Research Article

Study of physical and mechanical Properties of Sansevieria Ehrenbergii Fibres (SEF)

Abstract

The study is aimed to investigate physical and mechanical properties of fibres extracted from sansevieria ehrenbergii plant and its quality for different textile products such ropes, carpets and fabrics in order to enhance commercialization and utilization of the plant.

The SEF were extracted by means of the hand decortication from the plant leaves and physical and mechanical properties were determined. Analysis the fibres showed that were flexible, smooth with mean length of 138.48 cm, maximum breaking force of 19.51N, linear density of 44.76 tex, tenacity of 0.48 N/ tex at the maximum breaking force and Tensile strain was 0.0368 mm at the maximum breaking force. Also other absorption results showed that SEF had moisture regain of 9.46% and moisture content 8.67%.

A brief comparison of SEF with other similar fibres was performed and a promising comparison drawn.

Keywords: Sansevieria ehrenbergii, physical and Mechanical properties, textiles

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Introduction

SEF are one of the species of plants found in the tropics and mid dry areas. The plant grows in tight gatherings and in close proximity amongst itself, it`s occur from sea level up to 1900m altitude in open bush land, dry grassland and dunes mostly on the rock ground with minimum annual rainfall requirement of 250mm.[1,2] The plant consist of the point leaves from the base at the root or rhizomes sent out by the parent root. Best yields and quality of fibres are obtained by respecting a harvest interval that is long enough not to reduce the leaf length. A first harvest could take place at 2.5 -3.5 years after planting and consecutive harvest at 2 years interval at high growth rate the harvest interval can be shorter (Figure 1).[1]

Figure 1 Sansevieria ehrenbergii plants.

Indigenous people extract fibres from this plant to produce different textile products such as, natural bandages, ropes, baskets, roofs and clothes by the traditional methods. Mostly of the products produced using these fibres are ropes that frequently used in daily activities (Figure 2).

These handmade ropes produced doesn`t meet the demand therefore there are huge number braided ropes generally made of nylon, polyester, polypropylene or high modulus polyethylene in the market which imported. Ropes made of Synthetic fibres not friendly to environment during disposal phase and not comfortable to use and more likely to cause harms on human hands and part of animal.

Figure 2 Handmade rope of SEF.

This study is objected on establishment of performance and technical information of SEF extracted from Sansevieria ehrenbergii plant grown in Tanzania. The mechanical and physical properties to be studied are Length of the fibre, Moisture content and regain, Linear density (Fineness), Breaking force, Tenacity ,Tensile strain and lastly comparing the properties measured and the other cellulosic fibres which are sisal, agave American, Linen, Aramina, jutes and cotton fibres.

Methodology

These are methods, rules and postulates that were used during this study, below is explanation of the different methodologies used per activity. The study was comprised different works undertaken to accomplish a certain targeted purpose therefore contained interrelated activities at which completion of these activities lead to completion of the study.

Sampling of the plant

The Sansevieria ehrenbergii plant leaves was harvested from Chalinze district at Chamakweza village the location was selected as they had an abundance of the sep leaves. The leaves were purposively collected in order to obtain leaves almost of the same age; this was done by observing the colour, size and position of the leaf on the plant. The position of the extracted leaves was on third level from the base towards the apex, (third leaf from the base of the plant) to avoid very old or very young leaves. The oldest leaves are at the base while the youngest are at the apex. A total of ninety (90) plant leaves were harvested from thirty (30) different plants.

Extraction of the SEF

Mature leaves were harvested from the field for fiber extraction. All lower leaves, standing at an angle of more than 45° to the vertical are cut away from the plant by means of a sharp cutting tool. After harvesting, the leaves were transported to the fiber extraction area. Before extraction spine at the leaf tip is removed.[3] The methods used for extraction of SEF from plant leaves are similar to the methods that are used for extraction of sisal fibers.[4] There are three major fiber extraction methods which are Mechanical decortication, chemical method, retting method and enzymatic method. Hand decortication technique is method used for fibre extraction for this study as within mechanical decortication method. Historically, hand decortication was done by rural folk whereby the leaves were pounded and the pulp was scraped away with a knife.[5–7] Hand decortication is time consuming and needs a lot of manpower (Figure 3) (Figure 4).

Figure 3 Pounding of leaves for fibres extraction.

Figure 4 Extracted fibres from sansevieria ehrenbergii leaves.

