

Crafting with Nature - Blending Bio Dyes, BioFabricating & Growing Materials

Cpf Makerspace

Claudia Simonelli

BIO FABRICATING MATERIALS



BIOMATERIALS



















Fabricademy 2021-22



| Learning by doing

DIY fabrication

DIY / DIT FABRICATION

Eco-friendly

Plastic-free

Green materials

Veg materials

Biomaterials

Bio-based

Compostable

Bio-degradable

BIO MATERIALS

https://www.plasticfreejuly.org/the-plastic-pollution-issues/



More than 29 million tons of plastic became municipal solid waste **annually** in the U.S. alone and almost **half is plastic packaging**.

- We go through 10 billion plastic bags worldwide every week
- Plastics don't break down, they break up, becoming a permanent pollutant in our environment

How plastics are made

Polymer

+

Plasticizer

Filler agent

Stiffening
Expanding
agent

PETROLEUM MATERIALS

Biopolymers: biodegradable alternatives to the traditional ones







BIOPOLYMER	SOLVENT	PLASTICIZER
	+ ADDITIVES	

Techniques

Biofabricated

Crafted

CRAFTS /
BIO / DIGITAL
FABRICATION PROCESS

BIOPLASTICS, BIOSILICONES, BIORESINS, ALTERNATIVE LEATHERS - FISHLEATHER, FRUITLEATHER, ALGAE LEATHER, YARNS...

Techniques

Grown

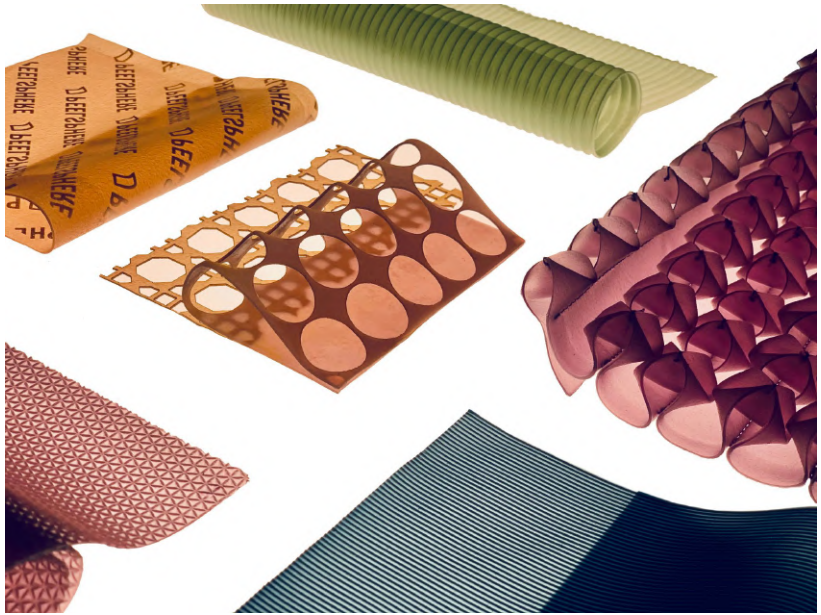
BACTERIAL / NATURAL /
FERMENTATION
PROCESS

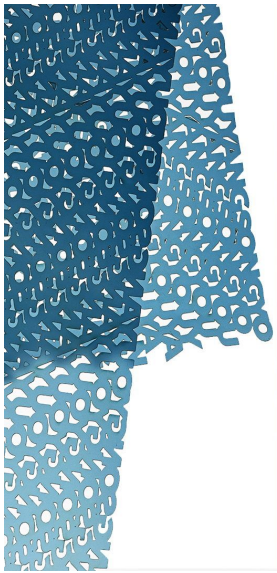
IT MIGHT REQUIRE THE USE OF A **BIO LAB**

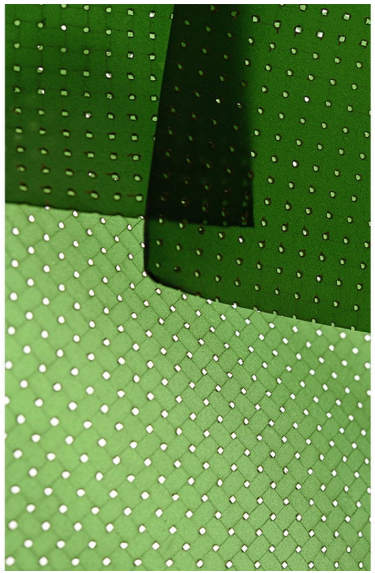
A process in which microbes break down chemical substances into organic acids, gases, and alcohol. Black tea, sweetened with sugar, is fermented by the SCOBY.

MICROBIAL LEATHER, FUNGI LEATHER, TEMPETH LEATHER KOMBUCHA, MYCELIUM, SPIDER SILK..

Peelsphere
YouYdng Song

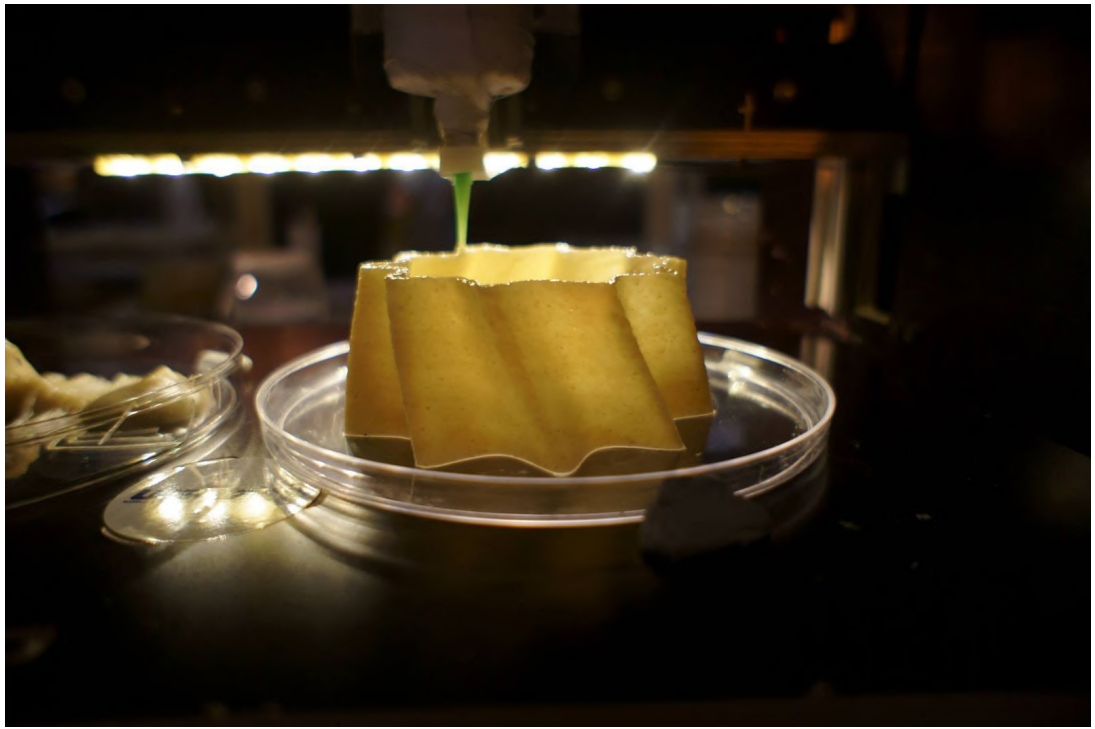








Officina
Corpuscoli
Maurizio Montalti





Remix El Barrio



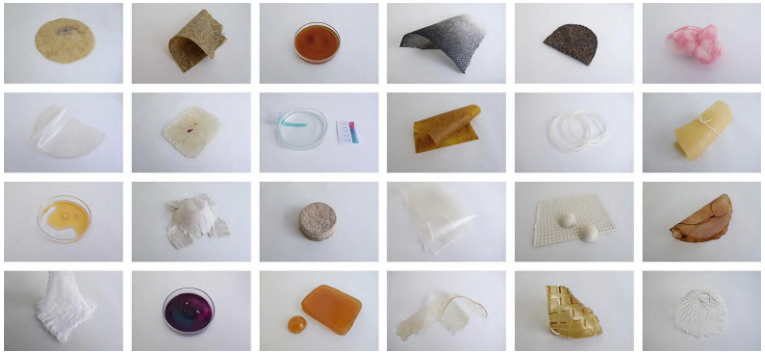
FABTEXTILES / **FAB LAB BARCELONA, SPAIN**
Mentored by Anastasia Pistofidou

