

How to make a handmade soap bar using BSFL fat

Context

Valorising organic waste with the Black Soldier Fly Larvae (BSFL) is becoming increasingly popular, especially in low and middle-income countries. The popularity links to high value raw materials like protein meal and fat that can be extracted from the harvested BSFL. The fat shows similar fatty acid profiles to coconut fat or palm kernel oil. These similarities make the BSFL fat an ideal ingredient for cosmetic products like soap. Organic soaps with natural and environmentally friendly ingredients become more popular, and thus leading to potentially higher sales prices. This factsheet provides detailed information on how to make a handmade soap bar using BSFL fat.



Table 1: Fatty acid profile of BSFL fat and coconut fat

Fatty acid	Unit	BSFL fat ¹	Coconut fat ²
Lauric	C12:0 %	50.3	50
Myristic	C14:0 %	10.6	16
Palmitic	C16:0 %	13.4	8
Palmitoleic	C16:1 %	4.0	-
Stearic	C18:0 %	2.8	3
Oleic	C18:1 %	12	14
Linoleic	C18:2 %	3.75	1.75
Linolenic	C18:3 %	1.87	0.2
Saturated fatty acids	- %	77.6	70
Monounsaturated fatty acids	- %	16.7	18
Polyunsaturated fatty acids	- %	5.73	4

¹ BSFL reared on fruit waste (2 replicates), ² Anon (2001)

Principle of saponification

Soap is made by mixing oils and fats with a lye solution (sodium hydroxide and water). Animal and plant fats and oils consist of one glycerine molecule attached to three fatty acids, so called triglycerides. During saponification, sodium hydroxide (NaOH) breaks the triglycerides into glycerine and soap molecules. Soap molecules are surfactants, which means they dissolve in water and oil and thus are good cleaning agents. The properties of the soap, like texture, cleaning efficiency or foaminess depend on the fatty acids from the oils and fats used.

Recipe

The proposed soap recipe here contains BSFL fat as main ingredient (50%) and is mixed with olive oil, sunflower oil, castor oil and beeswax. As the fatty acid profile of BSFL fat is very similar to coconut fat (see Table 1), also the final soap properties are similar to coconut fat based soaps. Coconut fat and BSFL fat contain high amounts of saturated fatty acids, especially lauric acid, which form a firm soap bar and lead to a creamy, gentle and bubbly foam. The fatty acid composition and of the BSFL fat is influenced by the feeding substrate of the BSFL, which also means that BSFL fat can be solid or liquid at room temperature (Ewald et al., 2020). The amount of water in the recipe is set at 38% of the total weight of oils and the water to lye (NaOH) ratio at 2.6:1. Each oil has different properties and changing type and amount will require also a change in water to lye ratio and will influence the soap quality. To find the right lye concentration for your own recipe, check soap calculators online (see below under useful links). The properties of BSFL fat can be best estimated by coconut fat. Usually, essential oils are used to add fragrance to the soap. This is recommended, as BSFL fat might have an unusual flavour. Essential oils from fennel, basil and lemongrass blend well with the earthy scent of BSFL fat.

The following ingredients are needed for 1.25 kg soap, fills up one soap mold (28 x 9 x 8.5 cm / ± 2 L):

- 400 g BSFL fat
- 200 g olive oil
- 80 g sunflower oil
- 80 g castor oil
- 40 g beeswax
- 10-15g essential oils
- 305 g deionized water
- 118 g NaOH



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Safety instructions

Saponification involves the usage of the strong base NaOH, which requires following some safety rules:



Wear gloves



Wear safety goggles



Wear long sleeves



Add NaOH to water

Equipment needed



Stove or heating plate



Thermometer



Stainless steel pan



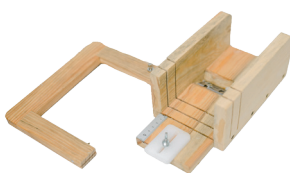
Hand mixer



Soap mold



Strainer



Soap cutting tool



Glas beaker



Soap curing rack

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Step 1 – Preparation of oils and fats

All oils and fats are added together to a stainless-steel pan. The mixture is heated to around 45 to 55°C. At this temperature all oils should be melted.



Step 1 – Preparation of oils and fats

Step 2 – Preparation of lye

Deionized water is added to a glass beaker. The NaOH is slowly added to the water. The chemical reaction causes heat and the temperature is likely to rise above 50°C. Therefore, the mixture is cooled down until a temperature between 40-50°C is reached.



Step 2 – Preparation of lye

Step 3 – Saponification

The oil and the lye mixture should be both at a temperature around 45°C and the temperature difference should not be higher than 10°C. Then, the lye is slowly poured through a strainer into the oil mixture. The hand blender is immersed, and the mixture is stirred until the texture becomes like a creamy pudding, the so called "trace stage." At this point essential oils of your preference can be added to give the soap a pleasant odour. After adding the essential oil, continue mixing for a few more seconds and then directly pour the soap into the soap mold. Shake the soap mold to remove any bubbles and wrap it in a clean towel or cling film.



Step 3 – Saponification

Step 4 – Curing and cutting

The mold is stored in a cool and dry place for 2 days. Then the soap can be removed from the mold. As the soap might still be a bit sticky, it is best to let it cure for around 2 weeks. After 2 weeks the soap can be cut into the desired shape. It is recommended to use a soap cutter which ensures easy and uniform cuts. Leave the soaps cure for another 2 weeks on a curing rack to make the soap bars denser and drier before packing or using it.



Step 4 – Curing and cutting

Useful links and references

Soap calculator: <http://soapcalc.net/calc/SoapCalcWPasp>

Anon.: Codex Standard for Named Vegetable Oils; CODEX STAN 210 (Amended 2003, 2005), 2001.

Ewald, N., Vidakovic, A., Langeland, M., Kiessling, A., Sampels, S., & Lalander, C. (2020). Fatty acid composition of black soldier fly larvae (*Hermetia illucens*) – Possibilities and limitations for modification through diet. *Waste Management*, 102, 40–47.