Nowadays, decortication can be done efficiently by using mechanical decorticator. In the mechanical decortication process, leaves are crushed and beaten by a rotating wheel set with blunt knives, so that only fibers remain.[4] Some decorticators are fed by hand and the pulp is first scraped from half of a leaf, the leaf is withdrawn, and then the opposite half is inserted for scraping. In some machines, the whole leaf is decorticated in single insert.

Fibres sampling from the bulk

Zoning method was used for selecting samples from fibre bundles that were extracted. A handful of fibres was taken at random from each of at least 40 widely spaced places (zones) throughout the bulk of the consignment. Each handful was divided into two parts and one half of it was discarded at random; the retained half was again divided into two and half of that discarded. This process was repeated until about single fibre bundles remain on hand. The process repeated until number of fibres sample reach around three hundred.[8]

Fibre testing

The fibre testing was carried out at the Textile and Leather department in Tanzania bureau of standards (TBS) in Dar es Salaam head quarter. The following sections explains each test and procedure.

Fibre testing procedure

Fibre samples were conditioned in a conditioning room in order to reach moisture equilibrium, then picked randomly and assigned for the experimental treatments. The tests were carried out with the standard textile testing conditions of room temperature 25±2^{0}C, relative humidity 65±2% Rh to ensure accuracy and reliability of result. The fibres were subjected to the following tests:

Physical test

Fibres length

The fibre length determined by calculating average fibre length for the selected samples .The length must be considerably great than the diameter. Minimum ratio of 100:1, this property shows such characteristics of yarn and fabric in terms of appearance, evenness and strength.[9]

Procedure: One hundred single fibres were drawn at random and each fibre was straightened out over a meter- ruler. The length was recorded in centimeters.

Moisture content and regain

This test was to determine the percentage of moisture contained by a fibres sample at moisture equilibrium in atmospheric condition for the testing standard (TZS 3: 1979) also helped to determine the percentage of moisture regain by dry sample of SEF. Textile is hygroscopic in their natural state and moisture content increases as humidity increase, this is important to determine the quality. Fibres with good moisture regain accept dyes and finishes more readily and hence produce a variety of attractive yarns and fabrics for consumer end use. However, fibre with low moisture regain will wash and dry quickly.

Moisture content

Five samples was conditioned for 24 hours in compliance with atmospheric condition for testing standard (TZS3: 1979) and then weight were recorded then after sample transferred to oven dry machine using desiccator incompliance with determination of the moisture content oven/dry method (TZS961: 2007), Oven dry machine was set at 100^{0}c then after every 30 minutes samples were quickly removed from oven dry machine and placed in the desiccator very quickly and then transferred for weight measurement using sensitivity weight balance machine. The processes repeated until the weight of the oven dry of the individual sample remain constant. The data obtained were used to calculate moisture content. Formula used for Moisture content is $\frac{(W-D)\times 100\%}{W}$ Where W is the weight of the conditioned sample in grams and D is the weight of the oven dry sample in grams.

Moisture regains

5 samples of the different weight were placed on the oven dry machine, and then oven dry machine was set at 100^{0}c accordingly to

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standard of determination of the moisture content oven/dry method (TZS961: 2007) then after every 30 minutes samples were quickly removed from the oven dry machine and placed on desiccator then transferred for the weight measurement using sensitivity weight balance machine. The processes repeated until the weight of the oven dry of the individual sample remain constant. Then all five samples were conditioned for twenty four hours compliance with atmospheric condition for testing (TZS3: 1979). Then weight of the sample was measured by using weight sensitivity balance machine for moisture regain calculation. Formula used for Moisture regains is

$$\frac{(W\text{-}D)\times 100\%}{W}$$

Where W is the weight of the conditioned sample in grams and D is the weight of the oven dry sample in grams.

Linear density (Fineness)

The samples were conditioned for 24 hours in compliance with atmospheric condition for testing standard (TZS3: 1979), 50 sample were selected randomly and then each subjected to weight and length measurement.

Mechanical test

Maximum Load, Tenacity (N/tex) and tensile strain (%) at the maximum load. The test was performed in compliance with Tanzania standard TZS 265: 1985(part 1) breaking strength and extension of the yarn. Maximum load (N), Tenacity (N/tex) at the maximum load and tensile strain (%) at the maximum load were directly obtained from the computer connected to the textile testing machine (instron 5566 series IX Automated Material Testing system 8.25.00).