Material
archives



MATERIAL SYSTEMS







Starch Rubber



Biolinoleum



Alginate net



Alginate string



Agar foil



Bio composite



Alum crystals



Kombucha scoby



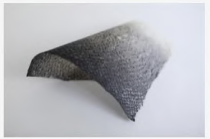
Kombucha foil



Mango leather



Banana Clay

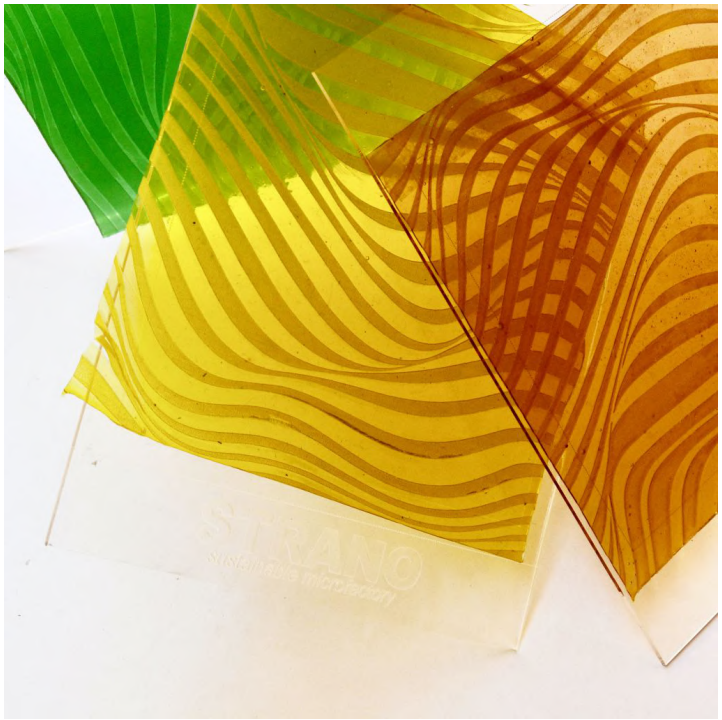


Fish leather

LOES BOGERS - MATERIAL ARCHIVE & 24 NEW NATURALS | FABRICADEMY AMSTERDAM

Lucrecia Strano

Fabricademy 2019







SUSTAINABLE MICROFACTORY AND MATERIALS SUPPLIER

Beatriz Sandini

Fabricademy 2019



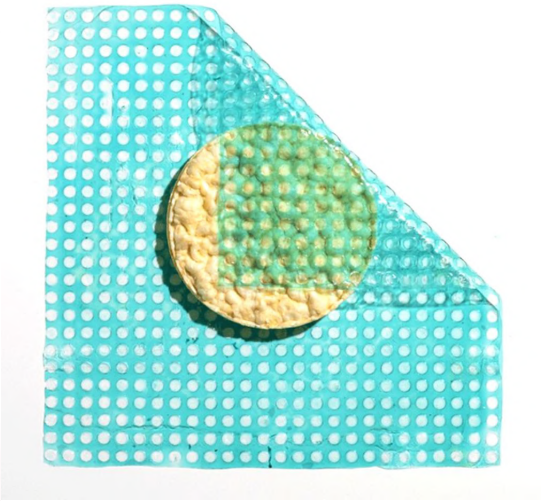


EPHEMERAL FASHION LAB

Carolina Delgado

Fabricademy 2019









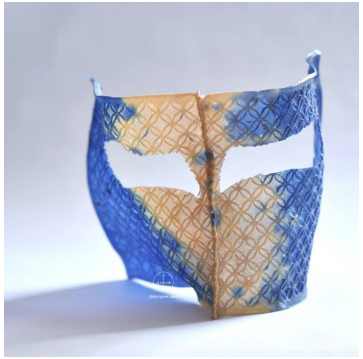
PACKAGING ALTERNATIVES

Rabab Abdulla

Fabricademy 2019











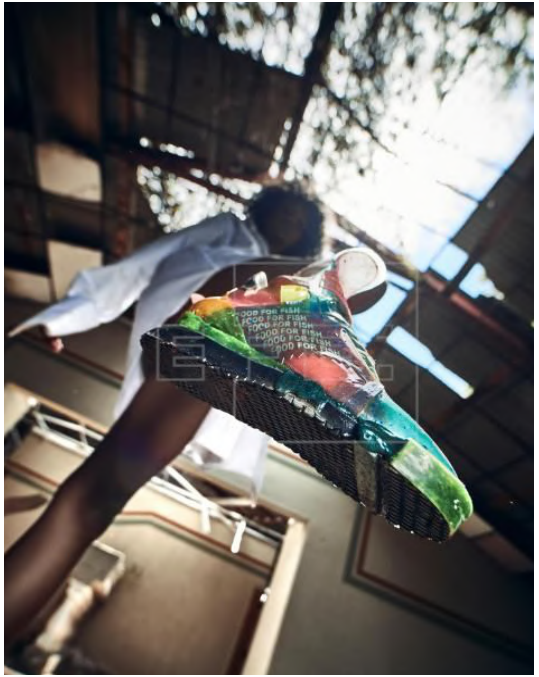
LOCAL HERITAGE

Felipe Fiallo

Fabricademy 2020

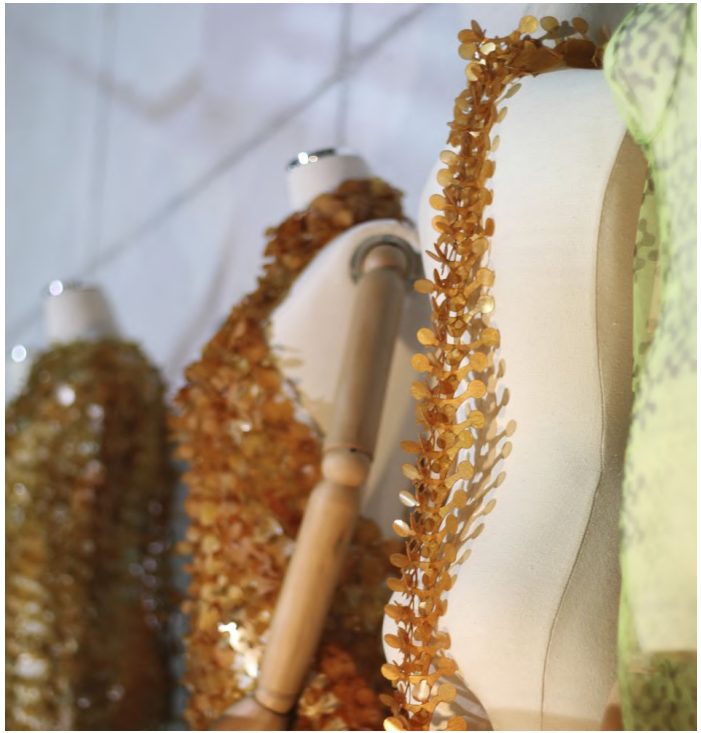






Eduardo Loreto

Fabricademy 2021





BIO COUTURE



ALBERTE BOJESEN

SEAWEED DIALOGUES

Generating a sensorial dialogue between human and seaweed, through Interactive seaweed vessels; posing the question of what seaweed is and can be.





Food
waste

Turning *trash* into treasure



Local materials

Start from what is available around you!















DRIED FRUITS / NUT**SHELLS** / **BANANA** PEELS / **POMEGRANATE** PEELS

Get ready to cook

BEST PRACTICES
TUTORIAL
TIPS & TRICKS



Step 01.
Harvest / collect



LOCAL MATERIALS
LOCAL FOOD WASTE

Lab Equipment
food processing



INGREDIENTS
FOOD WASTE
ORGANIC LEFTOVERS
NATURAL FIBRES
SPICES...

FOOD COLOURS / PIGMENTS / ESSENTIAL OILS







BLENDER/ HAND BLENDER



MORTAR / PESTLE



OVEN DEHYDRATOR

DIGITAL SCALE



(NOTEBOOK)

Step 02.



Let them dry in the sun for some days or use a **dehydrator / oven** to get rid of the water contained.

Step 03.





Shred / **blend** / **crush** / **hammer** / **process** your ingredients into fine powder that better incorporates within the mix.

Organic waste



FLOWERS
LEFTOVERS

FLOWERS WASTE

Food / spices
leftovers



ACTIVATED CHARCOAL
POWDER



PISTACHO
SHELLS



BIOMATERIALS

Food waste



ONION
PEELS

EGGS
SHELLS

COFFEE GELATINE BIOPLASTIC

Lab Equipment
cooking



INGREDIENTS
POLYMER
PLASTICIZER
SOLVENT

DIGITAL SCALE





MIXING TOOLS



STAINLESS STEEL POT



HEAT PAD

SINK / WATER ACCESS



SIRYING / PIPETTES



GRADUATED BEAKER

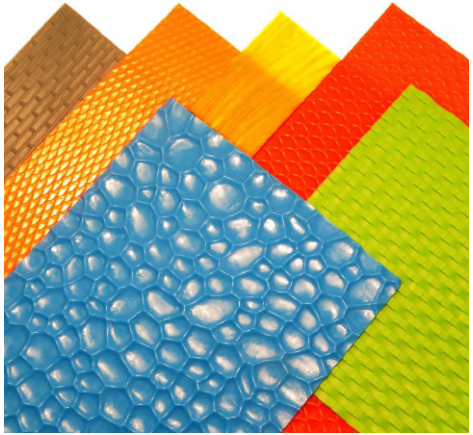


(NOTEBOOK)

Lab Equipment
casting



SPATULA



TEXTURED MATS
PLASTIC
GLASS
SILICONE

DIY / READY MADE MOLDS



BAKING PAPER / PLASTIC WRAP



PETRI DISHES

Step 03.
cooking > How to



> **Weight** your ingredients according to the recipe.

> **Warm up your solvent** and start dissolving / mixing your ingredients.

> **Always dissolve the plasticizer first then add the polymer while stirring.**



Step 03.
cooking > How to

> Add your **blended ingredients** or additive to the mix as soon as the ingredients are dissolved**.**

> Stir gently for **some time** according to your recipe and amounts of polymers and plasticizers, until the mixture becomes **sticky** and jelly**.**



Step 04.
casting > How to

> Turn off the heat and **cast** the mixture into the molds.

> Pour the mixture in the ready made molds or cast it into a thin sheet onto a **flat surface**.

> Check if your table or surface is flat before casting.
This will affect the thickness of your biomaterials.



