STUDY OF THE CHEMICAL COMPOSITION OF MARGILAN NATURAL SILK FABRIC

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Abstract. *Thus, for the first time, the elemental composition of samples of natural silk fabrics was studied in detail. To do this, we used the method of inductively coupled plasma mass spectrometry on an ICP-MS AT 7500 device. 44 elements were quantitatively determined in the elemental composition of tissue samples from natural silk. 43 elements were found in a mulberry leaf. It has been observed that 43 elements (B. more) are present in the silkworm. It turned out that the cocoon contains 41 elements, and silk - 41 elements. It was found that the silk fabric contains 26 elements, the Atlas fabric contains 39 elements and the Adras fabric 50% silk, 50% cotton fabric contains 39 elements. The natural tendency of the amount of the element to decrease with increasing mass is shown. It has been established that in natural silk fabrics there are hundreds and tens of thousands of times more macroelements than microelements.*

Аннотация. *Таким образом, впервые детально изучен элементный состав образцов тканей из натурального шелка. Для этого использовали метод масс-спектрометрии с индуктивно-связанной плазмой на приборе ICP-MS AT 7500. В элементном составе образцов тканей из натурального шелка количественно определено 44 элемента. В листе тутового дерева обнаружено 43 элемента. Было замечено, что в тутовом шелкопряде присутствует 43 элемента (Б. больше). Оказалось, что кокон содержит 41 элемент, а шелк — 41 элемент. Было установлено, что шелковая ткань содержит 26 элементов, ткань Атлас содержит 39 элементов и ткань Адрас 50% шелка, 50% хлопчатобумажная ткань содержит 39 элементов. Показана естественная тенденция количества элемента уменьшаться с увеличением массы. Установлено, что в натуральных шелковых тканях макроэлементов в сотни и десятки тысяч раз больше, чем микроэлементов.*

Keywords: *macro- and microelements, inductively coupled plasma mass spectrometer.*

Ключевые слова: *макро- и микроэлементы, масс-спектрометрия с индуктивно-связанной плазмой.*

Introduction. Uzbek atlases are rich in bright elegant colors, these flowers are in harmony with each other, forming an integral beautiful

pattern on the fabric. The most excellent kind of satin, woven from natural silk, is called honatlas with eight prongs. The whole secret of honatlas lies in its structure and method of weaving [1-2]. In the production of cocoons and raw silk, Uzbekistan ranks 3rd among 26 countries of the world after China and India. In Uzbekistan, they mainly specialize in the production of satin, adras, and dimensionless national fabrics. We studied the chemical properties of silk fabrics. Natural silk consists of protein, 70-81% of which consists of fibroin, 20-30% sericin, 1-1.5% fat and wax, 1-1.5% dyes and ash [3-4].

Silk belongs to a group of high-molecular organic polymers characterized by a repeating sequence of hydrophobic and hydrophilic peptides [5-6]. Silk fabrics for the sample were brought from the Margilan City Memorial Factory.

The experimental part. Determination of mineral composition. The study determined the elemental composition of silk samples using ICP-MS (inductively coupled plasma mass spectrometer), spectral analysis was performed on the AT 7500 device [7-8].

Preparation of the object for analysis: Mulberry leaf 10 g, silk kurti 11 g, cocoon 4 g, silk 8 g, silk fabric 4 g, satin fabric 6 g and adras fabric samples were weighed on electronic scales 4.5 g and each was placed in a separate heat-resistant stack.The muffle at a temperature of 8000c was dried in the oven for 3 hours. Then ash samples were taken from the muffle furnace and weighed on electronic scales [9-10].Mulberry leaves 2.3 g, silkworn 2.5 g, cocoon 2.4 g, silk 1.1 g, silk fabric 1.2 g, satin fabric 2 g and adras fabric 1 g of ash were obtained. 0.1 g was extracted from the ash of these obtained samples and placed in heat-resistant conical flasks [11-12]. 30 ml of concentrated nitric acid was added to the flasks and boiled on an electric stove for 30 minutes until a clear solution was obtained. Then the obtained solutions were filtered into flasks with a volume of 100 ml and distilled water was topped up to the mark [12-13].