100 samples were conditioned for 24 hours in compliance with atmospheric condition for testing standard (TZS3: 1979), then 50 samples were selected randomly and subjected to the test.

Procedures for machine setting ready for test of the samples Gauge length was set to 500mm and then zero, Upper and lower jaws was installed and aligned and then zero, Load range was set to 10kN and lastly crosshead speed was set to 500mm/min (Figure 5).

Figure 5 Instron tensile testing machine.

Result and discussion

The knowledge of the fibres helps to anticipate the contribution of the fibres to the performance of the fabric and other textile products made with it such ropes, the mechanical and physical properties were investigated to create potential opportunity with SEF bundle to the textile manufacturing industries. Below are the results of the parameters tested.

Physical properties

Fibre length

The fibres bundle length data are presented in a group frequency distribution table (Table 1) and graphically presented as in frequency distribution chart below (Figure 6) (Table 2).

$$\text{Mean length:} = (\Sigma fx) / N \quad (1)$$

$$= 13848/100$$

$$= 138.48\text{cm}$$

$$\text{Median:} = \frac{L + (N/2 - c)\ i}{F_m} \quad (2)$$

$$= \frac{145.5 + (100/2) - 42) \times 9}{75}$$

$$= 146.46 \text{ cm}$$

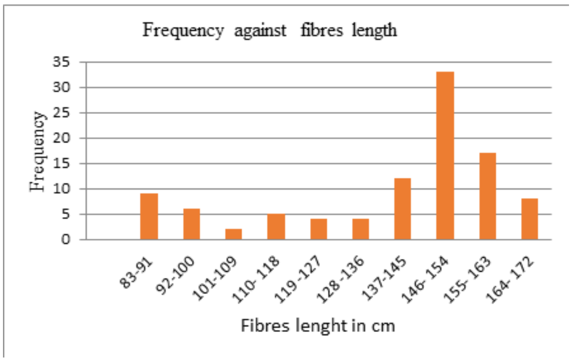

Figure 6 Graph of frequency against fibres length.

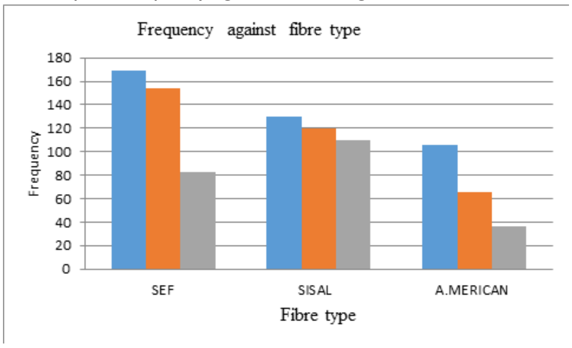

Figure 7 Graph of frequency against fibres type.

Where: L is lower class limit of the class containing the median, N is number of fibre, c is cumulative frequency of class below the median class, i is class interval and F_m is frequency of class contain the median.

$$\text{Standard deviation} = \sqrt{\frac{(\{\Sigma f(fx^2\} - \Sigma fx)^2)}{\Sigma f(\Sigma f - 1)}} \quad (3)$$

$$= \sqrt{\frac{(\{100 \times 1977300^2\} - (13848^2)}{100 \times 99}}$$

$$= 24.54$$

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$$\text{Coefficient of variation} = \frac{SD \times 100\%}{MEAN} \quad (4)$$

= (24.54 X 100)/138.48

= 17.72 % where SD is standard deviation

The length of the fibres ranged between 83 cm to 168.4 cm gave the range of 85.4cm. The range was high due to the different sizes of plant leaves and method of fibres extraction which was hand decortication resulted in fibres breakage. The median length was 146.46 cm and mean length was 138.48cm with standard deviation of 24.54 and co-efficient of variation was 17.72%.

The relative range in length of the fibres was relatively high because variation of the fibres length in leaves of plant, The fibres situated at the middle of the leaves always have high length and those fibres situated at the edges of the leaves have low length .Fibres length varies considerably within any sample.[10] The length of the fibres strands depend on the length of the sheath.[11] From the above data anticipate that SEF and spun yarn from these fibres will be of considerable strength and hence produce durable textile products (Table 3).