Step 04.
casting



Haneen Jaafreh
Biomaterials 2022

Step 05.
demould > How to

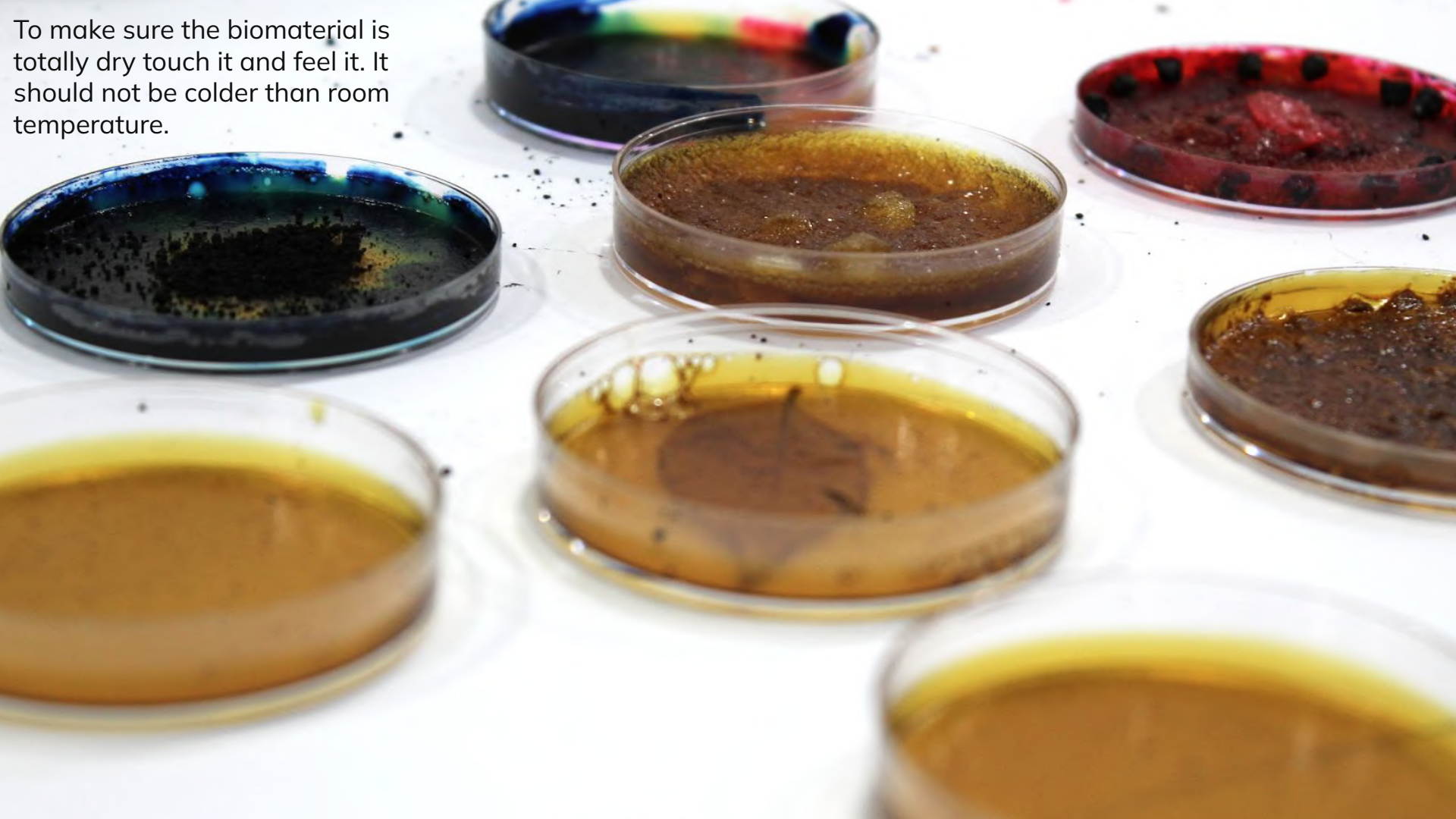
> Let your biomaterials dry at a **room temperature** in a **ventilated and dry area**.

> **Wait for some days before demoulding**.

The time may vary according to the recipes, ingredients, room condition and location.

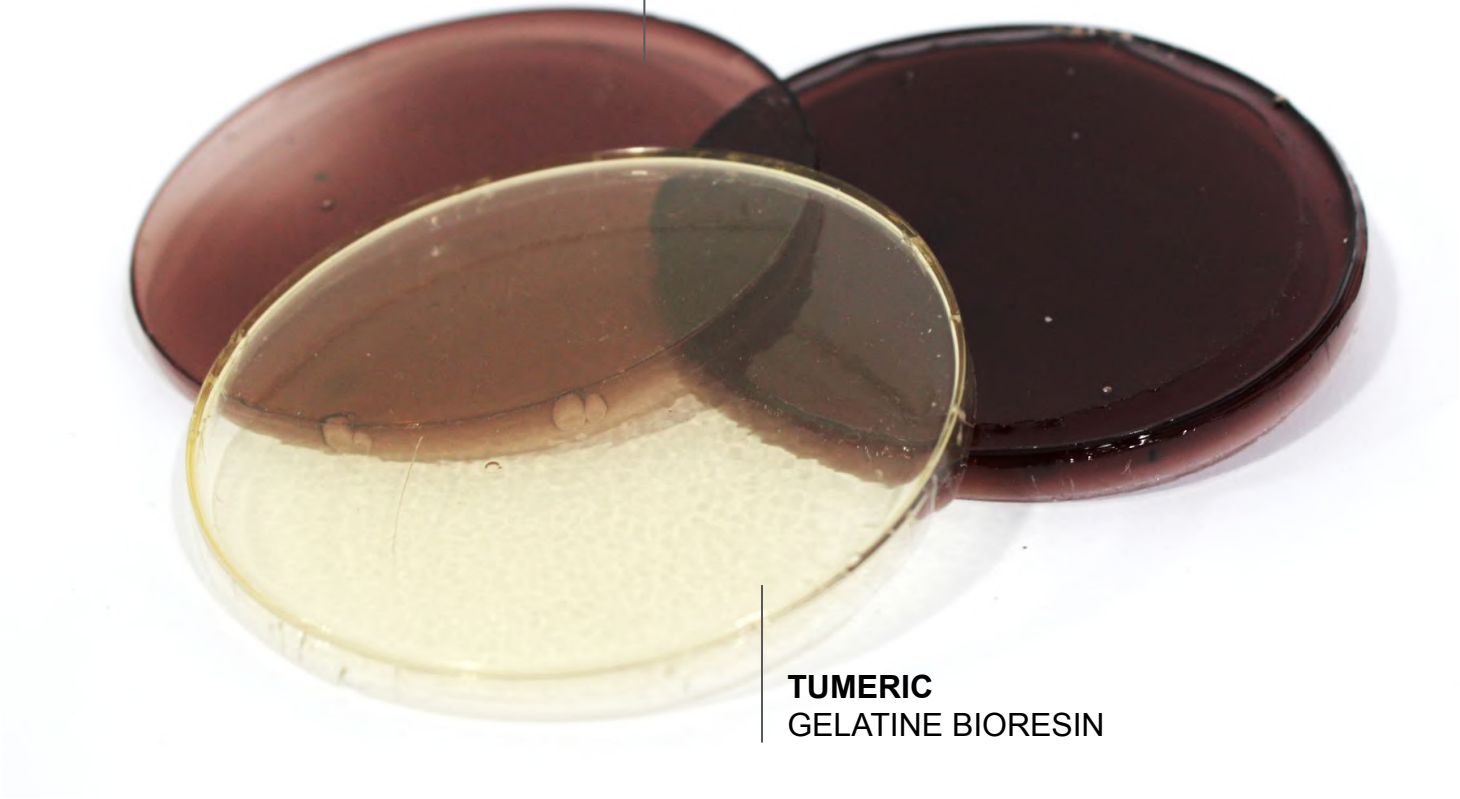


To make sure the biomaterial is totally dry touch it and feel it. It should not be colder than room temperature.



