Substantive Dye Experiment With Quercetagetin and Quercetin

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Abstract:

If one would soak textiles in a hot dye bath consisting of substantive dyes then it will affect the affinity if the time is fixed. The natural fibers had the highest affinity to the direct die. The dye bath that was held at the higher temperature would not create a higher affinity. Absorption of the substantive dyes by the fibers is due to hydrogen and Van Der Waal bonding. One can conclude that there is a stronger affinity to natural textiles compared to manufactured textiles at any temperature due to hydrogen bonding and Van Der Waal bonding.

Introduction:

The purpose of the experiment is to discover if one would soak textiles in a hot dye bath consisting of substantive dyes then would it affect the affinity if the time is fixed?

The affinity of a dye on a textile depends on the chemical structure of the dye(s) being used; quercetagetin and quercetin along with the textile molecule and the interaction between them. These interactions depend primarily on temperature, agitation and electrostatic attractions.

Substantive dyes interact with fabric primarily via hydrogen bonding between hydroxyl groups on the dye or electron donating nitrogen atoms in the dye and polar groups in the fabric.

Apparatus:

- Safety Glasses
- Rubber Gloves
- Plastic Apron
- Measuring Containers
- Glass Containers
- Hot Plate
- Thermal Gloves
- Permanent Black Ink Pens
- Fabric Samples (Four swatch sets of each type)
    1. Cotton
    2. Silk
    3. Wool
    4. Linen
    5. Bamboo
    6. Rayon
    7. Jute
    8. Nylon
    9. Polyester
    10. 64% Nylon, 32% Polyester, 4% Spandex
- Large Pins
- Onion Skins
- Chamisa Flowers
- Wash and Tubs
- Wooden Clothespins
- Drying Racks and Newspaper

Procedures:

Preparing the Swatch Sets:
Immersed swatch sets in large beaker of warm tap water for 30 minutes.

Creating Onion Dye Bath:
Placed 120 grams of onion skins in dye pot. Poured water in dye pot. Placed dye pot onto to hot plate, gradually raised temperature to boiling point on setting 10. Turned heat to a 80 degree celsius simmer for 45 minutes. Removed dye pot from hot plate. Strained onion skins which left extracted liquid remaining.

Creating Chamisa Dye Bath:

Placed 170 grams of dried out chamisa flowers in dye pot. Poured water in dye pot. Placed dye pot onto to hot plate, gradually raised temperature to boiling point on setting 10. Turned heat to a 80 degree celsius simmer for 45 minutes. Removed dye pot from hot plate. Strained chamisa flowers which left extracted liquid remaining.

Dying Sequence Onion:

Poured 500mL of onion dye bath into first beaker with thermal gloves on. Added 200mL of lukewarm water into that beaker. Repeated process for second beaker. Placed second beaker on hot plate on setting 5. Placed one swatch set into each beaker. Reported temperature of beakers every 30 minutes. Removed swatches after 1 hour. Rinsed efficiently. Laid on newspaper. Pinned swatches up on drying rack.

Dying Sequence Chamisa:

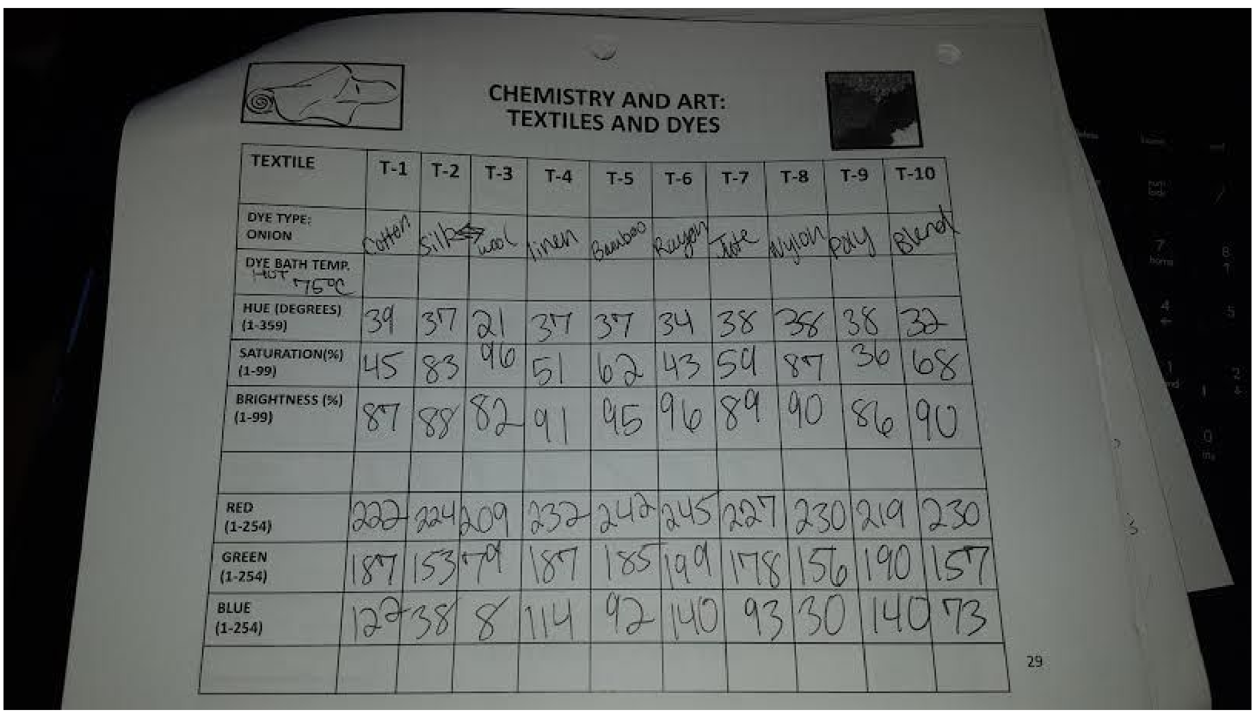
Poured 500mL of Chamisa dye bath into first beaker with thermal gloves on. Added 200mL of lukewarm water into that beaker. Repeated process for second beaker. Placed second beaker on hot plate on setting 5. Placed one swatch set into each beaker. Reported temperature of beakers every 30 minutes. Removed swatches after 1 hour. Rinsed efficiently. Laid on newspaper. Pinned swatches up on drying rack.