From the Figure 7 show that SEF leading sisal and agave American fibres in maximum and mean length. Therefore this indicates that SEF would be feasible to spinning and featured with quality yarn characteristics in terms of appearance, evenness and strength.[9]

Moisture content and regain

The test was performed in compliance with TZS 961: 2007 method of determination of moisture content and regain oven dry method. The data in Table 4 and Table 5 illustrate results. The formulae used to determine the moisture content and regain is indicated and explained below.

Table 1 Fibres length analysis

SN	L(cm)	SN	L(cm)	SN	L(cm)	SN	L(cm)	SN	L(cm)
1	147	21	143	41	143	61	134.6	81	166.9
2	147	22	156.1	42	156.1	62	143	82	145.7
3	148.8	23	162.9	43	162.9	63	153.7	83	115
4	98	24	154.4	44	154.4	64	90	84	163.4
5	148.5	25	143	45	143	65	163.3	85	152.7
6	162.3	26	146	46	146	66	132.8	86	86
7	149	27	156	47	156	67	89	87	139.3
8	148.7	28	113	48	113	68	148.9	88	163.4
9	167.2	29	145.8	49	145.8	69	163.4	89	149.1
10	112	30	147.5	50	147.5	70	143.3	90	85
11	90.5	31	168	51	168	71	92.5	91	137.4
12	156.3	32	123	52	123	72	147.1	92	162.6
13	162	33	148.4	53	148.4	73	139.8	93	152.7
14	145.5	34	156	54	156	74	163.3	94	96
15	109	35	166.5	55	166.5	75	167.2	95	107
16	149	36	83	56	83	76	145.8	96	129
17	139	37	162	57	162	77	122	97	149
18	95	38	149.5	58	149.5	78	164.2	98	146.4
19	156	39	155	59	155	79	168.4	99	153
20	124.9	40	148.9	60	148.9	80	153.6	100	137.2

Note: SN stands for number of sample and L (cm) stands for length of the fibre.

Table 2 Frequency distribution table of the data presented above

Length In cm	Frequency	Cumulative frequency	Mid-Point x	x2	fx	f(x)2
83-91	9	9	87	7569	783	68121
92-100	6	15	96	9216	576	55296
101-109	2	17	105	11025	210	22050
110- 118	5	22	114	12996	570	64980
119 -127	4	26	123	15129	492	60516
128 -136	4	30	132	17424	528	69696
137-145	12	42	141	19881	1692	238572
146- 154	33	75	150	22500	4950	742500
155- 163	17	92	159	25281	2703	429,777
164- 172	8	100	168	28224	1344	225792
Total					13848	1977300

Table 3 Fibres Length comparison table

Fibres type	SEF	Sisal grade (A&B)	Agave Americana
Maximum length (cm)	168.8	130	106
Mean length (cm)	153.6	120	65.2
Minimum in length (cm)	83	110	36

Sources [14, 10]

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Table 4 Moisture content

No of sample	Weight after condition in gram	Dry weight in gram	Moisture content (W-D)/W) X100
1	1.1	1.003	8.82%
2	1.019	0.928	8.90%
3	1.092	0.999	8.52%
4	0.989	0.906	8.37%
5	1.103	1.006	8.76%
Average moisture content			8.67%

Table 5 Moisture regains

No of sample	Dry weight in gram	Weight after conditioning	Moisture regain (W-D)/D) X 100
1	0.983	1.079	9.76%
2	0.994	1.085	9.15%
3	0.996	1.092	9.64%
4	1.012	1.105	9.19%
5	0.997	1.093	9.58%
Average moisture regain			9.46%

Moisture content

Moisture content of the textile material is the amount of the moisture in textile material expressed as a percentage of the total weight. Formula used for moisture content is ((W-D)/W) X 100% where W is weight of the conditioned sample and D is the weight of oven dry Sample.

Moisture regains

Moisture regain of the textile material is the amount of the moisture in textile material expressed as a percentage of the oven dry weight. Formula used for Moisture regain is ((W-D)/D) x 100% where W is weight of the conditioned sample and D is weight of the woven dry.