Gelatine bioplastics

HIBISCUS
GELATINE BIORESINS



TUMERIC
GELATINE BIORESIN

CRAFTED GELATINE BIOPLASTIC

Gelatine bioplastics



HIBISCUS TEXTURED
GELATINE BIORESIN

CRAFTED GELATINE BIOPLASTIC

Gelatine bioplastics

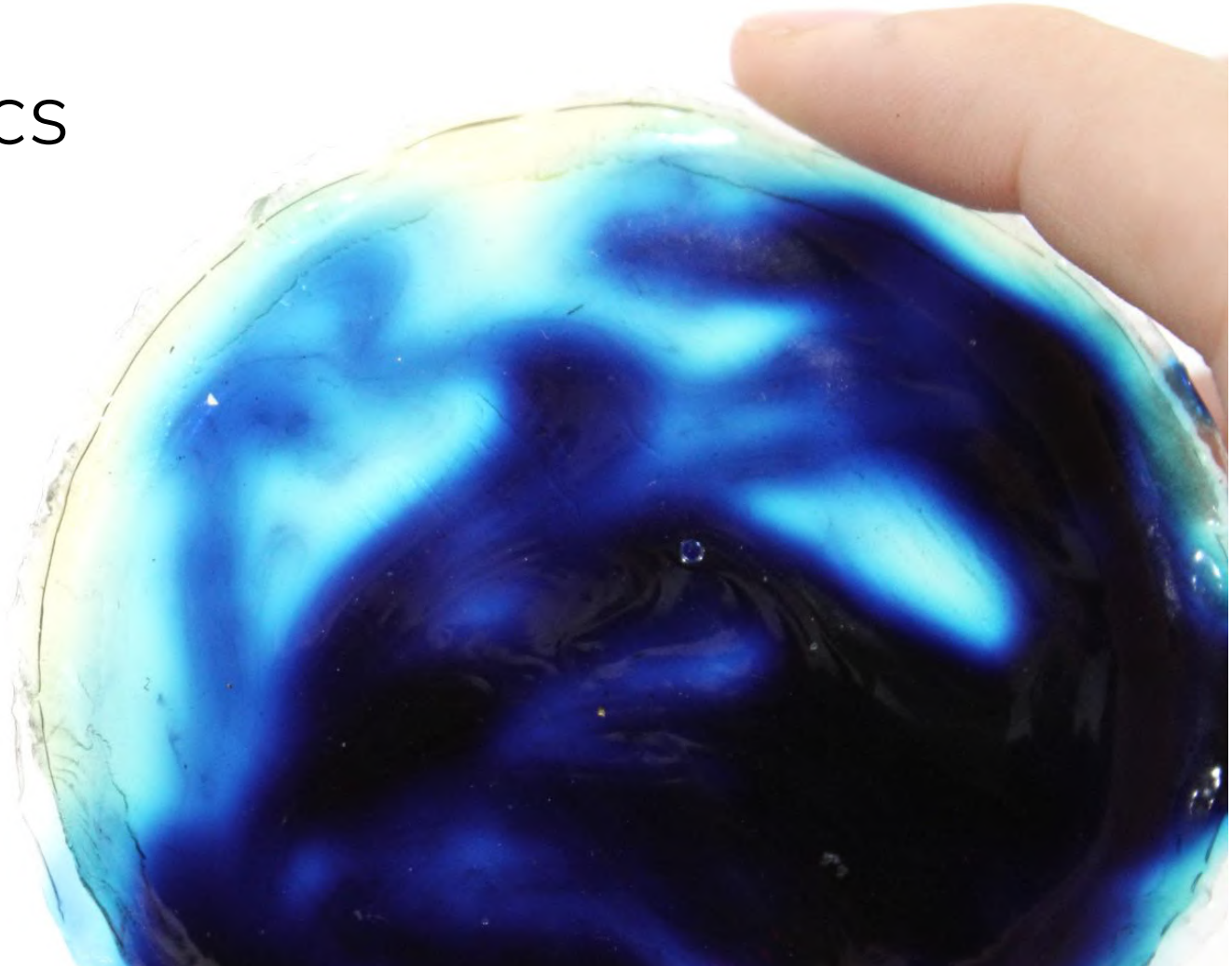
HIBISCUS
GELATINE BIORESINS

MEDIUM FLEXIBLE
TEXTURED
GELATINE
BIOSILICONES



CRAFTED GELATINE BIOPLASTIC

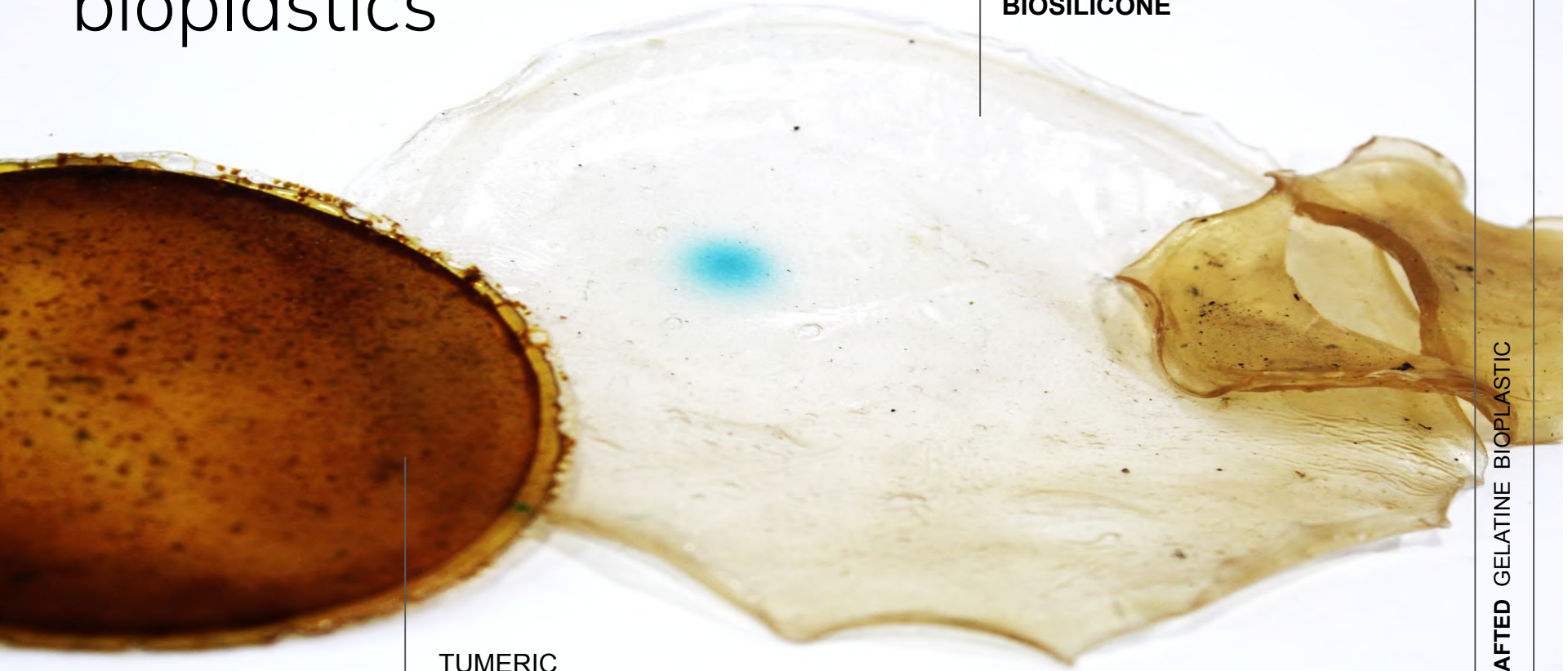
Gelatine bioplastics



SHADED
SMOOTH
FOOD COLORED
BIOPLASTIC

CRAFTED GELATINE BIOPLASTIC

Gelatine bioplastics

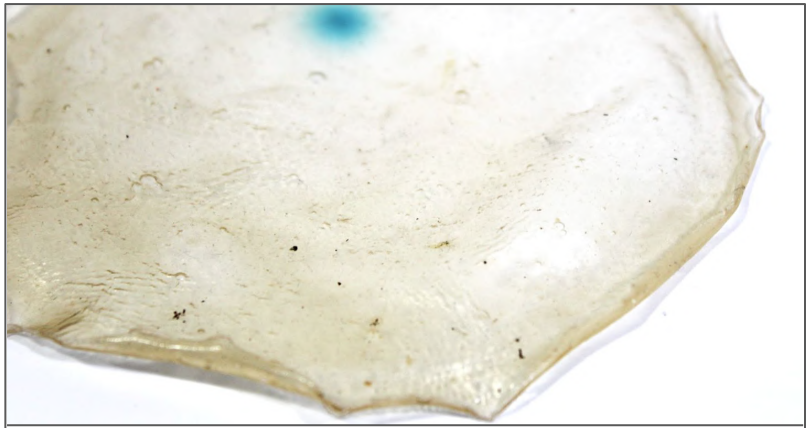


CLEAR
BIOSILICONE

TUMERIC
BIORESIN

CRAFTED GELATINE BIOPLASTIC

Evaluating biomaterials

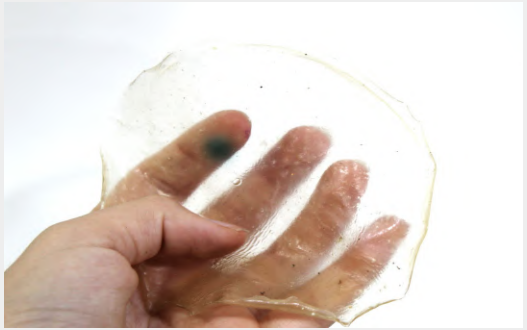


CLEAR FLEXIBLE GELATINE BIOSILICONE

FLEXIBILITY

SHRINKAGE

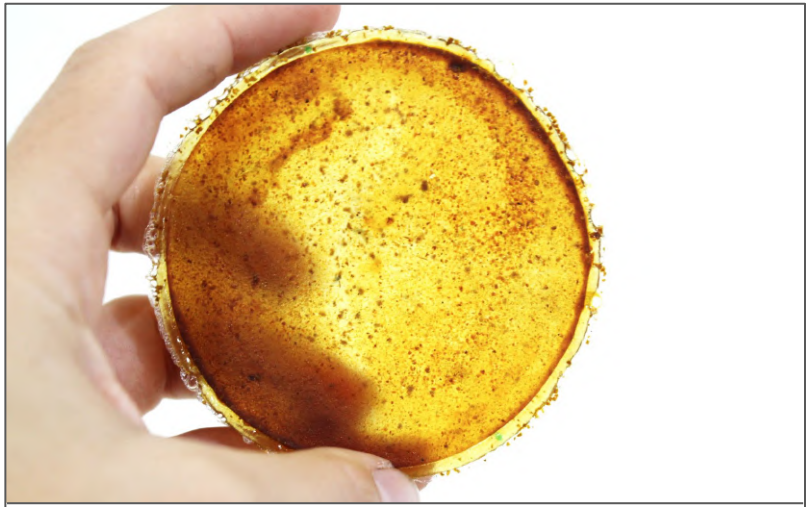






CRAFTED GELATINE BIOPLASTIC

Evaluating biomaterials



TUMERIC GELATINE BIOSILICONE

SHRINKAGE

FLEXIBILITY







CRAFTED GELATINE BIOPLASTIC

Evaluating biomaterials



COFFEE GELATINE BIOPLASTIC

SHRINKAGE

STIFFNESS







CRAFTED GELATINE BIOPLASTIC

Gelatine bioplastics



MOULDED
TEXTURED
COFFEE GELATINE
BIOPLASTICS

CRAFTED GELATINE BIOPLASTIC

Charcoal bioplastics



COFFEE GELATINE BIOPLASTIC



Gelatine bioplastics

Gelatin is a **biopolymer** which is prepared by thermal denaturalization of **collagen**, which is available in **animal skin** and **bones** in the presence of dilute **acids**.

gelatine characteristics

Gelatine – from *Latin*: gelatus meaning "*stiff*" or "frozen" is a translucent, colorless, flavorless food ingredient, commonly derived from collagen taken from animal body parts.



ingredients







GELATINE POWDER	**WATER**	**GLYCERINE**

Cooking

> Gelatine melts completely in water at around 90 C.

> Gently add the gelatine while stirring.