The silk samples prepared above were analyzed on an inductively coupled plasma mass spectrometer in the "Semiguant" half-quantity analysis mode. Device parameters: plasma power 1200 W, integration time 0.1 sec. Calibration of the device and quantitative calculations were carried out on the basis of the multi-element calibration standard "Agilent Technologies" (44 elements) [14-15].

Table 1

Elements composition of natural silk fabrics, g / kg

№	Ele-ments	The amount of elements of natural silk fabrics, g / kg						
		Mulberry leaf	**Silkworm *(B.more)***	**Cocoon**	**Silk**	**Silk fabric**	**Atlas fabric**	**Adras fabric 50% silk and 50% cotton**
1 (7)	Li	0.447	2.488	1.832	6.302	-	2.306	1.795
2 (9)	Be	0.015	0.021	0.001	0.066	-	0.027	0.012
3 (11)	B	32.038	71.203	59.464	1627.203	-	124.229	13.185
4 (23)	Na	157.000	4599.156	2752.190	26657.164	1.83	29430.462	17070.128
5 (24)	Mg	1832.401	22569.621	23659.473	36230.11	0.67	29643.570	36516.338
6 (27)	Al	72.409	151.912	1741.852	8234.155	0.081	2403.412	1020.703
7 (28)	Si	278.163	378.057	1414.603	5021.889	-	3870.846	2445.040
8 (31)	P	-	-	57355.007	15303.112	3.79	5156.664	15330.818
9 (32)	S	55.576	126.358	-	-	1.308	1043.820	1732.343
10 (39)	K	5009.326	76871.219	-	14063.153	1.007	5233.803	5947.524
11 (42)	Ca	37171.738	47099.057	100415.880	161781.971	1.439	126853.310	149286.635
12 (48)	Ti	16.966	41.706	259.742	471.606	0.017	243.098	70.285
13 (51)	V	0.045	0.863	0.509	1.694	0.00046	0.514	0.248
14 (52)	Cr	0.500	6.171	2.993	11.344	0.0209	12.646	1.605
15 (55)	Mn	10.764	142.637	35.367	33.746	0.0096	15.687	21.371
16 (57)	Fe	756.539	9982.923	1891.112	4753.646	0.484	31860.148	1762.797
17 (59)	Co	0.088	0.627	0.248	0.752	0.00038	0.487	0.253
18 (60)	Ni	0.866	4.797	2.923	5.513	0.0109	3.260	2.358
19 (63)	Cu	2.927	118.608	6.870	40.190	0.0327	920.354	7984.318
20 (66)	Zn	8.616	686.076	26.306	63.448	0.0379	11.811	32.112
21 (69)	Ga	0.210	0.252	0.193	1.409	-	0.447	0.701
22 (74)	Ge	0.004	0.044	0.004	0.016	-	0.010	0.002
23 (75)	As	0.110	3.360	0.175	0.409	0.0026	0.207	0.046
24 (82)	Se	0.301	1.358	1.341	6.284	0.0432	0.231	0.251
25 (85)	Rb	2.646	5.003	0.932	1.036	0.0013	0.276	0.232

26 (88)	Sr	81.479	41.730	416.703	1664.790	-	1429.467	1811.211
27 (90)	Zr	0.055	0.266	0.090	1.247	-	0.206	0.236
28 (93)	Nb	0.005	0.042	0.014	0.038	-	0.016	0.010
29 (98)	Mo	0.349	0.042	0.346	0.023	0.0029	0.001	0.249
30 (107)	Ag	0.003	0.021	0.007	0.039	-	0.025	0.035
31 (111)	Cd	0.003	49.328	1.548	17.872	-	0.401	0.121
32 (115)	In	0.002	0.001	-	-	-	-	-
33 (118)	Sn	15.729	9.732	0.029	0.160	0.379	0.292	0.102
34 (121)	Sb	0.003	0.374	0.016	0.155	0.0002 6	0.074	0.031
35 (133)	Cs	0.011	0.033	0.007	0.025	-	0.005	0.006
36 (138)	Ba	4.254	4.369	1.068	8.124	0.0157	1.814	2.515
37 (181)	Ta	0.009	0.007	0.002	0.003	-	-	0.02
38 (184)	W	0.001	0.182	0.005	0.028	-	0.009	0.013
39 (187)	Re	0.004	0.010	0.003	-	-	-	0.004
40 (202)	Hg	0.252	0.498	0.002	0.021	0.0009 29	-	0.334
41 (205)	Tl	0.002	0.003	0.002	0.004	-	-	0.006
42 (208)	Pb	0.128	311.590	7.065	1283.834	0.0013	0.391	4.397
43 (209)	Bi	0.001	0.019	0.002	0.014	0.0023	0.004	0.009
44 (238)	U	0.048	0.062	0.009	0.100	-	0.065	0.077

*In parentheses is the ordinal number of the element in the periodic table.