The moisture content of SEF is 8.67% it also comparable to other cellulosic fibre for example aramina 8.86% and Pineapple 9.45%. The overall moisture regain of SEF is 9.46% it's comparable to moisture regain of the other cellulosic fibres for example ramie 6%, cotton 8.5%, linen 12%, pineapple 10.4% and aramina 9.73%. SEF shows hydrophilic properties this implies that it absorbs enough water to prevent static build- up and also it influence comfort. Fibres with good moisture regain accept dyes and finishes more readily than fibre with low regain (Table 6) (Figure 8).[12]

Table 6 Moisture regain of the other cellulosic fibres

Fibres type	Percentage of the moisture regain
Sansevieria ehrenbergii fibres	9.6
Agave Americana fibres	9.98
Ramie fibres	6
Cotton fibres	8.5
Linen fibres	12
Pineaple fibres	10.4
Aramina fibres	9.73

Source [14]

SEF has moisture regains of less than that of the ramie and cotton fibres but lower than that of the agave American, linen, pineapple and aramina fibres. All fibre mentioned above are hydrophilic which greatest property of the natural fibres.

Linear density

To measure the cross sectional area of the natural fibres is extremely complex and result into incorrect data due thickness variation of fibres strands across the length. Therefore the cross sectional area of the natural fibres bundles measure in term of the linear density. Linear density in tex is weight of the fibres per unit length in one kilometers.

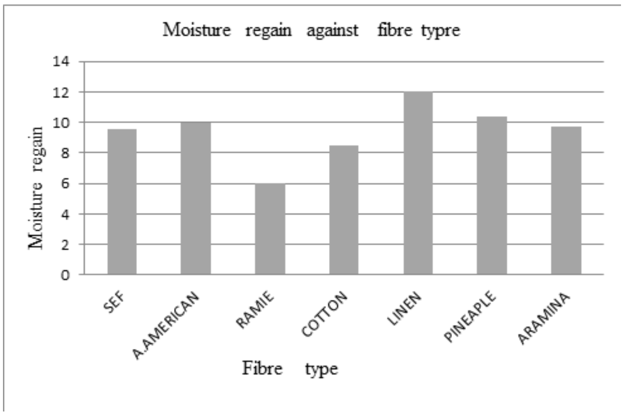

Figure 8 Moisture regain against Fibre type.

So samples were conditioned for 24 hours in compliance with atmospheric condition for testing standard (TZS3: 1979), 50 samples were selected randomly and then each subjected to weight and length measurement. Table 7 show the length and it corresponding weight of the SEF sample.

Table 7 Length of SEF and its corresponding weight

Number of sample	Length in m	Weight in gram
1	1.47	0.066
2	1.12	0.0506
3	1.488	0.067
4	0.98	0.0443
5	1.625	0.0687
6	1.49	0.0687
7	1.487	0.064
8	1.672	0.077
9	1.47	0.066
10	0.905	0.0409
11	1.563	0.0407
12	1.62	0.0732
13	1.45	0.064
14	1.09	0.0497
15	1.49	0.0668
16	1.39	0.0634

Table Continued...

Number of sample	Length in m	Weight in gram
17	0.95	0.0438
18	1.56	0.069
19	1.249	0.056
20	1.485	0.067
21	1.43	0.065
22	1.561	0.0701
23	1.629	0.0731
24	1.544	0.0701
25	1.43	0.065
26	1.46	0.067
27	1.56	0.0712
28	1.13	0.0507
29	1.458	0.067
30	1.475	0.068
31	1.68	0.069
32	1.23	0.051
33	1.484	0.066
34	1.56	0.0705
35	1.665	0.0753
36	0.83	0.0382
37	1.62	0.0782
38	1.495	0.0676
39	1.55	0.076
40	1.489	0.0673
41	0.9	0.044
42	1.6	0.072
43	1.46	0.067
44	1.49	0.061
45	1.11	0.055
46	1.56	0.071
47	1.515	0.068
48	1.458	0.065
49	0.94	0.044
50	1.515	0.069
Total	70.382	3.15
Mean	1.4076	0.063

From the table above, total weight of the samples is 3.15 gram and total length is 70.382 metres

$$\text{Mean weight} = \frac{\text{total weight in gram}}{\text{total number of the sample}}$$

$$\frac{3.15}{50} = 0.063\text{g}$$

$$\text{Mean length} = \frac{\text{total length in metres}}{\text{total number of the sample}}$$

$$\frac{70.382}{50} = 1.4076 \text{ metres}$$

$$\text{So linear density in tex} = \frac{\text{weight of the fibre in gram} \times 1000}{\text{unit length of the fibre}}$$

$$\frac{0.063 \times 1000}{1.4076} = 44.76 \text{ tex}$$

So linear density of SEF is 44.76 tex where linear density of the agave american and sisal fibres is 14.56tex and 19.98 tex respective (Figure 9).[9,13]