Determining HSB and RGB:

Took dyed swatches of both sets and compared it to the HSB/RGB chart at http://www.colorpicker.com/. Recorded the results to data chart.

Results/Data:

Data Table for Onion at Elevated Temperature:



CHEMISTRY AND ART:
TEXTILES AND DYES

TEXTILE	T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9	T-10
DYE TYPE: ONION	Cotton	Silk	wool	linen	Bamboo	Rayon	Jute	Nylon	Poly	Blend
DYE BATH TEMP. HOT 75°C										
HUE (DEGREES) (1-359)	39	37	21	37	37	34	38	358	38	32
SATURATION(%) (1-99)	45	83	96	51	62	43	59	87	36	68
BRIGHTNESS (%) (1-99)	87	88	82	91	95	96	89	90	86	90
RED (1-254)	222	224	209	232	242	245	227	230	219	230
GREEN (1-254)	187	153	79	187	185	199	178	156	190	157
BLUE (1-254)	127	38	8	114	92	140	93	30	140	73

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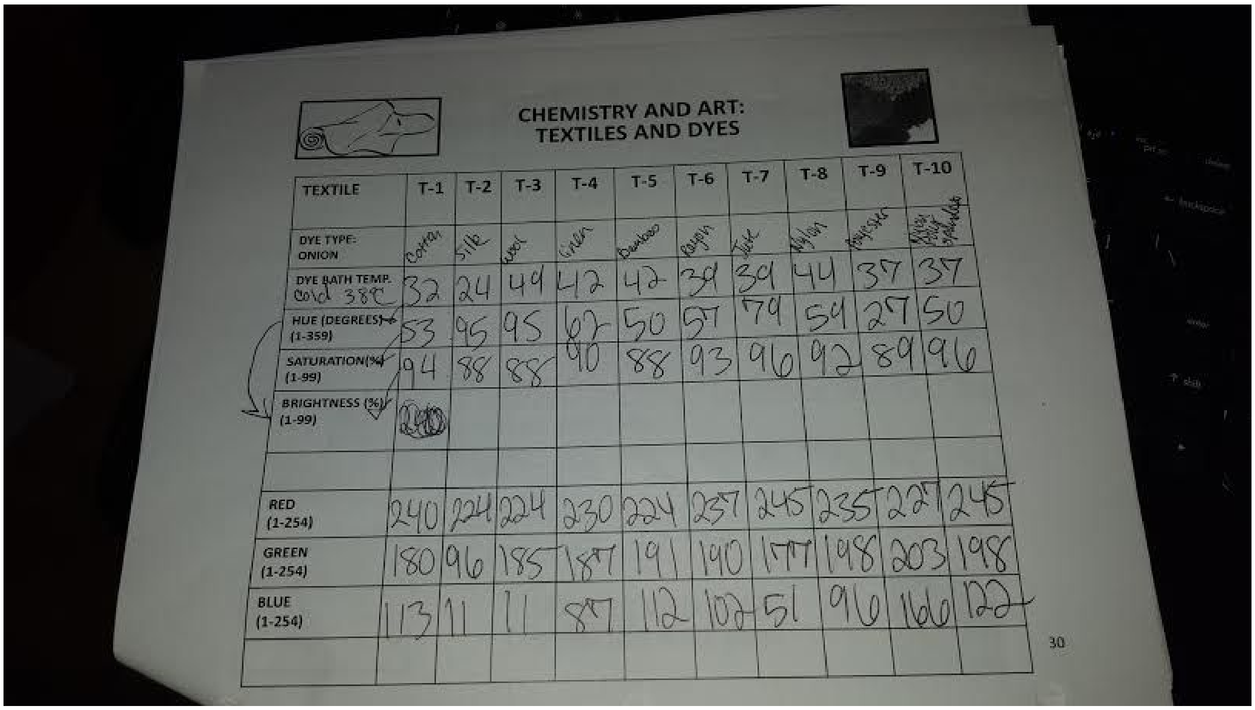
Data Table for Onion at Stagnant Temperature:



CHEMISTRY AND ART:
TEXTILES AND DYES

TEXTILE	T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9	T-10
DYE TYPE: ONION	Cotton	Silk	Wool	Linen	Bamboo	Rayon	Jute	Nylon	Polyester	[illegible]
DYE BATH TEMP. Cold 38°C	32	24	49	42	42	39	39	44	37	37
HUE (DEGREES) (1-359)	53	95	95	62	50	57	79	54	27	50
SATURATION(%) (1-99)	94	88	88	90	88	93	96	92	89	96
BRIGHTNESS (%) (1-99)	[illegible]									
RED (1-254)	240	224	224	230	224	237	245	235	227	245
GREEN (1-254)	180	96	185	187	191	190	177	198	203	198
BLUE (1-254)	113	11	11	87	112	102	51	96	166	122

