# APISARA

# FORMULATING SOAP FROM THE FATTY ACID PROFILE

A practical guide to moving from oil composition to a coherent, testable and improvable formula

Objective: learn to reason through a formula rather than simply reproduce a recipe.

Level: advanced beginner to professional

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> This guide complements the Apisara guide Fatty Acids in Soapmaking. It does not repeat it: it shows how to use a fatty acid profile to build, analyse and correct a formula.

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## 1. Why formulate from the fatty acid profile?

An oil contributes a group of fatty acids. After saponification, their salts do not all behave in the same way. The overall balance of the formula therefore matters more than the reputation of any single oil.

Reasoning from the profile helps examine bar structure, rate of wear, type of lather, cleansing character and potential susceptibility to oxidation. The profile remains a formulation tool: process, water, superfat, additives, cure, storage and raw-material variability also affect the final result.

## 2. Functional families to keep in mind

| Family / fatty acids | Useful formulation tendency | Watch point |
|---|---|---|
| Lauric + myristic | Fast, abundant lather; marked cleansing; contributes structure. | At high levels, the soap may feel too stripping for some uses. |
| Palmitic + stearic | Structure, firmness, hardness and denser/creamier lather. | Excess can make lather less immediate. |
| Oleic | Versatile base; finer lather; often associated with a milder feel. | Very oleic formulas may need a long cure to reach their best durability. |
| Linoleic + linolenic | Add diversity to the profile and tend toward softer soaps. | More unsaturated: greater attention to oxidation of raw materials. |
| Ricinoleic | Promotes solubility and lather stability; characteristic of castor oil. | Use as part of an overall balance, not as a universal solution. |

These are educational tendencies, not regulatory limits. Natural-oil composition varies with origin, variety, season and refining. Supplier data or lot analysis takes precedence.

## 3. The Apisara method in 7 steps

1 - Define the use. Bath, household, shaving or another purpose: priorities differ.

2 - Define priorities. Durability, lather, perceived mildness, unmoulding, local availability and cost.

3 - Choose 2 to 5 main fats. Seek complementary functions rather than accumulating ingredients.

4 - Calculate the weighted profile. For each fatty acid: proportion of the oil in the recipe × proportion of that fatty acid in the oil; then add all contributions.

5 - Read the balances. Lauric+myristic; palmitic+stearic; oleic; polyunsaturated; ricinoleic.

6 - Calculate alkali separately. The fatty acid profile never replaces NaOH/KOH calculation. Use a reliable SAP value, ideally supplier-specific.

7 - Make a pilot batch, observe, document and correct. Robust formulas emerge from measured iterations.

When correcting a soap, change one main variable at a time. Otherwise it becomes difficult to identify what actually improved the result.

## 4. Calculating a weighted profile: example

Educational formula: 50% olive oil, 25% coconut oil, 20% fat rich in palmitic/stearic acids and 5% castor oil.

Oleic acid in the formula = (0.50 × oleic in olive) + (0.25 × oleic in coconut) + (0.20 × oleic in the structuring fat) + (0.05 × oleic in castor).

Repeat the calculation for each relevant fatty acid. This weighted average describes the formula better than a simple list of oils.

## 5. Reading a profile without relying on 'magic numbers'

Calculator scores and suggested ranges are useful reference points, not universal standards. Two soaps with similar scores can behave differently because of process, cure and raw materials.

A robust reading asks five questions:

- Structure: are there enough structure-forming components for the intended use?
- Lather: do the lauric/myristic level and any ricinoleic contribution match the objective?
- Cleansing: is it appropriate for body or household use?
- Oxidation: do polyunsaturated fatty acids and the condition of the oils require special attention?
- Reproducibility: do cost, availability, traceability and consistency allow the formula to be repeated?

## 6. Building a formula by function

| Desired function | Families often involved | Examples |
|---|---|---|
| Fast lather / cleansing | Lauric, myristic | Coconut, palm kernel, babassu |
| Structure / durability | Palmitic, stearic | Palm, stearin, tallow, stearic-rich butters |
| More oleic base | Oleic | Olive, peanut, high-oleic oils |
| More stable / soluble lather | Ricinoleic | Castor |
| Local resource | Variable | Decide from analysis or supplier data |

> No raw material is indispensable. Different oils can produce an excellent soap when the final profile, process and specification are coherent.

## 7. Three practical correction cases

Case A - Soap is too soluble and wears away quickly

First check cure, residual water and drying conditions. If the profile is very high in oleic and low in palmitic/stearic, test a moderate increase in the structuring fraction, then recalculate the alkali and compare with a control batch.

Case B - Lather is considered too weak

Check test water, soap age and method of use. A lauric/myristic fraction can increase immediate lather; a small proportion of castor oil can also change lather quality and persistence.

Warning: sharply increasing coconut/palm kernel simply to 'make more lather' also increases cleansing character. Lather is not a direct measure of cleansing power or overall quality.

Case C - Formula is very rich in polyunsaturated oils

Focus on oxidation management: freshness, heat, light, packaging and storage. An antioxidant may slow oxidation, but does not replace sound raw materials or good storage conditions.

