101 - Beginners guide to cooking bioplastics

On this page you will find the most important information plus two easy recipes to get you going. Lab Pastoe also offers an in-depth course on making biomaterials, on two consecutive Wednesday evenings from 18:30 - 21:30. Please see the reservation tool for upcoming events or send an email to labpastoe@hku.nl.

What are bioplastics made of?

As with 'industrial' plastics, bioplastics are made by combining a ***polymer*** to make the material strong, with a ***plasticizer*** to make the material flexible, and something to mix and dissolve the two in. Extra ingredients can be ***colorants*** and ***fillers***, to give the material color, texture and added characteristics such as sturdiness, ferromagnetism or conductivity. Over the years we learned that a few drops of essential oil help prevent bacterial and fungal growth.

Biopolymers we often use are gelatin, agar, alginate, chitine, cellulose, carrageenan and starch. Plasticizers we use are vegetable glycerine and sorbitol. We mix and dissolve these ingredients in ***water***.

As colorants we often use natural dyes, teas, food colorings or mica powders, and as optional fillers we use dried organic debris or (food) waste materials such as coffee, eggshells, sawdust, wool, textiles etc. We have a collection of all of these, some for sale, some free to use. Please ask staff about it.

Which tools do I need?

To cook bioplastics you will need ***a scale*** to weigh ingredients, an ***electric or induction cooker***, ***a pan***, ***a wooden spoon*** to stir, ***a measuring beaker*** and ***a cooking thermometer***. All of these you can find in the cabinet in the washing-up / screenprinting room at Lab Pastoe.

You will also need ***a mold to cast your material*** in or on. The easiest way to cast flat materials is to use a wooden ***embroidery hoop***, in which you clamp some pvc plastic (which can take heat) or waterproof textile. You can find these in the washing-up / screenprinting room or under the drying table at Lab Pastoe.

== The upside of using an embroidery hoop, is that the bioplastic will stick to the wood, but not to the plastic. This means that after your material gellifies enough (about 24-48 hours), you will be

able to remove the outer hoop and the plastic from your material, and leave the material attached to the inner hoop to dry upright, with air able to flow on both sides of your material, speeding up the drying process. ==

Assembling ingredients and cooking

You can find all polymers, glycerine, colorants and fillers in the window cabinet in the office at Lab Pastoe. Please ask staff which are free to use, and which have a price.

To start, you can choose one of these two easy recipes, based on gelatine (not vegan, easier to use) or agar (algae-based, vegan):

1. ***Biosilicone (gelatine-based)***
   This is a flexible bioplastic that can be also used in the sewing machine to embroider on. Ingredients for a medium-sized embroidery hoop:

- Gelatine 48 gr
- Glycerine 24 gr
- Water (or dyed water) 240 ml
- Two drops of essential oil

   Assemble your ingredients, your mold/hoop and tools. Bring the water to a boil. (optional: replace part of the water, or all the water, with natural dye if you want a colored foil). Add the glycerine to the boiling water, and then add the agar. While the water is still boiling, dissolve the agar by stirring gently. Once the agar is fully dissolved, lower the heat to about 70 degrees and add the essential oil. Keep the mixture on this heat and stir gently for about 20-40 minutes until you see the mixture gellify into the consistency of a syrup. A thicker mixture renders a thicker foil after drying, also a thicker mixture (with more water evaporated) dries more quickly. Then cast the mixture in your hoop or on a surface. Leave to dry in a food dehydrator at lowest temp, near a heater or in a ventilated area.

   !! Always add a note with your name, material and date to your material when it is drying at Lab Pastoe. It is your own responsability to keep an eye on the drying process. After 10 days, materials that have not been picked up will be remelted and used again.

2. ***Agar bioplastic (algae-based)***
   This is a very flexible foil. Ingredients for a medium-sized embroidery hoop:

- Agar 5 gr
- Glycerine 15 gr
- Water (or dyed water) 250 ml/gr
- Two drops of essential oil

   Assemble your ingredients, your mold/hoop and tools. Bring the water to a boil. (optional: replace part of the water, or all the water, with natural dye if you want a colored foil). Add the glycerine to the boiling water, and then add the agar. While the water is still boiling,

dissolve the agar by stirring gently. Once the agar is fully dissolved, lower the heat to about 70 degrees and add the essential oil. Keep the mixture on this heat and stir gently for about 20-40 minutes until you see the mixture gellify into the consistency of a syrup. A thicker mixture renders a thicker foil after drying, also a thicker mixture (with more water evaporated) dries more quickly. Then cast the mixture in your hoop or on a surface. Leave to dry in a food dehydrator at lowest temp, near a heater or in a ventilated area.

Have a look at this cooking video from Fablab Barcelona that uses a slightly different method to make agar foil:

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Drying biomaterials

After about 24-48 hours (for agar it can take longer) take off the outer hoop and peel your bioplastic (which is now still attached to the inner hoop) off the plastic or waterproof fabric. If you find that it is not strong enough to do so, leave it to dry for another 8 hours. Clean the hoop and plastic with hot water, dry and store back in the crate. Dry your material upright in the hoop for another 5 or 6 days in a ventilated area. When completely dry (no longer cold to the touch) cut it out of the inner hoop. Clean the hoop with hot water, dry, and store back in the crate.

Post processing

Bioplastics can be lasercut, sewn (when using a sewing machine, transport goes better when you attach some thin paper under and on your material), remelted over an object with a heat gun, silkscreened on, used as glue... just experiment, don't forget to document your process, and get to know the material!

!! This was a quick and simple starting guide. Feel free to explore all the other recipes and cook books available on these pages, or sign up for our in-depth biomaterial course. Have fun!

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