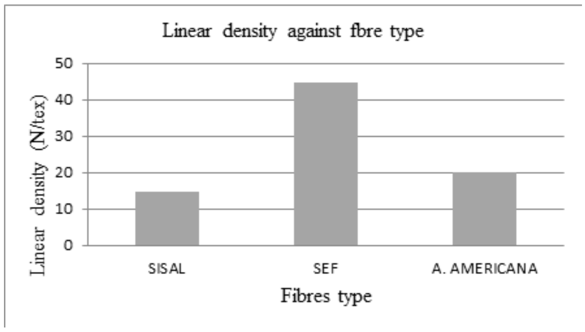

Figure 9 Graph of linear density (N/tex) against fibres type.

SEF show higher linear density than sisal and Agave Americana the higher the linear density the coarse the fibres therefore sansevieria ehrenbergii fibres is coarse than sisal and agave Americana fibres.

Mechanical properties

Mechanical properties measure on SEF was maximum breaking force (N), tenacity (N/tex) at the maximum load and tensile strain at the maximum load (%). Samples were conditioned for 24 hours in compliance with atmospheric condition for testing standard (TZS3: 1979).

Then 50 samples selected randomly and then subject to the test in compliance with testing standard TZS 265: 1985 (part 1) breaking strength and extension of the yarn. Computer connected to the instron 5566 series IX Automated Material Testing system 8.25.00 machine recorded the data and automatically it calculate the mean, coefficient of variation and standard deviation . The result tabulated in Table 8.

Maximum load

This is the maximum breaking force of the fibres when subjected to the load which expressed in newton, the mean breaking force of SEF from the Table 8 is 19.51N which can compared with other type of the fibres bundle like agave americana fibres with maximum load of 5.278N and sisal fibres with the maximum load of 17.11N (Table 9).[9,13]

From Figure 10 above it shows that SEF are more stable when subjected to different forces compared to agave Americana and sisal fibres therefore product made of SEF expecting to be suitable to high loaded application in comparison to sisal and agave Americana fibres.

Figures 11–13, below show maximum load in N against extension in mm of SEF when subjected to the mechanical test using Instron testing machine. Graph was drawn automatically by the computer connected to machine which show how the SEF respond to load up to breaking point and its work of rapture.

Tenacity at the maximum breaking force

This is maximum breaking force per unit cross-section area of the fibres, but due to complication of measuring cross section area of natural fibres, the linear density in tex used instead of cross sectional area and yield the same result. From the Table 8 the mean tenacity of 50 samples subjected to the test is 0.48 N/tex which can be compared with other cellulosic fibres in which their tenacity (N/tex) is in Table 10.[9,13]

From the Figure 14 show that tenacity of SEF leading agave Americana and sisal fibres. As the tenacity increase the strength of fibre increase therefore for the above comparison to the others fibres the SEF have higher strength.

Table 8 Mechanical properties of SEF

Number of sample	Maximum load in (N)	Tenacity at the maximum load in (N/tex)	Tensile strain at the maximum load in %
1	19.54	0.48	2.93
2	19.92	0.49	3.56
3	17.2	0.42	2.31
4	15.25	0.37	2.67
5	21.51	0.53	3
6	27.35	0.67	3.46
7	18.9	0.46	2.6
8	15.45	0.38	3.57
9	20.94	0.51	3.57
10	18.85	0.46	3.27
11	20.88	0.51	3.51
12	18	0.44	4.02
13	28.27	0.69	4.47
14	21.28	0.52	4.17
15	18.93	0.46	3.93
16	24.64	0.6	4.43
17	24.27	0.6	3.77
18	14.45	0.35	4.1
19	14.59	0.36	2.67
20	16.42	0.4	2.56
21	21.85	0.54	4.42
22	20.15	0.49	4.4
23	16.11	0.4	3.5
24	25.48	0.63	3.76
25	15.14	0.37	3.01
26	14.46	0.35	4.28
27	24.25	0.6	4.84
28	17.35	0.43	3.5
29	14.06	0.35	3.84
30	17.29	0.42	3.54
31	20.19	0.5	4.67
32	14.39	0.35	3.62
33	17.18	0.42	3.06
34	17.72	0.44	4.5
35	22.55	0.55	4.34
36	24.03	0.59	3.84
37	18.82	0.46	4.2
38	17.41	0.43	3.11
39	14.64	0.36	3.37
40	22.43	0.55	3.5
41	25.44	0.62	4.84
42	21.83	0.54	3.2
43	14.54	0.36	3
44	20.85	0.51	4.67
45	29.71	0.73	3.5
46	21.55	0.53	2.93
47	16.44	0.4	3.84
48	19.59	0.48	4.17
49	18.79	0.46	4.34
50	14.46	0.36	3.5
Mean	19.51	0.48	3.68
Coefficient of variation	20.36	20.36	17.52
Standard deviation	3.97	0.1	3.97