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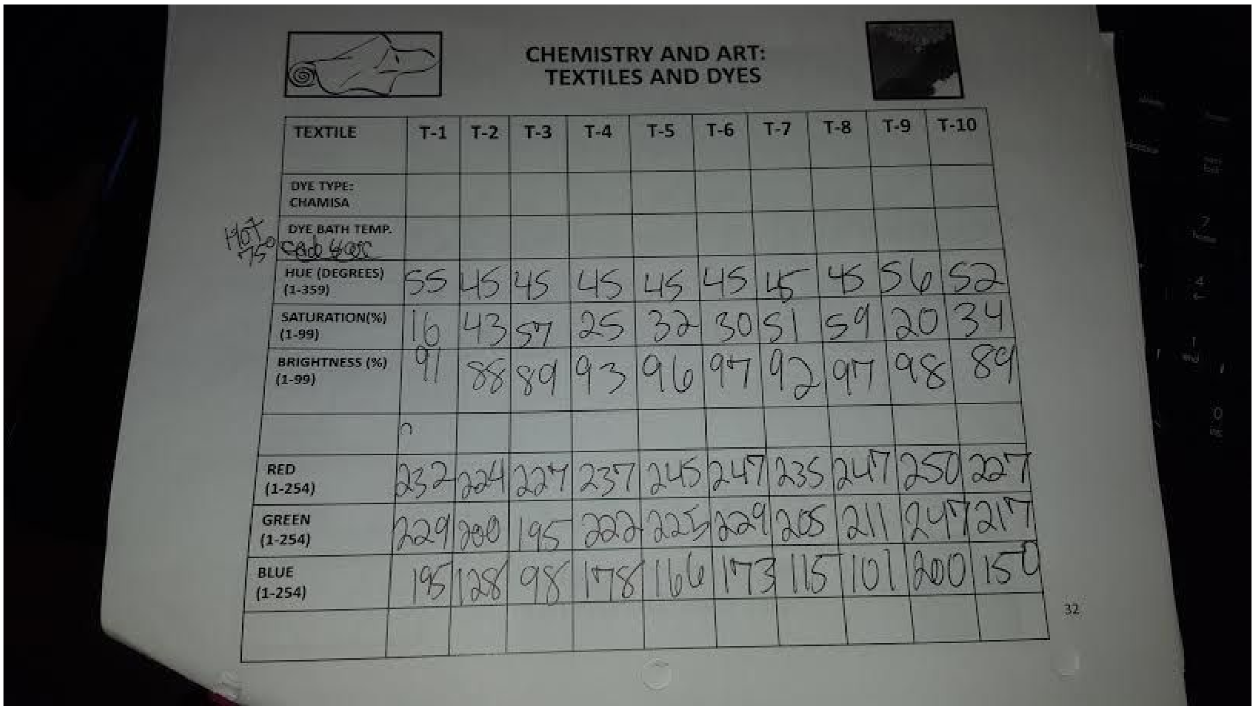
Data Table for Chamisa at Elevated Temperature:



CHEMISTRY AND ART: TEXTILES AND DYES

TEXTILE	T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9	T-10
DYE TYPE: CHAMISA										
DYE BATH TEMP. Hot 75°										
HUE (DEGREES) (1-359)	55	45	45	45	45	45	45	45	56	52
SATURATION(%) (1-99)	16	43	57	25	32	30	51	59	20	34
BRIGHTNESS (%) (1-99)	91	88	89	93	96	97	92	97	98	89
RED (1-254)	232	224	224	237	245	247	235	247	250	227
GREEN (1-254)	229	200	195	222	225	229	205	211	247	217
BLUE (1-254)	195	128	98	178	166	173	115	101	200	150

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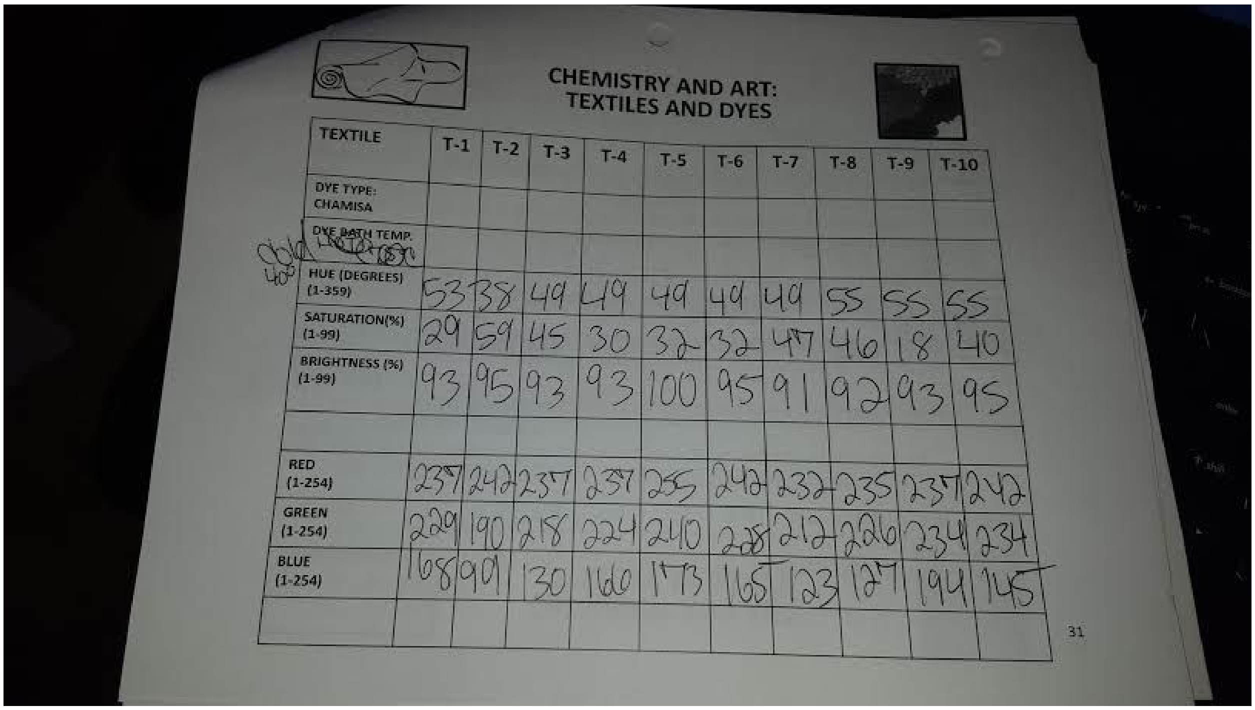
Data Table for Chamisa at Stagnant Temperature:



CHEMISTRY AND ART:
TEXTILES AND DYES

TEXTILE	T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9	T-10
DYE TYPE: CHAMISA										
DYE BATH TEMP.										
HUE (DEGREES) (1-359)	53	38	49	49	49	49	49	55	55	55
SATURATION(%) (1-99)	29	59	45	30	32	32	47	46	18	40
BRIGHTNESS (%) (1-99)	93	95	93	93	100	95	91	92	93	95
RED (1-254)	237	242	237	237	255	242	232	235	237	242
GREEN (1-254)	229	190	218	224	240	228	212	226	234	234
BLUE (1-254)	168	90	130	160	173	165	123	127	194	145

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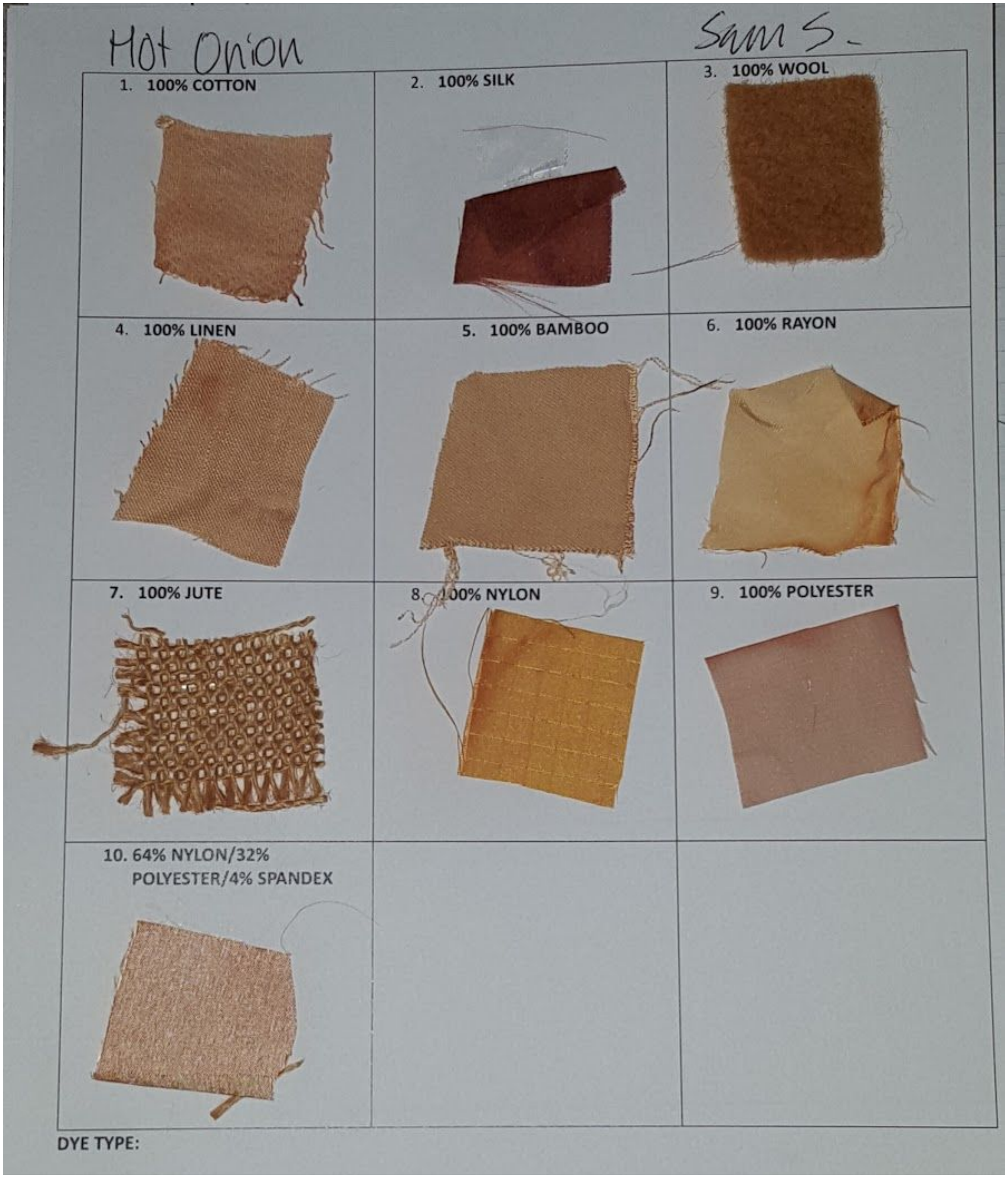
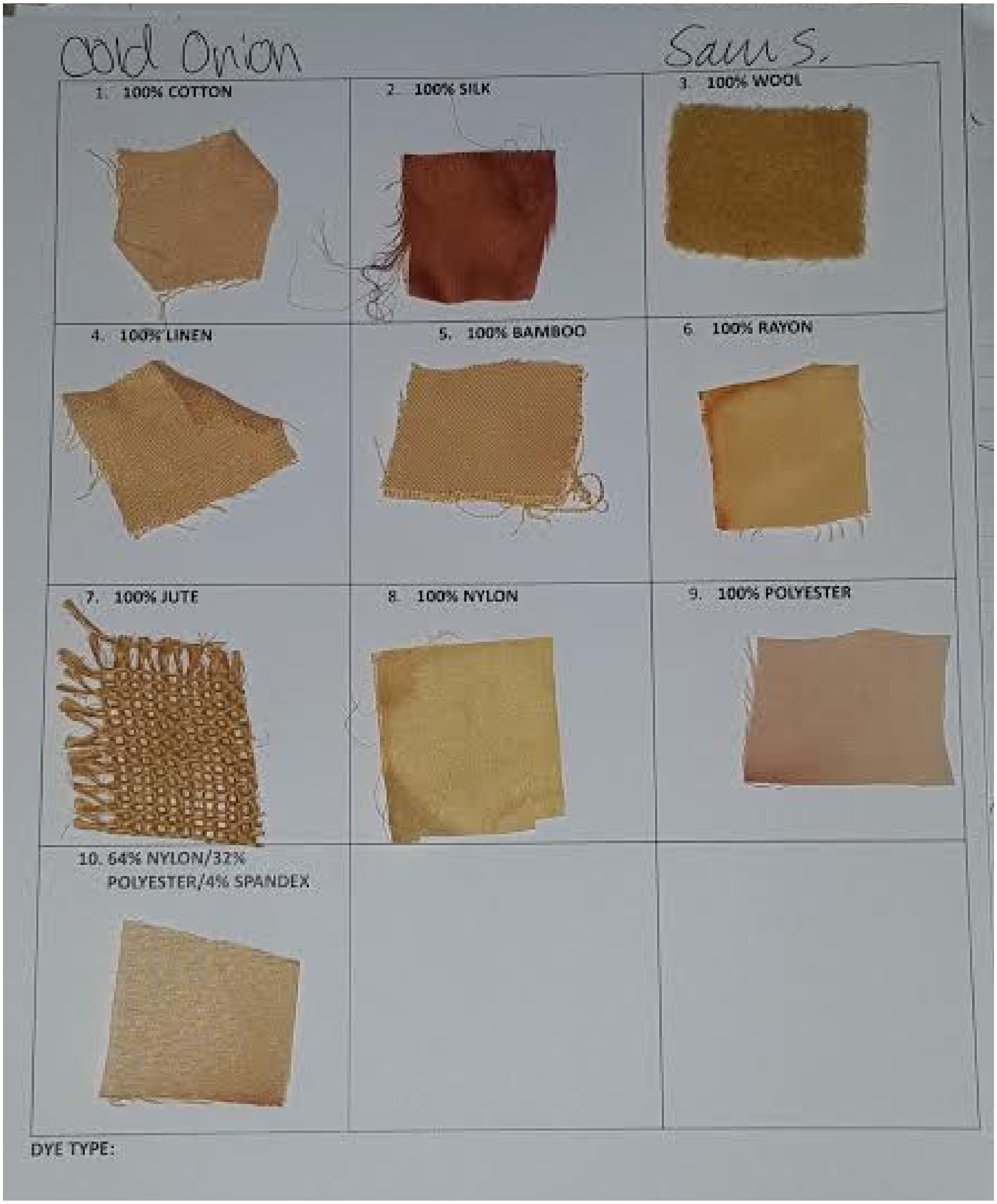
Color Swatches from Onion at Elevated Temperature:



Color Swatches from Onion at Stagnant Temperature:



Color Swatches from Chamisa at Elevated Temperature:

Color Swatches from Chamisa at Stagnant Temperature:

Substantive Dye Lab Notes:

Hot plate set at 5 heat setting
for ~~Hr~~ :30 turned of heat @ 5:50pm

Hot Chamisa @ 5:20 pm : 63 C°
Cold Chamisa @ 5:20pm: 53 C°

Hot Onion @ 5:15pm 60°C
Cold Onion @ 5:15pm: 55°C

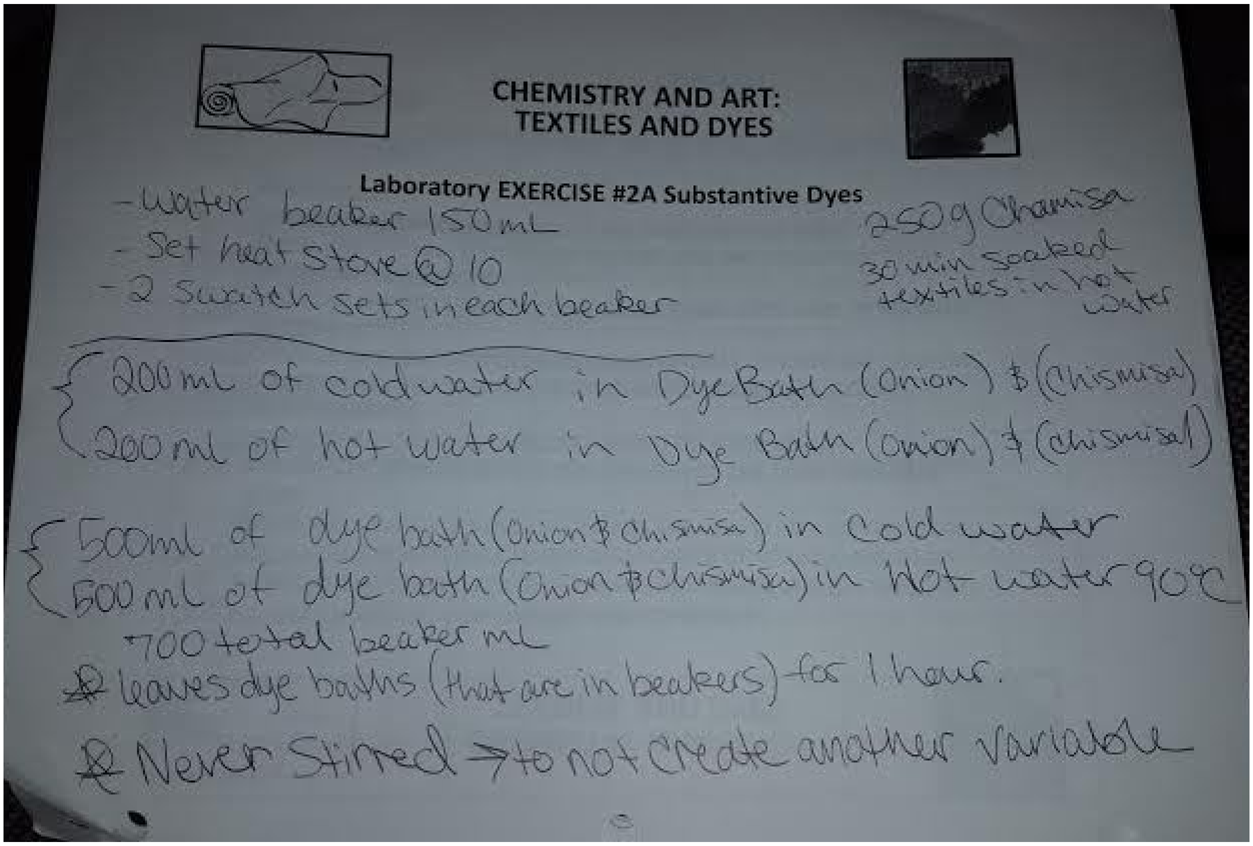
Hot Chamisa @ 5:50pm ; 93 C°
Cold Chamisa @ 5:50pm: 45 C°

Hot Onion @ 5:45pm · 90 C°
Cold Onion @ 5:45pm 40 C°

Hot Chamisa @ 6:20pm: 75 C°
Cold Chamisa @ 6:20pm: 40 C°

Hot Onion @ 6.15pm' 75 C°
Cold Chamisa @ 6:15pm: 36 C°

Substantive Dye Lab Notes Continued:



CHEMISTRY AND ART:
TEXTILES AND DYES

Laboratory EXERCISE #2A Substantive Dyes

- water beaker 150 mL
- Set heat Stove @ 10
- 2 Swatch sets in each beaker

250 g Chamisa
30 min soaked textiles in hot water

{ 200 mL of cold water in Dye Bath (Onion) & (Chismisa)
{ 200 mL of hot water in Dye Bath (Onion) & (chismisa)

{ 500 mL of dye bath (Onion & Chismisa) in cold water
{ 500 mL of dye bath (Onion & Chismisa) in Hot water 90°C
*700 total beaker mL

* leaves dye baths (that are in beakers) for 1 hour.

* Never Stirred → to not create another variable

Visual Assessment: Ranking Best Onion at Elevated Temperature

1. Silk
2. Wool
3. Cotton
4. Jute
5. Bamboo
6. Linen
7. 64% Nylon, 32% Polyester, 4% Spandex
8. Nylon
9. Polyester
10. Rayon

Visual Assessment: Ranking Best Onion at Stagnant Temperature

1. Silk
2. Wool
3. Cotton
4. Jute
5. Bamboo
6. Linen
7. 64% Nylon, 32% Polyester, 4% Spandex
8. Rayon
9. Nylon
10. Polyester

Visual Assessment: Ranking Best Chamisa at Elevated Temperature

1. Wool
2. Silk
3. Jute
4. Nylon
5. 64% Nylon, 32% Polyester, 4% Spandex
6. Cotton
7. Bamboo
8. Linen
9. Rayon
10. Polyester