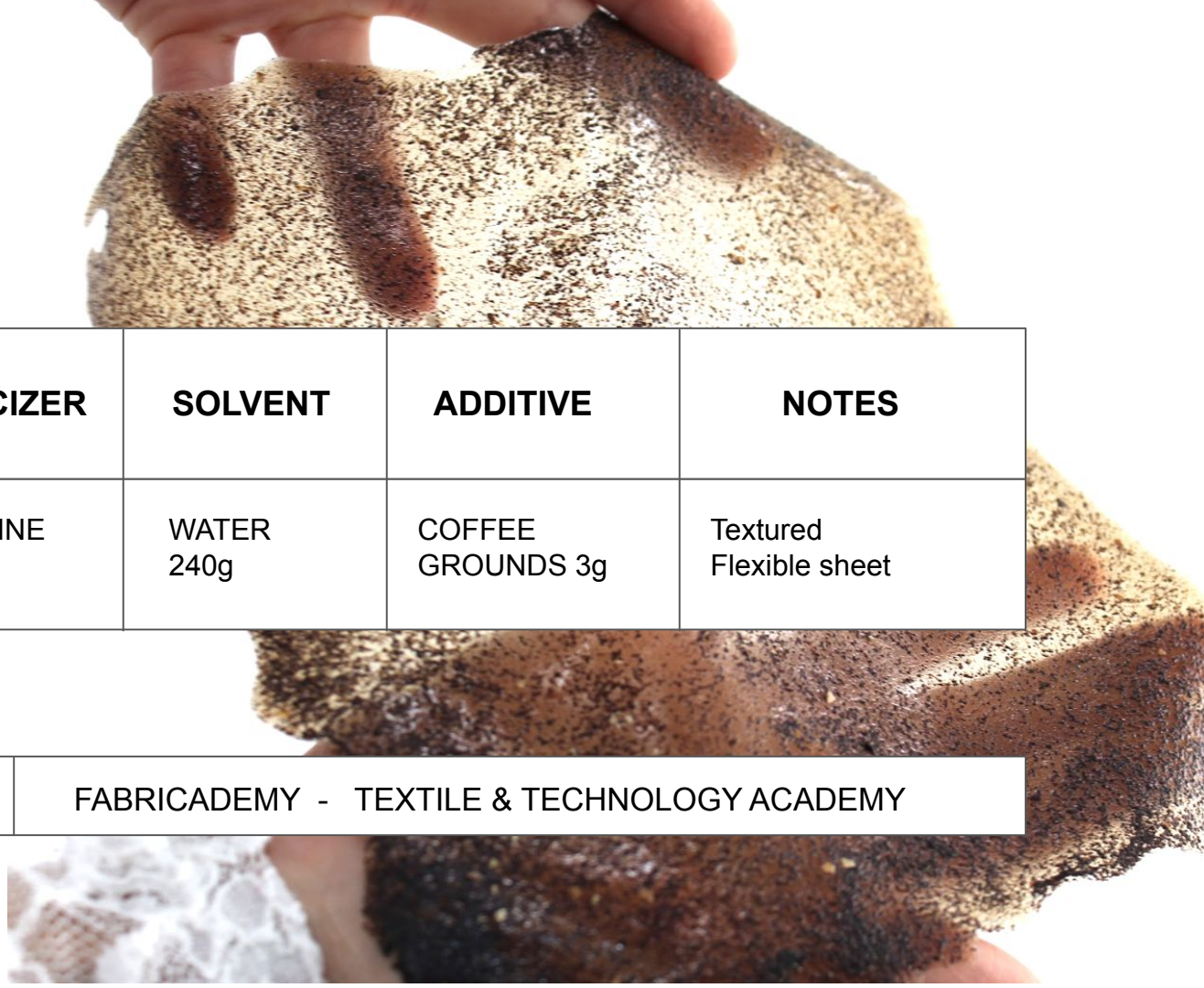
> Add food colouring or any additional ingredient before casting to have a smoother result.

> Make sure to not let it boil for too long past melting point as this can harm its **gelling ability**



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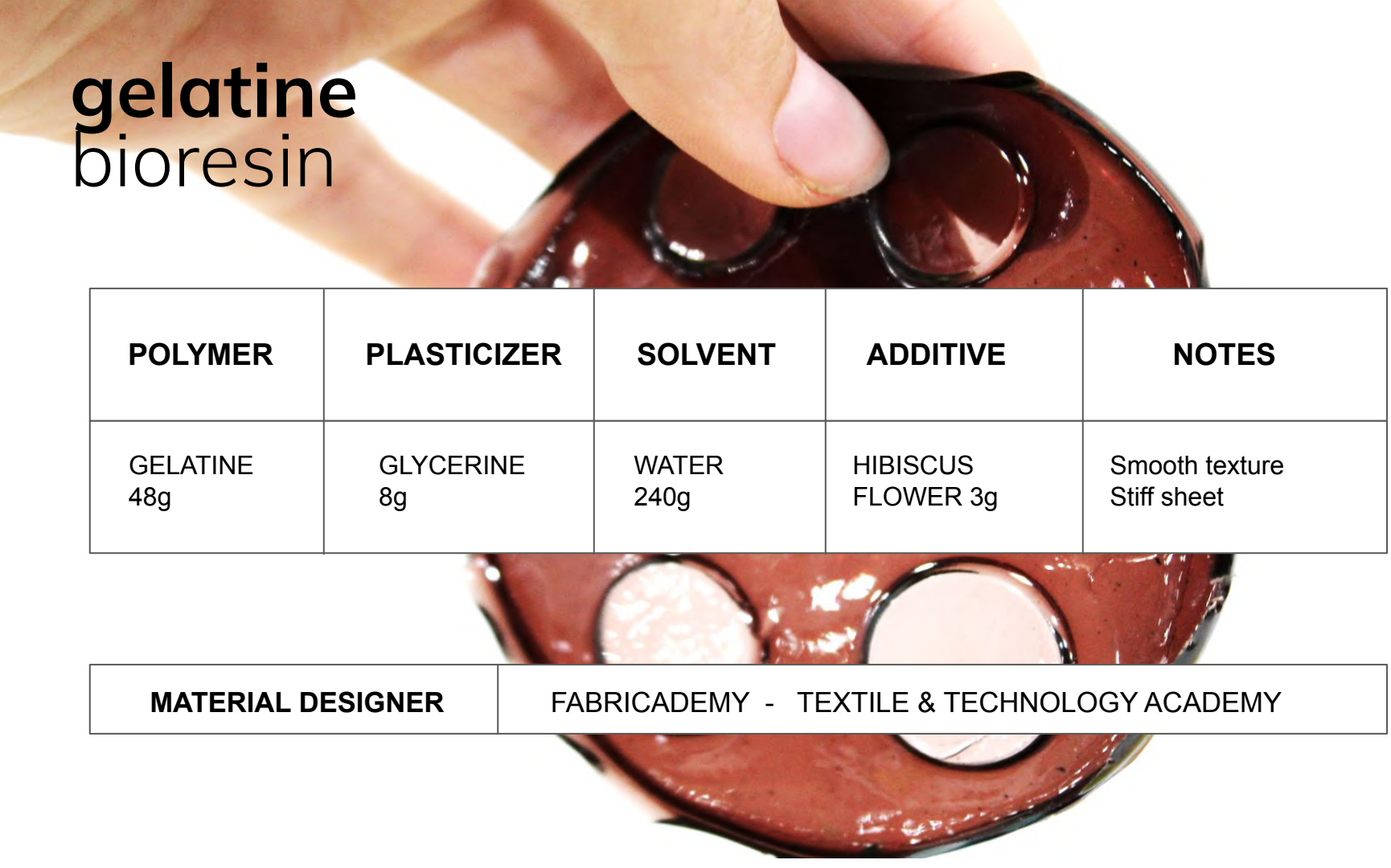
gelatine
bioplastic



POLYMER	PLASTICIZER	SOLVENT	ADDITIVE	NOTES
GELATINE 48g	GLYCERINE 12g	WATER 240g	COFFEE GROUNDS 3g	Textured Flexible sheet

MATERIAL DESIGNER	FABRICADEMY - TEXTILE & TECHNOLOGY ACADEMY

gelatine
bioresin



POLYMER	PLASTICIZER	SOLVENT	ADDITIVE	NOTES
GELATINE 48g	GLYCERINE 8g	WATER 240g	HIBISCUS FLOWER 3g	Smooth texture Stiff sheet

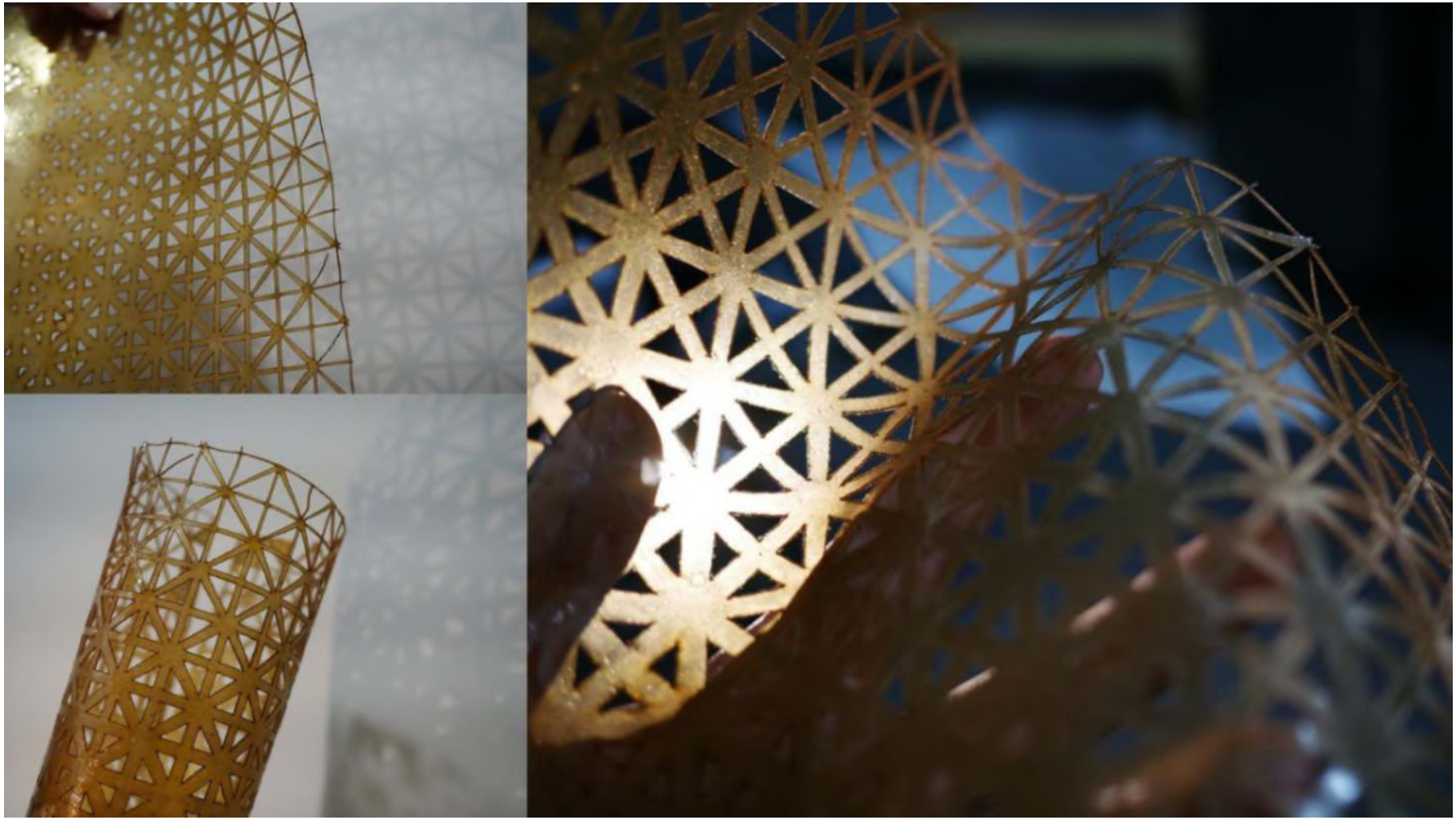
MATERIAL DESIGNER	FABRICADEMY - TEXTILE & TECHNOLOGY ACADEMY

gelatine
biosilicone

POLYMER	PLASTICIZER	SOLVENT	ADDITIVE	NOTES
GELATINE 48g	GLYCERINE 24g	WATER 240g	_____	Smooth texture Hyper Flexible sheet

MATERIAL DESIGNER	FABRICADEMY - TEXTILE & TECHNOLOGY ACADEMY







Agar agar

Agar is a compound known as polysaccharide, extracted from red algae.