Analysis of the results: analysis of the results shows that 7 different types of samples contain 44 elements quantitatively, including 6 macronutrients (Na, Ca, K, Mg, P and S), 33 trace elements (Li, Be, B, Al, Si, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, Se, Rb, Sr, Zr, Nb, Mo, Ag, Cd, In, Sn, Sb, Cs, Ba, Ta, W, TL, bi,) and ICP-MS (Inductively coupled plasma mass spectrometer) The samples were found to contain 5 toxic elements analyzed by ICP mass spectral analysis in the at 7500 instrument (As, Cd, Pb, Hg, U). Macronutrients in mulberry leaves, mulberry silkworm, saw, silk, silk fabric, satin fabric and adras fabric, magnesium has a minimum value, and calcium has a maximum value. The content of macronutrients in mulberry leaves increases in the following order: S < Na < Mg < K < Ca, for silkworm S < Na < K < Mg < Ca. Na < Mg < P < Ca for cocoon and K < P < Na < Mg < Ca for silk. Sodium from macronutrients for silk fabric has a minimum content, the maximum

phosphorus content in macronutrients increases in the following order Mg < K < s < Ca < Na < P. For satin fabric S < P < K < Na < Mg < Ca and for adras fabric (50% silk, 50% cotton) s < K < P < Na < Mg < Ca. Mulberry leaf, silkworm, cocoon, silk, silk fabric, atlas fabric and adras fabric (50% silk, 50% cotton) differ in lime content.