Visual Assessment: Ranking Best Chamisa at Stagnant Temperature

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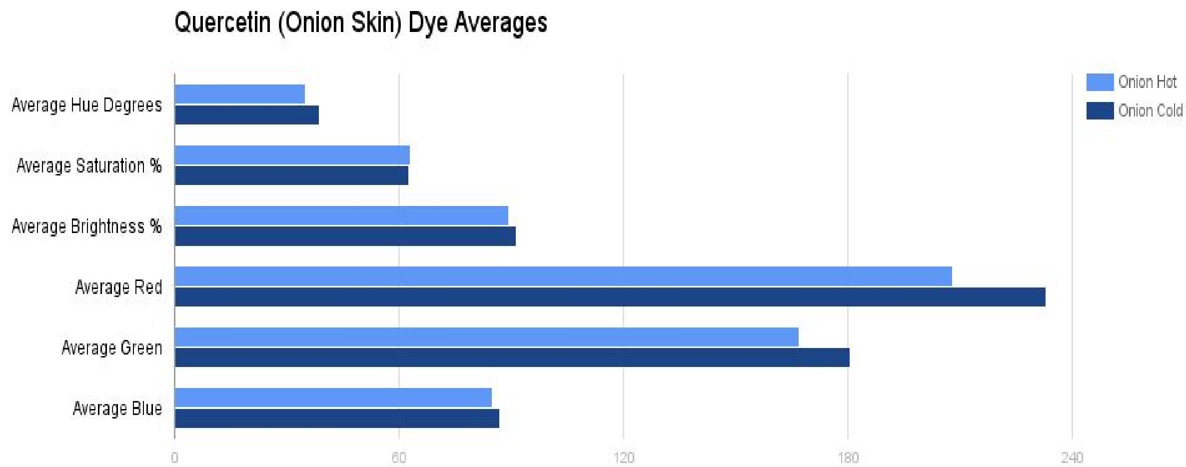