It is considered the best vegan alternative to an animal-based gelling agent like gelatine.

agar agar characteristics

Agar agar – is the *Malay* name for the red seaweed from which the powder is extracted. *The white and semi translucent vegetable gelatin is sold in flake, powder, bar, and strand form, and can be used in recipes as a stabilizing and thickening agent, for different applications.*

It can be used as a Vegan substitute for gelatin.

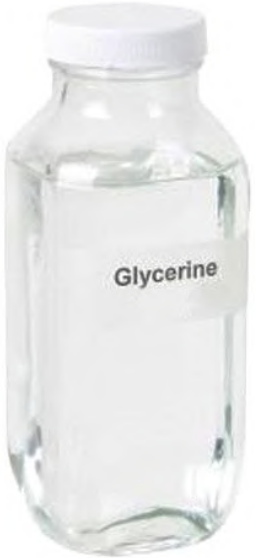
Among the others, agar is colourless, odourless and tasteless and preserves waterproof properties.
It is indeed insoluble in cold water.



ingredients







AGAR AGAR POWDER	**WATER**	**GLYCERINE**

Cooking

> Agar-agar needs to boil in order to set, while gelatin can simply dissolve in warm water; that is because agar melts at 85 C, whereas gelatin starts melting at around 40 C.

> Agar also sets more quickly than gelatin and doesn't need any refrigeration.

> 90°C to dissolve properly in liquid, the powdered form is easiest to work with.

> Make sure to not let it boil for too long past melting point as this can harm its **gelling ability.**



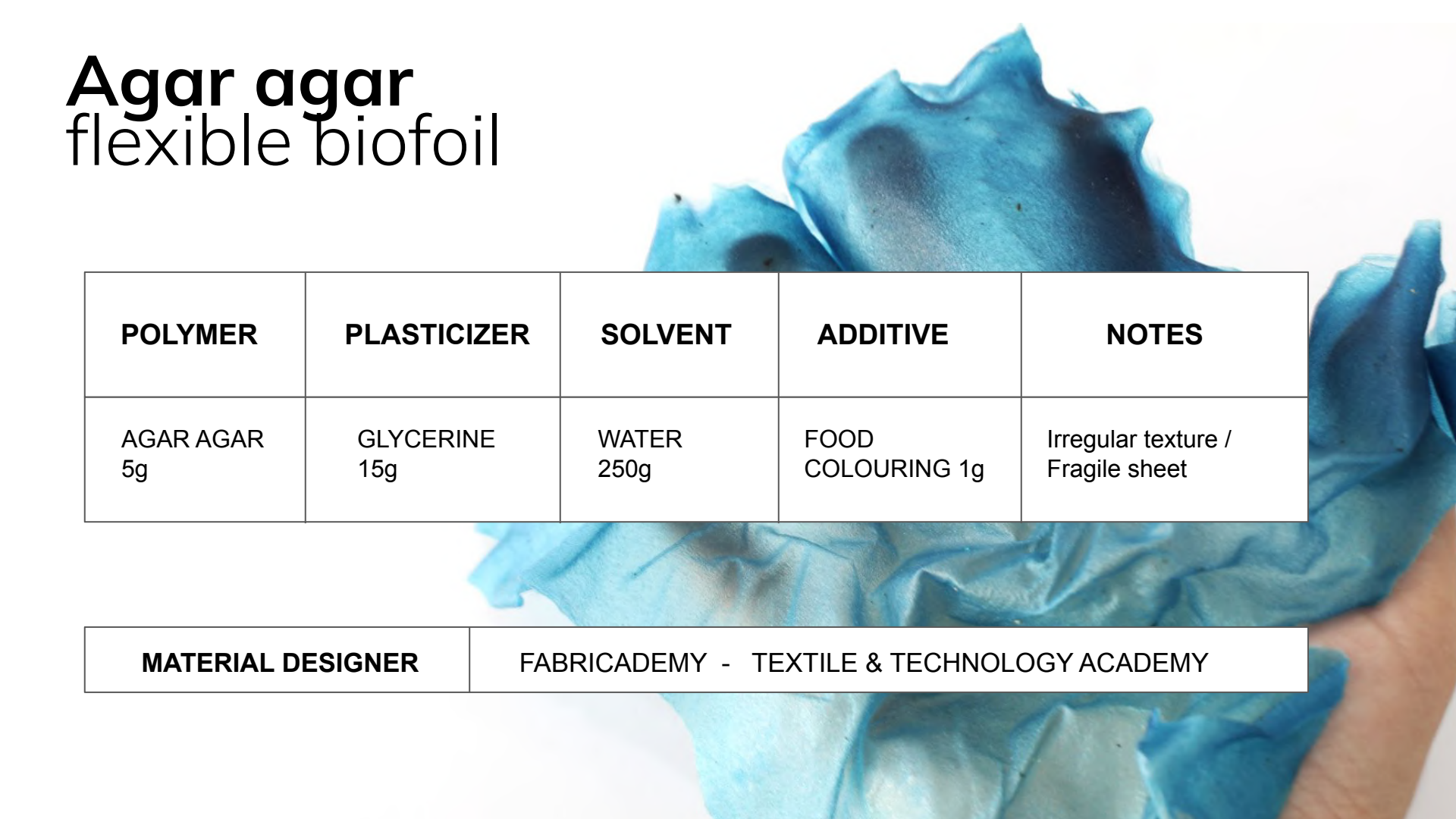
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Agar agar
flexible biofoil



THICKNESS = 0.5 mm
SHRINKAGE = 1%

Agar agar
flexible biofoil



POLYMER	PLASTICIZER	SOLVENT	ADDITIVE	NOTES
AGAR AGAR 5g	GLYCERINE 15g	WATER 250g	FOOD COLOURING 1g	Irregular texture / Fragile sheet

MATERIAL DESIGNER	FABRICADEMY - TEXTILE & TECHNOLOGY ACADEMY

Agar agar
flexible biofoil



THICKNESS = 0.5 mm
SHRINKAGE = 1%

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Agar agar
bioplastic

POLYMER	PLASTICIZER	SOLVENT	ADDITIVE	NOTES
AGAR AGAR 4g	GLYCERINE 12g	WATER 200g	FOOD COLOURING 1g	Irregular texture / Fragile sheet

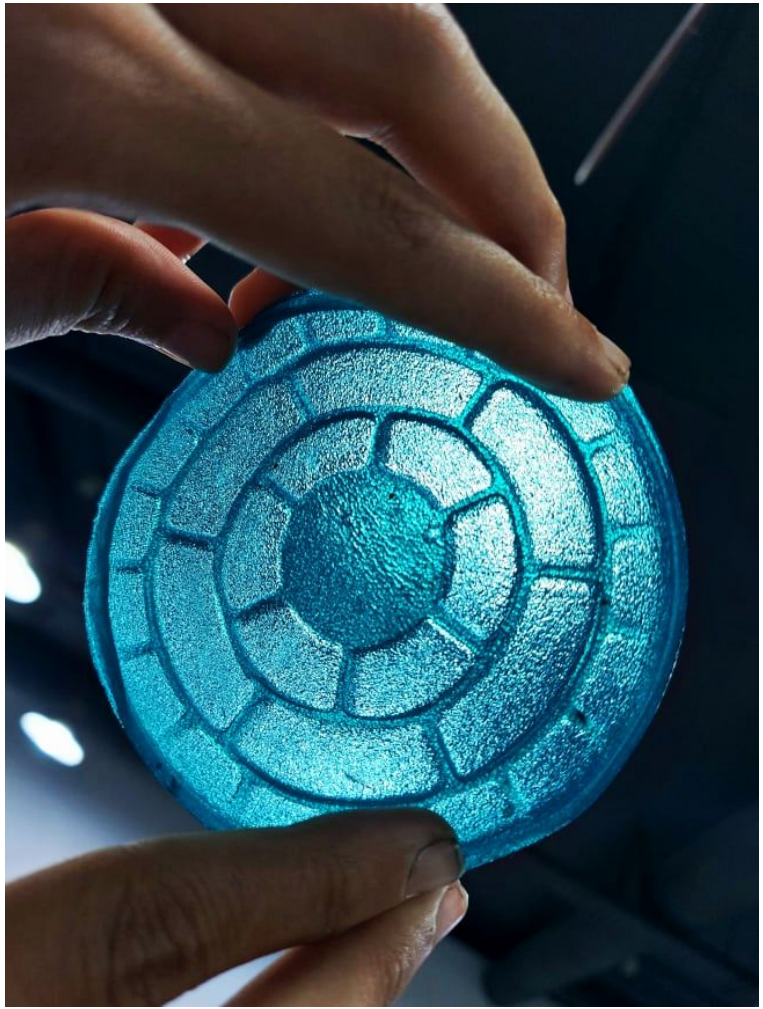
MATERIAL DESIGNER	FABRICADEMY - TEXTILE & TECHNOLOGY ACADEMY

Agar bioplastic



CASTED INTO **READY MADE MOLD**

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AGAR AGAR BIOPLASTIC

Considerations

> Make sure to **stir** the agar constantly until it **completely dissolves** to avoid it sticking to the bottom of the pot.

> Agar will set at **room temperature**
> Agar can be **re-melted** if necessary
> Agar biocompatible with humans' skin

Take into account that gar agar bioplastics shrink considerably its thickness and along the edges up to 20%.