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Table 9 Maximum load comparison

Fibre type	SEF	Agave Americana	Sisal
Minimum load (N)	14.06	2.411	5.04
Mean load (N)	19.51	3.782	10.11
Maximum load (N)	29.71	5.258	17.11

Table 10 Maximum load comparison

Fibre type	SEF	A.Americana	Sisal
Minimum tenacity (N/tex)	0.35	0.1655	0.26
Mean tenacity (N/tex)	0.48	0.2596	0.41
Maximum tenacity (N/tex)	0.73	0.3609	0.64

Tensile strain at the maximum load expressed in percentage (%)

Tensile strain is the extension of the fibre before it break when subjected to the forces, from the data in Table 8 the mean extension of the 50 sample that tested is 3.68%, this can compared with other cellulosic fibres at which their extension expressed millimeters on the Table 11.

Table 11 Fibres extension in in mm at the maximum load

Fibre type	SEF	A.Americana	Sisal
Minimum extension mm	0.0231	0.0698	0.005
Mean extension in mm	0.0368	0.129	0.012
Maximum extension in mm	0.0484	0.24229	0.0198

From Figure 15 above SEF have small extension when subjected to load compare with agave Americana fibre but extension is higher than sisal. For this result SEF can be processed and can sustain with mechanical process. Cellulosic fibres have low elongation and individual fibre must be able to undergo slight extension of 1-5% in length without breakage.[14] This property is great importance since fibres with good extension and elasticity resists tearing and can with stand spinning process. The amount of elongation is an important factor in evaluating elastic recovers.[9] From the above results in Table 11 the SEF has sufficient extension to produce durable textile products.[15]

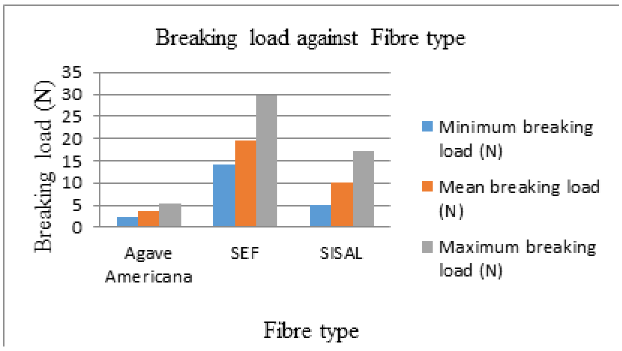

Figure 10 Graph of breaking force against Fibre type.

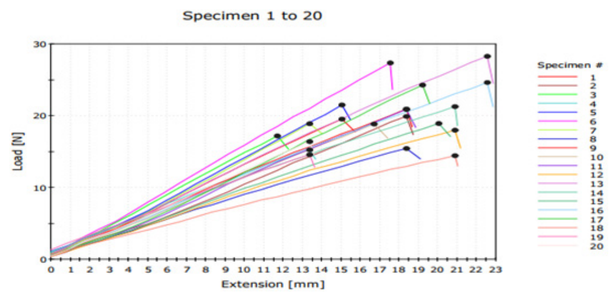

Figure 11 Graphs of load (N) against Extension in mm.

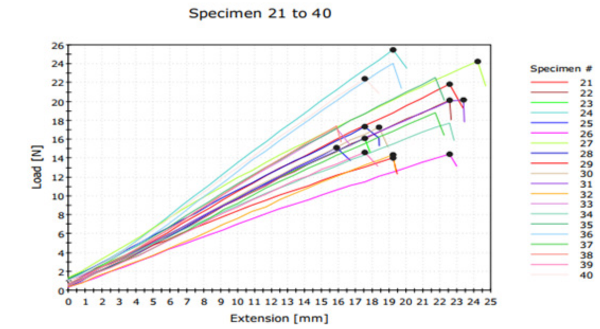

Figure 12 Graphs of load (N) against Extension in mm.