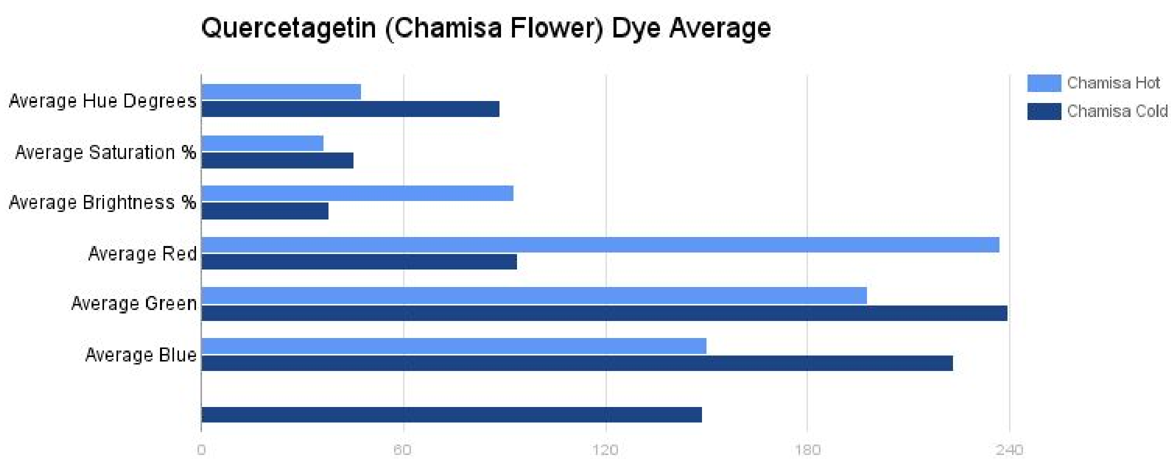
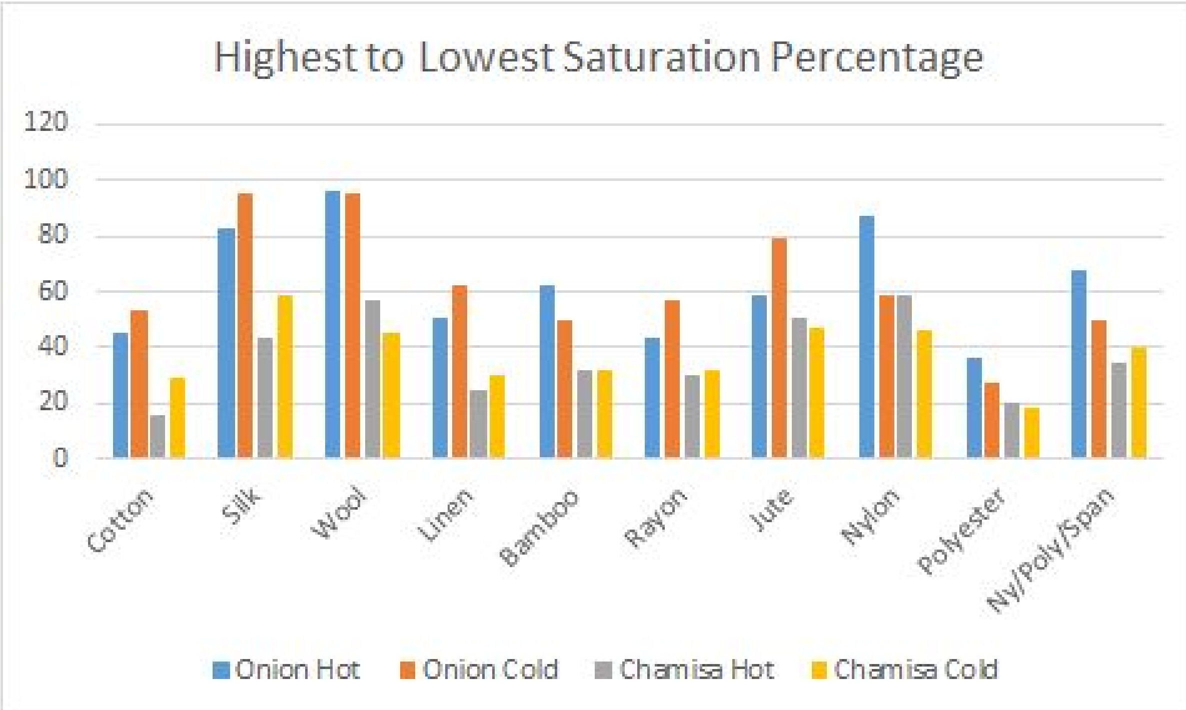
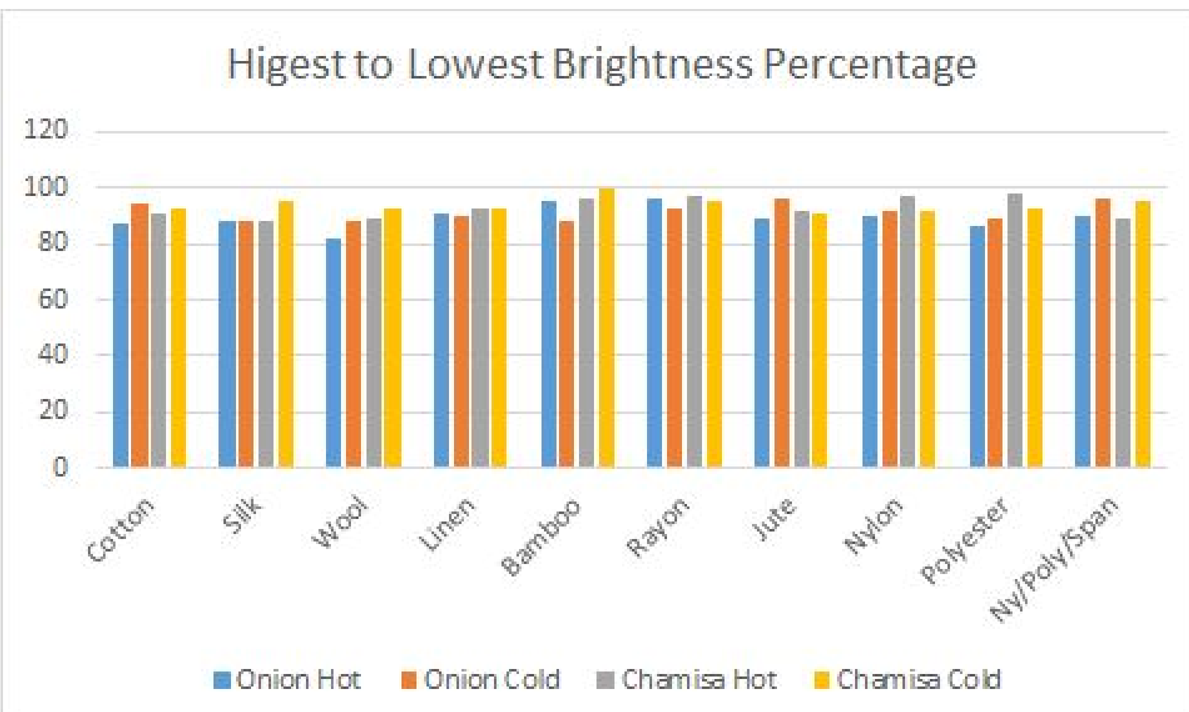
6. Rayon
7. Linen
8. Bamboo
9. Cotton
10. Polyester