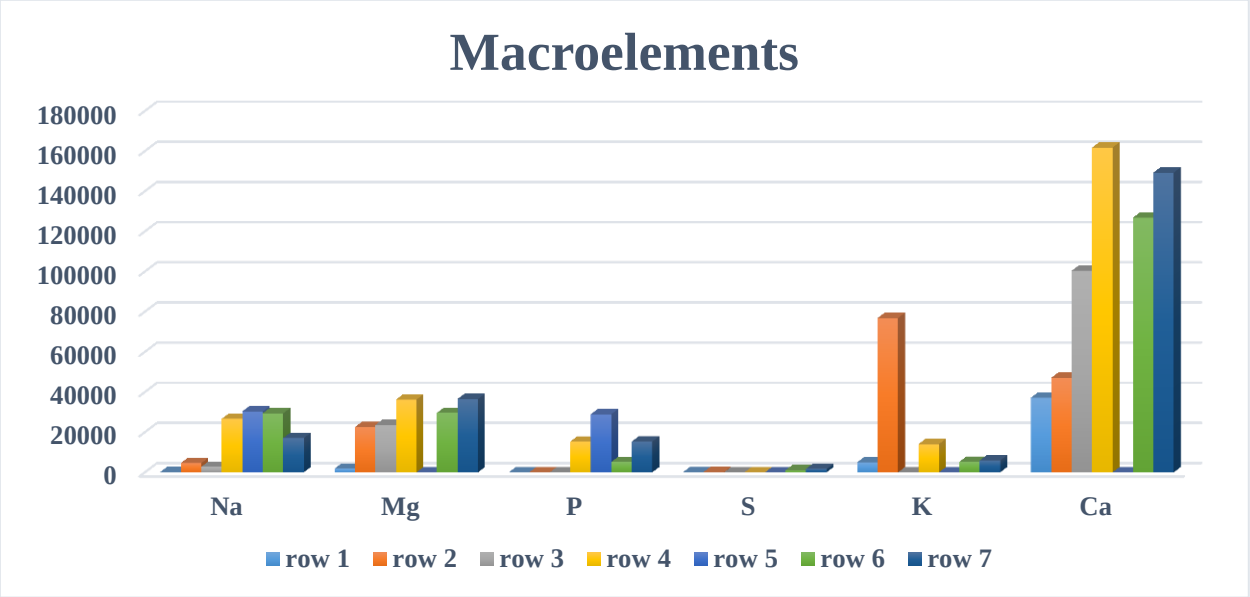

Figure 1. Composition and diagram of macroelements of natural silk fabrics

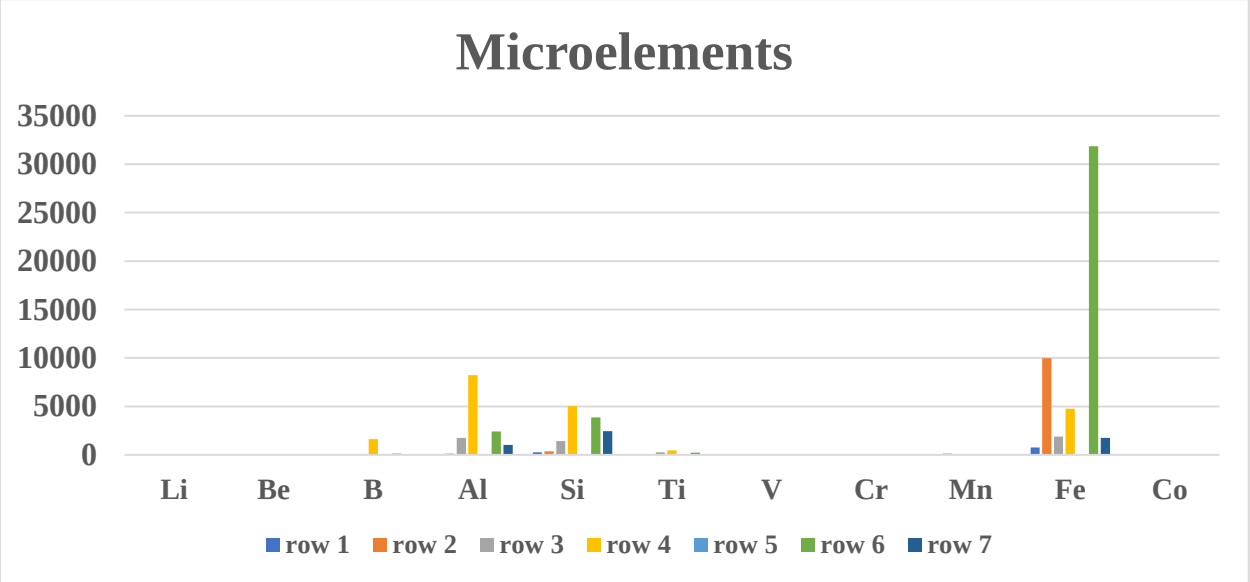

Figure 2. Composition and diagram of microelements of natural silk fabrics

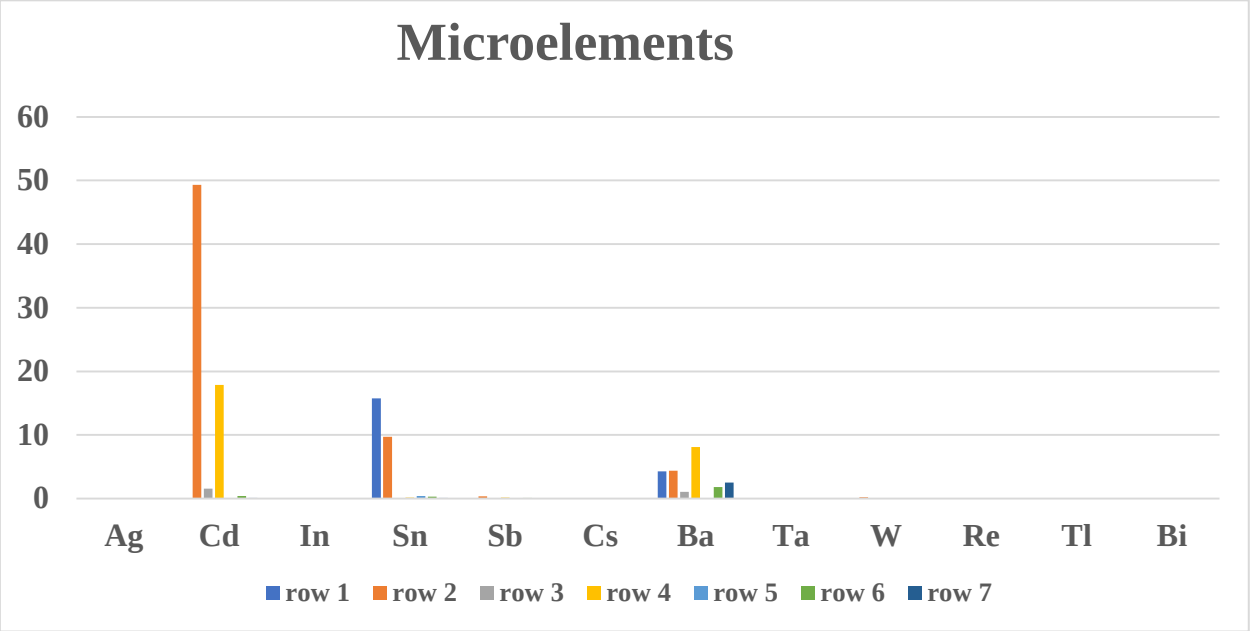

Figure 3. Composition and diagram of microelements of natural silk fabrics

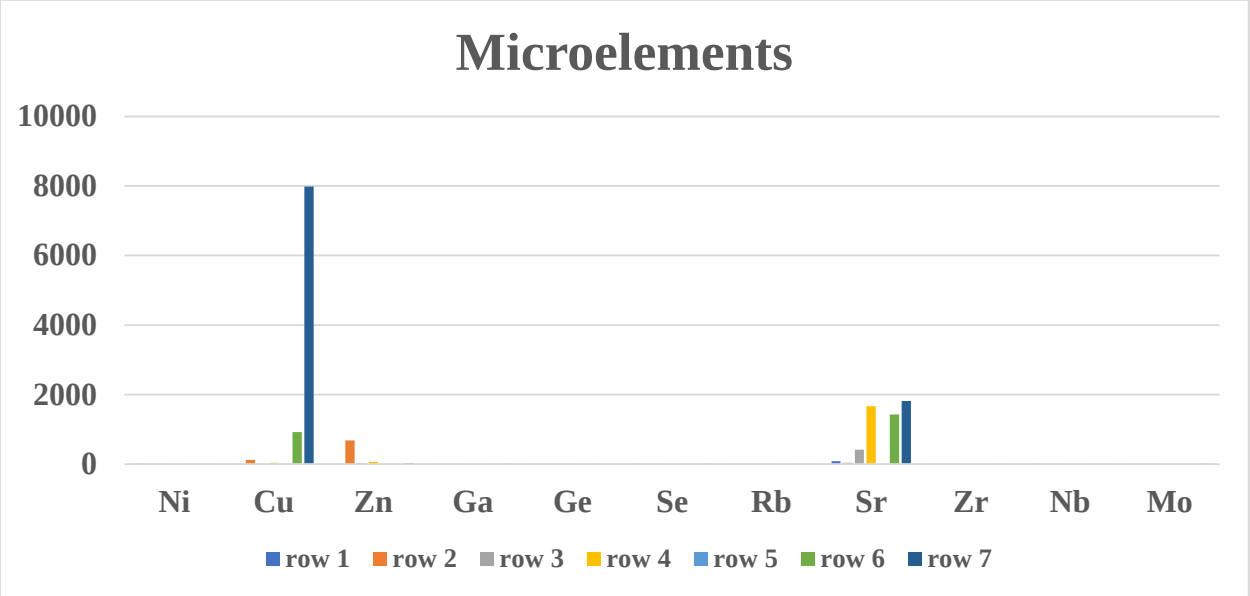

Figure 4. Composition and diagram of microelements of natural silk fabrics

The amount of 34 trace elements contained in 7 different samples was determined, of which Re, Tl were not detected in the test sample (Fig.2-4). Iron content prevails in mulberry leaves, mulberry silkworm, cocon, silk, satin fabric and adras fabric, aluminum prevails in the silk sample, and copper prevails in adras fabric. 43 elements were found in mulberry leaves, the highest iron content. The content of trace elements in mulberry leaves increases in the following order: Ti < B < Al < Sr < Si < Fe. 43 elements have been identified in the silkworm, iron has the highest content and increases in the following order Cu < Mn < Al < Si < Zn < Fe. The elements contained in