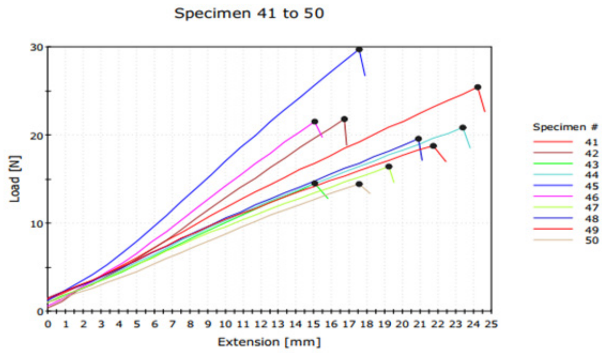

Figure 13 Graphs of load (N) against Extension in mm.

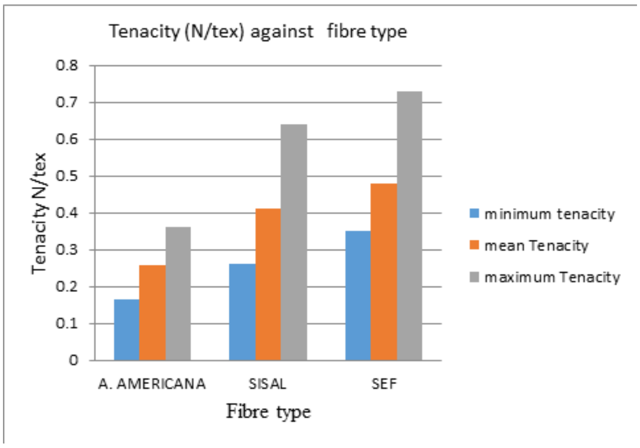

Figure 14 Graph of tenacity (N/tex) against Fibre type.

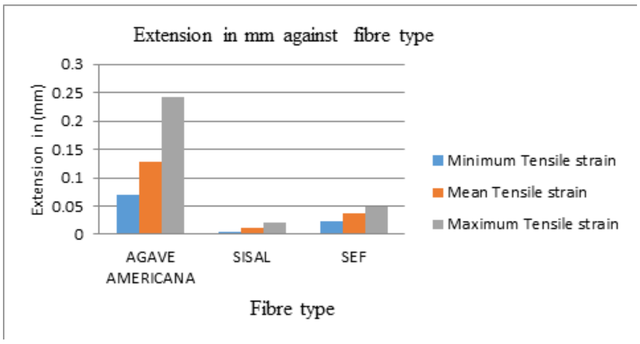

Figure 15 Graph of extension in mm against Fibre type.

General comparison of the SEF with other cellulosic fibres (Table 12)

Table 12 general comparison

Parameters	Cotton	Linen	Pineapple	Jute	Aramina	Agave americana	SEF	Sisal
Length in cm	6.25	56	70	-	46	65.2	138.48	120
Colour	White	Cream	White	Light to dark brown	Light brown	White to off white	Natural white and creamy	Natural Creamy and white
Tenacity in N/tex	0.2648 -0.4414	0.26 -0.512	0.2118	0.3354 -0.512	0.1221	0.2697	0.48	0.41
Elongation %	10-Mar	2.7-2.3	1.82	1.2-1.19	1.03	12.91	3.68	1.2
Moisture regain %	8.5	12	10.4	13.7	9.7	9.98	9.46	11.5
Lustre	low	high	-	-	-	Medium lustre	-	-

Source [14]

Conclusion

From the results obtained the SEF has ability to withstand all fibre processes since it has strong tenacity of 0.48 N/tex, the fibres also have high length to width ratio with mean length of 138.48 cm and moisture regain of 9.46%. Based on laboratory results the SEF succeed as good source quality textile fibres.

SEF have shown promising results as compared to similar fibre like sisal which shows it has a great potential to be used in textile industry and raw material for various useful products.

The Sansevieria ehrenbergii plants grows naturally on dry grassland, open bush land and dunes mostly on the rock ground and hence are locally available in most area of the country ,this could be prodigious benefit to small scale entrepreneurs by increase their income generation because they can be able to make a varieties textile value added products such as ropes , carpets, mats and hats in order to cover local market demand and stops Tanzania local market from being controlled by imported textile products.

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None.

Conflicts of interest

Authors declare that there is no conflict of interest.

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