Quercetin (Onion Skin) Dye Averages
Average Hue Degrees
Average Saturation %
Average Brightness %
Average Red
Average Green
Average Blue
0
60
120
180
240
Onion Hot
Onion Cold


Quercetagetin (Chamisa Flower) Dye Average
Average Hue Degrees
Average Saturation %
Average Brightness %
Average Red
Average Green
Average Blue
0
60
120
180
240
Chamisa Hot
Chamisa Cold


Highest to Lowest Saturation Percentage
120
100
80
60
40
20
0
Cotton
Silk
Wool
Linen
Bamboo
Rayon
Jute
Nylon
Polyester
Ny/Poly/Span
Onion Hot
Onion Cold
Chamisa Hot
Chamisa Cold


Higest to Lowest Brightness Percentage
120
100
80
60
40
20
0
Cotton
Silk
Wool
Linen
Bamboo
Rayon
Jute
Nylon
Polyester
Ny/Poly/Span
Onion Hot
Onion Cold
Chamisa Hot
Chamisa Cold

Discussion/ Analysis:

Interpret Your Data:

From referencing the *Quercetin Dye Averages* bar graph, the cold onion textiles had a higher average overall. But the average saturation percentage was the same compared to the onion skin dye bath at elevated temperature.

From referencing the *Quercetagetin Dye Averages* bar graph, the average brightness percentage and red average was higher with the hot chamisa textiles. But on the other hand, the cold chamisa had higher averages for everything else.

From referencing the *Highest to Lowest Saturation Percentage* column graph, hot and cold onion textiles had an equal amount of average saturation percentage on the 10 textiles used. The same goes with the hot and cold chamisa textiles, but, bamboo had the same average percentage for both.

From referencing the *Highest to Lowest Saturation Percentage* column graph, natural textiles, such as silk and wool had a higher saturation percentage compared to manufactured textiles, with hot onion nylon being the outlier.

From referencing the ***Highest to Lowest Brightness Percentage*** column graph, all the averages ranged around 80 to 100 percent.

Overall, from the qualitative data, I thought that natural textiles had the best response to the substantive dyes. I would say that the downfall of the manufactured textiles was that the dyes did not disperse thoroughly onto the fabrics as natural textiles did. Some of those fabrics include polyester and rayon.

As well, from the qualitative data, I thought the temperature of the dye bath for both onion skins and chamisa did not make much of a difference.

Draw Conclusion:

The substantive dye lab experiment did not validate my hypothesis that if one would soak textiles in a hot dye bath consisting of substantive dyes then it will affect the affinity if the time is fixed. The experiment is not validated because from the data taken, one can conclude that, textiles soaked at a stagnant temperature had the best averages, saturation, and most desirable color.

Discuss Assumptions:

An assumption I made was that the substantive dye baths that was elevated in temperature would create a higher affinity. But in actuality they did not. In fact, they did noticable worse.

Sources of Error:

An error was comparing our tangible textiles to a computer monitor in a poorly lit room to determine HSB and RGB.

Another error was when recording HSB and RGB I wrote the data in the wrong boxes. Which needed to be rewritten.

The last error made was reading the thermometer accurately and consistently during the one hour of soaking textiles.

Possible Improvements:

If we did this lab another time, I would conduct it not on computer but perhaps with color swatches to determine the shades of the substantives dyes. Also I would be sure to take my time when writing down the data because if not caught in time it could throw off all the results of the experiment. Lastly I would set an alarm for every time need to check the temperature of the dye baths. As well, I would have more than one person check temperature, to be sure it was an accurate number.

Conclusion: *A Final Comment*

I concluded that there is not a stronger affinity to textiles soaked in a substantive dye bath at an elevated temperature. Contrary to science, results from our lab showed that textiles soaked in a stagnant temperature had a greater HSB and RGB. Although there was some limitation in picking the correct HSB and RGB, we can make a generalization that the affinity is weaker at a higher temperature.