Bioleather

A biocomposite is a material ***composed of two or more distinct constituent materials*** *(one being naturally derived) which are* ***combined*** *to yield a new material with* ***improved performance*** *over individual constituent materials.*





Biocomposites

Polimer — Natural FIber





Fabtextiles coffee leather bag

2018







FABTEXTILES

PRODUCT / FASHION DESIGN

Experimentation





MANGO BIOLEATHER



base ingredients

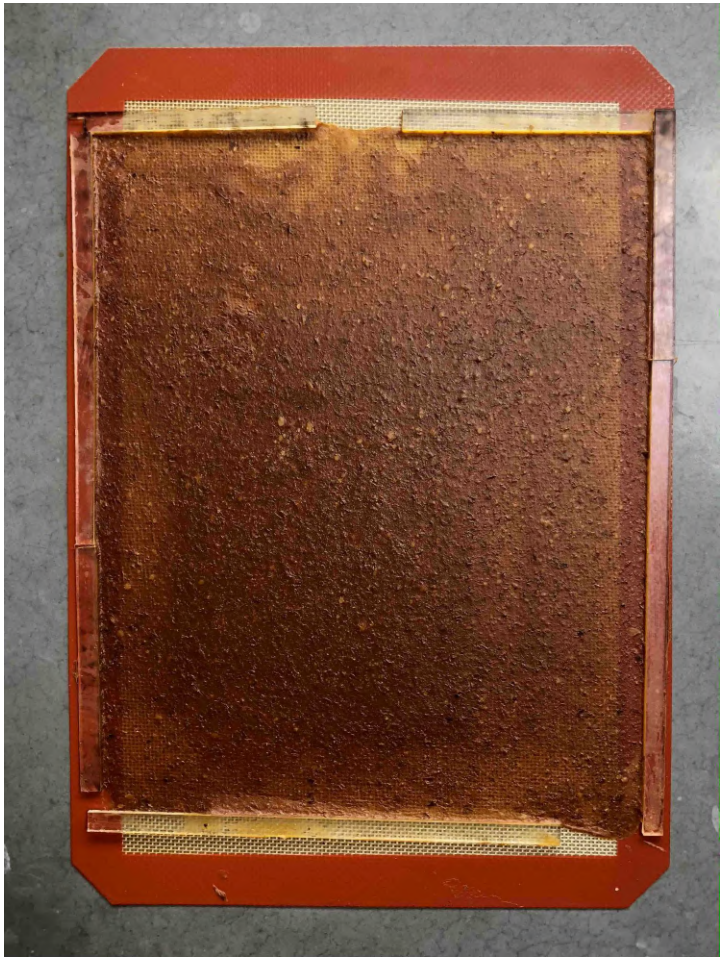
mango

lemon or vinegar

beeswax

Experimentation





BEATRIZ SANDINI - TEXTILELAB AMSTERDAM

Base Ingredient	MATERIAL MAIN ATTRIBUTES & PROPERTIES						
	WASTE AS INPUT	VEGAN	RECYCLABLE	STRENGTH	FLEXIBILITY	RESISTANCE: WATER	RESISTANCE: HEAT
	NO	NO	YES	■■■■□	■■■■□	■■□□□	■■□□□
	NO	YES	NO	■■■□□	■■■■□	■■■□□	■■■□□
	YES	YES	YES	■■■□□	■■■■□	■■□□□	■■□□□
	YES	YES	NO	■■■■□	■■■□□	■■■□□	■■■□□



Alginate



Alginate is a compound known as polysaccharide, (sodium salt from an alginic acid and gum) mainly extracted from brown algae.

It is considered a great vegan alternative to an animal-based gelling agent like gelatine and best waterproof material alternative.

ingredients

*Alginate is made by combining **sodium alginate**, **water**, **glycerine** and a curing agent: **Calcium chloride**.*

Calcium has the ability to form 2 bonds which will hold the alginate into a polymer.

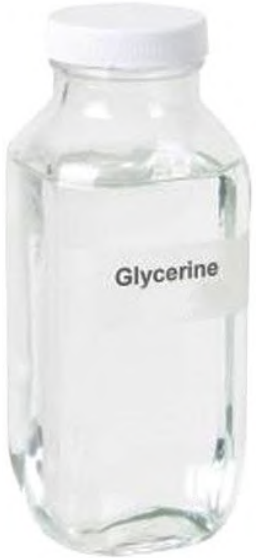




ingredients









SODIUM ALGINATE	WATER	GLYCERINE	CALCIUM CHLORIDE

ALGINATE RECIPES

flexible thin BIO-FOIL

12 gr Alginate
30 gr Glycerine
400 ml Water
10 ml Sodium Chloride hydrate
100 ml. Water

This recipe works best when casted in very thin foils. The foil will shrink in both size and thickness, but the amount of water will help the material in casting very thin even sheets.

flexible BIO-SHEET

12 gr Alginate
40 gr Glycerine
400 ml Water
10 ml Sodium Chloride hydrate
100 ml. Water

This recipe works best when casted in sheets. It will shrink in size and thickness, but less than the foil - make sure you let the liquid sit and spread before you start curing it.

flexible BIO-PLASTIC

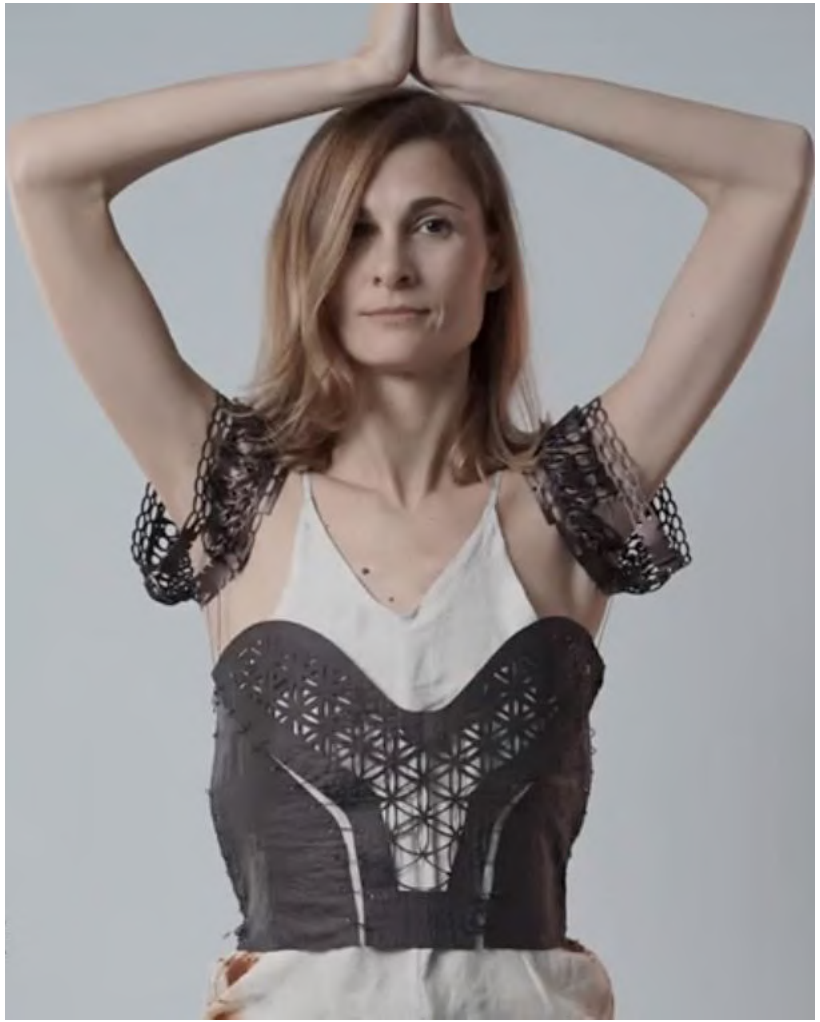
12 gr Alginate
20 gr Glycerine
10 gr Sunflower oil
200 ml Water
10 ml Sodium Chloride hydrate
100 ml. Water

This recipe works best when casted in thicker sheet foils. The foil will shrink in both size and thickness, but it will be strong and durable.

CECILIA RASPANTI - TEXTILELAB AMSTERDAM

Alginate
Leather





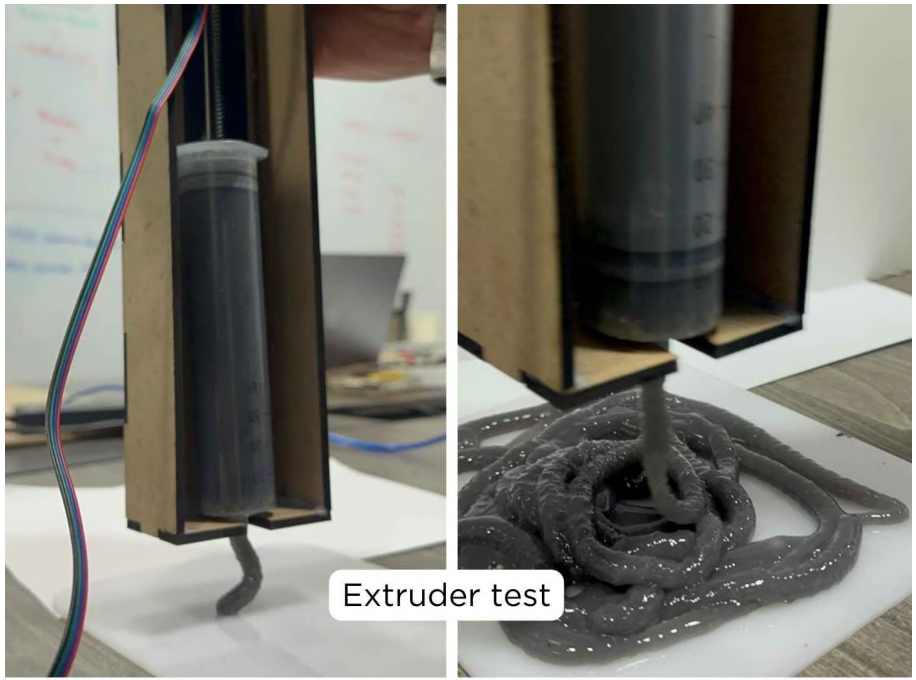
CATHERINE EUALE - FABTEXTILES, FAB LAB BCN