## 8. Comparing profiles

| Educational profile | L+M | P+S | Oleic | Main reading |
|---|---|---|---|---|
| Very oleic | Low | Low to medium | Very high | Quieter lather; cure/durability to monitor |
| Balanced | Moderate | Moderate | Moderate to high | Versatile compromise to test |
| Very lauric | High | Variable | Low to medium | Fast lather; stronger cleansing |
| Highly structured | Low to moderate | High | Moderate | Firm bar; solubility/lather to verify |

This table shows formulation directions; it does not impose target percentages.

## 9. From calculation to pilot batch

A formula on a screen is still a hypothesis. A pilot batch turns that hypothesis into data.

Record at least:

- reference and batch number of each raw material;
- percentages and actual weighed masses;
- SAP values used and their source;
- type of alkali, declared purity and calculated mass;
- water, lye concentration or chosen ratio;
- calculated superfat;
- temperatures, method and time to emulsion/trace;
- additives and order of incorporation;
- unmoulding, cutting, initial mass and mass change;

• observations at defined intervals during cure.

## 10. Mini evaluation grid

| Criterion | Question | Simple observation |
|---|---|---|
| Unmoulding | Does the bar keep its shape? | Record time and deformation |
| Durability | Does it resist wear in use? | Compare at the same cure age |
| Lather | Fast, abundant, fine, creamy? | Same water, action and duration |
| Solubility | Does it dissolve quickly? | Weigh before/after a standard protocol |
| Feel | How is washing perceived? | Internal panel, constant protocol |
| Stability | Do odour/colour change? | Documented periodic checks |

> For products placed on the market, these observations do not replace required testing, safety assessment, specifications, regulatory files or analyses applicable to the product and country concerned.

## 11. Common reasoning errors

- Treating a calculator range as a standard. A score remains a reference point.
- Confusing hardness with longevity. A hard bar at unmoulding is not necessarily the slowest-wearing bar.
- Always correcting lather by adding more coconut oil. This changes lather, solubility and cleansing at the same time.
- Changing several ingredients at once. The cause of improvement can no longer be identified.
- Ignoring oil variability. A generic table does not replace supplier data.
- Using the fatty acid profile to calculate lye. Alkali calculation requires appropriate SAP values.
- Judging too early. Comparing soaps of different ages distorts the assessment.

## 12. Worksheet - designing a formula

| Step | To complete |
|---|---|
| 1. Use | Bath / household / other: _____ |
| 2. Priorities | Durability: Lather: Mildness: Cost: ____ ____ ____ ____ |
| 3. Selected oils | _____ |
| 4. Calculated profile | L+M: P+S: O: Lino: Ric: ____ ____ ____ ____ ____ |
| 5. SAP / alkali | SAP source: NaOH/KOH: _____ _____ |
| 6. Water / concentration | _____ |
| 7. Superfat | _____ |
| 8. Hypothesis to test | _____ |
| 9. One correction only | _____ |
| 10. Result after cure | _____ |

This worksheet preserves the formulation logic, not just the final recipe.

## 13. Further study: properties are not simply additive

A recipe is not the mechanical sum of properties assigned to each oil. The soaps formed are a mixture of fatty-acid salts with differences in solubility, crystallisation and interfacial behaviour. Process and water content also modify bar structure.

The weighted fatty acid average is therefore excellent for reasoning and comparison, but it cannot quantitatively predict every physical and sensory property of the finished product.

When a property becomes critical - mechanical hardness, wear rate, stability, or lather in a particular water - it should be paired with a reproducible test method. This is the shift from intuitive formulation to product-development practice.

## 14. Local raw materials: a sound strategy

For a poorly documented local oil, avoid assigning properties from its name alone. Seek a fatty acid composition and, for alkali calculation, a reliable saponification value. If variability is significant, work with a purchasing specification or periodic analyses.

## 15. What the profile does not tell you

- the purity or oxidation state of an oil;
- its exact unsaponifiable content;
- the actual purity of sodium or potassium hydroxide;
- trace speed under your working conditions;
- the precise effect of a fragrance, essential oil or additive;
- regulatory compliance;
- a guaranteed shelf life.

## 16. Operational summary

Formulating from the fatty acid profile turns a list of oils into a design logic.

1. Define use and product specification.
2. Choose fats with complementary roles.
3. Calculate the weighted profile.
4. Read the major families rather than one isolated score.
5. Calculate alkali separately and rigorously using appropriate SAP values.
6. Make a documented pilot batch.
7. Compare using a constant method.
8. Correct one main variable at a time.

The useful question is not 'What is the perfect recipe?' but 'What balance meets my intended use, and how will I verify it?'

## 17. References and resources

Technical references used to verify this guide


- FAO - fatty acid composition tables for common oils and fats. FAO document.
- FAO / Codex - classification of vegetable oils by fatty acid composition. FAO/Codex document.
- Borhan F.P., Abd Gani S.S., Shamsuddin R. (2014) - mixture-design soap formulation study illustrating the influence of oil composition on soap hardness. AGRIS/FAO record.


Published composition values are ranges or averages; they are not a certificate of analysis for a particular batch.

### APISARA RESOURCES

In addition to the saponification calculator, visit apisara.org for Apisara technical guides and fact sheets, as well as links to our many educational articles available on Substack and Facebook. All these resources are provided free of charge to support learning and practical soapmaking.

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