the cocoon sample, 41, iron has the highest values and increases in the following order B < Ti < Sr < Si < Al < Fe. Of the elements contained in the silk sample 41, aluminum has the greatest value and increases in the following order Cu < Zn < Ti < Sr < Fe< Si < Al. Trace elements contained in the silk fabric sample 26, iron have the highest content and increase in the following order Zn < Cu < Cr < Ti < Sn < Fe. 29 elements were identified in the Atlas tissue sample, with iron having the highest value and increasing in the order Ti < Cu < Al < Si < Sn < Fe. Among the 29 elements contained in the Adras fabric sample (50% silk, 50% cotton), copper has the highest content, and the number of trace elements increases in the following order Ti < Al < Si < Fe < Sr < Cu.

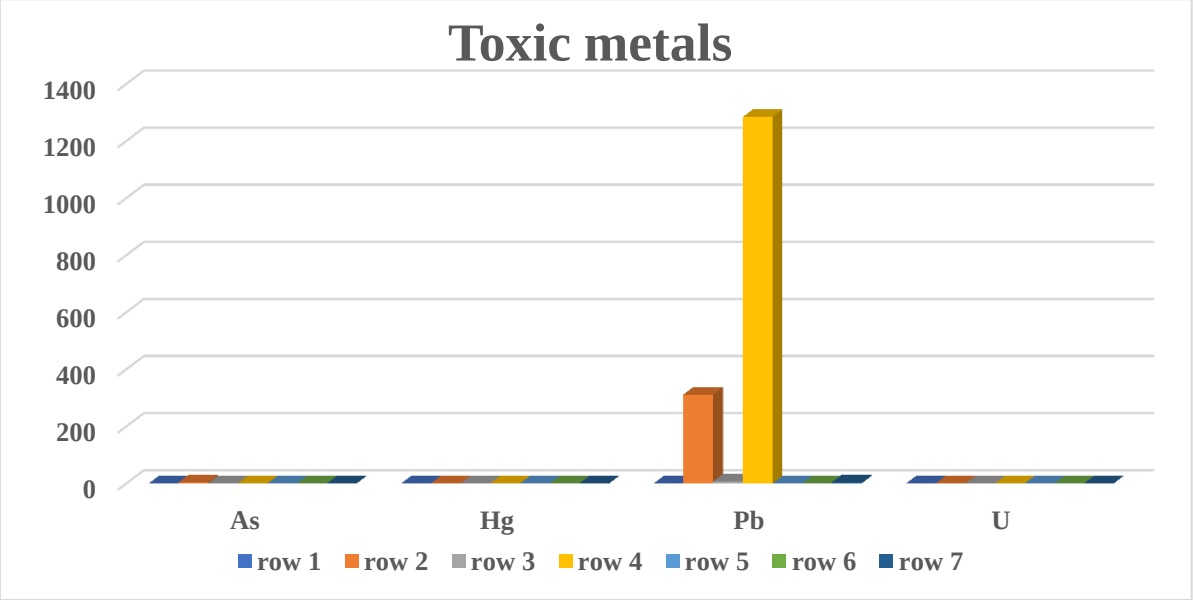

Figure 5. Heavy element composition and diagram of natural silk fabrics.

The amount of toxic elements in 7 different samples was investigated (Fig. Mulberry leaves, silkworm, cocoon, silk and adras fabric (50% silk, 50% cotton) toxic elements are contained in small quantities. Of the poisonous elements, uranium and cadmium were not found in silk fabric, and mercury was not found in satin fabric.

Conclusion: Thus, for the first time, the elementary composition of samples of natural silk fabric was studied in detail. For this purpose, the ISP-MS AT 7500 device used the inductively coupled plasma mass spectrometry method. In the elemental composition of the samples of natural silk fabric, the number of 44 elements was determined. It was found that mulberry leaves and silkworm contain 43 elements, cocoons and silk contain 41 elements, silk fabric contains 26 elements, satin fabric and adras fabric with 50% silk and 50% cotton contain 39 elements. A natural tendency to

decrease the amount of an element with an increase in its mass is shown. It has been established that natural silk fabrics contain hundreds, tens of thousands of times more macronutrients than the trace elements contained in them.the scheme of natural silk fabrics.

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