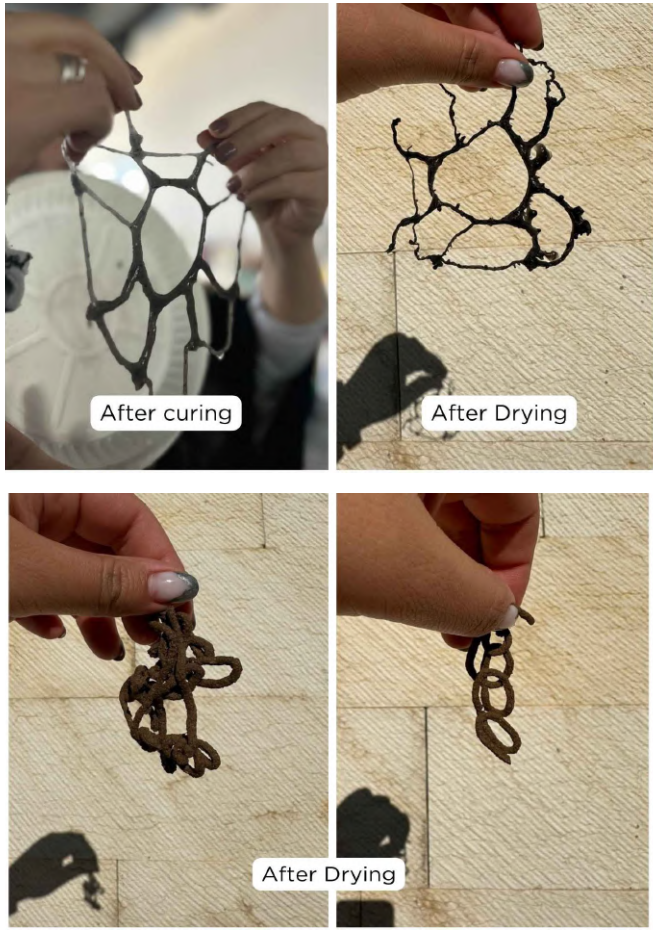
Bioyarns





BioPrinting





BioPrinting



BioPrinting





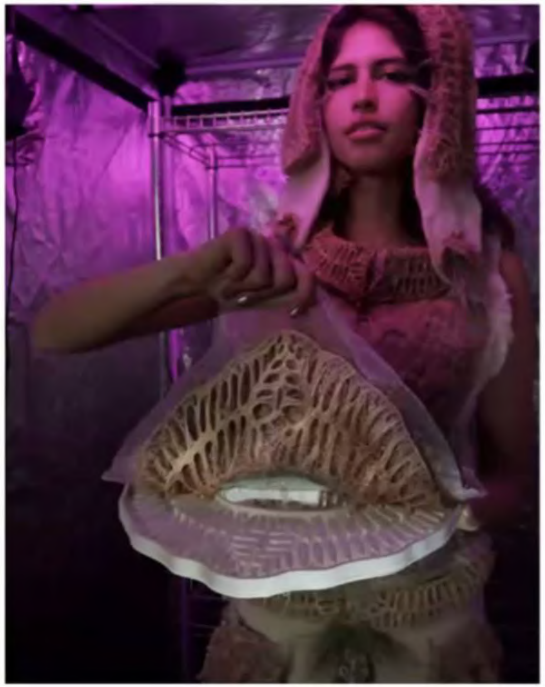






Roots







AMBER GRAIN EMBROIDERY

GROWN IN SHAPE ROOT SYSTEM

Grass roots





Weaving with banana leaves, palm, and straw is a tradition that has deep roots within Jordan & the Yarmouk Valleys.







Grown (Bio) Leather

Microbial Leather

GROWN MATERIALS



Kombucha

Kombucha is a probiotic, **fermented drink** made from black tea and sugar through fermentation using a **SCOBY** mother.

kombucha

Kombucha is produced by fermenting sugared tea using a ***Symbiotic Culture of Bacteria & Yeast*** (**SCOBY**) commonly called a "mother" or "mushroom".



SCOBY

***S**ymbiotic **C**ulture of **B**acteria & **Y**east*

Clothing
applications



Suzanne Lee
2011



source: kimdave.com

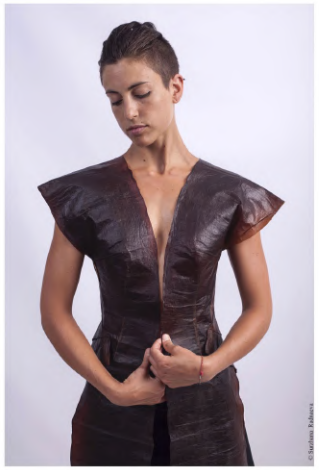
Suzanne Lee
Grow your clothes



Suzanne Lee
2011

clothing applications







Surzhana Radnaeva & thr34d5
REGROW, 2018
(Reshape Competition Winner)

clothing applications







Betiana Pavon
Fabricademy 2018-19



CNC Milling
Molding

clothing applications

Laser cutting
OS Circular Fashion



clothing applications

Cellulea
Suhaib Kamal

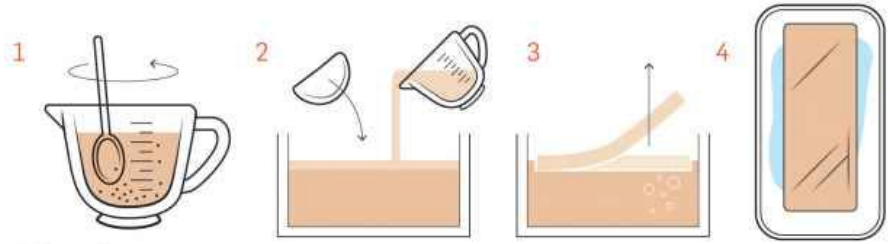




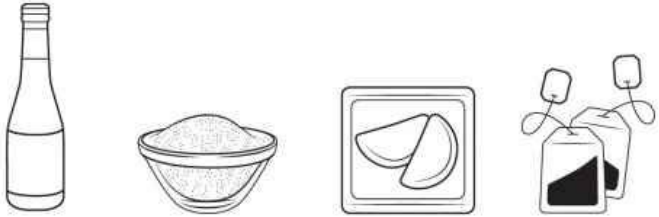
Laser cutting
OS Circular Fashion

Grow Fabric in Your Kitchen

The microbes used to brew the drink kombucha can also produce a strong, leathery cloth—no cow required. Use Suzanne Lee's recipe to make your own.



Materials:



200 milliliters of organic cider vinegar

200 grams of granulated sugar

1 live kombucha culture

2 green tea bags

Directions:

1. Brew the liquid: Boil 2 liters of water, and steep the tea for 15 minutes. Remove the tea bags and add the sugar, stirring until it's dissolved.

2. Prep the culture: Make sure the liquid is cooler than 86°F, and then pour it into your container. Add the cider vinegar and the kombucha culture. Cover the container with a cloth.

3. Harvest the mat: While it grows, the mixture should be kept at room temperature. First, the culture will sink to the bottom. You'll know fermentation has begun when bubbles and a transparent skin start to form at the surface. Over time, the culture will rise to the surface and accumulate in a thick layer. Once the mat reaches 2 centimeters in thickness (around three to four weeks), take it out of the container and gently wash it with cold, soapy water.

4. Dry the material out: Spread the sheet flat on a wooden surface. When it no longer feels wet, you can cut and sew it like any other fabric.

NOTE: This recipe will produce a piece of microbial leather as large as 7 x 6 inches, and it will take the shape of the container you put it in. To grow a larger or smaller sheet, adjust the proportions accordingly.

1. Get started

Lab Equipment, tools and ingredients

- **Kombucha drink** (500ml)
- **Water** (1Lt)
- **Black tea** (6 bags)
- **White sugar** (200 gr)
- *Pots and heaters*
- *Glass jar*
- *Cheesecloth*
- *Rubber bands*



2. Workflow

> Brew the **tea**, Add **sugar, filter** the solution

> Add a **splash of vinegar** to make the solution acidic



Brew the tea



Add sugar



strain



add vinegar

CPF MAKERSPACE
2024

2. Workflow

> **Check the PH** and keep adding vinegar until it reaches PH 3/4.

> Use gloves and disinfect your hands.

> **Add your SCOBY** mother being sure it floats on the liquid.



Add the mother



check PH

2. Workflow

> **Cover** it with a breathable cotton fabric cloth and tight it to the box with elastic bands.

> Let it rest at **around 30C**. The speed of growth depends on the **local temperature.**

> Weekly check the growth of the kombucha fabric without moving the box.





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2021

2. Workflow

> After some time (months) **harvest the kombucha** on a wooden board and **wash** it gently with lukewarm water and **hands soap**.

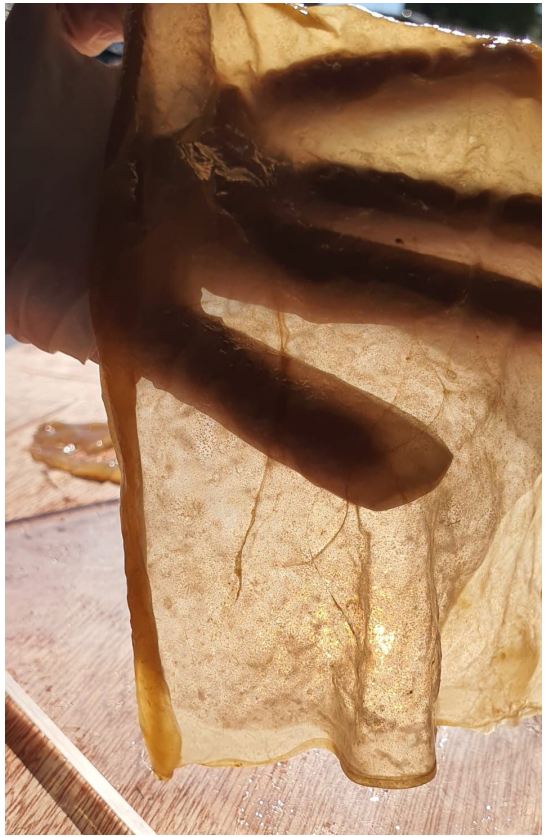


Suzanne Lee
2011

3. Workflow

> After drying, the material will **shrink and reduce consistently**, both edges and thickness.





CPF MAKERSPACE
2021

3. Workflow

> The result is a **thin layer of bioleather**, suitable to be stitched, embossed, laser cut.







Cellulea
2024


What will you make?