak load and deformation at peak load of the luffa fibers, the R square was (0.429) which means that the two variables (peak load and deformation at peak load) were %99 directly dependent to each other.

[IV] DISCUSSION

A variety of biologically active, non-nutritive compounds known as phytochemicals, are present in plant foods. These phytoconstituents have beneficial beyond basic nutritive value (6). In the present study, we determined the chemical components of luffa cylindrica by using three different types of extract from luffa for GC MS screening and examined the tensile strength of 20 single luffa fibers that were separated and prepared from the 5 weeks old fruits which were tested by Texture Analyzer CT3. Luffa cylindrica belongs to cucurbitaceae family (7). Luffa by having polymeric structure, good elasticity, enough strength, ability in wound healing and biocompatibility, gave us the idea to use this herbal source as suturing material because the basic property of suturing materials are; good elasticity, enough tensile strength, biocompatibility and good storage.

According to phytochemical test done by kao et.al (2012) luffa's chemical component can be classified to alkaloid, carbohydrates, flavonoids and phenolic compound that made luffa as a medicinal herbal plant having anti-inflammatory, antiallergic, antivirus and anticancer properties (8). Luffa by having these component can encourage researchers to do more experiments in terms of biocompatibility and cellular toxicity.

In present study, the mean value of fiber's diameter were calculated and measured by micrometer (0.45 mm). The morphology of these fibers had no significant effect on the tensile strength which is in agreement in previous reports of Maria ernest et.al (2013), were measured tensile strength of different natural fibers such as jute, sisal, curaua, coir and piassava fibers that were tested under direct tension in a universal testing machine and the cross sectional areas of the fibers were calculated using images obtained in scanning electron microscopy. According to their report tensile strength of different natural fibers were ndependent of the fibers diameter (9).

The mean value of tensile strength of the luffa fibers with the mean of 0.45 mm in diameter, were measured in this study was about 2086 pascal which is equal to 8.363 newton whereas the tensile strength measured in the previous study by vinayak et. al (2013) on different type of suturing material such as polyglycolic acid(PA), polyglactin (P), polyglycolid-co-caprolactin (PCC)and etc, with the size of 4-0 and 5-0 were reported that the tensile strength of size of 5-0 PA (8.13 N), P (8.00 N) and PCC (9.02 N) (10,11,12), which proved that the tensile strength of luffa fiber is at the same level of the named suturing materials.

[V] CONCLUSION

The main characteristic of specific material to consider as suturing material are strength (high strength- to- weight ratio), chemical inertness, biocompatibility, low flammability, low cellular toxicity, low coefficient of friction and low water adsorption. As described, Luffa fiber showed enough potential for more complex researches because these fiber by having valuable chemical components that made it as medicinal fruits, high tensile strength which is comparable to some suturing material's strength and by having a good storage liability would be considered as a valuable source of dental material specifically suturing material, dental floss and bristle brush.In this study we offer to use HPLC to the future researches for better determination and classification of chemical components of the fiber, from all data we gathered luffa's fiber could be a good source to use in different medical field.

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REFERENCES

1. B. P. Pimle.et al. Antidiabeticand Antihyperlipidemic activity of Luffa A cutangula Fruit extracts in streptozotocin induced nidddm rats,Asian journal of pharmaceutical and clinical research.2011:vol4
2. RaGhavan. G.Vijaya.Comprehensive Medicinal Plant.2011;Vol 4.2. Zargari,A.Medicinal plants,1982:vol1;3rd edition.
3. RaGhavan. G.Vijaya.Comprehensive Medicinal Plant.2011; Vol 4.
4. Ping Lun Jiang.et al.Journal of Biomed Research International. 2014;i d 458287..
5. Middleton Ej. Effect of Plant Flavonids on Immune and Inflammatory cell Function .Adv Exp Med Biol,1998;439:175-82.
6. B. P. Pimle.et al. Antidiabeticand Antihyperlipidemic activity of Luffa A cutangula Fruit extracts in streptozotocin induced nidddm rats,Asian journal of pharmaceutical and clinical research.2011:vol4.

7. Wong RCH,Fong WP, Ng TB. Multiple trypsin inhibitors from Mamordica Cochinchinensis seeds, the chinese drug mubiezhi. Peptiteds2004;25:163-169-B.P.Pimle.et al. Antidiabeticand Antihyperlipidemic activity of Luffa A cutangula Fruit extracts in streptozotocin induced nidddm rats,Asian journal of pharmaceutical and clinical research.2011:vol43.
8. De Groot H,Rauen U.Tissue Injury byReactive Oxygen Species and the Protective Effect of Flavonids. Function Clin Pharmacol ,1998;12:249-55.- Sastra University,Thanjavur, Tamil Nadu.quality control studies on luffa acutangula L.International Journal of Pharmacy and Pharmaceutical Science.2014;vol6.
9. Maria Ernestina Alves Fidelis,et al. The Effect of Fiber Morphology on the Tensile Strength of Natural Fibers, journal of Materials Reserch and Technology,2013;2;149-157..
10. Hotchberg,j.Suture Choice and other Method on Skin Closure.Surg Clin N AM.89. 2009;627-641
11. Bourne,RB.etal.In vitro Comparison of FourAbsorbable Suture;vicryl,dexon ,plus, maxon and PDS,The Canadian Journal of Surgery.1988:31.43-45.
12. vinayak,K.S,et al.Evaluation of Tensile Strength of Surgical Synthetic Absorbable Suture Materials;An in Vitro Study.Journal of Periodontal and Implant Science.2013:43:130-135..